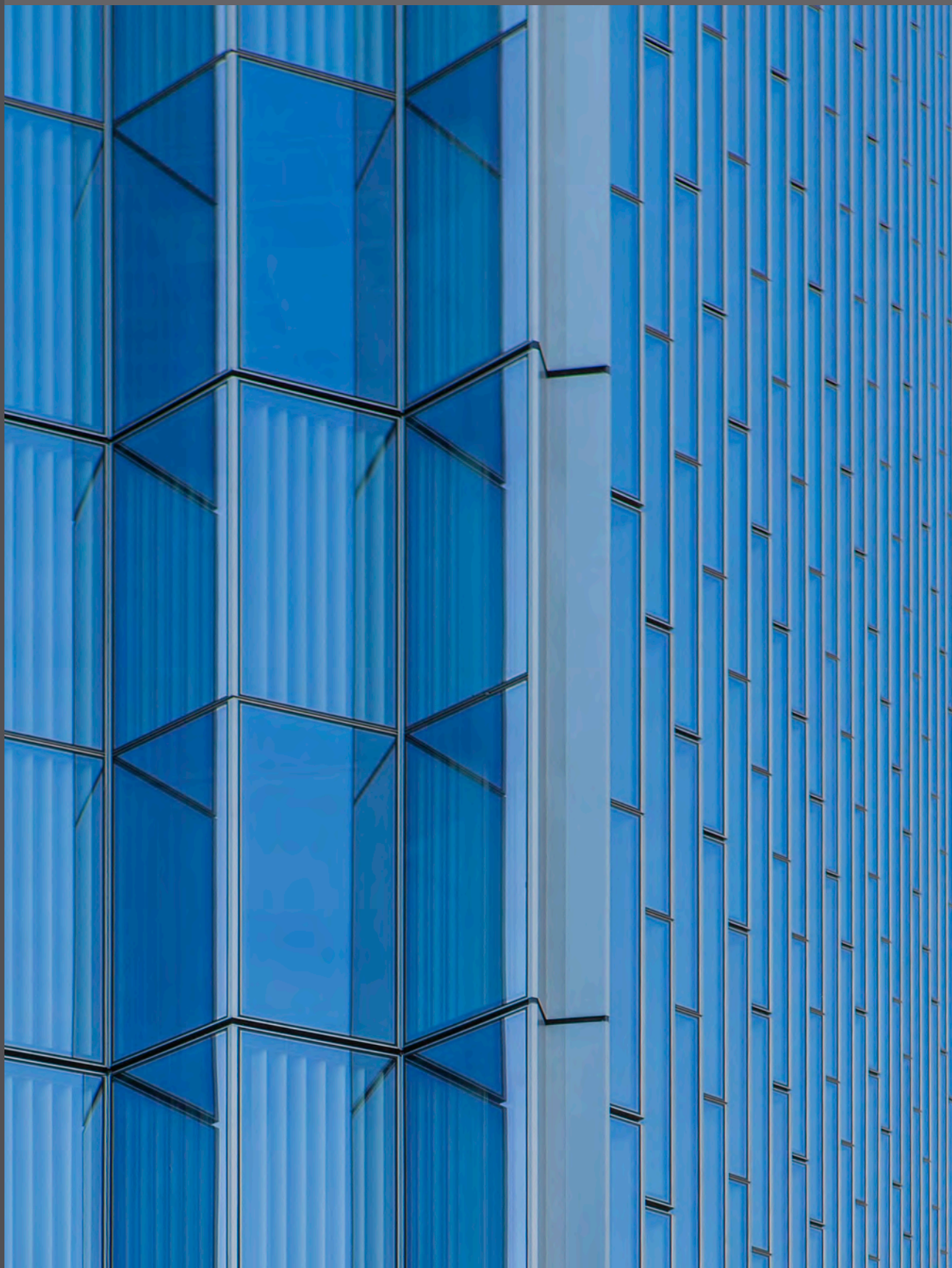
U.S. General Services Administration

# P100 FACILITIES STANDARDS FOR THE PUBLIC BUILDINGS SERVICE

JULY 2018



Cover:
U.S. Federal Courthouse
Los Angeles, CA

Figure 2:
U.S. Federal Courthouse
Façade Detail
Los Angeles, CA

# TABLE OF CONTENTS

**CHAPTER 1 • GENERAL REQUIREMENTS** **10**
1.1 PURPOSE OF THE FACILITIES STANDARDS 11
1.2 APPLICATION OF THE P100 11
1.2.1 REPAIRS, RENOVATIONS, MODERNIZATION AND ALTERATIONS 11
1.2.2 LEASE CONSTRUCTION FACILITIES THAT THE GOVERNMENT INTENDS TO OWN OR HAS AN OPTION TO PURCHASE 12
1.2.3 TENANT IMPROVEMENTS 12
1.2.4 DEVIATIONS FROM P100 12
1.3 FEDERAL LAWS, REGULATIONS, AND STANDARDS 13
1.3.1 PUBLIC BUILDINGS AMENDMENTS OF 1988 13
1.3.2 ENVIRONMENTAL PROTECTION 13
1.3.3 ENERGY AND SUSTAINABLE DESIGN 13
1.3.4 HISTORIC PRESERVATION 13
1.3.5 ACCESSIBILITY 14
1.3.6 THE ARCHITECTURAL BARRIERS ACT ACCESSIBILITY STANDARD (ABAAS) 14
1.3.7 ACCESSIBLE PUBLIC ENTRANCES 14
1.3.8 ACCESSIBILITY IN FEDERAL COURTHOUSES 14
1.3.9 OCCUPATIONAL SAFETY AND HEALTH REGULATIONS 14
1.3.10 RANDOLPH-SHEPPARD ACT 14
1.3.11 BUY AMERICAN ACT 15
1.3.12 FACILITY DEFINITIONS 15
1.4 NATIONALLY RECOGNIZED CODES AND STANDARDS 15
1.4.1 CONFLICTS BETWEEN CODES OR STANDARDS AND GSA REQUIREMENTS 15
1.4.2 ICC INTERNATIONAL CODES 16
1.4.3 NFPA LIFE SAFETY CODE 16
1.4.4 NFPA NATIONAL ELECTRICAL CODE 16
1.4.5 NATIONAL STANDARDS 16
1.5 STATE AND LOCAL CODES 16
1.5.1 STATE AND LOCAL GOVERNMENT CONSULTATION AND REVIEW 16
1.5.2 ZONING AND RELATED ISSUES 17
1.5.3 DESIGN REVIEW FOR CODE COMPLIANCE 17
1.5.4 CONSTRUCTION INSPECTIONS 17
1.6 PROGRAM-SPECIFIC GUIDES AND STANDARDS 17
1.6.1 FEDERAL COURTHOUSES 18
1.6.2 LAND PORTS OF ENTRY 18
1.6.3 CHILD CARE CENTERS 18
1.6.4 SECURITY 18
1.6.5 HISTORIC PRESERVATION 18
1.6.6 FIRST IMPRESSIONS 19
1.6.7 OTHER GUIDES AND STANDARDS 19
1.7 SUSTAINABILITY 19
1.7.1 LEED CERTIFICATION 20
1.7.2 SUSTAINABLE PERFORMANCE REQUIREMENTS 21
1.7.3 GUIDING PRINCIPLES FOR SUSTAINABLE FEDERAL BUILDINGS 22
1.8 ENERGY USE TARGETS 23
1.8.1 MAJOR RENOVATIONS 23
1.8.2 ENERGY USE INTENSITIES DESIGN MAXIMUMS 23
1.9 SAFETY AND HEALTH RISK REDUCTION 24
1.9.1 LOSS CATEGORIES 24
1.9.2 SPECIAL EXPOSURES 24
1.9.3 ORDER OF PRECEDENCE 25

1.9.4 Specific Health and Safety Requirements 25
1.10 Methodologies 26
1.10.1 Space Measurement and Building Efficiency 26
1.10.2 Workplace Tools and Processes 27
1.10.3 Building Information Modeling (BIM) 28
1.10.4 Total Building Commissioning 29
1.10.5 Building Operations and Maintenance 29
1.10.6 Life-Cycle Costing 30
1.10.7 Resilience—Management of Climate—Related and Extreme Weather Risks 30
1.10.8 Wildland Urban Interface 31
1.10.9 Indoor Firing Ranges 31
1.10.10 Smart Buildings 31
**CHAPTER 2 • URBAN DEVELOPMENT AND LANDSCAPE DESIGN 32**
2.1 Urban Planning and Public Use Performance Requirements 33
2.2 Urban Planning 36
2.2.1 Sustainable Locations 36
2.2.2 Collaborative Design Process 36
2.2.3 Design for Public Use 36
2.3 Urban Planning and Design, and Site Prescriptive Requirements 37
2.3.1 Process Criteria 37
2.3.2 Design Criteria 37
2.4 Landscape Performance Requirements 41
2.5 Landscape Prescriptive Requirements 44
2.5.1 Examples of Federal Design Criteria 44
2.5.2 Managing Existing Site Vegetation 44
2.5.3 Site Soils 45
2.5.4 Parking Fields 45
2.5.5 Pollinators 46
2.5.6 SITES Certification 49
**CHAPTER 3 • ARCHITECTURE AND INTERIOR DESIGN 50**
3.1 Enclosure Performance Requirements 51
3.2 Building Enclosure Performance Attributes 56
3.2.1 Natural Hazards 56
3.2.2 Serviceability 58
3.2.3 Water Penetration Resistance 58
3.2.4 Moisture and Condensate Control 59
3.2.5 Air Tightness 59
3.2.6 Thermal Performance 60
3.2.7 Building Enclosure Commissioning 60
3.2.8 Acoustic Control 60
3.2.9 Enclosure Service Life 60
3.3 Prescriptive Enclosure Requirements 60
3.3.1 Moisture Control 60
3.3.2 Below Grade Systems 60
3.3.3 Substructure 61
3.3.4 Wall Systems 61
3.3.5 Masonry and Concrete Materials 63
3.3.6 Fenestration Systems 63
3.3.7 Roof Systems 64
3.3.8 Quality Assurance 66
3.3.9 Sun Control Devices 66
3.3.10 Window Cleaning 66
3.3.11 Providing Access to Maintain Equipment in Atriums 67

3.3.12 Suspended Access to Elevated Locations 67
3.4 Interior Performance Requirements 71
3.5 Interior Construction and Interior Finishes Performance Attributes 94
3.5.1 Construction Products and Materials 94
3.5.2 Interior Finishes and Materials 97
3.5.3 Acoustics 99
3.5.4 Fire Performance and Smoke Development 102
3.6 General Architecture 103
3.6.1 Cornerstone 103
3.6.2 Registry of Designers and Builders 103
3.6.3 Promote the Use of Stairs 103
3.6.4 Vertical Transportation 104
3.6.5 Family Restrooms 106
3.6.6 Lactation Rooms 106
3.6.7 Bird-Safe Building Design 107
3.7 Workplace Performance Requirements 108
3.8 Workplace Performance Attributes 114
3.8.1 Planning and Design Strategies 114
3.8.2 Space Efficiency 114
3.8.3 Technology 115
3.8.4 Health and Comfort: Environmental Controls 115
3.8.5 Health and comfort: Ergonomics 115
3.8.7 Image 116
**CHAPTER 4 • STRUCTURAL ENGINEERING 117**
4.1 Structural Performance Requirements 118
4.2 Structural Performance Attributes 119
4.2.1 Live Load 119
4.2.2 Natural Hazard 119
4.3 Prescriptive Structural Requirements 120
4.3.1 Innovative Materials and Methods 120
4.3.2 IBC for Structural Design of New Buildings 120
4.3.3 ISC Security Standards 120
4.3.4 Design Methods 120
4.3.5 Structural Loads 120
4.3.6 Structural Systems and Elements 121
4.3.7 Alterations in Existing Buildings and Historic Structures 121
4.3.8 Seismic Upgrading 121
4.3.9 Seismic Instrumentation 121
4.4 Physical Security Performance Requirements 122
4.5 Physical Security Performance Attributes 123
**CHAPTER 5 • MECHANICAL ENGINEERING 124**
5.1 Mechanical Performance Requirements 125
5.2 Mechanical Performance Attributes 129
5.2.1 Temperature 129
5.2.2 Humidity Control 129
5.2.3 Air Movement 129
5.2.4 Pressure 129
5.2.5 Ventilation 130
5.2.6 Filtration 130
5.2.7 HVAC Noise Control 130
5.2.8 HVAC Operational Efficiency 130
5.2.9 Energy Performance 130
5.3 Mechanical Engineering Prescriptive Requirements 131

5.3.1 Design Criteria 131
5.3.2 HVAC Systems 133
5.3.3 HVAC Components 138
5.3.4 Air Distribution 141
5.3.5 Water Treatment 142
5.3.6 Plumbing Fixtures 143
5.3.7 Operability and Maintainability 145
5.3.8 Alterations in Existing Buildings and Historic Structures 146
5.4 Whole Building Energy Performance Requirements 148
5.5 Whole Building Performance Attributes 150
5.5.1 Energy Performance 150
**CHAPTER 6 • ELECTRICAL ENGINEERING 151**
6.1 Lighting Performance Requirements 152
6.2 Lighting Performance Attributes 156
6.2.1 Lighting Quality 156
6.2.2 Lighting Quantity 157
6.2.3 Energy Use 159
6.2.4 Power Quality 159
6.2.5 Maintenance 160
6.2.6 Service Life 160
6.3 Lighting Prescriptive Requirements 160
6.3.1 Indoor Lighting and Daylighting Criteria 160
6.3.2 Load Criteria 162
6.3.3 Security Lighting, Exit Signs, and Emergency Lighting 163
6.3.4 Specific Lighting Requirements 164
6.4 Electrical Performance Requirement 165
6.5 Prescriptive Electrical Engineering Requirements 170
6.5.1 Goals and Objectives 170
6.5.2 Codes, Standards, and Guidelines 171
6.5.3 Utility Coordination 175
6.5.4 Distribution System Alternatives 178
6.5.5 Space Conditions 180
6.5.6 Secondary Branch Power Distribution 182
6.5.7 Branch Wiring Distribution Systems 184
6.5.8 Voice and Data Distribution System 189
6.5.9 Emergency and Standby Power Systems 190
6.5.10 Clean Power Systems 193
6.5.11 Grounding Systems 195
6.5.12 Safety Systems, Equipment, and Personal Protection 196
6.5.13 Alterations in Existing Buildings and Historic Structures 197
6.5.14 Solar Photovoltaic Systems 198
6.5.15 Quality Assurance of Electrical Power Systems and Equipment 200
**Chapter 7 • FIRE PROTECTION 202**
7.1 Goals and Objectives 203
7.1.1 Scope 203
7.1.2 Applicability 203
7.1.3 Responsibilities 203
7.2 References 204
7.3 Fire Safety During New Construction Projects and Renovation Projects 204
7.3.1 Fire Safety During New Construction Projects 204
7.3.2 Fire Safety During Renovation Projects 204
7.3.3 Fire Safety During Demolition Projects 205
7.3.4 Existing Fire Protection Systems 205

7.4 Means of Egress 205
7.4.1 Special Requirements 205
7.4.2 Evacuation Route Signage 205
7.4.3 Exit Stair Path Markings 206
7.4.4 Exit Stairway Identification Signage 206
7.5 Interior Finishes 206
7.6 Fire Alarm and Emergency Communication Systems 206
7.6.1 Manual Fire Alarm Boxes 208
7.6.2 Waterflow Switches 208
7.6.3 Smoke Detectors 208
7.6.4 Audible Notification Appliances 209
7.6.5 Visible Notification Appliances 209
7.6.6 Occupant Notification 210
7.6.7 Fire Alarm Notification Strategies for High-Rise Buildings 210
7.6.8 Survivability for Fire Alarm and Emergency Communication Systems 210
7.6.9 Fire Command Center 211
7.6.10 Annunciator 211
7.7 Water Supply for Fire Protection 211
7.7.1 Fire Pumps 212
7.7.2 Pressure Maintenance Pump (Jockey Pump) 212
7.7.3 Fire Hydrants 212
7.7.4 Post Indicator Valve 212
7.8 Automatic Sprinkler and Standpipe Systems 212
7.8.1 Types of Sprinklers 214
7.8.2 Sprinkler Piping 214
7.8.3 Automatic Sprinkler Systems for Remote or Isolated Facilities 214
7.8.4 Fire Department Connections 215
7.8.5 Standpipes 215
7.8.6 Fire Department Hose Outlets 215
7.9 Non-Water-Based Fire Extinguishing Systems 216
7.9.1 Wet Chemical Extinguishing Systems 216
7.9.2 Dry Chemical Extinguishing Systems 216
7.9.3 Clean Agent Extinguishing Systems 216
7.9.4 Carbon Dioxide Fire Extinguishing Systems 216
7.9.5 Portable Fire Extinguishers 216
7.10 Elevator Systems 216
7.10.1 Fire Service Access Elevators 217
7.10.2 Occupant Evacuation Elevators 217
7.11 Special Fire Protection Requirements 217
7.11.1 Air Distribution Systems 217
7.11.2 Information Technology Equipment Rooms 218
7.11.3 Places of Confinement (Holding Areas) 218
7.11.4 Atriums 219
7.11.5 Cooling Towers 219
7.11.6 Residential Dwelling Units 219
7.11.7 Chemical Laboratories 220
7.11.8 Record Storage Facilities 220
7.11.9 Flammable and Combustible Liquid Storage Arrangements 220
7.11.10 Compact Storage Modules 220
7.12 Required Design Guides and Manuals 221
7.12.1 U.S. Court Facilities 221
7.12.2 U.S. Marshals Service Space 221
7.12.3 Land Port of Entry Facilities 221

7.12.4 GSA Child Care Centers 221
7.13 Historic Structures 221
7.13.1 Responsibility 221
7.13.2 Impact on Historic Fabric 221
7.13.3 Fire Protection Alternatives for Consideration 221
7.14 Mass Notification Systems 222
7.15 Performance-Based Design 223
7.16 Commissioning Fire Protection and Life Safety Systems 224
7.17 Integrated Fire Protection and Life Safety System Testing 224
**CHAPTER 8 DESIGN STANDARDS FOR U.S. COURT FACILITIES 225**
8.1 Goals and Objectives 226
8.2 Design Guidance 226
8.2.1 U.S. Courts Design Guide 226
8.2.2 U.S. Marshals Service Criteria 226
8.3 General Requirements 227
8.3.1 Planning for Future Requirements 227
8.3.2 Planning for Accessibility 227
8.3.3 Infrastructure 228
8.3.4 Acoustic Planning Requirements 228
8.3.5 Architectural and Interior Design 229
8.3.6 Building Enclosure Systems 230
8.3.7 Floor Systems 230
8.3.8 Interior Wall Systems 230
8.3.9 Ceiling Systems 230
8.3.10 Office and Conference Spaces 231
8.3.11 Courtrooms 231
8.3.12 Public Spaces 231
8.3.13 Detainee Areas 231
8.3.14 Fixed and Movable Furniture 231
8.3.15 Signage and Graphics 233
8.3.16 Identification and Information Signage 233
8.3.17 Directional Signage 233
8.3.18 Regulatory/Security Signage 233
8.4 Structural Systems 234
8.4.1 General Requirements 234
8.5 Mechanical Systems 234
8.5.1 System Selection and Design 234
8.6 Fire Protection and Security Systems 237
8.7 Electrical Systems 237
8.7.1 Spare Capacity 238
8.7.2 Number of Outlets 238
8.7.3 Grounding 242
8.7.4 Isolated Ground Circuits 242
8.7.5 Below-Floor Electrical Distribution 243
8.7.6 Emergency and UPS Power Systems 243
8.7.7 Service and Distribution 243
8.7.8 Exterior Connection 243
8.7.9 Coordination with Telecommunications System Design 243
8.7.10 Lighting Systems 244
8.7.11 Audiovisual Requirements in U.S. Court Facilities 244
8.8 Security Design: Agency Responsibilities 244
8.8.1 Battery backup 245

## TABLE OF CONTENTS


**APPENDIX** **246**
A.1 General Requirements 247
Drawings 247
Building Information Model 248
Specifications 249
Turnover Documents 249
Building Handover to Operations and Maintenance 250
Design Narratives and Calculations 251
Integrated Design Review 251
Energy Analysis 251
Cost and Schedule Management Requirements 251
A.2 Performance Matrix 251
A.3 New Construction and Modernization 254
Peer Review 254
Design Process Definitions 255
Site Analysis and Preliminary Concepts 257
Final Concept 260
Design Development 265
Construction Documents 275
A.4 Alteration Projects 283
Design Process Definitions 285
Concept 286
Design Development 289
Construction Documents 295
A.5 Surveys and Geotechnical Reports 300
Site Survey 300
Geotechnical Investigation and Engineering Report 301
Geologic Hazard Report 303
A.6 GSA Stormwater Management Submission 305
A.7 Energy Analysis Input and Output 305
Procedures 305
Conceptual Design 305
Design Development 305
Construction Documents 306
B.1 References 307
List of Reference Publications and Websites 307
Chapter 1 General Requirements 307
Chapter 2 Site Engineering and Landscaping 310
Chapter 3 Architecture and interior Design 310
Chapter 4 Structural Engineering 312
Chapter 5 Mechanical Engineering 312
Chapter 6 Electrical Engineering 313
Chapter 7 Fire Protection 315
B.2 Acronyms and Abbreviations 317
C.1 Summary of Changes for P100 2018 Version 320
**Image Credits** **325**

## About the P100

The *Facilities Standards for the Public Buildings Service* establishes design standards and criteria for new buildings, repairs and alterations, modernizations, and lease construction facilities that the Government intends to own or has an option to purchase, as well as work in historic structures for the Public Buildings Service (PBS) of the U.S. General Services Administration (GSA). This document contains both performance-based standards and prescriptive requirements to be used in the programming, design, and documentation of GSA buildings.

# INTRODUCTION

Through its Public Buildings Service (PBS), the U.S. General Services Administration (GSA) designs, constructs, and operates Federal civilian buildings. PBS provides workspace to 1.1 million Federal employees, primarily with courthouses, land ports of entry, and Federal office buildings. It ranks among the largest holders of real estate in the United States.

The PBS-P100, "Facilities Standards for the Public Buildings Service," is GSA's mandatory facilities standard. It applies to design and construction of new Federal facilities, major repairs and alterations of existing buildings, and lease construction facilities that the Government intends to own or has an option to purchase. P100 users span the entire spectrum of building professional disciplines, and the P100 informs and regulates decisions made throughout a project's life.

This edition of the P100 updates the document's substantial transformation from a prescriptive standard to one that contains both performance-based and prescriptive requirements. A large portion of the standard specifies levels of performance, allowing a design team and GSA's other professional partners to identify and implement the best strategies to meet those goals.

Four levels of performance are defined throughout the P100 in matrices. It is the project manager's responsibility to use the new P100 Performance Matrix to document the "baseline" performance for their project. Different building types may have a higher starting threshold, and the Matrix attempts to identify these cases, but the guides listed in section 1.6 provide the final requirements. Each project may implement any combination of performance levels, in order to prioritize performance opportunities that stem from climate, site, program, mandates, and other conditions. Performance goals must be validated at various phases of design with Design Excellence and through construction with total building commissioning.

# 1

# GENERAL REQUIREMENTS

Figure 3:
Eisenhower Executive
Office Building
Washington, DC

The design team must review compliance with the building program at each stage of the project, as required in Appendix A, to ensure that the requirements of the program, the P100, and relevant codes and standards have been met and to guard against unplanned expansion of the program because of design and engineering choices.

All prospectus-level projects are required to follow the Design Excellence Policies and Procedures found on the PBS/Design and Construction webpage at www.gsa.gov/designexcellence.

## 1.1 PURPOSE OF THE FACILITIES STANDARDS

The Facilities Standards for the Public Buildings Service PBS-P100 (known as the P100) establishes design standards and criteria for new buildings, repairs, renovations, modernizations and alterations for the Public Buildings Service (PBS) of the General Services Administration (GSA). This document contains policy and technical criteria to be used in the programming, design, construction, measurement and verification, and documentation of GSA facilities.

The P100 is a mandatory standard. It is not a guideline, textbook, handbook, training manual, nor substitute for technical competence. The P100 represents the current state of practice in designing facilities to meet GSA's commitments, maximize the efficiency of business processes, and comply with the requirements of law.

The P100 must be used in conjunction with the governing standards referenced in this document, as well as the building program for each project. If conflicts exist between the facilities standards and a specific program and project requirements, contact the PBS Office of Design and Construction for resolution.

## 1.2 APPLICATION OF THE P100

The P100 applies regardless of the funding source. Thus, the P100 applies equally to projects funded through BA51, BA54, and BA55, as well as customer-funded projects through a Reimbursable Work Authorization (BA80) and privately financed projects such as an Energy Savings Performance Contract. This document also applies to lease construction facilities where GSA's formal Request for Lease Proposal (RLP) has an option for GSA to purchase the building at a future date. The requirements of the P100 will be included in the RLP on a case-by-case basis, in consultation with the Chief Architect. Exclusion of the P100 from lease construction facilities where GSA's formal RLP has an option for GSA to purchase the building requires Chief Architect written approval.

### 1.2.1 REPAIRS, RENOVATIONS, MODERNIZATION AND ALTERATIONS

Repairs, renovations, modernizations, and alterations are improvements made to existing facilities. Generally, building systems need only be upgraded to correct deficiencies identified by GSA, unless the entire building is being renovated. All new work is required to meet the applicable national codes and standards adopted by GSA. If a major portion of the building is being renovated, the specific codes must be evaluated to determine if the entire building must be brought into compliance with the code. Any questions or concerns must be discussed with the GSA project manager.

The requirements of the P100 apply to repairs, renovations, modernizations, and alterations to the extent the work is identified in the approved and funded project prospectus. All items within the designer's scope of work must be designed in accordance with the P100. The designer must clarify ambiguities in writing before beginning the design.

### 1.2.2 LEASE CONSTRUCTION FACILITIES THAT THE GOVERNMENT INTENDS TO OWN OR HAS AN OPTION TO PURCHASE

Lease construction is new construction of a facility for Government use required by GSA's formal Request for Lease Proposals (RLP).

In lease construction where GSA's formal RLP has an option for GSA to purchase the building at a future date, the requirements of the P100 may be included in the RLP on a case-by-case basis with approval by the Chief Architect. In addition to the GSA-adopted nationally recognized codes and requirements, State and local government codes apply. If a conflict exists between applicable State and local government codes and the GSA requirements, the developer must identify these conflicts in writing and request a resolution from the GSA contracting officer.

### 1.2.3 TENANT IMPROVEMENTS

The P100 applies to standalone tenant improvement projects with respect to interior finishes only. Tenant improvements are defined in the GSA Pricing Desk Guide at www.gsa.gov/cdnstatic/PDG_4th_Ed.pdf

### 1.2.4 DEVIATIONS FROM P100

#### 1.2.4.1 WAIVERS

Most deviations from the P100 require an approved waiver. Waivers must be requested in writing by the regional commissioners and approved by the Office of Design and Construction before the concept submission is presented. Waivers must be processed through the responsible regional program coordinator in the Office of Design and Construction. The following deviations utilize other processes:

- Waivers for addressing the requirements in P100 Chapter 7, Fire Protection, are not permitted. However, alternative and equivalent compliance requests for deviations from the requirements in P100 Chapter 7 require an approved alternative and/or equivalent compliance solution in accordance with the requirements in Section 1.2.4.2. Such requests for alternative and/or equivalent compliance must also include a concurrence signature from the regional Fire Protection Program Office and follow a similar approval process as the waiver process.
- Waivers or modifications from the Architectural Barriers Act Accessibility Standard (ABAAS) must be approved by the Commissioner of PBS. The ABAAS process is explained in the "National Accessibility Program—Standards, Policies and Procedures," Chapter 6: www.gsa.gov/portal/mediaId/125178/fileName/National_Accessibility_Program_Standards_Policies_and_Procedures_2.action.
- Metric Waivers—See GSA Metric Order, GSA Metric Program, for guidance.

#### 1.2.4.2 ALTERNATIVE AND EQUIVALENT COMPLIANCE

GSA encourages the development of new and innovative building systems. The provisions of this document are not intended to prohibit the use of alternative systems, methods, or devices not specifically addressed by the P100. The use of alternative systems, methods, or devices is permitted to meet the intent of the prescribed

requirements in P100 where approved as being equivalent. All technical documentation for alternatives must be submitted and approved by the regional program office prior to final concept submission. Proposed alternatives must be equivalent or superior to the P100 requirements concerning quality, cost, strength, effectiveness, fire resistance, durability, efficiency, and safety. All proposed alternatives must be accomplished within the project budget and schedule. The approved alternative will be recognized as being an equivalent design solution and compliant with the P100. The use of an alternative and equivalent compliance method is not to be considered a waiver.

## 1.3 FEDERAL LAWS, REGULATIONS, AND STANDARDS

The following are Federal laws, regulations, and standards applicable to all projects.

### 1.3.1 PUBLIC BUILDINGS AMENDMENTS OF 1988

The Public Buildings Amendments of 1988, 40 U.S.C. 3312, require that each building constructed or altered by GSA or any other Federal agency must, to the maximum extent feasible, comply with one of the nationally recognized model building codes and with other applicable nationally recognized codes.

### 1.3.2 ENVIRONMENTAL PROTECTION

In addition to building-specific codes, GSA projects must comply with Federal, State, and local environmental laws, regulations, and Executive Orders. GSA's policy is voluntary conformance with State and local code requirements even when permitting or approvals from local regulators are not required. Project teams are advised to collaborate with the GSA regional environmental coordinator and the Office of the Chief Architect for assistance during the design process.

Among the key mandates is the National Environmental Policy Act (NEPA). NEPA requires that Federal agencies consider and document the environmental impacts of proposed actions as part of their decision process. As part of the NEPA process, GSA would issue either a Finding of No Significant Impact (FONSI) or a Record of Decision (ROD), both of which may contain legal commitments that GSA must incorporate into its project. GSA's design team must be aware of these commitments and must address them in the project design documents.

### 1.3.3 ENERGY AND SUSTAINABLE DESIGN

Legislation directed toward energy efficiency and sustainability continues to increase.

Laws, regulations, and Executive Orders affecting the design and operation of Federal buildings include:

- Executive Order 13834: Efficient Federal Operations
- Energy Independence and Security Act of 2007 (EISA 2007)
- Energy Policy Act of 2005 (EPAct 2005)
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles)

For information on the implementation of sustainable design and energy, see Section 1.7, Sustainability.

### 1.3.4 HISTORIC PRESERVATION

The National Historic Preservation Act (NHPA) of 1966 mandates that Federal agencies use historic properties to the greatest extent possible and strive to rehabilitate them in a manner that preserves their architectural character, in accordance with the Secretary of

the Interior's Standards for the Treatment of Historic Properties (36 CFR 67).

Further, projects impacting historic properties must comply with NHPA's Section 106 process. This process often results in GSA making legal commitments to execute the project in a certain way. In most cases, the Section 106 consultation process, and any resulting agreement documents, should be completed prior to the issuance of a FONSI or a ROD. As with NEPA, GSA's design team must be aware of these commitments and must address them in the project design documents. Project teams shall consult with GSA's Regional Historic Preservation Officer for assistance.

### 1.3.5 ACCESSIBILITY

GSA policy is to make all Federal buildings accessible without the use of special facilities for persons with disabilities. The intent of this policy is to use standard building products set at prescribed heights and with prescribed maneuvering clearances to allow easy access by disabled employees and visitors. Building elements designated specifically for use by persons with disabilities should be kept to a minimum.

### 1.3.6 THE ARCHITECTURAL BARRIERS ACT ACCESSIBILITY STANDARD (ABAAS)

ABAAS is mandatory for all GSA projects. If local accessibility standards exist, the architect/engineer (A/E) must follow the most stringent requirements between the local standards and ABAAS.

The criteria of these standards must be considered a minimum in providing access for persons with disabilities. Dimensions that are not stated as "maximum" or "minimum" are absolute. All dimensions are subject to conventional industry tolerances except where the requirement is stated as a range with specific minimum and maximum end points.

### 1.3.7 ACCESSIBLE PUBLIC ENTRANCES

All public entrances provided in accordance with Paragraph F206.4.1 (Public Entrances) of the ABAAS must have at least one entrance door complying with Section 404.3 (Automatic and Power-Assisted Doors and Gates) of the ABAAS. Where an accessible public entrance has a vestibule with exterior and interior entrance doors, at least one exterior door and one interior door must comply with Section 404.3.

### 1.3.8 ACCESSIBILITY IN FEDERAL COURTHOUSES

Please refer to Chapter 8, Design Standards for U.S. Court Facilities; Section 8.2, Planning for Accessibility; and Table 8.1, Accessibility Requirements.

### 1.3.9 OCCUPATIONAL SAFETY AND HEALTH REGULATIONS

The Department of Labor Occupational Safety and Health Administration (OSHA) does not directly regulate facility design; however, the construction, operation, and occupation of facilities must comply with OSHA regulations. The A/E must ensure that facilities can be constructed in a manner compliant with 29 CFR 1926; the design must anticipate facility operations and maintenance and ensure they can be performed in compliance with 29 CFR 1910; and must not subject building occupants to conditions in violation of 29 CFR 1910.

### 1.3.10 RANDOLPH-SHEPPARD ACT

The Randolph-Sheppard Act provides qualified blind persons the opportunity to operate businesses on Federal, State, or other property. The A/E must coordinate design with the vending

facility operators to meet the needs of vendors covered by the act.

### 1.3.11 BUY AMERICAN ACT

Only domestic construction materials shall be specified in construction contracts performed in the United States except when a waiver to the Buy American Act is granted or per FAR 25.11 and FAR 52.225.

### 1.3.12 FACILITY DEFINITIONS

#### 1.3.12.1 ESSENTIAL FACILITIES

The International Building Code (IBC) has defined essential facilities as “Any building and other structure that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquake". Buildings and other structures designated as essential facilities include, but are not limited to: Group I-2 occupancies that have surgery or emergency treatment facilities, aviation control towers, or fire and police stations.

#### 1.3.12.2 CRITICAL ACTION FACILITIES

The Department of Homeland Security Federal Emergency Management Agency has defined a facility as "Critical Action” when even a slight chance of flooding is too great. If critical action structures must be located within a 100 or 500-year floodplain (i.e., there are no practicable alternatives), critical infrastructure shall be elevated above the 500-year base flood elevation. Critical actions include, but are not limited to, those which create or extend the useful life of structures or facilities, such as: those that produce, use, or store highly volatile, flammable, explosive, toxic, or water-reactive materials; or hospitals and nursing homes, and housing for the elderly, which are likely to contain occupants who may not be sufficiently mobile to avoid the loss of life or injury during flood and storm events.

The US Courts has determined that all new Court Houses are critical action facilities.

#### 1.3.12.3 MISSION CRITICAL FACILITY

The tenant will determine this designation during project development. See electrical primary distribution and generator system for requirements. A mission critical facility contains any operation that, if electrical supply is interrupted, will cause a negative impact on business activities, ranging from losing revenue to jeopardizing legal conformity, and loss of life. Examples may include data centers, hospitals, laboratories, public safety centers, court houses, Land Points of Entry, research facilities, law enforcement, and critical file and payroll centers.

## 1.4 NATIONALLY RECOGNIZED CODES AND STANDARDS

For all design and construction work that GSA performs on Federal buildings, or those functions under GSA’s construction authority, GSA has adopted the technical requirements of the nationally recognized codes and standards referred to in this subsection. The technical requirements of these codes and standards are supplemented by mandates of Federal laws and Executive Orders, as well as GSA and other Federal agency criteria. The latest edition of these codes and standards, in effect at the time of design contract award, must be used throughout design and construction of the project.

### 1.4.1 CONFLICTS BETWEEN CODES OR STANDARDS AND GSA REQUIREMENTS

To ensure flexibility, GSA’s policy is to make maximum use of equivalency clauses in all codes and standards. If a conflict exists between GSA

requirements and the GSA-adopted codes or standards, the GSA requirements take precedence. All such conflicts must be brought to the attention of the GSA project manager as appropriate for resolution.

### 1.4.2 ICC INTERNATIONAL CODES

GSA has adopted the technical requirements of the International Codes, or I-Codes published by the International Code Council (ICC) including the International Green Construction Code (IGCC). Exceptions to the I-Codes are noted below. The ICC I-Codes are available at www.iccsafe.org.

### 1.4.3 NFPA LIFE SAFETY CODE

GSA has adopted the technical egress requirements of the National Fire Protection Association (NFPA), Life Safety Code (NFPA 101), in lieu of the technical egress requirements of the IBC. The Life Safety Code is available at www.nfpa.org.

### 1.4.4 NFPA NATIONAL ELECTRICAL CODE

GSA has adopted the technical electrical requirements of the NFPA, National Electrical Code (NFPA 70). The National Electrical Code is available at www.nfpa.org.

### 1.4.5 NATIONAL STANDARDS

Organizations writing voluntary national standards, including NFPA; the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE); the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA); the National Roofing Contractor Association (NRCA); the Institute of Electrical and Electronics Engineers (IEEE); and the American Society of Mechanical Engineers (ASME), publish standards on health, safety, welfare, and security that are recognized by GSA in various chapters of the P100. Consistent with GSA's long-standing policy to comply with nationally recognized standards to the extent practicable, these standards must be used as indicated in the P100. The latest edition of the nationally recognized standards herein, in effect at the time of design contract award, must be used during design and construction.

## 1.5 STATE AND LOCAL CODES

Facilities built on Federal property are exempt from State and local building codes. GSA recognizes that the national building codes are typically the foundation of State and local building codes, and that State and local codes represent important regional interests and conditions. It is GSA's policy to comply with State and local building codes to the maximum extent practicable; however, GSA has the final authority to accept or reject any recommendation from State and/or local government officials.

### 1.5.1 STATE AND LOCAL GOVERNMENT CONSULTATION AND REVIEW

The Public Buildings Amendments of 1988, 40 U.S.C. 3312, direct that each building constructed or altered by GSA shall be constructed or altered only after consideration of all design requirements (except procedural requirements) of State or local governments, which would apply to the building if it were not a building constructed by a Federal agency. This includes zoning as well as laws related to landscape, open space, building massing and orientation, and aesthetic considerations. In order to meet these requirements, GSA will consult in a timely manner with appropriate local officials in preparing plans for the building.

The GSA project manager must provide the appropriate State and/or local government officials the opportunity to review the project for compatibility with local planning, design

objectives, and zoning compliance. Local reviews must occur early in project development so that the design can easily respond to appropriate recommendations. These reviews include, but are not limited to, the review of drawings and specifications, making recommendations for compliance with local regulations, compatibility with local planning goals, and alignment with first responder requirements. In most cases, collaboration with local officials required to meet these standards will be in addition to, and not a substitute for, NEPA consultation with local officials. The GSA project manager must inform State and local government officials that GSA and its contractors are not allowed to pay any fee for any actions taken by the State and/or local government officials in connection with local reviews or inspections. GSA will review all recommendations made by State and local government officials. Each recommendation will be carefully considered based on adequacy, cost, and nationally accepted practice. GSA has the final authority to accept or reject any recommendation from State and/or local government officials. The GSA project manager will maintain a record of all recommendations and comments from State and local government officials for the duration of the project.

The above requirements are also directed by the Federal Urban Land Use Act of 1949 (40 USC Sect 901-905) and Executive Order 12072.

### 1.5.2 ZONING AND RELATED ISSUES

The A/E team must offer local officials timely opportunity to review and comment on the GSA project plans for compatibility with local plans, zoning, and design guidelines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the project manager must document this in the project file.

Local regulations must be followed without exception in the design of systems that have a direct impact on off-site terrain or infrastructure. These systems include, but are not limited to, fire protection services, storm water runoff, erosion control, sanitary sewers and storm drains, water, gas, electrical power, communications, emergency vehicle access, roads, and bridges.

### 1.5.3 DESIGN REVIEW FOR CODE COMPLIANCE

The GSA project manager must provide the appropriate State and/or local government officials the opportunity to review the design for building code compliance. The GSA project manager will officially forward design submissions to the appropriate local officials.

### 1.5.4 CONSTRUCTION INSPECTIONS

If State and local government officials elect to perform code compliance construction inspections, the GSA project manager must include provisions in both the A/E and construction contract for coordination of the work with local officials. State and local government officials do not have the authority to reject, accept, or make changes to the work, and their inspections are done only to assist GSA in achieving code compliance.

## 1.6 PROGRAM-SPECIFIC GUIDES AND STANDARDS

In addition to the P100, GSA and its customer agencies use a number of specific guides and standards that address program requirements. Use of these guides is mandatory. In case of conflicts between the P100 and a specific building guide, the more stringent requirement will take precedence. If conflicts exist between the facilities standards and specific program and

project requirements, contact the Office of Design and Construction for clarification. The websites for these guides are listed in Appendix Section B1, References.

### 1.6.1 FEDERAL COURTHOUSES

The Office of Design and Construction provides guidance on all levels of development of courthouse projects, including Congress, OMB, the Administrative Office of the United States Courts, and GSA, and serves as a liaison for all courthouse projects. See Chapter 8, Design Standards for U.S. Court Facilities, for detailed descriptions of the publications listed below and their application.

- GSA Courthouse Visitor's Guide, February 2003
- GSA Courthouse Project Handbook, August 2004
- U.S. Courts Design Guide
- U.S. Marshals Service Judicial Security Systems Requirements and Specifications, Volume 3, Publication 64, 2005
- U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space, Volume One: Architectural & Engineering, 2007; Volume Two: Electronic Security & Hardware, 2007

### 1.6.2 LAND PORTS OF ENTRY

The Office of Design and Construction provides guidance on the management of the border station program, including strategic planning, budgeting, benchmarking, and design guidance. For more information:

- United States Land Port of Entry Design Guide, 2014

### 1.6.3 CHILD CARE CENTERS

Requirements for child care centers must be incorporated early in the design and planning process. The references below provide guidance on such topics as site design, emergency evacuation, food services, safety, security, mechanical, electrical, and plumbing:

- Child Care Center Design Guide (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)

### 1.6.4 SECURITY

Please see the following documents for more information on the security design requirements for Federal buildings:

- The Risk Management Process: An Interagency Security Committee Standard, August 2013

### 1.6.5 HISTORIC PRESERVATION

Performance requirements for projects affecting historic properties must be incorporated into design team qualification requirements, project scopes of work, and construction contracts. Design teams undertaking feasibility studies, repairs, alterations, or new construction within or adjoining historic properties must include a historical architect, architectural conservator, or preservation specialist, as applicable, who meets U.S. Department of Interior Professional Qualification Standards and GSA Qualification Requirements.

Projects affecting historic properties, including landscape modifications and infrastructure work involving ground disturbance, must follow the Secretary of the Interior's Standards for the Treatment of Historic Properties in accordance with GSA ADM 1020.3 Procedures for Historic

Properties, Chapter 4, as directed by GSA's Regional Historic Preservation Office. The performance level to be met within the standards will be determined by the historical architect or preservation specialist, who must be integrally involved in the design and analysis of all alternatives affecting restoration or rehabilitation zones as defined in the Building Preservation Plan (BPP) or Historic Structure Report (HSR). The minimum standard treatment is rehabilitation with viable design alternatives that avoid adverse effects on historic spaces and materials. Each study and design submission must include a Section 106 Compliance Report documenting the development and analysis of preservation design alternatives in photographs, detail drawings, and project descriptions explaining how the recommended solutions address preservation issues raised by the project. Designs must follow applicable GSA Technical Guidelines and requirements for historic buildings in P100 Chapters 3-7.

Contract documents for repair, cleaning, restoration, or alteration of historic building materials must include GSA technical competency requirements for work requiring specialized skills required to meet preservation standards.

### 1.6.6 FIRST IMPRESSIONS

The First Impressions program extends the vision of Design Excellence into public lobbies of Federal buildings. These are the areas that shape a visitor's "first impression" of the Federal Government. Lobby security is a critical part of these public spaces, and visitors should be able to seamlessly navigate these areas without delay or confusion. The goal is to provide guidance for creating world-class lobbies. Five action points form the foundation of the First Impressions program. These action points are applicable across projects of all scopes and funding levels.

- Reduce Clutter—A place for everything and everything in its place.
- Consolidate Functions—Cluster amenities by function, creating centrally located business centers.
- Unify Signage—A unified signage system is critical to access.
- Streamline Security—Security should not be intrusive or intimidating.
- Transform your image—The result of integrating architectural, graphic, security, and signage design.

See the First Impressions Program Guide for more information: www.gsa.gov/firstimpression

### 1.6.7 OTHER GUIDES AND STANDARDS

- GSA National Business Space Assignment Policy
- PBS P-120, Public Buildings Service Cost and Schedule Management Policy (P-120)
- Metric Design Guide (see GSA Metric Order, GSA Metric Program, for guidance)
- GSA 3490.2 on Document Security for Sensitive but Unclassified Building Information
- Executive Order 13502, Use of Project Labor Agreements for Federal Construction Projects

## 1.7 SUSTAINABILITY

Sustainability is the conditions under which humans and nature can exist in productive harmony, and that permit fulfilling the social, economic, and other requirements of present and future generations. Sustainable design seeks to ensure that future generations are not disadvantaged by the depletion of natural or nonrenewable resources by the current

generation. Sustainable designs follow an integrated, synergistic approach, in which all phases of the facility lifecycle are considered. Following sustainable design principles improves building performance, promotes the health and comfort of building occupants, minimizes environmental impacts, and supports natural resource availability. The result must be an optimal synergy of cost, environmental, societal, and human benefits while meeting the mission and function of the intended facility or infrastructure. Subsequent chapters of the P100 include requirements and recommendations to meet these objectives.

The essential principles of sustainable design and development are:

- Optimize site potential
- Minimize nonrenewable energy consumption
- Protect and conserve water
- Use environmentally preferable products and materials
- Enhance indoor environmental quality
- Optimize operations and maintenance practices

These principles must serve as the basis for planning, programming, design, budgeting, construction, commissioning, operation, maintenance, and disposal of all new facilities, major renovations, and existing building alterations. These principles must be applied as appropriate to every project scope.

Applicable strategies and opportunities to improve sustainable performance must be included in all projects. New construction and major renovations of GSA buildings, as well as applicable work in existing GSA buildings, must comply with the Guiding Principles for Sustainable Federal Buildings. Strategies to meet the Guiding Principles are included in each appropriate chapter of the P100. For the latest guidance on implementing the Guiding Principles, see www.sustainability.gov/resources.html.

### 1.7.1 LEED CERTIFICATION

Through integrative design and application of sustainable design principles, all new construction projects and substantial renovations must achieve, at a minimum, a Gold rating through the Leadership in Energy and Environmental Design (LEED) version 4 Green Building Rating System of the U.S. Green Building Council. GSA uses LEED to measure and quantify building performance achievements in relation to its mandates and goals. Pursue LEED credits that align with the Guiding Principles for Sustainable Federal Buildings and are appropriate to the goals of GSA and to the type of project being designed. For more information, see GSA's Guiding Principles Checklist at www.gsa.gov/sustainabledesign.

## 1.7.2 SUSTAINABLE PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Energy** | | | | | | | | | |
| **Energy Net-Zero** | Designs must be Energy Net-Zero ready on a source energy basis with onsite renewables that are designated on the plan for future installation. | Designs must be Energy Net-Zero ready with 25% onsite renewables installed and the remainder designated on the plan for future installation. | Designs must be Energy Net-Zero ready with 50% onsite renewables installed and the remainder designated on the plan for future installation. | Designs must be Energy Net-Zero with 100% onsite renewables installed. | Report the projects ongoing energy performance in a sustainability benchmarking platform | Y | Provide 90.1 Appendix G energy model and calculations for proposed and installed renewable energy. | Show a project is energy net-zero ready by providing a written narrative on how the energy-efficient building, on a source energy basis, achieves actual annual delivered energy less than or equal to the on-site and/or proposed renewable exported energy. | CX agent to confirm installed renewables supply the required power to meet the high performance tiers. |
| **Water** | | | | | | | | | |
| **Water Net-Zero** | Meet current policy including EISA sec. 438. | Designs must be Water Net-Zero ready with 50% potable water returned back to the original water source on site. | Designs must be Water Net-Zero ready with 75% potable water returned back to the original water source on site. | Designs must be Water Net-Zero with 100% potable water returned back to the original water source on site. | Report the project's ongoing water performance in a sustainability benchmarking platform | Y | Provide calculations for water-use baseline. Show all methods of water conservation, reuse, and the amount of water returned to the original water source. | Provide written narrative showing how water baseline is offset by proposed and installed water saving or reuse measures. | NA |
| **High Performance Building Technologies** | | | | | | | | | |
| **GSA Proving Ground** | Designs must incorporate one technology from the GPG Published Findings. | Designs must incorporate two technologies from the GPG Published Findings. | Designs must incorporate four technologies from the GPG Published Findings. | Designs must incorporate five technologies from the GPG Published Findings. | | Identify technologies utilized from the GPG. | | Provide written narrative showing how the GPG technologies will be utilized. | CX agent to confirm GPG technologies are appropriately installed. |
| **Construction Personnel** | | | | | | | | | |
| **Green Credentialed** | No requirement | Specify that 30% of the contractor and subcontractor management be certified by a green builder program recognized in the LEED rating system. | Specify that 30% of contractor and subcontractor management and 15% of the tradespeople be certified by a green builder program recognized in the LEED rating system. | Specify that 30% of contractor and subcontractor management and 30% of the tradespeople be certified by a green builder program recognized in the LEED rating system. | Employ the LEED v4 rating system innovation and/or pilot credit | | | | Provide list of certified managers and tradespeople and calculate the percentage of each on site. |

#### 1.7.2.1 NET ZERO WASTE

A net zero waste Federal building is operated to reduce, reuse, recycle, compost, or recover solid waste streams (with the exception of hazardous and medical waste), thereby resulting in no waste disposal to landfills or incinerators. Based on the solid waste management policy, provide a written narrative supported by drawings to show: the building's waste collection and storage locations by waste stream; methods to maximize waste reduction and reuse (through interior construction and design) and to collect, separate, and divert waste (reuse, recycle, compost, waste to energy); and locations within the building for the anticipated management and final collection points of the waste streams to maximize waste reduction and diversion. This applies to all non-C&D waste (excluding hazardous and medical waste). For more information, go to www.sftool.gov/solidwaste.

#### 1.7.2.2 CONSTRUCTION AND DEMOLITION WASTE

Divert at least 50% of total non-hazardous construction and demolition (C&D) materials, by weight, from landfills. At substantial completion, report the following figures to GSA project manager: total tonnage of non-hazardous C&D materials generated at the project, and how many of those tons were diverted from landfills. Waste diversion methods include reuse, recycling, scrap, and donation.

#### 1.7.2.3 HIGH PERFORMANCE BUILDING TECHNOLOGIES

GSA's Proving Ground (GPG) program began in 2011 as a means to evaluate the most effective high-performance building technologies installed as part of the American Recovery and Reinvestment Act. In subsequent years, GPG has annually published a Request for Information, and selected 5-15 emerging technologies to install in test beds, where their real world performance can be evaluated. In this manner, GPG enables GSA to make sound investment decisions in next generation building technologies based on their real world performance.

Those technologies GPG has recommended for broad deployment have demonstrated cost-effective real-world performance, tenant and facility operator acceptance, and maintainability. They are ready for installation in GSA's existing buildings, as well as incorporation into GSA's major modernization and new construction projects. To learn more about these technologies, go to www.gsa.gov/portal/content/163479.

**Tech Tip:**

"Technology Tips" have been placed throughout this edition to encourage P100 users to consider GPG technologies. Additional investigation will be required to ensure considered technologies are appropriate and feasible for any major modernization or new construction project. In addition, for IP-enabled technologies, cybersecurity approval from PB-ITS needs to be obtained. Contact GPG for a list of technologies that have cleared PB-ITS scanning.

#### 1.7.2.4 GREEN CREDENTIALED CONSTRUCTION PERSONNEL

GSA supports and encourages the knowledge and understanding of high-performance construction practices by those implementing design in the field.

### 1.7.3 GUIDING PRINCIPLES FOR SUSTAINABLE FEDERAL BUILDINGS

New Construction and Major Modernization projects' design team must use GSA's Guiding Principles Checklist (composed of Guiding

Principles Criteria, or GPCs—see Appendix B.1) to track and report compliance with the Council on Environmental Quality's Guiding Principles for Sustainable Federal Buildings. Teams must use the Checklist throughout design, and articulate, via GSA's online "gBUILD" database described below, how GPC requirements are being met. If requirements cannot be met, supporting explanations and/or documentation is required. Related LEED credits are mentioned in the GPCs.

All GSA capital projects shall use GSA's Green Building Upgrade Information Lifecycle Database (gBUILD) to centrally track and report sustainability information. New construction and major modernization projects' compliance with the guiding principles is tracked in gBUILD, via the GPCs. gBUILD gathers projects' scope/technology details, anticipated energy and water performance, and total/diverted tons of construction and demolition waste at substantial completion. For more information or access, contact gbuild@gsa.gov.

## 1.8 ENERGY USE TARGETS

Buildings must be designed to comply with the energy performance requirements of EPAct 2005, EISA 2007, and the 2030 Challenge.

### EPACT 2005 BUILDING DESIGN ENERGY COMPLIANCE

EPAct 2005 requires buildings to be designed to be at least 30 percent more efficient than the design required by American National Standards Institute (ANSI)/ASHRAE/IES Standard 90.1 per the Secretary of the U.S. Department of Energy's rulemaking if life cycle cost effective. For guidance to achieve a level of energy efficiency 30 percent greater than Standard 90.1, see the final rule 10 CFR, Energy, Parts 433-435, issued by DOE at www.gpo.gov/fdsys/pkg/FR-2015-11-06/pdf/2015-28078.pdf.

### 2030 CHALLENGE FOR CARBON NEUTRAL BUILDINGS

2030 Challenge aligns with EISA and requires buildings to be designed so that the fossil fuel generated energy use is reduced by the following percentages over the latest version of the Energy Information Administration's Commercial Buildings Energy Consumption Survey (CBECS) in designs for prospectus-level new construction and major renovations:

- FY 2017 70% reduction
- FY 2020 80% reduction
- FY 2025 90% reduction
- FY 2030 100% reduction

### 1.8.1 MAJOR RENOVATIONS

The A/E must design all systems to be replaced with systems that offer the highest level of energy performance available. All designs that improve HVAC systems must include recommissioning of the entire HVAC system. For modernizations where all systems are replaced, the A/E must target at least a 20 percent reduction from the 2003 energy usage of the building. The building's 2003 energy usage can be obtained from the Office of Design and Construction.

### 1.8.2 ENERGY USE INTENSITIES DESIGN MAXIMUMS

Both EPAct 2005 and EISA 2007 require reductions in the energy use of the overall portfolio of buildings owned by GSA. To meet the goal of reducing total site energy usage, energy targets are established for all new construction. The A/E must design all new buildings to have an energy performance below the EISA 2007 energy target or 30 percent below ASHRAE 90.1, whichever is lower.

From concept design through each design phase, the project must demonstrate that it meets the

energy target. Use energy modeling that includes the building enclosure systems in concert with mechanical systems and provide documentation showing that systems were chosen based on a life-cycle cost analysis.

For courthouses, use the public safety buildings target. For land ports of entry, perform the energy analysis for the main building, commercial building, and headhouse, in addition to using the public safety target.

## 1.9 SAFETY AND HEALTH RISK REDUCTION

Most facility safety and health risks are adequately controlled through adherence to current building codes and regulations. However, codes and regulations only provide a minimum standard of care and generally do not address unique designs or optimize safety and health risks over the facility life-cycle. It should also be noted that building codes tend to focus on facility design with an emphasis on structural and fire safety issues while safety and health regulations (such as those promulgated by OSHA) are primarily employee or operationally-oriented and usually do not regulate building design. Therefore GSA requires designers take a systems approach to facility safety and health risk management to eliminate or mitigate facility life-cycle risks.

### 1.9.1 LOSS CATEGORIES

The following categories of potential exposures and losses shall be considered:

- Occupants. Facility designs shall consider the intended or potential occupancy and be designed so as to prevent or minimize workplace injuries and illnesses to those occupants during such occupancy or use.
- Visitors and the General Public. Facility designs shall consider expected use and unintended use by visitors and the public and be designed so as to eliminate or mitigate injury to such parties and liability to GSA.
- Contractors. Facility designs shall not present an unreasonable risk to GSA operations, maintenance, custodial, construction, or other contractors. Facility designs shall, to the extent practical, incorporate safety considerations into the design.
- GSA Assets. Facilities shall be designed to minimize susceptibility to property damage and loss due to fire, water damage, structural failure and other causes
- Business Continuity. Facilities shall be designed for maximum availability and mission continuity.

### 1.9.2 SPECIAL EXPOSURES

- Construction. Constructability reviews shall consider and address the risk of injury to personnel on or affected by the job site, and potentially exposed building occupants, other contractors, visitors and the public. The review shall also consider potential loss or damage to GSA, other Federal agencies, or private property.
- Maintenance, Repair, and Custodial Operations. Facility components that use or require the use of hazardous materials, work at elevation, entry into confined spaces, ergonomic stress, access to energy sources (electrical, mechanical, pressure, thermal), or access to other dangerous locations can present significant risks to the trades and GSA inspectors, and also increase costs when personal protective equipment and special procedures are required. Therefore these hazards shall be designed out or mitigated to the extent feasible. Refer to NIOSH

Prevention through Design (PtD) or USGBC Pilot Credit 93 (PtD) for guidance.

## 1.9.3 ORDER OF PRECEDENCE

Designers shall mitigate safety and health risks in accordance with the following ANSI Z10 order of precedence:

1. Hazard elimination. Elimination of the hazardous condition shall be the primary objective of safe design.
2. Engineering controls. If the hazard cannot be eliminated, reduce the associated risk to an acceptable level through isolation or substitution with a lower risk hazard.
3. Warning devices. If the hazard cannot be engineered to an acceptable level of risk, provide cautions and warnings. Provide detection and warning systems where required to alert personnel to specific hazards.
4. Procedures and training. As a last resort, risks may be reduced to an acceptable level through the incorporation of special procedures and training.

Mitigation with preferred methods generally requires higher initial cost; however, these methods provide the most effective protection, often with lower life-cycle costs. Where preferred methods are too costly, less preferred recommendations may be combined to provide redundant or overlapping solutions. For high consequence hazards, avoid using warning, caution, or other written advisories as the only risk reduction method.

## 1.9.4 SPECIFIC HEALTH AND SAFETY REQUIREMENTS

### 1.9.4.1 ASBESTOS

#### 1.9.4.1.1 MODERNIZATIONS

Modernizations of occupied spaces must include the removal of all asbestos-containing material (ACM) that has the potential for future disturbance both through normal occupancy and during future repairs, maintenance, or alterations. Enclosure or encapsulation of such ACM is prohibited.

#### 1.9.4.1.2 ASBESTOS PRE-ALTERATION ASSESSMENTS

The OSHA Construction Standard, 29 CFR 1926.1101, requires that surfacing and thermal systems insulation in buildings constructed prior to January 1, 1981, be presumed to contain asbestos unless demonstrated otherwise. GSA considers materials replaced by non-asbestos materials subsequent to January 1, 1981 to be exempt from the above OSHA requirement providing such replacements are properly documented. While buildings constructed after 1980 are not specifically regulated, OSHA requires building owners to use due diligence to identify any suspect asbestos-containing material. In addition, the EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) (10 CFR Part 61) requires that, prior to the commencement of a demolition or renovation, the building owner or operator thoroughly inspect the affected facility where the demolition or renovation operation will occur for the presence of asbestos.

Please note that the NESHAP is silent regarding the construction date of the building. While the use of asbestos-containing building materials has declined significantly over the last few decades, it must be noted that asbestos has not been entirely banned. Even today, asbestos sometimes finds its way into such products as drywall mud and flashing cement. Therefore, prior to the design of a renovation or demolition project, an evaluation must be conducted to

determine if asbestos is present in the project area. This evaluation includes the review of any available asbestos surveys and consultation with GSA regional environmental, health, and safety offices.

If asbestos is present, presumed, or suspected in the project area, then a "pre-alteration asbestos assessment" must be performed to determine whether and to what extent asbestos may be disturbed (41 CFR 102-80.15). Presumed and suspected asbestos must be sampled and tested or treated as asbestos-containing. Inaccessible areas affected by the project also have "destructive" samples collected and tested or presumed to contain asbestos.

Projects with the potential to disturb asbestos must include controls to protect the construction contractor, building occupants, the public and the environment. GSA complies with State and local asbestos regulations where such exist, in addition to the Federal NESHAP, including notification requirements. Designers shall consult with GSA regional environmental, health and safety offices for specific guidance.

#### 1.9.4.2 LEAD-BASED PAINT

Paint must be tested for lead content when alterations or demolitions require the sanding, burning, welding, or scraping of painted surfaces. Lead-based paint controls must be implemented in accordance with 29 CFR 1926.62. Lead-based paint that is intact and in good condition need not be abated unless required for alteration or demolition. Lead-based paint must be abated in child care centers. Refer to PBS-P140 for specific details. Construction waste containing lead-based paint must be considered hazardous waste unless testing proves otherwise.

#### 1.9.4.3 CONFINED SPACES

The designer shall avoid the creation of confined spaces except where required as part of a system (e.g., tanks, pits). Confined space is defined in 29 CFR 1910.

#### 1.9.4.4 FALL PROTECTION

All locations, both indoor and outdoor, where routine work is expected to be performed at elevations above four (4) feet must be addressed for the feasibility of including permanent work access and platforms in the design. Typical work locations include but are not limited to luminaires, mechanical equipment, window glass, and roofs. Inspection and testing is exempt from the work platform requirement. Specific detail is provided in the appropriate technical chapters.

## 1.10 METHODOLOGIES

### 1.10.1 SPACE MEASUREMENT AND BUILDING EFFICIENCY

The A/E must design to the area included in the approved prospectus and delineated in the program of requirements. The area must be confirmed at each phase of design and is to be measured in accordance with the GSA National Business Space Assignment Policy dated May 2009 or current edition, including any addendums or other clarifications. Projects that exceed the area included in the prospectus will need to be redesigned.

GSA’s National Business Space Assignment Policy establishes current PBS practices for the assignment of space within the federally owned and leased inventory. It provides the methodology and information necessary for the correct assignment of space.

Additionally, this policy document provides details and illustrations of how PBS uses the commercial ANSI and Building Owners and Managers Association International (BOMA) Standard Method for Measuring Floor Area in Office Buildings (ANSI/BOMA Z65.1) as the

foundation for space measurement and assignment.

PBS's measurement and assignment principles are not 100 percent compliant with ANSI/BOMA measurement standards. For example, PBS uses a PBS-specific category in conjunction with ANSI/BOMA's categories. This document provides the details and illustrations showing how PBS's assignment and measurement processes relate to and differ from ANSI/BOMA processes.

Space efficiency is defined as the minimum necessary space for the desired functions to be properly accommodated, with minimum "waste" between usable area and gross area. The target for the usable-to-gross ratio in new building construction is 80 percent. The National Business Space Assignment Policy established the definition of usable and gross area. In all building types, space efficiency must be balanced against effectively achieving space requirements and desired aesthetics.

The plan configuration, floor-plate depth, planning module, and circulation patterns together determine the space efficiencies of a building. The historic character of a building can create major inefficiencies where the primary circulation is typically wider and thereby affects the amount of usable space available. However, a building's historic value or design aesthetics must not be compromised to achieve greater space efficiencies.

Plan configuration describes the geometry of a typical floor within a building. A square or rectangular plan with a single central core will be inherently more efficient than a plan that is highly irregular, with distributed service cores. Building types other than office buildings, like courthouses and Land Ports of Entry, will likely have lower usable to gross ratios based on numerous special requirements that are addressed in their design guides. When efficiency ratios fall, the floor plan is likely to have more irregularities that, in turn, will increase space utilizations per full-time equivalent (FTE) and restrict furniture and tenant space planning. Configuration of space is an important consideration when selecting a new building design or comparing one with another.

## 1.10.2 WORKPLACE TOOLS AND PROCESSES

Use workplace program analysis and development tools and processes that provide cost- and time-effective ways to analyze existing space performance, space constraints, and organizational mission and goals, and provide design criteria that directly address these issues. The analysis must include the following.

### 1.10.2.1 A BALANCED SCORECARD APPROACH

Developed by Harvard's Kaplan and Norton, this provides a framework to analyze and measure the performance of an organization in four domains—finance, business process, customer, and human capital. GSA uniquely uses this framework to directly link workplace solutions to the organization's goals.

### 1.10.2.2 QUANTITATIVE AND QUALITATIVE DISCOVERY PROCESSES AND TOOLS

These are used to derive design concepts and solutions from an understanding of the organization—its goals, culture, and current and desired work practices—using both quantitative and qualitative data. This includes gathering quantitative and qualitative data; gaining in-depth knowledge of the customer organization; conducting on-site observations, interviews, and focus groups; and developing written guidelines

to inform the design and design review processes.

#### 1.10.2.3 CHANGE MANAGEMENT

This involves a broad segment of the organization to help define workplace needs and build project consensus. By engaging occupants early on, change management can be approached as an organizational opportunity, and occupant expectations can be managed proactively.

#### 1.10.2.4 FEEDBACK LOOP

This involves identifying connections between business and workplace goals and design solutions, measuring for desired outcomes, and using the findings to improve existing and future organizational operations and work-place projects. This includes preoccupancy and post occupancy surveys, design commissioning, testing, and measurement.

For more information on workplace analysis processes and tools, visit www.gsa.gov/portal/category/101130.

### 1.10.3 BUILDING INFORMATION MODELING (BIM)

As BIM technology has matured over the last two decades, GSA has worked with public owners and the private sector to create or update standards, develop best practices, and fully integrate the use of this technology in GSA projects. BIM has become an essential component of all delivery methods for complex public building projects. BIM's numerous post-construction uses inform operations and management throughout the building lifecycle. With the creation of the GSA Central Facilities Repository (CFR)—a building information database accessible through the single sign-on PBS Portal—GSA project teams from all PBS business lines now have the ability to catalog building and project information both as it is created and through the building lifecycle, thus ensuring that the most current building information is available on-demand to follow-on project stakeholders. The content of the CFR in each region is maintained by a Regional BIM Manager (BIMr) and Building Information Specialists (BIS), who manage the flow of information in and out of the CFR, working with the project teams early in their project cycle to provide critical information that will speed the delivery of each building project. GSA's BIM guideline documents are available at www.gsa.gov/bim.

The primary goal of the GSA 3D-4D-BIM program is to incorporate digital visualization, simulation, and optimization technologies in project planning and design, construction as-builts, and facility operations, and to increase quality and efficiency of business processes throughout the GSA project life-cycle. All new construction and major modernization projects are required to have a BIM deliverable submitted to GSA throughout the facility lifecycle. BIM also applies to lease construction facilities where GSA's formal Request for Lease Proposal (RLP) has an option for GSA to purchase the building at a future date. The requirements of BIM will be included in the RLP on a case by case basis, in consultation with the Chief Architect. Exclusion of BIM from lease construction facilities where GSA's formal RLP has an option for GSA to purchase the building requires written approval from the Chief Architect. The Regional Office, in consultation with the respective Central Office business line, may waive the BIM deliverable on certain small and single trade projects. Deliverables must include standardized facility asset data in IFC-based (Industry Foundation Class) Building Information Models, along with the native file BIM, for all phases of capital

projects, from design concept documents, to construction bid set documents, to construction as-built documents. BIM models must also include GSA's standardized National Computerized Maintenance Management System (NCMMS) data in open standard COBie (Construction Operations Building Information Exchange) format, to be used throughout the operations and maintenance activities of the facility. See P100 Appendix A and the GSA BIM Guide Series at www.gsa.gov/bim.

## 1.10.4 TOTAL BUILDING COMMISSIONING

Total Building Commissioning (TBC) is a systematic process of ensuring by verification and documentation, from the design phase to a minimum of one year after construction, that facility systems perform interactively in accordance with the design documentation and intent and in accordance with the owner's operational needs to include preparation of operation personnel.

TBC recognizes the integrated nature of all building systems' performance, which affects sustainability, workplace productivity, occupant safety, and security. All GSA capital construction projects must employ TBC practices.

For more information on how the designer must include commissioning requirements, see the Building Commissioning Guide, available at www.gsa.gov/portal/category/21595.

See Chapter 7, Fire Protection, for additional information on commissioning the fire protection and life safety systems.

## 1.10.5 BUILDING OPERATIONS AND MAINTENANCE

Long-term operations and maintenance costs are significantly higher over time than first costs. Systems must be designed for ease of operation and cost-effective maintenance and repair. System accessibility is a critical consideration in building design. The A/E shall anticipate the means and methods expected for the inspection, adjustment, cleaning, maintenance, repair, and replacement of building components.

### 1.10.5.1 WORKER ACCESS

All building components that require routine inspection, adjustment, cleaning, maintenance, repair, and replacement shall be so located, oriented, or otherwise designed to allow for safe and unencumbered access by building maintenance personnel. Access shall include both the route to the component and clearance. Access to components shall be addressed for each maintenance task and shall accommodate an anthropometric range of a 5th percentile female worker to a 95th percentile male worker based on MIL-STD-1472.

### 1.10.5.2 REMOVAL AND REPLACEMENT

Components shall be located and oriented to allow the removal and replacement of such components, or parts thereof, without the need for special rigging, removal of non-related components or equipment, or requiring special safety precautions.

### 1.10.5.3 VERIFICATION

Worker access and component removal/replacement shall be demonstrated in the BIM model. Animation is not required and verification may be provided through static "clash" modeling. All components that require routine inspection, adjustment, cleaning, maintenance, repair, and replacement shall be modeled. The GSA Project Manager may exclude components where adequate access and removal/replacement is obvious without modeling.

#### 1.10.5.4 Turn-Over

The A/E must specify that operation and maintenance manuals be provided in electronic format (MP4 files) with training videos for the startup and maintenance of all major equipment. Training videos must include the detailed instruction of all operational and maintenance aspects of any new Building Automation System software.

At the conclusion of design, the A/E must provide an electronic document describing the design intent for all building systems. These instructions must be developed during the design phase and incorporated into the comprehensive training for operations and maintenance personnel.

### 1.10.6 LIFE-CYCLE COSTING

Federal facilities must be designed to achieve the lowest life-cycle cost. A project's design must comprehensively define reasonable scope and performance requirements within the appropriated budget and approved prospectus for design and construction. Consistent with these constraints, building systems and features must be analyzed and selected to achieve lowest life-cycle cost per the requirements of the P120.

Life-cycle costing (LCC) must be used when selecting a system from several alternative systems or components for a project. LCC is the economic analysis method required by CFR Title 10, Part 436, Subpart A, "Program Rules of the Federal Energy Management Program." OMB requires this methodology, through the Federal Energy Management Program, to evaluate the cost effectiveness of systems that use energy and water. LCC compares initial investment options and operating and salvage costs over the life of the equipment and identifies the least costly alternatives. Examples of building systems that affect energy use are the building thermal envelope, passive solar features, fenestration, HVAC, domestic hot water, building automation, and lighting.

Many established guidelines and computer-based tools that effectively support present-value LCC analyses are available. The National Institute of Standards and Technology (NIST) has prepared the Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135) and annually issues real growth energy price indices and discount factors for life cycle cost analysis. As a companion product, NIST has also established the Building Life Cycle Cost (BLCC) computer program to perform LCC analyses. The latest versions of the BLCC program not only structure the analysis but also include current energy price indices and discount factor references. These NIST materials define all required LCC methodologies used in GSA design applications. The A/E may obtain the BLCC software and updates from NIST. The latest BLCC software is available at https://energy.gov/eere/femp/building-life-cycle-cost-programs.

The project team must integrate the LCC analysis into the concept design process, and the analysis must be completed by the design development phase.

### 1.10.7 RESILIENCE—MANAGEMENT OF CLIMATE—RELATED AND EXTREME WEATHER RISKS

Historic climatic design data is becoming less illustrative of the current and long-term climate conditions that Federal buildings endure. GSA must integrate both the observed and expected changes in climate and extreme weather for the asset service life when planning and designing their capital investments. Management of climate-related risks ensures that Federal investments have the ability to continue to

perform acceptably and ensure life safety in the face of changing trends and extremes.

Risk management is a qualitative, iterative process that addresses the risks and opportunities of plausible incremental climate–related risks, as well as extreme weather for the asset service life. It also addresses adaptations to the design, operation, and maintenance of a project in light of its vulnerabilities. This risk management must be prioritized for projects that have sites with existing vulnerabilities, house mission-critical/mission-dependent functions (e.g. land port of entries, data centers), have an intended asset life beyond the year 2040 or are designated as a historical/cultural resource.

Some projects may require energy and water surety in the event of extended utility disruption. In short, detailed assessment and design must establish these criteria on a case-by-case basis, as informed by a partner agency's mission, sensitivity to interruption, and other variables.

Designers for new construction, renovations, repairs and alterations and modernizations shall:

- Integrate climate information into designs per the GSA provided climate profile and statement of work for those prioritized project types listed above,
- Develop designs for the service life of the asset. Parts of a project may be designed for reliable performance throughout a building's lifespan; others may be adapted as conditions change.
- Exercise professional judgment in the context of resilience for climate-related risks and an evolving professional standard of care.

For more information, see Safeguarding Assets.

See related section on Flood Resistant Design and Construction in Chapter 3.

### 1.10.8 WILDLAND URBAN INTERFACE

Each building must comply with the latest edition of the International Wildland-Urban Interface Code (IWUIC), promulgated by the International Code Council, if the building is at moderate or greater wildfire risk as defined in the IWIUC, using the USDA "The 2010 Wildland-Urban Interface of the Conterminous United States" map.

### 1.10.9 INDOOR FIRING RANGES

The design, renovation, repairs and alteration, and modernization of an indoor firing range shall meet the minimum standards set forth in the GSA "Indoor Firing Range Policy and Criteria," www.gsa.gov/portal/category/25635.

### 1.10.10 SMART BUILDINGS

GSA intends to lead the Government in owning and operating smart buildings. Utilizing the latest technology and building systems, GSA is able to optimize energy usage and operations. Please reference the GSA Smart Buildings Program Guide for guidance on developing Smart Building projects and selecting smart building attributes. The GSA Smart Buildings Implementation Guide shall be referenced for guidance in specifying the smart building attributes.

# 2

# URBAN DEVELOPMENT AND LANDSCAPE DESIGN

Figure 4:
U.S. Coast Guard
Headquarters Courtyard
Washington, DC

# 2.1 URBAN PLANNING AND PUBLIC USE PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **2.2.1 Sustainable Locations** | | | | | | | | | |
| **Site Uses Existing Local Infrastructure Resources and Preserves Natural Resources** | oSite selection process meets GSA responsibilities under directives described in Section 2.2, incl GSA ADM 1097.1 and consults with local officials.<br><br>Site's immediate prior use was not a public park or designated open space.<br><br>Project earns 1pt under Sensitive Land Protection, LEED v4. | o The site meets the Baseline requirements, AND:<br><br>o Additionally, site is a previously developed infill site served by existing water and sewer infrastructure.<br><br>Proposed development on this site is designated by local planning officials as advantageous to local infrastructure and development goals. | o The site meets the Baseline requirements, AND:<br><br>o Additionally, site is an officially designated brownfield site and has been remediated to the satisfaction of the designating authority.<br><br>OR<br><br>Site is officially designated for priority redevelopment and earns 1 pt under Priority Designation under High Priority Site, LEED v4 | N/A | ODC review of maps, documents, project design narrative, and related materials.<br><br>Project teams are encouraged to make use of appropriate documentation they've prepared for LEED. | Site Acquisition and Design Concept materials | N/A | EOs 12072, 13006, 13693, and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED v4 | Verify relevant design elements from approved Concept presentation. |
| **Site Supports Neighborhood Connectivity, Walkability, and Transportation Access** | oProject's main entrance and all frontages are linked to surrounding sidewalk and crosswalk network, extending out in a 1 mile radius from entrance.<br><br>Project is within ¼ mile walkable distance of 4-7 diverse uses, as defined under Surrounding Density and Diverse Uses, LEED v4 | o The site meets the Baseline requirements, AND:<br><br>Additionally, project is served by qualifying transit routes and stops for bus, streetcar, light rail, etc. such that it earns at least 3 pts under Access to Quality Transit, LEED v4. | o The site meets the Baseline requirements, AND:<br><br>oAdditionally, project is served by qualifying transit routes and stops such that it earns 5 pts under Access to Quality Transit, LEED v4. | o The site meets the Baseline requirements, AND:<br><br>oAdditionally, project is within a 200-yard walking/bicycling distance of a designated bicycle network, connecting diverse uses, employment centers, and transit stops as defined under Bicycle Facilities, LEED v4. | ODC review of maps detailing connectivity around site and retail and other diverse uses within specified radius or buffer. Project teams are encouraged to use appropriate documentation materials they've prepared for LEED. | Site Acquisition and Design Concept materials | Calculations based on source material from vetted information service or GSA provided data. | EOs 12072, 13006, 13693 and Implementing Instructions for Sustainable Federal Locations (CEQ 09/2011); LEED ND, v2009 | Resubmission of previously specified maps using updated data as of time of substantial construction completion. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **2.2.2 Collaborative Design Process** | | | | | | | | | |
| **Design Process Considers Input of Local Officials** | o For new construction or other projects with significant impact on the public realm (e.g., landscape, facades, perimeter security), GSA's regional project team meets with local officials about the project and considers their input during the preparation of feasibility and similar analysis, prior to requesting design funding.<br>o Prior to Design Kick-off, GSA project manager and A/E meet with local officials, share project info, get officials' input, and review local plans.<br>o At first Peer Review, project team presents input from consultation with local officials, explains project's responding design strategy in that context.<br>o At Final Design Concept presentation for Commissioner's approval, design team presents local input, outlines responding design strategy, and presents detail regarding relevant building and landscape design elements to enable meaningful consideration of the concept. | o Meets Baseline performance requirements, AND:<br><br>o Prior to approval of the Final Design Concept, project team must share the relevant elements of the proposed design strategy with local officials and address their feedback in the Final Design Concept presentation. | o Meets Tier 1 High Performance Requirements AND:<br><br>o Project development must be based upon a Feasibility Study that includes input from local officials on relevant design elements. | o Meets Tier 2 High Performance Requirements AND:<br><br>o Project design and development must be informed by a neighborhood planning or charrette process that was conducted in partnership with local officials. | ODC Review of Design Narrative and presentation at relevant reviews | Design Concept materials | N/A | Applicable policies:<br>Federal Urban Land Use Act of 1949 (40 USC Sec. 901-905); Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072, 13006, and 13514 | Verify relevant design elements from approved Concept presentation. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Design for Public Use** | | | | | | | | | |
| **Design for Public Use - INTERIORS** | o Assembly areas in the base building program (e.g., auditoriums, atria, jury assembly rooms) are designed to allow for manageable public access for after-hours use. | o Meets Baseline Requirements AND:<br><br>o Assembly areas within the base building program are positioned in relation to public entries and other building amenities so as to enhance their visibility and utility and to encourage public interest in their use. | o Meets Tier 1 High Performance Requirements AND:<br><br>o Assembly areas for appropriate public use includes at least one contiguous space that provides a minimum of 2,000 SF. | o Meets Tier 2 High Performance Requirements AND:<br><br>o Design provides interior spaces or other permanent structures that will be leased for long-term private commercial or other mixed use. | ODC Review of Design Narrative and presentation at relevant reviews | Design Concept materials | N/A | Public Building Cooperative Use Act of 1976 (40 U.S.C. 601a) | Verify relevant design elements from approved Concept presentation, and submission of completed form 3453, when appropriate |
| | | | | | | | | | |
| **Design for Public Use - EXTERIORS** | Design provides clear vision for how all exterior public areas are meant to be used, whether for circulation, passive use, or programmed public use.<br><br>Design narrative must include ratio of provided site seating to expected building population (i.e. seats/person, assuming 2' linear per seat). | o Meets Baseline Requirements AND:<br>Onsite seating (2' linear per seat) provided for at least 5% of daily building users. Seating meets standards outlined in SITES credit HHWB C6.4. If not provided under construction contract, site furnishings (benches, etc.) are selected and located by the project designer, priced and sourced for later acquisition, and installed upon project opening. | o Meets Tier 1 High Performance Requirements AND:<br><br>oSite design includes a publicly accessible plaza space that provides for occasional programmed public use and includes electrical service to support it.<br><br>Gathering areas are equipped with publically accessible''guest' WiFi to support use by building occupants and visitors. | N/A | ODC Review Project teams are encouraged to use appropriate documentation materials they've prepared for LEED/SITES. | Design Concept materials | Design Concept materials | Public Buildings Cooperative Use Act of 1976 (40 U.S.C. 601a); the Public Buildings Amendments of 1988 (40 U.S.C. 3312) | Resubmission of previously specified documents using updated data as of time of substantial construction completion. |

## 2.2 URBAN PLANNING

GSA has the responsibility to leverage its Federal real estate actions in ways that support local community planning goals, catalyze economic development, and advance regional sustainability objectives while also meeting client agency needs, wherever possible. This derives from several laws and Executive Orders including the Federal Urban Land Use Act of 1949 (40 U.S.C. Sec. 901-905); the Public Buildings Cooperative Use Act of 1976 (40 U.S.C. 581(h)); the Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072 and 13006. GSA ADM 1097.1 encapsulates these factors. These requirements are in addition to and should be coordinated with the local consultation required under NEPA.

The goal of designing a Federal building that responds to its site, to the surrounding neighborhood design and plans, and its potential for interactions with the general public is leveraging Federal investment in support of local plans in ways that improve neighborhood design and experience. Achieving this level of design quality requires that attention be paid to sustainably locating the facility near transit and in pedestrian-friendly neighborhoods, to involving local officials collaboratively in the design process, and to designing the building for maximum potential public use of the exterior and interiors.

### 2.2.1 SUSTAINABLE LOCATIONS

Constructing Federal facilities in sustainable locations can lessen the cost burden on local infrastructure, provide transportation choice to reduce congestion, support access to jobs and services, conserve natural resources, and advance Federal and local sustainability goals. Sustainably locating a Federal facility requires consideration of several factors in addition to mission requirements. These factors include access to transit, walkability, proximity to neighborhood amenities, and maximization of existing road, sewer, and other infrastructure through infill and other efficient development opportunities.

### 2.2.2 COLLABORATIVE DESIGN PROCESS

The construction and renovation of a Federal facility may be one of the more significant real estate investments in many communities. GSA has a responsibility to meet client needs first and, where feasible, Federal investment also should support local development plans. This responsibility derives from the Federal Urban Land Use Act of 1949 (40 U.S.C. Sec. 901-905); the Public Buildings Amendments of 1988 (40 U.S.C. 3312); and Executive Orders 12072 and 13006.

In order to meet this responsibility, the project team must understand local plans and conditions and meet the requirements outlined in the previous matrix.

### 2.2.3 DESIGN FOR PUBLIC USE

The Public Buildings Cooperative Use Act of 1976 (40 U.S.C. 581(h)) requires GSA to encourage the location of commercial, cultural, educational, and recreational facilities and activities within GSA public buildings and sites, and to encourage the public use of these properties for cultural, educational, and recreational activities. Although much of this responsibility falls to how GSA manages and makes such space available, the design of the spaces–both interior and exterior–is fundamental.

Federal buildings are inherently public buildings, but their design determines how successfully the

public is able to access and use the building interior and exteriors. This is especially true given current security requirements and project budgets.

Buildings that are highly successful maximize public investment by both meeting the Federal space need and by enabling public use. Key factors in a successful project include the design's ability to support flexible passive or programmed use in gathering spaces, the shaping and orientation of the building program to encourage such use, and, where appropriate, the expansion of the building program to take advantage of site-specific public use opportunities.

All public areas of the project site, regardless of scale, should take a deliberate and proactive approach to providing a positive usable space for facility users and, where possible, the local community.

## 2.3 URBAN PLANNING AND DESIGN, AND SITE PRESCRIPTIVE REQUIREMENTS

### 2.3.1 PROCESS CRITERIA

The design team must identify relevant local planning and/or land-use officials and record interactions with them, including meeting schedules and minutes. Note that the appropriate level of government (local, county, State) will differ with each jurisdiction.

The design team must work with client agency and local officials to understand mode share split of employee and visitor commutes, i.e. identify how people arrive at the site and what percentage of people by each mode of transportation. This understanding will assist the design team in effectively orienting building approaches toward the highest-use pedestrian entry points to the site.

### 2.3.2 DESIGN CRITERIA

#### 2.3.2.1 EXTERIOR CONNECTIONS AND GATHERING SPACES

All outdoor pedestrian pathways must connect building entrances safely and contiguously to the means of transportation identified in consultation with client agency and local officials, described above, including transit stops off-site.

Building approaches, pathways, and plazas must be oriented toward primary pedestrian access points to the site. This orientation must give consideration to street connections to transit stops, when appropriate, and to primary neighborhood corridors.

The design team must demonstrate in design drawings how plazas and other gathering spaces allow for several different active and passive uses (such as farmers markets, seated assemblies, and employee breaks and lunches). Design teams must consider current best practices in public space design. For example, isolated bench seating, seating without shade, and gathering spaces not visible from building entrances or along primary pedestrian pathways are not likely to be used regularly.

Design drawings must demonstrate consideration of human scale in the exterior design by showing building perspectives at eye-level from designed pedestrian pathways (such as sidewalks adjacent to the buildings).

#### 2.3.2.2 INTERIOR SPACES AND ASSEMBLY AREAS

Assembly areas designed for flexible public use both during and after business hours must have

direct and clear wayfinding from building entrances.

The design team must demonstrate in design drawings how, when designed for public use, atriums, jury assembly rooms, and other gathering spaces allow for several different public uses, such as a standing reception, a seated dinner, an awards ceremony, or similar use.

### 2.3.2.3 Zoning and Related Issues

The A/E team must offer local officials an opportunity to review and comment on the design concepts for compatibility with local plans, zoning, and design guidelines. Local review must be done in coordination with the project design schedule. If local officials choose not to review the design concept, the project manager must document this in the project file. By law, the A/E must incorporate the National Environmental Policy Act (NEPA) record of decision (ROD) requirements in the design documents. Local regulations must be followed without exception in the design of systems that have a direct impact on off-site terrain or infrastructure. These systems include, but are not limited to, fire protection services, storm water runoff, erosion control, sanitary sewers and storm drains, water, gas, electrical power, communications, emergency vehicle access, roads, and bridges.

### 2.3.2.4 FIRST RESPONDER AND EMERGENCY ACCESS.

Provide fire department vehicle access in accordance with the requirements of the ICC International Fire Code.

### 2.3.2.5 Fire Apparatus Access Roads

The A/E must design the emergency vehicle access in accordance with the specific requirements of the local fire department. At a minimum, the fire department must be consulted regarding the surface material of the access roadways, minimum width of fire lanes, minimum turning radius for the largest fire department apparatus, weight of the largest fire department apparatus, and minimum vertical clearance of the largest fire department apparatus.

### 2.3.2.6 AERIAL APPARATUS ACCESS

For buildings or portions of buildings exceeding 9 meters (30 ft.) in height, from the lowest point of fire department vehicle access, provide access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines must not cross the access roadway.

### 2.3.2.7 SITE SIGNAGE

A well-designed site uses as few signs as possible. Signs must make the site wayfinding clear to the first-time user by identifying multiple site entrances, parking, and the main building entrance.

Generally, graphics and style of site signage should be consistent with signage used inside the building. Signs integrated with architectural elements can also be very effective. Signage must be consistent in font, style, and color as well as with any directional symbology used in site and building signage. Signage placement can be an important detail element of the building design whether prominently displayed and tooled into the exterior building wall materials or as a freestanding component near the entrance to the facility. Exterior signs identifying permanent rooms and spaces must comply with ABAAS (see ABAAS Section F216). Additional information about GSA graphic standards can be found at www.gsa.gov/logo.

### 2.3.2.8 CONSTRUCTION SIGNS

Construction signs are to be 3,600 mm by 1,800 mm (12 ft. by 6 ft.) and constructed of a durable, weather-resistant material, properly and securely framed and mounted. The sign will be black with white lettering and mounted at least 1,200 mm (4 ft.) above the ground. The sign must include the official GSA logo no less than 400 mm (16 in.) square. The lettering, graphic style, and format should be compatible with the architectural character of the building.

Construction signs must provide the following information:

- Building for the People of the United States of America
- (Name of) Federal Building
- U.S. General Services Administration–Public Buildings Service
- (President's name), President of the United States
- (Administrator's name), Administrator, GSA
- (Name), Commissioner, PBS
- (Regional Administrator's name), Region (Region Number) Administrator
- (Logo) Name of Architect
- (Logo) Name of General Contractor
- (Logo) Name of Construction Manager

Diagram of the GSA Construction Sign

GSA CONSTRUCTION SITE SIGN (6'x12')

FONTS:
ARIAL BOLD

### 2.3.2.9 NEW CONSTRUCTION SIGNS

Signs at new construction sites must include the name of the architect and general contractor and may contain an artist's rendering or photograph of the model of the building under construction.

### 2.3.2.10 REPAIR AND ALTERATION PROJECTS

Signs at prospectus-level repair and alteration project sites must include the name of the architect and/or engineers for the major systems work (e.g., structural, mechanical, electrical), in addition to the name of the general contractor.

### 2.3.2.11 SITE WAYFINDING

Minimize the number of wayfinding signs on the site. For complex sites with multiple buildings or other destinations, consider developing a wayfinding plan for review by the project manager and users.

Obtain approval of local authorities for entrance signs in the public rights-of-way.

Use variable message signs for high-volume areas where entrance patterns need to be altered.

### 2.3.2.12 FLAGPOLES

A ground-mounted flagpole, located preferably at the left of the entrance (facing the building), must be provided for new Federal buildings. If ground-mounted poles are not feasible, a roof-mounted pole is permissible; or, if roof mounting is not suitable, an outrigger pole may be used. Only one flagpole is needed for a complex of buildings on a common site. The flag must be illuminated and the light controlled with a seasonally adjustable time clock, photocell, or the BAS system.

**Table 2.1 The following are approved flagpole heights and the corresponding flag sizes.**

| Flagpole Height | Flag Dimensions |
|---|---|
| 20 ft. | 3 1/2 by 6 2/3 ft. |
| 30 ft. | 5 by 9 1/2 ft. |
| 40 ft. | 5 by 9 1/2 ft. |
| 50 ft. | 8 2/3 by 17 ft. |
| 60 ft. | 8 2/3 by 17 ft. |

## 2.4 LANDSCAPE PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Site Soils** | | | | | | | | | |
| **Reference** | SSI 4.3/4.4-2009 | SSI 4.3/4.4-2009 | SSI 4.3/4.4-2009 | SSI 4.3/4.4-2009 | SSI 4.3,4.4 | SSI 4.3,4.4 | SSI 4.8 | | |
| **Performance** | Option 1- Locate 70 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or)<br>Option 2- On all areas with healthy or minimally disturbed soil limit disturbance to:<br>a. 50 feet beyond the building perimeter,<br>b. 15 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter,<br>c. 20 feet beyond primary roadway curbs/roadway edges and main utility branch trenches,<br>d. 30 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area.<br>(SSI prerequisites 2.1 and 4.3) | Option 1- Locate 80 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or)<br>Option 2-On all areas with healthy or minimally disturbed soil limit disturbance to:<br>a. 50 feet beyond the building perimeter,<br>b. 15 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter,<br>c. 20 feet beyond primary roadway curbs/roadway edges and main utility branch trenches,<br>d.30 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area. .<br>(SSI prerequisites 2.1 and 4.3) | Option 1- Locate 90 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment.<br>(or)<br>Option 2-On all areas with healthy or minimally disturbed soil limit disturbance to:<br>a. 40 feet beyond the building perimeter,<br>b. 10 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter,<br>c. 15 feet beyond primary roadway curbs/roadway edges and main utility branch trenches,<br>d. 25 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area.<br>(SSI prerequisites 2.1 and 4.3) | •Option1- Locate 100 percent of soil displacement and disturbance on soils disturbed by previous development with moderate or severe soil disturbance as identified in a site assessment. (or)<br>Option 2- On all areas with healthy or minimally disturbed soil limit disturbance to:<br>a. 40 feet beyond the building perimeter,<br>b. 10 feet beyond surface walkways, terraces, surface parking, and utilities less than 12 inches in diameter,<br>c. 15 feet beyond primary roadway curbs/roadway edges and main utility branch trenches,<br>d. 25 feet beyond constructed areas with permeable surfaces that require additional staging areas in order to limit compaction in the constructed area.<br>(SSI prerequisites 2.1 and 4.3) | Yes. Employ the SSI Definitions. | Yes, and Provide Soil Management Plan | Provide comparative l analysis covering geotechnical, agricultural and drainage soil properties to establish the reference site soil condition and the proposed soil import/condition. | Describe proposed site zoning and corresponding, phasing, lay-down, and sequencing for all areas affected by the construction process that respond to project particulars. Describe engineering controls for restoring site disturbance. | Verify all imported soils and engineered soils meet project performance requirements. |
| **Vegetation** | | | | | | | | | |
| **Reference** | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.1/4.2/4.5/4.6/4.7/4.8/4.9/4.10/4.11/4.12/4.13-2009 | SSI 4.6 | | |
| **Performance** | Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements. | Provide an invasive species management plan. Propose non-invasive native or adapted species. Identify, and if possible preserve, all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements. | Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify and preserve all special status vegetation. Propose appropriate plant biomass for the site. Use vegetation to minimize building climate control requirements. | Provide an invasive species management plan. Exclusively propose plants native to the eco-region. Identify, preserve and reuse plant communities and special status vegetation native to the eco-region of the site to contribute to regional diversity of flora and provide habitat for native wildlife. Use vegetation to minimize building climate control requirements. | Yes. Employ the SSI Definitions. | Yes | Tier 1, 2 and 3 High Performance: provide an Invasive Species Management Plan. Tier 2 and 3 High Performance: Biomass Density Index. | Describe proposed distribution of plant communities throughout the site that respond to soil, topography and drainage responding to project particulars. | Verify all plant materials meet project performance requirements. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Water Use and Management** | | | | | | | | | |
| **Reference** | SSI 3.1/3.7/EISA 438 | SSI 3.2/3.3/3.7/3.8/EISA 438 | SSI 3.2/3.3/3.7/3.8/EISA 438 | SSI 3.2/3.3/3.6/3.7/3.8/EISA 438 | | | EPA | | |
| **Performance** | Reduce water use for irrigation by 50 percent from established baselines per SITES. If possible, design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. | Reduce water use for irrigation by 50 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Install a soil moisture monitoring system. | Reduce water use for irrigation by 75 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Install a soil moisture monitoring system. | Reduce water use for irrigation by 75 percent from established baselines. If applicable, protect and restore riparian, wetland, and shoreline buffers. Manage stormwater on site. Design rainwater/stormwater features into the site to provide a landscape amenity. Design water features with minimal or no make-up water from potable sources. Enhance on-site water resources and receiving water quality. Install a soil moisture monitoring system. | Yes. Employ the SSI Definitions. Submission narrative for planting and irrigation, landscape coefficients, calculations for peak watering month. Indicate all water sources. | Yes, and SWPPP | Provide a Baseline Landscape Water Requirement (BLWR) and a Designed Landscape Water Requirement (DLWR). Calculations that demonstrate that on-site water features can meet water requirements with sustainable water source/supply. Tier 2 and 3 High Performance: Provide a site materials list and narrative that describes how the selected materials minimize contributions of common pollutants to stormwater. | Describe proposed site hydrology that responds to existing and proposed topographic conditions responding to project particulars. | After occupancy, provide two year of two week trend history for irrigation system. Provide a one year two week trend history for soil moisture via a Soil Moisture Monitoring system so that any required irrigation can be adjusted. |
| **Stormwater Management** | | | | | | | | | |
| **Reference** | | | | | | | EPA | . | |
| **Performance** | Manage the 95th percentile storm event on site or manage to the predevelopment hydrology. | Manage the 96th percentile storm event on site or exceed management of the predevelopment hydrology by 10%. | Manage the 97th percentile storm event on site or exceed management of the predevelopment hydrology by 25%. | Manage the 98th percentile storm event on site or exceed management of the predevelopment hydrology by 50%. | Yes | Designate areas on site plan for stormwater management. | Provide analysis per GSA's Storm Proof of Concept found in Appendix A.6. Follow EPA guidance for further clarification. (EPA Technical Guidance: https://www.epa.gov/sites/production/files/2015-09/documents/eisa-438.pdf) | Provide written narrative showing how baseline stormwater will be offset by reuse and mitigation methods. | CX agent to confirm installed reuse and mitigation methods offset the stormwater baseline. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Site Materials** | | | | | | | | | |
| **Reference** | SSI 5.1/5.5/5.7-2009 | SSI 5.1/5.2/5.5/5.7/-2009 | SSI 5.1/5.2/5.3/5.5/5.7/5.8-2009 | SSI 5.1/5.2/5.3/5.4/5.5/5.7/5.8-2009 | | | SSI 4.1 | . | |
| **Performance** | Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Use recycled content materials. Use regional materials. | Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Use recycled content materials. Use regional materials. | Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Design for deconstruction and disassembly. Use recycled content materials. Use regional materials. Use adhesives, sealants, paints, and coatings with reduced VOC emissions. | Only use wood products extracted from non-threatened species to minimize negative effects on other ecosystems. Maintain or repurpose on-site structures and construction materials to extend life cycle of existing building materials and reduce waste. Design for deconstruction and disassembly. Reuse salvaged plant material. Use recycled content materials. Use regional materials. Use adhesives, sealants, paints, and coatings with reduced VOC emissions. | Yes. Employ the SSI Definitions. | yes | Provide a species list of all proposed wood products and threatened/endangered status. High performance: Provide a narrative with existing site materials and quantifications, including plants, and how it will be reused on site versus how much will enter the waste stream. | Describe proposed approach to site materials that achieves both visual and performative goals responding to project particulars. | Verify all site materials meet project performance requirements. |
| **Pollinators** | | | | | | | | | |
| **Reference** | 1. Supporting the Health of Honey Bees and Other Pollinators, October 2014, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes, October 2011, 2. USDA Pollinator Plant list, 3. Xerces Society Bloom Quality Plant list. 4 USFWS-Pollinator Portal, 5. Pollinator Partnership | | | | | | | | |
| **Performance** | Foraging: Consider the four following primary aspects of the planting design to provide adequate site foraging capacity for target pollinators. 1. Bloom Value, 2. Bloom Diversity of Form and Color, 3. Material Size and Structural Diversity, and 4. Pollinator-positive Plant Quantity. (Please see prescriptive requirements for resources). Plant a minimum of 3 different plant species for each viable blooming season. Pursue a non-mandatory 20% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. If a 20% target cannot be achieved provide written justification. All plants shall be adapted to the site's eco-region. Tree and shrub canopy diameter at maturity should be considered for the purpose of plantable area calculation. | Foraging: Consider the four following primary aspects of the planting design to provide adequate site foraging capacity for target pollinators. 1. Bloom Value, 2. Bloom Diversity of Form and Color, 3. Material Size and Structural Diversity, and 4. Pollinator-Positive Plant Quantity. (Please see prescriptive requirements for resources) Plant a minimum of 5 different plant species for each viable blooming season. Design to a mandatory 30% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. All plants shall be adapted to the site's eco-region. Tree and shrub canopy diameter at maturity shall be considered for the purpose of plantable area calculation. General signage shall be provided on the site that indentifies the pollinating-positive environment and the donor-recipient relationship and importance of pollinators. | Foraging: Consider the four following primary aspects of the planting design to provide adequate site foraging capacity for target pollinators. 1. Bloom Value, 2. Bloom Diversity of Form and Color, 3. Material Size and Structural Diversity, and 4. Pollinator-Positive Plant Quantity. (Please see prescriptive requirements for resources.) Plant a minimum of 7 different plant species for each viable blooming season. Design to a mandatory 40% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. All plants shall be adapted to the site's eco-region. Tree and shrub canopy diameter at maturity shall be considered for the purpose of plantable area calculation. General and specific signage shall be provided on the site that indentifies the pollinating-positive environment and the donor-recipient relationship and importance of pollinators, and particular planting strategies and maintenance methods. | Foraging: Consider the four following primary aspects of the planting design to provide adequate site foraging capacity for target pollinators. 1. Bloom Value, 2. Bloom Diversity of Form and Color, 3. Material Size and Structural Diversity, and 4. Pollinator-Positive Plant Quantity. (Please see prescriptive requirements for resources.) Plant a minimum of 9 different plant species for each viable blooming season. Design to a mandatory 50% target of pollinator-positive plant material, as a percentage of all newly introduced plant material to the site. All plants shall be adapted to the site's eco-region. Tree and shrub canopy diameter at maturity shall be considered for the purpose of plantable area calculation. General and specific signage shall be provided on the site that indentifies the pollinating-positive environment and the donor-recipient relationship and importance of pollinators, and particular planting strategies and maintenance methods. | Field Verified - Post Construction by CM or GSA PM | Provide a planting plan for approval during schematic design and construction documents that identifies both the pollinator foraging species included, a bloom table representing the period of bloom, and proposed site locations. Bloom value, quantity, and percentage of total shall be identified in the notes. | Provide a brief pollinator vegetation management plan as part of the maintenance plan. This plan shall simply identify how the pollinator zones are intended to be managed as are noted in the "Supporting the Health of Honey Bees and Other Pollinators." | | Verify all plant materials meet project performance requirements. |

## 2.5 LANDSCAPE PRESCRIPTIVE REQUIREMENTS

All proposed site design must meet baseline compliance with all applicable Federal, Tribal, State and local regulation and/or guidance. This includes all elements of work performed under the scopes of the landscape architect, architect, civil engineer, and geotechnical engineer. The applicable regulations must be determined on an individual project basis.

### 2.5.1 EXAMPLES OF FEDERAL DESIGN CRITERIA

#### 2.5.1.1 SECTION 438 OF THE ENERGY INDEPENDENCE AND SECURITY ACT (EISA) & EISA TECHNICAL GUIDANCE

The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.

#### 2.5.1.2 NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) OF THE CLEAN WATER ACT (AS DELEGATED TO THE STATES)

NPDES is a permitting program that applies to all activities resulting in water pollution discharges, including construction projects of certain sizes. Obtaining such a permit typically requires the development of an Erosion and Sediment Control Plan, and a Stormwater Pollution Prevention Plan (SWPPP). Minimum requirements are developed by the EPA, and delegated to the individual states. The states often add additional performance requirements; therefore, state-by-state compliance is required.

#### 2.5.1.3 REFERENCE STANDARDS

- SSI = Sustainable Sites Initiative (2009)
- EISA 2007
- Supporting the Health of Honey Bees and Other Pollinators, October 2014, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes, October 2011

### 2.5.2 MANAGING EXISTING SITE VEGETATION

#### 2.5.2.1 DOCUMENTING EXISTING VEGETATION

To supplement the topographic and boundary survey, a Certified Arborist Report (CAR) must be prepared and submitted that clearly demonstrates the size, species, and condition of all existing trees and shrubbery on site.

#### 2.5.2.2 INCORPORATING EXISTING VEGETATION INTO A PROPOSED PROJECT

Detailed plans must be provided for those plants that will be impacted and/or removed for the impacted site. For all new construction projects, this includes identifying proposed new tree locations and quantities, as well as the protection plan for existing trees during the construction activity. Further, all proposed grade changes affecting the protected site trees shall be identified.

#### 2.5.2.3 DEFINING TREE PROTECTION ZONE

The Tree Protection Zone is defined as the area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

#### 2.5.2.4 DETERMINE TREE PROTECTION ZONE

For trees, the locations of all Critical Root Zones (CRZs) are defined as the area for each tree that contains the estimated minimal amount of both structural and feeder roots that must be protected to minimize tree damage and retain structural stability. The CRZ for each tree is calculated based on the Tree Species Tolerance to construction impacts and age class, as outlined in the International Society of Arboriculture's Best Management Practices: Managing Trees During Construction (K. Fite, T. Smiley, 2008).

Although CRZs will differ by species and tree age, zones range from ½ foot per one inch DBH (diameter at breast height) to 1½ foot per one inch DBH. If the species tolerance is unknown, then the 1½ foot per one inch DBH standard is assumed. Mixed groupings of trees will base the required area of protection on that area which is required for maintaining the health of the most sensitive individual species composing the cluster. The 1½ foot standard applies unless sufficient information detailing the contrary is provided and a lesser area is approved. For large shrubs and groups of shrubs a protection area shall be provided equivalent to 1.5 times the diameter of the massing itself, unless otherwise indicated.

### 2.5.3 SITE SOILS

#### 2.5.3.1 PURPOSE

Limit disturbance of healthy soil to protect soil horizons and maintain soil structure, existing hydrology, organic matter, and nutrients stored in soil. Develop and communicate to construction contractors a soil management plan prior to construction to limit disturbance, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones.

#### 2.5.3.2 APPLICABILITY

All projects to preserve and conserve existing site soils to promote site health and cost savings.

#### 2.5.3.3 PRIMARY AREAS OF WORK

The primary areas of work include:

- Creating a Soil Management Plan and
- Minimizing soil disturbance in design and construction.

Note: Soil impacts described within are intended to manage impacts associated with significant construction activities, not surface landscape improvements. In cases where top soils need to be improved to provide an enhanced growing environment, such dimensional restrictions would not apply. The soils section shall be cross-referenced with "Vegetation" and "Water."

### 2.5.4 PARKING FIELDS

- If a parking lot is to be sealed, use only non-coal-tar-based pavement sealants.
- All open parking areas with 18 spaces or more, or 6,000 square feet that front upon a street, shall be screened by a perimeter landscaped area at least seven feet in width measured perpendicular to the street line.
- Perimeter landscaped areas may be interrupted only by vehicular entrances and exits, and select walkways that are providing a direct connection between a public sidewalk and walkway within or adjacent to the parking field.
- Where parking stalls are paved with permeable materials, rooting area computations can incorporate area located below the certified permeable system. Where such an approach is undertaken, sufficient trunk protection must be provided for any proposed trees that include provisions for full prospective tree growth,

including buttresses and expanded trunk growth. Further wheel-stops and average car overhang dimensions shall allow for the tree to safely reach maturity.

- The perimeter landscape area surface must typically include living plant material. On water challenged sites, non-paved mineral surfaces may be substituted for living plant materials on a qualitative basis.
- The open parking area shall be graded to allow stormwater runoff to drain into all required perimeter landscaped areas and/or planting infiltration islands.
- Proper stormwater drainage rates shall be attained, if required, through underdrains that are connected to detention storage that meet/exceed local/regional drainage and flow requirements. Computations are required. If underdrains are not provided, soil boring tests shall be conducted by a licensed engineer to ensure that ponded surface water is capable of draining in at least 24 hours.
- To allow for adequate drainage and promote water infiltration, proposed catch basins placed in the planting infiltration areas shall be elevated above adjacent grade to promote ponding and infiltration without posing a public nuisance or maintenance hardship for facility managers.
- One three-inch caliper tree shall be provided for every 1,250 SF of parking area. In regions where water is scarce and therefore establishment of a tree would be burdensome or consumptive of a dwindling resource, a shade structure can be proposed in lieu of trees to shade the interior parking field. The structure is expected to provide shade that is equivalent to the shade that would be provided by an open-grown mature shade tree grown under similar conditions in the region. This equivalency is to be submitted and provided for review. The use of a shade structure in lieu of trees would not eliminate the need for islands to reduce horizontal scale of the parking field, provide pedestrian refuge, and manage storm water. Each tree shall have a minimum planting zone of 150 SF of pervious area. Any space less than 2’ in width shall not contribute to the square footage requirement of the trees requisite planting zone. Computations are required.
- Planting island soil depths shall be measured to be at minimum 30” from finished elevation of adjacent parking field, or as required to support sufficient root development. Design details are required.

### 2.5.5 POLLINATORS

The intent of this section is to provide opportunities for pollinators to thrive through the intentional design and management of Federal landscapes.

During early project planning stages, project teams shall identify known pollinators in their immediate subject area and pollinators native to or likely to inhabit their region and climate zone, and identify design strategies for creating and preserving viable foraging and nesting areas to the maximum extent feasible. The “Supporting the Health of Honey Bees and Other Pollinators, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes,” can provide specificity for 1) Procedures, 2) Education, 3) Pollinator Profiles, 4) Resources, and 5) Case Studies for project-specific use. This requirement is intended to make actionable intents set forth in the June 20, 2014, Presidential Memorandum promoting the health of pollinators.

## 2.5.5.1 DESIGN

### 2.5.5.1.1 POLLINATOR NESTING

Each project shall identify viable pollinator nesting sites on the immediate project site or adjacent sites by 1) researching existing resources managed by both Federal Agencies and others Agencies and Institutions interested in promoting pollinator health and 2) by conducting a field inspection identifying the presence of pollinators. (Field inspection should be conducted during an active [non-dormant] pollinator season.) Because bees are often the predominant pollinator of concern in this measure, they should always be strongly considered and designed for in the absence of observed or known pollinators during the field inspection or background research. Whenever the existing pollinator nesting is identified and located on the project site during field inspections, the nesting site must be evaluated for preservation/protection to the maximum extent feasible. If nesting sites are located off-site, proposed foraging areas should be considered to be located to benefit the target pollinators, within the maximum foraging range if known. If observed nesting areas will be impacted through construction processes, landscape features should be considered that will meet nesting requirements of the impacted target species. If no nesting is known or observed, the design should consider, through site maintenance identified in the maintenance manual, providing overwintering/nesting opportunities for target and/or general species.

If native bees are a critical pollinator on site, identify areas of limited to no ground disturbance during construction operations to preserve current or future pollinator nesting habitats. These areas must be fenced during construction and identified as outside of project cut/fill zone impacts. Consider providing minor sand pits for future use of ground-nesting bees. Targeted bee nesting and foraging areas should be located away from entrances and other areas regularly visited by building occupants and visitors.

If butterflies are a critical pollinator on site, identify requisite plant species ranges for egg development and caterpillar and butterfly foraging areas, and through management allow likely nesting sites to remain intact for the purpose of over-wintering. See associated pollinator foraging section.

If bats are a critical pollinator on site, identify species nesting requirements such as tree vs. cave nesting, and preserve site nesting features to the maximum extent feasible. If nesting cannot be preserved, opportunities for new nesting areas should be explored.

### 2.5.5.1.2 POLLINATOR FORAGING

Bees, butterflies, and other beneficial insects need abundant nectar and pollen sources throughout the growing season. Select native plants with long bloom cycles wherever possible. Cultivate a landscape with diverse flower colors, shapes, sizes, and bloom times, with a goal of providing foraging opportunities throughout the specific sites' growing seasons. As some ornamental plants have been selected for aesthetics rather than ecological function, bloom value shall be identified. See the Xerces Society for Invertebrate Conservation website for more information: http://www.xerces.org/pollinator-resource-center.

Criteria for selecting flowering plants include:

- Material size and structural diversity—Native trees, shrubs, and herbaceous materials should be selected with a preference for pollinator-beneficial material. Trees and shrubs offer much of the critical habitat for

pollinators and should not be overlooked. Pollinator foraging areas should be located in areas adjacent to nesting sites in order to provide rich "nectar corridors" for pollinator access. See the Pollinator Partnership website for more information: www.pollinator.org/guides.

- Bloom diversity—Diverse plant species shall be provided for each viable growing season, such as early spring through late fall in the northeastern United States. These plant species should be appropriate for targeted pollinator species, if known, or general pollinators if not, to ensure sufficient bloom time and material. See USDA Plants Pollinators webpage for more information: www.plants.usda.gov/pollinators/NRCSdocuments.html.
- Bloom value—Beneficial plant species shall be provided for each growing season that constitutes high-bloom value for target pollinators. See the Xerces Society for Invertebrate Conservation website for more information: www.xerces.org/pollinator-resource-center.

### 2.5.5.2 SUBMITTAL

A design plan diagram shall be provided during the schematic design period to the Office of the Chief Architect, or GSA regional representative, for preliminary design compliance approval that clearly identifies the target performance level for the project and all of the requisite information. The plan diagram's plant key shall clearly identify the location of pollinator special-purpose plants being proposed for the project, the associated information related to each proposed plant's bloom quality and bloom time, and individual and aggregate percentage of overall composition of newly introduced plant material. The design plan shall identify the design target pollinators of the plan. If known, any existing, proposed, or potential pollinator nesting areas on site or nearby shall be annotated in a general or specific manner on the plan.

A refined technical plan shall be developed through the later design process for approval that shall clearly identify all aforementioned aspects of the planting plan, with a special note that these special purpose plants are not eligible to be substituted during construction without express consent of the GSA Office of the Chief Architect or regional representative.

Design plan and technical plans shall have a separate legend of annotations describing proposed resources, assumptions, and calculations.

### 2.5.5.3 SUPPLEMENTAL INFORMATION AND OTHER CONSIDERATIONS

#### 2.5.5.3.1 PROCUREMENT AND MAINTENANCE

To the extent feasible, plant material, particularly pollinator-friendly plant material, should be procured free of pesticide concentrations that negatively impact pollinator health. Many insecticides (and a handful of fungicides and herbicides) are present in nursery stock. These chemicals can kill or have sub-lethal effects on insect pollinators that reduce the number of offspring a female can produce. Refer to the "Supporting the Health of Honey Bees and Other Pollinators, addendum to Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes" for guidance at www.fws.gov/southwest/es/Documents/R2ES/Pollinators/6-Supporting_the_Health_of_Honey_Bees_and_Other_Pollinators_Oct2014.pdf. The general maintenance plan shall identify areas that are intended to be specially managed to promote pollinator nesting and foraging health. These areas shall be identified on the plan as

"pollinator sensitive zones" that shall be pesticide free to the maximum extent feasible. The maintenance plan shall also identify when mechanical removal of old growth is most appropriate to provide overwintering/nesting habitats for pollinators.

#### 2.5.5.3.2 SITE SOILS MANAGEMENT PLAN

Critical pollinator-specific no-cut no-fill lines, if required, shall be folded into the requisite soils management plan identifying areas to be preserved and/or protected for habitat nesting.

#### 2.5.5.3.3 DESIGN AREA DETERMINATIONS

When creating site area calculations as a percent of total, trees and shrubs shall be calculated based on canopy of diameter at full maturity. The canopy will be considered a flat plane for the purpose of calculations. See the Plants Database for additional information.
https://plants.usda.gov

#### 2.5.5.3.4 SITE MAINTENANCE

Facilities shall employ Integrated Pest Management (IPM) standards to ensure that special purpose plants and environs are managed effectively.

The U.S. Department of Agriculture NRCS, The Xerces Society, and the Pollinator Partnership, and others, all manage "Pollinator Conservation Resource" websites. These resources cover: 1) principal pollinators, 2) plant lists, 3) pesticide guides, 4) nesting guides, 5) plant nurseries, and 6) identification and monitoring resources.

www.plants.usda.gov/pollinators/NRCSdocuments.html

www.pollinator.org/
www.xerces.org/pollinator-resource-center/

### 2.5.6 SITES CERTIFICATION

Through integrative design and application of sustainable design principles, all new construction projects and substantial renovations with adequate scope must achieve, at a minimum, a SITES silver rating through the Green Building Rating System of the U.S. Green Building Council. GSA's use of the SITES framework allows its land-based projects to better protect ecosystems and enhance the mosaic of benefits they continuously provide our communities, such as climate regulation, carbon storage, and flood mitigation. Pursue SITES credits appropriate to the goals of GSA and to the type of project being designed.

For projects seeking SITES certification associated with site civil and landscape components, the following prerequisites and credits must be achieved to comply with SITES and the P100 Facility Standard baseline, and should be considered at the project inception. The project must protect floodplain functions, preserve wetlands, limit development on designated prime soils, reduce potable water use, preserve threatened or endangered species, create a soil management plan, eliminate the use of wood from threatened tree species, restore disturbed site soils, employ an integrated site development process, control construction-phase pollutants, utilize non-invasive plants, and plan for sustainable site maintenance.

# 3

# ARCHITECTURE AND INTERIOR DESIGN

Figure 5:
U.S. Federal Courthouse
Lighting Detail
Salt Lake City, UT

# 3.1 ENCLOSURE PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.2.1 Envelope - Natural Hazard** | | | | | | | | | |
| **Seismic Resistance** | Life Safety | Reduced Damage | Immediate Occupancy | Operational | Performance Mockup Testing | | IBC-2012<br>ASCE 7-10<br>FEMA356<br>ASTM E 2026<br><br>Design Team Calculations & Inspection | Describe seismic resistance design assumptions. | |
| **Windborne Debris Resistance** | Comply with IBC | Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade | Large Missile < 30-ft from Grade & Small Missile > 30-ft of Grade. No breach in envelope for wind zone. | Site Specific Risk Assessment (Tornado Hazard) | ASTM E 1996/1886<br><br>Wind Tunnel Testing & Projectile Impact Testing | | ICC/NSSA 500-2008<br>FEMA 361<br>ASTM E 1996<br><br>Design Team Calculations & Inspection | Describe windborne debris resistance design requirements. | Witness mockup test when provided. |
| **Flood Resistant** | Locate above the 100-year base flood elevation + 2 feet. Critical Action facilities must be elevated above the 1% annual chance (100-year) base flood elevation + 3 feet, or the 0.2% annual chance flood (500-year)elevation, whichever is higher. | Flood Hazard Areas not identified as Coastal High Hazard Areas and Coastal A Zones: ASCE 24 Flood Design Class | High Risk Flood Hazard Areas including Coastal High Hazard Area and Coastal A Zones: Site Specific Risk Assessment (Dam, Levee, and Floodwall Failure Hazards) | N/A | | Site Planning | FEMA Flood Maps<br>ASCE 24, "Flood Resistant Design and Construction"<br><br>Design Team Calculations & Inspection | Describe flood resistance design requirements. | Witness mockup test when provided. |
| **3.2.2 Envelope - Serviceability** | | | | | | | | | |
| **Wind Resistance** | Deflection within code limits. Deflection limit to be selected by design team to result in 8/1000 probability of breakage at design load. | Deflection less than code limits. Deflection limit to be selected by design team to result in 4/1000 probability of breakage at design load. | N/A | N/A | ASTM E 330<br>ASTM E 1300<br><br>Wind Tunnel Testing & Performance Mockup Testing | | IBC-2012<br>ASCE 7-10<br>Design Team Calculations & Inspection | Describe envelope wind resistance design requirements. | |

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.2.3 Water Penetration Resistance** | | | | | | | | | |
| **Fenestration** | CW30 @ 15% DP | CW30 @ 20% DP | AW40 @ 25% DP | AW40 @ 30% DP | ASTM E331<br>ASTM E1105<br>AAMA 501.1<br>AAMA E2268<br>AAMA 501.2 | Yes<br><br>Water Leakage = Uncontrolled Water Penetration<br><br>Delete Test Pressure Upper Limits from AAMA 101-08 | ASCE 7-10<br>AAMA 101-08 | Describe fenestration water penetration resistance level utilized in the design. | CxA to witness Performance Mock-Up Test outlined in ASTM E331-09 , E1105-08 as applicable |
| **Roofing and Horizontal Waterproofing-Membrane System** | Do not use roof surface for Storm Water Retention or allow water to otherwise pond or remain<br><br>Highly resistant to physical damage<br><br>Designs that prohibit entrapment of water | Baseline and<br><br>Fully Reinforced Membrane System<br><br>Membrane System Fully Bonded to the Structural Deck | Tier 1 HP and<br><br>Membrane System Fully Bonded to the Structural Deck<br><br>Monolithic/Seamless | Tier 2 HP and<br><br>System Protected from Temperature and Ultraviolet Radiation. Inverted Membrane Roof Assembly (IRMA) | NRCA Manual - current edition<br><br>AAMA 501.2<br>ASTM C1153<br>ASTM D4787<br>ASTM D5957 | Yes | Yes | Describe roofing and horizontal waterproofing membrane water penetration resistance construction. | CxA to verify installation and witness integrity testing. Refer to NRCA Manual Guideline: 'Quality Assurance and Water Test.' |
| **Roofing and Horizontal Waterproofing-Minimum Slope** | 2012 International Building Code, Section 1507 | N/A | N/A | N/A | N/A | 2012 IBC, Section 1507 | Yes | Describe roofing and horizontal waterproofing minimum slope used in design. | CxA to verify installation and witness integrity testing. Refer to NRCA Manual Guideline: 'Quality Assurance and Water Test.' |
| **Roofing and Horizontal Waterproofing-Drainage** | 2012 International Plumbing Code, Section 1106 for 100 yr. max. 1-hr rainfall design | 1.1 times greater than Baseline | 1.2 times greater than Baseline | 1.4 times greater than Baseline | N/A | 2012 IPC, Section 1106 for 100 yr. max. 1-hr rainfall design | 2012 IPC, Section 1106 for 100 yr. max. 1-hr rainfall design | Describe basis for designing the roofing and horizontal waterproofing drainage. | CxA to verify installation and witness integrity testing. Refer to NRCA Manual Guideline: 'Quality Assurance and Water Test.' |

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Roofing and Horizontal Waterproofing-Vegetative Systems** | Tier 3 requirements of Roofing and Horizontal Waterproofing Membrane System<br><br>IBC compliant minimum roof slope<br><br>Tier 1 For Roofing and Horizontal Waterproofing Drainage<br><br>Tier 1 for Roofing and Horizontal Waterproofing Testing and Monitoring | Baseline and<br><br>Tier 2 For Roofing and Horizontal Waterproofing Drainage | Tier 1 HP and<br><br>Tier 3 For Roofing and Horizontal Waterproofing Drainage<br><br>Shall meet Tier 2 for Roofing and Horizontal Waterproofing Testing and Monitoring | Tier 2 HP and<br><br>Tier 3 for Roofing and Horizontal Waterproofing Testing and Monitoring | Yes | Yes | Yes | Describe vegetative roofing systems water penetration construction, minimum slope and basis for sizing drainage. | CxA to verify installation and witness integrity testing. Refer to NRCA Manual Guideline: 'Quality Assurance and Water Test.' |
| **Roofing and Horizontal Waterproofing-Testing & Monitoring** | For Baseline and Tier 1 roofing systems, flood testing is not required and discouraged. Conduct integrity testing of the primary membrane under non-hydrostatic conditions. Utilize Electronic Leak Detection (ELD) or alternate methods that pin point breach locations in the membrane without reliance on water passage through the breach during construction. Testing agency confirmation of the suitability of using non-destructive test equipment (unit type and field protocol) must be established prior to proceeding with field test activities. Controlled water flow testing using a water nozzle similar to AAMA 501.2 shall be performed on all roof detailing not included in ELD testing or where ELD testing is not effective due to the conductivity of the membrane. | Same as Baseline. | Tier 1 HP and<br><br>Requires a "built-in" system wherein testing wiring etc. is left in-place for future use such as an ELD or an equivalent method of leak detection without removal or disassembly of the system or its protections as required during the life of the structure. | Tier 2 HP and<br><br>Requires integration of the leak detection into a maintenance plan for regular testing and the integration of the leak detection into the Building Management System (BMS).<br>Provide a maintenance plan including monitoring at regular intervals as determined. | AAMA 501.2<br>ASTM C1153<br>ASTM D4787<br>ASTM D5957<br>ASTM D7240<br>ASTM D7877 | Yes | N/A | Describe roofing and horizontal waterproofing testing requirements and leak monitoring system, when used. | CxA to review Testing & Monitoring procedures proposed by contractor<br><br>CxA to verify BMS system interface to leak detection in conjunction with balance of systems, if applicable<br><br>CxA to verify installation and witness testing. |
| **Ground Water Control** | Active Ground Water Control | Passive Ground Water Control with emergency back-up pump, as required. | N/A | Select a location, site, or building design that allows for ground water table to remain a minimum of 600mm (2 feet) below the lowest level of the structure. | N/A | 2012 IBC, Section 1805.1.3 | 2012 IBC, Section 1805.1.3 | Describe method of ground water control when required. | CxA to test emergency back-up pump, where applicable. |
| **Below Grade Waterproofing** | Relieve hydrostatic pressure on substructure walls and allow water drainage to the level of the drain.<br><br>Membrane waterproofing must be fully bonded to the substrate and seamless.<br><br>Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection drainage and protection course. | Baseline and<br><br>Tier 1 HP designation in Ground Water Control<br>Provide a system that does not rely on unpredictable or difficult to control site conditions to develop and maintain a water-tight installation.<br>Complete "Bathtub" waterproofing in the presence of water table to mitigate demand on dewatering system.<br>May require foundation modification.<br>System must not rely on compression to maintain the performance criteria, allowing construction activities and future earthwork without compromising the system. | Tier 1 HP and<br><br>Includes redundant below grade waterproofing systems, such as a water repellant additive to the concrete masonry foundation walls. | Tier 2 HP and<br><br>Include secondary drainage layer within below-grade horizontal concrete slab assemblies. | N/A | 2012 IBC, Section 1805 | 2012 IBC, Section 1805 | Describe waterproofing system for below grade waterproofing and test method proposed. | CxA shall witness below grade waterproofing test. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.2.4 Moisture and Condensation Control** | | | | | | | | | |
| **Moisture Control Opaque Assemblies** | Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160-2009, Criteria for Moisture Control Design Analysis in Buildings, is an acceptable basis of design. Provide a vapor barrier directly beneath all concrete slab-on-grade construction or where concrete structures separate conditioned from unconditioned spaces. | Baseline and<br><br>Provide continuous exterior insulation for roof, wall, and below-grade walls containing conditioned space. Provide analysis of project specific assemblies and exposures. Provide for the placement of a portion of the thermal control layer to the exterior of the air and moisture control layers to reduce thermal bridging and move the moisture potential toward the exterior. | Tier 1 HP and<br><br>Provide thermal controls to the exterior to maintain conditions within the assembly below a 30-day running average of 70% RH when the temperature is between 5°C (41°F) and 40°F C (104°F).<br>Provide monitoring of "vulnerable" exposures of the assemblies that alerts the building staff to approaching conditions that may be harmful to the assembly or the occupants. | Tier 2 HP and<br><br>All thermal controls are outboard of the air and vapor control layers of the assembly.<br><br>Monitoring of moisture content of assemblies tied to BMS for each exposure and cladding type. | ASTM C1601-05 | Yes | ASHRAE 160-2009 | Document requirement in basis of design | CxA to witness tests outlined in ASTM C1601-05, if applicable |
| **Condensation Resistance Fenestration** | NFRC 500<br><br>Thermal Analysis and Modeling | Baseline and<br><br>AAMA 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections. | Tier 2 and<br>testing on project specific extrusion profiles and assemblies, including typical anchors. | Tier 2 HP and<br><br>Provide a modified AAMA 501.5, Test Method for Thermal Cycling of Exterior Walls to include thermal couples of a full-scale, project specific laboratory mock-up to verify the NFRC 500 analysis. | NFRC 500<br>NFRC 102<br>AAMA 1503<br>AAMA 501.5 | NFRC 500<br><br>Testing and Modeling to show that no condensation occurs on uncontrolled surfaces based on the interior and exterior design criteria | NFRC 500 | Document requirement in basis of design | NFRC 500 and NFRC 102 (test procedure) are intended for the laboratory for establishing ratings, not field testing, so there is no CxA witness activity |
| **3.2.5 Air Tightness** | | | | | | | | | |
| **Fenestration** | CW30 Minimum Performance Class | Baseline and<br><br>< 1.5 L/s*m (0.3 cfm/ft)<br>@ 75 Pa (0.3" wc)<br><br>Performance data correlated to performance testing | Tier 1 HP and<br><br>AW40 Minimum Performance Class<br><br>< 1.5 L/s*m (0.3 cfm/ft)<br>@ 300 Pa (1.2" wc)<br><br>Durability testing as required for | Tier 2 HP and<br><br>AW40 Minimum Performance Class<br><br>< 0.5 L/s*m (0.1 cfm/ft)<br>@ 300 Pa (1.2" wc)<br><br>Additional Durability Testing as | ASTM E283<br><br>ASTM E783 | AAMA 101<br>NAFS-08 | AAMA 101<br>NAFS-08 | Document requirement in basis of design | CxA to witness Performance Mock-up Test outlined in ASTM E783 and ASTM E283, as applicable. |
| **Enclosure Airtightness (All Six Sides of the Building)** | 2 L/s/M$^2$ (0.40 cfm/ft$^2$)<br>@ 75 Pa (0.3" wc) | 1.25 L/s/M$^2$ (0.25 cfm/ft$^2$)<br>@ 75 Pa (0.3" wc) | 0.75 L/s/M$^2$ (0.15 cfm/ft$^2$)<br>@ 75 Pa (0.3" wc) | 0.5 L/s/M$^2$ (0.10 cfm/ft$^2$)<br>@ 75 Pa (0.3" wc) | ASTM E779<br>ASTM E1827<br>ASTM E1186<br>ASTM D4541 | Yes | no | Provide requirements for enclosure airtightness performance and describe measures designed to provide a continuous air barrier. | CxA to witness Blower Door Test outlined in ASTM E1827-11. Conduct testing before air barrier is concealed by completed construction. |
| **3.2.6 Thermal Performance** | | | | | | | | | |
| **Thermal Performance** | ASHRAE 90.1-2010, Section 5.5 and where section 5.5 is referenced | 1.15 times greater than Baseline | 1.3 times greater than Baseline | 1.5 times greater than Baseline | ASHRAE 90.1-2010 | Yes | ASHRAE 90.1-2010 | Provide thermal performance characteristics of the enclosure assemblies. | CxA to perform HVAC system testing per ASHRAE Guideline 1.1-2007 (Guideline 30 was integrated into Guideline 1 in 2007) |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.2.7 Building Enclosure Commissioning** | | | | | | | | | |
| **Building Enclosure Commissioning** | Fundamental Building Enclosure Commissioning (BECx) per ASTM E2813 | Baseline plus Enhanced BECx per ASTM 2813 | Baseline plus Enhanced BECx per ASTM 2813 with increased performance testing as required by OPR. Refer to ASTM 2813, Table A2.1, for possible testing. | N/A | ASTM 2813, Table A2.1<br>ASTM 2947<br>ASHRAE 202<br>ASHRAE Guideline 0 | STM 2813, Table A2.1<br>ASTM 2947<br>ASHRAE 202<br>ASHRAE Guideline 0 | ASTM 2813, Table A2.1<br>ASTM 2947<br>ASHRAE 202<br>ASHRAE Guideline 0 | Provide any special testing requirements anticipated during commissioning. | CxA inspection and verification to be performed as outlined in ASTM 2813 |
| **3.2.8 Enclosure Acoustic Control** | | | | | | | | | |
| **Acoustic Control Assuming NC-35 interior** | STC-40/OITC-35 based on standard performance values reported for assemblies | STC-45/OITC-40 & site assessment and lab tests of enclosure components | STC-45/OITC-40 & site assessment and site mockup testing | STC-50/OITC-45 & site assessment, mockup field tests and one field test per 20000 sf of enclosure | ASTM E90, E366 & E966. | Classification by E1332 | no | Provide enclosure sound control performance requirements. | Testing witnessed by the CxA per ASTM Standard E1124-10 |
| **3.2.9 Enclosure Service Life** | | | | | | | | | |
| **Walls<br>(In years to replacement/major rehabilitation)** | 50/25 | 75/30 | 100/40 | 150/50 | no | Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan | no | Describe expected service life for each enclosure wall type proposed. | CxA shall confirm through submittal review. |
| **Roofs<br>(Replacement)** | 20 | 30 | 40 | 50 | no | Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan | | Describe expected service life for roof type proposed. | CxA shall confirm through submittal review. |
| **Fenestration<br>(years to frame replacement / IGU + gaskets and seals replacement)** | 30/15 | 40/20 | 50/20 | 75/20 | | Yes, Design Review, Tier 1 and higher: Enclosure Cx CSA S478 plan, Maintenance plan | | Describe expected service life for each fenestration assembly proposed. | CxA shall confirm through submittal review. |

## 3.2 BUILDING ENCLOSURE PERFORMANCE ATTRIBUTES

### 3.2.1 NATURAL HAZARDS

#### 3.2.1.1 SEISMIC RESISTANCE

This attribute relates to building enclosure performance levels in terms of extent of damage and continuity of operations following a design basis earthquake with a 10 percent probability exceedance in 50 years (500-year return period). Seismic demands on the enclosure follow from deformation of the structure as characterized by peak transient inter-story drift and acceleration forces.

- Baseline: This performance level is characterized as Life Safety. Baseline performance anticipates serviceability degradation (e.g., glass breakage, weather seal damage, frame distortion, increased air and moisture infiltration) of the enclosure system. Controlled deformation of the enclosure system anchorage is accepted, but catastrophic failure is not allowable. The building structural system remains stable and has significant reserve capacity; hazardous nonstructural damage is controlled. Occupancy not expected after the event until repairs are performed.
- Tier 1 High Performance (★): This designation is characterized as Reduced Damage. This performance level anticipates moderate damage to the enclosure system. Ability to provide weather protection is locally compromised. Glass damage may occur, but breakage is mitigated. The building remains safe to occupy; structural and nonstructural repairs are minor.
- Tier 2 High Performance (★★): This designation is characterized as Immediate Occupancy. This performance level anticipates negligible structural and nonstructural damage with minimal damage to cladding components. Seals remain intact. Gaskets maybe loosened but remain functional. No glass breakage is expected.
- Tier 3 High Performance (★★★): This designation is characterized as Operational. This performance level anticipates that no serviceability degradation of the enclosure system occurs as a result of a 500-year design basis earthquake.

#### 3.2.1.2 WINDBORNE DEBRIS RESISTANCE

The attribute considers windborne missile impact and cyclic pressure loading resistance requirements in high wind zones and defined windborne debris regions.

- Baseline: This performance level for windborne debris resistance serviceability references the IBC. Windborne debris resistance shall be implemented in zones specified by IBC. In non-windborne debris zones, protection is not required at the baseline level.
- Tier 1 High Performance (★): This performance level incorporates windborne debris impact provisions designed to mitigate breaches of the enclosure system. The enclosure fenestration system is designed to resist large and small missile impacts and cyclic pressure loading per American Society of Testing and Materials (ASTM) E 1996/1886 as referenced in ASCE 7.
- Tier 2 High Performance (★★): This designation addresses a perceived increased level of windborne debris risk and decreased allowable impact compared to Baseline. This performance level requires that the building envelope remain unbreached for wind zone.
- Tier 3 High Performance (★★★): This performance level is governed by criteria

specified for building enclosure resistance to the impacts of tornado windborne debris and wind-induced loads. Risks associated with tornado hazards must considered as a separate item where applicable under a site specific assessment and where high performance is desired. Recommended tornado design wind speed is 250 mph (3-second peak gust). Protection of plant function and occupants is desired for critical facilities.

### 3.2.1.3 FLOOD RESISTANT DESIGN AND CONSTRUCTION

Flood resistance must be accounted for when developing designs for new construction or improvements to existing assets and must be correlated with the degree of hazard and the criticality of the asset as determined by the customer. Proposed buildings and structures within a flood hazard area shall be programmed and designed in accordance with ASCE 24, "Flood Resistant Design and Construction," provisions. Due diligence in risk-informed site evaluation per ASCE 24, enclosure damage, and continuity of operations are the metrics of performance for this attribute.

- Baseline: Evaluate site conditions to safeguard assets to prevent damage, loss, mission interruption, or site access. Compliance with ASCE-24-14 requires due diligence to evaluate site conditions for flood hazard identification and analysis for the intended service life of the Federal asset. This is required as flood hazard maps only reflect conditions at the time of the Flood Insurance Study, which may underestimate risk. This analysis includes but is not limited to “upland development that changes runoff characteristics, subsidence, riverine channel changes, shoreline erosion and accretion, sea level change, changes in precipitation patterns, changes associated with bridges, culverts, fills, and other artificial and natural alterations of the floodplain… Evaluation of site conditions must address the nature and history of flooding and whether any of the characteristics associated with high risk areas are present or if the maps do not reasonably reflect current conditions.” Buildings must be located above the 100-year base flood elevation + 2 feet. Critical Action facilities must be elevated above the 1 percent annual chance (100-year) base flood elevation + 3 feet, or the 0.2 percent annual chance flood (500-year) elevation, whichever is higher.
- Tier 1 High Performance (★): Flood Hazard Areas not identified as Coastal High Hazard Areas and Coastal A Zones. This designation addresses flood risk and the designated ASCE 24 Flood Design Class (in coordination with the customer) of the building or structure. The building enclosure system must be designed to resist or accommodate flood conditions per ASCE 24 provisions.
- Tier 2 High Performance (★★): High Risk Flood Hazard Areas, including Coastal High Hazard Area and Coastal A Zones. This is governed by ASCE 24 criteria for conditions regarding coastal high hazard areas and coastal A zones, as well as alluvial fan, flash flood, mudslide, erosion prone, high velocity flow, icejam, and debris. For coastal conditions, the building structural system must be elevated above the Base Flood Elevation per the designated ASCE 24 Flood Design Class (in coordination with the customer) and ASCE 24 provisions.
- References: E.O. 11988, Floodplain Management, of May 24, 1977
  PBS Environmental Management Floodplain

Management Desk Guide https://app_gsagov_prod_rdcgwaajp7wr.s3.amazonaws.com/Floodplain_Management_Desk_Guide.pdf

## 3.2.2 SERVICEABILITY

### 3.2.2.1 WIND RESISTANCE (SERVICEABILITY)

This attribute relates to the serviceability of the building enclosure system in response to wind loading. Wind speed and design wind load requirements shall be determined in accordance with applicable ASCE-7 prescriptive methods or wind-tunnel testing procedures. Wind-tunnel testing should be considered for large buildings or structures, in particular those with unusual shape or construction methodology, and those located in hurricane-prone regions or surrounded by unusual terrain. The applicability of wind-tunnel testing to optimize design should be evaluated by the design team as early as practical in the design process.

## 3.2.3 WATER PENETRATION RESISTANCE

### 3.2.3.1 FENESTRATION

Fenestration water penetration resistance requires calculation or wind tunnel testing to determine the project-specific design pressure (DP) and water penetration test pressure. Requirements must be communicated to the contracting parties in the construction documents. Water penetration resistance can be confirmed with product testing, laboratory mock-up testing, field mock-up testing, and in-situ field testing. Consideration shall be given to prescriptive minimum sampling requirements based on the type of test and number of assemblies to be included.

- The maximum limits provided in AAMA 101-2008 have been removed to allow higher test pressures as warranted by the project conditions. "No Uncontrolled Water Penetration" is also a departure from the AAMA 101-2008 definition and does not allow water penetration on any interior surface that is not drained to the exterior or otherwise controlled.

### 3.2.3.2 ROOFING AND HORIZONTAL WATERPROOFING MEMBRANE SYSTEM

A roofing and horizontal waterproofing membrane system requires a high resistance to physical damage, including impact resistance, and prohibits the entrapment of water within the assembly including insulation, protection, and drainage layers.

- Systems should prevent the retention of storm water or other accumulation or ponding of water on the membrane surface. Construct in accordance with the recommendations of the National Roofing Contractor Association (NRCA) Manual – Current Edition.

### 3.2.3.3 ROOFING MINIMUM SLOPE

Minimum slope is intended to eliminate the potential confluence of construction tolerance, creep, and other factors that may create ponding or a reduced evacuation of water from the membrane surfaces and to increase the longevity and performance of the membrane. As the slopes are increased, the required “drying” time of the roof is decreased.

- Comply with the minimum code requirement as per the current edition of the International Building Code, specifically section 1507, in which various minimum slopes are identified based on the type of roof covering system intended for use.

#### 3.2.3.4 ROOFING DRAINAGE (SIZE OF CONDUCTORS, LEADERS, AND DRAINS)

The intent of this requirement is to build redundancy into the drainage system. Redundancy in the roof drainage system is intended to mitigate ponding in the event of reduced evacuation of water from the membrane surfaces due to blockages, and to increase the longevity and performance of the membrane and the drainage systems. Roofing drainage must comply with the requirements of the International Building Code, which provides exceptions for new roofing at existing buildings.

#### 3.2.3.5 VEGETATIVE ROOFING SYSTEMS

Vegetative (green) roofing systems must be designed and constructed in accordance with ASTM E2777-14, Standard Guide for Vegetative (Green) Roof Systems. Roofing designs must be sufficiently robust to ensure continued performance in a concealed location that will be difficult to access.

#### 3.2.3.6 TESTING AND MONITORING OF ROOFING AND HORIZONTAL WATERPROOFING

Testing and monitoring are required to evaluate the water-tight integrity of new horizontal waterproofing and roofing surfaces. To detect moisture beneath existing roofing and horizontal waterproofing, use non-destructive testing methods, including capacitance testing, infrared thermography (ASTM C1153), and nuclear meter testing.

#### 3.2.3.7 GROUND WATER CONTROL

Ground water control requires active removal of ground water by means of pumping from the lowest level of the structure. Active systems consume energy and should not run on more than rare occasions.

#### 3.2.3.8 BELOW GRADE WATERPROOFING

Below grade waterproofing requires the relief of hydrostatic pressure on the structure's walls and provision for water to drain to daylight or a storm water management system.

### 3.2.4 MOISTURE AND CONDENSATE CONTROL

#### 3.2.4.1 MOISTURE CONTROL OPAQUE ASSEMBLIES

Moisture control in opaque assemblies requires analysis of project-specific assemblies and exposures to mitigate the risk of condensation and uncontrolled moisture migration.

#### 3.2.4.2 CONDENSATION RESISTANCE–FENESTRATION

Condensation resistance in fenestration is required to ensure no condensation occurs on uncontrolled surfaces based on the interior and exterior design criteria.

### 3.2.5 AIR TIGHTNESS

#### 3.2.5.1 AIR TIGHTNESS–FENESTRATION

Air tightness in fenestration is required to control air leakage in windows, doors, curtain walls, and skylights.

#### 3.2.5.2 ENCLOSURE AIR TIGHTNESS (ALL SIX SIDES OF THE BUILDING)

Enclosure air tightness is critical to ensuring the performance of the building enclosure and HVAC systems. The construction of a continuous air barrier is required. Construction documents should establish constructability and continuity.

Enclosure air tightness on all six sides of the building can be easily measured, and there is growing expertise in the industry of achieving the airtightness targets specified.

### 3.2.6 THERMAL PERFORMANCE

Thermal performance is critical to ensuring occupant comfort and the energy efficiency of the building.

**Tech Tip:**

- Consider Hi-R window panels during retrofits for buildings in cold climates with single pane windows.
- 41% winter heating energy savings

**Tech Tip:**

- Consider installing spectrally selective solar control film on single pane clear windows during retrofits in climates with hot summers, mild winters and direct sun exposure, exterior shading and south, east or west orientation.
- 22-29% cooling energy savings for reflective film when compared to single-pane glass

### 3.2.7 BUILDING ENCLOSURE COMMISSIONING

Building enclosure commissioning (BECx) is critical to ensuring designed performance. BECx is part and parcel to Total Building Commissioning. Develop a BECx plan as part of the overall Commissioning Plan.

### 3.2.8 ACOUSTIC CONTROL

Acoustic control is straightforward in theory, but there is little experience in the industry for achieving specific targets. The target inside acoustic signature must be adjusted for occupancies different than normal office occupancy. ASTM standards exist for measuring performance on-site during construction to verify that the desired performance has been achieved.

### 3.2.9 ENCLOSURE SERVICE LIFE

Service life, while very important to many, is very difficult to quantitatively predict, and there are few reliable methods of test and verification. Two targets for each performance level have been identified: the full service life and the time between major rehabilitation. The most important tools are material selection based on experience and design reviews by third parties who have experience and knowledge related to durability. Designers should recognize the differential durability of materials, products, and assemblies when attempting to realize maximum service life.

## 3.3 PRESCRIPTIVE ENCLOSURE REQUIREMENTS

### 3.3.1 MOISTURE CONTROL

Design of the above-grade building enclosure must be demonstrated early in the design development. ASHRAE 160, Criteria for Moisture Control Design Analysis in Buildings, is an acceptable basis of design. Demonstration of the transient hygrothermal behavior of the various multi-layer building components for all critical building enclosure systems must be confirmed through modeling.

Construction documents must clearly depict all drainage and air passages. Detail in three dimensions where practical, indicating critical corner terminations, interface of all differing systems, proper sealant methodologies, etc.

### 3.3.2 BELOW GRADE SYSTEMS

#### 3.3.2.1 GROUND WATER CONTROL

The drainage mat and soil filter must relieve hydrostatic pressure on substructure walls and

allow water drainage to the level of the drain. Pipes shall not slope less than 1:200. Subsurface drainage should discharge into the storm drain, by gravity if possible. Cleanouts must be provided at grade to facilitate washing out the system.

#### 3.3.2.2 WATERPROOFING

Membrane waterproofing must follow the recommendations of the National Roofing Contractors Association (NRCA) Manual – current edition.

#### 3.3.2.3 MEMBRANE PROTECTION

Below-grade waterproofing must be applied to the positive pressure side and must be covered by a protection mat to shield the waterproofing membrane from deleterious effects of construction activities, ultraviolet radiation, or aggressive vegetation.

#### 3.3.2.4 WATERSTOPS

Waterstops must be used at construction joints in below-grade walls, footings, and other elements where a waterproof system is required. Wherever possible, use level changes to create a redundancy with the substrate in the event the water barrier fails.

#### 3.3.2.5 UNDERSLAB INSULATION

Provide insulation under concrete slabs on grade where a permafrost condition exists, where slabs are heated, and where they support refrigerated structures.

#### 3.3.2.6 UNDERSLAB VAPOR BARRIER

Provide an impermeable vapor barrier immediately beneath concrete slabs on grade and where structural concrete slabs separate conditioned from unconditioned space. Do not place sand, gravel, or other materials between the vapor barrier and the concrete slab.

### 3.3.3 SUBSTRUCTURE

When soil radon or contaminant levels are present, a substructure depressurization system must be provided. If a passive system is designed, it must have the capability to accommodate future active depressurization.

### 3.3.4 WALL SYSTEMS

#### 3.3.4.1 CONNECTIONS AND FASTENERS EXPOSED TO WEATHER

Products constructed of carbon steel are not permitted in exterior construction, which includes exterior walls, soffits, or roofs, except where protected by a galvanic zinc coating of at least 460 grams per m2 (1.5 ounces per sq. ft.) of surface or other equivalent protection. Where possible, use stainless steel connections and fasteners.

#### 3.3.4.2 MATERIALS WITH ORGANIC CONTENT

Type II wall covering is not allowed on any surface where it could function as a vapor barrier and trap moisture within a wall assembly. On mass storage walls where water may penetrate the wall, avoid interior finishes made from paper-faced gypsum sheathing or other highly processed organic materials that may promote mold growth.

#### 3.3.4.3 AIR AND MOISTURE BARRIER SYSTEM

Air and moisture barriers are required of all new construction and should be employed wherever possible during remediation of existing exterior envelopes. The air barrier system is:

- A continuous element or combination of elements designed to control the movement of air through an exterior enclosure system.
- Continuous in three dimensions from roof to wall to foundation (all six sides).

- Consisting of materials and components that are, either individually or collectively, sufficient in stiffness and rigidity to resist air pressure differentials across the exterior wall assembly without permanent deformation or failure.
- Sufficiently durable to withstand the construction process.

The interior and exterior air pressures across an air barrier system that need to be examined include, but are not limited to, pressures caused by wind, stack effect, and mechanical systems. Air barriers may be located at different locations within a wall system, and the placement of the air barrier needs to be indicated by the designer on the drawings. The designer must carefully consider placement of the air barrier when the air barrier material(s) will act both as an air barrier and as a vapor retarder to determine if the drying of the enclosure system will be inhibited by the location of this material within the assembly. Portions of the air barrier may require regular maintenance, and an allowance should be made within the design to accommodate this maintenance.

A continuous plane of air tightness, herein called the air barrier system, must be installed as part of the building enclosure (both above- and below-grade) to effectively separate all conditioned air from outdoor and polluted spaces.

The air barrier system must be shown on the drawings as continuous through all section drawings of the enclosure. The air barrier materials and components of each assembly must be clearly identified and labeled as "Air barrier" on construction documents, and detailed at all penetrations, joints, and transitions. The pressure boundary of the air barrier system(s) and the zone(s) to be tested must also be shown on the drawings.

The air barrier material of each assembly must be joined and sealed to the air barrier material of adjacent assemblies with sufficient flexibility to allow for the relative differential movement and with sufficient strength to resist expected peak air pressure differences.

Penetrations of the air barrier system must be sealed to the air barrier system in an airtight manner. These penetrations include, but are not limited to: lighting fixtures, wiring, conduit, gas lines, cable services, windows, doors, ducts, fire protection standpipe connections, and plumbing pipes.

The air barrier system (and all materials and components comprising it) must last the anticipated service life of the enclosure or allow for easy maintenance, repair, and/or replacement.

Parking garages (attached to or under buildings), other structures connected to the building, including those connected via tunnels, walkways, service conduits, etc., and any storage with contents that can negatively affect indoor air quality must be separated from all other conditioned spaces by an air barrier system. Access to such spaces must be provided by doors in airtight vestibules or airtight hatches at building access points.

Boiler rooms not using sealed combustion equipment must be separated from the rest of the building space by an air barrier system and provided with make-up air for combustion.

Additional equipment and other items required for testing the building's airtightness are to be installed by the contractor as specified by the testing agency in accordance with the Commissioning Plan. This may include: indoor-

to-outdoor pressure taps at various locations across the air barrier system, air flow and pressure measuring stations in air conveyance and handling systems, and tight-sealing dampers on all ducts carrying air across the air barrier.

## 3.3.5 MASONRY AND CONCRETE MATERIALS

Brick masonry design must follow the recommendations of the Brick Institute of America contained in the publication, Technical Notes on Brick Construction.

Concrete masonry design must follow the recommendations of the National Concrete Masonry Association contained in the publication, TEK Manual for Concrete Masonry Design and Construction.

Architectural precast concrete design must follow the recommendations of the Precast Concrete Institute (PCI) contained in the PCI publication, Architectural Precast Concrete, Current Edition.

Exterior limestone design must follow the guidelines of the handbook published by the Indiana Limestone Institute of America.

Marble and marble veneer design must follow the recommendations in Exterior Marble Used in Curtain or Panel Walls, published by the Marble Institute of America. Extreme care should be used in the design and selection of marble veneers to prevent thermal hysteresis.

Design alterations and additions to minimize damage to or concealment of historic walls. Clean historic masonry prior to repointing or color matching new materials intended to blend with historic stone, brick, terra cotta or concrete.

## 3.3.6 FENESTRATION SYSTEMS

### 3.3.6.1 ALUMINUM WINDOWS

Aluminum windows must meet the requirements of ANSI/AAMA Standard 101-85. Only optimal performance classes may be used. Metal windows other than aluminum must meet the requirements of the National Association of Architectural Metal Manufacturers Standard SW-1 for the performance class required. Wood windows should meet the requirements of ANSI/NWMA Standard I.S. 2-87, Grade 60.

### 3.3.6.2 WINDOW FRAMES

Aluminum frames must have thermal breaks where there are more than 1,670 heating degree days $^{O}$C (3,000 heating degree days $^{O}$F). Window mullions, as much as possible, should be located on the floor-planning grid to permit the abutment of interior partitions.

Metal windows other than aluminum must meet the requirements of Steel Window Institute's (SWI) Specifier's Guide to Steel Windows for the performance class required.

Wood windows must meet the requirements of ANSI/NWMA Standard I.S. 2-87, Grade 60. Wood windows must meet the requirements of AAMA/WDMA 101/I.S.2/NAFS. AW Architectural Class.

Replacement windows in historic structures should exactly match original frame and muntin profiles. First consideration should be given to rehabilitating the existing windows. Insulated glass installed in historic sashes must include weep holes and, if required, glass fragmentation protection. For more information, see www.gsa.gov/cdnstatic/Windows.pdf

### 3.3.6.3 ENTRANCE DOORS

Entrance doors may be aluminum and/or glass of heavy duty construction. Glazed exterior doors and frames must be steel and meet the requirements of SDI Grade III with a G-90

galvanic zinc coating. Vestibules are desired to control air infiltration. Sliding automatic doors are preferred over swinging type. Motion detectors and push plates are preferred over mats as actuating devices. Historic entrance doors must be retained and upgraded with care to preserve the original appearance of the building. Where missing, replicas of the original doors should be installed. All door assemblies installed in the means of egress must meet the requirements of the National Fire Protection Association (NFPA), 101 Life Safety Code.

## 3.3.7 ROOF SYSTEMS

### 3.3.7.1 ROOFING DESIGN

Roofing design must follow the recommendations of the National Roofing Contractors Association (NRCA) Manual–current edition. Also follow the recommendations of the NRCA Manual–current edition to coordinate the design of metal flashing, trim, etc., with roofing terminations. The Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Manual is also a trusted resource for the design, fabrication, and installation of sheet metal roofing accessories. All roof assemblies and rooftop structures must meet the requirements in the IBC.

### 3.3.7.2 RE-ROOFING

Full replacement of roofing including insulation is the preferred approach to restoring the integrity of the enclosure system and realizing life cycle cost benefits. Where full replacement is not feasible, roof recovery or partial replacements are allowed to restore the integrity of the roofing system, protect the asset, and ensure continuity of operations. Where new roofs are installed over existing roofing, comply with the IBC and prevailing local code requirements. Survey and investigate the condition of the existing substrate to acquire warranties from the manufacturer and installer. The new roofing system shall not be of greater weight than the old roofing system, unless a structural analysis shows that the building can carry the additional weight. Ensuring the integrity of the building enclosure system takes precedence over less critical repairs or alterations. See the technical guidelines for Historic Building Roofing for guidance on repair, replacement, and modification of roofing on historic buildings.

### 3.3.7.3 ACCESS TO THE ROOF

An interior permanent stair must be provided to permit access to roof-mounted equipment. Permanent access to all roof levels must be provided to facilitate reoccurring inspection and maintenance.

### 3.3.7.4 INSULATION

Install roof insulation in a manner that ensures the continuity of thermal breaks. Where layers of insulation are used, alternate layouts so that joints are not aligned.

### 3.3.7.5 ROOF MOUNTED EQUIPMENT

Penthouses and screen walls on roofs should be integrated into the architectural design and constructed of materials used elsewhere in the building exterior. Some roof-mounted equipment, such as antennae, lightning rods, flagpoles, etc., does not have to be screened, but these elements must be integrated into the building design. Roof-mounted equipment should be elevated as recommended in the NRCA Roofing and Waterproofing Manual and set back from the roof edge to minimize visibility.

Penetrations through the roof to support equipment are extremely vulnerable to leaks. Flashing details must be studied to ensure

continuity of the waterproof barrier. Do not use pitch pockets as part of the roof design.

No building element may be supported by the roofing system except walkways. Provide protective walkways on the roof along routes to and around equipment for maintenance.

Before installing rooftop solar photovoltaic systems, a meeting must occur with the GSA project manager, the contractor, GSA property manager, GSA fire protection engineer, GSA safety specialist, local power utility company, and local fire official to ensure the proposed solar photovoltaic system design and layout is acceptable to all parties. See Chapter 6 for additional information on solar photovoltaic system requirements.

### 3.3.7.6 EXTERIOR SOFFITS

Design exterior soffits to resist displacement and rupture by wind uplift. Design soffits for access to void space where operating equipment is located or maintenance must be performed. Soffits can be considered totally exposed to weather and must therefore be designed to be moisture resistant. Provide expansion and contraction control joints at the edges and within the soffit. Spacing and configuration of control joints should be in accordance with the recommendations of the manufacturer of the soffit material.

Operating equipment or distribution systems that may be affected by weather must not be located inside soffits. Where it is necessary to insulate the floors over soffits, the insulation must be attached to the underside of the floor construction so that the soffit void may be ventilated to prevent condensation.

### 3.3.7.7 SKYLIGHTS AND SLOPED GLAZING

Skylights are defined as prefabricated assemblies shipped ready for installation, while sloped glazing is defined as field-assembled. Skylight design must follow the guidelines of AAMA Standard 1600. For the design of sloped glazing, two AAMA publications are available: Glass Design for Sloped Glazing and Structural Design Guidelines for Aluminum Framed Skylights.

Where manufactured skylight systems are specified, do not deviate from the manufacturer's proven standard details. Where the design intent or field conditions do not allow for the use of tested skylight assemblies, and where modifications to a manufacturer's standard details or a custom design is required, develop a rigorous course of design- and construction-phase testing as part of the Building Enclosure Commissioning (BECx) Plan to assure quality and performance.

Skylights and sloped glazing should use low emissivity glass. Placement should be calculated to prevent glare or overheating in the building interior. Condensation gutters and a path for the condensation away from the framing must be designed.

Consideration must be given to cleaning of all sloped glazing and skylights, including access and equipment required for both exterior and interior faces.

Skylights must be guarded for fall protection or meet OSHA structural requirements.

### 3.3.7.8 EDGE PROTECTION

Flat roofs designed for access must include edge protection such as parapets or railings. Edge protection includes the roof's outer edge and all unprotected sides and edges of inboard roof openings that could result in a fall to a lower level. Edge protection must be at least 42 inches in height with no openings exceeding 19 inches across the least dimension. Consult 29 CFR 1910 Subpart D for specific requirements.

Where parapets or railings are not feasible, the designer shall include other means of fall protection appropriate to the operations and maintenance access and work anticipated. Systems include, but are not limited to, warning lines when distance allows, and personal fall protection systems such as personal fall arrest, travel restraint, or positioning systems. Consult 29 CFR 1910 Subparts D, F, I, and the International Building Code for specific requirements.

Equipment should be located away from roof edges and oriented with access panels inboard of the roof edge.

Roof replacement projects shall include a review of the existing roof fall protection by a qualified consultant as defined in paragraph 3.3.12.5. Where such protection is deemed inadequate or unsafe, the design and installation of necessary fall protection systems, equipment, and components shall be included in the roof replacement project.

#### 3.3.7.9 ROOFTOP GARDENS AND LANDSCAPED ROOFS

Vegetated roofs, rooftop gardens, and landscaped roofs must also be installed and maintained in accordance with the requirements in the ICC International Fire Code (IFC) to ensure access and safety.

### 3.3.8 QUALITY ASSURANCE

#### 3.3.8.1 MOCK-UPS

Many unique contemporary building solutions require full scale, laboratory, and on-site mock-ups of critical portions of the building facade. Mock-ups confirm expected performance and establish acceptable standards of workmanship. The testing of a laboratory mock-up almost always assists in determining the final design solution. Performance mock-ups typically allow the builders to discover the proper sequence of the work that leads to successful completion. Mock-ups should be constructed by same team that will construct the facade. While in situ mock-ups are acceptable, separate mock-ups are preferred to eliminate the risk of accepting substandard work. Testing, verification, and approval of mock-ups must occur prior to proceeding with final installations.

#### 3.3.8.2 AIR BARRIER TESTING

For new construction, demonstrate performance of the air barrier system for the building enclosure. Tests can be conducted using either pressurization or depressurization. Conducting both tests provides diagnostic information. The building must not be tested until verifying that the continuous air barrier system has been installed as per the design in accordance with the specifications. Testing should occur during the course of construction and prior to the installation of insulation and exterior cladding materials that could impede access to the air barrier and prevent the identification of failures and required repairs.

### 3.3.9 SUN CONTROL DEVICES

Where operable or fixed sun control devices are installed, design for ease of maintenance, repair, and replacement. If automated sun control devices are provided, commission their performance as a requirement of the Building Enclosure Commissioning (BECx) Plan. Window washing systems used for the facility must also be compatible with any sunscreens or sun control devices.

### 3.3.10 WINDOW CLEANING

The facility must have provisions for cleaning the interior and exterior surfaces of all windows, skylights, and other glazed openings. The A/E must demonstrate that cleaning and

maintenance of interior glazing surfaces can be achieved without extraordinary means and methods. Submit this information with the construction documents.

## 3.3.11 PROVIDING ACCESS TO MAINTAIN EQUIPMENT IN ATRIUMS

The A/E must demonstrate that maintenance of equipment (e.g., lighting, smoke detectors, and other systems that are mounted within atrium spaces) can be achieved without extraordinary means and methods. Submit this information with the construction documents.

## 3.3.12 SUSPENDED ACCESS TO ELEVATED LOCATIONS

Suspended access primarily applies to vertical surfaces that cannot be feasibly reached from ground-based equipment. Typically these surfaces are exterior facades and interior atria. Access shall be designed for maintainability and safety. The following key factors influence design for suspended access:

- The need for access, frequency of access, and type of work depends on the maintenance and cleaning requirements of the vertical surfaces and associated equipment and components. Access includes, but is not limited to, window washing, facade inspection, facade maintenance, and access to lighting and security cameras.
- The architectural configuration of the building is a primary factor affecting access. Negative-sloped facades, appurtenances that project into the vertical plane, visual shields that block access to anchorages, and other architectural complexities can make access design challenging, compromised, or sometimes infeasible.
- The roof and penthouse (if applicable) structure affects anchorage and other access equipment installations. The design of the building structure should anticipate the location of anchorage connection locations to produce an integrated design.
- The layout of mechanical, electrical, plumbing, and other systems on the roofs of buildings may make the location of access systems difficult or may limit coverage. The A/E must coordinate the design of rooftop systems with anchorage connection locations to produce an integrated design and ensure access.

Roof replacement projects shall review the adequacy of access to vertical surfaces from roofs. Where such access is deemed inadequate, the design and installation of necessary access systems, equipment, and components shall be included in the roof replacement project.

### 3.3.12.1 ANCHORAGE

Technically the building structure is considered the *anchor* and the component installed to allow the connection of equipment or a worker to the structure is an *anchor connector*. However, the term “anchor connector” is also used to describe equipment components that attach to building anchor connectors. The term “anchorage” is used herein to describe the anchorage connector that is permanently attached to the building. The following are the three primary anchorage types:

- *Support Anchorages* are used to carry the load of a worker and equipment in a rope descent system. A variation of a support anchorage is a "tie-down" anchorage. This component is used to counter the moment of portable outriggers that are not counter-weighted.

- *Tie-back anchorages* are used as secondary safety connections for portable outriggers.
- *Lifeline anchorages* are used as secondary safety connections for worker protection. Each worker must be "tied off" to an independent lifeline anchorage.

### 3.3.12.2 ROPE DESCENT SYSTEM (RDS)

A Rope Descent System (RDS), also called a controlled descent system, is a suspension system that allows a worker to descend in a controlled manner and, as needed, stop at any point during the descent. The system typically consists of a roof anchorage, support rope, a descent device, carabiner(s) or shackle(s), and a chair (seatboard or "boatswain's chair").

### 3.3.12.3 POWERED PLATFORM

A powered platform is equipment used to provide access to the vertical surface of a building consisting of a suspended power-operated working platform, a suspension means, and the requisite operating and control devices. A powered platform may also be called a suspended scaffold, swinging scaffold, or swing stage.

### 3.3.12.4 DESIGNER TASKS

During the concept development phase of the project, the A/E shall retain the services of a qualified consultant to:

- Determine the type of access needed for the expected cleaning, inspection, and maintenance tasks for the proposed facility, and
- Recommend means and methods, equipment, and anchorage locations to accomplish such tasks in a safe, cost effective, and sustainable manner.

The consultant shall consider local trade availability and the ability to provide and operate the proposed system design in these recommendations. Anchorage connection locations shall be coordinated with the building structural design.

During design development the consultant shall design the system and specify the installation including requirements for quality assurance, maintenance, and periodic inspection and testing. The consultant shall provide a written certification that the anchorages meet the load requirements specified in paragraph 3.3.12.10.

### 3.3.12.5 DESIGNER QUALIFICATIONS

The consultant shall meet the following minimum criteria:

- The consulting firm shall be registered as a professional engineering firm and not be a manufacturer, distributor, installer, or supplier of access systems, anchors, anchorages, or anchorage connectors.
- The lead consultant(s) shall be dually licensed professional engineer(s) and certified safety professional(s).
- The consultant(s) shall demonstrate an understanding of current industry best practices, as well as applicable regulations and standards, including OSHA regulations and ANSI standards.
- The consultant(s) shall have a minimum of five (5) years of industry-specific experience in fall protection, including challenging work at structures of historical and architectural significance.

### 3.3.12.6 PERMANENT VS. PORTABLE EQUIPMENT

While anchorages are permanent components attached to the building, GSA allows for flexibility in choosing other access system components that are permanent or portable. Generally, GSA prefers that access equipment needed for each

cleaning or maintenance task be contractor-furnished (portable) to the greatest extent possible. Exceptions to this preference include the following:

- Building configurations that render the use of portable equipment infeasible, and
- Permanent access designs that have a lower Life Cycle Cost (LCC) or Total Cost of Ownership (TCO) than utilizing portable equipment. If such permanent systems are considered, a detailed LCC/TCO analysis must be performed that includes costs for periodic inspection, testing, maintenance, and re-certification of the permanent equipment.

### 3.3.12.7 SYSTEM PREFERENCES

The following order of preference shall be considered in matching an access system (or systems) to the proposed building design:

#### 3.3.12.7.1 ROPE DESCENT SYSTEMS

Where buildings are less than 300 feet above grade, contractor-supplied rope descent systems are the preferred means for access. Rope descent systems are generally the most efficient system for window washing and facade inspections. However, these systems generally are not feasible for facade work that requires equipment, heavy tools, or materials. OSHA limits rope descent systems to heights less than 300 feet above grade unless other means are not feasible or pose a greater risk than a rope descent system. Work to be completed at elevations above 130 feet requires intermittent, continuous or work station (suction cup) stabilization.

#### 3.3.12.7.2 GROUND-RIGGED POWERED PLATFORMS

When it is anticipated that a powered platform will be needed, contractor-supplied ground-rigged platforms and portable outriggers (generally counter-weighted or tie-down) are preferred. The designer shall consider the risk of damage to roofing during set-up and relocation caused by portable outriggers. For heights above 130 feet, continuous horizontal stabilization is required. The use of portable outriggers is limited to heights less than 300 feet. (29 CFR 1910.66 (f)(3)(ii))

#### 3.3.12.7.3 ROOF-RIGGED POWERED PLATFORMS

Ground-rigged platforms are generally not practical at elevations greater than 300 feet and cannot be used with intermittent stabilization. For these situations, roof-rigged powered platforms are generally the system of choice. Regarding suspension supports, it is generally not feasible to roof-rig a powered platform from a portable outrigger. This typically requires the installation of GSA-owned suspension structures such as swingable davits. Also, portable outriggers are prohibited above 300 feet. If contractor-supplied powered platforms are anticipated, the building design must provide adequate roof access (i.e., freight elevator) to transport the platform to the roof.

#### 3.3.12.7.4 PERMANENTLY INSTALLED POWERED PLATFORM SYSTEMS

Permanently installed systems are designed for dedicated building applications. GSA will consider such systems when simpler systems are not feasible or when a Life Cycle Cost (LCC) or Total Cost of Ownership (TCO) analysis shows a permanent system to be the best option.

### 3.3.12.8 STABILIZATION

For heights above 130 feet, horizontal stabilization is required to prevent lateral movement of a chair or platform due to wind loads. This stabilization is generally accomplished in three ways:

- Work Location Stabilization. This stabilization typically consists of suction cups placed on the glazing and is generally limited to window washers utilizing rope descent systems.
- Intermittent Stabilization. Intermittent stabilization consists of small anchorage points generally at every second floor. Intermittent stabilization can only be used with roof-rigged descents.
- Continuous Stabilization. These systems consist of channels or other sliding systems that run continuously along the vertical surface. These systems allow ground-rigging. However, it should be noted that continuous stabilization can be problematic architecturally, structurally, and functionally. The channel may affect the building aesthetics, the supporting structure (such as a mullion) must be capable of resisting the horizontal load, and the stabilization channels/rails must align smoothly at joints.

### 3.3.12.9 BUILDING ATTACHMENTS

Designs that utilize cornice hooks, roof hooks, roof irons, parapet clamps, or similar devices are prohibited unless approved by the GSA Office of Design and Construction.

### 3.3.12.10 ANCHORAGE DESIGN

Anchorage shall be designed to support a 5,000-pound ultimate load in all directions expected in use. Where feasible, anchorage shall be located to facilitate routine inspection, load testing, and maintenance.

### 3.3.12.11 REFERENCES

All components, equipment, and systems permanently installed on or in GSA buildings must comply with the following references:

- ANSI/ASSE Standard Z359 Fall Protection and Related Systems
- ANSI Standard A120.1, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance
- IWCA I 14.1—2001 Window Cleaning Safety (This standard expired as an ANSI standard in 2011.)
- 29 CFR 1910 Subpart D: Walking—Working Surfaces
- 29 CFR 1910.66, Subpart F: Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms (OSHA)

# 3.4 INTERIOR PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.1 Solid Core Wood Doors** | | | | | | | | | |
| **Construction** | Bonded stave core; AWI Custom Grade; 5-ply; Field applied paint | Bonded particle board core; AWI Custom Grade; 5-ply; Hardwood veneer; Field applied finish | Bonded structural composite core; AWI Premium Grade; 5-ply; Factory finish | Bonded structural composite core; AWI Premium Grade; 5-ply; Factory finish | N/A | WDMA I.S-1.A; AWI Architectural Woodwork Quality Standards | N/A | Describe door construction. | Verify door construction through shop drawing submittal and product submittal information. |
| **Durability** | 25 Year Warranty | Lifetime Warranty | Lifetime Warranty | Lifetime Warranty | Manufacturer's Warranty | N/A | N/A | Document warranty period. | Verify warranty through product submittal information. |
| **Acoustics** | No Rating | No Rating | STC 45 | STC 50 | N/A | ASTM E1425 | N/A | Document door STC rating, when applicable. | Verify STC ratings through product submittals during construction for compliance. |
| **Hardware** | Grade 1, Bored Locks | Grade 1; Standard duty mortise locks | Grade 1; Heavy duty mortise locks; solid stainless steel or bronze | Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission | N/A | BHMA A156 Series (door hardware) | N/A | Describe door hardware requirements. | Verify hardware submittal during construction to verify compliance. |
| **Frame** | Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated | Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated | Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized | Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout | N/A | ASTM/SDI 250.4 | N/A | Describe door frame construction. | Verify through shop drawing submittal and product submittal information. |
| **Security** | No Rating | No Rating | Time Rated | Forced Entry, Ballistic Resistant | N/A | UL 752 | Required for FE and BR ratings | Describe UL 752 door rating level (1-8) when applicable. | Verify through shop drawing submittal and product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.2 Hollow Metal Doors** | | | | | | | | | |
| **Construction** | Level 2; 0.042" (1.0mm)/untreated; Field applied paint | Level 3; 0.053" (1.3mm)/untreated; Field applied paint | Level 3; 0.053" (1.3mm)/untreated; Shop applied paint | Level 4; 0.067" (1.7mm)/galvanized; Electrostatically applied paint | N/A | ASTM/SDI 250.4 & ANSI/SDI 250.8 | N/A | Describe door construction. | Verify door construction through shop drawing submittal and product submittal information. |
| **Durability** | Heavy Duty | Extra Heavy Duty | Extra Heavy Duty | Maximum Duty | N/A | ASTM/SDI 250.4 & ANSI/SDI 250.8 | N/A | Document warranty period. | Verify warranty through product submittal information. |
| **Acoustics** | No Rating | No Rating | STC 35 | STC 35 | N/A | ASTM E1425 | N/A | Document door STC rating, when applicable. | Verify STC ratings through product submittals during construction for compliance. |
| **Hardware** | Grade 1; bored locks | Grade 1; Standard duty mortise locks | Grade 1; Heavy duty mortise locks; solid stainless steel or bronze | Grade 1; Heavy duty mortise locks; solid stainless steel or bronze; gasketed for sound transmission | N/A | BHMA A156 Series (door hardware) | N/A | Describe door hardware requirements. | Verify hardware submittal during construction to verify compliance. |
| **Frame** | Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated | Knock-down hollow metal, Level 3; 0.053" (1.3 mm); untreated | Welded hollow metal, Level 3; 0.053" (1.3 mm); galvanized | Welded hollow metal; Level 4; 0.067" (1.7mm)/galvanized; filled solid with grout | N/A | ASTM/SDI 250.4 & ANSI/SDI 250.8 | N/A | Describe door frame construction. | Verify through shop drawing submittal and product submittal information. |
| **Security** | No Rating | No Rating | Time Rated | Forced Entry, Ballistic Resistant, UL Level 3 | N/A | UL 752 | Required for FE and BR ratings | Describe UL 752 door rating level (1-8) when applicable. | Verify through shop drawing submittal and product submittal information. |
| **3.5.1.3 Glazed Aluminum Doors** | | | | | | | | | |
| **Construction** | 1/8" (3mm) extruded aluminum; mill finish | 1/8" (3mm) extruded aluminum; Class II anodic finish | 1/8" (3mm) extruded aluminum; Class I anodic or fluoropolymer paint finish | 3/16" (5mm) extruded aluminum; Class I anodic or fluoropolymer paint finish | N/A | AAMA 101/I.S.2/A440 | N/A | Describe door construction. | Verify door construction through shop drawing submittal and product submittal information. |
| **Durability** | Standard Warranty | Standard Warranty | Standard Warranty | 5 Year Warranty | Manufacturer's Warranty | N/A | N/A | Document warranty period. | Verify warranty through product submittal information. |
| **Hardware** | Offset pivots, BHMA Grade 2 | Offset pivots, BMHA Grade 1 | Center pivots, BMHA Grade 1 | Center pivots, BMHA Grade 1 | N/A | BHMA A156 Series (door hardware) | N/A | Describe door hardware requirements. | Verify hardware submittal during construction to verify compliance. |
| **Glazing** | 1/4" (6mm) clear safety glass | 1/4" (6mm) clear safety glass | 1" (25mm) clear insulating laminated glass | 1/2" (13mm) laminated clear or decorative glass | N/A | ASTM C 1048 | N/A | Describe glazing system proposed in glazed aluminum doors. | Verify glazing in glazed aluminum door submittal during construction to verify compliance. |
| **Security** | Lock Set Only | Lock Set Only | Lock Set Only | Electronically Controlled Access | N/A | N/A | N/A | Describe security requirement for glazed aluminum doors. | Verify through shop drawing submittal and product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.4 All Glass Entrances** | | | | | | | | | |
| **Construction** | All glass with stainless steel or chrome plated top and bottom rails or patches. | All glass with polished stainless steel, brass or chrome plated top and bottom rails or patches. | N/A | N/A | N/A | ASTM C1048 | N/A | Describe construction of all glass entrances. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Glazing** | Clear safety glass, 1/2" (13mm) thick. | Clear safety glass, 1/2" (13mm) thick. | Clear safety or decorative glass, 1/2" (13mm) thick. | N/A | N/A | ASTM C1048 | N/A | Describe proposed glazing for all glass entrances. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Hardware** | Grade 1 top and bottom pivots. Concealed floor or overhead closer. | Grade 1 top and bottom pivots. Concealed floor or overhead closer. | Grade 1 top and bottom pivots. Concealed floor or overhead closer. | N/A | N/A | N/A | N/A | Describe door hardware requirements. | Verify hardware submittal during construction to verify compliance. |
| **Durability** | Standard Warranty | Standard Warranty | 3 year warranty | N/A | Manufacturer's Warranty | N/A | N/A | Describe warranty period. | Verify warranty through product submittal information. |
| **Security** | Provided by lock function. | Provided by lock function. | Electronically controlled access. | N/A | N/A | ASTM C 1048 | N/A | Describe secuirty requirement for all glass entrances. | Verify through shop drawing submittal and product submittal information. |
| **3.5.1.5 Borrowed Lights** | | | | | | | | | |
| **Glazing** | Tempered, laminated or some other form of safety glass. | N/A | N/A | N/A | N/A | ASTM C1048 | N/A | Describe proposed glazing for borrowed lights. | Verify through mockup, shop drawing submittal and product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.6 Wood Framed Interior Lights** | | | | | | | | | |
| **Construction** | Field fabricated and finished. Painted birch, poplar or clear softwood. AWI Custom grade. | Shop fabricated with field applied clear or tinted stain. Oak, maple, cherry, walnut or similar hardwood. AWI custom grade. | Shop fabricated and finished with clear or tinted stain. Oak, maple, cherry, walnut or similar hardwood. AWI premium grade. | Shop fabricated and finished with clear or tinted stain. Teak, rosewood or similar hardwood. AWI premium grade. | N/A | N/A | N/A | Describe construction of wood framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Glazing** | 1/4" (6mm) clear safety glass | 1/4" (6mm) clear safety glass | Insulating glass or two 1/4" (6mm) lights of laminated glass with 1/2" (13mm) gap for reduced sound transmission. | Decorative laminated glass, 1/2" (13mm) think. | N/A | N/A | N/A | Describe proposed glazing for wood framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **3.5.1.7 Hollow Metal Framed Interior Lights** | | | | | | | | | |
| **Construction** | Untreated, field painted. | Galvanized for installation in wet areas, shop applied painted finish. | Galvanized for installation in wet areas and electrostatically applied painted finish. | Galvanized for installation in wet areas and electrostatically applied painted finish. | N/A | N/A | N/A | Describe construction of hollow metal framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Frame** | Knock-down hollow metal frame, 0.042" (1.0mm) thick. | Welded hollow metal frame, 0.053" (1.3mm) thick. | Welded hollow metal frame, 0.053" (1.3mm) thick with custom profile. | Welded hollow metal frame, 0.053" (1.3mm) thick with custom profile. | N/A | N/A | N/A | Describe frame construction of hollow metal framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Glazing** | 1/4" (6mm) clear safety glass | 1/4" (6mm) clear safety glass | Insulating glass or two 1/4" (6mm) lights of laminated glass with 1/2" (13mm) gap for reduced sound transmission. | Decorative laminated glass, 1/2" (13mm) think. | N/A | N/A | N/A | Describe proposed glazing for hollow metal framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.8 Aluminum Framed Interior Lights** | | | | | | | | | |
| **Construction** | Manufacturer's standard profile; mill finish | Manufacturer's standard profile; Class II anodic finish | Manufacturer's standard profile; Class I anodic or fluoropolymer paint finish | Custom profile; Class I anodic or fluoropolymer paint finish | N/A | AAMA 101/I.S.2/A440 | N/A | Describe construction of aluminum framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Frame** | 1/8" (3mm) extruded aluminum | 1/8" (3mm) extruded aluminum | 1/8" (3mm) extruded aluminum | 1/8" (3mm) extruded aluminum | N/A | AAMA 101/I.S.2/A440 | N/A | Describe frame construction of aluminum framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **Glazing** | 1/4" (6mm) clear safety glass | 1/4" (6mm) clear safety glass | 1" (25mm) clear insulating laminated glass | 1/2" (13mm) laminated clear or decorative glass | N/A | ASTM C 1048 | N/A | Describe proposed glazing for aluminum framed interior lights. | Verify through mockup, shop drawing submittal and product submittal information. |
| **3.5.1.9 Metal Stud Partitions** | | | | | | | | | |
| **Construction** | 3-5/8" x min. 25 ga. metal studs @ 24" o.c., 5/8" gypsum board, with Greenguard Gold certification, each side (max. deflection L/240) | 3-5/8" x min. 25 ga. metal studs @ 16" o.c., 5/8" gypsum board, with Greenguard Gold certification, each side (max. deflection L/360) | 3-5/8" x min. 16 ga. light gage metal framing studs @ 16" o.c., 2 layers 5/8" gypsum board, , with Greenguard Gold certification, 9 ga. wire mesh between studs and gypsum each side (max. deflection L/360) | N/A | N/A | ASTM C 645, ASTM C 1396, Greenguard Gold | N/A | Describe partition construction. Document envrionmental testing requirements for gypsum board | Verify compliance through design submittals, shop drawings and product submittal information. |
| **Durability** (Impact Resistance) | Standard | Standard | High | N/A | N/A | N/A | N/A | Describe impact resistance requirement, when applicable. | Verify compliance through product submittal information. |
| **Height** | Deck to Ceiling | Deck to Slab or Deck Above | Deck to Slab or Deck Above | N/A | N/A | N/A | N/A | Describe partition height requirements. | Verify compliance through design submittals. |
| **Acoustics** | STC 40 | STC 45 | STC 50 | N/A | N/A | ASTM E 90 | N/A | Document partition assembly STC rating. | Verify STC ratings through product submittals during construction for compliance. |
| **Security** | No Rating | No Rating | SCIF | N/A | N/A | N/A | Required for FE and BR ratings | Document security requirement. | Verify compliance through design submittals and shop drawings |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.10 Masonry Partitions** | | | | | | | | | |
| **Construction** | 6" CMU, 1-5/8" metal studs @ 16" o.c. and 5/8" gypsum board, with Greenguard Gold certification, each side | 8" filled and reinforced CMU, 9 ga. wire mesh one side, 1-5/8" metal studs @ 16" o.c. and 2 layers 5/8" high impact resistant gypsum board, with Greenguard Gold certification, each side | N/A | N/A | N/A | ASTM C 129, ASTM C 645, ASTM C 1396, Greenguard Gold | N/A | Describe partition construction. Document envrionmental testing requirements for gypsum board. | Verify compliance through design submittals, shop drawings, andproduct submittal information. |
| **Durability** (Impact Resistance) | Standard | High | N/A | N/A | N/A | N/A | N/A | Describe impact resistance requirement, when applicable. | Verify compliance through product submittal information. |
| **Acoustics** | STC 50 | STC 70 | N/A | N/A | N/A | ASTM E 90 | N/A | Document partition assembly STC rating. | Verify STC ratings through product submittals during construction for compliance. |
| **Security** | Moderate | High | N/A | N/A | N/A | N/A | Required for FE and BR ratings | Document security requirement. | Verify compliance through design submittals and shop drawings |
| **3.5.1.11 Demountable Partitions** | | | | | | | | | |
| **Construction** | Standard Panel Width Prefinished Metal Panels | Custom panel widths with gypsum board on exposed surfaces | Custom panel widths with gypsum board on exposed surfaces. Transoms and borrowed lights. | Custom panel widths with gypsum board on exposed surfaces. Transoms and borrowed lights. | N/A | N/A | N/A | Describe partition construction. | Verify compliance through product submittal information. |
| **Acoustics** | STC 40 | STC 45 | STC 45 | STC 50 | N/A | ASTM E 90 | N/A | Document partition assembly STC rating. | Verify STC ratings through product submittals during construction for compliance. |
| **3.5.1.12 Operable Walls** | | | | | | | | | |
| **Construction** | Steel or MDF/Vinyl/3" (75mm) thick | Steel or MDF/vinyl, fabric, or veneer/3" (75mm) think | Steel or MDF/vinyl, fabric, veneer, or marker board/3" (75mm) thick. Gasketed at top, bottom and panel joints. | Steel, MDF, or gypsum/vinyl, fabric, veneer, or marker board/4" (100mm) thick. Gasketed at top, bottom and panel joints. | N/A | N/A | N/A | Describe partition construction. | Verify compliance through product submittal information. |
| **Acoustics** | STC 40 | STC 45 | STC 50 | STC 55 | N/A | ASTM E 90 | N/A | Document partition assembly STC rating. | Verify STC ratings through product submittals during construction for compliance. |
| **Operation** | Single panels or hinged pairs, manual | Single panels or hinged pairs, manual | Continuously hinged panels, motorized | Hinged pairs, manual | N/A | N/A | N/A | Describe operable wall operation type. | Verify compliance through product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.1.13 Millwork and Cabinets** | | | | | | | | | |
| **Construction** | Particle Board with Plastic Laminate Veneer | Particle Board with Wood Veneer on exposed to view surfaces. | Particle Board with Wood Veneer on exposed to view surfaces. | Solid Wood, Custom Detailed Molding and Trim | N/A | N/A | N/A | Describe construction and document any environmental (temperature/humidity) limits, if any. | Verify compliance through product submittal information. |
| **Durability** | Moderate | Moderate | Extended Life | Extended Life | N/A | N/A | N/A | Describe anticipated service life. | Verify compliance through product submittal information. |
| **Quality** | AWI Custom grade, factory standard products. Grade 2 hardware, plated finish. | AWI Custom grade, shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, plated finish. | AWI Premium grade, shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless steel, brass or bronze. Provide AWI QCP Labels/Certificates. | AWI Premium grade, shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless steel, brass or bronze. Provide AWI QCP Labels/Certificates. | N/A | AWI Architectural Woodwork Quality Standards | N/A | Describe quality of millwork and cabinets. | Verify through shop drawing submittal and product submittal information. |
| **3.5.1.14 Countertops** | | | | | | | | | |
| **Construction** | Particle Board, Plastic Laminate Top and Edge | Particle Board, Exterior Glue, Solid Surface Material Top and Edge | Exterior Grade Plywood with Stone Top and Edge | Exterior Grade Plywood with Chemical Resistant or stainless steel top and edge | N/A | N/A | N/A | Describe countertop construction. | Verify compliance through product submittal information. |
| **Durability** | Limited | Moderate | Extended Life | Extended Life | N/A | N/A | N/A | Describe anticipated service life. | Verify compliance through product submittal information. |
| **Quality** | AWI Custom grade | AWI Premium grade | AWI Premium grade | AWI Premium grade | N/A | AWI Architectural Woodwork Quality Standards | N/A | Describe quality of countertops. | Verify through shop drawing submittal and product submittal information. |
| **3.5.2.1 Broadloom/ Carpet Tile** | | | | | | | | | |
| Durability | Heavy Traffic | Severe Traffic | | | | ASTM D 5252/ ASTM D 7330 | | Document the Texture Appearance Retention Rating (TARR). | Verify compliance through mockup and product submittal information. |
| | Type 6 or Type 6,6 BCF Nylon | Type 6 or Type 6,6 BCF Nylon | | | N/A | N/A | N/A | Describe the nylon type used. | Verify compliance through mockup and product submittal information. |
| Service Life | 10 Year Warranty | 10 Year Warranty | 10 Year Warranty Min | 10 Year Warranty Min | Provide copy of Manufacturers Published Warranty | N/A | N/A | Document warranty period. | Verify compliance through product submittal information. |
| Environmental | NSF-140 Platinum or Cradle to Cradle Bronze | NSF-140 Platinum or Cradle to Cradle Bronze | NSF-140 Platinum or Cradle to Cradle Bronze | Cradle to Cradle Gold | Provide Link to Published EPD & NSF 140 certificate | N/A | N/A | Describe NSF level. | Verify compliance through product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.2 Vinyl Composition Tile (VCT)** | | | | | | | | | |
| Durability | Standard VCT - (Class I Solid Color; Class II Through Pattern; Class III Surface Decorated) | Standard VCT - (Class I Solid Color; Class II Through Pattern) | N/A | Premium Vinyl Tile(SVT) (Class III 20 mil wear Layer) & (Class I Monolithic) | N/A | ASTM F 1066 for Standard VCT; ASTM F 1700 for Premium | N/A | Describe tile construction. | Verify compliance through product submittal information. |
| | Minimum Overall Thickness = nom 0.125 inch | Minimum Overall Thickness = nom 0.125 inch | N/A | Minimum Overall Thickness = nom 0.100 inches(Class III) & nom 0.125 inches(Class I) | N/A | N/A | N/A | Describe tile thickness. | Verify compliance through product submittal information. |
| | Static Limit Load > or equal to 125psi | Static Limit Load > or equal to 125psi | N/A | Static Limit Load > or equal to 175psi | N/A | ASTM F 970 | N/A | Document static limit load rating for VCT. | Verify compliance through product submittal information. |
| Maintenance | Factory Finish Applied | Specialty Finish Applied | N/A | Specialty Finish Applied | N/A | ASTM F 410 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 5 Year Warranty | 5 Year Warranty | N/A | 5 Year Warranty | N/A | N/A | N/A | Document warranty period. | |
| Environmental | NSF-332 Silver | NSF-332 Gold | NSF-332 Platinum | Cradle to Cradle Bronze | N/A | NSF/ANSI 332 | N/A | Document compliance with NSF-332 | Verify compliance through product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.3 Sheet Vinyl** | | | | | | | | | |
| Durability | Heterogeneous Vinyl | Heterogeneous Vinyl | N/A | Homogeneous Vinyl | N/A | ASTM F 1303/ ASTM F 1913 | N/A | Describe tile construction. | Verify compliance through product submittal information. |
| | Type I (Clear Wear Layer 0.014 inches) Type II (Filled Wear Layer 0.030 inches) | Type I (Clear Wear Layer 0.020 inches) Type II (Filled Wear Layer 0.050 inches) | N/A | Minimum 0.075 inches | N/A | ASTM F 1303/ ASTM F 1913 | N/A | Describe type of backing when used. | Verify compliance through product submittal information. |
| | Static Limit Load > or equal to 125psi | Static Limit Load > or equal to 175psi | N/A | Static Limit Load > or equal to 250psi | N/A | ASTM F 1303/ ASTM F 1913 | N/A | Document static limit load rating. | Verify compliance through product submittal information. |
| Maintenance | Factory Surface Applied | Specialty Top Coat Applied | N/A | Specialty Top Coat Applied | N/A | ASTM F 1303 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 5 Year Warranty | 5 Year Warranty | N/A | 5 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information. |
| Environmental | NSF-332 Silver | NSF-332 Gold | NSF-332 Platinum | Cradle to Cradle Bronze | N/A | NSF/ANSI 332 | N/A | Document compliance with NSF-332 | Verify compliance through product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.4 Rubber Tile** | | | | | | | | | |
| Durability | Class II Laminated A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer) | N/A | N/A | Class I Homogenous A&B (A=Solid Color Wear Layer; B=Mottled Wear Layer ) | N/A | ASTM F 1344 | N/A | Describe rubber tile construction. | Verify compliance through product submittal information. |
| | Min Overall Thickness = nom 0.080 inches Hardness >85 | N/A | N/A | Min Overall Thickness = nom 0.125 inches Hardness >85 | N/A | ASTM D 2240 | N/A | Describe tile thickness. | Verify compliance through product submittal information. |
| Maintenance | Class II A&B | N/A | N/A | Class I A&B | N/A | ASTM F 1344 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 5 Year Warranty | N/A | N/A | 5 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information. |
| Environmental | NSF-332 Silver | NSF-332 Gold | NSF-332 Platinum | Cradle to Cradle Bronze | N/A | NSF/ANSI 332 | N/A | Document compliance with NSF-332 | Verify compliance through product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.5 Linoleum** | | | | | | | | | |
| Durability | Thickness >2.5mm | N/A | N/A | Thickness >3.2mm | N/A | ASTM F 2034 | N/A | Describe linoleum thickness. | Verify compliance through product submittal information. |
| | Static Limit Load > or equal to 150psi | N/A | N/A | Static Limit Load > or equal to 400psi | N/A | ASTM F 970 | N/A | Document static limit load rating. | Verify compliance through product submittal information. |
| Maintenance | Factory Surface Applied | N/A | N/A | Low Maintenance Coating Applied | N/A | ASTM F 2034 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 2 Year Warranty | N/A | N/A | 3 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information. |
| Environmental | NSF-332 Silver | NSF-332 Gold | NSF-332 Platinum | Cradle to Cradle Bronze | N/A | NSF/ANSI 332 | N/A | Document compliance with NSF-332 | Verify compliance through product submittal information. |
| | Binder Content min 30 % | N/A | N/A | Binder Content min 30 % | N/A | N/A | N/A | Describe binder content. | Verify compliance through product submittal information and manufacturer certification. |
| | N/A | N/A | N/A | Voc Emissions = CDPH/EHLB/Standard Method v1.2 or Floor Score Certification | N/A | CDPH/EHLB/Standard Method v1.2 | N/A | Document compliance with CDPH/EHLB/Standard Method v1.2 | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.6 Pressed Floor Tile** | | | | | | | | | |
| Durability | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | N/A | Conforms to ANSI A137.1 | N/A | ANSI A137.1 | N/A | Document conformance with ANSI A137.1. | Verify compliance through mockup and product submittal information. |
| | Light Commercial Abrasion Class III | Commercial Abrasion Class IV | N/A | Commercial Abrasion Class IV | N/A | ASTM C1027 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| | N/A | Semi-virtuous Max. Absorp. Class P3 | N/A | Virtuous Max. Absorp. Class P2 | N/A | ASTM C373 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| | N/A | Breaking Strength > or equal to 350lbs | N/A | Breaking Strength > or equal to 400lbs | N/A | ASTM C648 | N/A | Document floor tile breaking strength. | Verify compliance through product submittal information. |
| Maintenance | Stain Class Reported | Stain Class B or Better | N/A | Stain Class A | N/A | ASTM C1378 | N/A | Describe Stain Class. | Verify compliance through product submittal information. |
| | Chem Class Reported | Chem Class B or Better | N/A | Chem Class A | N/A | ASTM C650 | N/A | Describe Chemical Class. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 18 Month Warranty | N/A | 2 Year Warranty | N/A | Manufacturer | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Green Squared Certification | Green Squared Certification | Green Squared Certification | Cradle to Cradle Bronze | Provide 3rd party Certificate, Provide link to EPD Operators Website | ANSI A138.1 & Green Squared Certification Program, ISO 14025 | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.7 Porcelain Tile** | | | | | | | | | |
| Durability | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | N/A | ANSI A137.1 | N/A | Document conformance with ANSI A137.1. | Verify compliance through mockup and product submittal information. |
| | Light Commercial Abrasion Class III | Commercial Abrasion Class IV | Commercial Abrasion Class IV | Heavy Commercial Abrasion Class V | N/A | ASTM C1027 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| | N/A | Virtuous (P3/E3/O3) | Virtuous (P2/E2/O2) | Virtuous (P1/E1/O1) | N/A | ASTM C373 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| | N/A | Breaking Strength >350lbs | Breaking Strength >400lbs | Breaking Strength >450lbs | N/A | ASTM C648 | N/A | Document floor tile breaking strength. | Verify compliance through product submittal information. |
| Maintenance | Stain Class Reported | Stain Class B or Better | Stain Class A | Stain Class A | N/A | ASTM C1378 | N/A | Describe Stain Class. | Verify compliance through product submittal information. |
| | Chem Class Reported | Chem Class B or Better | Chem Class A | Chem Class A | N/A | ASTM C650 | N/A | Describe Chemical Class. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 18 Month Warranty | 2 Year Warranty | 3 Year Warranty | N/A | Manufacturer | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Green Squared Certification | Green Squared Certification | Green Squared Certification | Cradle to Cradle Bronze | Provide 3rd party Certificate, | ANSI A138.1 & Green Squared Certification Program, ISO 14025 | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.8 Quarry Tile** | | | | | | | | | |
| Durability | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | N/A | ANSI A137.1 | N/A | Document conformance with ANSI A137.1. | Verify compliance through mockup and product submittal information. |
| | Light Commercial Abrasion Class III | Commerical Abrasion Class IV | Commercial Abrasion Class IV | Heavy Commercial Abrasion Class V | N/A | ASTM C1027 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| | N/A | Virtuous Max. Absorp. Class E3 | Virtuous Max. Absorp. Class E2 | Virtuous Max Absorp. Class E1 | N/A | ASTM C373 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| | N/A | Breaking Strength > or equal to 350lbs | Breaking Strength > or equal to 400lbs | Breaking Strength > or equal to 450lbs | N/A | ASTM C648 | N/A | Document floor tile breaking strength. | Verify compliance through product submittal information. |
| Maintenance | Stain Class Reported | Stain Class B or Better | Stain Class A | Stain Class A | N/A | ASTM C1378 | N/A | Describe Stain Class. | Verify compliance through product submittal information. |
| | Chem Class Reported | Chem Class B or Better | Chem Class A | Chem Class A | N/A | ASTM C650 | N/A | Describe Chemical Class. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 18 Month Warranty | 2 Year Warranty | 3 Year Warranty | N/A | Manufacturer | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Green Squared Certification | Green Squared Certification | Green Squared Certification | Cradle to Cradle Bronze | Provide 3rd party Certificate, Provide link to EPD Operators Website | ANSI A138.1 & Green Squared Certification Program, ISO 14025 | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.9 Mosaic Tile** | | | | | | | | | |
| Durability | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | N/A | ANSI A137.1 | N/A | Document conformance with ANSI A137.1. | Verify compliance through mockup and product submittal information. |
| | Light Commercial Abrasion Class III | Commercial Abrasion Class IV | Commercial Abrasion Class IV | Heavy Commerical Abrasion Class V | N/A | ASTM C1027 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| | N/A | Virtuous Max. Absorp. Class P3/E3/O3 | Virtuous Max. Absorp. Class P2/E2/O2 | Virtuous P1/E1/O1 | N/A | ASTM C373 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| | N/A | Breaking Strength > or equal to 350lbs | Breaking Strength > or equal to 400lbs | Breaking Strength > or equal to 450lbs | N/A | ASTM C648 | N/A | Document floor tile breaking strength. | Verify compliance through product submittal information. |
| Maintenance | Stain Class Reported | Stain Class B or Better | Stain Class A | Stain Class A | N/A | ASTM C1378 | N/A | Describe Stain Class. | Verify compliance through product submittal information. |
| | Chem Class Reported | Chem Class B or Better | Chem Class A | Chem Class A | N/A | ASTM C650 | N/A | Describe Chemical Class. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 18 Month Warranty | 2 Year Warranty | 3 Year Warranty | N/A | Manufacturer | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Green Squared Certification | Green Squared Certification | Green Squared Certification | Cradle To Cradle Bronze | Provide 3rd party Certificate, Provide link to EPD Operators Website | ANSI A138.1 & Green Squared Certification Program, ISO 14025 | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.10 Limestone Tile** | | | | | | | | | |
| Durability | Abrasion Resistance > or equal to 10 | NA | NA | Abrasion Resistance > or equal to 15 | N/A | ASTM C568 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Absorption max. 7.5 | NA | NA | Absorption max. 3 | N/A | ASTM C97 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| **3.5.2.11 Slate Tile** | | | | | | | | | |
| Durability | Abrasion Resistance > or equal to 8 | NA | NA | Abrasion Resistance > or equal to 15 | N/A | ASTM C629 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Absorption max. 0.45 | NA | NA | Absorption max. 0.25 | N/A | ASTM C121 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.12 Marble** | | | | | | | | | |
| Durability | Abrasion Resistance > or equal to 10 | NA | NA | Abrasion Resistance > or equal to 15 | N/A | ASTM C503 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Absorption max. 0.20 / Density 144 min | NA | NA | Absorption max. 0.20 / Density 168 min | N/A | ASTM C97 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| **3.5.2.13 Granite** | | | | | | | | | |
| Durability | Abrasion Resistance > or equal to 25 | N/A | N/A | Abrasion Resistance > or equal to 25 | N/A | ASTM C615 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Absorption max. 0.50 | N/A | N/A | Absorption max. 0.40 | N/A | ASTM C97 | N/A | Document water absorption requirement. | Verify compliance through mockup and product submittal information. |
| **3.5.2.14 Terrazzo** | | | | | | | | | |
| Durability | Cementitious Polyacrylate 3/8" thick | N/A | N/A | Epoxy 1/4" or 3/8" thick | N/A | N/A | N/A | N/A | N/A |
| | Abrasion < or equal to 40% Loss | N/A | N/A | Hardness > or equal to 10 minimum | N/A | MIL-D-3134 Par. 4.7.10/ ASTM C 241 | N/A | Document ASTM abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Anti-fracture Membrane | N/A | N/A | Flexible Membrane and vapor barrier | N/A | ASTM E 1745 | N/A | Document maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | No VOCs<br>Local Resources<br>Recycled Marble Chips | N/A | N/A | No VOCs<br>Local Resources<br>Recycled Glass/Stone Chips | N/A | N/A | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.15 Laminate Flooring** | | | | | | | | | |
| Durability | Commercial, Wear Resistance IP > or equal to 4000 cycles using NEMA test 3.7 - Taber model 5130 test or equivalent. | N/A | N/A | Heavy commercial Wear Resistance IP > or equal to 6000 cycles using NEMA test 3.7- Taber model 5130 test or equivalent. | N/A | NAFLA LF-01 | N/A | Document wear resistance rating. | Verify compliance through product submittal information. |
| | Static Load Limit > or equalt to 8 MPa (1160 psi) | N/A | N/A | Static Load Limit > or equal to 8 MPa (1160 psi) | N/A | NAFLA LF-01 | N/A | Document static load limit. | Verify compliance through product submittal information. |
| Maintenance | High Wear Resistant Thermoset Surface | N/A | N/A | High Wear Resistant Thermoset Surface | N/A | NAFLA Stds | N/A | Document maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 10 Year Warranty | N/A | N/A | 10 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| | CARB Verified Phase 2 Compliant | N/A | N/A | CARB Verified Phase 2 Compliant | 3rd Party Certified | ASTM E1333/ASTM D6007 | N/A | Document CARB compliance. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | VOC Emissions - CDPH/EHLB/Standard Method v1.2 | N/A | N/A | VOC Emissions - CDPH/EHLB/Standard Method v1.2 - (Floor Score Certified) | N/A | N/A | N/A | Document compliance with CDPH/EHLB/Standard Method v1.2 | Verify compliance through product submittal information and manufacturer certification. |
| | 50% Recycled Content | N/A | N/A | 90% Recycled Content | N/A | NAFLA Stds | N/A | Document the percent recycled content. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.16 Wood Flooring** | | | | | | | | | |
| Durability | Hardness - 380-950 | Hardness - 950-1500 | Hardness - 1500-2600 | Hardness - 2600-3800 | N/A | Janka Test | N/A | Document Janka Test hardness level. | Verify compliance through product submittal information. |
| Maintenance | Varnish top coat applied | Varnish top coat applied | Polyurethane top coat applied | Polyurethane top coat applied | N/A | ASTM D 4060 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | Local Resources, 91% Bio Based | Local Resources, 91% Bio Based | Local Resources, 91% Bio Based | Local Resources and recycled materials, 91% Bio Based | N/A | Green Label Certified | N/A | Describe regional material content, recycled material content and environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.17 Bamboo Flooring** | | | | | | | | | |
| Durability | Hardness 1300 min | Hardness 1400 min | Hardness 1500 min | Hardness 1600 min | N/A | Janka Test | N/A | Document Janka Test hardness level. | Verify compliance through product submittal information. |
| Maintenance | Varnish top coat applied | Varnish top coat applied | Polyurethane top coat applied | Polyurethane top coat applied | N/A | ASTM D 4060 | N/A | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | 91% Bio Based, Renewable & Recycled materials, Low VOCs | 91% Bio Based, Renewable & Recycled materials, Low VOCs | 91% Bio Based, Renewable & Recycled materials, Low VOCs | 91% Bio Based, Renewable & Recycled materials, Low VOCs | N/A | Green Label Certified | N/A | Describe regional material content, recycled material content and environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.18 Glazed Wall Tile** | | | | | | | | | |
| Durability | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | Conforms to ANSI A137.1 | N/A | ANSI A137.1 | N/A | Document wear resistance rating. | Verify compliance through product submittal information. |
| | Absorption Class P4 | Absorption Class P4, breaking strength greater than or equal to 175 lbs. | Absorption Class P4, breaking strength greater than or equal to 200 lbs. | Heavy commerical (Abrasion Class V), Virtuous (P1/E1/O1). Breaking strength greater than or equal to 450 lbs. | N/A | ANSI A137.1 | N/A | Document absorption and load limit. | Verify compliance through product submittal information. |
| Maintenance | Stain and chemical class reported. | Stain and chemical class B or better. | Stain and chemical class A. | Stain and chemical class A. | N/A | ANSI A137.1 | N/A | Document maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 18 Month Warranty | 2 Year Warranty | 3 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Green Squared Certified | Green Squared Certified | Green Squared Certified, Level 2 recycled/reclaimed content and publically available Environmental Product Data. | Green Squared Certified, Level 3 recycled/reclaimed content, 3 Innovation Credits and publically available Environmental Product Data. | N/A | N/A | N/A | Describe recycled material content and environmental testing requirements. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.19 Interior Architectural Coatings (Paint)** | | | | | | | | | |
| Durability | | | | | | | | | |
| | Scrubbability (ASTM D2450/MPI): Greater than 200 Scrubs | Scrubbability (ASTM D2450/MPI): Greater than 330 scrubs | N/A | N/A | ISO compliant lab verify ASTM compliance | ASTM D2486 | N/A | Describe finish types and maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | VOC Levels: Flat, Nonflat, and Nonflat High Gloss Coatings - Lower than 50 VOC grams per liter (g/l) post-tint | VOC Levels: Flat, Nonflat, and Nonflat High Gloss Coatings - Lower than 50 VOC grams per liter (g/l) post-tint | Master Painters Institute (MPI) Extreme Green standard or the GreenSeal 11 Standard for Paints, Coatings, Stains, and Sealers. | VOC level ≤ 50 g/L post-tint, and certified to the Cradle to Cradle Bronze | N/A | SCAQMD's Rule 1113 | N/A | Document requirements in basis of design. | Verify compliance through product submittal information, manufacturer certification. |
| Environmental | VOC Levels: All other architectural coatings categories - CARB 2007 SCM | VOC Levels: All other architectural coatings categories - CARB 2007 SCM | N/A | VOC Levels: All other architectural coatings categories - CARB 2007 SCM | N/A | CARB 2007 SCM | N/A | Document that all paints are listed in the CARB Approved Products List. | Verify compliance through product submittal information, manufacturer certification. |
| **3.5.2.20 Exterior Architectural Coatings** | | | | | | | | | |
| Durability | | | | | | | | | |
| | (ASTM D714-02), Blistering: No Blistering present after 12 months exposure. | Meet ASTM D714-02 Blistering | N/A | (ASTM D714-02), Blistering: No Blistering present after 18 months exposure. | ISO compliant lab verify ASTM compliance | ASTM D714-02 | N/A | Document requirements in basis of design. | Verify compliance through product submittal information. |
| | Erosion: No Erosion present after 12 months exposure. | N/A | N/A | Erosion: No Erosion present after 18 months exposure. | ISO compliant lab verify ASTM compliance | ASTM D662-93 | N/A | Document requirements in basis of design. | Verify compliance through product submittal information. |
| | (ASTM D772-86) Flaking/Peeling: No Flaking or Peeling after 12 months exposure. | Meet ASTM D772-86, Flaking/Peeling | N/A | (ASTM D772-86) Flaking/Peeling: No Flaking or Peeling after 18 months exposure. | ISO compliant lab verify ASTM compliance | ASTM D772-86 | N/A | Document requirements in basis of design. | Verify compliance through product submittal information. |
| | (ASTM D3274-95), Biologic Growth: No Biologic Growth present after 9 months exposure. | Meet ASTM D3274-95, Biologic Growth | N/A | (ASTM D3274-95), Biologic Growth: No Biologic Growth present after 12 months exposure. | ISO compliant lab verify ASTM compliance | ASTM D3274-95 | N/A | Document requirements in basis of design. | Verify compliance through product submittal information. |
| Environmental | VOC Levels: CARB 2007 SCM | N/A | N/A | VOC Levels: CARB 2007 SCM | N/A | CARB 2007 SCM | N/A | Document requirements in basis of design. | Verify compliance through product submittal information, manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.21 Wall Covering - Type II** | | | | | | | | | |
| Durability | Compliance to W-101 (2011) | Compliance to W-101 (2011) | Compliance to W-101 (2011) | Compliance to W-101 (2011) | Manufacturer Provided Specifications | N/A | W 101 Physical Test Requirements | Describe durability requirements. | Verify compliance through product submittal information. |
| Maintenance | Scrubbability - 300 cycles/ min Washability - 100 cycles/ min | Scrubbability - 300 cycles/ min Washability - 100 cycles/ min | Scrubbability - 300 cycles/ min Washability - 100 cycles/ min | Scrubbability - 300 cycles/ min Washability - 100 cycles/ min | Manufacturer Provided Specifications | ASTM F 793 | W 101 Physical Test Requirements | Describe maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | NSF 342 Conformant Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content | NSF 342 Silver Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content | NSF 342 Gold Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content | NSF 342 Platinum Level + 5% Minimum Recycled Post Consumer or 10% Pre-Consumer Content | Provide 3rd Party NSF 342 Certificate; Recycled content must be calculated in terms of total product weight | N/A | W 101 Physical Test Requirements | Document the percent recycled content. | Verify compliance through product submittal information and manufacturer certification. |
| | VOC - Meets CDPH/EHLB/Standard Method v1.2 | VOC - Meets CDPH/EHLB/Standard Method v1.2 | VOC - Meets CDPH/EHLB/Standard Method v1.2 | VOC - Meets CDPH/EHLB/Standard Method v1.2 | Provide 3rd Party Lab Results | N/A | N/A | Document compliance with CDPH/EHLB/Standard Method v1.2 | Verify compliance through product submittal information and manufacturer certification. |
| | Adhesives SCAQMD Rule 1168 | Adhesives SCAQMD Rule 1168 | Adhesives SCAQMD Rule 1168 | Adhesives SCAQMD Rule 1168 | Provide 3rd Party Lab Results | N/A | N/A | Document compliance with SQAQMD Rule 1168. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.22 Wall Paneling Plastic/Laminate** | | | | | | | | | |
| Durability | Standard Laminate | High Pressure Laminate | Fiber Reinforced Laminate | Fiberglass Reinforced Plastic | | ASTM D 695/ NEMA Testing | | Describe proposed laminate system. | Verify compliance through product submittal information. |
| | Abrasion Resistance > or equal to 400 | Abrasion Resistance > or equal to 420 | Abrasion Resistance > or equal to 440 | Abrasion Resistance > or equal to 460 | N/A | NEMA Testing | N/A | Document NEMA abrasion resistance. | Verify compliance through product submittal information. |
| Maintenance | Cleanability 20 cycles | Cleanability 18 cycles | Cleanability 14 cycles | Cleanability 10 cycles | N/A | NEMA Testing | N/A | Describe cleanability and maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 2 Year Warranty | 5 Year Warranty | 10 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | N/A | N/A | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| | 40% Recycled Material | 50% Recycled Material | 60% Recycled Material | 60% Recycled Material | N/A | N/A | N/A | Document the percent recycled content. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.23 Wall Paneling/ Wood** | | | | | | | | | |
| Durability | Hardness - 380-950 | Hardness - 950-1500 | Hardness - 1500-2600 | Hardness - 2600-3800 | N/A | Janka Test | N/A | Document Janka Test hardness level. | Verify compliance through product submittal information. Conduct Janka test to verify compliance after installation. |
| Maintenance | Varnish top coat applied | Varnish top coat applied | Polyurethane top coat applied | Polyurethane top coat applied | N/A | ASTM D 4060 | N/A | Describe cleanability and maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | Local Resources, 91% Bio Based | Local Resources, 91% Bio Based | Local Resources, 91% Bio Based | Local Resources, 91% Bio Based or Recycled Materials | N/A | N/A | N/A | Describe regional material content, recycled material content and environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.24 Wall Paneling/ Composite Board** | | | | | | | | | |
| Durability | Min 6mm thickness | Min 10mm thickness | Min 20mm thickness | Min 30mm thickness | | | | | |
| Maintenance | Factory Sealant applied | Top Coat applied | Top Coat applied | Polyurethane top coat applied | N/A | ASTM D 4060 | N/A | Describe cleanability and maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | N/A | N/A | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| | 40% Recycled Material or 89% Bio Based | 50% Recycled Material or 89% Bio Based | 60% Recycled Material or 89% Bio Based | 90% Recycled Material or 89% Bio Based | N/A | N/A | N/A | Document the percent recycled content. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **3.5.2.25 Wall Paneling/ Sculptural Panel** | | | | | | | | | |
| Durability | Min 6mm thickness | Min 10mm thickness, factory sealant applied | Min 20mm thickness, factory sealant applied | Min 30mm thickness, factory sealant applied | | | | Describe proposed thickness. | Verify compliance through product submittal information. |
| Maintenance | 900 psi. | 920 psi. | 940 psi. | 960 psi | N/A | ASTM D 638 | N/A | Describe cleanability and maintenance requirements. | Verify compliance through product submittal information. |
| Environmental | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | Low VOC/Low VOC Installation | N/A | N/A | N/A | Describe environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |
| | 20% Recycled Material or 89% Bio Based | 30% Recycled Material or 89% Bio Based | 40% Recycled Material or 89% Bio Based | 50% Recycled Material or 89% Bio Based | N/A | N/A | N/A | Document the percent recycled content. | Verify compliance through product submittal information and manufacturer certification. |
| **3.5.2.26 Wall Base** | | | | | | | | | |
| Durability | Thermoplastic vinyl, Type TV | Thermoplastic rubber, Type TPR | N/A | Vulcanized thermoplastic rubber, Type TS | N/A | ASTM F 1861 | N/A | Describe ASTM F 1861 wall base type. | Verify compliance through product submittal information. |
| Maintenance | Layered construction, Group II | Layered construction or solid (homogeneous), Group I or II | N/A | Solid (homogeneous) construction, Group I | N/A | ASTM F 1861 | N/A | Describe cleanability and maintenance requirements. | Verify compliance through product submittal information. |
| Service Life | 1 Year Warranty | 1 Year Warranty | N/A | 5 Year Warranty | N/A | N/A | N/A | Document warranty period. | Verify compliance through product submittal information and manufacturer certification. |
| Environmental | Low VOC conforming to NSF 332 | Low VOC conforming to NSF 332 | N/A | Low VOC conforming to NSF 332 PVC Free | N/A | NSF/ANSI 332 | N/A | Describe recycled material content and environmental testing requirement. | Verify compliance through product submittal information and manufacturer certification. |

| Attribute | Baseline | ★ Tier 1 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.5.2.27 Acoustical Ceilings** | | | | | | | |
| **Surface Texture** | Fine textures with perforations | Smooth White acoustical | | | | Describe surface texture for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Acoustics** | | | | | | | |
| **Open Office** | | | | | | | |
| **NRC** | ≥ 0.80 | ≥ 0.90 | UL Classified Acoustical Performance | ASTM C423 | N/A | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **CAC** | ≥ 3D | ≥ 3D | UL Classified Acoustical Performance | ASTM E1414 | N/A | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Privacy Index** | ≥ 80% | ≥ 80% | Articulation Index (Signal to Noise ratio) | ASTM E1130 | | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Sound Masking** | 45-48 dBA | 45-48 dBA | Measurement of SM levels | Sound Level Measurement | | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Reverberation Time** | < 0.8 sec | < 0.8 sec | Reverberation Time Calculator | Reverberation Time Measurement | | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Enclosed Office** | | | | | | | |
| **NRC** | ≥ 0.60 | ≥ 0.70 | UL Classified Acoustical Performance | ASTM C423 | N/A | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **CAC** | ≥ 35 | ≥ 35 | UL Classified Acoustical Performance | ASTM E1414 | N/A | Describe acoustical properties for each ceiling type | Verify compliance through product submittal information and manufacturer certification |
| **Privacy Index** | ≥ 80% | ≥ 90% | | | | | |
| **Sound Masking** | 40-42 dBA | 40-42 dBA | | | | | |
| **Reverberation Time** | < 0.6 sec | < 0.6 sec | | | | | |
| **Durability** | | | | | | | |
| **Impact Resistance** | Impact Resistance | Impact Resistance | Hess Rake Test | Modified ASTM D1037 | N/A | Verify compliance through product submittal information and manufacturer certification | Verify compliance through product submittal information and manufacturer certification |
| **Scratch Resistance** | Scratch Resistance | Scratch Resistance | Hess Rake Test | Modified ASTM D1037 | N/A | Verify compliance through product submittal information and manufacturer certification | Verify compliance through product submittal information and manufacturer certification |
| **Moisture Resistance** | Moisture resistance: indoor environment less than 90% relative humidity and less than 100 degrees F | Moisture resistance: indoor environment less than 90% relative humidity and less than 100 degrees F | Ceilings panels maintain superior sag resistance. Recommended for areas subject to high humidity, up to , but not including standing water and outdoor applications | ASTM D3274 | N/A | Verify compliance through product submittal information and manufacturer certification | Verify compliance through product submittal information and manufacturer certification |

| Attribute | Baseline | ★ Tier 1 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.5.2.27 Acoustical Ceilings Cont.** | | | | | | | |
| **Maintenance** | | | | | | | |
| **Scrubbable** | Cleanable | Cleanable | Follow Mfr recommendaitons | Modified ASTM D2486 | | Verify compliance through product submittal information and manufacturer certification | Verify compliance through product submittal information and manufacturer certification |
| **Warranty** | 30 Year Systems Warranty | 30 Year Systems Warranty | Manufacturer's Warranty | N/A | N/A | Describe service life for each ceiling type | Verify compliance through product submittal information |
| **Environmental** | | | | | | | |
| **Recycled Content** | Total Recycled Content ≥ 20% | Total Recycled Content ≥ 80% | N/A | ISO 14021 | N/A | Describe total recycled content, light reflectance and emission requirements. | Verify compliance through product submittal information, Product data Sheet; |
| **Recyclable - Extended Producer Responsibility** | Recyclable in a closed Loop process back to Mfr | Recyclable in a closed Loop process back to Mfr | Manufacturer's Certification Letter | Proven Industry Program | N/A | Describe the total amount of sf of ceilings recycled | Verify compliance through product submittal information, Product data Sheet; |
| **BioPreferred** | USDA Certified BioPreferred | USDA Certified BioPreferred | Listed on USDA BioPreferred website | USDA Certified BioPreferred | N/A | BioPreferred Certified | verification of USDA Certified BioBased. |
| **Light Reflectance** | Light Reflectance ≥ 85% | Light Reflectance ≥ 85% | N/A | ASTM E1477 | N/A | | |
| **Low Emitting** | CDPH /EHLP/V 1.1 2010 | CDPH /EHLP/V 1.1 2010 | Manufacturers Test Report | CA Dept of Health Services Std Practices 2010 | N/A | Emission Certrificate | Emission Certrificate |
| **Environmental Product Declaration** | Product EPD Available | Product EPD Available | Environmental Product Data | ISO 14025 | N/A | Certified product EPD | Verify EPD for product |
| **Ingredient Disclosure** | Safety Data Sheet 10,000 ppm | Ingredient Disclosure 1000ppm | Manufacturer Ingredient Disclosure | Mfr Self Disclosure; Living Building Challenge Declare | N/A | Disclosure of material ingredients to a specific ppm | Verify compliance through mfr ingredient reporting and self-disclosure |

## 3.5 INTERIOR CONSTRUCTION AND INTERIOR FINISHES PERFORMANCE ATTRIBUTES

Interior construction is described in two categories: construction products and materials, those elements that are built to create functional spaces, and finish materials, those products that are applied to the construction products to conceal, protect, or enhance the appearance of construction products or to provide wearing surfaces.

Construction Products and Materials include doors, windows (borrowed lights), permanent partitions, demountable partitions, operable partitions, and millwork. Each product has been evaluated based on its applicable characteristics. Products have been evaluated for construction, durability, acoustic properties, security, operability/flexibility, and other characteristics that reflect the functional requirements of the product under consideration.

Interior Finishes and Materials addresses performance levels of typical floor, wall, and ceiling finishes, focusing on each product's durability, maintenance, service life, and environmental qualities. Metrics and attributes vary by finish based on performance need. Durability describes composition/content, thickness, hardness, strength, wear resistance, load limit, and water absorption. Maintenance addresses wear layer/sealer, barrier/backing, cleanability, stain resistance, microbial resistance, and mold/mildew resistance. Service life is described in terms of the length of warranty available. Environmental addresses recycled content, renewable resources, local materials, and VOC emissions.

### 3.5.1 CONSTRUCTION PRODUCTS AND MATERIALS

Fire ratings must meet regulatory requirements without regard to performance level selected. They do not necessarily enhance performance, durability, appearance, or other attributes. Therefore, products and materials are described without regard to fire rating.

The baseline performance characteristics described are commercial quality products and would be suitable for use in most applications.

Acoustical performance is described in terms of Sound Transmission Coefficient (STC) as determined by ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements. Rules of thumb for interpreting ratings are:

- STC 35: Loud speech audible but not intelligible.
- STC 40: Onset of "privacy."
- STC 45: Loud speech barely audible.
- STC 50: Loud speech not audible; shouting barely audible.
- STC 55: Very loud sounds such as musical instruments or a stereo can be faintly heard.
- STC 60: Superior soundproofing; most sounds inaudible.

For specific guidance on office acoustics, refer to GSA Sound Matters.

#### 3.5.1.1 SOLID CORE WOOD DOORS

Wood doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level. Doors may have power assist or may be

power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors shall be fabricated in accordance with WDMA I.S.-1.A, Architectural Wood Flush Doors, and DHI A115-W, Wood Door Hardware Standards, Hardware Preparation. Hardware shall comply with BHMA A156 series requirements. Hollow metal frames shall be fabricated to meet requirements of ASTM/SDI 250.4, Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings. All doors and frames should be factory prepared for hardware installation. Hollow metal frames should be factory primed. Use of local hardwoods is preferable.

#### 3.5.1.2 HOLLOW METAL DOORS

Hollow metal doors may have vision panels and other features that do not change their level of performance. Performance characteristics described are a minimum combination for each group. Any one of the characteristics might be enhanced without changing the performance level. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Doors and frames shall be fabricated to meet requirements of ASTM/SDI 250.4, Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings and ANSI/SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100). Hardware shall comply with BHMA A156 series requirements. All doors and frames should be factory primed and prepared for hardware installation.

#### 3.5.1.3 GLAZED ALUMINUM DOORS

Aluminum doors are typically fully glazed. They are constructed as aluminum entrances or part of a storefront system even though they are for interior use. Aluminum doors are usually installed in aluminum frames. Doors and frames shall be fabricated in accordance with AAMA101/I.S.2/A440, North American Fenestration Standard/Specification for Windows, Doors, and Skylights. They cannot have a fire rating and are not bullet resistant or forced entry protected. Safety glass in compliance with ASTM C1048, Standard Specification for Heat Treated Flat Glass, must be used. Sound transmission can be reduced through the use of insulating glass. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes. Finishes shall comply with AAMA 611, Specification for Anodized Architectural Aluminum, or AAMA 260, Specification for Pigmented Organic Coatings.

#### 3.5.1.4 ALL GLASS ENTRANCES

All glass entrances are installed without traditional frames. They are not available as fire rated assemblies or forced entry resistant. They may be considered in and of themselves to be higher performance than any of the above door types because of their cost and appearance. Glass must be either laminated or tempered in compliance with ASTM C1048, Standard Specification for Heat Treated Flat Glass. Doors may have power assist or may be power operated and may have various types of electronically controlled locking mechanisms such as magnetic locks or electric strikes.

#### 3.5.1.5 BORROWED LIGHTS

Borrowed lights are used to allow natural light to penetrate into interior spaces or to allow visual connection between adjacent spaces. They can make small spaces feel more open. Borrowed lights include sidelights, transoms, and openings in other wall construction. Borrowed lights in

corridors and sidelights are required to be glazed with tempered, laminated, or some other form of safety glass complying with ASTM C1048, Standard Specification for Heat Treated Flat Glass.

#### 3.5.1.6 WOOD FRAMED INTERIOR LIGHTS

Wood framed borrowed lights cannot be fire rated.

#### 3.5.1.7 HOLLOW METAL FRAMED INTERIOR LIGHTS

Hollow metal framed borrowed lights may be fire rated if dimensions comply with the requirements for required rating and glazed with appropriate material.

#### 3.5.1.8 ALUMINUM FRAMED INTERIOR LIGHTS

Aluminum framed borrowed lights are typically fabricated from storefront or curtainwall framing systems. Aluminum framed borrowed lights cannot be fire rated. Finishes shall comply with AAMA 611, Specification for Anodized Architectural Aluminum, or AAMA 260, Specification for Pigmented Organic Coatings.

#### 3.5.1.9 METAL STUD PARTITIONS

Performance level does not take into account fire rating requirements. Metal stud framing shall comply with ASTM C645, Standard Specification for Nonstructural Steel Framing Members. Stud sizes and thickness are minimums; increased dimensions and/or reduced spacing may be necessary to meet deflection requirements. Gypsum board shall comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers. Gypsum board meets Greenguard Gold certification.

#### 3.5.1.10 MASONRY PARTITIONS

Performance level does not take into account fire rating requirements. Concrete masonry units shall comply with ASTM C129, Standard Specification for Non-load bearing Concrete Masonry Units. Metal furring shall comply with ASTM C645, Standard Specification for Nonstructural Steel Framing Members. Gypsum board shall comply with C1396, Standard Specification for Gypsum Board. Gypsum board selection will vary depending on application: Type X gypsum board for fire rated assemblies, Type MR for locations subject to moisture or high humidity, Type IR where impact resistance is needed, or cementitious backer board in showers. Gypsum board meets Greenguard Gold certification.

#### 3.5.1.11 DEMOUNTABLE PARTITIONS

Demountable partitions are prefabricated assemblies designed to be installed, removed, and relocated in various configurations. Partitions extend from finish floor to ceiling. Systems include doors, hardware, and borrowed lights. Demountable partitions do not have fire ratings.

#### 3.5.1.12 OPERABLE WALLS

Operable walls described below are welded steel construction, hung from a supporting structure above, and move on a fixed track system. Accordion-type room dividers are not considered here. Operable walls do not provide fire ratings.

#### 3.5.1.13 MILLWORK AND CABINETS

Millwork includes custom wood fabrications such as paneling, built-in furniture, shelving, and other items of architectural woodwork. Cabinets include base and wall cabinets. The descriptions below do not apply to metal cabinets or

casework such as the type that might be found in laboratories. Quality descriptions for millwork and cabinets are based on the Architectural Woodwork Institute's (AWI) Architectural Woodwork Quality Standards. Quality standards for hardware such as drawer slides, hinges, pulls, latches and locks, and shelf supports are based on ANSI/BMHA 156.9, Cabinet Hardware.

- Baseline: AWI Custom Grade. Particle board core with plastic laminate veneer. Factory fabricated to standard sizes. Grade 2 hardware, plated finish.
- Tier 1 High Performance (★): AWI Custom Grade. Particle board core with wood veneer on exposed to view surfaces. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, plated finish.
- Tier 2 High Performance (★★): AWI Premium Grade. Particle board core with wood veneer on exposed-to-view surfaces. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless, brass, or bronze. Provide AWI QCP Labels/Certificates.
- Tier 3 High Performance (★★★): AWI Premium Grade. Solid wood, custom detailed molding and trim. Shop fabricated by millworker to custom sizes and configurations. Grade 1 hardware, solid stainless, brass, or bronze. Provide AWI QCP Labels/Certificates.

#### 3.5.1.14 COUNTERTOPS

Countertops, often associated with millwork and cabinets, include any fabricated work surface including those in offices, kitchens, laboratories, or toilet rooms. Countertops include backsplashes and endsplashes. Quality descriptions are based on the AWI's Architectural Woodwork Quality Standards.

### 3.5.2 INTERIOR FINISHES AND MATERIALS

Finishes must meet the allowable fire performance and smoke development requirements of the International Building Code and P100 Chapter 7, Section 7.5, and all other requirements of the International Building Code. Other codes and application specific performance attributes (e.g., severe traffic area, raised access flooring) need to be taken into account. Finishes should incorporate recycled-content materials to the maximum extent where possible.

#### 3.5.2.1 BROADLOOM/CARPET TILE

- See requirements table.

#### 3.5.2.2 VINYL COMPOSITION TILE

- See performance requirements table.

#### 3.5.2.3 SHEET VINYL

- See performance requirements table.

#### 3.5.2.4 RUBBER TILE

- See performance requirements table.

#### 3.5.2.5 LINOLEUM

- See performance requirements table.

#### 3.5.2.6 PRESSED FLOOR TILE

- See performance requirements table.

#### 3.5.2.7 PORCELAIN TILE

- See performance requirements table.

#### 3.5.2.8 QUARRY TILE

- See performance requirements table.

#### 3.5.2.9 MOSAIC TILE

- See performance requirements table.

### 3.5.2.10 LIMESTONE TILE

- See performance requirements table.

### 3.5.2.11 SLATE TILE

- See performance requirements table.

### 3.5.2.12 MARBLE

- See performance requirements table.

### 3.5.2.13 GRANITE

- See performance requirements table.

### 3.5.2.14 TERRAZZO

- See performance requirements table.

### 3.5.2.15 LAMINATE FLOORING

- See performance requirements table.

### 3.5.2.16 WOOD FLOORING

- See performance requirements table.

### 3.5.2.17 BAMBOO FLOORING

- See performance requirements table.

### 3.5.2.18 GLAZED WALL TILE

- See performance requirements table.

### 3.5.2.19 INTERIOR COATINGS (PAINT)

Low VOC information for all Tiers: Flat, Non-flat, and Non-flat High Gloss Coatings: All interior flat, non-flat, and high gloss coatings containing colorants must meet the VOC limits indicated within the SCAQMD Rule 1113 after colorant has been added. For more information, see www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf.

Low VOC information for all Tiers: All other architectural coatings categories must meet the VOC limits indicated with the CARB 2007 AIM SCM, after colorant has been added: http://arb.ca.gov/coatings/arch/Approved_2007_SCM.pdf.

- See performance requirements table.

### 3.5.2.20 EXTERIOR ARCHITECTURAL COATINGS

Low VOC information for all Exterior Architectural Coatings must meet the VOC limits indicated with the CARB 2007 AIM SCM, after colorant has been added: http://arb.ca.gov/coatings/arch/Approved_2007_SCM.pdf.

- See performance requirements table.

### 3.5.2.21 WALL COVERING TYPE II

- Type II wall covering is not allowed on any surface where it could function as a vapor barrier and trap moisture within a wall assembly.
- See performance requirements table.

### 3.5.2.22 WALL PANELING–PLASTIC/LAMINATE

- See performance requirements table.

### 3.5.2.23 WALL PANELING–WOOD

- See performance requirements table.

### 3.5.2.24 WALL PANELING–COMPOSITE BOARD

- See performance requirements table.

### 3.5.2.25 WALL PANELING–SCULPTURAL PANEL

- See performance requirements table.

### 3.5.2.26 WALL BASE

- See performance requirements table.

### 3.5.2.27 ACOUSTICAL CEILINGS

- See performance requirements table.

## 3.5.3 ACOUSTICS

The standards in this section establish adequate acoustic qualities in Federal buildings. Post-construction commissioning will confirm that the acoustical standards have been met.

### 3.5.3.1 GENERAL CRITERIA FOR BUILDING SPACES

Four key concepts govern the quality of office acoustics. See Table 3.1 for design criteria.

1. Speech Privacy: The degree to which a conversation cannot be overheard in an adjacent space.
2. Background Sound: Continuous background sound may have to be supplemented with additional electronically generated sound to provide for masking of speech while private conversation is being conducted. The A/E will differentiate between enclosed and open office environments to meet these objectives.
3. Equipment Vibration and Reverberation: Office equipment noise levels must meet the standards at the workstations. Reverberation and echoes must be controlled in courtrooms, auditoriums, and conference, team, and training room spaces that may require professional acoustical engineers to meet the standards. Sound transmission through building frames must be inhibited.
4. Exterior Noise: Facilities located near airports, highways, rail corridors, or other sources of significant environmental noise levels must have building envelope assemblies controlling noise intrusions to the required standards.

### 3.5.3.2 CLOSED OFFICES VERSUS OPEN PLAN

For work that does not require acoustic and/or visual privacy, an open plan environment with low or no partitions between workstations is permitted. For work that requires a balance between ongoing, active collaboration, easy workgroup reconfiguration, flexible settings, and minimized unwanted acoustic distraction, an open plan setting with a well-engineered acoustical design is recommended.

Key components of such engineered open plan designs are highly absorptive ceilings, suitable height partition panels that both absorb and block sound, suitable levels of background sound (typically provided by electronic sound masking systems), and ready access to acoustically private (closed-office) meeting spaces.

Closed offices must be provided for workers who routinely require extended periods of concentration, in-office meetings, and/or confidential conversation. Meeting spaces and closed offices that require speech security must be designed in conjunction with a qualified acoustical consultant.

In enclosed offices, HVAC background sound may be an important component in achieving the required level of privacy because it helps to cover up or "mask" speech transmitted between adjacent spaces. In open plan areas, the background sound provided by contemporary HVAC equipment is often not uniform and/or does not have the tonal balance and loudness needed to mask speech transmitted between adjacent cubicles. For this reason, additional electronic background noise or sound masking is often deployed in these areas.

### 3.5.3.3 MECHANICAL AND PLUMBING NOISE

All mechanical equipment must be vibration isolated from the building frame as required by Chapter 5. Ambient noise from mechanical equipment must not exceed noise criteria (NC) values described in the acoustical section of this chapter. Diffusers with an NC rating 5 points less than the noise criterion for the space being served must be used where occupied space occurs adjacent to, above, or below mechanical or electrical equipment or machine rooms, or adjacent to HVAC or elevator shafts. The intervening structure (partitions, shaft walls, doors, floor and ceiling assemblies, etc.) must be sufficient to control noise intrusion to no greater than the maximum NC or room criteria (RC) values. Where an elevator shaft or equipment room occurs adjacent to noise-sensitive spaces (NC/RC 35 or lower), the maximum intrusion level of elevator noise must be limited to 5 dB below the maximum NC/RC for the space in all octave bands. In the walls, ceilings, and floors enclosing noise-sensitive spaces (Table 3.1, column 1, RC/NC 35 or less), all water, wastewater, and drain piping must be vibration-isolated from the structure, finishes, and other piping. Install R-11 batt insulation in all wall spaces where such piping is located and install the piping at least 200 mm (1 in.) away from the gypsum wall board.

### 3.5.3.4 NOISE ISOLATION, ROOM ACOUSTICS, AND SPEECH PRIVACY

Absorptive materials are required in speech-sensitive spaces to control reverberation and echoes. Table 3.1, columns 2 and 3, lists spaces that require absorptive finishes. The first number in each column refers to the minimum level of the material's performance; the second refers to the minimum percentage of the ceiling or wall that must have finishes achieving this performance.

Floor and ceiling assemblies separating office spaces must achieve an NIC of not less than 50 (when furnished) and Field Impact Isolation Class (FIIC) of not less than 50. Table 3.1, column 4, lists the minimum noise isolation (NIC) for spaces requiring acoustically rated walls.

For constructions on suitable slab floors, when properly detailed and constructed, and with all connections caulked airtight with acoustical sealant, the following wall assemblies typically will satisfy the minimum specified NIC requirements, with the spaces furnished typically. These wall examples are not the only constructions that will satisfy the performance criteria; they are intended solely to provide guidance on projects that do not require a qualified acoustical consultant during the design phase.

- NIC 53 (teleconference room): Double stud wall, two layers of gypsum board each side, batt insulation in the stud cavities. Full height (slab to slab).
- NIC 48 (meeting rooms, training facilities): Staggered stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab).
- NIC 45 (private offices, confidential speech privacy): Single stud wall, two layers of gypsum board each side, batt insulation in the stud cavity. Full height (slab to slab) or 6 inches above a hung gypsum board ceiling.
- NIC 40 (private offices, normal speech privacy): Single stud wall, two layers of gypsum board one side, one layer of gypsum board the other side, batt insulation in stud cavity. Slab to slab (preferred); minimum 6 inches above acoustical tile ceiling (minimum CAC 44).

- NIC 35 (private offices, normal speech privacy, sound masking): Single stud wall, single layer gypsum board each side, batt insulation in stud cavity. Minimum 6 inches above acoustical tile ceiling (minimum CAC 44).
- NIC 31 (private offices, normal speech privacy, low voice level, miscellaneous other spaces): Single stud wall, single layer of gypsum board each side, batt insulation in the stud cavity. Terminates at underside of acoustical tile ceiling (minimum CAC 35).

Acoustical performance will be verified during the commissioning of the building. The commission requirements are further defined in the GSA Building Commissioning Guide.

| Table 3.1 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Space** | **Maximum Mechanical Noise (RC/NC)** | **Minimum Absorption: Ceiling (SAA/NRC)** | **Minimum Absorption: Wall (SAA/NRC)[1]** | **Minimum Noise Isolation (NIC)** | **Optimum Reverberation (RT60)** |
| ***Teleconference Facility*** | ***20*** | ***0.8/ 50%*** | ***0.8/ 25%*** | ***53*** | ***0.5*** |
| ***Meeting rooms, Training facilities*** | ***25*** | ***0.8/ 50%*** | ***0.8/ 25%*** | ***48[2]*** | ***<0.6*** |
| ***Private offices, confidential speech privacy*** | ***30*** | ***n/a*** | ***0.8/ 25%*** | ***45*** | ***<0.6*** |
| ***Private offices, normal speech privacy*** | ***35*** | ***n/a*** | ***0.8/ 25%*** | ***40*** | ***<0.6*** |
| ***Open Plan offices, normal speech privacy, sound masking*** | ***35[3]*** | ***n/a*** | ***0.8/ 25%*** | ***35*** | ***0.8*** |
| ***Private offices, normal speech, low voice level*** | ***35*** | ***n/a*** | ***0.8/ 25%*** | ***31*** | ***<0.6*** |
| ***Open Plan offices, normal speech privacy, no sound masking*** | ***40[4]*** | ***0.9/ 100%*** | ***0.8/ 25%*** | ***n/a*** | ***< 0.8*** |
| ***Open Plan offices, No speech privacy*** | ***40*** | ***0.8/ 100%*** | ***n/a*** | ***n/a*** | ***n/a*** |
| ***Child care center*** | ***35*** | ***0.8/ 80%*** | ***0.8/ 25%*** | ***31*** | ***0.5*** |

***[1] Absorption should be placed on two adjacent walls.***
***[2] Operable walls and partitions must achieve the required NIC rating for the spaces that they are separating.***
***[3] Steady state background noise provided by electronic sound masking system: 40-42dBA.***
***[4] Steady state background noise provided by electronic sound masking system: 45-48dBA.***

### 3.5.3.5 PARAMETERS USED IN ACOUSTICAL DESIGN

The following parameters are used to specify acoustical standards for GSA buildings:

- Background noise—The loudness of noise is quantified by NC, balanced NC-B, and RC contours.
- Environmental noise—The continuous noise outside a building. The day-night average noise level (DNL) is a descriptor established by the U.S. Environmental Protection Agency to describe the average day-night sound level. Lower values are quieter.
- Noise isolation—The amount of noise transmitted through the perimeter boundary elements of a space. Sound transmission class (STC) quantifies the sound insulating performance of building elements such as walls, windows, and doors when tested in a laboratory in accordance with ASTM E90. NIC quantifies the field-tested sound isolation between two enclosed spaces separated by a partition when tested in accordance with ASTM E336. FIIC quantifies the field-tested impact sound insulating properties of a floor/ceiling assembly when tested in accordance with ASTM E1007.
- Reverberation time—The time required for sound to decay 60 decibels in the 500 Hz band in an enclosed space. Reverberation time becomes longer as the sound absorption is reduced and/or the room volume increases.
- Sound absorption—The amount of sound absorbed by a surface finish. Sound absorption average (SAA) quantifies the efficiency of a material in absorbing sound energy when tested in accordance with ASTM C423.

## 3.5.4 FIRE PERFORMANCE AND SMOKE DEVELOPMENT

Interior wall and ceiling finish materials shall comply with the applicable requirements in the IBC for fire performance and smoke development (i.e., flame spread index and smoke developed index). The allowable fire performance and smoke development of interior wall and ceiling finish materials are based on occupancy classification. Typically, interior wall or ceiling finishes are classified as either Class A (i.e., flame spread index 0-25; smoke developed index 0-450), Class B (i.e., flame spread index 26-75; smoke developed index 0-450), or Class C (i.e., flame spread index 76-200; smoke developed index 0-450) based on test results from ASTM E84 or ANSI/UL 723. Wherever the use of Class C interior wall and ceiling finish is required, Class A or Class B shall be permitted. Wherever the use of Class B interior wall and ceiling finish is required, Class A shall be permitted.

Interior floor finish and floor covering materials must meet the applicable fire performance floor finish and floor covering material requirements in the IBC. Typically, interior floor finishes are classified as either Class I having a critical radiant flux of not less than 0.45 $W/cm^2$ or Class II having a critical radiant flux of no less than 0.22 $W/cm^2$ but less than 0.45 $W/cm^2$ based on test results from NFPA 253 or ASTM E 648. Wherever the use of Class II interior floor finish is required, Class I interior floor finish shall be permitted.

Carpet and carpet-like interior floor finishes shall comply with ASTM D 2859 or DOC FF-1 “pill test” (CPSC 16 CFR Part 1630).

Decorative materials and trim shall comply with the applicable requirements in the IBC. Decorative materials are considered materials

applied over the building interior finish for decorative, acoustical or other effect (such as curtains, draperies, fabrics, streamers, and surface coverings), and all other materials utilized for decorative effect (such as batting, cloth, cotton, hay, stalks, straw, vines, leaves, trees, moss, and similar items), including foam plastics and materials containing foam plastics. Decorative materials do not include floor coverings, ordinary window shades, interior finish, and materials 0.025 inch (0.64 mm) or less in thickness applied directly to and adhering tightly to a substrate. Typically, decorative materials suspended from walls or ceilings shall meet the flame propagation performance criteria of NFPA 701 or be noncombustible.

Combustible materials installed on or embedded in floors of buildings of Type I or Type II construction shall comply with the applicable interior finish requirements in the IBC.

## 3.6 GENERAL ARCHITECTURE

### 3.6.1 CORNERSTONE

A cornerstone is required for all new buildings as a part of the exterior wall. The cornerstone must be a cut stone block having a smooth face of size adequate to present the following incised letters:

UNITED STATES OF AMERICA
(PRESIDENT'S NAME), PRESIDENT
GENERAL SERVICES ADMINISTRATION
(ADMINISTRATOR'S NAME), ADMINISTRATOR
(YEAR OF CONSTRUCTION START) – (YEAR OF PROJECT COMPLETION)

The words UNITED STATES OF AMERICA should be in letters 50 mm (2 in.) high and other letters should be proportionally sized by rank.

The names must be of the President in office at the time the construction contract was awarded, as well as the name of the confirmed GSA Administrator in office at the time the construction contract was awarded. In the event that a confirmed GSA Administrator was not in office at the time the construction contract was awarded, the name of the confirmed GSA Administrator in office at the time closest to the date that the construction contract was awarded through to project completion shall be included on the cornerstone. In the event that a confirmed GSA Administrator was not in office at any time from the date the construction contract was awarded through to project completion, the cornerstone shall not include the name of any GSA official, but instead will include "General Services Administration". The cornerstone shall also include the year construction began and the year of project completion. A confirmed GSA Administrator shall include an Acting Administrator who subsequently, without any break in service, becomes confirmed.

### 3.6.2 REGISTRY OF DESIGNERS AND BUILDERS

A plaque or electronic interface that names the individuals of the project team may be placed inside the building. Listed individuals are members of the GSA project design team, consultant architects and engineers, on-site construction managers, and construction workers who have completed at least 200 hours of service to the project. The list encompasses office staff and on-site workers.

The GSA project manager will provide the specifications for the design and construction of the plaque or electronic media. All signage in public areas of Federal buildings must comply with Appendix H in the International Building Code and meet ABAAS requirements

### 3.6.3 PROMOTE THE USE OF STAIRS

GSA encourages employees, tenants, and visitors to step up to a healthier lifestyle and consider taking the stairs. Regular physical activity, such

as stair climbing, can help reduce the risk for several diseases and health conditions such as heart disease, high blood pressure, and obesity.

Design stairs and circulation spaces to make stairs readily accessible, easy to find, and desirable to use.

## 3.6.4 VERTICAL TRANSPORTATION

All new and altered elevators and escalators must comply with ASME A17.1. All new and altered lifts must comply with ASME A18.1, Safety Standard for Platform Lifts and Stairway Chair Lifts. See Chapter 7, Fire Protection, for additional information regarding requirements for elevators, fire service access elevators, and occupant evacuation elevators.

The selection of type and quantity of conveying systems, such as elevators, escalators, and wheelchair lifts, must be made in conjunction with a thorough vertical transportation traffic analysis of the facility.

### 3.6.4.1 VERTICAL TRANSPORTATION/ELEVATOR TRAFFIC ANALYSIS

The elevator traffic analysis must be performed by an independent consultant to determine the type, quantity, capacity, and speed requirements of elevators. Separate calculations must be performed for each elevator classification.

The criteria by which the traffic analysis calculations should be judged are "average interval" and "handling capacity."

Average interval is defined as the calculated time between departures of elevators from the main lobby during the morning up-peak period. Calculated intervals during the up-peak period should not exceed 30 seconds for a typical elevator bank.

Handling capacity is defined as the number of persons the elevator system must move in any given 5-minute period of up-peak traffic used to measure average interval. GSA buildings must always be designed for a 12 percent handling capacity, even if the building is designed as a multitenant facility.

Elevator cab sizes must be in accordance with the standards established by the National Elevator Industries, Inc. (NEII), which are available at www.neii.org/neii-1/neii-1.cfm. Elevator cabs must be designed to reflect the architectural character of the building design.

### 3.6.4.2 ELEVATORS

If no separate freight or service elevator is provided, one passenger elevator must be designated as a service elevator with pads to protect the interior wall surfaces of the cab. The passenger elevator designated as a service elevator must not be considered as one of the elevators required by the traffic analysis.

A minimum ceiling height of 2,700 mm (9 ft.) is required in service elevator cabs. Freight elevators must have a ceiling height of not less than 3,700 mm (12 ft.).

In large or high-rise GSA buildings, the number of freight elevators provided should be determined by the elevator traffic analysis. The use of more than one freight elevator will provide better freight service for the tenants as well as provide redundancy for normal maintenance and during times when repair work is conducted.

Where equipment penthouses are provided, service elevators or freight elevators must provide access to that level. An elevator must service all maintenance floors.

Trap doors and hoist beams must be provided at the elevator machine rooms for traction elevators where the machine room is not served

by a freight or service elevator for removal of equipment for service and repair.

### 3.6.4.3 ELEVATOR CLASSIFICATIONS

Passenger: Passenger elevators must be sized to qualify for the disabled. Capacities of 1,590 kg to 1,810 kg (3,500 to 4,000 pounds) must be used for passenger elevators.

Service: A passenger elevator designed to meet the ASME A17.1 Code requirements for "Carrying Freight on Passenger Elevators" is required. The minimum rated load must be based on the inside net platform area for passenger elevators. See Figure 8.2.1.2 ASME A17.1 ñ 2007. The car doors must be horizontal sliding type. The car platform must be designed to the applicable freight class loading.

Freight/Service: A passenger elevator designed to meet the ASME A17.1 Code requirements for "Carrying Freight on Passenger Elevators" qualifies for freight purposes.

Security: Security or specific purpose elevators are designed to transport designated groups of people such as judges, cabinet members, or prisoners. These will be custom designed to meet specific program requirements.

Shuttle: Typically a passenger elevator that services a limited number of landings, e.g., parking garage to main lobby.

### 3.6.4.4 MACHINE-ROOMLESS (MRL)

A machine-roomless elevator is an elevator with the drive machine, governor, and other related components located in the elevator hoistway. These elevators require specific Government approval. The elevator must have a metal belt and the control system must be located outside of public areas to facilitate safe maintenance procedures. The MRL must meet the following minimum requirements:

- Controls must be installed in a fire rated control room
- The remote control room must be no more than 10 feet from the hoistway
- No other equipment is allowed in control room (only equipment directly related to the elevator)
- Main line disconnect switches must be installed within 18 inches of the strike jamb of control room door
- The car position, movement, and direction must be able to be determined from the control room
- Provide HVAC in the control room so that the temperature does not go below 50 degrees or above 90 degrees
- Access to the governor must be provided from outside the hoistway
- The suspension means must be manufactured for elevator use only and be constructed from steel only

### 3.6.4.5 ESCALATORS

Due to their high operation and maintenance costs, use escalators only where necessary. Their use must be justified by the vertical transportation analysis. Escalators may be installed as supplements to elevators when vertical transportation is required for a large unpredictable volume of public traffic. They should be used where the first floor is not large enough to contain the high public traffic so that the interval for elevators can be calculated with accuracy. Escalators should be located to be visible from the building entry and convenient to the areas they serve.

### 3.6.4.6 WHEELCHAIR LIFTS

Wheelchair lifts must comply with the current edition of ASME 18.1 Safety Standard for Platform Lifts and Stairway Chairlifts. Proper design of accessible routes in new construction

should not require the use of wheelchair lifts. In repair and alteration projects, ramps are preferred to wheelchair lifts.

### 3.6.5 FAMILY RESTROOMS

All Federal buildings shall provide one or more family restrooms. The symbol or sign on the door must indicate family, wheelchair accessible as well as availability for single user.

Locate one family restroom on each floor of a Federal building, preferably collocated with centrally located building restrooms and in a manner sensitive to historic features.

The physical characteristics of the family restroom must:

- Provide minimum size for accessibility following all ABAAS standards.
- Provide one accessible sink, one accessible toilet with appropriate accessibility hardware as required, one accessible urinal, and one baby changing station. Also install baby changing stations within building restrooms, if desired. In the event that a Family Restroom is not available on every floor, then provide the location of Family Restrooms in signage installed at building restrooms.
- Provide a lockable door with dead-bolt type occupancy designation.
- Provide finishes appropriate for ease of maintenance.

### 3.6.6 LACTATION ROOMS

Consistent with Section 4207 of the Patient Protection and Affordable Care Act, Federal agencies are required to provide a reasonable break time for female employees to express breast milk as needed for their nursing child for 1 year after the child's birth. Federal agencies must provide a place for lactation, other than a bathroom, that is shielded from view and free from intrusion from coworkers and the public.

As such, all Federal buildings must provide facilities to meet these requirements. Lactation rooms shall be provided according to Table 3.2 below, and should be located in close proximity to public family restrooms and/or a health unit.

Room size:

- For a single station lactation room, minimum footprint of 5 feet by 7 feet is recommended, as it allows for a 5-foot radius circle with 20-inch deep X 30 inch wide counter.
- For a multi-station lactation room, at least one station must meet accessibility requirements. Non-accessible stations must be a minimum of 4 feet X 4 feet.
- In multi-station lactation rooms, provide visual partitioning for each station.
- Determine the number of lactation stations according to Table 3.2 below. If the number of female employees is unknown, assume half of the number of employees to be female.

Minimum requirements:

- A lockable door. In single station lactation rooms, the lock should have an occupancy indicator.
- A comfortable chair and a work surface sufficient for lactation equipment.
- A small utility-type sink with adjacent counter. In a multi-station lactation room, provide a minimum of one sink per three stations.
- Storage for cleaning supplies and paper towels.
- Provision for towel dispenser and trash receptacle.
- A mirror.
- A bulletin board.

- Well-placed GFCI electrical outlets for each lactation station and near the sink if a multi-station room.
- Hard or resilient flooring suitable for regular mopping and sanitizing.
- Signage to identify that it is a Mothers' Room, with international signage to indicate women only.
- Accessibility guidelines must be met for all common features of the room.

Location

- Lactation rooms should be located in a safe area accessible to all and in close proximity to, or adjacent to, a family restroom or health unit. Consideration should be given to acoustics with respect to adjacent occupancies.

HVAC and Lighting

- Provide HVAC and lighting in accordance with Chapter 5 (Mechanical Engineering) and Chapter 6 (Electrical Engineering), respectively.

Milk Storage

- Install a lockable refrigerator for milk storage, sized sufficiently for the number of users.

Number of lactation stations based on female employee population:

| Table 3.2 Lactation Stations | |
|---|---|
| Number of Female Employees | Number of Stations Needed |
| Under 100 | 1 |
| Approximately 250 | 2 |
| Approximately 500 | 3 |
| Approximately 750 | 4 |
| Approximately 1000 | 6 |
| For every additional 1000 female employees | 6 additional stations |

## 3.6.7 BIRD-SAFE BUILDING DESIGN

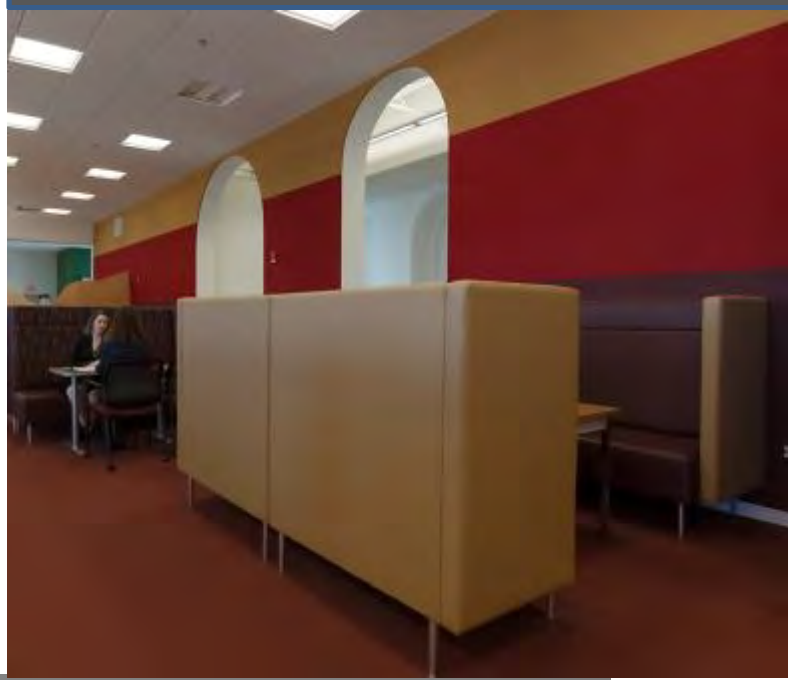
Design according to the guidelines for Bird-Safe Building Design relative to building exterior glazing and walls, interior lighting, and exterior lighting. Follow the available guidance documents from San Francisco, New York City, and Chicago, using the following resources:

San Francisco Standards for Bird-Safe Buildings
www.sf-planning.org/index.aspx?page=2506

Bird-Safe Building Guidelines, NYC Audubon
www.nycaudubon.org/our-publications/bird-friendly-building-design

Chicago Bird-Safe Building Design Guide for New Construction and Renovation
www.ilbirds.com/Environment/BirdMigration/pdf/BirdSafeBuildingDesignGuide.pdf

Figure 6: Sidney R. Yates Federal Building Workplace, Washington, DC



## 3.7 WORKPLACE PERFORMANCE REQUIREMENTS

This matrix demonstrates various design strategies for achieving successful workplaces that meet today's Federal agencies space requirements based on their mission. The baseline represents a minimum expectation and each additional tier builds on what the agency may need to maximize productivity and efficiency.

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.1. Planning and Design** | | | | | | | |
| Goal setting | Establish workplace strategies & design goals that are based on the customer's mission, business and financial objectives. | Provide Baseline, plus Customer leadership and employees are involved throughout the planning and design process. | Provide Tier 1, plus Appropriate training is offered to facilitate the shift to the new workplace and workstyles. | Provide Tier 2, plus Throughout the workplace planning & design process, changes are discussed, addressed, and adopted by the leadership and employees at all levels | Total Workplace Solutions Library, Utlilization Rate Bulletin, Total Workplace Scorecard [XLSX - 270.47 KB Updated 9/26/13], Needs Assessment Interview Tool | Customer Interview Design Team Interview | Employee survey |
| Planning & Design process | Hire a team of licenced professionals experienced in all aspects of this Workplace section. | Provide Baseline, plus Throughout the process, workplace requirements are based on customers mission, project goals, business and financial objectives. | Provide Tier 1, plus As early as possible, identify pilot projects, design & install mock-ups, and/or hold design charrettes to inform and validate planning & design decisions. | Provide Tier 2, plus Workplace protocols are developed and discussed throughout the organization, then distributed before occupancy. | Total Workplace Solutions Library, Utlilization Rate Bulletin, Total Workplace Scorecard [XLSX - 270.47 KB Updated 9/26/13], Needs Assessment Interview Tool | Customer Interview Design Team Interview | Employee survey |
| Requirements Development | Perform space requirement studies of client's work style and patterns, space utilization, and mobility readiness in order to design all space types: workplace, support, and special. Engage design consultants as necessary. | Provide Baseline, plus Determine appropriate ratio of collaborative to individual space, based on space requirement studies. | Provide Tier 1, plus Research and plan for financing for new furniture and technology, such as the Total Workplace Initiative, commonly known as FIT (Furniture & Information Technology). | Provide Tier 2, plus Space includes an adequate number of shared focus rooms for 1-2 persons and allow for private or business-related conversations, as determined by documented work tasks and patterns. | Total Workplace Standards Benchmark, Workplace Solutions Library, Utlilization Rate Bulletin,Total Workplace Scorecard, Workplace Investment & Feasibility Modeling (WIFM) tool | Design Team Interview | Site visit or photos |
| Balance of all design factors | Uses the PBS Workplace Scorecard score or another tool to measure & validate existing workplace conditions and the opportunity for improvement. | Provide Baseline, plus Uses PBS Workplace Scorecard to measure new workplace & scores 50 points or higher. | Provide Tier 1, plus Uses PBS Workplace Scorecard score for new workplace and scores 70 points or higher | Provide Tier 2, plus Uses PBS Workplace Scorecard score for new workplace and scores 90 points or higher. | PBS Workplace Scorecard, Sound Matters, LEED Interiors | Site visit or photos Customer interview Design Team Interview | Employee survey Site visit or photos |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.2 Space Efficiency** | | | | | | | |
| Right-sizing | Workplace space guidelines are established based upon documented work tasks and patterns, required business processes, and other mission drivers, including an appropriate mix of space types | Efficient planning of all spaces encourage multiple use. Large training and meeting spaces are easily sub-divided into a variety of sizes to serve different functions | All workplace components, including support furniture in shared spaces, is mobile and easily configurable by users to facilitate multiple functions | Space layout and furniture heights encourage informal discussions while offering limited privacy between individual workstations. Space also includes shared focus rooms for 1-2 persons and allows for private conversations | PBS Workplace Scorecard, GSA Workplace Solutions Library, Circulation: Defining and Planning, Sound Matters | | |
| Workstation and Office Sharing | Determine ratio of desk sharing (i.e, persons sharing one work station), when and where appropriate. "One person" is defined as one fulltime worker normally assigned to a workplace. Ratio: 1 person/1 work station | 1.5 persons/work station | 2 persons/work station | 3 persons/work station | Workplace Investment and Feasibility Modeling (WIFM) tool, Telework Dashboard, "All About Hoteling" slip sheet, Needs Assessment Interview Tool | | |
| **3.8.3 Technology** | | | | | | | |
| Network Access | Standard baseline computer configuration should be provided for all users | Virtual meeting technology and software for teleconferencing and/or video conferencing is provided on laptops | Virtual meeting needs are provided for all, including the capability for video teleconferencing in meeting rooms and/or individual work stations. Secured wireless access network is provided. | Secure wireless computer network is provided throughout the entire internal workplace. Multiple network access and support is available for remote workers from any location. | PBS Workplace Scorecard, "All About Wireless LAN" slip sheet [PDF 542 KB], "All About VoIP" slip sheet [PDF 287 KB] | | |
| Phone | Unified, enterprise-wide voice and data systems fully support the organization's work and allow data-sharing access across the organization. | Telephone service provides one-phone number access for each person, regardless of location. | Voice Over Internet Phone and/or mobile cell phone is the primary telephone service. | N/A | PBS Workplace Scorecard, "All About Wireless LAN" slip sheet [PDF 542 KB], "All About VoIP" slip sheet [PDF 287 KB] | | |

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.4 Health and comfort: Environmental Controls** | | | | | | | |
| Ventilation and thermal comfort | Workplace provides fresh, clean indoor air, as judged by client feedback rather than engineering data | Provide Baseline, plus Employees have the ability to control and adjust air ventilation and temperature in enclosed conference rooms | Provide Tier 1, plus Employees have the ability to control and adjust air ventilation and temperature in work area zones and enclosed conference rooms or other shared spaces. | Provide Tier 2, plus Employees have the choice of working in different spaces that have a range of environmental conditions (eg., warmer and cooler areas, brighter and darker areas, noiser and quieter areas.) | PBS Workplace Scorecard<br>P100 5.2.1 Temperature<br>P100 5.2.2 Humidity Control<br>P100 5.2.3 Air Movement<br>P100 5.2.4 Pressure<br>P100 5.2.5 Ventilation<br>P100 5.2.6 Filtration<br>P100 5.3.4 Air DIstribution<br>P100 Sustainability: Required Gold Requirements: P100 1.7.1 | Customer interview | Employee survey |
| Lighting/Daylighting | A variety of appropriate lighting levels based on space function are provided. When appropriate to the job function, employees have access to natural daylight from their primary workspace. | Provide Baseline, plus General lighting fixtures provide both downlight (direct) and uplight (indirect) lighting for primary workspaces | Provide Tier 1, plus All employees are able to control and adjust individual task lighting at their primary workspace | Provide Tier 2, plus Adjustable window treatments, including blinds and shades, allow users to control the amount of daylight and potential glare in individual and shared spaces or are automated with light sensors. | PBS Workplace Scorecard<br>P100 6.2.1 Lighting Quality<br>P100 6.2.2 Lighting Quantity<br>P100 6.3.1 Indoor Lighting and Daylighting Criteria<br>P100 3.3.9 Sun Control Devices | Site visit or photos<br>Customer interview<br>Design Team Interview | Employee survey<br>Site visit or photos |
| Acoustic comfort | Workplace is zoned so that quiet (concentrative) areas are separated from interactive (collaborative) zones and/or noise generated distractions using a variety of solutions. The use of sound-absorbing materials/finishes in the ceilings, walls, floors, and furniture components provides speech privacy | Provide Baseline, plus Individual workplace conversations are masked to enhance speech privacy by "white noise" and/or low level sound from mechanical systems | Provide Tier 1, plus Intelligible speech does not travel from one enclosed space to another or to adjacent open work areas | Provide Tier 2, plus For special use spaces, such as auditoriums, the geometry of the space, the surface treatments, and the audio system have been indiviidually designed to create rooms in which speech is audible and intelligible throughout. | Sound Matters,<br>P100 3.2.8 Acoustic Control<br>P100 3.6.3 General Criteria for Building Spaces (acoustics)<br>P100 5.2.7 HVAC Noise Control | Site visit or photos<br>Customer interview<br>Design Team Interview | Employee survey<br>Site visit or photos |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.5 Health and comfort: Ergonomics** | | | | | | | |
| Adjustability | Task chairs include: vertical and horizontal adjustments for seat, back tension, reclining and tilt adjustments; and separate arm and seat heights | All workplace furniture includes sufficient work surface area for task light, desktop equipment, and paperwork. 30 percent of total work surfaces are height adjustable. | 20 percent of work stations include adjustable height keyboard and mouse trays. All furniture is a minimum of BIFMA Level 1 certified | 30 percent of work stations include adjustable height keyboard and mouse trays. All workplace furniture includes computer monitor armature with adjustable height, pivot, and tilt options. All furniture is BIFMA Level 2 certified. | P100 Workplace Tools and Processes; P100 Workplace requirements Development; P100 Tenant Spaces ; P100 General Criteria For Building Spaces (acoustics); PBS Workplace Scorecard; OSHA Computer Workstation eTool; http://levelcertified.org | | |
| Building Amenities | The workplace or building provides a locker/changing room. | The workplace provides one of the following amenities: 1.filtered, hot and cold water dispensers; 2. coffee bar or cafe,, and/or kitchen area; 3. fitness center ; 4. childcare center | The workplace provides two of the following amenities 1.filtered, hot and cold water dispensers; 2. coffee bar or cafe,, and/or kitchen area; 3. fitness center ; 4. childcare center | The workplace provides three of the following amenities: 1.filtered, hot and cold water dispensers; 2. coffee bar or cafe,, and/or kitchen area; 3. fitness center ; 4. childcare center | P100 Site Supports Neighborhood Connectivity, Walkability, and Bikeability, as well as PBS Workplace Scorecard | | |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.6 Flexibility/Efficiency** | | | | | | | |
| Space utilization | 200 usf/work station. Workplace utilizes temporary, unreserved desks to maximize occupancy and space utilization | 180 usf/work station. The usable square feet per person is less than 200 sq ft | 170 usf/work station. The majority of standard enclosed offices are 120 sq. ft or less | 150 usf/ work station. Standard workstations are 48 square feet or less | P100 1.10.1 Space measurement and Building Efficiency and, Circulation: Defining and Planning Guide of Usable Square Feet, Workplace Investment and Feasibility Modeling (WIFM) tool | | |
| Partitions and interior walls | Maximize natural light by locating highest partitions perpendicular to window walls. Locate enclosed spaces away from the perimeter and select colors to enhance daylight effectiveness | Where appropriate for job functions and/or work patterns, workstations and bench seating have no partitions or low partitions (54 inches or lower) | Where appropriate for job functions and/or work patterns, workstations and bench seating have no partitions or low partitions (42 inches or lower) | Enclosed offices do not block access to natural light and views from other primary workspaces. When visual privacy is not required, enclosed offices and conference rooms that are located inboard have glass wall(s) to provide views of the interior workplace | PBS Workplace Scorecard | | |
| Alternative working environments/methods of working | The workplace provides an appropriate range of work settings and options necessary for employees to perform a variety of tasks and functions | Team neighborhoods are configured to support a variety of work patterns | Individual workstations are configured to support a variety of work patterns. Designs avoid panel-supported storage and work surfaces to all for quick reconfigurations by users | Percentage of Individual workstations, determined by desk-sharing ratios, offer adjustable task seating and work surface heights to adopt to a wide range of body sizes | PBS Workplace Scorecard and the GSA Workplace Solutions Library | | |
| Promote equitable resources, amenities, and alternative ways of working | All employees have the appropriate tools, and equipment to work anytime/anywhere | Space allocation is based upon job functions being performed, rather than on status, grade, or hierarchy | Common areas used by all have priority in the layout | Organization encourages telework when appropriate to an employee's job responsibilities | Telework Dashboard, PBS Workplace Scorecard, "All About Furniture" slip sheet, Workplace Investment and Feasibility Modeling (WIFM) tool | | |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Basis fo Design | Design | Construction |
|---|---|---|---|---|---|---|---|
| **3.8.7 Image** | | | | | | | |
| Work place images creates identity and enhances sense of place | Main entrance or customer's interior entrance welcomes all users and conveys the organization's mission and desired image. Lobby offers visitor seating and displays information about the agency's mission | Provide Baseline, plus Develop & maintain building design finish & furniture standards prior to occupancy of the workspace or building. | Provide Tier 1, plus Coordinated and finish colors are used throughout the workplace to provide visual interest,wayfinding, and aesthetic appeal | Provide Tier 2, plus Similar furniture styles/systems and interior finishes are coordinated in a consistent manner throughout the entire workplace | All About Furniture" slip sheet [PDF 270 KB], PBS Workplace Scorecard, | Site visit or photos Design Team Interview | Site visit or photos |
| Wayfinding | Wayfinding begins at the building entrance and is consistent and throughout the building. | Provide Baseline, plus ABAAS Accessibility Guidelines for signage, including location, size, color, and tactile qualities of signage and use of graphic symbols to assist persons with disabilities are met. | Provide Tier 1, plus Primary building layout/circulation design (main route connecting core to common spaces) and secondary (aisles between individual & support spaces) incorporates wayfinding. | Provide Tier 2, plus Natural and artificial lighting should enhance wayfinding. | SA P100 and ABAAS http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards, Circulation: Defining and Planning, Exterior connections and gathering spaces P100 2.3.3.8 Site Signage P100 2.3.3.12 Site Wayfinding | Site visit or photos Customer interview Design Team Interview | Employee survey Site visit or photos |

## 3.8 WORKPLACE PERFORMANCE ATTRIBUTES

Successful workplace design does not cause an organization to change; strong and focused leadership does. However, if leadership promotes change, the workplace design must embrace and ultimately facilitate the organization's cultural transformation.

Design of Federal Government workplaces today demands flexibility, effectiveness, and efficiency without compromise to aesthetics, functionality, and safety (See Chapter 1, Section 1.9, and Chapter 7, Section 7.4). These high-performing environments must offer a variety of space types that encourage dynamic, often impromptu but productive interactions. Productivity is no longer viewed as long, solitary hours of research, analysis, and documentation with an occasional break. In today's successful workplaces, workers are expected to collaborate, learn from each other, and even socialize.

A high-performance workplace is designed to

- Encourage internal and external mobility
- Increase work productivity
- Provide for a multi-generational workforce
- Foster diversity
- Advance the use of new technology
- Achieve sustainability
- Create work-life balance
- Promote team-based work modes
- Maximize space efficiency
- Assign space on the work performed, not the position

Intelligent planning and design strives to achieve the right balance between open and closed spaces, which requires careful consideration of the organization's culture, mission, goals, and work styles.

### 3.8.1 PLANNING AND DESIGN STRATEGIES

#### 3.8.1.1 GOAL SETTING

Goal setting for a high-performance workplace includes goals for measuring performance and involves all levels of stakeholders early in the process.

#### 3.8.1.2 PLANNING AND DESIGN PROCESS

The planning and design process for a high-performance workplace includes all stakeholders early within the process and includes plans for monitoring and maintaining workplace performance throughout the life of the facility.

#### 3.8.1.3 REQUIREMENTS DEVELOPMENT

Design standards and decisions should be based on expert analysis of the organization’s work styles and patterns, space utilization, and mobility readiness. Design consultants should be engaged as necessary.

#### 3.8.1.4 BALANCE OF ALL DESIGN FACTORS

Design for productivity considers the whole building synergistically.

### 3.8.2 SPACE EFFICIENCY

#### 3.8.2.1 RIGHT-SIZING

- See performance requirements table.

#### 3.8.2.2 ENCOURAGE WORKSTATION AND OFFICE SHARING

Desk sharing is the practice of leveraging individual workspaces by reducing the total number of seats per assigned headcount (the total number of employees including full-time, part-time, interns, and contractors, who work at

a designated office location). Desk-sharing strategies include free-address, hoteling, and shared-owned settings.)

## 3.8.3 TECHNOLOGY

### 3.8.3.1 NETWORK ACCESS

Connectivity enables mobility within the office as well as remote access. A wireless Local Area Network, for example, can improve utilization of common space and meeting rooms and lead to enhanced collaboration among coworkers.

### 3.8.3.2 PHONE

- See performance requirements table.

## 3.8.4 HEALTH AND COMFORT: ENVIRONMENTAL CONTROLS

### 3.8.4.1 VENTILATION AND THERMAL COMFORT

While the Temperature, Humidity, and Air Control sections of Chapter 5 address the designed and measurable values of ventilation and thermal comfort in the workplace, it is important also to measure employee satisfaction with workplace environmental comfort.

### 3.8.4.2 LIGHTING/DAYLIGHTING

While the Lighting Quality and Lighting Quantity sections of Chapter 6 address the designed and measurable values of lighting, it is important also to measure employee satisfaction with lighting and daylighting in the workplace.

### 3.8.4.3 ACOUSTIC COMFORT

While the Acoustic Control section of Chapter 3 addresses the designed and measurable values of sound in the workplace, it is important also to measure employee satisfaction with workplace acoustics.

## 3.8.5 HEALTH AND COMFORT: ERGONOMICS

### 3.8.5.1 ADJUSTABILITY

The high-performance workplace supports individual adjustments of space to meet work and organizational changes using ergonomic and accessible furniture, appliances, and hardware.

### 3.8.5.2 BUILDING AMENITIES

- See performance requirements table.

## 3.8.6 FLEXIBILITY/EFFICIENCY

### 3.8.6.1 SPACE UTILIZATION

The workplace utilizes temporary, unreserved desks to maximize occupancy and space utilization. Utilization can be measured as usable square feet/person (usf), which is defined as the area of a floor occupiable by a tenant area, which is where a tenant normally houses personnel and/or furniture.

### 3.8.6.2 PARTITIONS AND INTERIOR WALLS

- See performance requirements table.

### 3.8.6.3 ALTERNATIVE WORKING ENVIRONMENTS/METHODS OF WORKING

The workplace actively promotes alternative working environments/methods of working. It addresses an employee's mobility, defined as the ability to work freely inside and outside of the office. Mobility also encompasses all remote work that is functionally required for a job. Telework is a subset of mobility in which the employee works at home or at a satellite office near the employee's home.

### 3.8.6.4 PROMOTE EQUITABLE RESOURCES, AMENITIES, AND ALTERNATIVE WAYS OF WORKING

- See performance requirements table.

## 3.8.7 IMAGE

### 3.8.7.1 WORKPLACE IMAGE

The workplace image creates identity and enhances sense of place. Public spaces and private areas alike should present a professional image that conveys the organization's mission and business.

### 3.8.7.2 WAYFINDING

Wayfinding design is the organization of spatial and environmental information—including circulation paths, signage, and visual cues—to help users find their way.

Figure 7: Edith Green Wendell Wyatt Federal Building, Portland, OR

# 4

# STRUCTURAL ENGINEERING

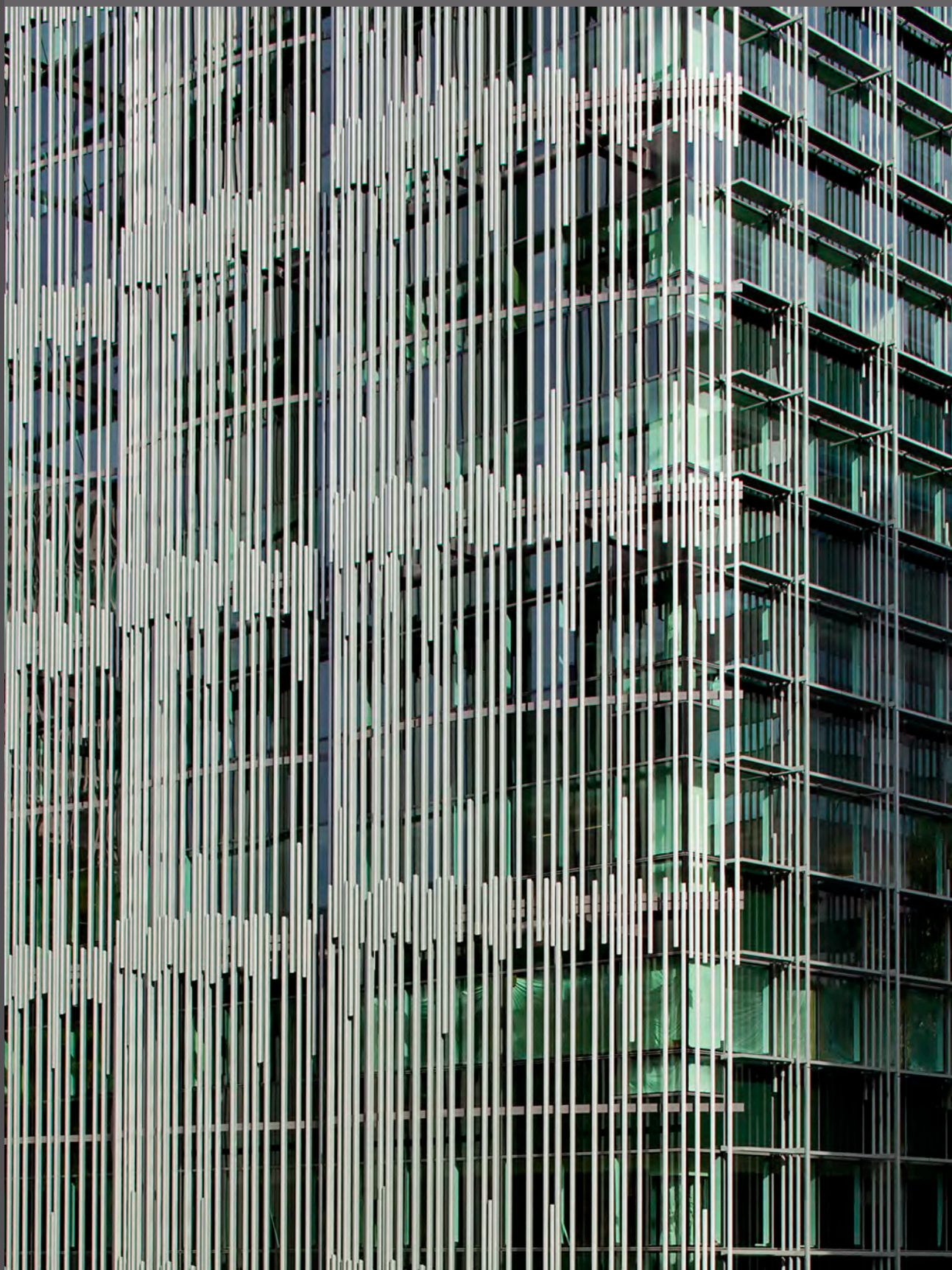


Figure 8:
Edith Green-Wendell Wyatt
Federal Building
Façade Detail
Portland, OR

## 4.1 Structural Performance Requirements

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **Live Load** | | | | | | | | | | |
| **Vibrations** | Limited Vibration Control | Enhanced Vibration Control for Still Environments | Enhanced Vibration Control for Laboratories and Sensitive Equipment | N/A | Y | Y | Design Team should provide calculations showing requirements are met. Calculations required at all performance levels. | AISC Design Guide Series 11, Floor Vibrations Due to Human Activity | Describe design narrative for how the floor structure design addresses the effects of vibration. | N/A |
| **Wind** | | | | | | | | | | |
| **Structure** | 15% in 50 Yr Exceedance or local code whichever is greater | 7% in 50 Yr Exceedance | 3% in 50 Yr Exceedance | N/A | Y | Y | Design Team should provide calculations showing requirements are met. Calculations required at all performance levels. | ASCE 7 | Describe wind resistance design assumptions. | N/A |
| **Seismic** | | | | | | | | | | |
| **Structure** | Life Safety | Damage Control | Immediate Occupancy | N/A | N/A | Y | Design Team should provide calculations showing requirements are met. Calculations required at all performance levels. | For existing buildings reference ASCE 41. For new buildings, reference IBC. For new buildings above baseline, also reference ASCE 41 for tiering performance goals. | Describe seismic resistance design assumptions. | The design review should include:<br>Review of any site-specific seismic criteria employed in the analysis including the development of site-specific spectra and ground motion time histories.<br>Review of acceptance criteria used to demonstrate the adequacy of structural elements and systems to withstand the calculated force and deformation demands, together with that laboratory and other data used to substantiate these criteria.<br>Review of the preliminary design including the selection of structural system and the configuration of structural elements.<br>Review of the final design of the entire structural system and all supporting analyses. |
| **Nonstructural** | Life Safety | Position Retention | Position Retention | N/A | N/A | Y | Design Team should provide calculations showing requirements are met. Calculations required at all performance levels. | For existing buildings reference ASCE 41. For new buildings, reference IBC. For new buildings above baseline, also reference ASCE 41 for tiering performance goals. | N/A | N/A |
| **Flood** | | | | | | | | | | |
| **Flood Mitigation** | 100-Year Base Flood Elevation + 2' | 500-Year Flood Elevation +1' or the 100 Year Base Flood Elevation +3', whichever is higher | Determined on a Site Specific Basis | N/A | N/A | Y | Design Team must provide calculations showing requirements are met. Calculations required at all performance levels. | FEMA Flood Maps<br>ASCE 24, "Flood Resistant Design and Construction" | Describe how structural design is responsive to the flood level performance metric. | N/A |

## 4.2 STRUCTURAL PERFORMANCE ATTRIBUTES

### 4.2.1 LIVE LOAD

#### 4.2.1.1 VIBRATIONS

This attribute relates to the design of floor systems for occupant comfort relating to walking induced vibrations. AISC Design Guide 11, "Floor Vibrations Due to Human Activity," is the primary reference for this attribute. The design should consider the proposed use of building and possible future uses.

- Baseline: The floors will be designed for "Office" acceleration limits per AISC Design Guide 11.
- Tier 1 High Performance (★): This performance level is intended for areas that require still environments, such as the bench in a courtroom. The floors will be designed for acceleration limits that are between the "Office" level and the ISO baseline level per AISC Design Guide 11.
- Tier 2 High Performance (★★): This performance level is intended for areas that contain sensitive equipment, such as laboratories. Design for the specific equipment type expected per AISC Design Guide 11 Chapter 6.

### 4.2.2 NATURAL HAZARD

#### 4.2.2.1 WIND RESISTANCE OF STRUCTURE LATERAL FORCE RESISTING SYSTEM

This attribute relates to building structure to resist wind loading. See the enclosure attributes for performance attributes related to the wind performance of the cladding and roof components. The primary reference for this attribute is ASCE 7. The higher performance levels correspond to designing the structure for higher velocity basic wind speeds associated with a less frequent wind event (expressed as probability of exceedance in a 50-year period). It is not permitted to design the building for wind speeds below the applicable building code specified minimum. Wind speeds are dependent on region and other factors specified in ASCE 7. Wind tunnel testing may be used during the design phase to determine loads on building structure more precisely than ASCE 7. A rigid model test can be used to determine localized pressures and overall mean loads applied to the building. An aero-elastic model test can be used to evaluate the dynamic response of the building due to wind loading.

#### 4.2.2.2 SEISMIC RESISTANCE OF STRUCTURE LATERAL FORCE RESISTING SYSTEM

This attribute relates to the performance of the structural system in response to a design basis earthquake. Higher performance levels are expressed as lower inter-story drifts and damage during the seismic event. The primary reference is ASCE 41, "Seismic Evaluation and Retrofit of Existing Buildings." The guidelines from ASCE 41 are intended to be applied to new buildings as well to existing buildings to achieve higher performance levels. It is not permitted to design the building for seismic performance below the minimum level specified by IBC and Standards of Seismic Safety for Existing Federally Owned and Leased Buildings.

#### 4.2.2.3 SEISMIC RESISTANCE OF NON-STRUCTURAL COMPONENTS

This attribute relates to the performance of the non-structural components in response to a design basis earthquake. Higher performance levels are expressed as lower damage states and

recovery costs after the seismic event. The primary reference is ASCE 41, "Seismic Evaluation and Retrofit of Existing Buildings." The guidelines from ASCE 41 are intended to be applied to new buildings as well as existing buildings to achieve higher performance levels. It is not permitted to design the building for seismic performance below the minimum level specified by the applicable building code.

#### 4.2.2.4 FLOOD MITIGATION

See section 3 for Flood Resistant Design and Construction.

## 4.3 PRESCRIPTIVE STRUCTURAL REQUIREMENTS

### 4.3.1 INNOVATIVE MATERIALS AND METHODS

The use of special construction, innovative methods and the installation of any material is permitted when necessary, advantageous, and economical. However, specifying new or untried materials or methods of construction should be avoided until the merits of the methods or materials have been established. When the merits are established, new, unusual, or innovative materials, systems, or methods may be incorporated into designs when evidence shows that such use is in the best interest of the Government from the standpoint of economy, lower life-cycle costs, and quality of construction. When new and innovative methods and materials are proposed for a specific building a peer review panel, determined by GSA, must evaluate the adequacy of the methods, systems, and materials proposed by the engineer. The evaluation will be based on the best interest of the Government from the standpoint of economy, lower life-cycle costs, and quality of construction.

### 4.3.2 IBC FOR STRUCTURAL DESIGN OF NEW BUILDINGS

The structural design (including wind, snow, and earthquake) of new buildings, structures, and portions thereof must be in compliance with the latest edition of the IBC.

### 4.3.3 ISC SECURITY STANDARDS

The "Risk Management Process: An Interagency Security Committee Standard" applies to new construction of Federal office buildings and courthouses. Where prudent and appropriate, the criteria apply to major modernization projects. Also see Physical Security Performance Requirements.

### 4.3.4 DESIGN METHODS

If Load and Resistance Factor Design (LRFD) method is used, the design narrative must specifically address floor vibration.

### 4.3.5 STRUCTURAL LOADS

Design loads shall be in accordance with IBC except as noted:

Since locations of corridors are not always known until after the completion of construction documents and are subject to change over time, use a uniform live load of 100 pounds per square foot (psf) over the entire floor for all elevated slabs unless the tabulated uniform live load required by the IBC is higher than 100 psf. This load includes 15 pounds per square foot of partitions, but excludes heavy loads like the planned use of space saver file systems.

Plazas: For buildings having plaza areas where there is a possibility of large trucks or vans

entering and parking, the design loads for the trucks and vans shall be provided for in the design of the plaza.

### 4.3.6 STRUCTURAL SYSTEMS AND ELEMENTS

Precast floor framing systems shall not be used in Federal Office Buildings or Courthouses. When the design can be demonstrated to adapt well to future changes in locations of heavy partitions or equipment, precast systems may be considered for low-rise structures such as parking garages, industrial buildings, and storage and maintenance facilities. Precast shall not be used as part of the structural framing to prevent progressive collapse.

Pre-tensioning and post-tensioning systems are not allowed.

Exception: Pre-tensioned or post-tensioned systems, bonded or unbonded, for parking structures that are separate from the occupied building are allowed. Post tensioning is allowed for repair or retrofit to reduce deflections or enhance capacity.

Footings and permanent support structures, such as tiebacks, must not project beyond property lines.

### 4.3.7 ALTERATIONS IN EXISTING BUILDINGS AND HISTORIC STRUCTURES

Alteration requires ingenuity and imagination. It is inherently unsuited to rigid sets of rules, since each case is unique. It is recognized that total compliance with standards may not be possible in every case. Where serious difficulties arise, creative solutions that achieve the intent of the standard are encouraged.

### 4.3.8 SEISMIC UPGRADING

Historic buildings should meet the same life safety objectives as other buildings while preserving historic spaces and features to the greatest extent possible. Any decision made to preserve essential historic features must not result in a lesser seismic performance than that required by “Standards of Seismic Safety for Existing Federally Owned and Leased Buildings.”

Where deficiencies in the attachment of elements of structures, nonstructural components, and equipment pose a life safety risk, they must be prioritized and those elements with the greatest life safety risk strengthened first to meet current standards.

### 4.3.9 SEISMIC INSTRUMENTATION

New and existing buildings undergoing a seismic upgrade in Seismic Design Category D, E, and F that are over six stories in height with an aggregate floor area of 5,574 $m^2$ (60,000 $ft^2$) or more, and every Seismic Design Category D,E, and F building over 10 stories in height regardless of floor area, must be provided with U.S. Geological Survey (USGS) approved recording accelerographs. The Seismic Instrumentation of Buildings (with Emphasis on Federal Buildings), Special GSA/USGC project, USGS Project No 0-7460-68170 (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.305.423&rep=rep1&type=pdf ) must be used.

## 4.4 PHYSICAL SECURITY PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **Physical Security Performance** | ISC Level I or II | ISC Level III | ISC Level IV | ISC Level V | N/A | N/A | Design Team must provide calculations showing requirements are met. Calculations required at Tier 1 High Performance and above. | The Risk Management Process: An Interagency Security Committee Standard | The Risk Management Process: An Interagency Security Committee Standard and the Building Specific Risk Assessment. Describe ISC Level used in design and how the criteria and risk assessment were met. See the Prescriptive Physical Security requirements section for further information. | N/A |

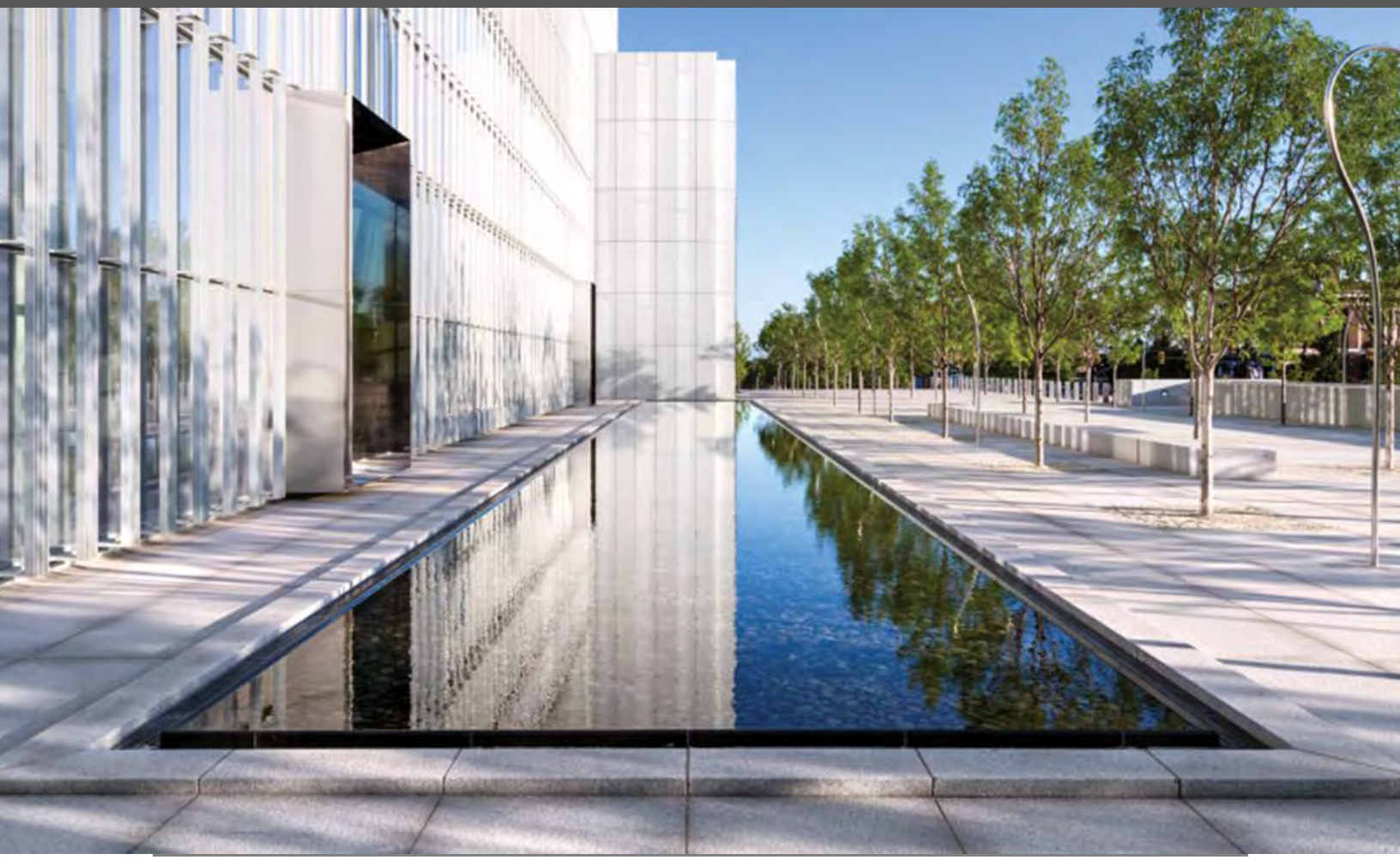
## 4.5 PHYSICAL SECURITY PERFORMANCE ATTRIBUTES

The following physical security performance levels reference The Risk Management Process: An Interagency Security Committee Standard, and GSA's interpretation of the Interagency Security Committee Risk Management Process. Each of these documents is For Official Use Only (FOUO) and contains sensitive details that are not repeated here. Refer to the ISC references for more information.

This attribute relates to the design of the building's physical security, and its ability to resist the Design Basis Threats. These threats include but are not limited to blast, progressive collapse, and vehicle ramming. GSA buildings are to meet the ISC Risk Management Process and Appendices for the given Facility Security Level (FSL).

The GSA P100 Physical Security Requirements are intended to align with the ISC Facility Security Level. These physical security performance requirements are not intended to supersede the ISC standards, but to coincide with them.

Figure 9: U.S. Federal Courthouse Courtyard Detail, Salt Lake City, UT



# 5

# MECHANICAL ENGINEERING

Figure 10:
Byron Rogers
Federal Building
Mechanical Room
Denver, CO

# 5.1 MECHANICAL PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **5.2.1 Temperature** | | | | | | | | | |
| **Reference** | ASHRAE 55 | ASHRAE 55 | ASHRAE 55 | ASHRAE 55 | ASHRAE 0 & 1.1<br><br>SMACNA TAB Procedural Guide | ASHRAE 0 & 1.1<br><br>SMACNA TAB Procedural Guide | | | |
| **Performance** | 24±2ºC (75±3ºF) cooling, 22±2ºC (72±3ºF) heating, Allowance for unoccupied hour setup and setback optimized with re-occupancy pick-up and pull-down energy demands within a range of 13ºC to 28ºC (55ºF to 83ºF), Thermal zones limited to 42 $m^2$ (450 $ft^2$) at the perimeter 5m (15ft) (or no more than 3 private offices on the same solar orientation) and 140 $m^2$ (1500 $ft^2$) interior | Baseline features and add passive control of surface radiant temperatuer to provide surface radiant temperatures ±4ºC (±7ºF) of the air temperature, Thermal zones limited to 42 $m^2$ (450 $ft^2$) at the perimeter 5 m (15ft) (or no more than 3 private offices on the same solar orientation) and 75 $m^2$ (800 $ft^2$) interior | Tier 1 High Performance features and add building automation system control of surface radiant temperatures to provide surface radiant temperaturese ±1ºC (±2ºF) of the air temperature, or inversely offset expanded air temperature ranges and do not form condensation. | Tier 2 High Performance and individual occupant controlled surface radiant temperatures within optimized limits determined by a BAS and optimized air at 24-27 ºC (75-80ºF) cooling 18-22 ºC (65-72ºF) heating | Baseline: No<br>Tier 1 High Performance: No<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Provide calculations of the transient coupled one-dimensional heat and moisture transport in multi-layer building components exposed to natural weather using WUFI-ORNL/IBP for each construction condition. | Show proposed zoning and corresponding square footage for all conditioned spaces. Show temperature range for each zone and interior surface temperatures, when applicable. | After occupancy, provide 2 weeks of 15 minute trend history of space and surface temperature (when controlled). |
| **5.2.2 Humidity Control** | | | | | | | | | |
| **Reference** | ASHRAE 55, graphic comfort zone method | ASHRAE 55, Michalski (1998), 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, Museums, Galleries, Archives, and Libraries | ASHRAE 55, Michalski (1998), 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, *Museums, Galleries, Archives, and Libraries* | ASHRAE 55 Michalski (1998), 2011 ASHRAE Handbook – HVAC Applications, Chapter 23, *Museums, Galleries, Archives, and Libraries* | ASHRAE 0 & SMACNA TAB Procedural Guide | ASHRAE 0<br>ASHRAE 1.1 | | | |
| **Performance** | Maximum 13ºC (55ºF) dew point | (For the preservation of "medium vulnerability" woodwork; this does not necessarily require humidification equipment) RH setpoint (Historic annual average at indoor dry bulb temperature = 21ºC (70ºF), default 50%RH), Class C (ASHRAE Applications) control (no short term RH range), 25% to 75% seasonal setpoint adjustment, and 13ºC (55ºF) dew point maximum. | (For the preservation of "high vulnerability" woodwork. No archival storage of fabrics, books, film, or photos is considered.) RH setpoint (Historic annual average at indoor dry bulb temperature = 21ºC (70ºF), default 45%RH), Class B (ASHRAE Applications) controlled range of +/- 10% RH short term, +/- 10% seasonal setpoint adjustment, and 13ºC (55ºF) dew point maximum. | (Preservation of "high vulnerability" woodwork, small risk to archival storage items e.g. fabrics, books, film, or photos.) RH setpoint (Historic annual avg at indoor DB temperature = 21ºC (70ºF), default 45%RH, Class A, controlled range of +/- 5% RH short term, +/- 10% seasonal setpoint adjustment (OR +/- 10% RH and NO seasonal setpoint adjustment), and 13ºC (55ºF) dew point max. | Baseline: No<br>Tier 1 High Performance: No<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | | Show relative humidity control range for each zone and describe method of control when applicable. | After occupancy, provide 2 weeks of 15 minute trend history of space relative humidity (when controlled). |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **5.2.3 Air Movement** | | | | | | | | | |
| **Reference** | ASHRAE 55 | ASHRAE 55 | ASHRAE 55 | ASHRAE 55 | ASHRAE 0 & 1.1<br><br>SMACNA Procedural Guide | ASHRAE 0<br>ASHRAE 1.1 | | | |
| **Performance** | Less than 0.2 m/s (40 fpm) at occupied level | Zone occupant controlled air speed at the occupied level between 0.1 and 0.76 m/s (20 and 150 fpm). No more than 6 occupants per zone. | Individual occupant controlled air speed at the occupied level between 0.1 and 0.76 m/s (20 and 150 fpm) | N/A | Baseline: No<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | | Describe air speed performance and how it will be achieved by the proposed design. | Verify space air speed at occupant level during TAB/Cx. |
| **5.2.4 Pressure** | | | | | | | | | |
| **Reference** | 2013 ASHRAE Handbook – HVAC Fundamentals | 2013 ASHRAE Handbook – HVAC Fundamentals | 2013 ASHRAE Handbook – HVAC Fundamentals, Lstiburek (1999), Quirouette (2004) | | ASHRAE 0 & 1.1<br><br>SMACNA Procedural Guide | ASHRAE 0<br>ASHRAE 1.1 | | Coordinate with Building Enclosure Air Tightness metric. | |
| **Performance** | Positive building pressure when occupied, and when outside dew point is higher than 8ºC (47ºF) when unoccupied. | Active exterior space pressure control by floor to achieve 12Pa (0.05" wc) positive building pressure when occupied, and when outside dew point is higher than 8ºC (47ºF) when unoccupied. | Maintain building perimeter zones at 5 Pa (0.02" wc) positive pressure with respect to outdoor; control per exposure per floor when outside dew point is higher than 8ºC (47ºF). No design negative pressure spaces at building perimeter. Return air plenums require isolation near the perimeter. | Tier 2 High Performance and provide envelope cavities at 5 Pa (0.02" wc) positive pressure with respect to interior occupied space when outside temperature drops below dew point of inside air. | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | | Describe building air pressure performance and how it will be achieved by the proposed design. | Prior to occupancy, provide 24 hours of 5-min trend history of building air pressure. |

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 High Performance | ★★★<br>Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **5.2.5 Ventilation** | | | | | | | | | |
| **Reference** | ASHRAE 62.1 - 2013 | ASHRAE 62.1 - 2013<br>LEED V4 | ASHRAE 62.1 - 2013<br>LEED V4 | ASHRAE 62.1 - 2013<br>LEED V4 | ASHRAE 0 & 1.1<br><br>SMACNA TAB Procedural Guide | ASHRAE 0<br>ASHRAE 1.1 | | | |
| **Performance** | • Standard 62.1 Ventilation Rate Procedure only<br>• Air Flow Measurement Stations (AFMS) on VAV systems | • Standard 62.1 Ventilation Rate Procedure only<br>• Comply with LEED V4 IAQ building materials credits 4.1, 4.2, 4.3 & 4.4<br>• Air Flow Measurement Stations on VAV systems | • Standard 62.1 Ventilation Rate Procedure only<br>• Comply with LEED V4 IAQ building materials credits 4.1, 4.2, 4.3 & 4.4<br>• Air Flow Measurement Stations on all systems | • Tier 2 High Performance, and:<br>• Provide an occupant indoor air quality survey in the Post Occupancy Evaluation (POE) | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Provide Standard 62.1 VRP calculations for each air handling system | Describe how minimum ventilation rates will be maintained for all systems. | Verify HVAC system minimum ventilation rates during TAB/Cx. Provide 24 hours of 15 minute trend history of each AFMS to verify minimum ventilation control. |
| **5.2.6 Filtration** | | | | | | | | | |
| **Reference** | ASHRAE 62.1 - 2013, ASHRAE 52.2 | ASHRAE 62.1 - 2013, ASHRAE 52.2 | ASHRAE 62.1 - 2013, ASHRAE 52.2 | ASHRAE 62.1 - 2013, ASHRAE 52.2 | ASHRAE 0<br>ASHRAE 1.1<br>AABC, NEBB, or TABB | ASHRAE 0<br>ASHRAE 1.1 | | | |
| **Performance** | • MERV 8 for all coils<br>• MERV 8 on OA where PM10 limit exceeded<br>• MERV 11 on OA where PM2.5 limit exceeded | • MERV 8 for all coils<br>• MERV 11 on OA | • MERV 8 for all coils<br>• MERV 13 for outdoor air | • Tier 2 High Performance and:<br>• UVGI at cooling coils, condensate drain pans and other devices with wetted surfaces. | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes<br>Tier 3 High Performance: Yes | | Describe proposed filtration design for all air handling systems. | Verify installed filtration during TAB/Cx. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **5 2.7 HVAC Noise Control** | | | | | | | | | |
| **Reference** | ASHRAE Handbook - Applications 2011 | ASHRAE Handbook - Applications 2011 | ASHRAE Handbook - Applications 2011 | | ASTM E336 | | | Coordinate with Building Enclosures STC Metric | |
| **Performance** | Comply with 2011 ASHRAE Applications Chapter 48, Table 1 | Comply with 2011 ASHRAE Applications Chapter 48, Table 1<br>Provide sound masking in open office spaces per PBS-P100 2010 | Comply with Tier 1 High Performance<br>Provide occupant indoor acoustical survey in the POE | NA | Yes, Field Measurement of Sound Insulation in Buildings and GSA Workplace 20.20 testing protocol for speech privacy calculation in private offices (Tiers 1 & 2) | Baseline: Yes<br>Tier 1 High Performance: Yes<br>Tier 2 High Performance: Yes | | List design RC level goals for all space types and describe how design will meet these goals. | Verify space acoustic sound levels during TAB/Cx. |
| **5.2.8 HVAC Operational Efficiency** | | | | | | | | | |
| **Equipment Performance** | Comply with ASHRAE 90.1-2016 Minimum Efficiencies | Comply with ASHRAE 90.1-2016 Minimum Efficiencies | Comply with ASHRAE 189.1 2014 | Comply with ASHRAE 189.1 2014 or Tier 2 Energy Star | Yes | Yes | | Describe what efficiency level is proposed for the HVAC equipment. | Cx agent to confirm equipment efficiencies during equipment submittal review. |
| **Fan Energy Performance** | Comply with ASHRAE 90.1-2016 Fan System Power Limitation Requirements | 5% Below ASHRAE 90.1-2016 Fan System Power Limitation Requirements | Comply with ASHRAE 189.1 2014 Fan System Power Limitation Requirements | 5% Below ASHRAE 189.1 2014 Fan System Power Limitation Requirements | | Yes | Provide fan power limitation calculation per 90.1 Table 6.5.3.1.1.A. | Describe how fan energy performance will be less than metric. | Cx agent to confirm fan equipment efficiencies during equipment submittal review. |
| **Builiding HVAC Energy Performance** | Comply with ASHRAE 90.1 2016 Appendix G | 10% Below ASHRAE 90.1 2016 Appendix G | 15% below ASHRAE 189.1 2014 Section 7.5.2 | 30% below ASHRAE 189.1 2014 Section 7.5.2 | | | Provide 90.1 Appendix G energy model demonstrating HVAC annual energy does not exceed project target. | Describe HVAC strategies employed in energy model that result in energy target being met. | Cx agent to confirm energy model HVAC equipment performance assumptions on design reviews and submittal reviews. |
| **HVAC Energy Metering** | Comply with ASHRAE 90.1 2016 | Install on 50% of HVAC Energy | Install on 80% of HVAC Energy | Install on 100% of HVAC Energy | Yes | Yes | Provide energy model results showing that % HVAC energy metering is met. | Describe proposed HVAC metering scheme. | Calibrate all meters and provide 2 weeks of 15 minute trend history for all HVAC meters. |

## 5.2 MECHANICAL PERFORMANCE ATTRIBUTES

The premise of achieving higher levels of building performance is to provide indoor environments that are most conducive to comfort, health, and productivity; to increase the longevity of the property; and to deliver these in an optimally energy efficient and cost effective manner. Protection of property includes assets such as wood furnishings, art, and archives where applicable, as well as minimizing detrimental effects of mold growth and material corrosion and decay.

### 5.2.1 TEMPERATURE

Temperature is one of several determining factors of a comfortable and productive environment; however, maintenance and control of temperature alone does not assure an acceptable environment. Other component attributes include air movement, humidity, acoustics, air quality, the physical and psychological dispositions of the occupants, and the ability of the occupants to have autonomy over the control of their environment. Increasing levels of indoor environmental performance as impacted by the discrete attribute of temperature are defined in the performance requirements table.

### 5.2.2 HUMIDITY CONTROL

Humidity is one of several determining factors of an acceptable environment, but the limits for occupant comfort and productivity are much more widespread than the humidity limits required for asset protection and longevity. ASHRAE Standard 55-2013, “Thermal Environmental Conditions for Human Occupancy,” does not require a lower limit of humidity with respect to maintaining an acceptable environment.

The high performance tiers of humidity performance are intended to protect humidity-sensitive finishes and contents of the space, if present, such as art collections, rare documents, vulnerable woodwork, etc. The selected levels of performance reference the 2011 ASHRAE Handbook–HVAC Applications, Chapter 23, Museums, Galleries, Archives, and Libraries.

Increasing levels of indoor environmental performance as impacted by the discrete attribute of humidity are defined in the performance requirements table.

### 5.2.3 AIR MOVEMENT

Air movement is discussed under the temperature attribute because the amount and control of air movement directly affects the level of temperature control required to maintain a comfortable and productive environment. Levels of indoor environmental performance as impacted by the discrete attribute of air movement are defined in the performance requirements table.

### 5.2.4 PRESSURE

Pressure is a factor contributing to longevity of the property and the resultant indoor air quality. Under ordinary conditions, the relatively small orders of magnitude of air pressure experienced in and immediately around a facility do not usually create uncomfortable indoor environments. Control of space pressurization is important, in overall facility operations, to manage moisture, water vapor, airborne contaminants, and the consequent effects of

mold growth. Levels of building performance as impacted by the discrete attribute of pressure are as shown in the performance requirements table.

### 5.2.5 VENTILATION

Ventilation is one of the key elements (along with source control and air cleaning) to achieving acceptable indoor air quality. Source control alone is not sufficient because it is impossible to eliminate all off-gassing materials in the built environment, and people are also a source of pollutants (bioeffluents). Hence, ventilation is required in all occupied spaces. ASHRAE Standard 62.1 is the consensus standard prescribing ventilation requirements in the United States. It has been integrated into the International Mechanical Code. Ventilation rates higher than Standard 62.1 rates have been shown in several studies to increase alertness, reduce indoor air quality concerns, and reduce absenteeism. See the performance requirements table.

### 5.2.6 FILTRATION

Filtration and air cleaning can improve indoor air quality by removing contaminants from ventilation air. It is particularly effective in areas where outdoor air quality is poor. Particulate filtration can also improve air quality by reducing dirt on surfaces that can support microbial growth such as cooling coils. See the performance requirements table.

### 5.2.7 HVAC NOISE CONTROL

Acoustics in the workplace can affect productivity, and excessive noise can also cause physical symptoms. Cross-talk in open offices can also be a detriment to worker productivity. However, there is no evidence to suggest that these factors are improved with lower sound pressure levels. Hence requirements are to simply meet the industry standard Room Criteria (RC) levels for all levels. See the performance requirements table.

### 5.2.8 HVAC OPERATIONAL EFFICIENCY

The goal of HVAC operational efficiency is to maximize system energy efficiency in order to reduce HVAC energy consumption and costs. Although annual HVAC energy consumption is impacted by many other factors in the building, including building envelope, lighting, and equipment loads, this metric focuses strictly on the HVAC equipment and system efficiencies by utilizing industry standards for the various levels of efficiency.

### 5.2.9 ENERGY PERFORMANCE

The attribute of energy performance considers the whole building synergistically and is measured with respect to both energy utilization (consumption) and carbon emissions (total or source) on an annual basis.

Federal law requires minimum levels of performance for Federal facilities and total portfolio performance for Federal agencies. The related attribute of energy cost is required to be reported for LEED certification, and this may be a driving requirement in terms of systems selection, particularly thermal storage and demand peak shaving/load offset.

Energy cost and its effect on life cycle cost is an essential consideration in the design of GSA buildings. However, because there is no Federal mandate on energy cost, it is not a direct report for P100 Performance.

Energy software used to demonstrate compliance must be compliant with ASHRAE

Standard 140-2011.

**Tech Tip:**

- Consider installing variable refrigerant systems for new construction at facilities with the following criteria: located in cold climates; 5,000 to 100,000 square feet; designed with limited room for ductwork changes; heated by electric reheat, supplemental heat or primary heating; and equipped with spaces that would benefit from independent temperature control.
- 34% HVAC savings projected relative to code-compliant HVAC

## 5.3 MECHANICAL ENGINEERING PRESCRIPTIVE REQUIREMENTS

All mechanical and electrical equipment within the building or on the property must be located in areas not subject to flooding and 1.6 meters (5 ft.) above the 100-year flood plain.

### 5.3.1 DESIGN CRITERIA

Outdoor air design criteria must be based on weather data tabulated in the latest edition of the ASHRAE Handbook of Fundamentals.

- Winter design conditions must be based on the 99.6 percent column dry bulb temperature.
- Summer design conditions for sensible heat load calculations must be based on the 0.4 percent column dry bulb temperature, with its mean coincident wet bulb temperature.
- Design conditions for the summer ventilation load, cooling tower selection, and all dehumidification load calculations must be based on the 0.4 percent dew point, with its mean coincident dry bulb temperature.

Include the following on the concept through construction drawings:

- Ventilation Schedule that includes (for all spaces in the project) room number, room, name and use, floor area, number of occupants, outside air per ASHRAE 62.1 2013 Ventilation Rate Procedure, actual supply air, return air, outside air, and exhaust air
- Building Pressurization table

| Type of Area | Summer DB | Winter DB |
|---|---|---|
| Locker rooms | 26˚C (78˚F) | 21˚C (70˚F) |
| Electrical closets | 26˚C (78˚F) | 13˚C (55˚F) |
| Mechanical spaces | 35˚C (95˚F) | 13˚C (55˚F) |
| Electrical switchgear | 35˚C (95˚F) | 13˚C (55˚F) |
| Elevator machine room | 26˚C (78˚F) | 13˚C (55˚F) |
| Emergency generator room | 40˚C (104˚F) | 18˚C (65˚F) |
| Transformer vaults | 40˚C (104˚F) | |
| Stairwells | (none) | 18˚C (65˚F) |
| Storage room | 30˚C (85˚F) | 18˚C (65˚F) |
| Other | | |

**Table 5.1 Indoor Design Conditions–Supplemental Spaces**

### 5.3.1.1 OCCUPANT LOADS

Occupancy loads must be determined as follows:

- Determine occupant density (persons/$m^2$ or persons/$ft^2$) from the occupancy schedule of the Project Program of Requirements.
- In the event this information is not available, use the occupancy density values in ASHRAE 62.1-2013.
- For dining areas, auditoriums, and other high-occupancy spaces, occupancy densities must represent the number of seats available.
- Sensible and latent loads per person must be based on the latest edition of the ASHRAE Handbook of Fundamentals.

The HVAC load calculations must be performed with a computer-based program using the latest ASHRAE Handbook of Fundamentals Heat Balance (HB) Method, Radiant Time Series (RTS) Method, or Transfer Function Method (TFM), developed for the hourly analysis of heating and cooling loads in commercial buildings.

The program must be capable of calculating each zone's peak heating and cooling loads as well as the whole-building simultaneous peak load. The program must, at a minimum, calculate solar gains through fenestration; internal gains from occupants, including latent heat for cooling purposes; internal gains from lighting and equipment; outside air loads (sensible and latent) from ventilation and infiltration; and heat and moisture gains or losses through fenestration, walls, floors, and roofs. The heating load calculations must be done without credit for occupants and internal gains. The HVAC load calculations must not include additional safety factors unless specifically asked for in the applicable tenant design guides (e.g., the Courts Design Guide has 20 percent sensible added to courtrooms).

Provide HVAC load calculations at each design phase. The HVAC load calculations report must include all input and output used in the heating and cooling calculation program. The report must also include zone peak heating and cooling

loads results and whole-building simultaneous peak load, air-handling unit coil selections, and Psychrometric charts that show the complete cycle of all of the processes in the HVAC system.

#### 5.3.1.2 ENERGY ANALYSIS

A building energy analysis must be performed at each phase of the design to demonstrate that the building design meets or exceeds the energy performance goals established for the project. Energy software used for proof of compliance must conform to ASHRAE Standard 140-2011.

The compliance methodology must be in accordance with Sections 5 (except Section 5.6), 6, 7, 8, 9, and 10 of ASHRAE Standard 90.1. See A.7 Energy Analysis Input and Output for procedures.

### 5.3.2 HVAC SYSTEMS

The designer must specifically address capacity turndown with respect to minimum building loads, chiller tonnage/ boiler MMBtu, and pumping capacity. For systems over 1000 tons, at no time shall there be less than 65 percent chiller capacity in the case of a single chiller's failure.

#### 5.3.2.1 CHILLER PLANT

If the whole building or property simultaneous peak cooling load is 3520 kW (1000 Tons) or more, a minimum of three chillers must be provided sized for the peak cooling capacity. If the whole-building simultaneous peak cooling load is less than 3520 kW (1000 tons), either three equally sized chillers must be provided sized for the peak cooling capacity or two equally sized chillers sized for the peak cooling capacity with a jockey chiller sized for approximately 1/4 of the peak cooling capacity. All units must have adequate valving to isolate the offline unit without interruption of service.

**Tech Tip:**

- Consider installing variable-speed oil-free centrifugal chillers with magnetic bearings or variable speed screw chillers with no mechanical unloaders when replacing chillers at the end-of-life.
- 42% cooling energy savings

A waterside-economizer cycle must be analyzed during the design of the chiller plant and incorporated in the design if it improves the performance.

In addition to meeting the minimum efficiency requirements of the latest edition of ASHRAE Standard 90.1, air-cooled and water-cooled electric chillers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

**Tech Tip:**

- Consider installing control optimization systems during new construction or retrofits for chiller plants with cooling loads > 3 million tons per year.
- Estimated 35% cooling energy savings

Chillers must use acceptable refrigerants in accordance with the U.S. Environmental Protection Agency's Significant New Alternatives Policy (SNAP) Program.

#### 5.3.2.2 BOILER PLANT

The central boiler plant within the building or on the property must be provided with modular boilers. For boiler plants greater than 300kW (1,000 MBH), a minimum of three boilers must be provided. For buildings with less than 300kW

(1,000 MBH) peak demand, two equally sized modular boilers sized at 67 percent of peak demand must be provided.

In addition to meeting the minimum efficiency requirements of the latest edition of ASHRAE Standard 90.1, boilers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

**Tech Tip:**

- Consider installing wood-fired biomass boilers when replacing convention boilers at the end-of-life in cold climates that use fuel oil and are located within 50 miles of a biomass pellet mill.
- 85.6% heating energy efficiency at 45% partial load. Increased loads will increase efficiency.

**Tech Tip:**

- Consider installing a condensing boiler when replacing conventional boilers at the end-of-life.
- 14-41% natural gas heating energy savings

### 5.3.2.3 COOLING TOWERS

Each chiller must have its own matching cooling tower or cell, and condenser and chilled water pump. Multiple cooling towers must have equalizing lines and the necessary automatic control valves for individual chiller/cooling tower operation.

### 5.3.2.4 DISTRIBUTION SYSTEMS

Supply air distribution systems must be fully ducted to the spaces that are served.

For plenum return air systems, the horizontal distance from the farthest point in the plenum to a return air duct shall not exceed 50 feet. All transfer air openings shall be sized with no more than 300 FPM air velocity.

### 5.3.2.5 ROOF-MOUNTED EQUIPMENT

Mechanical equipment, except for cooling towers, air-cooled chillers, Dedicated Outside Air Systems (DOAS), evaporative condensers, and exhaust fans, is not permitted on the roof of the building. Access to roof-mounted equipment must be by stairs or freight elevator; ship's ladders are not permitted.

### 5.3.2.6 SPECIAL AREA HVAC SYSTEMS

Develop a table to show dedicated systems, energy requirements, and redundancy requirements.

Special areas such as atriums, auditoriums, entrance lobbies and vestibules, cafeterias, mail rooms, loading docks, computer and server rooms, fire pump rooms, building automation systems (BAS) control rooms, and fire command centers must have dedicated HVAC systems, separate from all other HVAC in the building, with individual controls to condition these spaces as required.

Two courtrooms may share a dedicated air-handling unit, and each courtroom must be provided with a minimum of three thermostatic zones. The air handling unit shall be sized to carry the combined load of both courtrooms plus the 20 percent sensible per the courts design guide. A separate dedicated air-handling system must be provided for each mail room. Airflow must maintain negative pressure in the room relative to adjacent spaces.

### 5.3.2.7 CONTROLS/BUILDING AUTOMATION SYSTEMS

For new construction, use direct digital control (DDC) with an open BACnet or LonTalk communication protocol in accordance with ASHRAE Standard 135-2012.

For repair and alteration projects and new additions to existing projects, the following options are permitted: 1) installation of DDC with the BACnet or LonTalk protocol, 2) integrating the existing system with customized gateways to the BACnet or LonTalk protocol.

**TECH TIP:**

- Consider installing wireless pneumatic controls during retrofits at facilities with conventional pneumatic controls to provide DDC functionality.
- Estimated 43-52% heating energy savings; 20% cooling energy savings

### 5.3.2.8 COORDINATION OF DIGITAL CONTROL SYSTEMS

Digital building control systems are beginning to share common protocols, compatible equipment, and uniform standards with other building IT services. GSA seeks BAS designs that integrate with other IT systems to minimize costs and improve operations. Since this technology is in a constant state of improvement and contract methodologies are not well established in the design and construction industry, the A/E and Project Manager must coordinate the design of controls and monitoring systems with the PBS CIO (Chief Information Officer) at the beginning of design. These systems include, but are not limited to: utility metering, HVAC building automation systems, lighting controllers, and renewable energy systems.

The CIO may provide Government Furnished Equipment and will specify system components to insure compatibility with the GSA network. Related IP network design must be reviewed and approved by the CIO. All network connections will be made through the GSA network. All server applications must be able to be hosted in a virtual server environment. Other GSA IT policies and procedures may also apply.

### 5.3.2.9 BUILDING AUTOMATION SYSTEM SOFTWARE

BAS are often thought of as the central system for smart buildings. These systems are designed to control the Heating, Ventilation, and Air Conditioning (HVAC) equipment from the chiller plant to the thermostat on the wall. HVAC is a major energy consumer in most commercial facilities and therefore offers a big opportunity for energy savings

Any BAS software system must follow all GSA IT requirements. This includes requiring that all IP addressable devices complete the Scan and Remediation process as well as all networking infrastructure (switches, routers, servers, and workstations) must be Government furnished. GSA will provide **Building Technologies Technical Reference Guide** for details on scanning, servers, and other network requirements.

BAS software must be installed in the GSA environment, including server software, client software, and any additional tools needed for management and control of the system. This includes system update tools, network management tools, and any software that is used to make changes to the controllers.

BAS software shall be compatible with the most current version of required standard software and all OS and database software updates (Microsoft Server, Linux, SQL, etc.)

BAS software must be capable of trending and exporting data.

BAS software shall have multiple user level controls, including administrator, programmer, and users. These user levels shall be capable of an audit to determine operator's use.

BAS software credentials shall be unique for every user.

BAS software shall be installed with a minimum number of licenses needed for system use. In cases of virtual environment installation, the number of licenses required should consider the cases in which client use could come from an off-site user.

BAS client software shall have point-and-click graphics, configured for system operators, unless a Unified User Interface is included in the project scope.

BAS software licenses shall be software licenses and not rely on a physical license key or dongle.

BAS must be licensed to GSA. End user license agreements (EULA) must be approved by GSA IT prior to installation onto GSA equipment.

### 5.3.2.10 BUILDING AUTOMATION SYSTEM CONTROLLERS

Building Automation systems generally rely on network controllers that communicate to a server and control edge devices. These controllers are generally the system engines making the majority of the control decisions. The following apply for all BAS controllers:

Building automation systems shall be 100 percent DDC systems, utilizing a server, controller, and edge device hierarchy.

BAS controllers shall be programmed to maintain schedules, set point and normal operation control in cases of network connection loss. Network connection loss scenarios shall be tested and verified as part of the commissioning process for any BAS.

BAS controllers should be capable of storing data and uploading data in case the server connection is lost.

BAS controllers should host graphics or terminal interfaces to allow for direct connection and control from a workstation for emergency control. This could be accomplished over IP, serial or USB connections.

BAS controllers should have embedded tools or means to direct connect that allow for troubleshooting or programming in cases of communication loss. Means to "direct connect" to building system controls could include IP, serial cable, or USB connectivity options. Please see the Building Technology Technical Reference Guide for details on IT Security requirements.

Building automation systems are subject to PBS fire protection/life safety requirements, e.g., fire alarm systems may permit read-only data interchange with, but may not share control infrastructure with, other building automation systems. See Chapter 7, Section 7.6. This information is from the OFM "Building Monitoring and Control System Technology Policy" dated January 2011.

### 5.3.2.11 POINT NAMING

GSA has created a point naming convention for standardization of point naming for all new

construction, ESPC, and R&A projects. The intent of this standard is to establish and require a consistent means of naming building automation points across the GSA portfolio. The term "point" is a generic description for the class of object represented by analog and binary inputs, outputs, and values either physical or virtual. All systems shall use this naming convention and process. Point naming shall be consistent through system drawings, records, files, and documents. Please reference *The GSA Point Naming Convention for Building Management Systems* for more information.

Designs for Building Control System and HVAC controllers are unique to every project. Designs can be influenced by budget, climate, system type, size of system, desired sequence of operations, existing infrastructure, and a multitude of other factors. As such, the equipment, level of control, sensors, and sophistication of systems will vary greatly. Good system design and proper control sequence documentation will always clearly dictate the points in a BAS required to execute the control sequence.

### 5.3.2.12 INTEGRATED SEQUENCES OF OPERATIONS (ISOO)

Successful designs hinge on the smooth, integrated interaction between the systems installed in a building and the functions they are to perform. Integrated Sequences of Operations (ISOO) allow for more unified controls strategies and can not only save energy but improve the tenant experience. By allowing building systems to act in unison and react to changing conditions identified by each system, a smarter, more efficient solution can be realized. Integrated sequences should be considered in all designs.

### 5.3.2.13 SPACE UTILIZATION SYSTEMS

#### 5.3.2.13.1 HOTELING

Effective management of tenants and space utilization presents another unique way to save resources across a portfolio. These activities, in unison with mechanical and electrical building systems, cannot only provide efficiencies but can improve tenant satisfaction.

Hoteling systems allow for automated control of building populations and space sharing. Implementing a system that can dynamically control population and distribution of tenants can allow for a greater balance of resources in a smaller footprint. Hoteling systems should be considered when building populations are flexible and operations allow for a mobile tenant.

Hoteling systems shall be coordinated with tenant agencies, building managers, and operations and maintenance organizations to ensure the understanding of multiuse tenant space and how it affects the Building Operation Plan (BOP).

When utilizing a hoteling system, the information available on occupancy, space utilization, and population density should be used to best manage the other building systems. This information may be connected directly to schedules of HVAC and lighting controls to ensure the systems are only occupied when spaces are reserved, or may be useful indicators to system operators of expected building population for a given day.

If tenant space is flexible and reservations are required, building managers and operators should consider using the reservation system to "dynamically stack" the building. By consolidating the population into a select area, areas, wings, or entire floors could be put into an

"unoccupied" mode, reducing the energy use. This dynamic stacking requires flexible tenants and tenant spaces but offers great energy savings when fully deployed.

#### 5.3.2.13.2 OCCUPANCY COUNTING

Public buildings or offices that share spaces can have large fluctuations in the building population, and these variances often go unnoticed by building systems. Deploying occupancy detection or people counting technology can help maximize building utilization, manage effective use of shared workspaces, and improve the operation of mechanical systems. Several solutions to occupancy counting include but are not limited to physical access control systems or passive sensor technologies placed at entries and exits.

Occupancy counting systems should be configured to capture all entry and egress locations, excluding emergency exits. The data from these systems should provide a live count of the population inside a building. Occupancy counting systems should be designed and installed with methods of utilizing the data they create with the ability to save and archive occupancy data. This data could be useful for digital signage (normalizing energy usage per person), HVAC control, security, or other building operations. Any device or system installed to monitor or record use of a means of egress must be designed and installed to meet the requirements in NFPA 101 so that it cannot, even in case of failure, impede or prevent emergency use of such means of egress.

## 5.3.3 HVAC COMPONENTS

### 5.3.3.1 AIR HANDLING UNITS

All air handling units (AHUs) must have DDC (BACnet or LonTalk) self-contained controls that are capable of being connected to the central BAS. Controller must have a current-sensing device that transmits information to the BAS for calculating the energy consumption of the AHU motor.

All AHUs except OAVS must be provided with factory-fabricated mixing boxes on the return side of the AHU.

AHU housing must consist of formed and reinforced, insulated panels, fabricated to allow removal for access to internal parts and components. All AHUs must be double wall construction.

There shall be a maximum 1 percent leakage on the casing. Outside air intakes for AHUs with air side economizers shall be provided with minimum and maximum outside air dampers.

### 5.3.3.2 OUTDOOR AIR INTAKE LOCATIONS

The placement and location of outdoor air intakes must be in compliance with the ISC criteria.

On buildings more than 12 m (40 ft.) tall, intakes must be located a minimum of 12 m (40 ft.) above grade. On buildings less than 12 m (40 ft.), the intakes must be located as high as practical on the roof or on a wall. Table 6-2 provides requirements for minimum separation distances between ventilation air intakes and other building features.

Outdoor air intakes must be ducted directly to the AHU cabinet; the equipment room must not be used as an outdoor air intake plenum.

| Object | Minimum Distance | |
|---|---|---|
| | m | ft |
| Garage entry, loading dock | 7 | 25 |
| Driveway, street, or public way | 3 | 10 |
| Limited-access highway | 7 | 25 |
| Cooling tower or evaporative condensers | 7 | 25 |
| Exhaust fans and plumbing vents | 5 | 15 |
| Kitchen exhaust air | 7 | 25 |
| Mail Rooms and Entrance Lobbies | 9 | 30 |

**Table 5.2 Air Intake Minimum Separation Distances**

### 5.3.3.3 TEMPERATURE AND AIRFLOW CONTROL

Psychrometric process charts must be prepared for each air-handling unit application, characterizing full-load and part-load operating conditions for all processes in the system. Air-handling unit/coil designs must ensure that conditioned space temperatures and humidity levels are within an acceptable range, per programmed requirements.

### 5.3.3.4 COOLING AND HEATING COILS

Equipment and other obstructions in the air stream must be located sufficiently downstream of the coil so that it will not come in contact with the water droplet carryover. Cooling coils must be selected at or below 2.5 m/s (500 fpm) face velocity. Heating coils must be selected at or below 3.8 m/s (750 fpm) face velocity.

HVAC coils subject to outside air in hot, humid, and marine climates shall be provided with copper tubes and copper fins or electro coated copper tubes with electro coated aluminum fins with a coating thickness to be maintained between 0.6 –mil and 1.2- mil and with minimum salt spray resistance of 6,000 hours.

Individual finned-tube cooling coils five or fewer rows may have a maximum of 12 fins per inch. Individual finned-tube cooling coils of six rows or more should not exceed 10 fins per inch.

### 5.3.3.5 BOILERS

Boilers for hydronic heating applications must be modular units. Boilers must be installed in a mechanical room with all provisions made for breaching, flue stack, and combustion air.

Boilers must meet the minimum Federal Energy Management Program (FEMP) efficiency requirements.

### 5.3.3.6 HYDRONIC, STEAM, NATURAL GAS, AND FUEL OIL PIPING

HYDRONIC

Materials acceptable for hydronic piping are black steel and copper. Specify ASTM A53 Sch 40 black steel pipe up to 12 in. diameter. For hydronic piping 12 in. and larger, use schedule 30 pipe. For copper piping, specify type L copper for above ground and type K for below ground.

STEAM and CONDENSATE

Steam piping all sizes use ASTM A53 Sch 40 and for all steam condensate use ASTM Sch 80.

FUEL OIL

Fuel oil piping shall be ASTM Sch 40.

NATURAL GAS

Natural gas piping shall be ASTM Sch 40. Only Sch 40 black steel pipe is acceptable. Gas piping shall comply with Chapter 4 of International Fuel Gas Code. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but shall not be used in concealed locations.

STEEL PIPE FITTINGS

For steel piping, threaded malleable iron fittings for 50mm (2”in.) and under, and welded Sch 40 fittings for pipes 64mm (2 ½”) and over are acceptable.

Grooved fittings are acceptable for water services 110-deg C (230 deg F) and under. All grooved products shall be of a single manufacturer. The grooving tool shall be of the same manufacturer as the grooved components. The grooved manufacturer shall provide on-site training for the contractor’s field personnel and shall periodically visit the job site to ensure best practices in grooved joint installation are being followed. Grooved pipe and fittings shall not be installed in concealed spaces, shafts, or above hard ceilings. Coordinate access for future repairs or replacements.

Steel Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but shall not be used in concealed locations.

COPPER PIPE FITTINGS

For copper piping, brazed, soldered, and press-seal (test to 2100 1050 kPa [300 150 psig]) fittings are acceptable. Grooved or mechanically formed T-type fittings are not acceptable. Piping shall not be installed in concealed locations when press-seal fittings are used.

Refrigerant piping shall be Type ACR or Type K copper with brazed joints.

### 5.3.3.7 HYDRONIC PUMPS

Pumps shall be centrifugal type and shall generally be selected to operate at 1750 RPM. The number of primary pumps shall correspond to number of boilers, chillers, or cooling tower cells plus a stand-by pump. Secondary piping system shall be provided with variable flow pumping system with a stand-by pump.

### 5.3.3.8 ISOLATION OF PIPING AT EQUIPMENT

Isolation valves, shutoff valves, bypass circuits, drain valves, flanges, and unions must be provided for piping at equipment to facilitate equipment repair and replacement. Equipment requiring isolation includes boilers, chillers, pumps, coils, terminal units, and heat exchangers. Valves must also be provided for zones off vertical risers, including drain valves.

### 5.3.3.9 HOUSEKEEPING PADS

Housekeeping pads for the floor mounted equipment shall be minimum 152 mm (6 in.) high and shall extend minimum 102 mm (4 in.) beyond on all sides of the equipment they support.

### 5.3.3.10 FLEXIBLE PIPE CONNECTORS

Flexible pipe connectors must be fabricated from annular close pitched corrugated and braided stainless steel. All pumps, chillers, cooling towers, and other rotating equipment must have flexible connectors. All flexible piping must be sized one size larger than the piping connected size.

### 5.3.3.11 COOLING TOWERS

Galvanized steel is prohibited on water contact surfaces for cooling towers.

### 5.3.3.12 METERS, GAUGES, AND FLOW MEASURING DEVICES

Each piece of mechanical equipment must be provided with instrumentation in addition to test ports to verify critical parameters, such as capacity, pressures, temperatures, and flow rates. Each meter, gauge, and flow measuring device must be calibrated before startup and

must have provisions for periodic calibration at its location. All the metering devices must be capable of transmitting information to the central BAS for monitoring and control.

## 5.3.4 AIR DISTRIBUTION

### 5.3.4.1 AIR DELIVERY DEVICES

Ceiling diffusers or booted-plenum slots must be specifically designed for VAV air distribution. Booted plenum slots must not exceed 1.2 m (4 ft.) in length unless more than one source of supply air is provided. The locations of the air delivery devices and the ranges of their outlet airflow rates must be selected to ensure that the air diffusion performance index values remain above 80 percent during all full-load and part-load conditions, and below the specified noise level to achieve the background noise criteria, in accordance with the test procedures specified in Appendix A of ASHRAE Standard 113. Adequate space ventilation requires that the selected diffusers effectively mix the total air in the room with the supplied conditioned air that contains adequate ventilation air.

Shall be submitted in Basis of Design:

| Application | Controlling Factor–Noise Generation | | | |
|---|---|---|---|---|
| | Main Ducts | | Branch Ducts | |
| | m/s | fpm | m/s | fpm |
| Private offices<br>Conference rooms<br>Libraries | 6 | 1,200 | 4 | 800 |
| Theaters<br>Auditoriums | 4 | 800 | 2 | 400 |
| General offices | 7.5 | 1,500 | 5 | 1,000 |
| Cafeterias | 9 | 1,800 | 6 | 1,200 |

**Table 5.3 Recommended Air Velocities for Supply, Ducted Return, and Exhaust**

#### 5.3.4.2 NOISE CONTROL IN DUCT SYSTEMS

Acoustic duct lining used in air systems shall be non-fiberglass material impregnated with an antimicrobial agent and, above 6 m/s (1200 fpm), covered by an internal perforated sheet metal liner.

### 5.3.5 WATER TREATMENT

#### 5.3.5.1 SUBMITTAL REQUIREMENTS

A licensed water treatment specialist must design the water treatment for closed and open hydronic systems with consideration of the operational and maintenance needs of all system equipment, including such components as boilers, chillers, cooling towers, other heat exchangers, pumps, and piping. The design must address four aspects of water treatment: biological growth, dissolved solids and scaling, corrosion protection, and environmental discharge regulations. Subject to the specific requirements of the components, the performance of water treatment for closed and open systems must include:

#### 5.3.5.2 CLOSED SYSTEMS

- The pH must be in the ranges of 8.5–9.5 for chilled water systems, and 9–10.5 for heating water systems.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- Total dissolved solids must have a maximum value not to exceed 1500 ppm.

#### 5.3.5.3 OPEN SYSTEMS

- The pH of the water must be maintained between 7.5 and 9.5.
- The alkalinity of the water must be maintained between 100 and 500 ppm.
- The iron content of the water must have a maximum value not to exceed 3 ppm.
- Soluble copper must have a maximum value not to exceed 0.2 ppm.
- Total dissolved solid must have a maximum value of 1500 ppm.
- Total aerobic plate counts shall have maximum values not to exceed 1,000 organisms/ml, and an additional limit of 10 CFU/ml Legionella.

The methods used to treat the systems' makeup water must have demonstrated prior success in existing facilities on the same municipal water supply and must follow the guidelines outlined in ASHRAE Applications Handbook.

The chemical feed system must have BACnet or LonTalk self-contained controls.

#### 5.3.5.4 CORROSION MONITORING

The Contractor shall install coupon racks, or an equivalent electronic monitoring system for corrosion, in condenser water loops, heating hot water loops, and the building main chilled water loop, if not already present, not later than 30 calendar days after submission of the water treatment plan. (For the primary condenser water system, the installation of the water treatment monitoring system described elsewhere in this document meets this requirement.) The Contractor shall propose the type and manufacture of the proposed coupon racks to be installed to the CO or their designee for final approval before installation. If coupon racks are present, the Contractor may use such existing equipment, but is responsible for bringing it into conformity with all requirements in this document. The minimum quantity of coupons and frequency of inspections shall be described in the water treatment plan. Laboratory analysis of coupons shall be no less frequent than quarterly for major

systems (e.g., primary building condenser and chilled water loops, as opposed to specialized systems serving limited areas), and annually for other systems. At a minimum, two coupon racks shall be installed for each loop, and used to monitor mild steel and copper. Coupon racks will be the property of the Government upon installation. The Contractor shall have responsibility for maintaining (and if necessary replacing) the coupon racks for the duration of the Contract. The liability threshold for repairs does not apply to this equipment; the Contractor has full responsibility. Acceptable corrosion rates are established in the most current Public Buildings Service Operations and Maintenance Standards. Molybdenum shall not be used in GSA buildings.

#### 5.3.5.5 PRIMARY HEATING SYSTEMS

GSA requires low-temperature hot water heating systems, with the lowest working pressure suitable for the system and a maximum temperature limitation of 93.3°C (200°F).

#### 5.3.5.6 DISTRICT STEAM HEATING

When steam is furnished to the building, it must be converted to hot water with a heat exchanger in the mechanical room near the entrance into the building. Steam heating is discouraged inside the building, other than the conversion of steam to hot water in the mechanical room.

The designer must investigate the use of district steam condensate for preheating domestic hot water.

#### 5.3.5.7 HOT WATER HEATING SYSTEMS

If glycol is used for freeze protection, it must be propylene glycol; use of ethylene glycol is prohibited.

#### 5.3.5.8 PIPING SYSTEMS

Hot water and chilled water air systems must use a four-pipe main distribution system. Dual temperature piping systems are not permitted.

#### 5.3.5.9 PIPING INSULATION

Pipes operating at a temperature below ambient must be insulated with closed-cell insulation with all joints sealed and having a system permeance of ≤0.02 perms, such as cellular glass, or with closed-cell insulation covered with a continuous vapor retarder with a permeance of ≤0.02 perms. All insulation and vapor retarder materials must meet the appropriate ASTM material standard for that type.

### 5.3.6 PLUMBING FIXTURES

Plumbing fixtures must comply with the International Plumbing Code and local building codes.

In compliance with EISA 2007 Section 433(a), water conservation technologies must be applied to the extent that the technologies are life-cycle cost-effective.

GSA requires the use of plumbing products labeled under the EPA WaterSense program. WaterSense is a partnership program sponsored by the U.S. Environmental Protection Agency. Its mission is to protect the future of our nation's water supply by promoting and enhancing the market for water-efficient products and services.

More information is available at EPA WaterSense: www.epa.gov/watersense.

Plumbing fixture accessibility clearances, installation, and accessories must be compliant with the Architectural Barriers Act Accessibility Standard (ABAAS).

All plumbing fixtures must be water-conserving/saving-type fixtures, faucets, and valves. Low-flow water fixtures must be provided.

#### 5.3.6.1 WATER CLOSETS (TOILETS)—FLUSHOMETER VALVE TYPE

Water closets must be either dual-flush or low-flow type, manually controlled. For single flush, maximum flush volume when determined in accordance with ASME A112.19.2–4.8 L (1.28 gal). For dual-flush, effective flush volume determined in accordance with ASME A112.19.14 and USEPA WaterSense Tank-Type High Efficiency Toilet Specification–4.8 L (1.28 gal).

#### 5.3.6.2 HIGH EFFICIENCY TOILETS (HET) WATER CLOSETS—TANK-TYPE

Tank-type water closets must comply with the performance criteria of the U.S. EPA WaterSense Tank-Type High-Efficiency Toilet Specification.

#### 5.3.6.3 HIGH EFFICIENCY URINALS (HEU)

Urinals must be low-flow, flush-type fixtures. Maximum flush volume when determined in accordance with ASME A112.19.2–0.5 L (0.125 gal).

#### 5.3.6.4 PUBLIC LAVATORY FAUCETS

Use metered-type faucets for lavatories. Maximum water use—1.0 L 0 (.25 gal) per metering cycle when tested in accordance with ASME A112.18.1/CSA B125.1.

#### 5.3.6.5 KITCHEN FAUCETS

Maximum water use—6.8 L/min (1.8 gpm) when tested in accordance with ASME A112.18.1/CSA B125.1.

#### 5.3.6.6 EMERGENCY FIXTURES

Eyewash (0.025 L/s [0.4 gpm] per fountain), face wash (0.2 L/s [3 gpm] each), or shower (1.3 L/s [20 gpm] each) must be tempered immediately at the fixture or group of fixtures within 7.6 m (25 ft) to deliver tepid water between 29°C (85°F) and 37.8°C (100°F), at 0.207 megapascal (30 psi), within 10 seconds, for a minimum period of 15 minutes, and must account for temperature drop across the valve (generally 7°C or 20°F) at flow.

#### 5.3.6.7 SOLAR WATER HEATING

In compliance with EISA 2007, if lifecycle cost-effective, as compared to other reasonably available technologies, not less than 30 percent of the hot water demand for each new Federal building or Federal building undergoing a major renovation must be met through the installation and use of solar hot water heaters.

#### 5.3.6.8 PLUMBING PIPING

SANITARY, WASTE, VENT, AND STORM PIPNG

Sanitary, waste, vent, and storm piping above ground shall be hub and spigot service weight cast iron pipe and fittings with compression gaskets conforming to the requirements of ASTM C564 or hubless pipe and fittings shall be service weight cast iron pipe and fittings conforming to ASTM A 888 with heavy duty couplings complying with ASTM C1277 and ASTM C1540, stainless steel shield with stainless steel bands (4 straps) with tightening devices. A two strap fitting does comply with code but a 4 strap is mandatory. ASTM C564 rubber sleeve with integral enter rubber stop will not be accepted.

No PVC pipe and fittings allowed. Type DWV Copper piping with soldered joints may be used for piping above ground (except for urinal drains)

in lieu of cast iron pipes for pipe sizes 102 mm (4”) and under. Where copper tubing is used for urinal drains, the tubing shall be “K” copper. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but shall not be used in concealed locations.

Sanitary, waste, vent, and storm piping below ground shall typically be hub and spigot service weight cast iron pipe and fittings with compression gaskets conforming to the requirements of ASTM C564. Plastic piping used for underground installations shall be one standard schedule or SDR higher than required by code or calculations.

DOMESTIC WATER PIPING

Above ground domestic water piping shall be Type L copper with lead free soldered joints. Press fitting systems may be used between ½" to 2" where approved by code and with proper approvals and certifications but shall not be used in concealed locations.

#### 5.3.6.9 GAS AND FUEL OIL PIPING

See section 5.3.3.6 for gas and fuel oil piping requirements.

#### 5.3.6.10 FUEL STORAGE TANKS

Aboveground storage tanks (ASTs) and underground storage tanks (USTs) used to store fuel are herein referred to collectively as fuel storage tanks (FST). All newly installed FSTs shall be installed in accordance with all Federal, state and local regulatory requirements, codes and GSA Policy.

USTs shall meet the regulatory design, monitoring, and installation criteria for USTs whether or not the UST meets the regulatory definition of a regulated UST. Each new UST shall also be equipped with an automatic tank gauge (ATG).

Upgrades to USTs shall meet current regulatory requirements and include a method of continuous leak detection that can detect a release from any portion of the tank and the connected underground piping that routinely contains product. Based on engineering soundness, existing tanks shall also be retrofitted with ATGs.

Aboveground storage tanks shall be equipped with a method of leak detection and appropriate secondary containment.

### 5.3.7 OPERABILITY AND MAINTAINABILITY

#### 5.3.7.1 ACCESSIBLE FOR MAINTENANCE

Install equipment so that it can be safely and easily maintained and inspected. Comply with requirements for mechanical room sizes and manufacturer’s recommended clearances around installed equipment.

Do not install equipment that requires maintenance below a raised access floor.

#### 5.3.7.2 SIMPLE/UNDERSTANDABLE TO OPERATE

The sequence of operation for the control systems must be clearly described and comprehensively documented. The HVAC system design should minimize the need for overly complex control systems.

#### 5.3.7.3 OPERATIONS

Design the HVAC system so that equipment failures and normal maintenance have minimal impact on the tenants. Failure of one piece of equipment should not shut down large portions of the building. Install piping and valves so that

equipment can be easily isolated for repair and so that different combinations of equipment can be used during replacement and overhaul. Equipment components, spare parts, and materials should be readily available and the equipment should be repairable by crafts people available in the local area. This is especially important in the remote locations of some Land Ports.

#### 5.3.7.4 ROBUST AND RELIABLE: EXTENDED LIFE EXPECTANCY

Public buildings have a longer life expectancy than most commercial office buildings. Forty percent of GSA's occupied inventory is over 50 years old. Many buildings are over 100 years old and are expected to continue in service for decades to come. HVAC systems are expected to have extended service lives. They will be modified many times over the life of the building and operated by many different maintenance firms and occupied by many different tenants. Selection of robust, reliable, energy efficient equipment is important. Systems that can be reliably operated at near design conditions over the long term are needed.

### 5.3.8 ALTERATIONS IN EXISTING BUILDINGS AND HISTORIC STRUCTURES

The following steps must be followed for HVAC work in historic buildings:

- Design HVAC systems to avoid affecting other systems and historic finishes, elements, and spaces.
- Place exterior equipment where it is not visible. Recess equipment from the edge of the roof to minimize visibility of the equipment from grade. Alternatively, explore creating a vault for easier access to large mechanical equipment. If equipment cannot be concealed, specify equipment housings in a color that will blend with the historic face. As a last resort, enclose equipment in screening designed to blend visually with the facade.
- Locate equipment with particular care for weight and vibration on older building materials. These materials cannot accept the same stress as when the equipment is used in newer construction.
- If new ceilings are to be installed, ensure that they do not block any light from the top of existing windows or alter the appearance of the building from the outdoors. Original plaster ceilings in significant spaces, such as lobbies and corridors, must be retained to the extent possible and modified only as necessary to accommodate horizontal distribution. Use soffits and false beams where necessary to minimize the alteration of overall ceiling heights.
- In buildings containing ornamental or inaccessible ceilings, piping and ductwork must be routed in furred wall space or exposed in the occupiable building area. Exposed ducts must also be considered in historic industrial buildings with open plan, tall ceiling, and high window spaces suited to flexible grid/flexible density treatments.
- If new vertical air distribution risers are required, they should be located adjacent to existing shafts.
- Select system types, components, and placement to minimize the alteration of significant spaces. In previously altered spaces, design systems to allow historic surfaces, ceiling heights, and configurations to be restored. Reuse of HVAC system elements is permitted only with written

documentation obtained from GSA Property Management by the A/E.

- Retain decorative elements of historic systems where possible. Ornamental grilles and radiators and other decorative elements must be retained in place.
- Retain and enhance the performance of the original type of system where a new one cannot be totally concealed or would adversely affect historic spaces or features. For example, adapt existing radiators with modern heating and cooling units, rather than adding another type of system that would require the addition of new ceilings or other non-original elements.
- To the greatest extent possible, ensure that space is available to maintain and replace equipment without damaging significant features and select components that can be installed without dismantling window or door openings. Select temperature and humidity conditions that do not cause deterioration of building materials.

Refer to HVAC Upgrades in Historic Buildings https://www.gsa.gov/cdnstatic/HVAC.pdf for additional guidance.

## 5.4 WHOLE BUILDING ENERGY PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Whole Building Energy Performance** | | | | | | | | | |
| **Reference** | EISA 2007 Section 433, Executive Order 13693, Guiding Principles for Sustainable New Construction and Major Renovations | EISA 2007 Section 433, Executive Order 13693, Guiding Principles for Sustainable New Construction and Major Renovations | EISA 2007 Section 433, Executive Order 13693, Guiding Principles for Sustainable New Construction and Major Renovations | EISA 2007 Section 433, Executive Order 13693, Guiding Principles for Sustainable New Construction and Major Renovations | | | | | |
| | ASHRAE 90.1 | ASHRAE 90.1 | ASHRAE 90.1 | ASHRAE 90.1<br>U.S. Department of Energy, Zero Energy Buildings: A Critical (Washington, DC: GPO, 2006), 6-7. Definition of Net Zero Site Energy. | | | | | |
| **Whole Building Energy Utilization** | 30% reduction in energy usage compared to an ASHRAE Standard 90.1 baseline building as analyzed using the informative Appendix G | 40% reduction in energy usage compared to an ASHRAE Standard 90.1 baseline building as analyzed using the informative Appendix G | 50% reduction in energy usage compared to an ASHRAE Standard 90.1 baseline building as analyzed using the informative Appendix G | The expected annual EUI when the building is designed in compliance with a goal to achieve zero-net-energy (ZNE) | Baseline thru Tier 3 High Performance: No | Baseline thru Tier 3 High Performance: No | Provide 90.1 Appendix G energy model demonstrating whole building energy performance. | Provide written narrative showing how energy model meets energy reduction target. | Cx agent to confirm energy model material and equipment performance assumptions on design reviews and submittal reviews.<br><br>Calibrate building energy model to first year building historical data and compare energy performance to actual measured energy performance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **Whole Building Energy Performance** | | | | | | | | | |
| **Whole-Building Carbon Emissions Reduction** | Reduce fossil fuel-generated energy consumption by 65% when compared to a similar building in most recent CBECS Database | Reduce fossil fuel-generated energy consumption by 80% when compared to a similar building in most recent CBECS Database | Reduce fossil fuel-generated energy consumption by 90% when compared to a similar building in most recent CBECS Database | Reduce fossil fuel-generated energy consumption by 100% | Baseline thru Tier 3 High Performance: No | Baseline thru Tier 3 High Performance: No | Provide calculation showing fossil-fuel based energy reduction compared to a similar building in FY 2003. | Provide written narrative showing how building meets carbon reduction target. | Calculate fossil-fuel based energy used in the first year of operation from utility bills as kBtu/ft2-yr. |
| **Whole-Building Metering** | All major utilities | Baseline, plus All major building systems | Tier 1 High Performance, plus Building subsystems | Tier 2 High Performance, plus Tenant Metering | Baseline thru Tier 3 High Performance: No | Baseline thru Tier 3 High Performance: No | | Describe proposed building metering and subsystem metering scheme. | Calibrate all meters and provide 2 weeks of 15 minute trend history for all HVAC meters. |

## 5.5 WHOLE BUILDING PERFORMANCE ATTRIBUTES

### 5.5.1 ENERGY PERFORMANCE

The attribute of energy performance considers the whole building synergistically and measured with respect to both energy utilization (consumption) and carbon emissions (total or source) on an annual basis.

Federal law requires minimum levels of performance for Federal facilities and total portfolio performance for Federal agencies. The related attribute of energy cost is a driving requirement in terms of systems selection, particularly thermal storage and demand peak shaving/load offset.

Energy cost, however, is not a direct report for P100 Performance, as it is possible to decrease energy consumption without a corresponding decrease in the annual cost of energy. It is possible to decrease the annual energy cost while experiencing an increase in annual energy consumption through technologies such as thermal storage. Because this would be counter to the goals of the Federal mandates, it is for this reason that only energy consumption and carbon emissions are to be measured here.

Figure 11: Federal Center South Interior, Seattle, WA

# 6

# ELECTRICAL ENGINEERING

Figure 12:
Bishop Henry Whipple
Federal Building
Electrical Switchgear
Fort Snelling, MN

# 6.1 LIGHTING PERFORMANCE REQUIREMENTS

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **6.2.1 Lighting Quality - Interior Electric** | | | | | | | | | |
| **Luminance Balance** | Minimum of 40 to 1 | 3 to 1 (task to immediate surround); 20 to 1 (non work areas) | 3 to 1 (task to immediate surround); 10 to 1 (non work areas) | 3 to 1 (task to immediate surround); 10 to 1 (non work areas) | Yes | Yes | Provide photometric calculations. | Describe luminance balance requirements. | Using photometer measure footcandle levels at task and at immediate surroundings at 3' above floor level . Record illumination levels in footcandles and verify conformance to attribute. |
| **Spectral Distribution** | | | | | | | | | |
| **CCT** | <4100K | Tunable between the ranges of 3000 t0o 6200K | Tunable between the ranges of 3000 t0o 6200K | Tunable between the ranges of 3000 t0o 6200K | Yes | Yes | | Document color temperature requirements. | Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute. (Deleted CRI) |
| **CRI** | ≥80 | ≥80 | ≥90 | ≥90 | | Yes | | Document color rendering index requirements. | |
| **Lighting Layers** | | | | | | | | | |
| **Ambient** | Yes | Yes | Yes | Yes | Yes | Yes | | Describe how ambient lighting requirement is met. | Verify provision of ambient lighting layer after construction |
| **Personalized** | Minimal | Task | Personal | Personal | Yes | Yes | | Describe task lighting system. | Verify provision of personal lighting layer after construction. |
| **User Acceptance** | >60% | >70% | >80% | >90% | | | Yes | Describe how this POE Survey will be implemented. | Survey users after installation to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users. |
| **6.2.1 Lighting Quality - Interior Daylight** | | | | | | | | | |
| **Luminance Balance** | Manual | Manual View Preserving Blinds | Manual View Preserving Blinds | Automatic View Preserving Blinds | Yes | Yes | | Describe blind system to preserve luminance balance. | Verify provision of the blinds during design submittal. |
| **Lighting Layers** | None | Maximize daylight access with toplighting, sidelighting, interior glazing, and low partitions on the perimeter spaces. | | | Yes | Yes | Yes | Describe lighting layers utilized in design. | Confirm provision of daylighting during submittal review |
| **Visual Comfort (Glare)** | Manual | Manual View Preserving Blinds | Manual View Preserving Blinds | Automatic View Preserving Blinds | Yes | Yes | | Describe blind system to preserve luminance balance. | Verify provision of the blinds during design submittal. |
| **User Acceptance** | >60% | >70% | >80% | >90% | | | Yes | Describe how this POE Survey will be implemented. | Survey users after installation/occupancy to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users. |
| **Views (11 degree minimum)** | Minimal | 50% | 80% | 100% | Yes | Yes | | Document provision of views in basis of design | Measure angle of views from each user to confirm direct views to daylight/outside. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **6.2.1 Lighting Quality - Exterior** | | | | | | | | | |
| **Spectral Distribution** | | | | | | | | | |
| **CCT** | <4100K | <4100 | <4100K | <4100K | Yes | Yes | | Describe color temperature requirement. | Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute. |
| **CRI** | ≥80 | ≥90 | ≥90 | ≥90 | | Yes | | Describe color rendering index requirement. | |
| **Environmental** | <3500K | <3500K | <3500K | <3500K | Yes | Yes | | Describe color temperature requirements. | Use luminance meters with built in color sensors to confirm CCT and verify conformance with attribute. |
| **User Acceptance** | >60% | >70% | >80% | >90% | | | Yes | Describe how this POE Survey will be implemented. | Survey users after installation/occupancy to determine the percentage of users that are satisfied with lighting quality and quantify the percentage of satisfied users. |
| **Light Pollution / Light Trespass** | Meet BUG ratings per lighting zone of site | Meet BUG ratings per LZ2 | Meet BUG ratings per LZ1 | Meet BUG ratings per LZ1 | | Yes | | Describe BUG ratings for fixtures. | Verify luminaire BUG ratings during submittal review. |
| **6.2.2 Lighting Quantity - Interior Electric** | | | | | | | | | |
| **Illuminance** | | | | | | | | | |
| **Horizontal** | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook | | | Provide photometric calculations. | Describe horizontal illuminance requirements. | Measure light levels at 3' A.F.F. using a footcandle meter after installation/commissioning to verify compliance with IES. |
| **Vertical** | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook adjustable | Meets IES 10th Handbook adjustable | | | Provide photometric calculations. | Describe vertical illuminance requirements. | Measure light levels on vertical surfaces/walls using a footcandle meter after installation/commissioning to verify compliance with IES. |
| **Availability** | | | | | | | | | |
| **Surface Reflectance (Ceiling/Wall/Floor)** | >80/50/20 | >90/60/20 | >90/70/25 | >90/70/30 | Yes | Yes | | Define accepted surface reflectance of ceiling/wall and floor. | Measure surface reflectance levels using a reflectance meter after installation/commissioning to verify compliance. |
| **Operational Efficiency** | | | | | | | | | |
| **Ambient** | None | 80% | 70% | 60% | Yes | Yes | Provide calculations. | Define percentage of ambient lighting. | Measure provision of ambient lighting levels as a percentage of overall lighting using a footcandle meter after installation/commissioning to verify compliance. |
| **Personalized** | None | 20% | 30% | 40% | Yes | Yes | Provide calculations. | Define percentage of personalized lighting. | Verify conformance by calculating the installed percentage of personalized lighting to overall lighting. |
| **Daylight Autonomy** (10-500 fc) | Meets ASHRAE 90.1 | Meets ASHRAE 90.1 | Meets ASHRAE 90.1 | Meets ASHRAE 90.1 | Yes | Yes | | Describe provision of daylighting autonomy to meet ASHRAE 90.1. | Provide daylight model as part of submittals to verify compliance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **6.2.2 Lighting Quantity - Exterior** | | | | | | | | | |
| **Illuminance** | | | | | | | | | |
| **Horzontal** | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook | Yes | Yes | Provide photometric calculations. | Define acceptable exterior illuminance levels in conformance with IES 10th HB. | Measure horizontal light levels at pavement/grade using a footcandle meter after installation/commissioning to verify compliance with IES. |
| **Vertical** | Meets IES 10th Handbook | Meets IES 10th Handbook | Meets IES 10th Handbook (adjustable) | Meets IES 10th Handbook (adjustable) | Yes | Yes | Provide photometric calculations. | Define acceptable illuminance levels in conformance with IES 10th HB. | Measure light levels using a footcandle meter after installation/commissioning on vertical walls/facades to verify compliance with IES. |
| **6.2.3 Lighting Energy Use - Interior Electric** | | | | | | | | | |
| **System Efficiency** | Exceeds ASHRAE 90.1 by 30% | Exceeds ASHRAE 90.1 by 40% | Exceeds ASHRAE 90.1 by 50% (performance) | Exceeds ASHRAE 90.1 by 70% (performance) | Yes | Yes | Yes | Provide ASHRAE 90.1 Appendix G energy model demonstrating lighting annual energy does not exceed project target. | Measure interior lighting energy after installation/commissioning and confirm percentage exceeding ASHRAE requirements by documenting the ratio of actual interior lighting power density to ASHRAE allowed lighting power density and calculate/document actual percentage. |
| **Controls** | Addressable + personal | Addressable + personal | Addressable + personal | Addressable + personal | Yes | Yes | | Describe lighting control system. | Verify control system operation/commission system after installation to verify compliance. |
| **Real Time Energy Use** | Minimal | Modeling | Modeling + Monitoring | Modeling, Monitoring, Feedback | | Yes | Yes | Describe real time energy use scheme proposed in the design. | Document interior lighting energy after installation/commissioning and confirm/document actual interior lighting energy consumed to modeled energy. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 High Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Design | Construction |
|---|---|---|---|---|---|---|---|---|---|
| **6.2.3 Lighting Energy Use - Exterior** | | | | | | | | | |
| **Lighting Power Density** (w/sf) | Exceeds 90.1 by 30% if life-cycle cost effective | Exceeds 90.1 by 40% | Exceeds 90.1 by 50% (performance) | Exceeds 90.1 by 60% (performance) | | Yes | Provide calculations. | Provide requirement for describing exterior lighting energy separately and showing exceeding ASHRAE requirements. | Measure exterior lighting energy after installation/commissioning and confirm percentage exceeding ASHRAE requirements by documenting the ratio of actual exterior lighting power density to ASHRAE allowed lighting power density and calculate/document actual percentage. |
| **Controls** | Nighttime setback controls added (Not less than 50% maximum output) | Nighttime setback controls added (Not less than 50% maximum output) | Network Controls (Not less than 50% maximum output) | Network Controls (Not less than 50% maximum output) | Yes | Yes | | Describe lighting control system. | Verify control system operation/commission system after installation to confirm nighttime set back controls at less than 50%. |
| **Real Time Energy Use** | Minimal | Modeling | Modeling + Monitoring | Modeling, Monitoring, Feedback | | Yes | Yes | Describe real time energy use scheme proposed in the design. | Document exterior lighting energy after installation/commissioning and confirm/document actual exterior lighting energy consumed to modeled energy. |
| **6.2.4 Power Quality** | | | | | | | | | |
| **Power Factor (Full Light Output)** | >0.90 | >0.90 | >0.90 | >0.95 | | Yes | | Describe power factor accepted values in basis of design for lighting at full brightness | Use power meter to confirm ratio of total active to reactive power to confirm the power factor of the system. Measure input power on light fixtures circuits to confirm the parameter and verify compliance. |
| **Power Factor (Fully Dimmed)** | .>.75 | .>.80 | .>.85 | .>.85 | | Yes | | Describe power factor accepted values in basis of design for lighting at lowest lighting levels | Use power meter to confirm ratio of total active to reactive power to confirm the power factor of the system. Measure input power on light fixture circuits to confirm the parameter and verify compliance |
| **Total Harmonic Distortion at the LED driver (Full Light Output)** | <20% | <15% | <10% | <5% | Yes | Yes | | Describe acceptable percentages of total harmonic distortion in drivers. | ` |
| **Total Harmonic Distortion at the LED driver (Fully Dimmed)** | <30% | <30% | <20% | <20% | Yes | Yes | | | |
| **Wiring** | Run separate neutral for each circuit | Run separate neutral for each circuit | Run separate neutral for each circuit | Run separate neutral for each circuit | | Yes | | Indicate provision of a separate neutral for each lighting circuit in basis of design. | Provide in Lighting specifications and confirm by inspecting during installation to verify compliance. |
| **6.2.5 Maintenance** | | | | | | | | | |
| **Equipment Life** | 5 Yr Warranty | 10 Yr Warranty | 10 Yr Warranty | 15 Yr Warranty | | Yes | | Describe warranty for each equipment. | Verify through light fixture submittals and warranty certificates. |
| **Accessibility** | Coordinate design with facilities maintenance to ensure all luminaires can be reached with lifts, ladders, etc. | | | | Yes | Yes | Yes | Provide requirement for easy access to luminaires and their components. | Verify installation of fixtures heights and locations in shop drawing submittal and actual heights and clearances after installation. |
| **Diagnostics** | Minimal | Minimal | Full Ability | Full Ability + Predictive | Yes | Yes | | Describe the ability to diagnose lighting systems. | Verify through shop drawing submittal and product submittal information. |
| **6.2.6 Service Life** | | | | | | | | | |
| **Replacement** | 10 Years | 15 Years | 20 Years | 20 Years | | Yes | | Describe serviceable life of lighting system. | Verify through light fixture submittals and warranty certificates. |
| **Retrofit** | 2 Years | 5 Years | 10 Years | 10 Years | | Yes | | Describe service life requirement for retrofit of system. | Verify through light fixture submittals and warranty certificates. |

## 6.2 LIGHTING PERFORMANCE ATTRIBUTES

The following attributes make up a lighting system for any space. The descriptions below do not isolate electric lighting from daylighting. Instead, the attributes apply to both sources of light and continually interact throughout the day to provide adequate and appropriate visibility.

### 6.2.1 LIGHTING QUALITY

The quality of a visual environment considers a wide range of variables including luminance balance, color appearance, visibility of multiple visual tasks (often accomplished by a layered lighting system), visual comfort, daylight and views, control and finally, user acceptance.

Luminance balance refers to the brightness of surfaces (vertical and horizontal) within the view of an occupant. When excessive brightness and darkness are combined in the same view, the contrast leads to visual discomfort and even headaches as the eyes continually adjust between the extremes. Balancing these luminance values means maintaining good uniformity between all the surfaces that make up a field of view. Lighting the vertical wall surfaces is one of the best ways to improve luminance balance. Since luminance, especially for interior areas, is difficult to calculate, the IES 10$^{th}$ Edition Handbook recommends illuminance and uniformity values for vertical surfaces such as walls. If surfaces have very low reflectance values such as dark wooden walls, these illuminance values may need to be increased.

Color appearance is made up of the correlated color temperature (CCT–the color of the light source) and the color rendering index (CRI–how well the light portrays the color of objects), as well as the individual wavelengths that make up the light (the Spectral Power Distribution [SPD]).The R9 value refers to a specific rating of the red component of the light color.

Office and industrial building occupants generally prefer warm to neutral color temperatures in the 3000-4100K range. Cooler colors than this can produce slightly higher visual acuity in some applications but may also create a sense of starkness and institutionalism. Tunable lighting allows occupants to automatically (or manually) change ambient light color in the ranges of 3000-6200K to better match occupants' body circadian rhythm.

Layering the lighting system with ambient, task, and accent light creates variety in spaces and makes it easier to maintain the luminance balance. An ambient layer provides a low level of diffuse lighting that can help illuminate objects and people's faces, which is helpful for general wayfinding, face-to-face communication, and a sense of brightness, and illuminates the architectural surfaces, such as the walls and ceiling. Task lighting provides the actual quantity of light necessary to perform a job (such as reading paperwork or filing) and draws the eye to the work surface. Accent lighting adds emphasis and visual variety in a space. Luminance balance means keeping enough brightness variety in the space to make it interesting and to highlight work areas, without making the lighting appear spotty or full of shadows.

Visual comfort relates mostly to glare from any light source–a luminaire, window, skylight, etc. Unfortunately, glare tolerance is often subjective and varies between individuals. Glare is controlled by selecting luminaires that direct their light toward the ceiling, walls, or work areas, but not into the employee's eyes. Louvers,

shields, fins, overhangs, and blinds all reduce glare from windows and skylights; louvers, lenses, baffles, and the optics of the luminaire control glare from electric sources.

Closely related to visual comfort, views to the outdoors are essential parts of visual comfort– providing a link to activity, changes in time and weather, more organic forms, and other variety for the eyes. However, care must be taken to eliminate unwanted glare and excessive brightness that can occur at some times of day at some times during the year. Glare from windows must be minimized and balanced with the other views of the space.

Lighting control is essential for the users. View-preserving blinds or shades minimize direct sun and glare from windows or skylights. Personal controls give the individual user the ability to adjust task lighting and balance brightness in their own workstation. Automatic controls for daylight dimming and occupancy save energy.

The true test of a quality lighting system is customer feedback. Post-occupancy evaluation of the daylighting, views, electric lighting, and controls will be the best evaluator of the lighting quality success.

All of these components result in some level of user acceptance of the lighting system.

- Baseline: Does not have any requirements for vertical surface illuminance or color appearance, allows for CCT up to 4100K and minimum CRI of 80. Minimum illuminance uniformity ratio shall be 40:1. The baseline also has no minimal requirements for task lighting, glare control, and access to views.
- Tier 1 High Performance (★): This level requires maximum illuminance uniformity ratios of 20:1 , Tunable CCT ambient overhead lighting between the ranges of 3000 to 6200K shall be provided for a more natural lighting environment and help coincide with the human circadian functions, and CRI of at least 80. It also requires task lighting, direct/indirect ambient lighting, view-preserving blinds, and views for at least 50 percent of regularly occupied areas.
- Tier 2 High Performance (★★): Raises uniformity ratios to 10:1 and CRI to 90. The R9 value shall have a minimum value of 50 with tunable CCT ranges of 3000 to 6200K. Occupants should have personal control over their entire work area or task lighting and access to views is increased to 80% of regularly occupied area.
- Tier 3 High Performance (★★★): This performance level continues Tier 2 High Performance (★★).

### 6.2.2 LIGHTING QUANTITY

The quantity of light is easier to measure and verify than the many components of lighting quality.

Illuminance measures the quantity of light falling on a surface (either vertical or horizontal). Recommended values of illuminance can be found in Table 6-1 below and as stipulated by the Illuminating Engineering Society (IES).

| Interior Lighting Requirements* | | |
|---|---|---|
| **Area/Activity** | Required Illuminance Average Lighting Levels | |
| | Lux | Fc |
| **Office Enclosed (ambient)** | 323 | 30 |
| **Office Open (ambient)** | 323 | 30 |
| **Conference/Meeting** | 323 | 30 |
| **Classroom/Lecture** | 323 | 30 |
| **Lobby** | 108 | 10 |
| **Atrium** | 108 | 10 |
| **Lounge/Recreation** | 108 | 10 |
| **Dining Area** | 108 | 10 |
| **Food Preparation** | 538 | 50 |
| **Restrooms** | 108 | 10 |
| **Corridor/Transition** | 108 | 10 |
| **Stairs** | 108 | 10 |
| **Active Storage** | 108 | 10 |
| **Inactive Storage** | 54 | 5 |
| **Electrical/Mechanical/Technology** | 323 | 30 |

*Unless otherwise required by agency design guides.

Availability refers to the how well the daylight is provided to the space. With good building orientation and glare control, quality daylight can be provided throughout the space. High reflectance surfaces and high ceilings also help to distribute daylight throughout the space. Low partitions and interior glazing allow for daylight delivery deeper into the building, as well as providing views to the outdoors for more occupants. Operational efficiency relates to the availability and the quality aspect of layered lighting. Because the light level recommended

for a particular task does not need to be provided throughout an entire space, a specific portion of the work area can be illuminated with task lighting. As more and more of the lighting requirements are met with task lighting (close to the task) the ambient layer can be lowered as long as luminance balance is maintained. This shifting between lighting layers results in a net improvement in system efficiency.

- Baseline: Meets the IES 10th Edition Handbook recommendations for horizontal illuminance and meets minimum average base surface reflectance recommendations of 80% for ceilings, 50% for walls, and 20% for floors.
- Tier 1 High Performance (★): Meets the IES 10th Edition Handbook recommendations for both horizontal and vertical illuminance. Surface reflectances are increased to 90%/60%/20%. Daylight provides adequate lighting for 50% of the daytime occupancy and the electric lighting system is made up of 80% ambient and 20% task (+/- 10%).
- Tier 2 High Performance (★★): This level maintains Tier 1 High Performance (★) but also allows for adjustable illuminance levels and recommends 90%/70%/25% minimum base surface reflectance. Additionally, daylight now provides for 80% of the daytime requirements and layers are divided 70% ambient and 30% task (+/- 10%).
- Tier 3 High Performance (★★★): This level maintains Tier 2 High Performance (★★), but increases daylight autonomy to 100%, and splits electric light between 60% ambient and 40% task(+/- 10%). Daylight autonomy refers to the percentage of annual daytime hours that daylight alone provides

the required illuminance levels in regularly occupied spaces.

### 6.2.3 ENERGY USE

The lighting power density (LPD) of a space reflects the actual lighting power use in a space if the entire lighting system is energized at one time. However, with the use of controls, the actual energy use is significantly lower than what the LPD might suggest. Controls can provide energy efficiency and a level of user satisfaction with adjustability of the working environment. They also eliminate energy use when daylight provides adequate or a partial level of visibility, when a space is unoccupied, and when less light is desired.

An additional element of lighting control shows the building manager the real time energy use of the different building systems including lighting. While not a control that reduces energy use, it can identify potential maintenance and operation issues or potential areas for additional energy savings.

Daylighting glare control is also necessary for each occupant near windows or skylights. Either manual or automatic shade controls helps the occupant adjust the personal luminance balance when glazing luminance is too high.

- Baseline: Exceeds ASHRAE 90.1 by 30% for LPD values.
- Tier 1 High Performance (★): This level exceeds ASHRAE by 40% for LPD values. Additionally, daylight, occupancy, and personal controls are required in all occupied spaces.
- Tier 2 High Performance (★★): Exceeds ASHRAE by 50% for LPD values. Addressable lighting control systems are required at this level in additional to personal control. Lighting control system shall be capable and employ energy monitoring of the lighting system.
- Tier 3 High Performance (★★★): Exceeds ASHRAE by 60% for LPD values. At this level, tunable CCT, addressable and personal controls are required along with real time energy monitoring and feedback features.

### 6.2.4 POWER QUALITY

Lighting, and especially dimmable lighting, can have a negative effect on the overall power quality of a building. Dimming of Solid State Lighting sources can lower the power factor and introduce harmonic distortion to the electrical system. In many cases, electrical components must be added at the building service entrance.

Additionally, separate neutrals must be run for circuits that contain LED dimming. Otherwise, flickering can occur over the entire circuit, even when part of the circuit is not being dimmed.

- Baseline: All circuits must run separate neutrals. The overall electrical system must have a power factor (PF) of at least 0.90 and have a Total Harmonic Distortion (THD) less than 20% at the driver. Fully dimmed power factor and Total Harmonic Distortion are controlled to prevent damage to other building electrical components.
- Tier 1 High Performance (★): Continues all of the Baseline criteria but lowers the THD limit to 15%.
- Tier 2 High Performance (★★): Continues all of the Baseline criteria but lowers THD to 10%.
- Tier 3 High Performance (★★★): This level maintains Tier 2 High Performance (★★) but lowers THD to 5% and increased power factor to .95.

### 6.2.5 MAINTENANCE

Maintenance of a lighting system includes starting out with long life light sources and high quality luminaires and drivers that will not fail before the light sources. Fluorescent luminaires are no longer the lighting fixture of choice due to dwindling manufacturers, lower efficacy, and the maturing of the Solid State Lighting market. GSA facilities should be designed to utilize Solid State Lighting luminaires; however, mock ups are required prior to fixture luminaire final selection. Solid State Lighting sources now are rated for at least 50,000 hours. Induction lighting is rated for 100,000 hours. Solid state lighting such as LEDs burn out and dim slowly over the course of their life. Per LM-80, lamp life is based on an L70 or when the light source is producing only 70% of its initial light output.

In addition to the life of the lighting equipment, diagnostic controls and models can pinpoint failed components such as drivers and predict the end-of-life periods, provide real time energy use, and recommend replacement times.

- Baseline: 5 year warranty on all lighting equipment.
- Tier 1 High Performance (★):10 year warranty on all lighting equipment.
- Tier 2 High Performance (★★):10 year warranty on all lighting equipment.
- Tier 3 High Performance (★★★): 15 year warranty on all lighting equipment.

### 6.2.6 SERVICE LIFE

The serviceable life of the lighting system may not be as long as the actual life of all of its individual components. Space uses change. Retrofits may make sense for improved energy savings. Renovations may require changes in lighting locations. The replacement of luminaires and sources might make sense in some cases. Ideally, individual components could be easily replaced rather than entire luminaires. Sources could be relocated or simply replaced with more efficient versions with the same form factor. As solid state lighting takes on a wider range of applications and shapes while still rapidly increasing in efficiency, service life must be carefully considered.

- Baseline: Lighting equipment should be expected to be replaced within 15 years.
- Tier 1 High Performance (★): At this level, improved lighting equipment should not need replacement within 15 years as technological advances such as Solid state Lighting efficacy continues to advance, additional retrofitting maybe desirable.
- Tier 2 High Performance (★★): Replacement and retrofit levels increase to 20 years.
- Tier 3 High Performance (★★★): Replacement and retrofit levels increase to 20 years.

## 6.3 LIGHTING PRESCRIPTIVE REQUIREMENTS

### 6.3.1 INDOOR LIGHTING AND DAYLIGHTING CRITERIA

#### 6.3.1.1 QUALIFICATIONS OF THE LIGHTING PRACTITIONER

Lighting design for new construction, lighting renovations, and energy retrofits must be performed or supervised by a lighting practitioner with a minimum of 10 years full-time experience in lighting design with at least two of the three following qualifications of LC, IES member, or IALD member, and who devotes the majority of his/her professional time to the design of architectural lighting.

#### 6.3.1.2 ARTWORK

Solid State Lighting is the correct light source for highlighting artwork, fabrics, and historical artifacts due to the absence of light IR energy spectrum that is detrimental to their preservation. Additional museum standards for lighting works of art must follow the IES 10th Edition Handbook; see Chapter 4.1, Installation Standards, in Fine Arts Collection Policies and Procedures 2007 for additional information.

#### 6.3.1.3 EXTERIOR LIGHTING DESIGN CRITERIA

Exterior lighting must meet the IES 10th Edition Handbook recommendations and comply with the IDA/IES Model Lighting Ordinance (MLO) for lumen density limits and backlight, up-light, and glare (BUG) ratings or light pollution and light trespass performance method.

All Federal facilities shall be designed to the RP-8 Standard for "Enhanced Security Lighting."

Exterior luminaries and control systems must comply with all local zoning laws, and lighting levels for exterior spaces shall not exceed the IES 10th Edition Lighting Handbook recommendations.

Luminaires with instant strike light sources at all entrances and exits must be connected to the emergency lighting system.

#### 6.3.1.4 SITE LIGHTING

Illumination of exterior exit discharges must be in accordance with the requirements in NFPA 101.

#### 6.3.1.5 OPEN PARKING LOTS AND ROADWAY LIGHTING

Parking lots and roadway lighting must be designed per RP-8 and RP-20 in addition to the IES and IDA/IES MLO requirements.

#### 6.3.1.6 PARKING STRUCTURES

Parking structure lighting must be designed per RP-20. Meet ASHRAE 90.1 requirements for controls related to parking garage luminaires. Luminaires must meet the following standards:

- Efficacy of a minimum of 85 lumens per watt (LPW)
- Wet-location & NEMA 4X rated
- Withstand mechanical vibration
- Life of minimum 50,000 operating hours for solid state lightings before reaching the $L_{70}$ lumen depreciation per IES standard TM-21
- Lumen depreciation per IES standard LM-79
- Luminaire classification per IES TM-15

#### 6.3.1.7 ILLUMINATION OF MEANS OF EGRESS

Illumination of means of egress shall be provided in accordance with the requirements in NFPA 101. In addition, the use of automatic, motion sensor-type lighting switches shall be permitted within the means of egress, provided that the lighting control devices comply with the requirements in NFPA 101.

#### 6.3.1.8 EXIT STAIR ILLUMINATION AND PHOTOLUMINESCENT MATERIALS

Exit enclosures where photoluminescent materials are installed must comply with the requirements in NFPA 101. When photoluminescent materials are present, the lowest light level must be selected to keep the photoluminescent material fully charged.

Enclosed stairway lighting shall be dimmed to at least 50 percent during periods of inactivity with brightness automatically raised upon detecting occupancy.

#### 6.3.1.9 EMERGENCY LIGHTING CRITERIA

Power loss resulting from utility system interruptions, building electrical distribution

system failure, or the accidental opening of switches or circuit breakers dictates the requirement for emergency lighting.

#### 6.3.1.10 LUMINAIRES

Emergency electric lighting systems may consist of separate luminaries and wiring with an independent power source, e.g., a diesel generator, or separate luminaries or unit devices supplied by the normal power supply and a secondary source that comes on automatically when the normal power supply fails.

#### 6.3.1.11 EMERGENCY LIGHTING

Emergency lighting for means of egress must be provided in accordance with the requirements in NFPA 101 and tenant mission requirements. Emergency lighting outside the building must also provide illumination to either a public way or a safe distance away from the building, whichever is closest to the building being evacuated.

#### 6.3.1.12 PERFORMANCE OF EMERGENCY LIGHTING SYSTEM

The performance of the emergency lighting system must be in accordance with the requirements in NFPA 101.

### 6.3.2 LOAD CRITERIA

#### 6.3.2.1 LIGHTING LOADS

The lighting and daylighting systems must be sensitive to the architectural design, provide adequate quality and quantity of illumination for interior and exterior lighting, comply with the design criteria, minimize maintenance requirements, and use 30 percent less electrical energy (kwh) than required for compliance with Section 9.6 (Alternative Compliance Path: Space-by-Space Method) of ASHRAE Standard 90.1.

General lighting must comply with the following luminaire, lamp, and driver requirements.

#### 6.3.2.2 SOLID STATE LUMINAIRES AND RETROFIT KITS

All new solid state luminaires must be high efficiency Design Lighting Consortium (DLC) PREMIUM. All luminaires must be appropriately selected based upon the expected application and be provided with replaceable dimmable drivers.

Where parabolic luminaires are used, louvers must be semi-specular or diffuse finishes; specular finishes must not be used.

LED lamps must not be retrofitted into existing luminaires unless the retrofitted product meets all of the following requirements:

LED retrofit kits may be used in existing luminaire housings if the photometric output is similar to the original fixture and meets the following requirements:

- UL rating is maintained for ENTIRE fixture to include UL 1598C and UL 1993.
- LED retrofits kits must be Design Lighting Consortium (DLC), Premium and be published on their Qualified Products website: https://www.designlights.org/.
- Retrofitted lamps must be tested by a recognized Testing Laboratory in accordance with IES standards LM-79.
- Product MUST BE dimmable using 0-10V and compatible with existing lighting control systems and future daylighting technologies.
- LED products must have a “low risk” level of flicker (light modulation) of less than 5%, especially below 90Hz operation, to prevent photosensitivity-epileptic seizures as defined by IEEE standard 1789-2015LED.
- Space photometrics and glare control must meet IES guidelines for tasks performed in the retrofitted spaces.

- A mock up retrofit of typical areas of the building is required to confirm the above performance requirements of lighting output suitability controllability and flicker measurements.

Minimize lamps, light sources, and driver types.

**TECH TIP:**

- Consider installing linear LED retrofit kits during retrofits or when relamping fluorescent fixtures in facilities with high energy costs and higher light levels than required by the P100.
- 27-29% lighting energy savings

#### 6.3.2.3 LAMPS

Effort must be made to minimize the number of fixture and lamp types within a facility to simplify lamp maintenance.

In retrofit scenarios, all fluorescent lamps must be recycled by firms that recover the mercury that is contained within the lamps. All applicable lamps must be FEMP compliant and/or ENERGY STAR certified as applicable.

**TECH TIP:**

- Consider installing LED downlight lamps to replace CFL fixtures during retrofits where advanced lighting controls are not desired or useful.
- 40-50% lighting energy savings over typical CFL lamps

#### 6.3.2.4 DRIVER ACOUSTICS

Electronic Drivers must be used wherever possible and have a sound rating of "A." All PCB-containing ballasts must be disposed of through specialized disposal firms that destroy the PCBs.

#### 6.3.2.5 LIGHTING CONTROLS

Control systems must be compatible with lamps, light sources, and drivers.

Lighting controls must use individual luminaire control. Ambient lighting must be adjusted per daylight availability, occupancy/vacancy, and other BAS signals such as demand response. Controls shall be provided in accordance with ASHRAE-90.1 or Task or personalized ambient lighting must be adjusted per occupancy/vacancy and personal dimming.

Lighting controls must be commissioned to operate as intended without false triggering. All lighting controls must be compatible with luminaires. Lighting control devices provided for illumination within exit enclosures must comply with the requirements in NFPA 101. Please see the Building Technology Technical Reference Guide for details on IT Security requirements.

**TECH TIP:**

- Consider installing advanced lighting controls during LED retrofits, end-of-life replacement and new construction in facilities with EUI > 3.25 kWh/sf/year, effective lighting power density of 1.1, and utility rates > $0.1/kWh.
- 69% lighting energy savings when compared to the GSA average of 3.25 kWh/sf/year

### 6.3.3 SECURITY LIGHTING, EXIT SIGNS, AND EMERGENCY LIGHTING

#### 6.3.3.1 SECURITY LIGHTING

Security lighting is lighting that remains on during unoccupied hours per applicable GSA and tenant criteria. Security lighting in daylit spaces must be controlled by photosensors. When security lighting also functions as emergency lighting, separate circuits and emergency ballasts are required.

#### 6.3.3.2 EXIT SIGNS

Exit signs must meet the requirements in NFPA 101 and be energy efficient and environmentally friendly products (e.g., light emitting diodes (LED type), photoluminescent type. Tritium exit signs must not be installed.

#### 6.3.3.3 EMERGENCY LIGHTING

Emergency lighting must be provided in accordance with the requirements of NFPA 101. At a minimum, unswitched emergency lighting must be provided in the following areas:

- Zones covered by closed-circuit TV cameras
- Security zones
- Fire command center
- Security control center
- Where required in NFPA 101
- UPS and battery rooms

Emergency lighting may be manually switched from within in the following areas:

- Communication equipment rooms
- Electrical rooms
- Technology/server rooms
- Engineers' offices

Supplemental battery-powered emergency lighting must be provided in the following spaces to bridge the generator startup time:

- Generator rooms
- Main mechanical and electrical rooms
- Any locations where lighting cannot be interrupted for any length of time

### 6.3.4 SPECIFIC LIGHTING REQUIREMENTS

#### 6.3.4.1 SPECIAL AREAS

Certain areas, where the lighting design must be an integral part of the architecture, require special lighting design concepts. The certified lighting designer must integrate the design with the interior finishes and furniture arrangement to enhance the functionality of the spaces. Further consideration must be taken to adhere to the energy criteria and maintenance criteria, as well as minimizing the number of special lamp types and fixtures required. Areas generally requiring special lighting treatment are as follows:

- Main entrance lobbies
- Atriums
- Elevator lobbies
- Public corridors
- Public areas
- Auditoriums
- Conference rooms
- Training rooms
- Dining areas and serveries
- Libraries

#### 6.3.4.2 LIGHTING – HISTORIC BUILDINGS

Historic chandeliers, pendant lights, sconces, and other period lighting may be upgraded with energy efficient light sources and optical enhancements that preserve the historic appearance of the luminaire and space. Replica lighting for restoration zones should be fabricated or modified to accept energy efficient lamps. Supplemental lighting, when required, must be designed and located to minimize penetration of ornamental wall and ceiling surfaces and to avoid competing visually with historic lighting. Recommended alternatives for increasing light levels in ceremonial spaces, when relamping is not sufficient, include compatibly designed floor lamps, task lights, and discretely placed indirect lighting. Refer to Upgrading Historic Building Lighting https://www.gsa.gov/cdnstatic/TechnicalGuideLightingFINAL2.pdf for additional guidance.

# 6.4 ELECTRICAL PERFORMANCE REQUIREMENT

| Attribute | Baseline | ★<br>Tier 1 High Performance | ★★<br>Tier 2 H gh Performance | ★★★<br>T er 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Des gn | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **6.4.1 Transformers** | | | | | | | | | | |
| **Efficiencies for Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)** | 10 CFR 431 Part 196 | 10 Percent less losses than 10 CFR 431 Part 196 | 20 Percent less losses than 10 CFR 431 Part 196 | 25 Percent less losses than 10 CFR 431 Part 196 | Yes | Submit certified performance data for each unit | | 10 CFR 431 Part 196 | Describe transformer efficiency requirements. | Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance. |
| **Insulating fluid for oil-filled Distribution Transformers, Network Transformers and Substation Transformers (<= 600V Secondary & <=34.5 KV Primary)** | 65 °C USDA -designated biobased insulating oil (minimum 66% biobased synthetic ester-based or minimum 95% biobased vegetable oil-based) | 65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content) | 65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content) | 65 °C USDA - designated vegetable oil-biobased insulating oil (95% or greater biobased content) | | Yes | | 7 CFR part 3201.20, ASTM D6866. ASTM D6871 or IEEE C57.147 | Describe transformer insulating fluid requirements. | Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance. |
| **Efficiencies for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)** | 10 CFR 431 Part 196 | 10 Percent less losses than 10 CFR 431 Part 196 | 20 Percent less losses than 10 CFR 431 Part 196 | 25 Percent less losses than 10 CFR 431 Part 196 | | Certified Representative Factory Test Report | | 10 CFR 431 Part 196 | Describe low voltage distribution transformer efficiencies. | Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance. |
| **Impedance for Low-voltage Distribution Transformers (120/208 3Ph, 4W Secondary; 480V, 3Ph, 3W Primary)** | >4 %Z | >4 %Z | >4 %Z | >5 %Z | | Certified Representative Factory Test Report | | NEMA TP-1 -2002<br>10 CFR 431 Part 196 | Describe transformer impedance requirements. | Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance. |
| **Harmonic Rated Transformers & Harmonic Mitigating Transformers** | Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics) | Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics) | Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics) | Zigzag 3rd Harmonic Mitigating Transformers (0 degree, and 30 degree), Copper or aluminum windings, >4% Z, (Match 0 and 30 degree transformers in distribution for harmonic mitigation of 5th and 7th order harmonics) | | Certified Representative Factory Test Report | | NEMA TP-1 -2002 | Describe transformer harmonic requirements. | Verify submittals and certified performance data from manufacturer for supplied transformer units to verify compliance. |
| **6.4.2 Variable Frequency Drives** | | | | | | | | | | |
| **Use on motors 5HP (3.7kW) to 25 Hp (18.7kW)** | 6-pulse width modulation (PWM) IGBT Drives<br>Passive Harmonic Filtration <5% THD Current at Drive Terminals | 6-pulse width modulation (PWM) IGBT Drives<br>Passive Harmonic Filtration <5% THD Current at Drive Terminals | 6-pulse width modulation (PWM) IGBT Drives<br>Active Harmonic Filtration <5% THD Current at Drive Terminals | 12-pulse width modulation (PWM) IGBT Drives<br>IGBT Front End <5% THD Current at Drive Terminals<br>>95% Input Power Factor | | | | IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals | Describe VFD requirements to show compliance with metrics. | Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance. |
| **Use on motors 30HP (22.4kW) to 100HP (74.6 kW)** | 6-pulse width modulation (PWM) IGBT Drives. Provide 12 or 18 pulse where the harmonic analysis indicates noncompliance<br>Passive Harmonic Filtration <5% THD Current at Drive Terminals | 12-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | 18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | 18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | | | | IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals | Describe VFD requirements to show compliance with metrics. | Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance. |
| **Use on motors 125HP (93.3kW) and larger** | 12-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | 18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | 18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | 18-pulse width modulation IGBT Drives with integral input phase shifting transformers (PWM)<br><= 5% THD Current at Drive Terminals | | | | IEEE 519 5% Current THD at Drive Input Terminals, IEEE 519 3% Voltage THD in at Sensitive Equipment Panels, and 5% Voltage THD at 480/277 Transformer Secondary Terminals | Describe VFD requirements to show compliance with metrics. | Verify submittals and certified performance data from manufacturer for supplied VFD's s to verify compliance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 H gh Performance | ★★★ T er 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Des gn | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **6.4.3 Metering/Monitoring** | | | | | | | | | | |
| **Metering/Monitoring at Building Mains** | Voltmeter reading all phase to phase and phase to neutral voltages. Switchable ammeter and three-phase totalizing watt-hour meter. The power meter should be pulse-type and digital networked and/or tied into the Advanced Metering System. | Baseline, plus Utility Class 0.2%, (Phase Volts, Phase Currents, Neutral Currents, Ground Currents, power consumption KWH, adjustable power demand KW, KVA & KVAR, Power Factor) | Tier 1 High Performance, plus Harmonic Waveform Analysis | Tier 2 High Performance, plus Transient Disturbance Monitoring for capture, remote alarm monitoring and disturbance download to laptop | yes | | yes | ANSI C12.1 & C12.20 ASHRAE 90.1 | Describe building electrical meter requirements and show on single line diagram. | Verify submittals and supplied meter specifications to verify compliance. |
| **Metering/Monitoring for Feeders** | As required for ASHRAE 90.1 and Advanced Building Metering | As required for ASHRAE 90.1 and Advanced Building Metering and to coordinate with ECMs for M&V (KW, KVA Demand, KWH) | As required for ASHRAE 90.1 and Advanced Building Metering and to coordinate with ECMs for M&V (KW, KVA Demand, KWH) | As required for ASHRAE 90.1 and Advanced Building Metering at the individual branch circuit level | yes | | | ASHRAE 90.1 | Describe building electrical sub-metering requirements and show on single line diagram. | Verify submittals and supplied meter specifications to verify compliance. |
| **Metering/Monitoring Trending** | As required for ASHRAE 90.1 and Advanced Building Metering | As required for ASHRAE 90.1 and Advanced Building Metering and to coordinate with ECMs for M&V (KW, KVA Demand, KWH) | As required for ASHRAE 90.1 and Advanced Building Metering and to coordinate with ECMs for M&V (KW, KVA Demand, KWH) | As required for ASHRAE 90.1 and Advanced Building Metering at the individual branch circuit level | yes | | yes | ASHRAE 90.1 | Describe electrical metering scheme and trend requirements. | Verify submittals and supplied meter specifications to verify compliance. |
| **6.4.4 Building Automation System - Interface from Electrical Systems** | | | | | | | | | | |
| **Electrical Meters input to BAS and graphic displays** | MODBUS/TCP/IP Protocol Meters/BACnet/LonWorks protocol Meters to match BAS with twisted pair to BAS for monitoring. The power meter should be networked and/or tied into the Advanced Metering System. | MODBUS/TCP/IP/BACnet/LonWork s Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics. Interfaced to BAS and configured for Advanced Metering System. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end) | MODBUS/TCP/IP/BACnet/LonWorks Protocol Meters to match BAS with twisted pair to BAS for monitoring and graphics (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end) and Wireless Submeters | yes | | yes | ANSI C12.1 & C12.20; EPACT 2005, EISA 2007 - Section 434(b) | Describe meter/BAS interface requirements. | Verify interface with BAS system and confirm metering data to verify compliance. |
| **PV Systems Input to BAS and graphic displays** | MODBUS/TCP/IP Protocol Meters/BACnet/LonWorks protocol Meters to match BAS with twisted pair to BAS for monitoring. The power meter should be networked and/or tied into the Advanced Metering System. | MODBUS/TCP/IP/BACnet/LonWork s Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH], status and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH], status and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end | yes | | | eMerge Alliance 24VDC Occupied Space Standard | Describe PV system metering/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |
| **Automatic Transfer Switches input to BAS and graphic displays** | N/A | MODBUS/TCP/IP/BACnet/LonWork s Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for ATS status (also ethernet for TCP/IP for ATS customized graphical GUI at BAS front end) | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] status, and alarms Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH] status, and alarms Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | | | | | Describe ATS/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 H gh Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Des gn | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **6.4.4 Building Automation System - Interface from Electrical Systems (Cont.)** | | | | | | | | | | |
| **Standby Generator input to BAS and graphic displays** | N/A | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for generator status and alarms | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and generator status and alarms (NFPA 110 status and alarms) | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and generator status and alarms (NFPA 110 status and alarms) Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | | | | | Describe Standby Generator/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |
| **Uninterruptible Power Systems input to BAS and graphic displays** | N/A | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for alarms (also ethernet for TCP/IP for metering customized graphical GUI at BAS front end) | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH} and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | Yes | | | | Describe UPS/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |
| **Variable Frequency Drives Input to BAS and graphic displays** | N/A | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for power measurements [KW, KVA, Power Factor, KWH, Amps, % speed}, status( HOA, run, bypass), troubles, and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | Yes | | | | Describe VFD/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |
| **Motor Starters Input to BAS and graphic displays** | N/A | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers | MODBUS/TCP/IP/BACnet/LonWorks Protocol to match BAS with twisted pair to BAS for monitoring data registers and graphics screens for status [HOA, run], power measurements [KW, KVA, Power Factor, KWH}, and alarms. Also ethernet for TCP/IP for metering customized graphical GUI at BAS front end. | Yes | | | | Describe motor starters/BAS interface requirements. | Verify interface with BAS system and confirm indicated metered data to verify compliance. |
| **Additional computer-based BAS interface requirements** | DDC using BACnet or LonTalk open communication protocols | IP sensors, thermostats, & devices | wireless self powered switches & devices | wireless self powered switches & devices | Yes | | yes | EnOcean Alliance | Describe BAS interface requirements with switches and devices. | Verify interface with BAS system and confirm indicated devices to verify compliance. |
| **Additional computer-based BAS energy management requirements** | Energy management & monitoring software | interface with smart phones & tablets | interface with smart phones & tablets | interface with smart phones & tablets | yes | | yes | | Provide BAS interface requirements with smart phones and tablets. | Verify interface with BAS system and confirm indicated devices to verify compliance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ Tier 2 H gh Performance | ★★★ Tier 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Des gn | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **6.4.5 Interior Electrical Distribution** | | | | | | | | | | |
| **Energy saving controls for automatic interruption of non-critical power after operating hours** | ASHRAE 90.1 | ASHRAE 90.1<br>Time of day scheduling for auto shutdown of task lighting receptacle circuits or integrate occupancy sensors with task lights. | ASHRAE 90.1<br>Time of Day controllable branch panel breakers for automatic shutdown of computers, displays and task lighting after scheduled hours | ASHRAE 90.1<br>IT network smart controls for automatic hot standby after initial period of inactivity & automatic power down after extended period of inactivity. Automatic controls for automatic shutdown of task lighting or time of day scheduling for auto shutdown of task lighting receptacle circuits or integrate occupancy sensors with task lights. | yes | | | ASHRAE 90.1,<br>LEED M&V Standards | Describe scheme for automatic shut down of lighting and computer/display and task lighting circuits. | Verify shut down of stated loads after installation of systems to verify control sequences and shut down of stated loads after scheduled hours. |
| **6.4.6 Arc- Flash Reduction Maintenance Switches (ARMS) and Arc Flash barriers** | | | | | | | | | | |
| **Arc Reduction Maintenance Switches (ARMS)** | NEC 240.87 Arc Energy Reduction Applies | NEC 240.87 Arc Energy Reduction Applies at 1000A | NEC 240.87 Arc Energy Reduction Applies at 600A | NEC 240.87 Arc Energy Reduction Applies at 200A | | | | NFPA 70, 70E, NEMA, UL | Describe requirements of arc flash maintenance switches. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **6.4.7 Power Factor Correction** | | | | | | | | | | |
| | 95% PFC with harmonic-tuned filters | 95% PFC with automatic controls and harmonic-tuned filters | 95% PFC with automatic controls and active harmonic filters | 98% PFC with automatic controls and active harmonic filters | | | | NFPA 70, NEMA | Describe power factor correction requirements. | Measure power factor using a power meter to confirm compliance with stated requirements. |
| **6.4.8 Surge Protection Devices** | | | | | | | | | | |
| **277/480 Volt distribution at Main Switchgear** | Surge Protection Device - Type 2 (SPD-2) (250KA) | Surge Protection Device - Type 2 (SPD-2) (250KA) | Surge Protection Device - Type 2 (SPD-2) (250KA) | Surge Protection Device - Type 2 (SPD-2) (250KA) | | | | UL 1449 Current Edition | Describe surge protection requirements at main switchgear. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **277/480V Volt distribution at Distribution Panels** | Surge Protection Device - Type 2 (SPD-2) (160KA) | Surge Protection Device - Type 2 (SPD-2) (160KA) | Surge Protection Device - Type 2 (SPD-2) (160KA) | Surge Protection Device - Type 2 (SPD-2) (160KA) | | | | UL 1449 Current Edition | Describe surge protection requirements at distribution panels. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **277/480V Volt Branch Panels** | NFPA 70 700.8 (Emergency Panels) | NFPA 70 700.8 (Emergency Panels) | NFPA 70 700.8 (Emergency Panels) | Surge Protection Device - Type 2 (SPD-2) (50KA) | | | | NFPA 70 700.8,<br>UL 1449 Current Edition | Describe surge protection requirements at branch panels. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **120/208V Volt Branch Panels** | NFPA 70 700.8 (Emergency Panels) | NFPA 70 700.8 (Emergency Panels) | NFPA 70 700.8 (Emergency Panels) | Surge Protection Device - Type 2 (SPD-2) (50KA) | | | | NFPA 70 700.8,<br>UL 1449 Current Edition | Describe surge protection requirements at branch panels. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |

| Attribute | Baseline | ★ Tier 1 High Performance | ★★ T er 2 High Performance | ★★★ T er 3 High Performance | Measurement & Verification | Plans & Specs | Calculations & Analysis | Reference Standard | Des gn | Construction |
|---|---|---|---|---|---|---|---|---|---|---|
| **6.4.9 Lightning Protection Systems (LPS)** | | | | | | | | | | |
| **Lightning Protection Systems** | Yes where required per NFPA evaluation | Yes where required per NFPA evaluation | Yes where required per NFPA evaluation | Yes where required per NFPA evaluation | | Yes | | UL 96, NFPA 780 | Describe lightning protection system. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **Lightning Protection Systems UL Compliance** | UL 96 | UL 96 | UL 96 | UL 96 | | Yes | | UL 96, NFPA 780 | Describe lightning protection system. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **Lightning Protection Systems UL Master Label Compliance** | N/A | N/A | Master Label | Master Label | | Yes | | UL 96 (Master Label) | Describe lightning protection system. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **Surge Protection for building service, incoming copper cables and equipment per Master Label Requirements** | N/A | N/A | Yes | Yes | | Yes | | UL 96 (Master Label) | Describe lightning surge protection requirements. | Verify submittals and shop drawings from manufacturer for supplied units to verify compliance. |
| **6.4.10 Grounding** | | | | | | | | | | |
| **Earth counterpoise** | N/A | 5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | 2 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | 1 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | Yes | | | NFPA 70, IEEE, BICSI/TIA | Describe grounding requirements. | Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values. |
| **Separate grounding system for Lightning Protection System and single point bond to building counterpoise system.** | N/A | 5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | 5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | 5 Ohm to Earth (Engineered system based on earth testing and confirmed by fall-of-potential method. | | | | NFPA 70, 780, UL 96 | Describe grounding requirements. | Measure grounding resistance using fall of potential method per IEEE 81 standard to verify compliance with stated values. |
| **Equipment Grounding Conductors** | All low voltage power distribution systems must be supplemented with a separate, insulated ground conductor routed with the phase and neutral conductors. | | | | | | | | Describe grounding conductor requirements. | Verify provision of grounding conductors for each of the low voltage distribution systems. |
| 6.4.11 Uninterruptible Power Systems (UPS) | | | | | | | | | | |
| **Efficiency** | Double conversion efficiency of 90% | Double conversion efficiency of 95% | IGBT rectifier and IGBT inverter Double conversion efficiency of 96% | IGBT rectifier and IGBT inverter Double conversion efficiency of 97% | Yes | | | | Describe UPS efficiency requirements. | Verify submittals from manufacturer for supplied units to verify compliance. |
| **Power Factor - Output** | 80% | 80% | 90% | 90% | Yes | | | | Describe UPS output power factor requirements. | Measure output power factor using a power meter to confirm compliance with stated requirements. |
| **Power Factor - Input** | 80% | 80% | 90% | 100% | Yes | | | | Describe UPS input power factor requirements. | Measure input power factor using a power meter to confirm compliance with stated requirements. |
| **Input Harmonics** | <30% current THD | Rectifier with filters for <7% current THD | IGBT rectifier for <5% current THD | IGBT rectifier for <5% current THD | Certified Representative Factory Test Report | | | | Describe UPS THD requirements. | Measure harmonics using a power meter per IEEE 519 standard to confirm compliance with stated requirements. |

## 6.5 PRESCRIPTIVE ELECTRICAL ENGINEERING REQUIREMENTS

### 6.5.1 GOALS AND OBJECTIVES

This chapter identifies criteria that must be used to program and design electrical power, lighting, and communications systems in GSA buildings. These systems support the many types of equipment in a reliable fashion. During the life span of a Federal building, many minor and major alterations are necessary as the missions of Government agencies change. The flexibility to adjust to alterations and perform maintenance must be designed into the building systems from the outset. Maintenance requirements (6.5.15) should be taken into consideration within each system design, which serves to maximize equipment reliability, performance, and usability/life span. Electrical power, lighting, and communications systems must provide ample capacity for increased load concentrations and allow modifications and maintenance to be performed in one area without causing major disruptions in other areas of the facility.

The electrical system design must be signed by a registered professional electrical engineer.

#### 6.5.1.1 DESIGN INTENT

The design of electrical power, lighting, communications systems, and other building components must function together resulting in a building that meets the project's program requirements, as well as incorporating GSA's commitment to sustainability and energy efficiency.

GSA recognizes that communication needs and technology are growing at an increasingly rapid pace. Work stations are becoming more powerful, requiring faster and easier access to more information. It is GSA's intent to provide the wiring and interfaces to support these requirements. The design of all communications cabling systems is the responsibility of GSA's Federal Acquisition Service (FAS).

A computer-based Building Automation System (BAS) that interfaces, monitors, and automatically controls lighting, heating, ventilating, and air conditioning is critical to the efficient operation of modern Federal buildings, including courthouses, office buildings, and other facilities. GSA requires the integration of building automation systems, with the exception of fire alarm and security systems, which must function as stand-alone systems with a monitoring-only interface to the BAS (see Electrical Performance Criteria).

Security is important in the design, construction, and operation of electrical power, lighting, and communications systems design. Refer to ISC Security Guidelines.

Electrical power, lighting, and communications systems must be adapted to support all performance objectives defined for the project, typically including sustainability, workplace performance (productivity and efficiency), fire safety, security, historic preservation, and improved operations and maintenance. All new or modified electrical equipment shall be UL listed. Compliance with Appendix A, Submission Requirements, is required to demonstrate that these systems have been adapted into the project at each phase of the design.

Maintainability and reliability are paramount to the operation of Federal buildings. Therefore, the design and installation of all electrical systems and equipment must allow for the safe repair, removal, and replacement—including major components such as switchgear, motor control centers, and emergency/standby

generators—without removal of exterior walls and impact to adjacent equipment and building occupants.

Electrical power, lighting, and communications systems must be specifically designed to meet all of the defined performance objectives of the project at full-load and part-load conditions that are associated with the projected occupancies and modes of operation.

Commissioning of major changes to electrical power, lighting, and communications systems must be initiated at the conceptual design phase of the project and continue through all design and construction phases.

For special design considerations and design criteria for U.S. Court facilities, see Chapter 8, Design Standards for U.S. Court Facilities.

## 6.5.2 CODES, STANDARDS, AND GUIDELINES

Refer to Chapter 1 for guidance on code compliance.

### 6.5.2.1 ELECTRICAL DESIGN PUBLICATIONS AND STANDARDS

The latest editions of publications and standards listed here are intended as guidelines for design. They are mandatory only where referenced as such in the text of this chapter or in applicable codes. The list is not meant to restrict or preclude the use of additional guides or standards.

When publications and standards are referenced as mandatory, any recommended practices or features must be considered as "required." When discrepancies between requirements are encountered, GSA will determine the governing requirement.

The following Codes and Standards requirements must be incorporated into any GSA project design.

Codes and Standards

- ANSI/NETA ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- ANSI/NETA ECS, Standard for Electrical Commissioning Specifications for Electrical Power Equipment and Systems
- ANSI/NETA ETT, Standard for Certification of Electrical Testing Technicians
- ANSI/NETA MTS, Maintenance Testing Specifications for Electrical Power Equipment and Systems
- ASME: American Society of Mechanical Engineers
- ASME A17.1, Safety Code for Elevators and Escalators
- ASTM: American Society for Testing and Materials
- ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- BICSI, (Building Industry Consulting Service International) Telecommunications Distribution Methods Manual
- BICSI, Wireless Design Reference Manual
- California Energy Commission, Building Energy Efficiency Standards (Title 24) for applicable projects
- ETL: Electrical Testing Laboratories
- FAA: Federal Aviation Agency
- Federal Information Processing Standard 175, Federal Building Standard for Telecommunication Pathways and Spaces
- IEEE Standard 1789, IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers

- IES: Illuminating Engineering Society of North America
- IES Lighting Handbook
- IESNA G-1 Guideline for Security Lighting for People, Property, and Public Spaces
- IES RP-1-04, American National Standard Practice of Office Lighting
- IES RP-5-13, Recommended Practice for Daylighting
- IES RP-8, Roadway Lighting
- IES RP-20, Lighting for Parking Facilities
- IES LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IES LM-80, Measuring Lumen Maintenance of LED Light Sources
- IES LM-83, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- IES TM-15, Luminaire Classification System for Outdoor Luminaires
- IES TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources
- IEEE: Institute of Electrical and Electronics Engineers
- ICEA: Insulated Cable Engineers Association
- NEMA: National Electrical Manufacturers Association
- NETA: International Electrical Testing Association
- NFPA: National Fire Protection Association
- NFPA 70, National Electrical Code
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems
- UL: Underwriters' Laboratories
- UL50, Enclosures for Electrical Equipment for Types 12, 3, 3R, 4, 4X, 5, 6, 6P, 12, 12K, and 13
- UL67, Panelboards
- UL 96 , Marking and Application Guide Lightning Protection
- UL1558, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- UL1598C, Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits

### COMMUNICATION SYSTEM PATHWAYS AND SPACES DESIGN STANDARDS

The communications system pathways and spaces must be designed in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual, and coordinated with GSA's FAS to fulfill specific system requirements. Proprietary wireless communication for lighting controls may be considered if scanned and approved by GSA IT. The following standards define the minimum allowable requirements.

Wireless systems must be designed in accordance with the latest edition of the BICSI Wireless Design Reference Manual, and coordinated with GSA's FAS to fulfill specific requirements.

Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) Standards are listed below.

- EIA/TIA Standard 568, Commercial Building Wiring Standard (and related bulletins)
- EIA/TIA Standard 569, Commercial Building Standard for Telecommunications Pathways and Spaces (and related bulletins)

- EIA/TIA Standard 606, Administration Standard for the Commercial Telecommunications Infrastructure (and related bulletins)
- EIA/TIA Standard 607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (and related bulletins)
- EIA/TIA Standard 758, Customer-Owned Outside Plant Telecommunications Cabling Standard

### 6.5.2.2 LOAD CRITERIA

In determining electrical loads for Federal buildings, it is important to look beyond the immediate requirements stated in the project program. Future moves and changes have the effect of redistributing electrical loads. Unless otherwise specifically defined in the program requirements, the connected receptacle loads and lighting loads must be combined with other electrical loads in the building, multiplied by the appropriate demand factors and with spare capacity added, to determine the overall electrical load of the building. The specific electrical power loads must be determined independently for the following load groups:

- Lighting
- Receptacle loads
- Motor and equipment loads
- Elevator and other vertical transportation loads
- Miscellaneous loads

#### RECEPTACLE LOADS

A list of typical receptacle load requirements is shown in Table 6-2. Refer to Section 6.5.7 for further information on the receptacle design conditions and constraints.

Figure 13: Edith Green Wendell Wyatt Entrance Detail, Portland, OR

| Area/Activity | Service Equipment | | Distribution Equipment | |
|---|---|---|---|---|
| | $W/m^2$ | $W/ft^2$ | $W/m^2$ | $W/ft^2$ |
| Office/enclosed | 14.00 | 1.30 | 27 | 2.50 |
| Office open | 14.00 | 1.30 | 35 | 3.25 |
| Non-workstation areas | 5.00 | 0.46 | 10 | 0.93 |
| Core and public areas | 2.50 | 0.23 | 5 | 0.46 |
| Technology/server rooms | 540.00 | 50.18 | 700 | 65.06 |

Table 6-2. Minimum Receptacle Load

### MOTOR AND EQUIPMENT LOADS

Loads associated with motors and equipment must use the rated brake horsepower of specified equipment and nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE Standard 90.1. Refer to Section 5.3 for additional criteria.

### ELEVATOR AND OTHER VERTICAL TRANSPORTATION LOADS

Electrical power loads for elevators and other vertical transportation equipment must be based on the rated brake horsepower of the specified equipment and nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE Standard 90.1. Demand factors identified in NFPA 70, Chapter 6 must be applied. Refer to Section 5.3 for additional criteria.

### MISCELLANEOUS LOADS

These loads include:

- Security, communication, BAS, and alarm systems
- Heat tracing
- Kitchen equipment
- Central computer servers and data centers
- Uninterruptible power supply (UPS) and battery rooms

Electrical loads for miscellaneous equipment must be based on the rated electrical power requirements or brake horsepower of the specified equipment and on the nominal full-load efficiencies that meet or exceed those in Chapter 10 of ASHRAE Standard 90.1. Demand factors identified in NFPA 70 must be applied.

## 6.5.2.3 DEMAND LOAD AND SPARE CAPACITY

To ensure maximum flexibility for future systems changes, the electrical system must be sized for the demand load with additional spare capacity as follows:

Demand factors identified in NFPA 70, Chapter 6, must be applied.

- Panelboards for branch circuits: 50 percent spare ampacity and 35 percent spare circuit capacity
- Panelboards serving lighting only: 50 percent spare ampacity and 25 percent spare circuit capacity
- Switchboards and distribution panels: 35 percent spare ampacity and 25 percent spare circuit capacity
- Main switchgear: 25 percent spare ampacity and 25 percent spare circuit capacity

All distribution equipment ampacities must be calculated in accordance with NFPA Article 220 and as modified in this chapter. If the addition of 25 or 35 percent spare circuit capacity results in the need for a two-section panel, the design engineer must limit the spares to the capacity of the panel in question and assign sufficient space

in the electrical closet layout to accommodate a future panel and associated transformer.

All panelboards must be fully populated with breakers of a size and rating of breakers most frequently used in the panelboard or as directed by GSA.

Before adding the spare equipment ampacity to account for future load growth, it is important that the load study reflect actual demand loads rather than connected loads. The designer must apply realistic demand factors by taking into account various energy-conserving devices such as variable frequency drives applied to brake horsepowers, energy-efficient motors, occupancy sensors, and so on. The designer must also avoid adding the load of standby motors and must be careful to distinguish between summer and winter loads by identifying such "noncoincidental" loads. A "diversity factor" must be applied to account for the fact that the maximum load on the elevator system, as a typical example, does not occur at the same time as the peak air conditioning load. Once the estimated "peak demand" load is established, the factor for load growth must be added.

#### 6.5.2.3.1 MAXIMUM VOLTAGE DROP

The maximum allowable voltage drop for feeders is 2 percent and for lighting and branch circuits is 3 percent. Both normal and emergency distribution must comply.

### 6.5.2.4 VISUAL IMPACT

Options regarding the location and selection of electrical work that will have a visual impact on the interior and exterior of the building must be closely coordinated with the architectural design. This includes the placement and specification of the lightning protection system, colors, and finishes of light fixtures, outlets, switches, and device plates.

### 6.5.2.5 LIGHTNING PROTECTION

Lightning protection must be provided in accordance with NFPA 780. The system must be carefully designed to ensure that static discharges are provided with an adequate path to ground. Surge arrestors on the main electrical service must be provided. Systems served at utilization voltages 208Y/120V or 480Y/277V must be provided with two levels of protection for sensitive electronic loads.

## 6.5.3 UTILITY COORDINATION

### 6.5.3.1 POWER COMPANY COORDINATION

A detailed load study, including connected loads and anticipated maximum demand loads, as well as the estimated size of the largest motor, must be included in the initial contact with the local utility company to prepare its personnel for discussions relative to the required capacity of the new electrical service.

The service entrance location for commercial electrical power must be determined concurrently with the development of conceptual design space planning documents. Standards for equipment furnished by utility companies must be incorporated into the concept design. Locations of transformers, vaults, meters, and other utility items must be coordinated with the architectural design to avoid conflicts with critical architectural features such as main entrances and must accommodate both equipment ventilation and equipment removal. All major electrical equipment must be located 5 feet above the 100-year flood plain.

### 6.5.3.2 COMMUNICATIONS SERVICE COORDINATION

The telecommunications design professional must contact the local telecommunications providers and coordinate with the client agency and GSA's FAS to determine the number, size,

and location of the incoming services and to determine the enclosure and pathway requirements for telecommunications systems. The scope of services varies with each project; it includes, at a minimum, the design of the infrastructure (pathway and enclosure) and may include the full design and specification of the telecommunications system. The design professional must contact the local telecommunications providers through GSA's FAS early in the project.

Provision must also be made to provide either cable television (CATV) or satellite service to the facility. CATV or satellite service may be independent from other communications services. The need for multiple space service conduits to accommodate multiple voice/data vendors must be evaluated.

The need for separate redundant internal and external pathways may be required depending on the level of security and mission that may be required by the building occupant.

### 6.5.3.3 SITE REQUIREMENTS

The routing of site utilities and location of manholes must be determined early in the design process in coordination with the site civil engineer. The designer must coordinate with the utility company to determine the capabilities, rate structure options, and associated initial costs to the project and must evaluate the available utility service options. All incoming electrical utility feeders shall be installed underground.

#### ELECTRICAL POWER SERVICES

For buildings less than 100,000 gross square-feet (gsf), utility power must be requested at the main utilization voltage, i.e., 480Y/277V or 208Y/120V.

For buildings greater than 100,000 gsf and less than 250,000 gsf, electrical secondary service shall be a minimum of 480Y/277V. For buildings 250,000 gsf and larger, or for campus sites, secondary electrical service must be provided to the building, at medium-voltage distribution, up to 34.5kV, for primary power distribution to substations.

For renovated buildings greater than 25,000 gross square feet where the local utility only has network voltage of 120/208 volt primary service available, the normal and emergency voltages upon entering the building shall be stepped up to 480/277 volt.

#### PRIMARY CABLE SELECTION

Medium-voltage cable selection must be based on all aspects of cable operation and on the installation environment, including corrosion, ambient heat, rodent attack, pulling tensions, potential mechanical abuse, and seismic activity. Conductors for new construction buildings rated above 150 amperes may be copper or aluminum, insulated with cross-linked polyethylene (XLP) or ethylene propylene rubber (EPR). Conductors rated 150 amperes and below shall be copper. New cabling to be connected to equipment built or installed before 1980 shall be investigated to determine compatibility of aluminum-to-copper terminations prior to specifying aluminum cabling. Insulation must be rated at 133 percent. Individual conductor size must not exceed 240 mm2 (500 mcm).

#### DIRECT BURIED CONDUIT

If PVC conduit is used, it must be schedule 80. Coated intermediate metallic conduit (IMC) or coated rigid galvanized steel may also be used for the distribution of exterior branch circuits. Backfill around the conduits must be selected based on the thermal conductivity and be free of materials detrimental to the conduit surface.

Direct buried duct banks must be continuously indicated by installation of tracer tape 300 mm (12”) above the exterior of the duct bank.

### CONCRETE-ENCASED DUCTBANKS

PVC Schedule 40 must be used for all services entering the building (power, communications, and/or life safety) and a minimum conduit diameter of 100mm [4in] shall be utilized. Where redundant service is required, alternate and diverse paths must be provided.

Concrete-encased ducts must be provided with a cover that is at least 750 mm (30 in.) thick. Ductbanks under railroads must be reinforced. Ducts must slope toward manholes and all entries into buildings must have watertight seals. Changes in direction must be by sweeps with a radius of 1.2 m (4 ft.) or more. Stub-ups into electrical equipment may be installed with manufactured elbows. Duct line routes must be selected to avoid the foundations of other buildings and structures. Electrical power and communication ducts must be kept clear of all other underground utilities, especially high-temperature water, steam, or gas.

Where it is necessary to run communication cables parallel to power cables, two separate ductbanks must be provided with separate manhole compartments. The same holds true for normal and emergency power cables. Ductbanks must be spaced at least 300 mm (1 ft.) apart. BICSI Standards govern the installation of telecom infrastructure.

### DUCT SIZES AND QUANTITY

Ducts must be sized as required for the number and size of cables. Inner ducts must be provided inside communication ducts wherever fiber optic cables will be used. Spare ducts must be included for planned future expansion; in addition, a minimum of 50 percent spare ducts must be provided for unknown future expansion and/or cabling replacement.

### MANHOLES

Manholes must be spaced no farther than 150 m (500 ft.) apart for straight runs. The distance between the service entrance and the first manhole must not exceed 30 m (100 ft.). Double manholes must be used where electric power and communications lines follow the same route. Separate manholes must be provided for low- and medium-voltage systems. Manholes must have clear interior dimensions of no less than 1,800 mm (6 ft.) in depth, 1,800 mm (6 ft.) in length, and 1,800 mm (6 ft.) in width, with an access opening at the top of not less than 750 mm (30 in.) in diameter. Medium-voltage manholes must be sized in accordance with utility company requirements. Manholes must have a minimum wall space of 1,800 mm (6 ft.) on all sides where splices may be racked. Manholes must be provided with pulling eyes, sumps, and grounding provisions as necessary.

### STUBS

A minimum of two spare stubs must be provided (to maintain a square or rectangular ductbank), so that the manhole wall will not need to be disturbed when a future extension is made. Stubs for communications manholes must be coordinated with GSA’s Federal Technology Service.

### HANDHOLES

Handholes may be used for low-voltage feeders (600V and below), branch circuits, or communications circuits. If used, they must be not less than 1,200 mm (4 ft.) in depth, 1,200 mm (4 ft.) in length, and 1,200 mm (4 ft.) in width, and must be provided with standard manhole covers and sumps of the same type provided for manholes. Generally, at least four racks must be installed. Where more than two

splices occur (600V feeders only), a 1,800 mm (6 ft.) by 1,800 mm (6 ft.) by 1,800 mm (6 ft.) manhole must be required.

#### PENETRATIONS

Lighting and communication circuits that penetrate fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions, and between floors must be properly sealed in accordance with the requirements of the IBC with approved firestopping materials.

#### EXTERIOR CONCRETE

Concrete pads constructed to support exterior mechanical and electrical equipment must be provided with sufficient conduit penetrations to provide the necessary power and control connections plus an additional 50 percent for future equipment additions and modifications. Spare conduits need not extend more than 1,200 mm (4 ft.) past the end of the concrete slab. All spare conduits must be capped at both ends.

### 6.5.3.4 ADVANCED BUILDING METERING AND CONTROL

All projects must install advanced meters for electricity in accordance with EPAct 2005, and install advanced meters for gas and steam in accordance with EISA 2007, Section 434 (b), and EPAct 2005, "Guidance for Electric Metering in Federal Buildings." Government facilities must be prepared to reduce demand quickly and effectively and include intelligent electric meters capable of bidirectional monitoring of phase voltages, phase currents, power consumption (demand), power factor, kVAR, and availability. These meters must be capable of communicating via MODBUS/TCP/IP. Meters must meet at a minimum the definition stated. Government projects must also include demand reduction logic in the building automation system that is capable of activation upon input from the building operator or the intelligent meters. Ideally, the logic would be capable of three tiers of demand reduction—low/no occupant impact, minor occupant impact, and some impact. The equipment curtailed or set-points changed during each level must be identified by the A/E and agreed to by the project manager.

Building lighting, receptacle loads, and equipment larger than 5 kva shall be provided with metering in compliance with ASHRAE 90.1 (8.4.3.1).

Further information for advanced metering and guidance is offered by the PBS Chief Information Officer's Advanced Metering System Implementation Guide. Please see the Building Technology Technical Reference Guide for details on IT Security requirements.

## 6.5.4 DISTRIBUTION SYSTEM ALTERNATIVES

### 6.5.4.1 PRIMARY DISTRIBUTION

Where the design alternatives have been thoroughly evaluated and a medium-voltage service is selected as the optimal utility service for the application, the design professional must request that the utility company provide multiple 15 kV (nominal) feeders to serve the facility. Feeders must not be connected to the same utility switchgear bus section. Where feasible, it should be requested that facility feeders be extended from different substations.

The following types of primary distribution systems are listed in terms of increasing flexibility, reliability, and cost:

1. Looped primary
2. Radial primary
3. Primary selective
4. Primary selective-secondary selective
5. Network

Where primary service is provided, GSA will purchase, own, and maintain the building transformers.

Mission critical facilities shall be provided with dual utility feeders. In the event only a single utility feeder is available, the feeder shall be double tapped to provide a dual feed.

### MEDIUM-VOLTAGE SWITCHGEAR

Design of the medium-voltage switchgear must meet all of the requirements of the local utility and UL1558. Switchgear must be provided with enclosed, drawout-type vacuum interrupter breakers, one per each size fully equipped spare cubicle/breakers up to 1,600 amps, a breaker lifting device, and a ground and test device. The ground and test device must be stored in a spare switchgear cubicle.

Voltmeters, ammeters, and watt-hour digital meters with demand registers on each feeder must be provided for medium-voltage switchgear in addition to utility-approved digital relaying. Meters must be digital pulse-type for connection to and monitoring by the Advanced Metering Equipment. IR camera inspection ports shall be provided on the enclosure of all medium voltage switchgear for ease of inspecting switchgear for thermal problems while under load.

All switchgear sections must be installed on four-inch concrete housekeeping pads.

### MEDIUM-VOLTAGE CONDUCTORS

Conductors rated for less than 250A must be copper. Aluminum conductors must use properly rated crimp connections. All conductor insulation must be either XLP or EPR and be rated at 133 percent of the voltage rating. Individual conductor size must not exceed 240 mm2 (500 mcm).

### NETWORK TRANSFORMERS

Network transformers must be liquid-filled and have a kVA rating as required, with either aluminum or copper primary and secondary windings. Transformers must be equipped with provisions for fans and/or dual temperature ratings to increase the rated capacity and must be provided with sufficient contacts to permit the remote monitoring of the status of the network protector, temperature and pressure in the enclosure, and other components recommended by the manufacturer. Fans must not be used in determining the initial rating of the transformer. In addition, transformers must be provided with voltage taps ±2.5 percent with a no-load tap changer. Network transformers and tap changers located in areas subject to flooding or water backup must be specified as waterproof. Network transformers must be provided with disconnects for safe isolation servicing. The energized status of the transformers must be monitored by the Advanced Metering System.

### DOUBLE-ENDED SUBSTATIONS

Where either a primary selective or primary selective-secondary selective (double-ended) substation is selected, the following paragraph applies:

If reliability is critical and spot networks are not feasible, double-ended substations must be used. Transformers must be equipped with provisions for fans to increase the rated capacity. The sum of the estimated demand load of both ends of the substation must not exceed the rating of either transformer and must not exceed the fan cooling rating. All double-ended substations must be equipped with two secondary main breakers and one tie breaker configured for open transition automatic transfer, initiated through the use of an under-

voltage relaying scheme. Breakers must be of the electrically operated drawout type.

#### NETWORK SUBSTATIONS

Network substations are usually close-coupled to the secondary switchboards serving the respective loads. All circuit breakers up to and including the secondary switchgear main circuit breaker must be drawout type.

#### TRANSFORMERS

Transformers in double-ended and network substations must be dry type with epoxy resin cast coils or liquid filled, 300 C° or greater fire point, USDA-designated biobased insulating-oil type. Liquid-filled transformers must be used outdoors and for below-grade vault construction. Provide lightning arrestors on the primary side of all transformers. Provide surge suppression on the secondary and/or downstream busses. Transformer efficiencies shall meet or exceed 10 CFR 431, part 196.

Where silicon or oil-filled transformers are used, the design must comply with all spillage containment and electrical code requirements. Transformer location design must comply with all Federal and state spillage containment and electrical code requirements.

### 6.5.4.2 SECONDARY DISTRIBUTION

#### MAIN SWITCHGEAR (480 V SERVICE)

In the case of double-ended substations, all main and secondary feeder breakers must be draw-out power type. Breakers with solid state trip units must have modbus communications and shall be tied into the BAS for status and power monitoring.

All breakers in the 480 volt-rated service main switchgear must be fully rated. Series rating is not to be permitted. Main and feeder breakers must be provided with integral solid-state ground-fault protection tripping elements.

#### SURGE SUPPRESSION

Surge suppression on the main incoming service secondary switchboard must be provided.

#### SWITCHGEAR METERING

All utility main switchgear metering sections must contain a voltmeter capable of reading all phase-to-phase and phase-to-neutral voltages. The meter section must have a switchable ammeter and a three-phase totalizing watt-hour meter. The power meter must be networked and tied into the Advanced Metering System.

## 6.5.5 SPACE CONDITIONS

Provide adequate space and suitable locations for the electrical systems serving the facility and a planned method to install and replace this equipment. During the concept phase, provide detailed space requirements and suggested preferred locations of all critical space requirements for the power and communication systems for the facility. Provide the required space conditions, clear of any structural columns or beams as well as shear walls, stairways, duct shafts, and other obstructions. Equipment space selection must take into consideration adjacencies, such as stairs, mechanical rooms, toilets, elevators, air/piping shafts, and fire-rated assemblies, to permit secondary distribution of electrical and telecommunications circuitry to exit the assigned spaces.

Do not run electrical power or communication systems within stair enclosures unless power or communication serves the stair or is part of the emergency communication system.

Note: The designers must refer to Chapter 7, Section 7.6, for design criteria related to the following elements of the electrical and communication systems:

- Main equipment rooms
- Electrical rooms

- Communications rooms
- Building engineer's office
- Security control center
- Fire command center
- UPS systems and batteries
- Emergency generator

### 6.5.5.1 MAIN EQUIPMENT ROOMS– ELECTRICAL AND TELECOMMUNICATIONS

Main switchgear room doors must be large enough (in width and height) to allow for the removal and replacement of the largest piece of equipment. All equipment doors and personnel doors must swing out and be provided with panic hardware. Refer to NEC 110.26 for clearance requirements.

The sizes and locations of the telecommunications service rooms must be established in concert with the local communications service provider. Depending on the equipment selected, telecommunication service rooms may require 24-hour HVAC service, and may need protection from contaminants by proper filtration equipment.

Where the application of water from fire sprinklers installed in a main electrical room constitutes a serious life or fire hazard, the main electrical room must be separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.

### 6.5.5.2 ELECTRICAL ROOMS

Electrical rooms are generally located within the core areas of the facility and must be stacked vertically. Adequate numbers of electrical rooms must be provided, such that no electrical room serves more than 930 m2 (10,000 sq. ft.) and no branch circuit is more than 120 feet long horizontally. Electrical rooms must be provided with minimum unobstructed dimensions of 1,800 mm by 3,000 mm (6 ft. by 10 ft.) and are not scalable down in size to match floor plate dimension. A minimum of 30 percent future use wall space must be provided with available NEC clearance. If transformers are located in the rooms, ventilation must be provided. All transformers shall be floor mounted in new construction and shall only feed the floors on which they are located.

Electrical rooms are distinct from electrical closets, in that electrical closets shall not contain transformers, motors, or other heat-generating equipment.

### 6.5.5.3 COMMUNICATIONS ROOMS

Communications rooms are also generally located within the core areas of the facility and must be stacked vertically. Rooms must be sized to contain adequate floor space for frames, racks, and working clearances in accordance with EIA/TIA standards. Depending on the equipment selected, provisions may be required for 24-hour air conditioning in these rooms. The installation of dedicated electrical panelboards within the communications rooms should be considered to minimize electrical noise and to prevent unauthorized access.

### 6.5.5.4 BUILDING ENGINEER'S OFFICE

Even if not included in the building program, office space for the building engineer must be evaluated. Most GSA buildings require such a space, which houses the consoles for the BAS and remote annunciators for other critical systems such as fire alarm, generator status, miscellaneous alarm systems, and lighting control systems. This space is normally located near the loading dock or main mechanical spaces.

#### 6.5.5.5 SECURITY CONTROL CENTER

Each GSA building with a local security force must have a control center. In the event that the building will not be served by a local security force, this room may be combined with the building engineer's office or the fire command center.

The security control center must be located within the most secure area of the building and must be sized to house the command station for the security guards and their equipment, for current as well as anticipated future building needs.

#### 6.5.5.6 SPACES FOR UNINTERRUPTIBLE POWER SYSTEMS (UPS) AND BATTERIES

Since all UPS systems are considered above standard for GSA space, the requirement for a UPS system will be a tenant agency requirement. To establish the proper size, locations, and environmental requirements for the UPS and battery systems, the electrical engineer must arrange to meet with the architect and representatives of the tenant agencies to determine the required/estimated load and physical size requirements and the nature of the critical loads. Refer to the UPS and battery manufacturers' installation instructions for heat dissipation requirements, weights, dimensions, efficiency, and required clearances in the design.

For small systems up to 50kVA, the UPS modules and sealed cabinet batteries must be installed in the room with the equipment being served.

For medium and large systems greater than 50kVA, the UPS system must be provided with standby generator backup to limit the battery capacity. The UPS system equipment and batteries must be in separate rooms if wet cell batteries are utilized. Weight and noise must be considered in UPS placement.

Space for storage of safety equipment, such as goggles and gloves, must be provided. Special attention must be given to floor loading for the battery room, entrance door dimensions for installation of the UPS, and ceiling height for clearance of the appropriate HVAC systems and exhaust systems.

#### 6.5.5.7 FIRE COMMAND CENTER

See Fire Protection, for specific requirements for the Fire Command Center.

#### 6.5.5.8 FLOOD PLAIN CLEARANCE

Electrical equipment must be located at five feet above the 100-year flood plain. Electrical equipment for facilities classified as Critical Action Facilities must be located five feet above the 500 year flood plain. The electrical engineer must determine from local jurisdictions any additional freeboard requirements above this base level.

### 6.5.6 SECONDARY BRANCH POWER DISTRIBUTION

#### 6.5.6.1 FEEDER ASSIGNMENTS (BUS DUCTS VS. CABLE-IN-CONDUIT)

The secondary main branch power distribution system conveys power to the various load groups distributed throughout the building. The decision as to whether this power is conveyed to the various loads in copper cables-in-conduit or in either aluminum or copper bus duct must be based on the following factors:

- Size and shape of the facility
- Design of the main switchgear
- Coordination with piping and ductwork in the lower levels
- Design of the electric rooms–proximity to the transformer vault
- Ceiling space available
- Access to bus splice connections for testing

- Flexibility
- Reliability
- Cost

At the early stages of a project, alternate designs comparing the factors listed above must be evaluated to determine the feeder assignments. Results must be submitted in accordance with Appendix A.

#### BUS DUCT

Bus ducts must be copper or aluminum, fully rated, 3-phase, 3-wire or 3-phase, 4-wire with 100 percent neutral, and an integral ground bus, sized at 50 percent of the phase bus, NEMA Class 3R or higher. Calculations supporting the specified short-circuit rating must be submitted in accordance with Appendix A.

### 6.5.6.2 MOTOR CONTROL CENTERS

Grouped motor controls must be used where eight or more starters are required in an equipment room. Motor control center (MCC) construction must be NEMA Class I, Type B copper, with magnetic (or solid-state if appropriate) starters and either molded case solid state circuit breakers or fused switches. The minimum starter size in motor control centers must be Size 1. MCCs must be provided with Advanced Metering for remote monitoring. Control circuit voltage must be 120V connected ahead of each starter via a fused control transformer. Reduced-voltage starters may be used for larger motors to reduce starting kVA.

Time-delay relays must be incorporated in the starters or programmed in the BAS system to reduce inrush currents on the electrical system.

Where variable frequency drives (VFDs) are used on a project, an LCC evaluation must be conducted to determine when VFDs must be incorporated into the MCCs. If determined not appropriate, then VFDs must be powered from distribution panels installed for that purpose. See below for additional VFD requirements.

### 6.5.6.3 ELEVATOR AND OTHER VERTICAL TRANSPORTATION POWER

If two or more switchgears are available, the load of the elevator and other vertical transportation feeders must be divided among the secondary switchgears, provided that alternate elevator machines must be fed from different switchgears.

Note: One elevator in each bank must be connected to the emergency generator. Where multiple elevators are in a common bank, provide a common emergency feeder from the elevator automatic transfer switch (ATS) to allow each elevator to be operated individually during an emergency. See Section 6.5.9 for additional requirements. Interlocking the ATS with the elevator group controller, programming must be made by the elevator supplier to set up a controlled return to the terminal floor and then to limit the number of elevators in that bank that can be run concurrently.

See Chapter 7 for additional information on standby power requirements for fire service access elevators and occupant evacuation elevators. Sufficient standby power must be provided to operate all designated fire service access elevators and occupant evacuation elevators along with their associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces, simultaneously.

Elevator machines must be electrically powered by non-auto resetting circuit breakers with padlocking capabilities. Shunt trip circuit breakers must be provided when automatic sprinklers are installed in hoist ways, machine rooms, and control rooms containing elevator

driving machines. The electrical supply shall disconnect automatically prior to application of water. Elevator breakers must be located in the elevator machine room.

#### 6.5.6.4 VARIABLE FREQUENCY DRIVE

Variable frequency drives must be used on all speed control motors larger than 3.7 kW (5 horsepower) to reduce the energy consumption of the project. However, VFDs generate harmonics, which are injected into the secondary power distribution system. These harmonics must be minimized through the use of filters tuned to the peak harmonic generated by the drive. All VFDs must be provided with a contactor bypass option. All motors sized 5 horsepower and larger shall be provided with either Shaft Grounding Rings (SGRs) or Common Mode Filters to eliminate high frequency damage to motor bearings.

VFDs must use a minimum 6-pulse width modulation (PWM) design because of their excellent power factors and high efficiencies. VFDs must be specified with passive harmonic filters and also with isolation transformers where required. Individual or simultaneous operation of the variable frequency drives must not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator (if applicable), per IEEE 519, latest edition. The load side of the main breaker must be the point of common coupling.

A harmonic (voltage and current) analysis must be conducted by the electrical engineer, including all calculations, and submitted in accordance with Appendix A.

Where the harmonic analysis indicates noncompliance, the application of 12-pulse, pulse width modulation, or zig-zag transformers or other approved alternate method must be used to reduce the total harmonic voltage distortion.

Thermal sensors must be specified that interlock with the VFD control circuit for additional protection for motors running at low speeds and subject to overheating. This is in addition to the standard over-current protection required.

Distance between VFDs and their load shall not exceed VFD manufacturer's recommendations or 25', whichever is stricter. VFD rated wire shall be provided between the VFD and the motor being served.

### 6.5.7 BRANCH WIRING DISTRIBUTION SYSTEMS

#### 6.5.7.1 LIGHTING–CIRCUIT LOADING

120 volt circuits must be limited to a maximum of 1,400 volt-amperes.

277 volt circuits must be limited to a maximum of 3,200 volt-amperes.

#### 6.5.7.2 RECEPTACLES–CIRCUIT LOADING

120 volt circuits must be limited to a maximum of 8 duplex receptacles.

Each special purpose receptacle must be circuited on a dedicated circuit to a protective device to match the rating of the receptacle.

Emergency receptacles must be red. Isolated grounding receptacles must be orange. Special purpose and dedicated receptacles must be gray. ASHRAE 90.1 controlled receptacles must be green. The color of standard receptacles and switches must be coordinated with the architectural color scheme; for example, white, not ivory, devices must be used if walls are white or light gray.

Building standard receptacles must be duplex, specification-grade NEMA 5-20R. Each Ground

Fault Circuit Interrupter (GFCI) receptacle must have a light indicating when it has been tripped. Communication room equipment receptacles must be locking type to prevent accidental disconnection. Special purpose receptacles must be provided as required. Device plates must be plastic, colored to match the receptacles.

Occupancy-based, time-schedule based, or building-management system based plug load controls must be considered by the designer for all office cubicles and private office workstations.

### 6.5.7.3 PLACEMENT OF RECEPTACLES

#### CORRIDORS

Receptacles in corridors must be located 15 m (50 ft.) on center and 7.5 m (25 ft.) from corridor ends.

#### OFFICE SPACE

Receptacles for housekeeping must be placed in exterior walls and walls around permanent cores or corridors. Where receptacles are placed on exterior walls, installation of conduits and wallboxes must minimize air infiltration and moisture incursion. See Section 5.3 and Chapter 3 for additional requirements.

Placement of receptacles in walls must be avoided where raised access floors are used. See Section 6.5.7.4, Underfloor Raceway Systems, for additional requirements. For areas where raised access floors or underfloor raceway systems are not used, placement of receptacles must comply with the project requirements.

#### CONFERENCE AND TRAINING ROOMS

Conference rooms and training rooms must be served in the same fashion as office space, except where specifically outfitted for audio-visual equipment.

#### COURTROOMS AND RELATED AREAS

Refer to Chapter 8 for special electrical requirements.

#### MAINTENANCE SHOPS

Maintenance shops require plug-mold strips above work benches with duplex outlets 900 mm (36 in.) on center. Receptacles must be wired on alternating circuits. Receptacles or circuit breakers must be of the ground fault interrupt (GFI) type. Provide emergency power off stations and associated contactors for shops containing freestanding equipment.

#### COMMUNICATIONS ROOMS

Communication rooms must contain power and grounding for the passive and active devices used for the telecommunications system, including at least two dedicated 20A, 120 volt duplex electrical outlets on emergency power, and additional lock type convenience outlets at 1,800 mm (6 ft.) intervals around the walls and direct connection to the main building grounding system. If uninterruptible power is required in communications rooms, it must be furnished as part of the communications system. Larger communication rooms must be provided with ceiling-mounted locking receptacles on ceiling-hung strain relief whips.

#### MECHANICAL AND ELECTRICAL ROOMS

All mechanical and electrical equipment rooms must each have, at a minimum, one emergency power receptacle that is identified as such at the receptacle.

#### EXTERIOR MECHANICAL EQUIPMENT

Provide one receptacle adjacent to mechanical equipment exterior to the building, including each roof section. Receptacles must be of the weatherproof GFI type. Receptacles must be located within 7.62 m (25 ft.) of each piece of equipment in accordance with NFPA 70 210-63.

#### TOILET ROOMS

Each toilet room must have at least one GFI receptacle at the vanity or sink. All receptacles located in toilet rooms must be GFI protected.

Carefully coordinate the location of the receptacles with all toilet accessories.

#### LAW ENFORCEMENT AND SPECIAL LAB DESIGN REQUIREMENTS

Law Enforcement facilities and critical lab functions must be designed to insure high reliability of electrical service throughout operation, tenant upgrades, and maintenance. TI funded maintenance risers must allow a continual feed to critical equipment while primary electrical risers are undergoing maintenance.

### 6.5.7.4 UNDERFLOOR RACEWAY SYSTEMS

Underfloor raceways fall into three categories:

#### RAISED ACCESS FLOORS

All wiring beneath a raised access floor must meet the requirements in NFPA 70 and must be routed in rigid metal or flexible conduit to underfloor distribution boxes. One distribution box per bay is recommended. Flush-mounted access floor service boxes must be attached to the underfloor distribution boxes by means of a modular, prewired system to facilitate easy relocation.

#### CELLULAR METAL DECK

In cellular metal decks that frame the concrete floor slabs in a steel building, the cells are generally fully “electrified” by the placement of steel sheets enclosing the underside of the cells. Access to the individual cells is obtained by a series of compartmented header ducts. The width of the header duct is sized according to the area served and the depth is 63 mm (2 1/2 in).

#### UNDERFLOOR DUCT SYSTEM

A 3-cell underfloor duct system is placed in a 100 mm (4 in.) concrete fill over the concrete slab. The cells are generally located on 1,500 mm (5 ft.) to 1,800 mm (6 ft.) centers. Note: This type of raceway system is frequently found in existing buildings selected for modernization.

The cell assignments in cellular metal deck systems and the 3-cell duct systems are generally designated as 1) power, 2) voice/data, and 3) signal. However, the recent increase in bandwidth required by the latest IT equipment has been accompanied by the use of CAT 6 cables and fiber optic cables. The CAT 6 cables cannot tolerate the proximity to the power cables and neither of these cables is compatible with the sharp bends from the header ducts to the cells and to the outlets, which significantly diminishes the practical use of these systems.

### 6.5.7.5 PANELBOARDS

Panelboards must be constructed to comply with the requirements of UL 67 and UL 50.

All panelboard interiors must be constructed using hard-drawn copper of 98 percent conductivity, with AIC bracing greater than the calculated available fault current. The minimum short circuit rating for 208Y/120V panelboards must be 10,000 amperes symmetrical. The minimum short circuit rating for 480Y/277V panelboards must be 14,000 amperes symmetrical. A full-size copper ground bus for connecting ground conductors must be bonded to the steel cabinet.

Branch circuit breakers must be bolt-on designed for replacement without disturbing the adjacent units. Breakers must comply with the requirements of UL 489, thermal magnetic type with a short-circuit rating greater than the calculated available fault current. Panels must be specified with “door-in-door” trim.

#### POWER DISTRIBUTION PANELS

Circuit breaker-type panels must be the standard of construction for Federal buildings. With the exception of lighting and receptacle

panelboards, fusible switches may be considered if specific design considerations warrant their application, such as in electrical coordination of electrical over-current devices.

#### LIGHTING AND RECEPTACLE PANELBOARDS

Lighting and receptacle panelboards must be circuit breaker type: a maximum of 30 poles for 100 amp panelboards.

#### PANELBOARD SURGE PROTECTION

All new emergency panelboards shall be provided with integral surge protection devices as required by NFPA 70, section 700.8. Panelboard circuits feeding outside loads (lighting, receptacles, charging stations, etc.) shall also be protected with type 2 SPDs if building lightning protection is provided.

### 6.5.7.6 CONDUCTORS & CONDUIT SYSTEMS

The specification must list the various types of conduit systems that are approved for use on the project and the specific raceway applications for which they are to be used. MC cabling is not an acceptable conduit system. Approved conduit systems are as follows:

- RSC – Rigid galvanized steel conduit – ANSI C80.1 Exposed outdoors, wet, or damp locations
- RAC – Aluminum conduit (with steel elbows) Indoor feeders – exposed and/or concealed
- IMC – Intermediate steel conduit – ANSI C80.6 Exposed outdoors, wet, or damp locations. Indoor feeders, exposed and/or concealed
- EMT – Electrical metallic tubing (full compression steel fittings) – ANSI C80.3 Branch circuit wiring, exposed and/or concealed
- FMC – Flexible steel conduit – connections to recessed lighting fixtures, motors, or concealed in movable wall partitions.
- LFMC – Liquid flexible steel conduit with PVC jacket. Connections to vibrating equipment (motors, transformers, etc.)
- PVC – Underground feeders encased in concrete envelope. Indoors and outdoors. Transition to steel or aluminum when not encased.

#### CONDUCTORS

Aluminum or copper conductors are acceptable for motor windings, distribution transformer windings, switchgear bussing, and switchboard bussing, where the conductor is purchased as part of the equipment.

Conductor insulation shall be colored in accordance with the following:

(208/120-V: A-black, B-red, C-blue, neutral-white, ground-green, isolated ground-green w/ yellow stripes)

(480/277-V: A-brown, B-orange, C-yellow, neutral-gray, ground-green w/ yellow stripes, isolated ground-green w/ yellow stripes)

MC cable may be used for portions of branch circuits not excluded below and that do not terminate directly at a panelboard.

Materials and Construction

- Metal-Clad Cable shall be steel armored and not exceed #10 AWG.
- Metal-Clad Cable shall be labeled a minimum of every three feet with 360 degree paint bands indicating number of conductors and voltage (either 480/277 or 208/120v) of conductors
- All circuit home runs shall be in conduits and labeled as required in section 6.5.7.5. Conduit systems must be used between the panelboard and the first terminated device.
- All accessible and serviceable Metal-Clad Cable runs shall be provided with permanent

typed labels every 10 feet and at all wall penetrations with tags indicating panelboard and circuit feed from.

- Individual Metal-Clad Cables shall NOT contain more than three current carrying conductors to prevent having to derate the cables due to heat; however, integral lighting control conductors are acceptable for lighting circuits.
- Metal-Clad Cable shall be secured to the structure as stipulated in the National Electric Code unless otherwise noted in this document. All cables shall be secured within 12 inches of the cable termination device.
- Snap in type fittings shall not be used.

Metal-Clad Cable shall not be used in the following areas:

- In highly finished spaces such as courtrooms, judge's chambers, historical areas, lobbies, and conference centers
- In wet, damp, hazardous, chemical using areas, outdoor structures, basements, garages, penthouses, elevator shafts, mechanical rooms/spaces, or areas subject to physical damage from vehicular or maintenance equipment
- Metal-Clad Cables shall NOT be directly embedded in concrete structures/columns or below unmovable flooring (e.g., hardwood flooring)
- Metal-Clad Cable shall not be directly embedded in finished plaster surfaces
- Metal-Clad Cable shall NOT be used to feed either building or tenant critical electrical infrastructure such as servers, HVAC, intrusion detection, access control and fire alarm/protection systems.

### 6.5.7.7 EQUIPMENT LABELING

All electrical equipment installed must be provided with exterior, typewritten, machine-made labels indicating the panel and circuit number from which they electrically fed in conformance with NEC 408.4 Field Identification Required. This requirement applies to all electrical cover plates, lighting switch plates, disconnects, transformers, etc.

### 6.5.7.8 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

Conduit pathway infrastructure shall be provided for both GOV and POV electric charging stations (EVSEs). The infrastructure must be installed within federally owned parking lots/garages and/or facilities. These charging stations shall be located as close as possible to their electrical supply service while also assuring that the EVSEs are conveniently located for drivers. EVSEs must not be located near hazardous areas. Charging cords associated with EVSEs must not interfere with pedestrian traffic or present tripping hazards. Curbs, bollards, wheel stops, and/or equipment setbacks should be used to prevent vehicles from damaging EVSEs. Accessibility issues shall be considered when locating EVSEs. Lighting about the charging station shall be provided for both safety and the reading of equipment instructions. If the charging station is to be enclosed, provide adequate ventilation. Each EVSE shall be labeled to indicate the panelboard and circuit number from which it is electrically fed.

Federal fleet EVSE infrastructure shall include:

- Minimum Level 2 Charger
- For lots with fewer than 5 GOVs, install infrastructure for two (2) charging stations
- For lots with 5 – 25 GOVs, install infrastructure for four (4) charging stations

- For lots with greater than 25 GOVs, infrastructure for 20% of the planned GOV's.

Where no tenant policy on the number of POV EVSE requirements exists, provide the following EVSE infrastructure:

- For lots with fewer than 50 POVs, install infrastructure for (2) two charging stations
- For lots with 50-100 POVs, install infrastructure for (5) five charging stations
- For lots with greater than 100 POVs, infrastructure for 6% of the planned POV parking shall be installed

Infrastructure for each charging station, including both GOVs and POVs, shall consist of two conduits, one for power and one for communications of the sizes listed below. Install the conduits between the nearest electrical room and the charging station locations. Each conduit run shall be capable of servicing at least two adjacent vehicle locations. Minimum conduit size for power cabling shall be 2-1/2 inches for circuit runs up to 100' and 3 inches for longer runs. Conduits at the charging station end shall terminate in a concrete traffic rated hand-hole enclosure. The associated communication conduit shall be a minimum of 1-1/2 inches and terminate in an independent concrete traffic rated hand-hole enclosure. All conduits shall be sealed with water proof plugs at both ends. Traffic rated hand hole enclosures are not required in locations not exposed to vehicular traffic. Underground conduit installation requirements can be found in Part 6.5.3.3 of this document.

## 6.5.8 VOICE AND DATA DISTRIBUTION SYSTEM

The configuration and type of the voice and data cabling distribution systems must be developed at the earliest stages of design, since the space requirements are so significant and widespread. System requirements are user generated and are generally translated into distribution system requirements by the design engineer in conjunction with GSA's FAS, who together develop systems in accordance with the latest edition of the BICSI Telecommunications Distribution Methods Manual and the GSA IT Telecommunications Distribution Design Guide found at infrastructure@gsa.gov

### 6.5.8.1 EQUIPMENT GROUNDING CONDUCTOR

Except for isolated ground systems, all low-voltage power distribution systems must be supplemented with a separate, insulated equipment grounding conductor.

### 6.5.8.2 COMMUNICATIONS RACEWAYS

Communication raceways must meet the installation requirements in NFPA 70.

#### RAISED ACCESS FLOOR

If GSA has determined that raised access floors are to be used for cable management in the project (see Section 6.5.7.4), the communications services must be installed by laying the cable in a tray for main runs and then branching directly on the floor slab below the raised access flooring system.

#### CABLE TRAYS IN HUNG CEILINGS

Since underfloor raceway systems cannot accommodate the large turning radii required by the CAT 6 and fiber optic cables, the primary alternative to a raised floor system is a series of cable trays installed above accessible hung ceilings. Cable trays must be continuously grounded.

## 6.5.9 EMERGENCY AND STANDBY POWER SYSTEMS

Emergency and standby power systems must be designed to comply with the requirements of the IBC, NFPA 110, and NFPA 111. Compliance with the electrical safety of the installation, operation, and maintenance of emergency systems is required, as addressed in Article 700 of NFPA 70. Unless otherwise specifically authorized by the contracting officer, all facilities must be provided with a standby generator to supply power to the facility in the event of a sudden loss of power.

### 6.5.9.1 CLASSIFICATION OF EMERGENCY POWER SUPPLY SYSTEMS (EPSS)

The class and type of Emergency Power Supply Systems (EPSSs) for Federal buildings must be a minimum of Class 72, where 72 is the minimum time in hours for which the EPSS is designed to operate at its rated load without being refueled (see Chapter 4, NFPA 110). The EPSS must have a designation of Type 10, where 10 is the maximum time in seconds that the EPSS will permit the load terminals of the transfer switch to be less than 90 percent of the rated voltage.

Where the standby generator supplies a switchboard, power may be distributed from the switchboard to the emergency, legally required standby, and optional standby systems, in accordance with Figure B.1 (a) and B.1 (b), NFPA 110.

#### EMERGENCY SYSTEM

The EPSS must supply emergency loads through an automatic transfer switch upon failure of the normal supply. The transfer time limit must not exceed 10 seconds. At all critical facilities, automatic transfer switches shall be provided with maintenance bypass switches to allow the automatic transfer switch to be maintained while still providing power to the building. Emergency illumination must include all required egress lighting, illuminated exit signs, and all other lights specified as necessary to provide required illumination. See Sections 6.3 for additional criteria and requirements.

An emergency supply source must supply equipment classified as emergency through an automatic transfer switch upon failure of the normal supply.

Emergency loads (life safety loads) must include:

- Emergency lighting
- Fire alarm system
- Exit signs
- Automatic fire detection equipment for smokeproof enclosures
- Emergency voice/alarm communication systems
- Smoke control systems
- Exit stairway pressurization systems
- Fire pump
- Pressure maintenance (jockey) pump
- Air compressors serving dry pipe or pre-action systems
- Power and lighting for fire command center and security control center
- Fire service access elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators)
- Occupant evacuation elevators and associated controllers and the cooling and ventilation equipment serving their machinery rooms and machinery spaces (simultaneously all designated elevators)

#### REQUIRED STANDBY SYSTEM

This system must automatically supply power to selected loads (other than those classified as the

emergency system) upon failure of the normal source. The transfer time limit must not exceed 60 seconds.

Required standby loads must include:

- Visitor screening equipment
- Telephone switches and fiber cable battery systems
- Security systems
- Mechanical control systems
- BASs
- Sump pumps
- Sewage ejection pumps
- Uninterruptible power systems serving technology/server rooms
- HVAC systems for technology/server rooms, UPS rooms, and communications rooms
- Exhaust fan in UPS battery rooms
- FAA aircraft obstruction lights
- Drinking water booster pumps (high rise buildings)

#### OPTIONAL STANDBY SYSTEM

This system must supply power to the facilities or property where life safety does not depend on the performance of the system. The optional standby system must supply on-site generated power to selected loads, either automatically or by manual transfer.

Optional standby system loads may include:

- General areas of the buildings
- HVAC and refrigeration systems
- Data processing and communications systems
- Boiler, hot water pumps, perimeter HVAC units, and any other ancillary heating equipment necessary to freeze-protect the building
- Receptacles and emergency lighting in large conference rooms to facilitate command and control operations during an emergency situation

### 6.5.9.2 GENERATOR SYSTEM

The emergency and standby generator system must consist of one or more central engine generators and a separate distribution system with automatic transfer switches, distribution panels, lighting panels, and, where required, dry-type transformers feeding 208Y/120V panels. The electrical engineer must coordinate with the mechanical engineer and architect on the design of the generator system.

Diesel fuel and natural gas are permitted as energy sources for building emergency generators. However, if natural gas/propane is selected for level 1 and mission critical facilities that may be located in areas where the probability of fuel interruptions is high (due to earthquakes, floods, poor utility reliability, or operational/facility requirements), the A/E shall develop a risk assessment (e.g., probability and consequences) that analyzes these types of parameters. This assessment shall also address issues such as block loading limitations, building height, seismic zone, continuity of tenant mission requirements, facility security, etc. GSA will make the final determination as to the fuel source assessment that will be utilized. Generators shall be registered with the applicable regulatory authority.

Generators shall be certified as fully EPA compliant at the manufacturing facility.

#### SERVICE CONDITIONS

If possible, locate the generators outside and on grade. If installed outdoors, they must be provided with a suitable walk-in acoustic enclosure and jacket water heaters to ensure reliable starting in cold weather. If critical action structures must be located within a floodplain,

generators shall be elevated above the 500-year base flood elevation.

When installed at high altitudes or in areas with very high ambient temperatures, the generators must be derated in accordance with manufacturers' recommendations. Operation of starting batteries and battery chargers must also be considered in sizing calculations. In humid locations heaters can reduce moisture collection in the generator windings. Critical silencers are required for all generators. Acoustical treatment of the generator room must be provided as necessary. Temperature and ventilation must be maintained within the manufacturers' recommendations to ensure proper operation of the unit. Calculations to support the size of the intake air supply for combustion, cooling, and radiation, as well as exhaust piping and exhaust paths, must be provided by the mechanical engineer in accordance with Appendix A.

Radiators must be unit mounted if possible. If ventilation is restricted in indoor applications, remote installation is acceptable. Heat recovery and load shedding must not be considered. The remote location of radiators must be designed to avoid excess pressure on the piping seals.

A permanently installed load bank, sized at a minimum of 50 percent of generator rating, must be provided. The load bank may be factory mounted to the radiator. Care should be taken in selecting materials that will tolerate the high temperatures associated with radiator-mounted load banks to include belts, flex connections, motors, sprinkler heads, and so on.

For diesel generators, the load bank shall provide a load add/shed feature that will maintain load levels at a minimum, including building load, of the generator manufacturer's recommended loads when operating at 50 percent of generator KW name plate. The load bank shall have a minimum of four automatic load taps controlled by a load add/shed relay incorporated into the run circuit on the generator.

### CAPACITY

The engine generators must be sized to serve approximately 150 percent of the design load and to run at a maximum of 60 percent to 80 percent of their rated capacities after the effect of the inrush current declines. When sizing the generators, the initial voltage drop on generator output due to starting currents of loads must not exceed 15 percent. Day tanks must be sized for a minimum capacity of four hours of generator operation. Provide direct fuel oil supply and fuel oil return piping to the on-site storage tank. Piping must not be connected into the boiler transfer fuel oil delivery "loop."

Care must be exercised in sizing fuel oil storage tanks by taking into account that the bottom 10 percent of the tank is unusable and that the tank is normally not full (normally at a 70 percent level) before the operation of the generator.

### GENERATOR ALARMS

Generator alarms must be provided on the exterior wall of the generator room. All malfunctions must be transmitted to the BAS. In all buildings, with or without BAS, a generator alarm annunciator must be located within the fire command center. The generator output breaker must have a contact connected to the BAS indicating output breaker position, to allow annunciation of the open position on the BAS.

### AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches serving motor loads must have in-phase monitors (to ensure transfer only when normal and emergency voltages are in phase) to prevent possible motor damage caused by an out-of-phase transfer. They must also have pretransfer contacts to signal time

delay returns in the emergency motor control centers.

Automatic transfer switches must include a bypass isolation switch that allows manual bypass of the normal or emergency source to ensure continued power to emergency circuits in the event of a switch failure or required maintenance.

#### LOCATION

The generators and the generator control panel must be located in separate rooms or enclosures.

#### LOAD SHEDDING

Life safety generators may be designed to operate in parallel with the local utility, thus allowing for load shedding and smart grid and intelligent building initiatives. Before designing emergency generators for peak shaving purposes, local, State, and Federal authorities must be contacted due to the need for possible noise, air quality permitting, and additional hardware requirements.

## 6.5.10 CLEAN POWER SYSTEMS

### 6.5.10.1 UNINTERRUPTIBLE POWER SYSTEMS AND BATTERY ROOMS

In some facilities, technology/server room backup systems are designed by the tenant agency. If this is the case, shell space and utility rough-ins must be provided. In facilities where UPS systems are to be provided as part of the building construction, they must be designed as described in this section. All UPS systems are considered to be above standard for GSA space. Tenant agencies with UPS requirements should be advised that a maintenance contract is recommended.

Requirements for UPS systems must be evaluated on a case-by-case basis. If UPS is required, it may or may not require generator backup. When generator backup is unnecessary, sufficient battery capacity must be provided to allow for an orderly shutdown.

#### CRITICAL TECHNICAL LOADS

The nature, size, and locations of critical loads to be supplied by the UPS will be provided in the program. Noncritical loads must be served by separate distribution systems supplied from either the normal or electronic distribution system. A UPS system must be sized with at least a 25 percent spare capacity. The specification of a redundant module must depend upon the criticality of the loads.

#### EMERGENCY ELECTRICAL POWER SOURCE REQUIREMENTS

When the UPS is running on the site emergency generator, the amount of current to recharge the UPS batteries must be limited so as to not overload the generator. This limited battery charging load must be added to the required standby load (see Section 6.5.9) when sizing the standby generator.

If the UPS system is backed up by a generator to provide for continuous operation, the generator must provide power to all necessary auxiliary equipment, i.e., the lighting, ventilation, and air conditioning supplying the UPS and the critical technical area (see Section 6.5.9).

#### SYSTEM STATUS AND CONTROL PANEL

The UPS must include all instruments and controls for proper system operation. The system status panel must have an appropriate audio/visual alarm to alert operators of potential problems. It must include the following monitoring and alarm functions: system on, system bypassed, system fault, out of phase utility fault, and closed generator circuit breaker. It must have an audible alarm and alarm silencer button. Since UPS equipment rooms are usually

unattended, an additional remote system status panel must be provided in the space served by the UPS. The alarms must also be transmitted to the BAS.

#### UPS AND BATTERY ROOM REQUIREMENTS

Emergency lighting must be provided in both spaces and a telephone must be provided in or adjacent to the UPS room. The battery room design must provide proper ventilation, hydrogen detection, spill containment, and working clearances. See Chapters 3, 5, and 7 for additional requirements for the UPS and battery rooms. Also, see NFPA 70.

### 6.5.10.2 COMPUTER CENTER POWER DISTRIBUTION UNIT

In some GSA buildings the power distribution system for computer centers is designed by the tenant agency. If this is the case, utility rough-in must be provided under the construction contract. If power distribution is to be provided under the building contract, it must be designed according to the criteria in this section.

#### POWER DISTRIBUTION UNITS (PDUS)

PDUs with internal or remote isolation transformers and output panelboards must be provided in all computer centers to reduce/eliminate harmonic currents generated by nonlinear loads and reflected back to the neutral service conductors. PDUs with internal or remote isolation transformers must be harmonic mitigating to serve nonlinear loads.

#### COMPUTER CENTER GROUNDING

To prevent electrical noise from affecting computer system operation, a low-frequency power system grounding and a high-frequency signal reference grounding system must be provided. The design of the technology/server room grounding system must be coordinated with the computer center staff.

#### LOW-FREQUENCY POWER SYSTEM GROUNDING

A safe, low-frequency, single-point grounding system must be provided that complies with Article 250 of NFPA 70. The single-point ground must be established to ground the isolation transformer or its associated main service distribution panel.

A grounding conductor must be run from the PDU isolation transformer to the nearest effective earth grounding electrode as defined in NFPA 70. All circuits serving automated data processing equipment from a PDU must have grounding conductors equal in size to the phase conductors.

#### HIGH-FREQUENCY POWER SYSTEM GROUNDING

A high-frequency signal reference grounding system shall consist of a grid made up of 600 mm (2 ft.) squares must be provided as a signal reference grounding system. If a raised floor has been provided, its grid with mechanically bolted stringers may be used. Alternatively, a grid can be constructed by laying a 600 mm mesh (2 ft. squares) of braided copper strap or 1.3 mm (16 gauge, 0.051 in.) by 50 mm (2 in.) copper strap directly on the structural floor. Data processing equipment must be connected to the reference grid by the most direct route with a braided copper strap.

#### COMMON-MODE NOISE REDUCTION

The reduction of common-mode noise is particularly important for the proper operation of computer-based, distributed microprocessor-based systems, i.e., BASs, electronic security systems, card-access control systems, and local area networks.

The following steps must be taken to reduce common-mode noise:

- Avoid running unshielded metallic signal or data lines parallel to power feeders.
- Where metallic signal or data lines are routed in noise-prone environments, use shielded (grounded at one end) cables or install wiring in ferrous metal conduit or enclosed cable trays.
- Locate metallic signal or data lines and equipment at a safe distance from arc-producing equipment such as line voltage regulators, transformers, battery chargers, motors, generators, and switching devices.
- Provide isolation transformers, electronic power distribution panelboards, or power conditioners to serve critical electronics equipment loads.
- Provide isolated grounding service on dedicated circuits to critical data terminating or communicating equipment.
- Replace metallic data and signal conductors with fiber optic cables where practical.

#### 6.5.10.3 HARMONIC MITIGATION—TRANSFORMERS

Harmonic frequencies are introduced into the branch circuit distribution system by electronic ballasts, variable frequency drives, PCs, printers, file servers, copiers, and communication equipment. This harmonic distortion will create overheating and power quality problems such as overheating in transformers and conductor neutrals, premature motor failures, false tripping of protective devices, computer operational problems, and hardware component failures. To accommodate/correct these problems, the electrical design must utilize Harmonic Mitigating Transformers  rated distribution transformers.

Application of these engineered strategies shall be confirmed by the harmonic (voltage and current) analysis submitted in accordance with Appendix A, sections A.3 and A.4.

Transformer efficiencies of all building transformers shall meet or exceed 10 CFR 431, part 196.

### 6.5.11 GROUNDING SYSTEMS

Grounding systems must be designed to coordinate with the specific type and size of the electrical distribution system, including the following applicable generic types of grounding systems or grounding components.

#### 6.5.11.1 SEPARATE EQUIPMENT GROUND CONDUCTORS

The types, sizes, and quantities of equipment grounding conductors must comply with NFPA 70, Article 250, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

- Insulated equipment grounding conductors must be installed with circuit conductors for the following items, in addition to those required by NFPA 70:
- Feeders and branch circuits
- Lighting circuits
- Receptacle circuits
- Single-phase motor and appliance branch circuits
- Three-phase motor and appliance branch circuits
- Flexible raceway runs
- Metal clad cable runs
- Cabletrays (bond each individual section)

#### 6.5.11.2 BUSWAY SUPPLY CIRCUITS

Insulated equipment grounding conductors must be installed from the grounding bus in the switchgear, switchboard, or distribution panel to the equipment grounding bar terminal on the busway.

#### 6.5.11.3 SEPARATELY DERIVED GROUNDS

To minimize extraneous "noise" on certain systems, particularly those in which harmonics are generated, the specific system grounds must be separated before grounding at the service grounding electrode or counterpoise.

#### 6.5.11.4 RAISED FLOORS

All access floors must be grounded. A grounding conductor must be bonded to every other floor pedestal and must be extended to the technology/server room common ground bus.

#### 6.5.11.5 COUNTERPOISE

Where feasible, a grounding conductor (counterpoise) must be provided in an isosceles triangle configuration with sides greater than or equal to 3 meters (10 ft.). The conductor must be tinned copper not less than No. 4/0 AWG and must be electrically connected to the incoming domestic water services (provided the piping for the water service is a conducting material) on either side of the building as well as the various clusters of three ground rods spaced at intervals. Ground rods must be 15 mm (5/8 in.) diameter by 2,400 mm (96 in.) long and must be zinc coated copper. The counterpoise loop will involve direct burial in earth 600 mm (24 in.) below grade. The following items must be connected to the counterpoise loop. All ground rod and grounding connections must be exothermically welded:

- Lightning protection system "down conductors"
- Transformers in substations
- Emergency generator ground
- Telecom and data room grounds
- Separately derived grounds
- Isolated ground panels
- Main switchgears
- Normal and emergency distribution systems
- Flagpoles

#### 6.5.11.6 COMMON GROUND SYSTEM

Consideration should be given to providing a common ground bus throughout the building. Conceptually a common ground bus would originate from the main service entrance and run up through stacked electrical rooms, where an insulated wall-mounted copper ground plate would be installed for connecting any equipment needing a common ground. Where conditions might prohibit an isosceles triangle counterpoise ground, consideration should be given to installing chemical ground rods in trenches or borings supplemented with conductivity-enhancing soil conditioners such as Bentonite clay or conductive concrete.

### 6.5.12 SAFETY SYSTEMS, EQUIPMENT, AND PERSONAL PROTECTION

#### 6.5.12.1 LIGHTNING PROTECTION SYSTEMS

Lightning protection systems are important safety features in the design of electrical distribution systems. Their application on any specific project is a function of its geographic location, height, proximity of taller adjacent structures, regional ground resistance, and the architectural configuration of the building. The decision to provide a lightning protection system must be made at the earliest stages of design and must be supported by a study, as prescribed by NFPA 780.

If a decision is made to provide a lightning protection system, specify that it be installed in compliance with NFPA 780 and the components meet the requirements of UL 96.

##### ALTERNATE SYSTEMS

The requirement of a UL certification imposes certain restrictions or limitations on the design of the system, which may be in conflict with the

architectural design, particularly if the facade includes large curved surfaces that preclude the installation of air terminals and where the spacing of down conductors is limited. In those instances, the electrical engineer may appeal to the contracting officer to waive the UL certification requirement on the basis that the design generally follows the Faraday Cage principle of lightning protection.

#### GROUNDING

The down conductors must follow direct paths from the air terminals to the ground connections or to the counterpoise loop. Lightning ground conductors should have long sweeping bends and not hard 90 degree bends forcing them to conform to architectural building features.

### 6.5.12.2 SECURITY SYSTEMS

Every Government building, virtually without exception, whether new or existing, large or small, recent vintage or historic, must have provisions for a security system. The type and level of security system must be determined by GSA, FPS, and the client agency. The security requirements must be integrated into the design for the project. The systems must be integrated with the emergency and standby power systems.

### 6.5.12.3 SHORT CIRCUIT AND COORDINATION STUDY

The electrical engineer must submit a preliminary short circuit analysis on all projects in accordance with Appendix A. The final coordination and analysis must be completed by the electrical contractor's testing agency or by an independent agency employed by GSA, and a report must be submitted as part of the commissioning process (see Chapter 1 for commissioning requirements). The building power system model shall be provided in a format coordinated by the region. GSA shall be provided the source code for the analysis and have rights to the source native files at no additional cost to the Government.

#### ARC FLASH AND ARC ENERGY

The design engineer must submit a computer-generated arc flash analysis for the entire building electrical distribution system. The data from the arc flash calculations for individual pieces of electrical equipment must be transposed to NFPA 70E-approved labels and all panelboards, motor control centers, switchgear, and major electrical equipment must be appropriately labeled and protection boundaries delineated per OSHA 1910 Subpart S and NFPA 70E requirements. New and refurbished equipment shall conform to NEC 240.87.

The utility service entry and tie circuit breaker(s) shall be equipped with remote operation capabilities.

## 6.5.13 ALTERATIONS IN EXISTING BUILDINGS AND HISTORIC STRUCTURES

The goal of alteration projects is to meet the same standards described in this document for new projects. The prospectus for a capital project, or statement of work for a smaller project, will describe the extent of the replacement and upgrade of existing systems and equipment. Equipment that is unsafe or beyond the useful service life must be demolished and new systems designed to meet the current and future usage of the facility. Renovation and rehabilitation designs must satisfy the immediate occupancy needs and anticipate additional future changes. Remodeling must make building systems more flexible. Parameters of reuse and disruption of service must be clearly specified in construction documents. All replacement and upgrades must comply with the requirements of this chapter.

The result of these projects should be enhanced performance, not just equipment replacement.

#### 6.5.13.1 LIGHTING – HISTORIC BUILDINGS

Historic fixtures may be upgraded with energy efficient lamps, ballasts, reflectors, or other means to achieve required light levels, if changes can be made without affecting the appearance of the fixture. Energy-efficient light sources should match incandescent light or daylight correlated color temperature as closely as possible, 2700K and 4000K respectively. In restoration zones, opportunities should be sought to replace unsympathetic contemporary lighting with replicas of original historic fixtures. Replica fixtures in which light sources are not exposed should incorporate high-output, energy efficient lamps as necessary to achieve required light levels and meet energy conservation standards. Supplemental lighting is designed and placed to minimize penetration of ornamental wall and ceiling surfaces and to avoid competing visually with historic lighting. Freestanding torchieres, task lighting, and discrete accent lighting are recommended for increasing light levels in ceremonial spaces containing historic chandeliers, pendant lights, or sconces.

### 6.5.14 SOLAR PHOTOVOLTAIC SYSTEMS

The installation of solar photovoltaic (PV) systems presents concerns for safety (energized equipment, trip hazards, etc.) and firefighting operations (restricting venting locations, limiting walking surfaces on roof structures, etc.). The intent of the requirements below is to address these issues while embracing the environmental advantages of this technology.

Be cognizant that because of the growing demand for PV system products, manufacturers are developing new products and methods daily and therefore GSA may encounter PV systems that will require an alternative means of compliance. Please note that it is not intended to prohibit the use of alternative systems, methods, or devices not specifically prescribed, provided GSA approves all proposed alternatives.

Before the PV system installation, the GSA project manager must meet with the contractor, GSA property manager, GSA fire protection engineer, GSA safety specialist, local power utility company, and local fire official to ensure the proposed PV system design and layout is acceptable to all parties.

Before the acceptance of the PV system, the GSA project manager must confirm that the PV system has been tested. All testing must be witnessed and documented by a qualified independent third party test entity. The third party test entity must have an advanced understanding of the installation, operation, and maintenance of the PV system installed. The project's commissioning agent must witness the PV system testing. At the completion of witnessing the PV system testing, the project's commissioning agent entity must provide to the GSA project manager documentation verifying that the PV system is in compliance with the design and specifications.

#### 6.5.14.1 REQUIREMENTS

The installation of PV systems at GSA Federal buildings must comply with the requirements in the International Building Code, International Fire Code, and National Fire Protection Association (NFPA) 70, National Electrical Code.

#### 6.5.14.2 MARKING

PV systems must be marked in accordance with NFPA 70, Article 690, and the following:

##### MARKING DIRECT CURRENT (DC) CIRCUITS

All interior and exterior DC conduits, raceways, enclosures, cable assemblies, and junction boxes

associated with the PV system must be marked to alert individuals that DC power is present. The marking must be placed every 10 feet or fraction thereof, at turns and above and below penetrations, and on all DC combiner and junction boxes.

The marking must contain the text "CAUTION: PV CIRCUIT ENERGIZED" in capital letters a minimum of 3/8 inches in height with white letters on a red background. The materials used for marking must be reflective and weather resistant in accordance with UL 969 that is suitable for the environment.

#### MARKING STAIRWAY ACCESS TO ROOFS

Signage is required on all stairway doors providing access to the roof where PV systems are installed. Each stairway door providing access to the roof must have a sign affixed to the interior side of the stairway door.

The signage must contain the text "CAUTION PHOTOVOLTAIC SYSTEM INSTALLED ON ROOF." The sign must consist of letters at least 2 inches high on a contrasting background.

### 6.5.14.3 SMOKE VENTILATION

The PV system must be designed such that smoke ventilation opportunity areas are provided on the roof and meet the following requirements:

Each array must be no greater than 150 x 150 feet in distance in either axis.

Ventilation options between array sections must meet one of the following:

- A pathway 8 feet or greater in width;
- A pathway 4 feet or greater in width that borders on existing roof skylights or ventilation hatches; or,
- A pathway 4 feet or greater in width bordering 4 ft. x 8 ft. "venting cutouts" every 20 feet on alternating sides of the pathway.

### 6.5.14.4 LOCATION OF DC CONDUCTORS

Exposed conduit, wiring systems, and raceways for PV circuits must be located as close as possible to the ridge or hip or valley on the roof to reduce trip hazards and maximize ventilation opportunities.

Conduit runs between subarrays and conduit runs to DC combiner boxes must be designed in a manner that minimizes total amount of conduit on the roof. The DC combiner boxes must be located such that conduit runs are minimized in the pathways between arrays.

To limit the hazard of cutting live conduit in fire department venting operations, DC wiring must be run in metallic conduit or raceways when located within enclosed spaces in a building and must be run, to the maximum extent possible, along the bottom load-bearing members.

### 6.5.14.5 ROOF CLEARANCE REQUIREMENTS

The PV system, including supports and power conductors, must not interfere with roof drains, expansion joints, air intakes, existing electrical and mechanical equipment, existing antennas, and planned areas for future installation of equipment.

Rooftop installation must coordinate with the building rigging plan associated with powered platforms, boatswain chairs, etc., and address the relocation or incorporation of the davits.

In addition to the pathway requirements noted above, a 3-foot clear path of travel must be maintained to and around all rooftop equipment.

#### 6.5.14.6 ROOF MOUNTING REQUIREMENTS

Mounting systems must be either fully ballasted or must limit penetrations of the roofing system. All roof penetrations must be designed and constructed in collaboration with the roofing professional or manufacturer responsible for the roof and roofing material warranty for the specific site. The number and size of the penetrations necessary to extend the power and control cable into the building must be kept to a minimum and grouped in a single location when practicable. All weather-proofing of penetrations must be compatible with the roof warranty.

#### 6.5.14.7 EQUIPMENT AND COMPONENTS

All PV hardware and structural components must be either stainless steel or aluminum. All interconnecting wires must be copper. Power provided must be compatible with on-site electric distribution systems.

#### 6.5.14.8 SAFETY

Provide detailed Lock Out/Tag Out instructions for all equipment.

Provide lightning protection meeting UL96 and NFPA 780.

PV Modules must be UL Listed and must be properly installed according to manufacturer's instructions, IBC, IFC, and NFPA 70.

#### 6.5.14.9 REQUIRED: PV SYSTEM APPROVAL

Before PV system installation, the GSA project manager must ensure the proposed PV system design and layout is acceptable to all parties:

- GSA Property Manager
- GSA Fire Protection Engineer
- GSA Safety Specialist
- Local fire officials

### 6.5.15 QUALITY ASSURANCE OF ELECTRICAL POWER SYSTEMS AND EQUIPMENT

The purpose of field-based electrical testing and commissioning is to assure that electrical power generation and distribution systems are safe, reliable, operational, and are in conformance with applicable codes, standards and manufacturers' tolerances, and are installed in accordance with design specifications. Electrical acceptance and commissioning specifications should describe the systematic process of documenting, assessing the suitability for initial energization, placing into service, and final acceptance of newly installed, or retrofitted electrical power equipment and systems. ANSI/NETA ATS and ANSI/NETA ECS must be consulted and referenced when defining these specifications. Continued quality assurance relies on routine, preventive maintenance as specified by the ANSI/NETA MTS.

#### 6.5.15.1 ELECTRICAL TESTING FIRM

Accredited, third-party, field-experienced, electrical testing firms or OEM certified technicians should be utilized for field-testing and commissioning inspections and tests of major electrical upgrades /installations to assure accurate electrical power system and component testing, reporting, and recommendations. Section 3.1 of the ANSI/NETA ATS and ANSI/NETA ECS should be consulted along with considering the project requirements as related to the credentials of the electrical testing/commissioning firm.

#### 6.5.15.2 QUALIFIED ELECTRICAL TESTING PERSONNEL

Qualified electrical testing technicians certified in accordance with ANSI/NETA ETT or OEM certified technicians should be specified when

performing the visual, mechanical, and electrical tests and inspections. Section 3.2 of these standards should be consulted when considering project requirements as related to the qualifications of field testing and commissioning personnel.

### 6.5.15.3 SAFETY, SUITABILITY OF TEST EQUIPMENT, AND DOCUMENTATION

When specifying project requirements for safety and precautions, suitability of test equipment, test instrument calibration, and test reports, Section 5 of the ANSI/NETA ATS, ANSI/NETA ECS, should be consulted and referenced.

### 6.5.15.4 POWER SYSTEM STUDIES AND ELECTRICAL COMMISSIONING PROCESS

When specifying power system studies such as short-circuit, coordination, arc-flash hazard analysis, load-flow, stability, and harmonic-analysis, Section 6 of the ANSI/NETA ATS should be referenced. When designing commissioning specifications for electrical power systems, section 6 of the ANSI/NETA ECS should be consulted and referenced with regard to commissioning intent, project requirements, basis of design, and the commissioning plan.

### 6.5.15.5 VISUAL, MECHANICAL, AND ELECTRICAL INSPECTIONS AND TESTS AND INSPECTION AND COMMISSIONING PROCEDURES

When specifying necessary visual, mechanical, and electrical inspections, tests, and results for electrical acceptance and electrical commissioning of electrical power generation and distribution equipment and systems, Section 7 of the ANSI/NETA ATS ANSI/NETA ECS should be consulted and referenced.

### 6.5.15.6 VISUAL, MECHANICAL, AND ELECTRICAL INSPECTIONS AND TESTS FOR ROUTINE AND PREVENTIVE MAINTENANCE

When specifying necessary visual, mechanical, and electrical inspections, tests, and results for routine and preventive maintenance of electrical power generation and distribution equipment and systems, Section 7 of the ANSI/NETA MTS should be consulted and referenced.

# 7

# FIRE PROTECTION

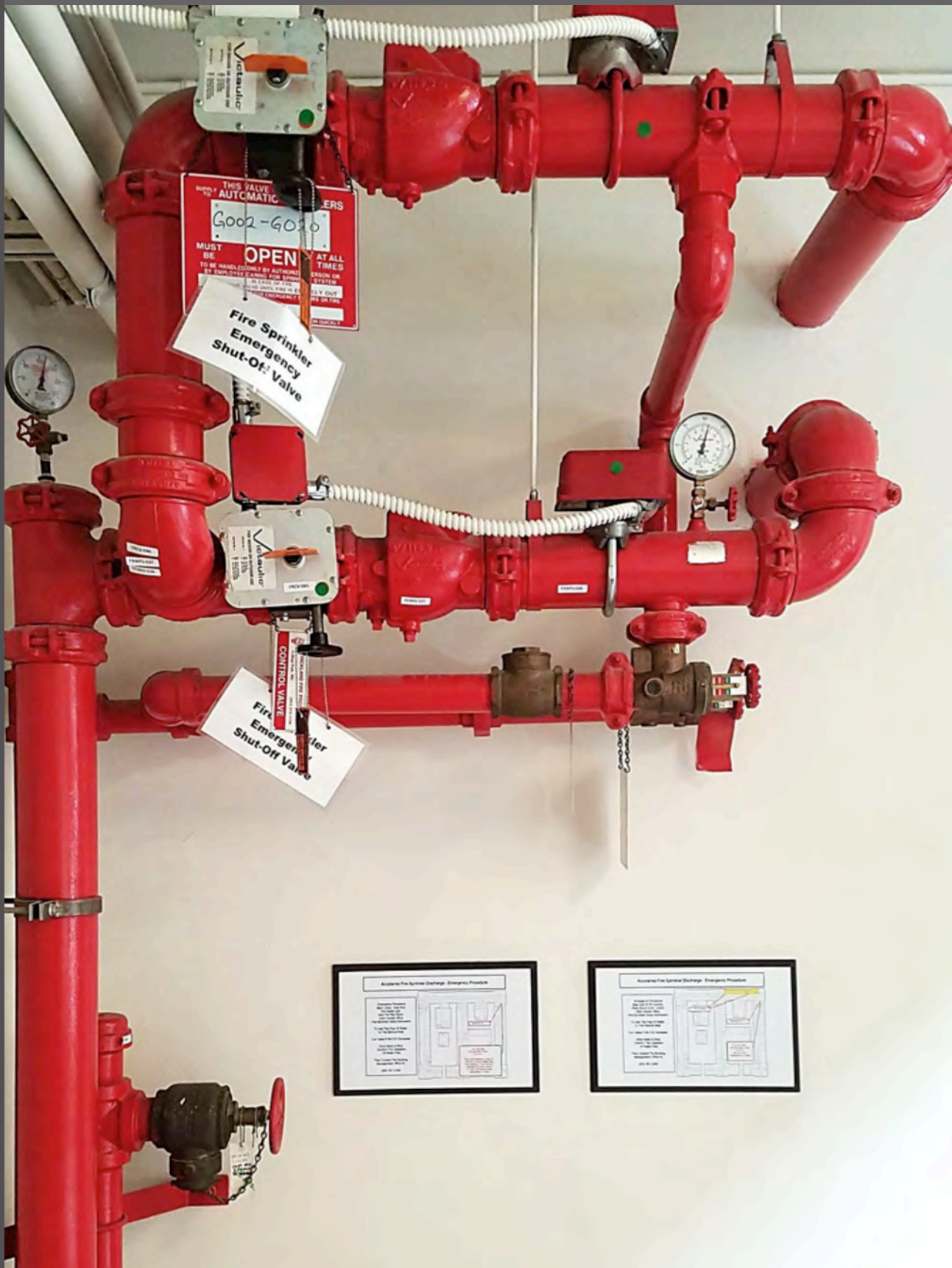



Figure 14:
1800 F Street
Fire Piping
Washington, DC

## 7.1 GOALS AND OBJECTIVES

The goal of GSA's fire protection program is to incorporate into all projects fire protection and life safety systems that are effective in detecting, extinguishing, or controlling a fire event, thereby improving overall building safety to an acceptable level. The primary goal is to protect human life from fire and products of combustion. The secondary goals are to reduce Federal Government and taxpayers' potential losses from fire (i.e., protect Federal real and personal property, maintain client agency mission continuity, and control environmental impact).

### 7.1.1 SCOPE

This chapter provides the fire protection and life safety requirements for GSA facilities to meet the goals identified above. Areas where GSA's requirements differ from the referenced national codes and standards are delineated in Chapter 1. The provisions located in the introduction and in Chapter 1 within this document also apply to this chapter. All other text is mandatory.

### 7.1.2 APPLICABILITY

Where work areas consist of portions of a building, the requirements within this chapter must be limited to the work area in which work is being performed, unless specified otherwise by the GSA regional fire protection engineer.

### 7.1.3 RESPONSIBILITIES

#### 7.1.3.1 DESIGN TEAM FIRE PROTECTION ENGINEER

A fire protection engineer must be a full participant of the design team for each phase of the project from concept through design, construction, and occupancy.

The design team fire protection engineer must be a licensed engineer who has passed the principals and practice of engineering examination in fire protection administered by the National Council of Examiners for Engineering and Surveying (NCEES) and which can be verified by documentation. The design team fire protection engineer must have three consecutive years directly involved in fire protection engineering and life safety applicable to the specific project as determined by the GSA regional fire protection engineer, and which can be verified by documentation. (Please note that GSA does not require the design professional to be licensed in the state where the project is being constructed, so the design team fire protection engineer may be licensed in any state that formally recognizes a professional fire protection engineer.) The design team fire protection engineer must perform the following:

Analysis of:

- Building construction
- Occupancy classification
- Means of egress
- Fire alarm system
- Water-based fire extinguishing system(s)
- Non-water-based fire extinguishing system(s)
- Smoke control system(s)

Calculations for:

- Egress
- Water supply
- Smoke control (fire dynamics)

Design of all fire protection and life safety systems, including, but not limited to:

- Egress system
- Fire alarm system
- Water-based fire extinguishing system(s)

- Fire detection system

See the Appendices for New Construction and Modernizations and for Alteration Projects for specific submission requirements.

#### 7.1.3.2 GSA REGIONAL FIRE PROTECTION ENGINEER

The GSA regional fire protection engineer will participate in each phase of the project from concept through design, construction, final acceptance, and occupancy to ensure fire protection and life safety requirements are incorporated into the project. The GSA regional fire protection engineer will review design plans, specifications, and related information; review contractors' submittals for compliance with contract documents; witness acceptance testing and commissioning of fire protection and life safety systems; and upon successful completion of commissioning and acceptance of tested systems, will issue certificates of occupancy (or temporary certificates of occupancy) before occupancy.

The GSA regional fire protection engineer is the authority having jurisdiction (AHJ) for technical requirements in this chapter, including all fire protection and life safety code interpretations and code enforcement requirements. As the AHJ, the GSA regional fire protection engineer has the right to revise the specific requirements within this chapter based on a technical evaluation and analysis and the project's specific needs.

#### 7.1.3.3 ALTERNATIVE DESIGNS

The design team fire protection engineer may propose alternative designs to that prescribed herein, but the GSA regional fire protection engineer must approve the alternative design. Such review must determine if the proposed alternative is deemed equivalent or superior to the intent of the prescribed requirements in this chapter. See Chapter 1 for additional information.

#### 7.1.3.4 CERTIFICATE OF OCCUPANCY

No portion of a project may be occupied until the GSA regional fire protection engineer has issued a certificate of occupancy or a temporary certificate of occupancy to the GSA project manager. Issuance of a certificate of occupancy must not be construed as an approval of any violation of a national code or GSA design standard or criterion.

## 7.2 REFERENCES

The national codes and standards adopted by GSA are discussed in Chapter 1. Additional codes and standards for the design of fire protection and life safety systems are included in the text of this chapter and listed in Appendix B, References.

## 7.3 FIRE SAFETY DURING NEW CONSTRUCTION PROJECTS AND RENOVATION PROJECTS

### 7.3.1 FIRE SAFETY DURING NEW CONSTRUCTION PROJECTS

Fire safety during new construction projects must comply with the requirements in the IBC, IFC, and NFPA 241.

### 7.3.2 FIRE SAFETY DURING RENOVATION PROJECTS

Fire safety during renovation projects must comply with the requirements in the IBC, IFC, and NFPA 241.

#### SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in the IBC, IFC, and NFPA 241:

1. A fire prevention program superintendent is not required for a renovation project unless required by the GSA regional fire protection engineer.

### 7.3.3 FIRE SAFETY DURING DEMOLITION PROJECTS

Fire safety during demolition projects must comply with the requirements in the IBC, IFC, and NFPA 241.

### 7.3.4 EXISTING FIRE PROTECTION SYSTEMS

Disruptions to existing fire alarm and sprinkler systems must be kept to a minimum or avoided. The design team fire protection engineer must delineate phasing of construction to ensure that installations of new systems are expedited and existing systems are kept in service until the replacement system is operational. If fire protection systems are to be disrupted, procedures must be incorporated into the design to maintain equivalent levels of fire protection and provide formal notification to the facility while systems are down.

## 7.4 MEANS OF EGRESS

The means of egress requirements for the building must meet the requirements in NFPA 101. The technical egress requirements in NFPA 101 must be used in place of the technical egress requirements in the IBC.

### 7.4.1 SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 101:

1. In buildings that are protected throughout by an automatic sprinkler system, one-hour fire-rated corridors are not required.
5. Interlocking (scissor) stairs must count as only one exit stair. A minimum of two exit stairs are required for any multistory building.
6. Fire escapes, as defined in the NFPA 101, are not considered approved exits.
7. In new buildings where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, or more than 9.1 m (30 ft.) below the level of exit discharge serving such floor levels, exit stairways must be pressurized in accordance with the requirements in the IBC.

### 7.4.2 EVACUATION ROUTE SIGNAGE

Evacuation route signage must be posted in a tamper-resistant frame or engraved on a placard that is mounted on the walls in each passenger elevator lobby, freight elevator lobby, and any mechanical spaces that may be occupied by contractors or other personnel not familiar with floor layouts and exit locations. The minimum size of the signage must be 8½ inches by 11 inches. This signage must be depicted in either landscape or portrait form depending on the architectural layout and orientation of the elevator lobbies at each floor. Provide labeling as required in PBS ORDER 3490.2. The signage must consist of a CADD-generated floor plan for each floor with the evacuation routes identified. A minimum of at least one route to an exit must be shown. When two routes are available they both must be shown and the nearest route to an exit must be the primary route and shown in a bold, red, solid line weight while the alternate route to an exit must be shown in a bold, red, dashed line type. Any and all Manual Pull Stations along any Evacuation Route must be shown as an F within a square box (in the color red). Provide a “YOU

ARE HERE" designation pointing directly to the sign's final installed orientation. Also, provide a main heading titled "EVACUATION PLAN." This signage may contain a zoomed-in core area of the building (for a larger view of routes) if all evacuation routes and evacuation stairways are legibly shown. The signage must contain a legend for clarification purposes of any additional items shown on these evacuation plans. For buildings that have occupant evacuation elevators and/or fire service access elevators, note on plans with the appropriate signage. For other buildings, include the following statement on plans "IN CASE OF FIRE DO NOT USE ELEVATORS—USE STAIRS," unless there have been acceptable elevators provided for emergency egress.

### 7.4.3 EXIT STAIR PATH MARKINGS

In new buildings where the building has an occupied floor surface located more than 22.8 m (75 ft.) above the lowest level of fire department vehicle access, exit enclosures must be equipped with exit stair path markings meeting the requirements in NFPA 101.

### 7.4.4 EXIT STAIRWAY IDENTIFICATION SIGNAGE

In new buildings, exit stairway identification signage must meet the requirements in NFPA 101 and be made of a material having a luminescent background.

## 7.5 INTERIOR FINISHES

The interior finish requirements for walls, ceilings, floors, draperies, curtains, and movable partitions must meet the requirements in the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Adhesives and other materials used for the installation of carpets must be limited to those having a flash point of 60° C (140° F) or higher.
2. Wood used in construction that is required to be fire retardant must be treated with fire retardant chemicals by a pressure impregnation process or other method that treats the materials throughout (as opposed to surface treatment).

## 7.6 FIRE ALARM AND EMERGENCY COMMUNICATION SYSTEMS

Fire alarm and emergency communication systems must be installed in accordance with the requirements in NFPA 72 and the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

1. All fire alarm systems installed in buildings must be an emergency communication system when any one of the following conditions exists:

a. The building is two or more stories in height above the level of exit discharge.

b. The total calculated occupant load of the building is 300 or more occupants.

c. The building is subject to 100 or more occupants above or below the level of exit discharge.

2. The emergency communication system must provide an automatic voice message in response to the receipt of a signal indicative of a fire emergency. Manual control with the capability of making live voice announcements must also be furnished to provide occupants notification on either a selective or all-call basis.

3. With the exception of mass notification, a fire alarm and emergency communication system is not permitted to be integrated with other building systems such as building automation, energy management, security, and so on. Fire alarm and emergency communication systems must be self-contained, standalone systems able to function independently of other building systems.
4. Fire alarm and emergency communication system control equipment that is installed in non-high-rise buildings must be located within a room separated from the remainder of the building by not less than a one-hour fire resistance-rated fire barrier. The room must be provided in a location approved by the GSA fire protection engineer after consultation with the local fire department. The room must be a minimum of 9.3 m2 (100 sq. ft.) with a minimum dimension of 2.4 m (8 ft.).
5. Fire alarm and emergency communication system control equipment that is installed in U.S. Courthouses must include redundant functionality installed within the U.S. Marshals Service (USMS) Command and Control Center. The redundant controls must have the same capabilities and operation as the main fire alarm and emergency communication system control unit, including annunciation, except there must be no capability to initiate "Signal Silence" (turning notification appliances off), "Acknowledge" (of any signal), and "Reset" (resetting the system to normal) operations. In addition, the control unit's alarm, supervisory, and trouble audible signals must be capable of being silenced. Subsequent alarm, supervisory, and trouble conditions must cause the local audible signal to resound. The master microphone located at the main fire alarm and emergency communication system control unit must be arranged to take priority over the redundant microphone located in the USMS Command and Control Center.
6. All fire alarm signals (i.e., alarm, supervisory, and trouble signals) must be automatically transmitted to a supervising station evaluated by Underwriters Laboratories (UL) to UL Standard 827, Central Station Alarm Services (UUFX Category Code). The communication methods used to transmit signals to the supervising station must meet the requirements in NFPA 72. Two different communication paths are required to be provided.
7. All fire alarm wiring must be solid copper wiring. Stranded wiring must not be used.
8. All fire alarm wiring must be installed in conduit. Conduit must be rigid metal or electrical metallic tubing, with a minimum inside diameter of 19 mm (3/4 inch) that utilizes compression type fittings and couplings.
9. Each fire alarm system must be provided with a power conditioner to protect the fire alarm system from electrical surges, spikes, over-voltages, and electrical noise. The power conditioner must be sized by the design team electrical engineer to provide the correct power supply including safety factor. The power conditioner must be U.L. listed and must have built in overload protection.
10. All new emergency generators must be monitored by the fire alarm system for the following supervisory conditions: Generator

Running, Generator Common Trouble. In addition, the generator controllers must include the NFPA 110 required generator monitoring and output contacts.

## 7.6.1 MANUAL FIRE ALARM BOXES

Manual fire alarm boxes must be installed in accordance with the requirements in NFPA 72 and the IBC.

### SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

1. Manual fire alarm boxes must be installed in all new fire alarm system projects, including in buildings protected throughout with an automatic sprinkler system.
2. Manual fire alarm boxes must be installed in accordance with the spacing and location requirements in NFPA 72.
3. Manual fire alarm boxes installed in public areas located on the ground floor of a building must be equipped with a protective cover to prevent unwanted alarms without restricting legitimate operation.

## 7.6.2 WATERFLOW SWITCHES

Waterflow switch(es) must be installed in accordance with the requirements in NFPA 13, NFPA 72, and the IBC.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13, NFPA 72, and the IBC:

1. Waterflow switch(es) must be installed on each floor or fire area protected by sprinkler systems.
2. Each waterflow switch must be separately annunciated at the main fire alarm control unit and all required annunciators.

## 7.6.3 SMOKE DETECTORS

Smoke detectors must be installed in accordance with the requirements in NFPA 72 and the IBC.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72 and the IBC:

1. Area smoke detectors must not be installed in any of the following rooms: mechanical equipment rooms, electrical closets, telephone closets, and emergency generator rooms.
2. Smoke detectors specifically for the protection of the fire control unit(s), notification appliance circuit power extenders, and supervising station transmitting equipment must not be installed in a building protected throughout by an automatic sprinkler system.
3. Smoke detection appropriate for the application must be installed in each of the following: uninterruptible power service rooms, electrical switch gear rooms, transformer vaults, telephone exchanges, and information technology equipment as specified in this chapter. When smoke detection is installed in rooms having high voltage equipment, the smoke detection must not be installed directly above the high voltage equipment.
4. Duct smoke detectors and associated operations shall be provided as outlined in NFPA 90A.
5. Operation of a duct smoke detector must initiate a supervisory signal.
6. Smoke detectors used solely to initiate elevator recall must initiate an alarm signal, unless specifically approved by the GSA

regional fire protection engineer to initiate a supervisory signal.

7. Smoke detectors located at doors for the exclusive operation of automatic door release must initiate an alarm signal, unless specifically approved by the GSA regional fire protection engineer to initiate a supervisory signal.

## 7.6.4 AUDIBLE NOTIFICATION APPLIANCES

Performance, location, and mounting of audible notification appliances must be in accordance with the requirements in NFPA 72.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. The design for achieving the required minimum dBA levels must take into consideration all building construction materials such as carpeting, hard surfaces, walls, doors, etc., and any other materials that can cause sound level attenuation and/or clarity problems in the placement and location of all audible notification appliances.
2. Where emergency communication systems are provided, fire alarm speakers must be installed in elevator cars and exit stairways; however, they must only be activated to broadcast live voice messages (e.g., manual announcements). The automatic voice messages must be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cars.
3. To prevent external tapping of the audio/speaker circuit(s) serving a sensitive compartmented information facility, any of the following methods are permitted to be used:

a. Self-amplified speakers

b. Remote dedicated amplification

c. Remote signal modules

## 7.6.5 VISIBLE NOTIFICATION APPLIANCES

Placement and spacing of visible notification appliances must be in accordance with the requirements in NFPA 72.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. Unless the project includes a new fire alarm system or a complete replacement of an existing fire alarm system, visible notification appliances are not required to be installed in areas where visible notification appliances do not currently exist or where noncompliant existing visible notification appliances currently exist. This requirement does not preclude the addition of new visible notification appliances to existing fire alarm systems that contain existing compliant visible notification appliances.
2. Visible notification appliances must be installed only in public and common areas. For the purposes of this requirement, visible notification appliances are not required to be installed in individual offices. Public and common areas include, but are not limited to, public restrooms, reception areas, building core areas, conference rooms, and open office areas.
3. Visible notification appliances are not permitted to be installed in exit enclosures (e.g., exit stairs).

## 7.6.6 OCCUPANT NOTIFICATION

Transmission of an alarm signal from any fire alarm system initiation device to notify the occupants throughout the building must be in accordance with the requirements in NFPA 72 and the IBC.

### SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in NFPA 72 and the IBC:

1. All alarm signals transmitted from any fire alarm system initiation device must activate the respective building audible and visible notification appliances to notify the occupants.

a. Exception: Where approved by the GSA Regional Fire Protection Engineer, smoke detectors used solely to initiate elevator recall and smoke detectors located at doors for the exclusive operation of automatic door release are permitted to initiate a supervisory signal in lieu of an alarm signal.

b. Duct smoke detectors must not activate the fire alarm system notification appliances.

## 7.6.7 FIRE ALARM NOTIFICATION STRATEGIES FOR HIGH-RISE BUILDINGS

In high-rise buildings, the fire alarm and emergency communication system must be designed for selective evacuation, unless specifically approved otherwise by the GSA regional fire protection engineer. The GSA regional fire protection engineer must establish a dialogue with the design team fire protection engineer to determine specific evacuation strategies for the building and subsequent operational features of the fire alarm system. This includes, but is not limited to, determining how and where the “fire zone” and “safe area zone” messages are used. The visible alarm notification appliance circuits must not be activated on floors designated as safe area zones.

## 7.6.8 SURVIVABILITY FOR FIRE ALARM AND EMERGENCY COMMUNICATION SYSTEMS

The fire alarm and emergency communication system must meet the survivability requirements in NFPA 72.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 72:

1. Two vertical risers (e.g., supply and return inter-connected network circuits Class X) must be installed as far from each other as practicable so that a single fire does not impact both risers.

2. The two vertical risers shall be protected as follow:

a. In buildings with an occupied floor less than or equal to 120 feet above the lowest level of fire department vehicle access, the two vertical risers must be protected by a minimum one-hour fire rated enclosure or a two-hour rated cable or system.

b. In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, the two vertical risers must be protected by a minimum two-hour fire rated enclosure or a two-hour rated cable or system.

3. The horizontal interconnections between the two vertical risers shall be protected as follows:

a. In buildings with an occupied floor less than or equal to 120 feet above the lowest level of fire department vehicle access, must have

one-hour fire rated enclosure or an approved two-hour rated cable or system.

b. In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, must have two-hour rated enclosure or an approved two-hour rated cable or system.

4. All circuits (speaker/audio, SLC, network, and/or power) necessary for the operation of the notification appliances must be protected until they enter the evacuation signaling zone (usually a floor) as follows:

a. In buildings with an occupied floor less than or equal to 120 feet above the lowest level of fire department vehicle access, must have the vertical risers protected by a minimum one-hour fire rated enclosure or a two-hour rated cable or system.

b. In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, must have the vertical risers protected by a minimum two-hour fire rated enclosure or a two-hour rated cable or system.

5. A minimum of two distinct fire alarm audible notification appliance circuits and a minimum of two distinct visible notification appliance circuits must be provided on each floor.

6. Circuit integrity cable, if used, must be installed only in EMT and be supported in accordance with manufacturer's requirements and UL 2196.

7. Provide a minimum of two (2) Class B Signaling Line Circuits (SLC) per floor. The system shall be designed and installed so that a single open, wire to wire short, or any other Class B impairment on an SLC does not affect more than 2,415 m2 (26,000 ft2) of gross floor area. The floor SLCs shall be isolated from the SLC risers and network.

### 7.6.9 FIRE COMMAND CENTER

The fire command center must meet the requirements in the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Each fire command center must be provided in a location approved by the GSA regional fire protection engineer after consultation with the local fire department.

2. Each fire command center must be provided with appropriate lighting, ventilation, and emergency lighting.

### 7.6.10 ANNUNCIATOR

All fire alarm systems must have at least one annunciator located in plain view within 7.6 m (25 ft.) of the primary fire department entrance to the building.

## 7.7 WATER SUPPLY FOR FIRE PROTECTION

The design team fire protection engineer must assess the adequacy of the existing water supply. The design team fire protection engineer must perform water supply flow testing of fire hydrants and/or fire pumps. If the hydraulic data is less than one year old and is available from the local jurisdiction, the design team fire protection engineer must verify the locations involved as well as the quality and accuracy of the data. The required fire water flows and pressures for buildings must comply with the requirements in NFPA 13, 14, and 20. In addition, a secondary on-site water supply equal to the hydraulically calculated sprinkler demand must be provided

for high-rise buildings assigned to Seismic Design Category C, D, E, or F as determined by the IBC.

### 7.7.1 FIRE PUMPS

When a fire pump is necessary to supplement fire water flow and pressure, the size and the installation of the fire pump must be in accordance with the requirements of NFPA 13, 14, and 20.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13, 14, and 20:

1. The building's fire pump must be sized for the sprinkler system requirements only if the local responding fire department can provide the necessary flow and pressure for manual firefighting operations (i.e., standpipes), through fire department connections. Where fire pumps are provided to supply other fire suppression activities, they must be sized in accordance with the appropriate NFPA standard.
2. A fire pump must start automatically at 69 kPa (10 psi) below pressure maintenance pump (jockey pump) start pressure. The fire pump must be manually shut down. The fire pump installation must include a test header, a closed flow loop, and a flow meter
3. Emergency power must be provided in accordance with the requirements in Chapter 6.
4. The power transfer switch and the fire pump controller must be factory assembled and packaged as a single unit. Separate transfer switches are not permitted. The fire pump controller must be monitored by the fire alarm system.

### 7.7.2 PRESSURE MAINTENANCE PUMP (JOCKEY PUMP)

A pressure maintenance pump must be used to maintain a uniform or relatively high pressure on the fire protection system. A jockey pump must be sized to make up the allowable leakage rate within 10 minutes or 3.8 lpm (1 gpm), whichever is larger. The pressure maintenance pump must be equipped with emergency power.

### 7.7.3 FIRE HYDRANTS

New fire hydrants must be installed in accordance with the requirements in NFPA 24 and the IFC unless the locations of the existing fire hydrants provide adequate coverage for the subject project. The local fire department must be consulted with regard to the location of the fire hydrants and thread types for hydrant outlets.

### 7.7.4 POST INDICATOR VALVE

In a campus setting a post indicator valve is required on the fire protection service for each building.

## 7.8 AUTOMATIC SPRINKLER AND STANDPIPE SYSTEMS

Automatic sprinkler systems must be installed in accordance with the requirements in NFPA 13, and the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

1. Automatic sprinklers must be installed throughout all new construction projects.
2. Automatic sprinklers must be installed throughout all renovation projects where the building has a sufficient municipal water supply system for the design and installation

of a sprinkler system at the site or where the installation of a new fire pump is not cost prohibited.

3. Automatic sprinklers must be installed throughout the designated work area for all alteration projects where the building has a sufficient municipal water supply system for the design and installation of a sprinkler system at the site or where the installation of a new fire pump is not cost prohibited.
4. Where project sites are located in remote or isolated areas having insufficient or nonexistent water supplies in close proximity, design the fire sprinkler system in accordance with NFPA 13. See Automatic Sprinkler Systems for Remote or Isolated Facilities for additional information regarding automatic sprinkler system requirements.
5. Where automatic sprinklers are required to be installed, they must be installed throughout all locations unless the subject locations are specifically exempted by NFPA 13 or the IBC. Where sprinklers are exempted from rooms or areas, such rooms or areas must be separated from adjacent sprinklered rooms or areas by fire barriers having a two-hour fire-resistance rating.
6. All sprinkler systems must be wet-pipe sprinkler systems, unless installed in areas subject to freezing.
7. Heat tape is not permitted on sprinkler piping.
8. Dry-pipe sprinkler systems must incorporate a nitrogen inerting process that replaces air with nitrogen gas when used to charge, maintain, or supervise a dry-pipe sprinkler system.
9. Seismic protection must be installed where required in the IBC.
10. Sprinkler systems must be designed using a minimum system design area of 139 m2 (1,500 sq. ft.). No decreases are permitted.
11. Where floor openings are not classified as atriums, the sprinklers at the ceiling must be zoned with the lower level if it is enclosed on the upper level (the enclosure is effectively creating a high ceiling). Otherwise, sprinklers must be zoned with the upper level.
12. Sprinkler system control valves must be located in accessible spaces. Sprinkler system control valves are not permitted in above ceiling spaces.
13. Antifreeze sprinkler systems are not permitted to be installed.
14. Pre-action-type sprinkler systems are not permitted to be installed.
15. Sprinkler guards must be provided in the following locations:

a. Sprinklers installed less than 2.1 m (7 ft.) above the floor
b. Sprinklers installed within elevator machine rooms and elevator pits
c. Sprinklers installed within electrical closets
d. Sprinklers installed within electrical equipment rooms
e. Sprinklers installed in electrical switchgear rooms and transformer vaults must be provided with separate manual isolation valves and a separate water flow switch located outside the room in an accessible location. Tamper switches must be provided on all such valves.

## 7.8.1 TYPES OF SPRINKLERS

Sprinklers must be selected based on the associated hazards within the occupancy to be protected in accordance with the requirements in NFPA 13 and the IBC.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13 and the IBC:

1. Sprinklers equipped with "O-ring" water seals are not permitted to be installed.
2. The use of saddle tees fitted with rubber gaskets is not permitted.

## 7.8.2 SPRINKLER PIPING

Sprinkler piping, fittings, control valves, check valves, and drain assemblies must meet the requirements in NFPA 13.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13:

1. Black steel piping or copper tubing must be used for all wet-pipe sprinkler piping installed in new Federal Buildings and renovation projects in existing Federal buildings. UL-listed nonmetallic sprinkler piping is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
2. Chlorinated polyvinyl chloride sprinkler piping is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
3. Galvanized (internal and external) sprinkler piping is not permitted to be used for dry-pipe sprinkler systems.
4. Steel pipe sizes 51 mm (2 in.) and smaller must be Schedule 40 and must be threaded.
5. Steel pipe sizes larger than 51 mm (2 in.) must be minimum Schedule 10. Piping less than Schedule 40 must be roll grooved.
6. Threadable lightwall pipe is not permitted be installed.
7. Steel piping having a corrosion-resistant ratio less than 1 is not permitted to be installed.
8. Plain-end fittings are not permitted to be installed.
9. UL-listed or FM-approved flexible sprinkler hose fittings and their anchoring components intended for use in installations connecting the sprinkler system piping to sprinklers is permitted to be installed. When installed and supported by suspended ceilings, the design team fire protection engineer must certify in writing that the ceiling meets ASTM C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, and will be installed in accordance with ASTM C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

## 7.8.3 AUTOMATIC SPRINKLER SYSTEMS FOR REMOTE OR ISOLATED FACILITIES

The requirements below apply to facilities located in remote or isolated areas having insufficient or nonexistent water supply sources for the design and installation of a fire sprinkler system in accordance with the requirements in NFPA 13.

If the following conditions exist, the sprinkler system must be designed and installed in accordance with the requirements in NFPA 13D:

- The costs associated with the installation of the interior NFPA 13 fire sprinkler system (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) exceed $10.00 per square foot; and
- The costs associated with connecting the interior NFPA 13 fire sprinkler system to the adequate water supply source (which include all costs such as labor, materials, the adequate water supply source, pumps, etc.) are greater than 50 percent of the cost for the installation of the interior NFPA 13 fire sprinkler system.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 13D:

1. The water supply source for the sprinkler system must be a minimum of 3,785.4 liters (1,000 gallons) and must be capable of providing the hydraulic demand of the two hydraulically most demanding sprinklers for a minimum 30 minutes.
2. The number of sprinklers in the design area must be all of the sprinklers within a compartment, up to a maximum of two sprinklers that require the greatest hydraulic demand.
3. Black steel piping and copper tubing must be used for all sprinkler piping installed in facilities located in remote or isolated areas having insufficient or nonexistent water supply sources. UL-listed nonmetallic sprinkler piping and tubing is not to be installed unless specifically approved for installation by the GSA regional fire protection engineer.
4. Hydrostatically test the sprinkler system at 200 psi for 2 hours.
5. Antifreeze sprinkler systems are not permitted to be installed.

### 7.8.4 FIRE DEPARTMENT CONNECTIONS

Fire department connections must meet the requirements in the IBC.

#### SPECIAL REQUIREMENTS

The following requirement takes precedence over the requirements in the IBC:

1. UL-listed locking fire department connection caps must be installed on all fire department connections where the local fire department has a program and the hardware to accommodate locking fire department caps.

### 7.8.5 STANDPIPES

Standpipes must be installed in buildings where required in the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. All standpipes must be connected to the fire protection water supply, permanently pressurized, and installed in accordance with the requirements in NFPA 14. The standpipe water supply must be in accordance with the requirements specified within this chapter.
2. Dry standpipes must be permitted to be installed only in spaces subject to freezing.
3. Where standpipe and sprinkler systems are required, a combination sprinkler/standpipe system design must be provided.

### 7.8.6 FIRE DEPARTMENT HOSE OUTLETS

Fire department hose outlets must be installed in buildings where required in the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. Each fire main riser must be provided with 63 mm (2 1/2 in.) fire department hose outlets.
2. Each outlet must be located in the stair shaft and have a removable 38 mm (1 1/2 in.) adapter and cap. Threads and valves must be compatible with the local fire department requirements.

## 7.9 NON-WATER-BASED FIRE EXTINGUISHING SYSTEMS

### 7.9.1 WET CHEMICAL EXTINGUISHING SYSTEMS

Wet chemical extinguishing systems must be installed to protect commercial food heat-processing appliances required to have a Type 1 hood in accordance with the requirements in NFPA 17A.

### 7.9.2 DRY CHEMICAL EXTINGUISHING SYSTEMS

Dry chemical extinguishing systems are not permitted to be installed to protect any commercial cooking equipment installations.

### 7.9.3 CLEAN AGENT EXTINGUISHING SYSTEMS

Clean agent extinguishing systems are not permitted to be installed, unless specifically approved for installation by the GSA regional fire protection engineer. The approved clean agent extinguishing system is considered a supplemental fire extinguishing system and is not to be installed in place of a wet-pipe sprinkler system.

### 7.9.4 CARBON DIOXIDE FIRE EXTINGUISHING SYSTEMS

Carbon dioxide fire extinguishing systems are not permitted to be installed.

### 7.9.5 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers must be installed in accordance with the requirements in the IBC.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. In office buildings protected throughout with quick-response sprinklers, portable fire extinguishers must only be installed in areas such as mechanical and elevator equipment areas, computer rooms, UPS rooms, generator rooms, kitchen areas, and special hazard areas.

## 7.10 ELEVATOR SYSTEMS

Elevator systems must be designed and installed in accordance with the requirements in ASME Standard A17.1/CSA B44, the IBC, and NFPA 13.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the ASME Standard A17.1/CSA B44, the IBC, and NFPA 13:

1. Where elevator machine rooms, machinery spaces, control rooms and control spaces containing elevator control equipment are protected with automatic sprinklers, the sprinkler system for these areas must be provided with separate manual isolation valves and a separate waterflow switch located outside each room in an accessible location. An alarm test connection must be provided to test each waterflow alarm device for each system. Tamper switches must be provided on all such valves. In

addition, ANSI A17.1, Safety Code for Elevators and Escalators, requires the shutdown of power to the elevator upon or prior to the application of water in the elevator machine room, machinery space, control space, or control room. The fire alarm initiating devices used to initiate elevator shutdown, typically are a heat detector or a waterflow switch. If heat detectors are used to shut down elevator power prior to sprinkler operation, they must meet the necessary performance sensitivity requirements (e.g., operating temperature and response time index, etc.) to operate prior to the sprinkler and be located within 24 inches of each sprinkler and installed in accordance with NFPA 72, National Fire Alarm and Signaling Code. If a waterflow switch is used to shut down elevator power prior to sprinkler operation, the waterflow switch must not have a time delay such that it will interrupt elevator power before significant sprinkler discharge.

2. Except for enclosed lobbies required for fire service access elevators and occupant evacuation elevators, enclosed elevator lobbies are not required to be provided in buildings protected throughout by an automatic sprinkler system unless the total height of any hoistway(s) sharing a common atmosphere exceeds 420 feet (128 m).

3. The height of elevator hoistways sharing a common atmosphere by elevator door openings at a common floor or by openings between hoistways shall be measured from the top of the lowest finished floor to the top of the highest finished floor of the floors served by the non-separated hoistways.

4. Fire service access elevators and occupant evacuation elevators can share a common lobby. Access to not more than one of the two required exits can be provided through enclosed elevator lobbies.

### 7.10.1 FIRE SERVICE ACCESS ELEVATORS

Fire service access elevators must be designed and installed in accordance with the requirements in the IBC and ASME Standard A17.1/CSA B44.

### 7.10.2 OCCUPANT EVACUATION ELEVATORS

Occupant evacuation elevators must be designed and installed in accordance with the requirements in the IBC and ASME Standard A17.1/CSA B44.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC and ASME Standard A17.1/CSA B44:

1. General—In any new construction project, when the building has an occupied floor more than 36.5 m (120 ft.) above the lowest level of fire department vehicle access, occupant evacuation elevators must be installed.

## 7.11 SPECIAL FIRE PROTECTION REQUIREMENTS

### 7.11.1 AIR DISTRIBUTION SYSTEMS

Fire dampers and smoke dampers installed in air distribution systems must be installed in accordance with the requirements in NFPA 90A.

#### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 90A:

1. In buildings protected throughout by an automatic sprinkler system, smoke dampers are not required to be installed at

penetrations of shafts unless smoke dampers are used as part of a smoke control system.

## 7.11.2 INFORMATION TECHNOLOGY EQUIPMENT ROOMS

Information technology equipment rooms containing high-value or mission-essential electrical equipment (such as mainframe computers) with the potential for high dollar loss or business interruption must be designed in accordance with the requirements in NFPA 75 and the appropriate GSA computer room fire alarm system specification.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 75:

1. A wet-pipe sprinkler system must be provided throughout the area, including data storage areas.
2. Quick-response sprinklers must be installed throughout the area, including data storage areas.
3. The sprinkler system must have a separate isolation valve and a separate water flow switch located outside of each protected area in an accessible location. Each valve must be provided with a tamper switch that is connected to the building's fire alarm system.
4. Activation of the sprinkler water flow switch must disconnect power to the information technology equipment and to the HVAC systems with no time delay.
5. The activation of one intelligent analog/addressable photoelectric smoke detector utilizing early warning smoke detection technology (e.g., smoke detectors having enhanced algorithms, fire alarm control panel having capability to program individual smoke detector response parameters, or smoke detectors using air sampling technology for use in information technology equipment rooms) within a single protected area must disconnect power to the information technology equipment and to the HVAC system after a preset time delay.
6. Clean agent fire extinguishing systems are not permitted to be installed in information technology equipment rooms, unless warranted by risk and specifically approved by the GSA regional fire protection engineer.
7. Underfloor spaces within information technology equipment rooms must be protected with a fire suppression system only where the risk warrants this protection and when approved by the GSA regional fire protection engineer. If underfloor fire suppression is to be installed in an underfloor space that is 457 mm (18 in.) or greater in height, an automatic sprinkler system must be installed. If underfloor fire suppression is to be installed in an underfloor space that is less than 457 mm (18 in.) in height, use of a clean agent extinguishing system is permitted provided the design is specifically approved by the GSA regional fire protection engineer.

## 7.11.3 PLACES OF CONFINEMENT (HOLDING AREAS)

Places of confinement must be designed in accordance with the IBC.

### SPECIAL REQUIREMENTS

The following requirements pertaining to places of confinement take precedence over the requirements in the IBC when the aggregate number of detainees within each holding area is

not more than 50 detainees, and where no individual is detained for more than 24 hours.

1. Places of confinement must be designed in accordance with the requirements in NFPA 101 for lock-ups.
2. Sprinklers must be installed within all places of confinement, including, but not limited to, prisoner holding cells, the main prisoner detention cell block, and prisoner attorney interview rooms.
3. The sprinklers installed must be institutional quick-response flush pendent sprinklers designed for standard and extended coverage applications.
4. The institutional sprinklers must have a solder-link-type fusible element, a tamper-resistant escutcheon, and a retaining flange that prevents sprinkler movement away from walls and ceilings.

## 7.11.4 ATRIUMS

Atriums must be designed in accordance with the requirements in the IBC.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IBC:

1. The atrium sprinkler system must be designed as a separate sprinkler zone. In addition, a separate manual isolation valve and a separate water flow switch must be located in an accessible location. A tamper switch must be provided on all such valves.
2. Atrium smoke control systems must be installed using the exhaust method in accordance with the requirements in the IBC.
3. For new construction, the atrium smoke control system must not utilize automatic opening of exterior door(s) as a means to supply makeup air to satisfy the system's design objectives.

## 7.11.5 COOLING TOWERS

Cooling towers must meet the requirements in NFPA 214.

## 7.11.6 RESIDENTIAL DWELLING UNITS

Residential dwelling units must meet the requirements in the International Residential Code (IRC).

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in the IRC:

1. Stairways in residential dwelling units must have a maximum riser height of 178 mm (7 in.) and a minimum tread depth of 279 mm (11 in.).
2. Residential dwelling units are required to be protected by an automatic sprinkler system. The design of the automatic sprinkler system for the residential dwelling unit must be based on the design and installation requirements in NFPA 13D. Each residential dwelling unit must be provided with a local waterflow switch that will initiate a local alarm. The sprinkler waterflow alarm must be arranged so that the operation of the waterflow switch must produce an alarm signal that is audible throughout all inhabited areas of the individual dwelling unit. The sprinkler system waterflow switch and control valve must be monitored for alarm, supervisory, and trouble conditions.
3. UL-listed nonmetallic sprinkler piping and tubing is permitted to be installed in residential dwelling units if approved for installation by the GSA regional fire protection engineer.

4. Residential dwelling units must be provided with approved multiple-station smoke alarms in all of the following locations:

a. In all sleeping rooms

b. Outside of each separate sleeping area in the immediate vicinity of the sleeping rooms

c. On each level of the dwelling unit, including basements

5. All smoke alarms must be designed and installed in accordance with the requirements in the NFPA 72. All smoke alarms within the residential dwelling unit must be interconnected in such a manner that the activation of any single smoke alarm will activate all the smoke alarms within the individual residential dwelling unit and produce an alarm signal that is audible throughout all inhabited areas of the individual residential dwelling unit.

6. Manual fire alarm boxes must not be installed in the residential dwelling unit.

## 7.11.7 CHEMICAL LABORATORIES

Laboratories must meet the design requirements in NFPA 45 and the IBC.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 45:

1. Laboratories handling or storing hazardous chemicals, flammable gases, flammable liquids, explosives, and biological laboratories must not be expanded in existing office buildings.

2. All chemical laboratories must be equipped with sprinklers, regardless of size. Sprinkler protection must be calculated to provide a density of 6.1 (L/min)/$m^2$ (0.15 gpm/$ft.^2$) over 279 $m^2$ (3,000 $ft.^2$).

## 7.11.8 RECORD STORAGE FACILITIES

Record storage facilities that have a storage volume of records exceeding 1,416 $m^3$ (50,000 cu. ft.) must meet the requirements in NFPA 232.

### SPECIAL REQUIREMENTS

The following requirements take precedence over the requirements in NFPA 232:

1. Record storage facilities that store Federal records must meet the requirements in the National Archives and Records Administration (NARA) guidelines published in the NARA Code of Federal Regulations—36 CFR Part 1234, Appendix B—Alternative Certified Fire-safety Detection and Suppression System(s) and, when specified by NARA, the archival storage standards published in NARA Directive 1571.

## 7.11.9 FLAMMABLE AND COMBUSTIBLE LIQUID STORAGE ARRANGEMENTS

The storage arrangements and protection of a flammable and combustible liquid storage area must meet the requirements in NFPA 30 and the applicable factory mutual data sheets.

## 7.11.10 COMPACT STORAGE MODULES

A type of shelving unit consisting of compact storage whereby the units move to allow for storage to be pushed together creating a storage unit with no flues or minimal spaces between units. Aisles are created by moving the shelving unit. Compact storage modules can be manual or electric in operation.

Compact storage modules must meet the following requirements:

1. Compact storage modules must meet the requirements in NFPA 13.

2. For floor loading requirements, refer to Chapter 4.

## 7.12 REQUIRED DESIGN GUIDES AND MANUALS

### 7.12.1 U.S. COURT FACILITIES

For special fire protection and life safety requirements for U.S. Court facilities refer to Chapter 8 and the U.S. Courts Design Guide.

### 7.12.2 U.S. MARSHALS SERVICE SPACE

For special fire protection and life safety requirements for U.S. Marshals Service space, refer to the USMS Requirements and Specifications for Special Purpose and Support Space, Volumes I, II, and III.

### 7.12.3 LAND PORT OF ENTRY FACILITIES

For special fire protection and life safety requirements for land port of entry facilities, refer to the Land Port of Entry Design Guide.

### 7.12.4 GSA CHILD CARE CENTERS

For special fire protection and life safety requirements for GSA child care centers, refer to the GSA Child Care Center Design Guide (PBS-140).

## 7.13 HISTORIC STRUCTURES

For an overall fire protection plan and to emphasize the design team's responsibility to address fire protection and to preserve the historic integrity of historic structures, the design team must explore alternative approaches outlined in State rehabilitation codes, International Existing Building Code, and national performance-based codes to resolve conflicts between prescriptive code requirements and preservation goals. In addition, the requirements and recommendations in NFPA 914 must be considered for rehabilitation projects in historic structures. The design team must also evaluate the U.S. Department of Housing and Urban Development Guideline on Fire Ratings of Archaic Materials and Assemblies, which provides test data on the fire resistance of a variety of historic materials, and the GSA publication titled Fire Safety Retrofitting in Historic Buildings.

### 7.13.1 RESPONSIBILITY

The GSA regional fire protection engineer is the AHJ for all fire protection and life safety requirements who must exercise professional judgment to assess the acceptability of alternative compliance solutions. Early and frequent coordination between the architects, State historic preservation officer, regional historic preservation officer, preservation specialists, external review groups, and the design team's fire protection engineer is needed for timely resolution of conflicts between fire safety and preservation goals.

### 7.13.2 IMPACT ON HISTORIC FABRIC

Before the design development submission for a project in a historic building, the design team fire protection engineer must consult with the GSA regional historic preservation officer and the GSA regional fire protection engineer regarding the impact of the fire protection design features as required within this chapter on the historic fabric.

### 7.13.3 FIRE PROTECTION ALTERNATIVES FOR CONSIDERATION

Listed below are fire protection alternatives for the design team's fire protection engineer to consider when designing a project in a historic building:

1. New stair enclosures in historic buildings should be designed to minimize visual impact on significant spaces, including historic lobbies and corridors. Cross-corridor

doors should be designed to provide maximum height and width clearance and avoid visually truncating the corridor. Oversized hold-open doors will achieve this end in most circumstances. For more ornamental spaces, accordion-rated doors may be used. Transparent treatments, such as rated glass assemblies or historic doors modified to incorporate rated glass, should be considered when barriers should be kept closed to maintain a rated enclosure. Nonprescriptive compliance solutions, such as modification of historic door assemblies, should be approved by GSA's regional fire protection engineer.

2. New fire-rated doors in preservation zones should be designed to resemble historic doors in panel detailing and finish. True-paneled fire doors are preferred for replacement of original paneled stair or corridor doors.

3. In historically significant spaces, sprinklers should be carefully placed to minimize damage to ornamental materials. Develop detailed drawings for architecturally sensitive areas, showing precise sprinkler locations and finishing notes as necessary to ensure proper installation. Sprinklers should be centered and placed symmetrically in relation to ornamental patterns and architectural features defining the space, such as arched openings.

4. Sprinklers and escutcheons should match original architectural surfaces or hardware. Oxidized brass or bronze heads are recommended for use in deeply colored (unpainted) woodwork. In elaborately decorated ceilings, heads should be camouflaged by custom coating and omitting escutcheon plates. In such cases, low-profile, quick-response sprinklers are preferred.

5. In historically significant spaces, smoke detectors should be placed to minimize destruction of ornamental surfaces. Where ceilings are elaborately embellished, explore alternative detection products and approaches such as air sampling detection, projected beams, low-profile spot detectors, recessed installation, or custom-coating detector housings to blend with ornamental finishes. Application of special finish treatments outside of the standard factory process should be coordinated with, and approved in writing by, the manufacturer to ensure that UL labels and detector performance are not compromised. Smoke detector housings should be removed before application of special finishes.

## 7.14 MASS NOTIFICATION SYSTEMS

Mass notifications systems are emergency voice communications systems that can be used to broadcast nonfire emergencies such as severe weather, biological/chemical spills, terrorist acts, etc. to occupants within a single building, to multiple buildings, or throughout a campus. Mass notification systems use audible and visible notification appliances, similar to fire alarm and emergency communication systems; however, the appliances may be used to direct occupants to remain in the building for their safety, rather than evacuate or relocate as they would normally do in a fire emergency.

Mass notification systems may merely be simple extensions to fire alarm and emergency communication systems, involving additional audible and visible devices. This would typically be for systems installed within a single building. Mass notification systems become more costly

and complex when installed to serve multiple buildings or a campus, as these installations involve additional wiring, multiple command centers and the possibility of exterior audio and visual devices. Because of these variances, every mass notification system project needs to be evaluated individually, and involve the GSA regional fire protection engineer. It should also be noted that a good time to install a mass notification system is when a new fire alarm system is being installed, since mass notification systems generally use the same equipment contained in a fire alarm and emergency communication system.

Regardless of the scope, a mass notification system must be designed in accordance with NFPA 72. However, the following special requirements take precedence over the requirements in NFPA 72:

1. Mass notification system control equipment must be integrated with the fire alarm and emergency communication system control equipment.
2. Occupant emergency notification must use fire alarm audio-visual appliances (e.g., speakers and strobes).
3. Nonfire alarm notification appliances are permitted to be used for exterior building broadcasting announcements.
4. Mass notification systems must have the capability of generating both automatic prerecorded and manual (live voice) emergency messages via the audible notification appliances, including speakers that are installed in elevator cars and exit stairways.
5. Live voice emergency messages must override any automatic prerecorded message.
6. Mass notification messages are permitted to over-ride the fire alarm and emergency communication system if approved by the GSA regional fire protection engineer.
7. Visible notification appliances must be the same type as used for the fire alarm system visible notification appliances; however, they must not be identified by the word “fire.”
8. Additional means for notifying occupants of a nonfire emergency (e.g., emergency message displays, scrolling text message displays, video displays, or text messaging) are permitted provided they are approved by the GSA regional fire protection engineer.
9. The building fire alarm and emergency communication system must have manual over-ride capabilities at the main fire alarm and emergency communication control equipment and USMS Command and Control Center where appropriate. Additional locations are permitted if approved by the GSA fire protection engineer.
10. An abnormal condition of a mass notification system component must not adversely affect the performance of the fire alarm and emergency communication system and vice versa.

## 7.15 PERFORMANCE-BASED DESIGN

GSA encourages the use of performance-based design for new construction and major renovation and alteration projects. Performance-based design is an engineering approach to fire protection design based on established fire safety objectives and functional statements, analysis of fire scenarios, and assessment of designs based on those objectives and functional statements. Performance-based design differs from traditional prescriptive design in that specific methods for achieving compliance with

the design intent are established by the design team, subject to the GSA regional fire protection engineer's concurrence, and a life safety solution is developed that is tailored to the specific building, fire, and occupant characteristics contained within the building being assessed. Information on performance-based designs can be found in the International Code Council Performance Code, Society of Fire Protection Engineers (SFPE) Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings, and the SFPE Handbook of Fire Protection Engineering.

## 7.16 COMMISSIONING FIRE PROTECTION AND LIFE SAFETY SYSTEMS

When total building commissioning is required as part of the project, the commissioning process must verify that the fire protection and life safety systems and equipment perform in compliance with the owner's project requirements, basis design, and applicable GSA adopted codes and standards.

The commissioning team must include a qualified fire commissioning agent (FCxA) to perform all fire protection and life safety commissioning activities. The FCxA must be separate, both by contract and employment, from the A/E design team or equipment manufacturers, suppliers, or installers for any such equipment provided as part of the project. As such, qualified, independent third-party firms or individuals must be considered for designation as the FCxA. The FCxA must have a minimum of five years' experience in facility construction, inspection, acceptance testing, or commissioning as it relates to fire protection and life safety systems. In addition, the FCxA must have an understanding of installation, operation, and maintenance of all fire protection and life safety systems proposed to be installed in the project, with particular emphasis on integrated testing of fire protection and life safety systems. The qualifications of the FCxA must be reviewed and approved by the GSA Fire Protection Program Office prior to selection.

Commissioning of fire protection and life safety systems must meet the procedures, methods, and documentation for the commissioning of active and passive fire protection and life safety systems and their interconnections with other building systems in accordance with NFPA 3, Standard for Commissioning of Fire Protection and Life Safety Systems.

## 7.17 INTEGRATED FIRE PROTECTION AND LIFE SAFETY SYSTEM TESTING

Integrated fire protection and life safety systems shall be tested in accordance with the requirements in the IBC and NFPA 4.

# 8

# DESIGN STANDARDS FOR U.S. COURT FACILITIES

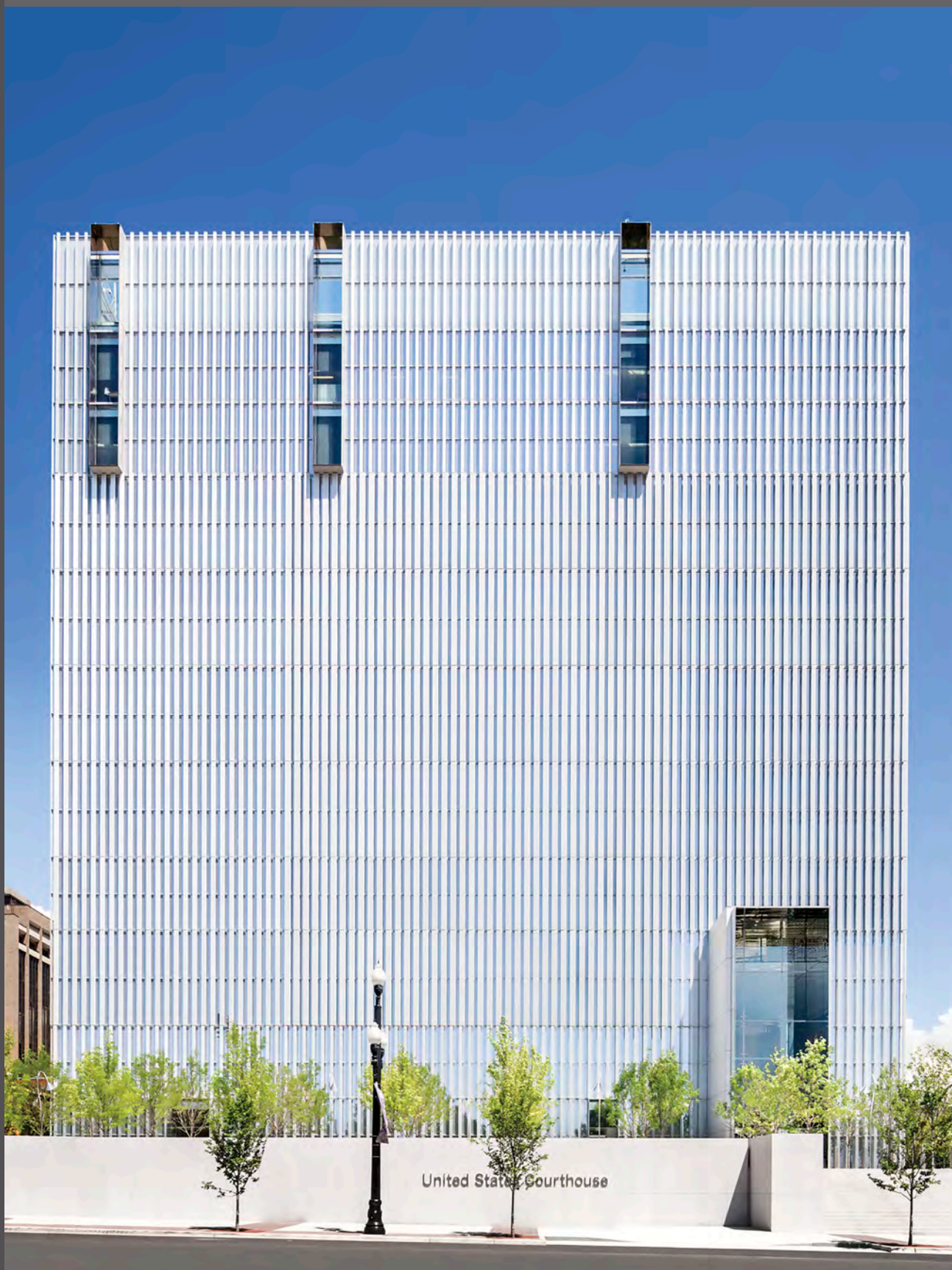



Figure 15:
U.S. Federal Courthouse
Salt Lake City, UT

## 8.1 GOALS AND OBJECTIVES

This chapter refers to program and design issues in an effort to relate the design intent directly to the technical requirements for the building systems and finishes.

This chapter does not cover issues related to selection of audiovisual, data, or telecommunications systems. (These criteria are developed in the U.S. Courts Courtroom Technology Manual.) Reference is made to these systems in Chapter 8 only with regard to the electrical service requirements in the areas where they are being installed.

The following complementary documents provide comprehensive programming and design criteria for U.S. Court facilities.

## 8.2 DESIGN GUIDANCE

### 8.2.1 U.S. COURTS DESIGN GUIDE

This publication focuses on the functional program requirements, Court and court-related adjacency relationships, finish materials, and specific performance criteria for acoustics and environmental systems, including special heating, cooling, and lighting requirements. The USCDG also addresses security, telecommunications, and audio-visual design requirements.

The USCDG includes a tabular comparison of funding responsibilities for all components of the courthouse and court functional space. (This information is organized into budget requirements for GSA, judiciary, and the judiciary-related executive branch agencies.)

The USCDG refers to technical information related to performance criteria to help illustrate the rationale for the requirements and to establish the standard for level of quality.

### 8.2.2 U.S. MARSHALS SERVICE CRITERIA

Criteria for space controlled by the U.S. Marshals Service (USMS) are found in Requirements and Specifications for Special Purpose and Support Space Manual (USMS Publication 64). Use the latest version including all volumes and addenda. This publication provides the finish criteria for USMS functional program requirements, spatial relationships, electronic and physical security, and hardware standards and special HVAC requirements within the U.S. Courts and court-related spaces.

The USCDG and USMS Publication 64 speak directly to the functional requirements of the user and tenant. Chapter 8 presents a cost-effective and efficient building system as well as materials to achieve the appropriate environment from the perspective of the building owner (GSA) by reference to applicable technical standards, security standards, and life safety and accessibility requirements.

The USMS Publication 64 standards are complementary documents to both the USCDG and this chapter. These documents establish, in detail, the environmental, security, functional, and technical requirements for the USMS spatial accommodations within U.S. courthouses. They include information regarding secure environments for prisoners being held in preparation for a court appearance, USMS staff facilities, and general building security requirements. GSA is responsible for power to the electronic security devices, but the design consultants should understand that the USMS security contractor provides detailing and environmental requirements related to security within the functional area dedicated to the courts. Chapter 8 indicates general requirements, but the USMS Publication 64 is the standard the A/E must follow.

## 8.3 GENERAL REQUIREMENTS

### 8.3.1 PLANNING FOR FUTURE REQUIREMENTS

The master plan for each courthouse facility is intended to accommodate 30 years of growth, and the design of the initial phase of construction must provide the spatial requirements for 10 years.

The conversion of general office or other support spaces to courtroom use will potentially put greater demands on the HVAC, electrical, and communications systems. These systems will require expansion capacity and space for additional equipment related to the future courts in the initial building design. Historic courthouses require special considerations. For guidance on renovation of historic courthouses, consult with the regional historic preservation officer. Accessibility ramps should be installed in historic buildings, unless such ramps will result in substantial loss of historic material. Under exceptional conditions, an application for a waiver may be made for a temporary ramp.

### 8.3.2 PLANNING FOR ACCESSIBILITY

All U.S. Court facilities must be accessible to persons with physical challenges.

The detailed functional aspects of each courtroom component include an integrated reference to accessibility accommodation within the description of Courtroom Requirements in chapter 4 of the USCDG.

The following information is intended only as a summary of the basic circulation, change in elevation, and spatial requirements that must be addressed at each respective component with regard to accessibility for individuals with physical challenges.

Design for accessibility must comply with the requirements of the Architectural Barriers Act Accessibility Standard (ABAAS).

GSA and judiciary policy requires all Federal courtrooms have the lectern, counsel tables, witness stands, and jury boxes accessible in the original design, and the judge's bench, clerk's station, and other court personnel workstations adaptable for accessibility, regardless of local or State code.

ABAAS requires a totally accessible interior route from the point of entry to all areas of a building used by the public. The design elements affected by this requirement can include:

- Vestibule configuration
- Door sizes and pressure of operation
- Corridor widths
- Elevator access and control
- Toilet room and stall dimensions
- Telephone and TTY (text telephone) provisions
- Drinking fountain location and dimensions
- Visual and audible alarm accommodations
- Signage design and location
- Quantity of accessible seating
- Ramps or platform lift access to all raised seating

Access to all raised areas in courtrooms must be by platform lifts or permanent ramps. If platform lifts are provided, they must be an integral part of the architecture of the courtroom. Bench areas must be designed to accommodate this equipment, including structural slabs with a shallow pit for the lift platform.

U.S. Court facilities have several conditions that are unique to Federal building planning and design. There are provisions within the courtroom for fixed millwork to include elevated platforms for judges, witnesses, clerk staff,

reporters, and jurors. In addition, design of spectator seating areas must consider visitors with physical challenges, including individuals with sight and hearing difficulties. (All areas of the courtrooms must accommodate listening systems for the hearing impaired, and translators, note takers, and interpreters for the visually disabled.)

Table 8-1 outlines the accessible standards that apply specifically to courts and highlights instances where policy or preferences developed by GSA, in conjunction with the Judicial Conference of the United States, differ from ABAAS. Adaptability requires that dimensional consideration be included in the original design to incorporate accessible elements at a later time. Wherever ramps or platform lifts are provided for access to a raised area, railings must be provided as required.

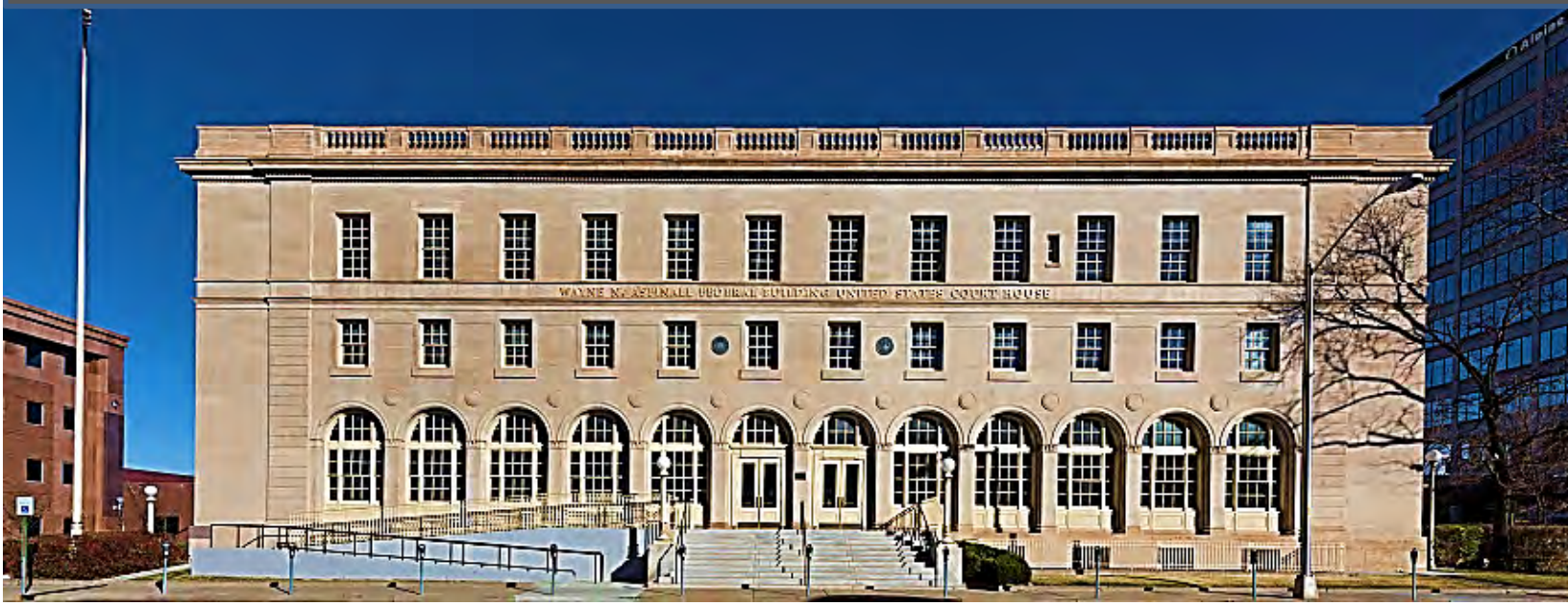
### 8.3.3 INFRASTRUCTURE

Electrical outlets, wiring, conduit, or raceways to support sound and visual communication equipment for persons with physical challenges will be provided by GSA. Electrical service may be required for transcription services, telephone handset amplifiers, telephones compatible with hearing aids, closed caption decoders, text telephones (TTYs), or other devices to assist those with hearing or visual impairments.

### 8.3.4 ACOUSTIC PLANNING REQUIREMENTS

Acoustical performance is of the utmost importance in courthouse design. The A/E must include an acoustic consultant who must develop the appropriate information at each stage of the design process to assure the courts and GSA that sound and vibration issues have been properly addressed. Chapter 14 of the USCDG has specific guidance and requirements for the acoustic performance of each courthouse facility space. The design must provide these acoustic requirements. The finished space performance will be tested against these specific requirements. Where detailed criteria are not provided in the USCDG the requirements of P100 will be followed.

Figure 16: Wayne Aspinall Federal Building and U.S. Federal Courthouse, Grand Junction, CO



| SPACE | ACCOMMODATION |
|---|---|
| COURTROOM | |
| Circulation routes | Clearance and turning radius for wheelchairs throughout the courtroom. |
| Public seating | Number of wheelchair spaces and location are set by ABAAS |
| Litigant and counsel tables | Height clearance at table(s) and circulation space requirements of ABAAS. |
| Jury box | One wheelchair space along the general circulation path at the box. (If located on a tier, provide a ramp or lift.) |
| Witness stand | Comply with clear floor space and maneuvering requirements of ABAAS. Permanent ramp or platform lift to provide access. (Adjacent space is required for an interpreter.) |
| Judge's bench | Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for future platform lift.) |
| Courtroom clerk, bailiff, and court reporter stations | Comply with clear floor space and maneuvering requirements of ABAAS. Adaptable for future inclusion of ramp or platform lift. (Electrical service, space, and floor depression must be included in the initial design for a future platform lift.) |
| Lectern | Include an adjustable platform with a height variation between 710 mm and 760 mm (28 in. and 30 in.) above the floor. Knee space at least 685 mm (27 in.) high. The lectern must be at least 760 mm (30 in.) wide and 480 mm (19 in.) deep. |
| JURY & ANCILLARY FACILITIES | |
| Jury assembly room | Must be located on accessible route. Refer to ABAAS for number of wheelchair spaces. ABAAS also determines requirements for listening devices, kitchenette-type service units, and associated vending and seating areas. |
| Jury deliberation rooms | One space at tables. Clearance provided at coat storage and dedicated toilet rooms. Portable assistive listening system (provided by judiciary) may be used if there is more than one deliberation room. |
| Attorney/witness rooms, attorney work rooms and conference rooms | Provide proper clearance for circulation and height at tables for wheelchairs. |
| Grand jury suite | Refer to ABAAS for the number of wheelchair spaces and listening devices. Clearance provided at coat storage, service unit, and toilet rooms. Witness stand with wheelchair turning radius clearance. |
| USMS FACILITIES | |
| Court holding areas | Each classification of holding must have one holding cell accommodating wheelchair clearances and an appropriate toilet plus lavatory in accordance with ABAAS. |
| Visitor booths and attorney/prisoner areas | At least 5 percent, but no less than 1 percent, of booth/areas must provide clear floor space, maneuvering clearances, and counter height dimensions for a wheelchair on both sides in accordance with ABAAS. |

Table 8.1 Accessibility Requirements

## 8.3.5 ARCHITECTURAL AND INTERIOR DESIGN

This section addresses technical requirements for architectural materials and systems in buildings designed to serve the U.S. Courts.

Specific requirements are presented for all special or unique court spaces and court-related agencies, including those to accommodate the U.S. Marshals Service.

General building design concepts for GSA-owned structures are based on an overall "systems"

approach, utilizing all design elements of the building, including ceiling cavities, floor cavities created by use of access flooring, stacked vertical distribution cores, and centrally located support areas to increase functionality, improve flexibility for future modifications, and provide buildings that are efficient regarding construction, operation, and maintenance costs.

### 8.3.6 BUILDING ENCLOSURE SYSTEMS

The baseline standard for exterior materials of U.S. Court facilities is precast concrete with limited stone, brick, or other durable materials attached to the precast. Fundamental construction standards for the majority of the exterior building systems are discussed in Chapter 3.

Specific additional provisions for U.S. Court facilities include:

- Vehicular sallyport doors that meet USMS requirements
- Appropriate (ballistic-resistant) glazing at various levels of a facility
- Physical and electronic security design features at vulnerable areas that will decrease risk of attack to occupants or escape of prisoners

### 8.3.7 FLOOR SYSTEMS

Accessible flooring systems are defined as a suspended floor plane above the structural slab with relocatable modular components. Raised access floor systems for Federal facilities must use a minimum of 150 mm (6 in.) above the concrete deck to allow adequate space for wire management systems and the crossing of large conduits. The requirement for raised access flooring in courthouses is described in Chapter 15 of USCDG.

The height of the accessible floor system must be included in the determination of floor-to-floor dimensions.

Select standard floor finishes within each function of the court facility primarily based on acoustic enhancement, general durability, and ease of access to underfloor electrical, telecommunication, and data distribution systems.

The USCDG contains detailed information on specific requirements for the use of carpet and other floor finish materials under each category of functional space. See Chapter 12 of the USCDG. The USMS Publication 64 contains very stringent requirements for the USMS in all detention-related areas of its facilities.

### 8.3.8 INTERIOR WALL SYSTEMS

Most interior wall partitions will be composed of gypsum board on metal studs, with the exception of USMS detention spaces. There may be instances in the general building construction where concrete masonry is used if building elements, including elevator or plumbing shafts, are stacked systematically floor upon floor.

### 8.3.9 CEILING SYSTEMS

The USCDG outlines all of the appropriate interior finishes for U.S. Court-related spaces.

Chapter 3 of this document outlines the general parameters for selection of a ceiling system in typical office spaces. There are several types of spaces with custom ceiling system requirements, which may include courtrooms, public spaces, office and conference spaces of the courts or other agencies, and detainee areas. In historic buildings, acoustical requirements should be satisfied using removable finishes and features so that original ornamental surfaces may be maintained.

### 8.3.10 OFFICE AND CONFERENCE SPACES

In office and conference spaces, flexibility and durability are also the main considerations in the selection of a ceiling system that must accommodate change and accessibility above the ceiling plane. The ceiling material must absorb sound to provide speech privacy and control transfer of noise from machines, computers, light ballasts, and other sources within adjacent office areas.

The use of a standard 600 mm by 600 mm (2 ft. by 2 ft.) suspension system with a commercial-quality acoustic ceiling tile is recommended. The use of this system allows future flexibility in partition arrangement and corresponding relocation of mechanical diffusers, lights, sprinklers, and components of other systems such as speakers and fire alarm notification appliances.

### 8.3.11 COURTROOMS

In courtrooms, acoustic characteristics and aesthetics are the main considerations in the selection of a ceiling system. The ceiling design and materials must enhance the acoustic performance of the well area. (Ideal reverberation time in a courtroom is 0.6 to 0.7 seconds. See Chapter 14 of the USCDG.) This will involve the use of reflective and absorptive materials in the space. At no point in the ceiling design must the highest point exceed the maximum ceiling height requirements in the USCDG.

### 8.3.12 PUBLIC SPACES

In public spaces, the ceiling system must accommodate future changes to the layout of the space and allow access for maintenance of the building systems above and within the ceiling plane, including mechanical systems, diffuser locations, communication devices, lights, and fire protection systems. Acoustic tile in a suspended ceiling grid is typically provided in these areas, along with supplemental use of gypsum wallboard in soffits, perimeter coves, recesses, and reveals.

### 8.3.13 DETAINEE AREAS

In detainee areas, security and durability are the main considerations in the selection of a ceiling system. Refer to USMS Publication 64 for suggested ceiling materials in these spaces.

### 8.3.14 FIXED AND MOVABLE FURNITURE

Components to be provided by GSA in U.S. Court facilities include fixed and limited movable furniture and millwork required for the operations of the courts in courtrooms, grand jury rooms, hearing rooms, jury assembly rooms, and public transaction counters. See Chapter 12 of the USCDG.

In general, built-in furniture must be designed with integral cable raceways plus conduits sized for future expansion and change. Built-in furnishings must also include access panels to permit easy cable and wiring changes. Provisions for power, data, and telecommunications outlets and inputs, and sound and other systems must be confirmed during the design development phase of the project on a position-by-position basis. Courthouse furniture must meet a variety of needs, and selection must consider function, cost, availability, and aesthetic criteria. The selection and design of fixed and limited movable furniture must be carefully coordinated to achieve a consistent image, proper function, and required clearances.

The movable furniture provided by GSA in the U.S. Court facilities are lecterns and counsel tables for courtrooms. Typical provisions for

movable furnishings in U.S. Courts are indicated in tables provided for each category of space use in the USCDG. All items to be provided by GSA within the baseline rent charges are assumed to be included within the anticipated construction budget.

Refer to USMS Publication 64 for a detailed description of USMS fixed and movable furniture requirements in U.S. Court facilities.

Table 8-2 outlines the basic fixed furniture elements that are provided for all court-related functions.

**Table 8.2 Typical Interior Fixed Furniture Elements**

| SPACE | TYPE OF FURNITURE ELEMENT |
|---|---|
| Courtroom | Judge's bench (See AO publication U.S. Courts Design Reference Manual 2007)<br>Deputy clerk desk (Adaptable for computer and printer)<br>Court reporter/Recorder desk<br>Witness box<br>Fixed base chairs for jury and one not fixed<br>Spectator rail and seating<br>Jury box<br>Spectator benches |
| Grand Jury Room | Bench<br>Witness stand<br>Jury rails |
| Judge's Chambers Suite | Kitchenette-type serving unit with sink (cabinets above and below)<br>Built-in book shelves |
| Judge's Robing Room | Lockers for robes |
| Judge's Private Toilet and Judge's Robing Room Toilet | Vanity, mirror, and medicine cabinet |
| Jury Assembly | Check-in counter<br>Coat closet with rods<br>Kitchenette-type serving unit (cabinets above and below) |
| Jury Areas | Toilets with vanity and mirror<br>Kitchenette-type serving unit<br>Coat closet with rods |
| Library Spaces | Standup counter and stacks |
| Probation and Pretrial Services Entrance and Urinalysis Testing Toilets and Lab | Standup counter (break resistant windows)<br>Toilet with mirror |
| Bankruptcy Appellate Panel Clerk | Intake counters |
| District and Bankruptcy Public Areas | Public counters and workstation |
| USMS Detention Cells | Benches<br>Modesty screen |
| USMS Prisoner/Attorney Interview Room | Counter<br>Stool (Prisoner side) |

| SPACE | TYPE OF FURNITURE ELEMENT |
|---|---|
| USMS Reception/Cashier Area | Service counter |
| USMS Staff Locker Rooms (Men's and Women's) | Lockers and benches<br>Grooming shelf and mirrors<br>Metal lockers<br>Hooks or open closet rod and shelf for coats |
| USMS and CSO Work/Mail Room | Base cabinets<br>Work surface<br>Shelving |
| Central Mail Facilities | Personal Protection equipment storage, counter sink with eye wash |

## 8.3.15 SIGNAGE AND GRAPHICS

Many Federal courthouses are large, complex structures requiring clear and coordinated systems of signage and wayfinding that allow first-time users to locate their destination as quickly and directly as possible.

A standardized system of signage, with interchangeable components, must be provided throughout the courthouse. ABAAS guidelines are specific about parameters of design, including location, size, color, and tactile qualities of signage and use of graphic symbols to assist nonreaders.

In addition to providing all general building identification and way-finding signage, GSA supplies all court-related signs in public corridors of the building. Signage requirements within the courts' dedicated space, related to their function, are provided by the courts. See Chapter 13 of the USCDG. GSA supplies signs for life safety and public convenience (restrooms) within the functional areas of the courts. The A/E is responsible for designing all GSA-supplied signage and graphics.

For installation of signage in historic buildings, the A/E must consult with the regional historic preservation officer regarding the integration of signage in the historic facility or district.

The following signage must be furnished by GSA under the A/E design contract, and any remaining requirements will be determined and provided by the courts.

## 8.3.16 IDENTIFICATION AND INFORMATION SIGNAGE

- Building identification/seal/cornerstone
- Division/department, tenant agency identification
- Courtroom/room/area identification
- Special function identification—library, media center, cafeteria, etc.

## 8.3.17 DIRECTIONAL SIGNAGE

- Main directory at building entrance—graphic plan
- Floor directory on each floor—graphic plan
- Directory of building occupants with suite locations
- Directional signage for building access by persons with physical challenges
- Directional signage for parking/restricted entrances
- Directional signage for service vehicles

## 8.3.18 REGULATORY/SECURITY SIGNAGE

- Signage for core functions—restrooms, stairs, telephones, and other elements on ABAAS-accessible path to building services

- Signage for controlled access areas—judicial and staff areas; if admission to controlled areas is based on acceptable identification, instructions for operating the call button/camera must be provided at the controlled door
- Signage for dedicated systems/facilities—elevators, stairs, staff restrooms (identification as dedicated and regulations for use must be stated)
- Signage for special locking arrangements

## 8.4 STRUCTURAL SYSTEMS

### 8.4.1 GENERAL REQUIREMENTS

See Chapter 4 Structural Engineering, the USMS Pub 64, and the U.S. Courts Design Guide for specific information.

## 8.5 MECHANICAL SYSTEMS

This section focuses on technical requirements for the mechanical engineering systems that should be provided in buildings designed to serve the U.S. Courts. Specific requirements are presented for all special or unique spaces used by the U.S. Courts and court-related agencies, including spaces designed to accommodate the U.S. Marshals Service.

Federal court facilities must be designed to take advantage of integrated systems and controls to provide better building performance through energy conservation, economy of operations, maintenance, and flexibility for changes. Opportunities for system integration must be evaluated throughout the design process.

U.S. Court facilities require a variety of space types, each with its own set of specific requirements. In addition, court functions require flexibility in the time of operation and control of dedicated HVAC systems. See Chapter 15 of the USCDG.

### 8.5.1 SYSTEM SELECTION AND DESIGN

All criteria in this section are mandatory.

#### 8.5.1.1 HVAC SPECIFIC DESIGN CRITERIA

Outdoor winter temperature equal to ASHRAE 1-percent design dry bulb and coincident wet bulb.

Outdoor summer temperatures equal to ASHRAE 99-percent design dry bulb/97.5 percent wet bulb.

- Indoor air in courtrooms: 24° +/- 1°C (75° +/- 2°F) in summer and 22° +/- 1°C (72° +/- 2°F) in winter.
- Maintain 45 to 50 percent relative humidity for summer conditions and 25 to 35 percent relative humidity for winter conditions.
- All materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire-resistance-rated wall assemblies must meet the requirements of the International Building Code.
- Do not use duct lining. Ductwork must be acoustically designed as described in Chapter 5 of the P100 and Chapter 15 of the Courts Design Guide.
- HVAC systems must be designed to provide optimum flexibility in scheduling the use of courtrooms and chamber areas.

#### 8.5.1.2 GENERAL CRITERIA

The selection of the HVAC systems, equipment, and source of energy must be in accordance with the guidelines and procedures established in Chapter 5.

The HVAC system must be designed to provide 23.4°C (74°F) +/- 2° in judges' chambers, courtrooms, and trial jury suites on average. The courtroom HVAC system must be designed so

that courtroom thermostats can be reset from the building automation system to precool the courtrooms to 21.1°C (70°F) before scheduled occupancy.

Trial jury suites (when located adjacent to a courtroom), judges' chamber suites (when located adjacent to a courtroom), attorney/witness rooms, attorney work room, and courtrooms must be placed on the same system with separate zones having related thermostats and the design must account for variation in occupancy load.

Humidification must be provided as specified in Chapter 5. See Chapter 15 of the USCDG.

The HVAC systems must be zoned in such a manner that the requirements of the special areas can be satisfied by efficient use of the systems and equipment.

To allow flexible and efficient use of the HVAC systems for hours of activity occurring at times other than standard building operations and to satisfy specific requirements in a U.S. Court facility, the central plant equipment (chillers, boilers, cooling towers, pumps, AHUs, etc.) must be designed using redundant equipment of various sizes to satisfy the requirements of differing number and sizes of zones. The design strategy shall optimize and minimize energy consumption during these operational events. The design narrative shall describe how this will be done. The HVAC design must allow submetering of utilities and equipment to permit the facility manager to allocate cost of operation beyond standard hours of operation.

The HVAC system design for the courtroom, judge's chamber suite, and the jury deliberation room, which compose a single "court set," must be designed to allow the HVAC system to operate after standard building operations hours in an efficient manner.

The design must include winter humidification for areas in the building with custom millwork.

### 8.5.1.3 COURTROOMS/CHAMBERS

#### AIR DISTRIBUTION (SEE CHAPTER 15 OF THE USCDG)

Three HVAC zones must be provided: one for the judge and attorney areas; a second for the jury areas; and a third for the spectator area.

The diffusers serving the spectator areas must be sized to serve the allowable seating capacity, plus 25 percent, to accommodate extra seating. The diffusers must be selected to meet minimum ventilation requirements at no loads, with no appreciable increase in system noise during load changes.

See Chapter 14 of the USCDG for air exchanges per hour. Systems must be designed to meet these requirements when spaces are fully occupied, unless otherwise noted.

If the courtroom is served by a fan system dedicated to more than one courtroom, the return air from each courtroom and its associated areas must be ducted directly to the unit.

Return air from the chamber suites must be ducted directly toward the return air shaft for a minimum distance of 4.5 meters (15 ft.). Ductwork will be treated to meet the acoustical courtrooms/chambers design criteria.

### 8.5.1.4 JURY FACILITIES

#### SYSTEM DESCRIPTION AND CONTROL

Trial jury suites should be served from the same system as the associated courtrooms with a separate thermostat for each trial jury room.

### AIR DISTRIBUTION

Air distribution systems in the jury facilities must provide separate temperature control and a high degree of acoustical isolation, particularly in the grand jury and trial jury rooms. Ductwork will be treated to meet the acoustical deliberation room design criteria.

### AIR CHANGES

Refer to USMS Publication 64 for all detention requirements.

### EXPANSION CAPABILITY

Since U.S. Court facilities are expected to have a long, useful life, new construction and renovation projects must be planned to provide adequate mechanical and electrical capability to the site and building(s) to support future additions. It is particularly important to design the systems for specialized areas of the building (lobby, food service, mechanical rooms, and electrical rooms) to support the anticipated 30-year needs of the occupants.

This can be accomplished by building additional space for future growth of the HVAC systems during initial construction and temporarily allocating it to building or tenant storage.

The A/E must locate equipment adjacent to the building perimeter wall that will abut future expansion for orderly tie-in to new system components.

## 8.5.1.5 ACOUSTIC PERFORMANCE

Acoustic performance must be a major consideration in the selection of HVAC equipment. Systems serving the courtrooms and auxiliary spaces must be designed with sound attenuation to provide consistent and acceptable sound levels. This is particularly critical in the design of court facilities that require extensive use of sound and audiovisual equipment for recording and presentations.

To control noise during all modes of operation and for all load conditions, the HVAC system should be provided with one or more of the following:

- Sound traps
- Low-velocity, low static-pressure fan systems
- Special low-noise diffusers

If air is returned by the ceiling plenum, special attention should be given to the location of any partitions extending to the floor structure above and to the acoustical treatment of the required penetration of these partitions for return air.

HVAC equipment, including AHUs and variable air volume (VAV) boxes, must not be located in close proximity to courtrooms, jury rooms, and chambers. The minimum distance should be 7.6 meters (25 ft.) between AHU and courtrooms. (Refer to Chapter 5, Theaters and Auditoriums, for criteria regarding maximum duct velocity.) General system design must provide appropriate treatment of mechanical supply/return ducts to minimize sound and voice transfer from courtrooms, chambers, jury deliberation spaces, and witness rooms to surrounding areas.

Noise criteria (NC) (the limits that the octave band spectrum of noise source must not exceed) must range from 25 to 30 in courtrooms. (See Chapter 14 of the USCDG). For sound level maintenance, the courtroom must be served by constant volume air supply. The system must also support variable outside air requirements and variable cooling loads. Air ducts serving the trial jury and grand jury suites must be double-walled sound-attenuating ducts for a length of at least 3.7 meters (12 ft.) from the diffuser or return air intake.

#### 8.5.1.6 MECHANICAL SYSTEM DIFFUSERS AND VENTS

Mechanical system diffusers and grills in public and staff areas must be secure from tampering, particularly in areas that provide some degree of seclusion and privacy (restrooms, attorney-client visitation rooms, etc.). Maximum-security detention-type grilles, secured with tamper-proof fasteners, must be provided at all areas accessible to prisoners. (Refer to USMS Publication 64 for more information.)

#### 8.5.1.7 CHANGES IN BUILDING ENVELOPE TO MEET ENERGY GUIDELINES

Due to the energy load requirements of court facilities, designers must use the alternative design processes of ASHRAE 90.1R to meet Federal energy guidelines for overall building energy usage. Improvements in building enclosure system performance, including increased thermal resistance and the construction of a continuous air barrier, must be used to compensate for higher-than-average load requirements resulting from court functions. Total building energy usage must be established according to calculations using mandatory design standards contained in Chapter 5. To demonstrate the same total energy usage, a new calculation must be done, incorporating factors for energy reduction strategies to offset increased lighting, cooling, and heating energy loads.

#### 8.5.1.8 INFORMATION TECHNOLOGY SYSTEM LOADS

Information technology systems are not the largest source of heat within the office spaces, but may be the largest sources in other areas. Information technology systems may be the most uncertain source of heat flows during design phases; therefore, the HVAC system must be planned with capacity and control to accommodate the need for constant temperature and humidity environments 24 hours a day, where systems hardware could be placed.

The design of the HVAC systems must take into consideration provisions for separate units for critical areas such as computer rooms, USMS control room, elevator machine rooms, etc., which generate additional heat loads. The HVAC design for these areas must have redundancy and be connected to the emergency power system.

## 8.6 FIRE PROTECTION AND SECURITY SYSTEMS

Refer to Chapter 7, Fire Protection, for all fire protection and life safety system requirements.

All security systems must be connected to emergency power. In addition, any security hardware (e.g., electronic locks, card readers, magnetic locks) that is installed on exit doors and exit access doors must meet the requirements of the National Fire Protection Association 101, with regard to function, design, operation, and maintenance. This includes, but is not limited to, any security hardware being installed on exit stair doors, building perimeter exit doors, and elevator lobby enclosure doors, as well as any door in the means of egress.

## 8.7 ELECTRICAL SYSTEMS

GSA will provide emergency power for life safety systems and critical building infrastructure.

Normal and emergency building distribution systems must be designed to comply with Chapter 6. They must include a special electrical distribution system consisting of an isolation transformer with associated branch circuit distribution equipment, and must be designed to

serve the tenants' data network system and associated equipment supporting nonlinear loads.

Uninterruptible power systems (UPS) must be provided to serve security, emergency smoke evacuation, and any other critical systems and be connected to the emergency power distribution system. Additional systems must be provided by the tenants for any specific tenant related requirements.

### 8.7.1 SPARE CAPACITY

General design requirements for office and courtroom areas must be based on anticipated loads and requirements as outlined in Chapter 6.

The capacity of the feeders serving all areas of the building must accommodate growth to the extent shown in the 30-year long-range plan for the facility.

### 8.7.2 NUMBER OF OUTLETS

The number of outlets provided in U.S. Court facilities must be in accordance with Table 8-3, electrical codes, and good practice.

Figure 17: Wayne Aspinall Federal Building and U.S. Courthouse Solar System, Grand Junction, CO

**Table 8.3 Electrical Power Requirements/Outlets***

| LOCATION | EQUIPMENT/OUTLET(S) | NOTES |
|---|---|---|
| COURTROOMS | | |
| Judge's Bench | Isolated ground quadruplex receptacle for general purpose use; Duplex receptacle for computer, monitor; additional duplex receptacle for video arraignment. | |
| Courtroom Lobby | Duplex outlet with dedicated circuit for portable magnetometer. Branch circuits will be provided for additional loads dictated by the courts. | |
| Court Deputy Clerk Workstation | One isolated ground quadruplex receptacle (general use) and one duplex receptacle for PC and monitor per clerk position. | Printers as a group. |
| Court Reporter/Recorder's Workstation | One quadruplex receptacle (general use), one duplex receptacle for reporter's computer/CRT | Provide additional duplex receptacle(s) at alternate CR position(s) in the courtroom. |
| Witness Box | One duplex receptacle and one dedicated outlet. | |
| Jury Box | One quadruplex receptacle for general purpose use. | Mounted on inside of jury box enclosure. |
| Attorney Tables | One quadruplex receptacle (general use) Recessed floor box. | Per attorney table position. |
| Appellate Judge's Courtroom Clerk | One isolated ground quadruplex receptacle (general use) and one duplex receptacle for PC and monitor. | Printer |
| Spectator Seating | One Isolated ground duplex outlet at front rail ("bar") for computer/monitor for CRT or other use. | Mounted on spectator side of rail enclosure. |
| Equipment Room/Area | Multiple outlets (as required) for sound, assisted listening system (ALS), data, telecommunications, and video recording and presentation equipment. | |
| Other | Duplex outlets at 20 ft. intervals along the walls of courtroom. Duplex outlets at two locations (minimum) in front of bench millwork. Additional outlets at appropriate locations for ceiling-mounted screen, fixed or movable positions for slide projector, video monitor, video recorder, interactive white-board and image copier, and x-ray viewer equipment. Locate underfloor boxes for multiple possible locations of a lectern and alternative locations for attorney tables. Provide additional outlets for initial/future location of video cameras. Provide outlet for wall-mounted clock. Provide outlet(s) for ALS unit(s). Provide outlets as required for video conferencing/arraignment equipment, video monitors/VCR equipment, security, and so on. | The courtroom well will have a suspended access floor system for flexible location of outlets |
| COURT SUPPORT | | |
| Witness Waiting Rooms | Distributed convenience outlets, including provisions for cleaning and housekeeping. | |
| Attorney/Witness Conference | Distributed convenience outlets, including provisions for cleaning and housekeeping, and for audiovisual equipment (monitor/VCR). | |
| Public Waiting Areas | Distributed convenience outlets, including provisions | |

| LOCATION | EQUIPMENT/OUTLET(S) | NOTES |
|---|---|---|
| | for cleaning/housekeeping. Provide outlets for clock. Duplex outlet with dedicated circuit for magnetometer outside sound lock. | |
| Media Room(s) | Distributed convenience outlets, including provisions for cleaning equipment and motor loads. Provide separately metered power outlets for news agencies' telecast equipment. | |
| Court Reporter Office | One isolated ground quadruplex receptacle (general use). Duplex outlet(s), two minimum, for PC, monitor, printer, FAX. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Judges Shared Conference/Reference Room(s) | Distributed convenience outlets. Provide Isolated ground outlets as required for video conferencing/arraignment equipment, video monitors/DVR equipment, security, sound-system, ALS and other equipment, based on anticipated locations of equipment. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| JUDICIAL CHAMBERS | | |
| Judge's Chambers | Quadruplex receptacle for general purpose use. Two duplex receptacles for miscellaneous uses (TV monitor, slide projector use, etc.). Two isolated ground duplex receptacles for PC, monitor, printer and other computer equipment. Additional duplex receptacle for video arraignment and FAX equipment where required (initial/future use). | Duplex outlets for PC and monitor positions to be located in multiple positions (based on likely furniture placement). Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Secretary/Judicial Assistant | One quadruplex receptacle (general use). Duplex isolated ground outlets, two minimum, for PC, monitor, printer, FAX. | |
| Law Clerk Office | One quadruplex receptacle (general use). Duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Work Area | Quadruplex receptacle for general purpose use. Duplex outlets for coffee machine, microwave unit, refrigerator, based on equipment/furniture layouts. Additional outlet(s) for copier. | Equipment not included in base building budget. Refrigerator included in FF&E budget. Other equipment (PC, monitor, printer, FAX, copier, etc.) not in FF&E budget. |
| Conference /Reference General | Provide isolated ground outlets for video conferencing, TV monitor, projectors. Distributed convenience outlets in reception/waiting and general office areas. Provide outlets for floor-cleaning equipment and motor loads. Provide outlets as required for video conferencing/arraignment equipment, security, sound-system, ALS, or other equipment, based on anticipated locations of equipment. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Service Unit | Distributed convenience outlets | Coffee maker, microwave, refrigerator |
| TRIAL JURY SUITE(S) | | |
| Jury Deliberation Room | Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate | Computer and office equipment (PC, monitor, |

| LOCATION | EQUIPMENT/OUTLET(S) | NOTES |
|---|---|---|
| | circuit for kitchen type service unit equipment (microwave, coffee maker). Isolated ground outlets for film/slide projection equipment, TV monitor and DVR, audio tape recorder/player. Outlet for wall-mounted clock | printer) not in FF&E budget. |
| Other areas | Distributed convenience outlets, including provisions for cleaning/housekeeping. | GFI in toilet areas, per codes. |
| GRAND JURY | | |
| Witness Box | Duplex receptacle. | |
| Jury Seating | Convenience outlets, including provisions for cleaning equipment and motor loads. | |
| Court Reporter's Workstation | One quadruplex receptacle (general use), one isolated ground duplex receptacle for reporter's computer/CRT. | Provide additional duplex receptacle(s) at alternate court reporter position(s), if applicable. |
| Attorney Tables | One quadruplex receptacle (general use). Recessed floor box, if appropriate. Foreperson: one quadruplex receptacle (general use). | Recessed floor box, if appropriate. |
| Other areas | Distributed convenience outlets, including provisions for cleaning/housekeeping. | GFI in toilet areas, per codes. |
| General | Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate circuit for kitchen type service unit equipment (microwave, coffee maker). Outlets for film/slide projection equipment, TV monitor and VCR, audio tape recorder/player. Outlet for wall-mounted clock. Power for sound, video system, if any. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| JURY ASSEMBLY | | |
| Jury Assembly Room | Distributed convenience outlets. Provide isolated ground outlets as required for video conferencing equipment, video monitors/DVR equipment, security, sound-system, ALS, and other equipment, based on anticipated locations. Provide outlets for use at carrels and tables for jurors' for personal use. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Jury Clerk Workstation(s) | One quadruplex receptacle (general use). Duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Other Area(s) | Distributed convenience outlets, including provisions for cleaning equipment/motor loads. | |
| LAW LIBRARY | | |
| Circulation Desk | Isolated ground outlets for PC, other equipment. Distributed convenience outlets. | |
| Public Waiting Areas | Distributed convenience outlets, including provisions for cleaning/housekeeping. | |
| Entry Control | Isolated ground outlets for security equipment. Distributed convenience outlets, including provisions for cleaning/housekeeping. | Recessed floor box, if/as required. |
| Staff Offices | One quadruplex receptacle (general use). Duplex isolated ground outlet(s), two minimum (for PC, monitor, printer, FAX) per workstation. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |

| LOCATION | EQUIPMENT/OUTLET(S) | NOTES |
|---|---|---|
| Staff Work Areas | Distributed convenience outlets; quadruplex receptacle(s) for general purpose use. Additional outlet(s) for copier. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| CALR Areas | Duplex isolated ground outlet(s), two minimum (for PC, monitor, printer, FAX) per workstation. | Recessed floor box, if/as required. |
| Carrel/Casual Seating Areas | Distributed convenience outlets. Provide outlets for use at carrels and tables. | |
| Conference/Group Study/Work Rooms | Multiple outlets (as required) for sound, ALS, data, telecommunication and video recording and presentation equipment. Duplex outlet for microfiche machine. | |
| CLERK OF COURT AREAS | | |
| Public Counter and Workstations | One quadruplex receptacle (general use); duplex isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX, per workstation. Provide additional outlet(s) for cash registers, additional printers, shared-access PCs, printers | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Records Exam Areas | Provide duplex outlet(s) for public access PCs, monitor, printer, and FAX equipment. Provide outlet(s) on separate circuits for public access copier(s). | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Other Staff Workstations | One quadruplex receptacle (general use). Duplex Isolated ground outlet(s), two minimum, for PC, monitor, printer, FAX. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Shared Staff Work Areas | Distributed convenience outlets; quadruplex receptacle(s) for general purpose use. Additional outlet(s) for copier(s), FAX equipment, etc. | Computer and office equipment (PC, monitor, printer) not in FF&E budget. |
| Staff Break Rooms | Distributed convenience outlets, including provisions for cleaning/housekeeping. Outlets (GFI) on separate circuit for kitchen type service unit equipment (microwave, coffee maker). | Equipment not included in base building or FF&E budget. |
| COURT-RELATED AGENCIES/SPACES | | |
| | Similar to Court Clerk/Court Administrative areas above. | |
| NOTE: | | |
| | (1) For all electrical power and outlet requirements in USMS-dedicated spaces, refer to USMS Publication 64.<br>(2) The power outlet requirements for each project should be verified. | |

* This table is comprehensive, but may not be complete as needs and systems change over time and from court to court. These requirements are in addition to those in Chapter 6.

## 8.7.3 GROUNDING

Provide grounding as indicated in Chapter 6.

## 8.7.4 ISOLATED GROUND CIRCUITS

Most courthouse computers and data/telecommunication equipment will not be connected to the building backup emergency

generators or UPS system. To minimize this type of equipment operational and performance problem, it is necessary to mitigate the amount of electrical disturbance to which this type of equipment will be subjected. All courthouse desks and work areas should be provided with regular power receptacles as well as an isolated ground (IG) power receptacle. IG power systems are especially designed to minimize electrical disturbances, thus only computers and data/telecommunication should be connected. All other types of equipment including task lighting, heaters, radios, photocopiers, and vacuum cleaners should be connected to the regular power receptacles.

### 8.7.5 BELOW-FLOOR ELECTRICAL DISTRIBUTION

Most areas of the courthouse incorporate below-floor horizontal distribution systems. Final horizontal distribution plans must be designed considering potential EMI/RFI sources. (Access floor areas must comply with Chapter 6.)

### 8.7.6 EMERGENCY AND UPS POWER SYSTEMS

In addition to the emergency power systems required in Chapter 6, provide backup power to systems described in Chapter 15 of the Courts Design Guide.

### 8.7.7 SERVICE AND DISTRIBUTION

Emergency and normal electrical panels, conduits, and switchgear must be installed separately at different locations. Electrical distribution must also run at separate locations.

### 8.7.8 EXTERIOR CONNECTION

Conduit and feeders must be installed on the exterior of the building to allow use of a trailer-mounted generator to connect to the building's electrical system. This must be regarded as a tertiary source of power for systems in the building where operational continuity is critical. (An operational plan must be in place to provide this service quickly when needed.)

Emergency power must be derived from generators sized to carry the required loads. Generators must be synchronized to serve a common distribution board which, in turn, serves appropriate ATSs and the fire pump. Separate ATSs must be provided for the life safety/security system, UPS system, and essential systems. Essential systems will serve the ventilation and equipment loads required for personnel and building protection in the event of a commercial power failure or other catastrophic event.

### 8.7.9 COORDINATION WITH TELECOMMUNICATIONS SYSTEM DESIGN

Electrical IG power distribution for the various areas of U.S. Court facilities must be coordinated with the design of the telecommunications powering/grounding systems to improve the overall integrity of the telecommunications utility. See Chapter 15 of the USCDG.

As technology continues to increase in speed/performance, better distribution coordination becomes necessary. If this is not done, the grounding systems will not operate efficiently at the higher frequency ground currents, reducing the integrity of the telecommunications utility, creating errors in transmission, etc.

A secure, air-conditioned data/telecommunications closet must be located near the judges' chambers, courtrooms, and court offices to contain network equipment. The

use of cable trays rather than conduits must be considered.

### 8.7.10 LIGHTING SYSTEMS

Illumination levels, lighting types, and lighting controls in specific court functional areas are provided in the USCDG. See Chapter 15 of the USCDG. In all other spaces, illumination levels and lighting controls must be provided as specified in Chapter 6. Task lighting must be variable to 100 FC (1100 lx).

The use of indirect pendant-mounted fixtures provides good, soft diffuse general lighting in a courtroom, complemented with recessed concentrated light sources at the judge's bench, the witness box, and attorneys' tables. Lighting levels must consider the impact on courtroom finishes.

An override switch will be located at the judge's bench and at the courtroom deputy clerk station to allow an instantaneous override of all dimming controls in an emergency.

The following lighting controls can be specified depending on the size of the courtroom, lighting arrangements, and lamp types:

- A more complex lighting installation consisting of local, wall, box-type, electronic, silicon-controlled rectifier dimmers; or
- Remote electronic dimmers with preset lighting arrangements, for large courtrooms with high ceilings.
- Control of lighting is the responsibility of the courtroom deputy clerk or another designated court officer and must be operated with a key. Light switches must not be accessible from the spectator seating area or witness box. Provision of integrated electronic controls must be considered with preset lighting schemes having integrated controls for shading devices at windows and skylights, plus controls for presentation screens (if provided by the courts). The controls must allow varying levels of light to suit the needs and desires of the courtroom participants.

Electronic ballasts for fluorescent lamps must not be used in areas that contain sensitive security devices or special equipment that is sensitive to electronic interference, such as ALD infrared emitters.

Guidelines for site illumination are specified in Chapter 6. Lighting in parking areas must allow for identification of vehicle color, and the design should avoid the use of low-pressure sodium fixtures.

Emergency lighting for courtrooms and security areas, to include USMS detention facilities, must have built-in batteries plus emergency generator service.

### 8.7.11 AUDIOVISUAL REQUIREMENTS IN U.S. COURT FACILITIES

All audiovisual design and technical infrastructure requirements are indicated in the Administrative Office of the United States Courts publication, Courtroom Technology Manual. These requirements are provided and funded by the tenant.

## 8.8 SECURITY DESIGN: AGENCY RESPONSIBILITIES

Courthouse security is the joint responsibility of the judiciary, U.S. Department of Homeland Security, Federal Protective Service, and USMS. The USMS has the primary role in security decisions. Decisions regarding security planning and design are made by individual agencies and the local Court Security Committee (CSC), or for

multitenant buildings, the Facility Security Committee (FSC). See Chapter 16 of the USCDG.

The CSC is responsible for identifying a court's specific security requirements and developing a security plan for judicial facilities and operations throughout the district.

All security systems and equipment must be consistent with requirements in ISC Physical Security Criteria for Federal Facilities and the ISC Security Level Determination of Federal Facilities dated February 21, 2008; USCDG; and Requirements and Specifications for Special Purpose and Support Space Manual Volumes 1-3, USMS Publication 64. The CSC must be informed about and have the opportunity to review all security-related design decisions.

The USMS Central Courthouse Management Group's (CCMG) facilities management team is responsible for design considerations involving secure prisoner movement, holding cell and interview facility requirements, and USMS-occupied office and support space. The Judicial Security Systems Team within the CCMG is responsible for the planning, design, and installation of security systems in spaces occupied by the judiciary. The USMS coordinates the work of the security system and security construction contractors.

In addition, the CCMG often acts as security engineer for court buildings, designing and integrating security systems for building perimeters in conjunction with GSA and FPS.

Refer to the USCDG and USMS Publication 64 for a more detailed explanation of security design responsibilities.

Once the functional planning criteria including security-related issues, as outlined in the USCDG and USMS Publication 64, are implemented into the conceptual design for the new or renovated court facility, they are intended to help in the development of the technical drawings, specifications, and other information to incorporate the security components into the project.

### 8.8.1 BATTERY BACKUP

Areas that require battery backup to maintain camera and direct visual surveillance in the event of power failure include:

- Vehicular sallyports
- Prisoner sallyports and secured circulation
- Detention cell block areas
- Communications centers
- Prisoner processing areas
- Squad rooms
- Public reception rooms
- Prisoner-attorney interview rooms
- Court holding cell areas
- Judges' chambers
- Interconnecting doors from public corridors to controlled corridors
- Command and control centers
- Courtrooms
- Witness/Attorney rooms
- Restricted circulation

# A

# APPENDIX

Figure 18:
U.S. Land Port of Entry
San Ysidro, CA

# A.1 GENERAL REQUIREMENTS

These design submission requirements have been developed to ensure a rational, well-documented design process and to facilitate reviews by GSA staff, tenant agencies, and local regulatory agencies or review boards as the design develops. The submission requirements listed here apply to all projects where design services are performed by architects and engineers under contract to GSA.

These requirements are the minimum standards and the specific A/E scope of work will take precedence on each project.

In each phase of work, project documents must be submitted to GSA in electronic and hard copy format as determined by the GSA project manager.

## DRAWINGS

### DRAWING SIZE

All drawings of a single project must be a uniform standard size, as designated by the American National Standards Institute (ANSI) below. International Organization for Standardization (ISO) or architectural-sized sheets may also be approved for use.

Table A-1 Drawing Sizes

| | Size (in) | Size (mm) |
|---|---|---|
| ANSI A | 8.5 x 11 | 216 x 279 |
| ANSI B | 11 x 17 | 279 x 432 |
| ANSI C | 17 x 22 | 432 x 559 |
| ANSI D | 22 x 34 | 559 x 864 |
| ANSI E | 34 x 44 | 864 x 1118 |

### DRAWING LETTERING

Lettering on drawings must be legible when drawings are reduced to half size. This applies to concept and design development drawings as well as construction documents.

### DRAWING SCALE

All drawings are to be created at full scale and plotted at a selected scale. The drawings or views (such as details) must include numeric and graphic scales. The scale selected should be appropriate for high resolution and legibility to include reduced copies (such as half-sized).

There are nine preferred metric scales: 1:1 (full size), 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, and 1:1000. Other scales may be used as needed (such as 1:2 half full size). Floor plan drawings should be plotted at 1:100 (close to 1/8 inch scale).

### CAD STANDARDS

The PBS CAD Standards must be obtained from GSA's www.gsa.gov/cad website. These guidelines must be followed for all CAD deliverables. GSA regions and other programs, such as Spatial Data Management (SDM), may have further requirements. These further requirements are considered supplements to the PBS CAD Standards, for example, see base scale example above under Drawing Scale. Check for and obtain any supplements from the PBS CAD Manager or SDM Coordinator in the region where the project is located.

A north arrow must be included on all site drawings and plan view drawings.

### DIMENSIONING

Metric Design Guide (see GSA Metric Order, GSA Metric Program, for guidance)

### SEALS

Each sheet of the construction documents must bear the seal and signature of the responsible design professional (specification and calculations cover page only). In addition, each design professional must comply with any seal, stamp, and/or signature requirements in accordance with State law. Electronic plans may have digital signatures and seals.

### COVER SHEET

Provide code certification statement for compliance with specified codes and standards by each discipline with the professional seal and signature. The intent is to formally recognize the responsibility for compliance.

## DOCUMENT SECURITY REQUIREMENTS

All sensitive but unclassified (SBU) building information must be handled as described in GSA Order PBS 3490.2, Document Security for Sensitive But Unclassified Building Information.

Within any electronic or printed document, pages containing SBU building information must have the following mark imprinted or affixed:

SENSITIVE BUT UNCLASSIFIED (SBU)
PROPERTY OF THE UNITED STATES GOVERNMENT
FOR OFFICIAL USE ONLY

Do not remove this notice

Properly destroy or return documents when no longer needed

The following mark must be affixed to the cover or first page of any document (such as the cover page on a set of construction drawings) containing pages marked as required by the paragraph above:

SENSITIVE BUT UNCLASSIFIED (SBU)
PROPERTY OF THE UNITED STATES GOVERNMENT
COPYING, DISSEMINATION, OR DISTRIBUTION OF THIS DOCUMENT TO UNAUTHORIZED RECIPIENTS IS PROHIBITED

Do not remove this notice

Properly destroy or return documents when no longer needed

The previous two statements must be prominently labeled in bold type in a size appropriate for the document or portable electronic data storage device or both, if applicable. On a set of construction drawings, for example, the statements must be in a minimum of 14 point bold type or equivalent. The SBU markings must be used regardless of the medium through which the information appears or is conveyed.

The construction drawings, plans, and specifications are to be disseminated only to those requiring the information necessary for design, construction bidding, construction coordination, or other GSA procurement competition processes.

## BUILDING INFORMATION MODEL

As stated in Chapter 1, GSA requires the deliverable of interoperable Building Information Models (BIM) on all new construction and major modernization projects throughout the project lifecycle. BIM also applies to lease construction facilities where GSA's formal Request for Lease Proposal (RLP) has an option for GSA to purchase the building at a future date. The requirements of BIM will be included in the RLP on a case-by-case basis, in consultation with the Chief Architect. Exclusion of BIM from lease construction facilities where GSA's formal RLP has an option for GSA to purchase the building requires Chief Architect written approval. All other projects should be submitted in a deliverable determined by the Regional Office. Where existing BIM models exist, they must be incorporated and updated as determined by the Regional Office, in consultation with the respective Central Office business line. For questions or feedback, please contact your GSA Regional BIM Champion or visit GSA's BIM website, www.gsa.gov/bim.

### BIM STANDARDS

The GSA BIM Guide Series contains requirements and guidelines. The requirements shall be followed for all BIM submissions. The BIM shall be set up such that 2D CAD drawings should be derived from the model and meet PBS CAD Standards. For more information, visit GSA's BIM website (www.gsa.gov/bim).

### BIM EXECUTION PLAN

A BIM Execution Plan is required for each project to ensure that BIM objectives, processes, workflows, technologies, and performances are established and tracked in alignment with the project requirements. The BIM Execution Plan shall be established in coordination with GSA Project Managers, GSA Regional BIM Champions and Subject Matter Experts,

and GSA Central Office Subject Matter Experts. The BEP must comply with requirements set forth in GSA's BIM Guide 07—Building Elements. The BIM Execution Plan shall be agreed upon by all parties prior to the start of design.

## GEOGRAPHIC INFORMATION SYSTEM (GIS) STANDARDS

The GSA GIS Standards must be obtained from GSA's website at **www.gsa.gov/gis**. These guidelines must be followed for all GIS deliverables. GSA regions and other programs, such as Building Information Modeling (BIM), may have further requirements. These further requirements are considered supplements to the GSA GIS Standards. Check for and obtain any supplemental requirements from the regional GIS Analyst where the project is located.

## SPATIAL DATA MANAGEMENT

Project teams shall provide at each submission stage 2D CAD plans, one for each level of the facility, with assignment data and space boundaries in compliance with the National Business Space Assignment Policy and an IFC/BIM in compliance with BIM Guide 02.

- Provide space boundaries as MPOLYGON AutoCAD drawing elements on layer LNK-NON separately for every room and space such that all areas within the total level area are contained in one and only one boundary and the sum of the areas of the space boundaries is exactly equal to the total level area.
- Provide a comma delimited ASCII text file with double quote mark text identifiers and column headers containing the assignment data for every boundary in the facility
- Provide assignment data tags for each boundary as MTEXT AutoCAD drawing elements on layer Q_TXT_SPACE placed within the associated boundary with the following data as shown below:
    - Space ID
    - Agency Short Name: Agency Bureau Code
    - Room Name
    - Occupancy Agreement number
    - ANSI BOMA classification code: PBS space category code: PBS space type code
    - Area in sq. ft. (2 decimal places)

SDM deliverable requirements can be met by generating deliverables from a BIM that meets the GSA BIM Guide 02 – Spatial Program Validation standards. Project teams shall contact the Regional BIM Champion and SDM Coordinator for additional guidance to streamline BIM and SDM deliverables.

## SPECIFICATIONS

### FORMAT

Specifications should be produced according to the 2004 edition Construction Specification Institute (CSI) division format. Each page should be numbered. Specifications should be bound and include a table of contents. The specifications must include instructions to bidders and Division 1, edited to GSA requirements.

### EDITING OF SPECIFICATIONS

The A/E is responsible for the editing of all specification sections, including any Government-furnished guide sections, to reflect the project design intent, GSA policy requirements, and Federal law. Technical specifications must be carefully coordinated with drawings to ensure that everything shown on the drawings is specified. Specification language that is not applicable to the project must be deleted.

### DIMENSIONING IN SPECIFICATIONS

Metric Design Guide (see GSA Metric Order, GSA Metric Program, for guidance)

## TURNOVER DOCUMENTS

Electronic and hard copy documentation on all building systems should be provided for the guidance of the building engineering staff and long-term asset management. Documents should show the actual elements that have been installed, how they performed during testing, and how they operate as a system in the completed facility. Examples are as follows:

- Final P100 Performance Matrix
- Contractor "redline" as-built drawings and specifications (including building/site actual measurements, changes to details, actual panel schedules, etc.) as required by the construction contract.
  - Architect/engineer's final "record" drawings to include final changes to design and contractor noted as-built conditions.
  - Operating manuals with a schematic diagram, sequence of operation, and system operating criteria for each system installed. Custom-written operating manuals; minimum standard should be submission of Word documents.
  - Training materials and videos.
  - Equipment maintenance manuals with complete information for all major components.
- In addition, asset data and documentation, including special data and documentation as to engineering, calculations, record drawing information, and visual media, should be provided to document the configuration, engineering assumptions, actual material/sizes installed for future maintenance, repairs, and improvements. Prior to acceptance for design completion or substantial completion, all required submittals and deliverables must be verified by a Government representative as received and complete, such as:
- Drawings: design, redline, and record drawings
- Submittals, fabrication, and shop drawings, including:
  - Equipment schedules;
  - Equipment (or other) data sheets, product literature, minimum standard should be submission of PDFs, allows for regional supplementation;
  - Equipment inventories, testing, adjusting, and balancing (TAB) reports, and Commissioning functional performance test (FPT) results to be submitted as electronic data tables (Excel or Access files are acceptable), including fields specified in the specifications;
  - BAS point and device data must be submitted as electronic data tables, to include necessary unique identification information such as point numbers, device ID numbers, network numbers, etc., as well as English-language descriptions and location information;
  - All test records; and
  - Fire Sprinkler and Alarm Systems: Calculations (including energy, structural, lighting, fire alarm system voltage drops and battery requirements, fire sprinkler hydraulics, etc.).

All electronic media must be readable by GSA's current software versions and optimum file sizes of desktop media, such as Acrobat, Microsoft, AutoCAD DWG format, BIM native and IFC format, video media, electronic photo (e.g., ".jpg"), and Webcam archive data. Electronic data should be provided to the Government via the GSA electronic project management system (ePM) and on CD-ROM, unless otherwise specified. As-built BIM files shall be delivered in accordance with As-Built Documentation specifications in P100. BIM Guide 07—Building Elements, the project BIM Execution Plan, and Model Progression Matrix.

For all software installed in support of installed equipment, provide backup CDs with all files necessary to reinstall, all user and programming support manuals, and all files produced for the specific installation (e.g., graphics files, DDC program files).

Note that specification section 01781, Project Record Documents, should be edited to reflect Electronic Final Submittals and Data as noted above.

## BUILDING HANDOVER TO OPERATIONS AND MAINTENANCE

Contractor will hold a meeting with the building operations and maintenance group to train them on

operations, turnover documents, and contract close out documents including warranty information.

## DESIGN NARRATIVES AND CALCULATIONS

### FORMAT

Typed, bound narratives should be produced for each design discipline.

### CONTENT

Narratives serve to explain the design intent and to document decisions made during the design process. Like drawings and specifications, narratives are an important permanent record of the building design. Drawings and specifications are a record of what systems, materials, and components the building contains; narratives should record why they were chosen. The narrative of each submittal may be based on the previous submittal, but it must be revised and expanded at each stage to reflect the current state of the design.

### CALCULATIONS

Manual and/or computer based calculations should accompany narratives where required to support technical analysis. Each set of calculations should start with a summary sheet, which shows all assumptions, references applicable codes and standards, and lists the conclusions. Calculations should include engineering sketches as an aid to understanding by reviewers. The calculations for each submittal should be cumulative, so that the final submittal contains all calculations for the project. Calculations submitted at early stages of the project must be revised later to reflect the final design. Calculations must refer to code, paragraph of code used, standards, and text books used for specific portion of calculation. Refer to drawing number where the results of the calculations have been used. Example: number and sizes of re-bars used in reinforced concrete members.

### PERFORMANCE CRITERIA

As part of the development of concepts through construction documents there must be a check of building performance criteria as noted in Section A.2.

### INTEGRATED DESIGN REVIEW

Integrated Design Reviews provide an organized process and location for regional and national offices to input, track and align project goals, objectives, scopes of work, and designs. These reviews will take place at different milestones based on project types per the IDR website. After each review, the A/E is required to adequately address comments before being allowed to submit for the next phase of the project.

### ENERGY ANALYSIS

In addition to GSA's requirement of USGBC LEED Gold Certification for all new construction and major modernizations, there is increased importance of Federal energy and sustainability goals. An energy analysis must be submitted at the preconcept phase of design and updated throughout the development of the project to continually look for creative ways to reduce energy use. Many opportunities exist for the reduction, recycling, or production of new energy in site, architectural, and building systems design. An energy analysis as described in Section A.7 and in Section 5.3 (Energy Analysis Criteria) is required for each project.

### COST AND SCHEDULE MANAGEMENT REQUIREMENTS

All deliverables and supporting practices must be provided at various stages of the project's life cycle in compliance with the P120.

## A.2 PERFORMANCE MATRIX

At the beginning of each project, the GSA project manager and client must define the performance requirements of the project. The required

performance matrix, Figure A-1, allows for these decisions to be documented and included as project requirements.

Minimum requirements above baseline for land port of entries are indicated in the matrix. Any performance below the indicated minimum will require a P100 waiver.

For limited scope or system projects, the matrix includes a Not Applicable (N/A) for systems/items that are not being renovated.

The A/E or design/build team should review the matrix for their project and look for opportunities to increase performance where life cycle cost benefits can be demonstrated.

The Performance Matrix will be included with all concept review submissions so reviewers, peers, and others are clear on the required performance of the project. The final constructed performance aspects will be updated in the matrix and submitted with the turnover documents.

The 2018 P100 Performance Matrix is located at www.gsa.gov/p100.

Figure 19: 1800 F. St. Atrium, Washington, DC

Figure A1: Sample P100 Performance Matrix

| 2018 P100 Performance Matrix | | | | | |
|---|---|---|---|---|---|
| Attribute | Baseline | Tier 1 | Tier2 | Tier 3 | N/A |
| **1.7.2 Sustainable Performance Requirements** | | | | | |
| Energy | | | | | |
| Energy Net Zero | | | | | |
| Water | | | | | |
| Water Net Zero | | | | | |
| High Performance Building Technologies | | | | | |
| GSA Proving Ground | | | | | |
| Construction Personnel | | | | | |
| Green Credentialed | | | | | |
| **2.1 Urban Planning and Public Use Performance Requirements** | | | | | |
| 2.2.1 Sustainable Locations | | | | | |
| Site Supports Neighborhood Connectivity, Walkability, and Transportation Access | | | | | |
| Site Uses Existing Local Infrastructure Resources and Preserves Natural Resources | | | | | |
| 2.2.2 Collaborative Design Process | | | | | |
| Design Process Considers Input of Local Officials | | | | | |
| 2.2.3 Design for Public Use | | | | | |
| Interior | | | | | |
| Exterior | | | | | |

Sample

## A.3 NEW CONSTRUCTION AND MODERNIZATION

The design process and related submission requirements for new construction and modernizations are somewhat different than those for alteration projects. A modernization is defined as the comprehensive replacement or restoration of virtually all major systems, tenant-related interior work (such as ceilings, partitions, doors and floor finishes), and building elements and features. The following flow diagram, Figure A-3, and related definitions describe this process for New Construction and Modernization.

### PEER REVIEW

The peer review, arranged through the Office of Design and Construction, is required for all new construction projects and any modernization project with significant alterations to the building aesthetic or systems. Designs must be presented to the PBS Commissioner, chief architect, chief engineer, key GSA project team members, and Nationally Selected Peers for approval. See Design and Construction Excellence: Policy and Procedures for the peer process.

**Figure A-3: Design Process and Related Submission Requirements for New Construction and Modernization**

| STAGES | ACTIVITES | SUBMISSIONS |
|---|---|---|
| CONCEPTS | | |
| ● Review Space Directive<br><br>● Integrate Expectations into Major Systems and Features | PROGRAM REVIEW<br><br>DESIGN CHARRETTE<br><br>PRELIMINARY CONCEPTS (3 or more)<br><br>INTEGRATED DESIGN REVIEWS<br><br>VALUE MANAGEMENT Systems Level)<br><br>COMMISSIONER'S APPROVAL<br><br>FINAL CONCEPTS | ● Massing Models (New Construction only)<br><br>● Narrative to Include Proposed Building Systems<br><br>● Rendering/Photos<br><br>● Concept Drawings and BIM<br>Level: Narratives/Studies<br>Calculations<br>Cost Estimates<br><br>● Space Program Statement/Reconciliation |
| DESIGN DEVELOPMENT | | |
| ● System/Feature Analyses for Selection<br><br>● Final Selection of All Building Systems<br><br>● Inter System Coordination | PROGRAM REVIEW<br><br>VALUE MANAGEMENT<br><br>(Analysis Stage)<br><br>PRODUCTION STAGE<br><br>PROJECT DIRECTIVE MEETING | ● Architectural Background Drawings Complete<br><br>● Design Development Level: Drawings and BIM Narratives/Studies Calculations Cost Estimates<br><br>● Concurrence on Narrative for All Building Design Characteristics & Systems<br><br>● Space Program Reconciliation |
| CONSTRUCTION DOCUMENTS | | |

| | | |
|---|---|---|
| ● Presentation of Design in a Format Suitable to Parties Unfamiliar with the Site | PROGRAM REVIEW<br><br>75% COMPLETE<br><br>90% COMPLETE<br><br>100% COMPLETE<br><br>POST DESIGN SERVICES | ● Progress Drawings<br><br>● Draft Specifications<br><br>● Narrative Update<br><br>● Current Calculations<br><br>● Final: Drawings and BIM<br>Specifications<br>Narratives<br>Calculations<br>Cost Estimate<br><br>● Incorporation of Review Comments<br><br>● Space Program Reconciliation |

# DESIGN PROCESS DEFINITIONS

## GENERAL

These definitions are for new construction.

Some requirements will be eliminated for a modernization project, such as zoning area, form, massing, etc.

## PROGRAM REVIEW

Prior to initiating each phase of design, the design team (including the GSA, A/E, and customer agency) must meet to review design program expectations and to exchange ideas, lessons-learned, and concerns.

Such technical "partnering" sessions allow a clearer understanding of expectations, a well defined project scope, and help keep the project on budget and schedule.

## PRELIMINARY CONCEPTS

A submission that demonstrates compliance with the Building Program (space tabulation of building program) including all adjacency and functional requirements.

This submission also shows that the proposed project is within the zoning area, and that the building and massing are compatible with the surroundings. The aesthetics should support the design philosophy of GSA shown in the general approach to architecture in the preceding chapters of this document. Building systems and building envelope appropriate for the conceptual designs must be defined in order that they can be evaluated early for effectiveness and efficiency related to operation, maintenance, and energy consumption.

Since there are many options to accomplish these ends with any particular program and site, GSA will participate in the normal design process of comparing options by working with the A/E through Preliminary Concepts. In this phase, the design team should develop their strategy for achieving LEED Gold Certification as defined by the U.S. Green Building Council.

During Preliminary Concepts, three or more concepts must be presented; these Preliminary Concepts are intended to be working level and not presentation documents. They are to be developed only to the level that allows selection of a concept that will still be within program operation and budget goals. This selected concept is to be further refined and presented as the Final Concept by the A/E.

## VALUE MANAGEMENT (SYSTEMS LEVEL)

Value management (VM) is a process that is somewhat continuous throughout the project but its greatest emphasis should be in the early stages of the project (concepts and design development) per the PBS P-120.

GSA policy is to have an independent VM consultant facilitate a value management study with an independent team, including participation by the design A/E and the design A/E estimator throughout the study and implementation process. The A/E team must be part of this effort and incorporate the VM consultant's recommendations that were approved by the GSA into the design as part of the scope of work.

## FINAL CONCEPTS

The concept phase study is conducted to focus on the macro level elements of the design. These elements include, but are not limited to, siting, building massing, and environmental and community impacts and concerns. The conceptual phase study workshop is generally of two to four days duration.

For major projects, a presentation is made to the Commissioner of the Public Buildings Service for final approval.

## DESIGN DEVELOPMENT (DD)

This set of submissions reflects a more comprehensive project design developed from the selected final concept design. DD finalizes the selection of all systems with respect to type, size, and other material characteristics.

Systems are not only structural, mechanical, fire protection, and electrical, but include all other building components such as the building envelope (wall, window, and roof), interior construction (flooring, ceiling, and partitions), service spaces, elevators, and so on.

In this phase, the design team should submit a LEED worksheet or comprehensive plan for how the architectural and buildings systems will achieve a LEED Gold Certified building as determined by USGBC.

The design submissions consist of a combination of drawings, narratives, calculations, specifications, and cost management deliverables. Although final design development plans, sections, and elevations must be to scale, drawings made in the analysis stage to illustrate various options may be freehand.

These submissions are not preliminary construction documents. The approval at the project directive meeting may require that building layout or size changes be incorporated into the construction documents. No design discipline should start work on construction documents until the project directive has been approved.

## LIFE-CYCLE COST ANALYSIS

As specified herein and within programming requirements, life-cycle cost assessments must be made, leading to system/feature selections. Though customer agencies might only look at the first costs of a project, the design team must evaluate life-cycle costs, especially as they relate to sustainable technologies and the GSA energy goals for reducing cost of energy and water consumption over time. Life-cycle cost analysis must also accurately assess the costs of operation, maintenance, cleaning, repair, and replacement, in addition to utility costs. The benefit of life-cycle costs may far outweigh the first costs of a project.

## PRODUCTION STAGE

The production stage is the development of each system with supporting calculations and narrative. Plans, sections, elevations, and details showing systems must be included.

## VALUE MANAGEMENT (ANALYSIS STAGE)

Per the P-120, GSA requires that an independent VM consultant facilitate a value management study with an independent team, including participation by the design A/E and the design A/E estimator throughout the study and implementation process. The A/E team must be part of this effort and incorporate the VM consultant’s recommendations that were approved by GSA into the design as part of the scope of work.

The DD-phase VM study is conducted to focus on the subsystem and detail level elements of the design. These elements include but are not limited to the following:

- Material selections
- Specific building systems selection and design
- Proposed design details
- Overall layout options within overall building shell
- Phasing and scheduling plans
- Structural loads and elements
- Major constructability issues
- Site paving, grading, and utilities
- The DD phase study generally takes three to five days. The DD phase study is held after receipt of the draft DD phase submission of the documents. The final design development submission is prepared upon agreement of all implemented VE proposals.
- As the project is developed the focus will shift to detailed aspects of the earlier decisions during design development.
- Diagrams, narratives, and sketches with calculations to demonstrate the life-cycle cost effectiveness of the system must be prepared and received during this phase.
- This approach requires a diligent effort and commitment by all project team members early in the project to systems and materials that make sense economically and allow quality and durability.

### PROJECT DIRECTIVE

The report summarizes analysis and design to date at completion of the DD phase. A meeting among GSA, the client, and A/E staff, particularly those who will be working on the construction documents, is held to review the project directive for concurrence.

### CONSTRUCTION DOCUMENTS

This phase requires a detailed set of documents coordinated by all disciplines into one coherent document to become the basis for a construction contract. The construction documents should include all levels of detail drawings from site planning to construction details, as well as specifications, cost estimates, and calculations.

### AS-BUILT DOCUMENTS

The as-built BIM must meet the GSA BIM Guide 07—Building Elements standards and must be populated with, at a minimum, all equipment attributes required for regional or national computerized maintenance management system (CMMS) use. The content, format, and classification system of the attributes shall be provided by GSA and incorporated into the BIM execution plan at the beginning of the project. Mechanical, electrical, plumbing and vertical transportation equipment, roofs, window systems and all other building equipment with moving parts must be incorporated in the BIM with links to electronic copies of product documentation and shop drawings. All data must be organized in compliance with COBie and GSA BIM Guide 08—Facility Management.

### DESIGN AWARDS

Every two years GSA recognizes outstanding projects through its biennial Design Awards program. Designers are required to submit each new construction project for consideration.

## SITE ANALYSIS AND PRELIMINARY CONCEPTS

### REQUIREMENTS

The preliminary concepts submittal consists of three or more distinctly different architectural design schemes presented in sketch format (single line, drawn freehand to scale), along with massing models, site slides and photographs, and sufficient narrative to allow comparison and selection of a design direction for preparation of a final design concept.

### SITE SURVEY

If a survey is part of the scope of work for the project, see Appendix A for requirements.

The information requested in subparagraphs 1 and 2 may be in progress and not yet complete. Present site sketches as appropriate.

## DRAWINGS

1. Site location plan (at least 2 kilometers [1.25 miles] around site), showing:

a. Site relative to location of city center, major landmarks, major parking facilities, major roads, and airport

b. Location of subway stations and other mass transit links

c. Location of distinct land use types and districts in the vicinity of the site (e.g., historic districts, retail nodes, civic districts)

2. Existing site plan (at least one block around site), describing:

a. Site boundaries, approximate topography, existing buildings, setbacks, and easements

b. Climatic conditions including path of sun

c. Description of flood plain issues related to building location and mechanical and electric equipment

d. Location of on-site and off-site utilities

e. Natural landscape

f. Pedestrian and vehicular circulation (include direction of traffic on adjoining streets)

g. Neighboring land uses, existing and planned

3. Site plans for each design scheme, showing:

a. Building location and massing

b. Building expansion potential

c. Parking and service area

d. Description of local plans for surrounding area, relation of each concept to those plans, and summary of relevant recommendations from local officials

4. Floor plans, showing at a minimum:

a. Entrances, lobbies, corridors, stairways, elevators, work areas, special spaces, mechanical rooms for major equipment and air handlers, and service spaces (with the principal spaces labeled). Dimensions for critical clearances, such as vehicle access, should be indicated.

5. Building sections (as necessary), showing:

a. Floor-to-floor heights and other critical dimensions

b. Labeling of most important spaces

c. Labeling of floor and roof elevations

6. Photographs

a. Minimum of six 8 x 10 photographs showing the site and elevations of existing buildings (or landscape, as applicable) surrounding the site

7. Models

a. Massing models of each architectural design scheme on a common base. (No fenestration should be provided at this stage of design development.)

8. Narrative

a. Site statement, describing:

i. Existing site features

ii. Climatic conditions

iii. Topography and drainage patterns

iv. Any existing erosion conditions

v. Wetlands and locations of flood plains

vi. Surrounding buildings (style, scale)

vii. Circulation patterns around site

b. Site access

i. Noise/visual considerations

ii. Local zoning restrictions

iii. Federal Aviation Administration requirements

iv. Hazardous waste

v. Pollution

c. Historic preservation considerations, if applicable

i. Site photographs, showing contiguous areas and affected preservation zones

ii. Existing major site utilities

iii. Potential archeological artifacts

d. Description of each architectural design scheme, explaining:

i. Organizational concept

ii. Expansion potential

iii. Building efficiency

iv. Energy considerations

v. Advantages and disadvantages

e. Sustainable design considerations

i. Potential for incorporation of renewable energy systems in the design

ii. Potential use of geothermal systems

f. Mechanical system and strategy to comply with P100, Chapter 5 and with the assigned energy goal.

g. Description of structural design scheme considerations for each design scheme explaining:

i. design loads

ii foundation system

iii. building framing system

iv. lateral load resisting system

v. advantages and disadvantages

h. Fire protection design considerations

i. Security features

j. Code statement. Provide a brief statement from each design team discipline member regarding the code requirements that relate to the site and occupancy use. For example, items such as, but not limited to classification of construction and occupancy group(s), fire resistance requirements and general egress requirements, etc., would be prepared by the design team fire protection engineer.

k. Preliminary concept phase cost estimates

i. Cost management deliverables will be in accordance with the requirements of the PBS P-120

ii. Provide separate estimate for phased work, or bid alternates/options

iii. Verify that each design scheme presented can be constructed within the project budget

l. Preliminary energy analysis for compliance with the assigned energy goals for each architectural concept in accordance with Section A.7

m. Art in Architecture statement. Provide statement of the lead designer's architectural design philosophy as exemplified by past building projects, including those that featured collaborations with artists, and discuss way he or she can envision working with artists on the GSA project. Provide a summary of meetings with the Art in Architecture Panel.

n. A description of any deviation from the PBS P100.

## BUILDING INFORMATION MODEL

A BIM for each preliminary concept is required to a minimum Level 100 detail (in accordance with AIA E202 Standards and GSA's BIM Guide 07—Building Elements). The BIM shall be the source for 2D drawings as well as SDM and COBie data. The BIM Execution Plan shall also be reviewed and, if required, revised and resubmitted.

# FINAL CONCEPT

## SITE PLANNING AND LANDSCAPE DESIGN

The following information must be complete for the final concept submittal of all buildings. (If materials produced for the preliminary concepts submittal do not require modification, such materials are acceptable for this submission.)

## SITE PLAN

At least one block around site, describing:

1 Site boundaries, approximate topography, existing buildings, setbacks, and easements

2 Building orientation with respect to path of sun

3 Building massing and relationship to massing of surrounding buildings

4 Future building expansion potential

5 Location of on-site and off-site utilities

6 Grading and drainage

7 General landscape design, showing location of major features

8 Pedestrian and vehicular circulation (include direction of traffic on adjoining streets)

9 Parking and service areas

10 Fire protection, water supplies, fire hydrants, and fire apparatus access roads

Narrative

1 Description of site and landscape design final concept

2 Demolition, if required

3 Circulation

4 Parking

5 Paving

6 Landscape design

7 Irrigation, if any

8 Utility distribution and collection systems

9 Method for storm water detention or retention

10 Landscape maintenance concept

11 Fire protection, water supplies, fire hydrants, and fire apparatus access roads

12 Accessibility path for the physically disabled

13 Summary of consultation with local officials regarding site and architectural design and the design's response to relevant recommendations

## ARCHITECTURAL

1. Drawings

a. Demolition plans, if required

b. Floor plans, showing at a minimum:

i. Work areas, lobbies, corridors, entrances, stairways, elevators, special spaces, and service spaces (with the principal spaces labeled). Dimensions for critical clearances, such as vehicle access, should be indicated.

ii. Office areas must show proposed layouts down to the office level of detail verifying the integration between the approved program and the building concept is achievable.

c. Proposed interior layouts showing:

i. Open office plan

ii. Enclosed office plan

iii. Indicate how major mechanical and electrical equipment can be removed/replaced

d. Elevations of major building facades, showing:

i. Fenestration

ii. Exterior materials

iii. Cast shadows

e. Elevations of major interior spaces, showing:

i. Lobby/atrium

ii. Typical public elevator lobby

iii. Typical courtroom elevations

f. Building sections (as necessary), showing:

i. Adequate space for structural, mechanical and electrical, telecommunications, and fire protection systems

ii. Mechanical penthouses

iii. Floor-to-floor and other critical dimensions

iv. Labeling of most important spaces

v. Labeling of floor and roof elevations

**2. Color rendering** [Minimum size must be 600 mm by 900 mm (24 in. by 36 in.).]

3. Photographs

a. Four 200 mm by 250 mm (8 in. by 10 in.) color photographs, mounted, identified, and framed of the rendering or model image (showing at least two vantage points). In addition, provide for all building elevations (at least one vantage point per each elevation).

b. Two of the photographs are to be sent to the GSA project manager.

c. Provide two additional 600 mm by 900 mm (24 in. by 36 in.) photographs of the rendering for the GSA project manager. (For courthouse projects only.)

4. Model

a. Provide a model of the final concept with sufficient detail to convey the architectural intent of the design.

5. Calculations

a. Acoustical calculations, including noise transmission through:

i. Envelope

ii. Interior walls, floors (including raised floors), and ceilings

iii. Mechanical and electrical equipment

b. Heat transfer through and dew point locations in building envelope

c. Toilet fixture count analysis

d. Illumination, daylighting, and glare analysis

e. Passenger and freight elevator analysis

f. Loading dock analysis

g. Energy analysis in accordance with Section A.7.

6. Narrative

a. Architectural program requirements

i. Show in tabular form how the final concept meets the program requirements for each critical function.

ii. A revised description of any deviation from P100.

iii. Description of final concept, explaining:

(1) Expansion potential

(2) Building floor efficiency

b. Location and sizes of mechanical equipment rooms for accessibility, maintenance, and replacement of equipment (including cooling towers and emergency generators)

c. Conveying systems design (passenger and freight elevators, escalators)

d. Loading docks

e. Thermal, air leakage, and operational performance and maintainability of the building envelope

f. Design strategy to attain the assigned energy goal

g. Treatment of historic zones, if applicable

h. Operations and maintenance goals (exterior and interior window washing, relamping, etc.)

i. Sustainable design concepts (LEED strategy)

j. Vertical transportation analysis (passenger and freight elevators and escalators)

k. Code analysis

i. The Code criteria must be reviewed by each design team discipline member to the degree of detail necessary to assure that tasks accomplished in this phase meet all the Code requirements.

ii. A Code/Criteria analysis must be prepared by each design team discipline member that documents an investigation of the applicable codes and agency criteria that will govern the design of a specific project. This analysis should alert the Government to any conflicts in the project's design criteria so that they can be resolved early. The analysis should also provide a common perspective for the design and review of the project. This analysis is probably most critical in building modernization and repair/alteration projects.

## HISTORIC PRESERVATION

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

1. Narrative

a. General: Project purpose, scope, groups, and individuals involved

b. Existing conditions, describing:

i. Overall building size, configuration, character

ii. Project location

iii. Existing original materials and design, relevant alterations

c. Preservation design issues and prospective solutions, including:

i. Location of new work/installation: visibility, impact on historic finishes

ii. Compare options for preserving/restoring historic materials and design

iii. Identify further study required to avoid adverse effects as applicable

2. Photographs

a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each view

b. Captions identifying location, subject, condition shown

3. Drawings

a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket

b. Site and floor plans, as applicable

c. Sketches or schematic CAD drawings (elevations, plans) showing preservation design concepts

## STRUCTURAL

1. Drawings

a. Framing and foundation plans of the proposed structural system showing column locations, bay sizes, and location of expansion and seismic joints

2. Narrative

a. Identification of unusual local code requirements

b. Code compliance statement

c. Name of model building code followed

d. Building classification

e. Identification of region of seismicity, wind speed, etc.

f. Identification of special requirements, such as high-rise

g. For new buildings:

i. Statement certifying that the structural engineer has reviewed the building configuration for blast, seismic, progressive collapse, and hurricane adequacy, and the criteria in PBS P100 have been met. The structural engineer and the architect must sign this statement.

## MECHANICAL

For the system approved and selected from the three concepts, provide the following:

1. Drawings

a. Demolition plans, if required

b. HVAC Systems

i. Floor plan(s):

(1) Identification of equipment spaces for mechanical equipment

(2) Location of mechanical equipment, including size, weight, access to loading docks and freight elevators, and clearance requirements for operation, maintenance, and replacement

ii. Flow diagram(s):

(1) Air flow riser diagrams representing supply, return, outside air, and exhaust systems

(2) Water flow riser diagrams of the main mechanical systems in the mechanical room(s) and throughout the building

c. Plumbing Systems

i. Floor plan(s):

(1) Proposed building zoning and major piping runs

(2) Locations of proposed plumbing fixtures and equipment

ii. Systems schematics and flow diagrams

2. Narrative

a. HVAC

A written narrative describing the selected mechanical systems and equipment, including:

i. Indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions

ii. Ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions

iii. Equipment capacities, weights, sizes, and power requirements

iv. Description of heating, cooling, ventilating, and dehumidification systems for each major functional space

v. Description of heating, cooling, ventilating, and dehumidification control strategies for each air handling system under occupied, 24-hour, and unoccupied conditions

vi. Fuel and utility requirements

vii. A code compliance statement

b. Plumbing

i. Description of proposed plumbing systems, including domestic cold and hot water, sanitary and storm drainage, and irrigation

ii. Evaluation of alternate sources for preheating of domestic water (solar or heat recovery)

c. Calculations and energy and water analyses

i. Building heating and cooling load calculations

ii. Psychrometric calculations for HVAC systems at full load and partial loads. (Partial loads at 50% and 25%, and unoccupied periods)

iii. Energy consumption calculations and analysis in accordance with Section A.7

iv. Water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation

v. Fuel consumption estimates

3. Specifications

a. Table of contents identifying specifications to be used on the project

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Drawings

a. Plans showing

i. Equipment spaces for fire protection systems (e.g., fire pump, fire command center)

ii. Fire protection water supplies, fire hydrant locations, fire apparatus access roads, and fire lanes

2. Narrative

a. Description of the building's proposed fire protection systems, including the egress system

b. Code compliance analysis

i. The design team fire protection engineer must prepare an analysis of the applicable codes and agency criteria that will govern the design of the specific project. For example, items such as, but not limited to classification of construction and occupancy group(s), rating of structural components, fire resistance requirements, interior finish, occupant load calculations, exit calculations, identification of areas to receive automatic sprinkler systems and/or automatic detection systems, and smoke control systems would be prepared by the design team fire protection engineer as necessary to provide a complete fire protection and life safety analysis for the final concept.

## ELECTRICAL

1. Drawings

a. Plans showing equipment spaces for all electrical equipment to include: panels; switchboards; transformers; uninterruptible power supply (UPS); and generators

2. Narrative

a. Description of at least two potential electrical systems

b. Describe the proposed lighting and lighting control system

c. Proposed special features of electrical system

d. Code compliance statement

## CERTIFICATION REQUIREMENTS

The architect/engineer (lead designer) must certify that the concept design complies with the program requirements, PBS P100, GSA's energy goals, Federal energy goals, and local regulatory agencies and review boards.

In bullet form, identify how proposed design features will support performance expectations of the project. Expectations are identified in the project's design program and within the Functional Objectives Matrix, Figure A-1.

Final concept energy analysis, in accordance with Section A.7.

## LIFE-CYCLE COST ANALYSIS

A life-cycle cost analysis of three options for the various building systems under design and evaluation

that have been modeled should be included with this submittal per the requirements of the PBS P-120.

## FINAL CONCEPT COST ESTIMATE

Cost management deliverables shall be in accordance with the requirements defined in the PBS P-120.

The final concept estimate submission must include the following:

- Executive summary
- Basis of estimate, rationale, assumptions, and market analysis as required in P120
- GSA Report 3474, GSA Report 3473
- Summary reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- Detail line item cost reports
- Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.
- Provide separate estimates for phased work, or bid alternates/options.
- To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
- Verify that the final concept can be constructed within the project budget.
- A life-cycle cost analysis of three options for the various building systems under design and evaluation that have been modeled should be included with this submittal.

## BUILDING INFORMATION MODEL

A BIM for each final concept is required to a minimum Level 200 development (in accordance with AIA E202 Standards and GSA's BIM Guide 07—Building Elements). The BIM shall be the source for 2D as well as SDM and COBie data. The BIM Execution Plan shall also be reviewed and, if required, revised and resubmitted.

# DESIGN DEVELOPMENT

## SITE PLANNING AND LANDSCAPE DESIGN

1. Calculations

a. Site storm drainage combined with building storm drainage and sanitary sewer calculations

b. Storm water detention calculations, if applicable

c. Parking calculations, if applicable

d. Dewatering calculations

i. Calculations modeling dewatering rates during dry and wet season excavation. Calculations must take into account effect of dewatering on adjacent structures and improvements.

ii. Calculations must assume a specific shoring system as part of a comprehensive excavation system.

2. Narrative

a. Site circulation concept, explaining:

i. Reasons for site circulation design and number of site entrances

ii. Reasons and/or calculations for number of parking spaces provided

iii. Reasoning for design of service area(s), including description of number and sizes of trucks that can be accommodated

iv. Proposed scheme for waste removal

v. Proposed scheme for fire apparatus access and fire lanes

b. Site utilities distribution concept

i. Brief description of fire protection water supplies

ii. Brief description of fire hydrant locations

iii. Drainage design concept

c. Landscape design concept, explaining:

i. Reasoning for landscape design, paving, site furnishings, and any water features

ii. Reasoning for choice of plant materials

iii. Proposed landscape maintenance plan and water conservation plan

iv. Brief operating description of irrigation system

d. Site construction description

i. Brief description of materials proposed for pavements and utilities

e. Code analysis

i. The code criteria must be reviewed by each design team discipline member to the degree of detail necessary to ensure that tasks accomplished in this phase meet all the code requirements.

ii. Identify local zoning and all building code requirements and provide a complete analysis as they pertain to the project.

3. Drawings

a. Demolition drawings, if required

b. Site layout plan, showing:

i. All buildings, roads, walks, parking, and other paved areas (including type of pavement)

ii. Accessible route from parking areas and from public street to main facility entrance

iii. Fire apparatus and fire lanes

c. Grading and drainage plan, showing:

i. Site grading and storm drainage inlets, including storm water detention features

d. Site utilities plan, showing:

i. Sizes and locations of domestic and fire protection water supply lines, sanitary sewer lines, steam/condensate lines, and chilled water supply and return lines, if applicable

e. Landscape design plan, showing:

i. General areas of planting, paving, site furniture, water features, etc.

ii. Irrigation plan, if applicable

## ARCHITECTURAL

1. Calculations

a. Acoustical calculations, including noise transmission through:

i. Envelope

ii. Interior walls, floors (including raised floors), and ceilings

iii. Mechanical and electrical equipment

b. Heat transfer through dew point locations in building envelope

c. Toilet fixture count

d. Illumination, daylighting, and glare

e. Passenger and freight elevator analysis

f. Loading dock analysis

g. Energy analysis in accordance with Section A.7

2. Narrative

a. Building concept, explaining:

i. Reasons for building massing, entrance locations, and service locations

ii. Building circulation and arrangement of major spaces

iii. Interior design

iv. Adherence to the building preservation plan, if applicable

v. Energy conservation design elements

vi. Water conservation considerations

vii. Explain how all these design considerations are combined to provide a well integrated cohesive design concept

viii. Analysis of refuse removal, recycled materials storage and removal, and maintenance requirements

b. Building construction description, explaining:

i. Structural bay size

ii. Exterior materials, waterproofing, air barriers/vapor retarders, and insulation elements

iii. Roofing system(s)

iv. Exterior glazing system

v. Interior finishes, with detailed explanation for public spaces

c. Potential locations for artwork commissioned under the Art in Architecture program, as a result of collaboration between the artist, architect, and Art in Architecture Panel.

d. Use of recycled materials

e. Sustainable design concepts and LEED strategy

f. Review of project for code compliance

i. Code criteria should be reviewed by each discipline to the degree of detail necessary to assure that tasks accomplished in this phase meet the code requirements.

ii. For major alterations, provide a determination whether an accessible floor is needed.

g. Building maintenance, explaining:

i. How unique and tall architectural spaces such as atriums or grand staircases will be cleaned, have their light fixtures maintained, have interior and exterior glass surfaces cleaned and typical maintenance performed.

ii. How courtrooms, dining facilities, and other assembly spaces with fixed seating, multilevel spaces, or with sloped floors will have their ceilings, lights, and other ceiling elements maintained and repaired.

iii. Proposed scheme for window washing equipment

iv. Consideration and prevention of bird nesting on exterior surfaces

v. How major mechanical and electrical equipment can be serviced and/or replaced in future years giving the necessary dimension clearances

h. Describe the project-specific security design

i. Report verifying the current design's compliance with the approved space program. Any deviations must be clearly reported.

j. Curtain Wall Report

i. In projects with complex curtain wall systems, describe size and locations of major movement joints to accommodate structural drift due to seismic and/or wind loading. Describe proposed curtain wall attachment methods to accommodate these lateral movements.

ii. Describe water migration

iii. Describe exterior fire safety systems, if applicable

iv. Describe typical interfaces between exterior wall system and interior finishes

v. Describe interfaces between major enclosure assemblies such as glass curtain wall to precast or stone panels

vi. Identification of at least three suppliers that can provide proposed exterior wall system

vii. Address any requirement for blast resistance in the context of "Windgard" simulations and/or blast testing results, as provided by the Office of Design and Construction

k. Design development energy analysis, in accordance with Section A.7

l. Building keying: Report must fully define the keying hierarchy for the entire building incorporating various levels of access, security, and fire egress. A/E should coordinate with GSA fire safety engineer for keying.

m. Signage Report: Signage system and room numbering system must be integrated with keying system.

n. Provide two finish boards for both public and tenant interior areas and two finish boards of exterior finishes composed of actual material samples and color coded plans, sections, and elevations of major space showing their use.

3. Drawings

a. Demolition drawings, if required

b. Building floor plans, showing:

i. Spaces individually delineated and labeled

ii. Enlarged layouts of special spaces

iii. Dimensions

iv. Planning module

c. Building reflected ceiling plans, showing:

i. Enlarged layouts of special spaces

ii. Spaces individually delineated

iii. Materials labeled

iv. Ceiling heights labeled

v. Lighting fixture types indicated and scheduled

d. Building roof plan, showing:

i. Drainage design, including minimum roof slope

ii. Dimensions

iii. Membrane and insulation configuration of the roofing system

iv. Mechanical equipment rooms and their relationship to freight elevators

e. Elevations, showing:

i. Entrances, window arrangements, doors

ii. Exterior materials with major vertical and horizontal joints

iii. Roof levels

iv. Raised flooring and suspended ceiling space

v. Dimensions

f. Interior elevations, showing:

i. Lobby, atrium

ii. Public corridors

iii. Jury assembly room

iv. Grand jury

v. Restrooms

vi. Chambers

vii. Typical public elevator lobby

viii. Typical courtroom elevations

ix. Typical tenant corridors

x. Typical conference rooms

g. One longitudinal and one transverse section, showing:

i. Floor-to-floor dimensions

ii. Stairs and elevators

iii. Typical ceiling heights

iv. General roof construction

h. Exterior wall sections, showing:

i. Materials of exterior wall construction, including flashing, connections, method of anchoring, insulation, vapor retarders, and glazing treatments

ii. Vertical arrangement of interior space, including accommodation of mechanical and electrical services in the floor and ceiling zones

i. Proposed room finish schedule, showing:

i. Floors, bases, walls, and ceilings

ii. Finish schedule may be bound into narrative

iii. Perspective sketches, renderings and/or presentation model, if included in the project scope

j. Proposed site furniture, showing:

i. Site furniture cut sheets or photos

ii. Proposed locations

k. Diagrams illustrating the ability to access, service, and replace mechanical/electrical equipment showing the pathway with necessary clearance

l. Location of accessible pathways and services for the physically disabled

m. Placement of Art in Architecture elements

n. Design of typical building signage, including wayfinding and room identification, building directory, exterior building signage, and major interior building identification

4. Photographs

a. Two sets of 200 mm by 250 mm (8 in. by 10 in.) photographs for:

i. rendering or model image (if changed from concept submission)

ii. elevation views for all exposures (if changed from concept submission)

## HISTORIC PRESERVATION

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

1. Narrative

a. Cover page: Building name, address, project title, project control number, author (preservation architect), preservation architect's signature, date of submission

b. General: Project purpose, scope, groups and individuals involved, substantive changes to approach described in concept submission

c. Existing conditions, describing:

i. Overall building size, configuration, character

ii. Project location

iii. Existing original materials and design, alterations

iv. New findings from testing or analysis in concept phase

d. Preservation solutions explored, how resolved and why, including:

i. Location of new work: visual impact, protection of ornamental finishes

ii. Design of new work/installation: visual and physical compatibility with existing original materials and design; materials/finishes chosen

iii. Methods of supporting new work/installation

iv. Preservation and protection of historic materials during construction through tenant move-in

e. Effects, describing:

i. How project will affect the building's architecturally significant qualities

ii. Measures proposed to mitigate any adverse effects on historic materials or design

f. Photographs

i. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each photo view

ii. Captions identifying location, subject, condition shown

2. Drawings

Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:

a. Site and floor plans, as applicable

b. Elevations, plans, and section details showing preservation design solutions for each issue identified, as approved by regional preservation officer

## STRUCTURAL

Design report containing structural design criteria and the following information:

1. Calculations For any computer-generated results, submit a program user's manual, a model of the input data, and all pertinent program material required to understand the output. A narrative of the input and results for computer-generated calculations for the recommended structural concept should be contained in the calculations as well.

a. Gravity load and lateral load calculations, with tabulated results showing framing schedules

b. Foundation calculations

c. Calculations showing that the system is not vulnerable to progressive collapse

d. Vibration calculations

e. Blast calculations

2. Narrative

a. Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in this phase meet the code requirements.

b. Comparative cost analysis of at least three potential framing systems

i. The analysis should compare first costs based on the design of a typical cross-section of the building, one interior column bay in width, including a comparison of lateral load-resisting elements. Nonstructural building systems that have a bearing on the overall cost of the systems must be included. For example, in a comparison between steel and concrete systems, the cost of fireproofing the steel structure must be considered, if fireproofing is required by code.

ii. The analysis should include a brief narrative listing factors that may have a bearing on the final selection, such as the availability of local labor skilled in the erection systems, speed of construction, and other concerns.

c. Description of recommended structural concept, including:

i. Choice of framing system, including lateral load-resisting elements, and proposed foundation design

ii. Verification of adequacy of all assumed dead and live loads

d. Identify all code requirements and provide a complete analysis as it pertains to this project including but not limited to:

i. Required fire-resistance rating of structural elements

ii. Summary of special requirements resulting from applicable local codes

e. Proposed methods of corrosion protection, if applicable

f. Geotechnical engineering report, including boring logs (if part of scope of work)

i. See Section A.5 for specific requirements

g. Geologic hazard report. See Section A.5 for specific requirements

h. Blast consultant's report and analysis (if part of scope of work)

i. Progressive collapse, seismic, and wind analysis if applicable

3. Drawings

a. Framing plans and key details

4. Specifications

a. Provide an index of specification section to be used on the project

## MECHANICAL

1. Calculations and Energy and Water Analyses

a. Updated building heating and cooling load calculations

b. Updated psychrometric calculations for HVAC systems at full and partial loads (partial loads at 50% and 25%, and unoccupied periods)

c. Updated energy consumption calculations and analysis in accordance with Section A.7

d. Updated water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation

e. Updated fuel consumption estimates

2. Drawings: HVAC

a. Demolition drawings, if required

b. Floor plan(s):

i. Single line piping and ductwork schematic layout

ii. Show terminal air units

iii. Perimeter terminal units

c. Quarter-inch scale drawings of mechanical equipment room(s) showing all mechanical equipment, ductwork, and piping, including equipment access and service requirements in plan, elevations, and cross-sections

d. Roof plan showing all roof-mounted equipment and access to roof

e. Show adequate access from mechanical equipment room(s) to freight elevators

f. Single line schematic flow and riser diagram(s):

i. Airflow quantities and balancing devices for all heating/cooling equipment

ii. Water flow quantities and balancing devices for all heating/cooling equipment

iii. Flow/energy measuring devices for water and air systems for all cooling, heating, and terminal equipment

g. Automatic control diagram(s):

i. Control flow diagrams showing all sensors, valves, and controllers (analog and digital)

ii. Sequence of operations of all the systems that describes the control sequences during occupied, 24-hour operations, and unoccupied conditions

h. Schedules:

i. Provide schedules of major equipment that includes chillers, boilers, pumps, air handling units, and terminal units, cooling towers, and all equipment required for 24-hour operations

i. Air terminal devices

j. Air balance relationships between spaces

3. Drawings: Plumbing

a. Demolition drawings, if required

b. Floor plan(s):

i. Proposed building zoning and major piping runs

ii. Locations of proposed plumbing fixtures and equipment

c. Systems schematics and flow diagrams

4. Narrative: HVAC

A written narrative describing the final mechanical system and equipment selection including:

a. Updated indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions

b. Provide a dew point analysis

c. Updated ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions

d. Updated equipment capacities, weights, sizes, and power requirements

e. A complete description of the air side and water side systems and the associated components including operating characteristics, ranges, and capacities, spaces served, and special features

f. Descriptions of control strategy and sequence of operations for all spaces under occupied, 24-hour, and unoccupied conditions

g. Updated fuel and utility requirements

h. A P100 compliance statement

i. A description of any deviation from the HVAC system as approved in the Final Concept submittal, in accordance with P100

5. Narrative: Plumbing

a. Updated description of plumbing system, including domestic cold and hot water, sanitary and storm drainage, and irrigation systems

b. Updated evaluation of alternate sources for reheating of domestic water (solar or heat recovery)

6. Specifications

a. Draft of each specification section to be used on the project

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Calculation

a. Occupant load and egress calculations

b. Fire protection water supply calculations

i. Includes water supply flow testing data

c. Fire pump calculations where applicable

d. Smoke control calculations where applicable (e.g., atrium)

e. Stairway pressurization calculations where applicable

f. Calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

2. Drawings

a. Floor plans showing:

i. Equipment spaces for fire protection systems (e.g., fire pump, fire command center)

ii. Fire protection water supply lines, fire hydrant locations, fire apparatus access roads, and fire lanes

iii. Standpipes and sprinkler risers

iv. Remoteness of exit stairways

v. Location of firewalls and smoke partitions

vi. Identification of occupancy type of every space and room in building

vii. Calculated occupant loads for every space and room in the building

viii. Location of special fire protection requirements (e.g., kitchens, computer rooms, storage)

b. Riser diagrams for sprinkler system

c. Riser diagram for fire alarm system

3. Narrative

a. Building egress description

i. Includes egress calculations and stairway exit capacities, remoteness, exit discharge, etc.

b. All building fire alarm and suppression systems

c. Smoke control system(s), where applicable

d. Special fire protection systems (e.g., kitchen extinguishing system), where applicable

e. Fire resistance rating of building structural elements

i. Coordinate with structural engineer

f. Fire alarm system

i. Interface of fire alarm system with BAS and security systems

ii. Review of building for compliance with life safety requirements and building security requirements

g. Interior finish requirements as they pertain to the life safety requirements

h. Mass notification system

## ELECTRICAL

1. Calculations

a. Lighting calculations for a typical 186 m2 (2,000 sq. ft.) open office plan with system furniture

b. Lighting calculations for a typical one-person private office

c. Power calculations from building entry to branch circuit panel

d. Load calculations

e. Life-cycle cost analysis of luminaire/lamp system and associated controls

f. Power density analysis for lighting of each area

2. Narrative

a. Description of alternative power distribution schemes

i. Compare the advantages and disadvantages of each approach. Include the source of power, potential for on-site generation, most economical voltage, and primary vs. secondary metering.

b. Proposed power distribution scheme

i. Provide a detailed description and justification for the selected scheme. Address special power and reliability requirements, including emergency power and UPS systems.

c. Proposed lighting systems

i. Discuss typical lighting system features, including fixture type, layout, and type of controls

ii. Discuss special spaces such as lobbies, auditoria, dining rooms, and conference rooms

iii. Discuss exterior lighting scheme

iv. Discuss lighting control systems and daylighting

v. Describe the energy usage of the lighting system

vi. Interface with BAS

vii. Methods proposed for energy conservation and integration with BAS

viii. Engineering analysis for demand limit controls

d. Description of each proposed signal system

i. Description of proposed security systems' features and intended mode of operation

ii. Proposed zone schedule

iii. Proposed card access controls, CCTV assessment and intrusion protection system, if applicable

e. Proposed telecommunications Infrastructure

i. Systems proposed for infrastructure and cabling to accommodate the communications systems. These must be designed and provided in compliance with EIA/TIA building telecommunications wiring standards.

f. Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in this phase meet the code requirements.

3. Drawings

a. Site plan

i. Proposed site distribution for power and communications, proposed service entrance and location of transformers, generators, and vaults, etc.

b. Floor plans

i. Proposed major electrical distribution scheme and locations of electrical rooms and closets and communication closets

ii. Proposed major routing of major electrical feeder runs, bus duct, communication backbone systems, and security systems

iii. Plan layouts of electrical rooms, showing locations of major equipment, including size variations by different manufacturers

c. Single line diagram of the building power distribution system

d. Plan of typical office lighting layout

e. Single line diagram of other signal system including: telephones, security, public address, and others

f. Security system site plan

i. Proposed locations for CCTV, duress alarm sensors, and access controls for parking lots. If the system is not extensive, these locations may be shown on the electrical site plan.

ii. Security system floor plans

iii. Proposed locations for access controls, intrusion detection devices, CCTV, and local panels

g. Lightning protection and building grounding

## DESIGN DEVELOPMENT COST ESTIMATE

Cost management deliverables shall be in accordance with the requirements defined in the PBS P-120.

The Design Development Estimate submission must include the following:

• Executive summary

• Basis of estimate, rationale, assumptions and market analysis as required in P120

• GSA Report 3474, GSA Report 3473

• Summary Reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)

• Detail line item cost reports

• Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.

• Provide separate estimates for phased work, or bid alternates/options

• To ensure the project is developing on-budget, provide a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget,

• Verify that the design development submission can be constructed within the project budget• Address what value management items were incorporated from the concept VM workshops. (Document all VM workshop sessions during design development and show what is to be incorporated into the final design.)

## SPECIFICATIONS

Assemble all project-related construction guide specifications and mark out all content that does not apply to the project.

## CERTIFICATION REQUIREMENTS

The A/E (lead designer) of record must provide certification that the project has been designed and is in compliance with project program requirements, PBS P100, and GSA's energy goal.

Assemble material for LEED rating submission, indicating features and points that ensure desired LEED rating.

The A/E of record must provide certification that all VE decisions made during DD are in compliance with the program requirements and PBS P100, and approved by the design team and all GSA and client stakeholders.

In bullet form, identify how selected design features will support the project's performance expectations. All building systems involved with the project must be discussed, each addressing all performance expectations as covered in the design program and Section A.2.

## BUILDING INFORMATION MODEL

A BIM for design development is required to a minimum Level 200 development (in accordance with AIA E202 Standards and GSA's BIM Guide 07—Building Elements). The BIM shall be the source for 2D drawings as well as SDM and COBie data. The BIM Execution Plan shall also be reviewed and, if required, revised and resubmitted.

## CONSTRUCTION DOCUMENTS

The construction documents must be complete, coordinated between disciplines, biddable, readable, and buildable, with no room for unreasonable additional interpretation. The drawings listed below represent requirements for GSA's review, and do not constitute any limitation on the documentation required to properly contract for the construction of the project, or limit the professional design liability for errors and omissions.

Update of code analysis. Each design team discipline member must review, to the degree of detail necessary, the design to assure all the code requirements are met.

## SITE PLANNING AND LANDSCAPE DESIGN

1. Calculations

a. Final drainage calculations, including stormwater detention

b. Final parking calculations, if applicable

c. Pipe sizing calculations for water and sewer pipes

d. Pavement design calculations

2. Drawings, General: The plans listed below, except the demolition plans, may be combined on small projects.

a. Demolition plans, if required

b. Site layout plan

i. Location of all buildings, roads, walks, accessible routes from parking and public street to

building entrance, parking and other paved areas, and planted areas

ii. Limits of construction

iii. Locations and sizes of fire protection water supply lines, fire hydrants, fire apparatus access roads, and fire lanes

iv. Location of floodplains and wetlands

c. Grading and drainage plan, showing:

i. Existing and new contours [use 600 mm (2 ft.) interval minimum in area around buildings]

ii. Spot elevations at all entrances and elsewhere as necessary

iii. Elevations for walls, ramps, terraces, plazas, and parking lots

iv. All surface drainage structures

v. Water retention and conservation

d. Site utilities plan, showing:

i. All utilities, including inlets, manholes, clean-outs, and invert elevations

e. Planting plan, showing:

i. Building outline, circulation, parking, and major utility runs

ii. Size and location of existing vegetation to be preserved (include protection measures during construction)

iii. Location of all new plant material (identify function, such as windbreak or visual screen where appropriate)

iv. Erosion control

f. Planting schedule, showing:

i. Quantity of plants, botanical names, planted size, and final size,

g. Irrigation plan, if applicable

i. Include schematic of irrigation control system

h. Planting and construction details, profiles, sections, and notes as necessary to fully describe design intent

i. Construction phasing, if part of project

i. Survey of surrounding buildings, structures, and improvements in both wet and dry season to document preconstruction elevations

j. Potential archeological artifacts

## ARCHITECTURAL

1. Calculations and Compliance Reports

a. Final acoustical calculations, including noise transmissions through:

i. Envelope

ii. Interior walls, floors (including raised floors), and ceilings

iii. Mechanical and electrical equipment

b. Final heat transfer through and dew point locations in building envelope

c. Final toilet fixture count

d. Final illumination, daylighting, and glare analysis

2. Drawings

a. Project title sheet, drawing index

b. Demolition plans if required

c. Floor plans

d. Show planning grids and raised access floor grid, if applicable,

i. Reflected ceiling plans

ii. Show ceiling grid and location of all elements to be placed in the ceiling

e. Building sections

i. Vertical zoning for electrical and mechanical utilities must be indicated on sections

f. Roof plans

i. Roof plans must show slopes, low points, drains and scuppers, equipment, equipment supports, roof accessories, and specialty items, if applicable

g. Exterior elevations

h. Wall sections

i. Interior elevations

j. Details

k. Schedules. Diagrams illustrating proper clearance for servicing and replacement of equipment

3. Specifications

a. Room finish, ceiling types, floor finish, color, and door schedules can be incorporated into either the specifications or drawings

b. Call for thermographic scans of building envelope to identify sources of heat transfer

c. Call for assembly of visual and performance mock-ups for spaces such as courtrooms and sample office space fit outs

d. Provide lighting fixture type schedule

## HISTORIC PRESERVATION

Specifications

Competency of bidder and restoration specialist qualification requirements, Sections 00120 and 009[00], cross-referenced in material specifications.

1. Technical specifications for repair and restoration of historic materials, including:

a. Specialized materials and procedures for repair and restoration of historic materials

b. Procedures for protecting historic materials in areas being altered

c. Sample review requirements of repair and restoration procedures

d. Sample submittal requirements for replacement materials and new installations in preservation zones

## STRUCTURAL

Calculations

For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output. A narrative of the input and results should be contained in the calculations as well.

Whenever a figure is obtained from some other page of the calculations, refer to that page number in parentheses next to the figure used in the calculation.

Provide sketches showing framing plans with dimensions and grid lines, free-body/force diagram in support of the calculations. Refer to drawing numbers where the calculated items are shown on the drawing: for example, structural sizes, rebar sizes, and connection details.

Narrative/description must be submitted explaining the computer program used to perform the calculation.

1. Final structural calculations, including:

a. Gravity loads

b. Lateral loads (seismic and wind)

c. Foundations

d. Thermal loads where significant

e. Vibration propagation

f. Progressive collapse

g. Supports for nonstructural elements, including mechanical and electrical equipment on the roof and in equipment rooms, louvers, and other penetrations

h. Steel connections

i. Blast analysis

2. Drawings

a. Demolition plans (when applicable)

b. Full set of structural construction drawings

i. Drawings must be fully dimensioned, noted and detailed for accurate bidding and construction

ii. Load criteria for all floor live loads, roof live load, roof snow load, wind load, earthquake design data, and special loads must be shown on drawings. Live load reduction of the uniformly distributed floor live loads, if used in the design, must be indicated.

iii. Basic wind speed (3-second gust), miles per hour (km/hr), wind importance factor, I, and building category, wind exposure, the applicable internal pressure coefficient must be indicated.

iv. Seismic design criteria, such as seismic use group, spectral response coefficients SDS and SD1, site class, basic seismic-force-resisting system, design base shear, and analytical procedure must be indicated. Additional information may be required by the local building official.

v. Soil bearing pressure and lateral earth pressure must be indicated.

vi. Properties of basic materials must be indicated

vii. Blast-resistant requirements if applicable

viii. Indicate the codes and standards used to develop the project.

c. Schedules

i. Schedules for foundations, columns, walls, beams, slabs, and decks, as applicable

d. Structural details. (All typical details must be shown on the drawings.)

i. Include details for steel connections

ii. Include details for all fire-rated assemblies, indicating Underwriters Laboratories Inc. or other nationally recognized testing laboratory fire resistance directory design numbers

iii. Include details indicating if the assembly is restrained or unrestrained in accordance with Appendix X to ASTM E119 (the classification must be determined by a licensed structural engineer)

iv. Include details for anchorage of building system equipment and nonstructural building elements (may be shown on mechanical, electrical, or architectural drawings, as applicable). The anchorage details, if shown on other disciplines, must be referenced on the structural drawings.

## MECHANICAL

1. Drawings HVAC

a. Demolition plans, if required

b. Floor plan(s):

i. Double line piping and ductwork layout

ii. Show terminal air units

iii. Perimeter terminal units

iv. Show locations of automatic control sensors (e.g., temperature, relative humidity, $CO_2$, room pressurization)

c. Roof plan showing all roof-mounted equipment and access to roof:

i. Show adequate access from mechanical equipment room(s) to freight elevators

d. Mechanical details:

i. Quarter-inch scale drawings of mechanical equipment room(s) showing all mechanical

equipment, ductwork, and piping including access and service requirements in plan, elevations, and cross-sections.

ii. All valves must be shown. Indicate locations where temperature, pressure, flow, contaminant/combustion gases, or vibration gauges are required, and if remote sensing is required.

iii. Mechanical room piping and ductwork layout must be double line.

iv. All dampers—both fire dampers and volume control dampers—must be shown. Ductwork ahead of the distribution terminals must be indicated in true size (double line).

e. Single line schematic flow and riser diagram(s):

i. Airflow quantities and balancing devices for all heating/cooling equipment

ii. Water flow quantities and balancing devices for all heating/cooling equipment

iii. Show location of all flow/energy measuring devices for water and air systems for all cooling, heating, and terminal equipment, and their interface with the BAS

f. Automatic control diagrams:

i. Control flow diagrams showing all sensors, valves, and controllers (analog and digital inputs for controllers, front end equipment, and system architecture)

ii. Diagrams to show control signal interfaces, complete with sequence of operation of all heating, ventilating, and cooling systems during occupied, 24-hour, and unoccupied conditions

g. Schedules:

i. Provide schedules of equipment that includes chillers, boilers, pumps, air handling units, terminal units, cooling towers, and all equipment required for 24-hour operations.

ii. Air terminal devices

h. Air balance relationships between spaces

2. Drawings: Plumbing

a. Demolition plans, if required

b. Floor plans

i. Plumbing layout and fixtures, equipment and piping; large-scale plans should be used where required for clarity

c. Riser diagrams for waste and vent lines

d. Riser diagrams for domestic cold and hot water lines

e. Plumbing fixture schedule

3. Narrative HVAC

a. A written narrative describing the final mechanical system and equipment selection including:

i. Final indoor and outdoor design conditions for all spaces under occupied, 24-hour, and unoccupied conditions

ii. Final ventilation rates, dehumidification, and pressurization criteria for all spaces under occupied, 24-hour, and unoccupied conditions

iii. Final equipment capacities, weights, sizes, and power requirements

iv. Final psychrometrics of HVAC systems

v. A final description of the air side and water side systems and the associated components including operating characteristics, ranges, and capacities, spaces served, and special features

vi. Final descriptions of the control strategy and sequence of operations for all spaces under occupied, 24-hour, and unoccupied conditions

b. Final fuel and utility requirements

c. A final code compliance statement

d. A final P100 compliance statement

e. A final description of any deviation from the HVAC system as approved in the Final Concept submittal, in accordance with P100

4. Narrative: Plumbing

a. A final description of plumbing system, including domestic cold and hot water, sanitary and storm drainage, and irrigation systems

b. A final evaluation of alternate sources for preheating of domestic water (solar or heat recovery)

5. Calculations and Energy and Water Analyses HVAC

a. Final building heating and cooling load calculations

b. Final system pressure static analysis at peak and minimum block loads for occupied and unoccupied conditions

c. Building pressurization analysis for peak and minimum block loads for occupied and unoccupied conditions

d. Acoustical calculations for peak and minimum block loads for occupied conditions

e. Flow and head calculations for pumping systems for peak and minimum block loads for occupied conditions

f. Final selection of equipment, cut sheets of selected equipment

g. Final psychrometric calculations for the selected HVAC systems at full and partial loads (partial loads at 50% and 25%, and unoccupied periods)

h. Final energy consumption calculations and analysis in accordance with Section A.7

i. Final fuel consumption estimates

j. Sizing of fuel storage and distribution system

k. Sizing of vibration isolators for mechanical equipment

6. Calculations: Plumbing

a. Include entire building, including roof drainage calculations and hot water heating calculations

b. Water supply calculations, including pressure

c. Roof drainage calculations

d. Sanitary waste sizing calculations

e. Final water consumption calculations and analysis including make-up water for HVAC systems, domestic water consumption, and water consumption for irrigation

7. Specifications

a. Completely edited version of each specification section to be used on the project

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Drawings

a. Demolition plans, if required

b. Full set of fire protection construction drawings

i. Drawings must be carefully dimensioned, noted, and detailed for accurate bidding and construction

c. Fire protection details (all typical details must be shown on the drawings)

i. Building construction

(1) Building's construction type (e.g., 443, 222, etc.)

(2) Firewalls and smoke partition

(3) Panel and curtain walls

(4) Fire-stopping configurations. Include details of all openings between the exterior walls (including panel, curtain, and spandrel walls) and floor slabs, openings in floors, and shaft enclosures

(5) Mass notification system equipment

ii. Life safety

(1) Each stair

(2) Horizontal exits

(3) Each required fire door

(4) Stairway pressurization fans

(5) Security door hardware, including operation procedures

iii. Water supply

(1) Fire pump configuration

(2) Anchorage of underground fire protection water supply lines

(3) Standpipe riser

iv. Water-based fire extinguishing systems

(1) Installation of waterflow switches and tamper switches

(2) Sprinkler floor control valves, sectional valves, and inspector text assembly

v. Non-water-based fire extinguisher systems

(1) Special fire extinguishing systems (e.g., wet chemical)

vi. Fire alarm system

(1) Fire alarm riser

(2) Typical firefighter telephone station

(3) Typical firefighter telephone jack

(4) Electrical closets for fire alarm system panels

(5) Fire alarm telephone panel (includes voice paging microphone and firefighter telephone system)

(6) Visual indicating device control and power detail, typical for floors (state location)

(7) Amplifier rack (state location)

(8) Typical location of duct smoke detectors

(9) Outdoor fire alarm speaker

(10) Wall-mounted cone fire alarm speaker

(11) Typical terminal cabinet

(12) Lay-in ceiling-mounted fire alarm speaker

(13) Lay-in ceiling-mounted fire alarm combination speaker/strobe

(14) Wall-mounted strobe device

(15) Typical manual fire alarm box installation

(16) Fire alarm system input/output matrix

(17) Graphic annunciator panel

(18) Installation of the graphic annunciator

(19) Fire command center showing the locations of each panel to be installed

2. Specifications

a. Final specifications

b. Specifications must be based on GSA Fire Protection Supplements to Masterspec

3. Calculations For any fire modeling generated results, submit a copy of the input data and all pertinent program material and assumptions required to understand the output and the analysis. A

narrative of the input and results must be part of the calculations.

a. Final occupant load and egress calculations

b. Final fire protection water supply calculations. Includes water supply flow testing data.

c. Final fire pump calculations where applicable

d. Final smoke control calculations where applicable (e.g., atrium)

e. Final stairway pressurization calculations

f. Fire modeling

g. Final calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

## ELECTRICAL

1. Drawings: General Systems must be fully drawn and sized to permit accurate bidding and construction.

a. Demolition plans, if required

b. Floor plans

i. Show lighting, power distribution, and communications raceway distribution, and locations of fire alarm and annunciator panels

c. Single-line diagram of primary and secondary power distribution

d. Include normal power, emergency power, and UPS

e. Single-line diagram of fire alarm system

f. Single-line diagram of telecommunications system

g. Circuit layout of lighting control system

h. Details of underfloor distribution system

i. Site plan

i. Indicate service locations, manholes, ductbanks, and site lighting,

j. Layout of electrical equipment spaces

i. Show all electrical equipment. Include elevations of substation transformers and disconnect switches

k. Schedules for switchgear, switchboards, motor control centers, panelboards, and unit substations

l. Grounding diagram

m. Complete phasing plan (if required) for additions and alterations

n. Security systems site plan

i. Final locations of all security devices and conduit runs

o. Security system floor plans

i. Layout of all security systems

p. Storage areas for electrical equipment/spare parts

2. Specifications

a. Final specification

b. Zone schedules may be bound into the specifications or shown on drawings

3. Calculations

a. Illumination level and lighting power calculations

b. Lighting power densities must be calculated by the electrical engineer. The illumination levels for all spaces are to be calculated by the architect, who must also calculate daylighting and glare.

The following shall be provided during the submittal review process.

c. Short circuit calculations

d. Voltage drop calculations

e. Overcurrent coordination study (Normal, Standby, & Emergency)

f. Arc-Flash Hazard Analysis

g. Power Quality including Harmonic and Power Factor analysis

h. Generator calculations (Include starter loads)

### CERTIFICATION REQUIREMENTS

The A/E (lead designer) must provide certification that the project has been designed and is in compliance with ASHRAE 90.1 and will meet GSA energy goal requirements.

Certification will also indicate that the architectural/engineering design elements have been integrated with the overall project design, and that the building can meet the programmed LEED rating.

All VE decisions made during construction documentation are in compliance with code requirements, the PBS P100 criteria and requirements, and have been approved by the GSA and client stakeholders.

The A/E certification must be signed and sealed by a principal of the architectural/engineering firm in charge of the project.

### CONSTRUCTION DOCUMENTS COST ESTIMATE

Cost management deliverables shall be in accordance with the requirements defined in the PBS P-120.

The construction documents estimate submissions must include the following:

- Executive summary
- Basis of estimate, rationale, assumptions, and market analysis as required in P120
- GSA Report 3474, GSA Report 3473
- Summary Reports (ASTM UNIFORMAT II and CSI MasterFormat formats as applicable)
- Detail line item cost reports
- Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.
- Provide separate estimates for phased work, or bid alternates/options.
- To ensure the project is developing on-budget, provide a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.
- Verify that the construction documents submissions can be constructed within the project budget.

### DATA AND OPERATIONS MANUAL

An operations manual must be prepared and training provided for the building Operations and Maintenance personnel describing the design objectives and how to operate the building. The manual must include as a minimum: as-built drawings, environmental regulatory operating licenses/registrations/permits for each piece of equipment, equipment data, model numbers for the equipment, parts lists, equipment options, operating manuals for each piece of equipment, testing and balancing reports and certifications, maintenance schedules, videos, and warranty schedules. The manual must be reviewed and certified complete by the GSA project manager before submission to the facilities manager.

### BUILDING INFORMATION MODEL

A BIM for construction documents is required to a minimum Level 300 development (in accordance with AIA E202 Standards and GSA's BIM Guide 07—Building Elements). The BIM shall be the source for 2D drawings as well as SDM and COBie data. The BIM Execution Plan shall also be reviewed and, if required, revised and resubmitted.

## A.4 ALTERATION PROJECTS

The design process and related submission requirements for alterations are somewhat different than those for new construction and modernizations. An alteration is defined as a limited construction

project for an existing building that comprises the modification or replacement of one or a number of existing building systems or components. Alterations are less than total building modernizations. Figure A-4 and the following definitions define the design process and related submission requirements for alterations, including renovations.

Figure 20: West Quincy Court Federal Building Roof, Chicago, IL

Figure A4: Design Process and Related Submission Requirements for Renovation

| STAGES | ACTIVITES | SUBMISSIONS |
|---|---|---|
| CONCEPTS | | |
| ● Review Space Directive<br>● Study<br>Adjacencies<br>Circulation<br>Aesthetics<br>● System/Features that Integrate Delivery of Expectations | PROGRAM REVIEW<br>DESIGN CHARRETTE<br>CONCEPT<br>(1 or more)<br>VALUE MANAGEMENT<br>(Systems Level) | ● Drawings<br>● Narratives<br>● Rendering/Photos<br>● Proposed Systems<br>● Cost Estimates |
| DESIGN DEVELOPMENT | | |
| ● System/Feature Analyses for Selection<br>● 30% Complete Documentation<br>● Final Selection of All Building Systems | PROGRAM REVIEW<br>VALUE MANAGEMENT<br>(Analysis Stage) | ● Drawings<br>● Narratives<br>● Calculations<br>● Cost Estimates |
| CONSTRUCTION DOCUMENTS | | |
| ● Presentation of Design in a Format Suitable to Parties Unfamiliar with the Site | PROGRAM REVIEW<br>75% COMPLETE<br>90% COMPLETE<br>100% COMPLETE<br>POST DESIGN SERVICES | ● Progress Drawings<br>● Draft Specifications<br>● Narrative Update<br>● Current Calculations<br>● Final: Drawings<br>Specifications<br>Narratives<br>Calculations<br>Cost Estimate<br>● Incorporation of Review Comments |

## DESIGN PROCESS DEFINITIONS

### PROGRAM REVIEW

Prior to initiating each phase of design, the design team should meet to review design program expectations and to exchange ideas, lessons-learned, and concerns. Such technical "partnering" sessions allow a clearer definition of expectations while remaining within the project's scope and budget.

### PHASES OF CONSTRUCTION

Prior to each phase of design, a construction phasing plan must be prepared to ensure that services such as power, lighting, HVAC, plumbing, elevators, fire-safety, building security, telecommunications, and data are available in the area/spaces which will be occupied during the phased construction. This phasing plan must be coordinated with clients, property managers, and other stakeholders.

### DEMOLITION PLAN

Prior to each phase of design, a demolition narrative and drawings must be prepared for each element (i.e., architectural, site, structural, mechanical, electrical, fire-safety) to ensure coordination of the demolition and removal of the elements. Abandonment-in-place of unused elements is not permitted.

### CONCEPT

A submission that will demonstrate that the space program has been accomplished, including any adjacency and functional requirements. This submission will also show that the proposed project is

compatible with the project authorization and complies with the criteria and requirements in Chapters 1-9 of this document. A preliminary analysis of proposed building systems must be accomplished to determine the most cost-effective alternatives.

## DESIGN DEVELOPMENT

A set of submissions and meetings that will finalize the selection of type, size, and other material characteristics of all systems. Systems are not only structural, mechanical, fire protection, and electrical, but all other building components such as envelope (wall, window, and roof), interior (flooring, ceiling, and partitions), toilet and service rooms, elevators, and so on. The submission will consist of a combination of drawings, narrative, and calculations.

## CONSTRUCTION DOCUMENTS

A set of detailed and coordinated submissions that become the basis of a construction contract. They must be produced in a general fashion that any construction contractor nationwide can understand. Designs must be illustrated to distinguish between existing construction and new work, and be clear enough to result in a single interpretation of a specific set of data or facts. Language used in the specifications must be consistent and complementary to notes on the drawings. The documents must avoid using terms that the design specialist may know, but which have nothing to do with the purchase and installation of a product.

## SPECIFICATIONS

Specifications to be organized according to CSI format, fully edited, typed, and bound.

## CODE ANALYSIS

Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks accomplished in each phase meet the code requirements.

# CONCEPT

## SITE PLANNING AND LANDSCAPE DESIGN

A sitework drawing and narrative need to be submitted only if sitework is a substantial part of the scope of work for the alteration.

1. Drawings

a. Site plans as described in Section A.3

2. Narrative

a. Existing site features

i. Topography and drainage patterns

ii. Any existing erosion conditions

iii. Wetlands and location of flood plains

iv. Circulation patterns around site

v. Site access

b. Noise/visual considerations

c. Local zoning restrictions

d. Historic preservation considerations, if applicable

i. Potential archeological artifacts

e. Fire protection considerations, if applicable

f. Site analysis of utilities, if utilities are to be changed

g. Description of site and landscape design concept

i. Proposed changes to circulation design

ii. Proposed changes to parking

iii. Proposed method for stormwater detention or retention

iv. Proposed changes to paving

v. Description of local urban design goals for surrounding neighborhood and summary of relevant recommendations from local officials

## ARCHITECTURAL

An architectural concept needs to be submitted only if architectural work is a part of the scope of work for the alteration.

1. Drawings

a. Demolition plans

b. Floor plans, elevations, and sections as described in Section A.3

c. Existing and new spaces, circulation, entrances, stairways, elevators, freight elevators, loading docks, special spaces and service spaces, and service rooms and space for mechanical, fire protection, electrical, and communication equipment. Dimensions for critical clearances, such as vehicle access, fire apparatus access, deliveries, and maintenance should be indicated.

2. Narrative

a. Architectural program requirements

i. Describe how the design meets the project authorization

b. Design concept, explaining:

i. General layout

ii. Treatment of historic zones, if applicable

3. Calculations

a. Where building renovation involves window or insulated wall systems, perform a life-cycle cost assessment to optimize selection

## HISTORIC PRESERVATION

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

1. Narrative

a. General: Project purpose, scope, groups, and individuals involved

b. Existing conditions, describing:

i. Overall building size, configuration, character

ii. Project location

iii. Existing original materials and design, relevant alterations

c. Preservation design issues and prospective solutions, including:

i. Location of new work/installation: visibility, impact on historic finishes

ii. Compare options for preserving/restoring historic materials and design

iii. Identify further study required to avoid adverse effects as applicable

2. Photographs

a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each view

b. Captions identifying location, subject, condition shown

3. Drawings

a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:

i. Site and floor plans, as applicable.

ii. Sketches or schematic CAD drawings (elevations, plans) showing preservation design concepts.

## STRUCTURAL

Structural drawings and narrative only need to be submitted if a structural upgrade is part of the scope of work.

1. Drawings

a. Structural plans as described in Section A.3

2. Narrative

a. Description of current structural systems, state of repair, variances from present codes and available spare load capacity. Data may be obtained from review of original construction drawings and codes or from an analysis of the actual structure.

i. This report may have been completed as part of the prospectus development study

b. Identification of governing codes

c. Description of recommended changes to the structural system, addressing:

i. Structural materials, required selective demolition or alteration of existing structural elements, roof and floor framing system, means of resisting lateral loads, and connections between existing and new structural systems

d. If a seismic evaluation study exists for the building, describe any variations taken in design, compared to the study's recommendations.

## MECHANICAL

Mechanical drawings, narrative, and calculations need to be submitted only if the alteration scope of work involves changes to the mechanical systems.

1. Drawings

a. Demolition plan of all piping, ductwork, equipment, and controls that are to be removed

b. Drawings for new work must be provided as described in Section A.3

2. Narrative

a. Description of current mechanical systems, state of repair, variances from present codes and P100. Data may be obtained from review of original construction drawings, P100 requirements and codes, and from an analysis of the actual facility.

b. Description of changes to existing systems as authorized and described in the prospectus and the building evaluation report

c. Describe existing and proposed HVAC and plumbing systems, including available capacities, compliance with the criteria and requirements in Chapter 5 of this document and their operational characteristics

d. Identify how new systems will be integrated with existing systems

e. Provide analysis of energy conservation opportunities for the project

3. Calculations and Energy Analysis

a. Calculations and energy analysis for alterations must show compliance with Chapters 1, 3, 5, and Sections A.3 and A.7.

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate fire protection section as outlined in this document.

1. Drawings

a. Demolition plans

i. Identify existing fire protection systems (e.g., sprinklers, fire alarm notification appliances)

b. Floor plans, showing a minimum:

i. New fire protection systems (e.g., sprinklers, fire alarm notification appliances)

<u>2. Narrative</u> A fire protection narrative needs to be submitted only if the fire protection work is a substantial part of the scope of work for the alteration or involves changes to a fire protection system.

a. Fire protection program requirements

b. Description of the building's proposed fire protection systems including modifications to the existing egress systems

c. Code statement identifying changes in building occupancy classification, occupancy group(s), fire resistance requirements, egress requirements, and so on.

### ELECTRICAL

An electrical narrative needs to be submitted only if the alteration scope of work involves changes to the type or location of major electrical systems.

1. Narrative

a. Description of requested changes to existing systems.

i. Describe lighting, power, and signal systems, including available capacity versus criteria in Chapter 6, and operational characteristics.

ii. Describe code deficiencies. Identify how new systems will be tied into existing systems.

iii. This report may have been completed as part of the prospectus development study.

b. Describe both existing and new distribution systems within the building

i. Special power and reliability requirements should be addressed, including emergency power and UPS systems.

### CONCEPT COST ESTIMATE

The final concept phase estimate submission must include all requirements of the PBS P-120 as well as the following:

1. Executive summary

2. Basis of estimate, rationale, assumptions and market analysis as required in P120

3. GSA Report 3474, GSA Report 3473

4. Summary reports (ASTM UNIFORMAT II, Work Items and CSI MasterFormat formats as applicable)

5. Detail line item cost reports

6. Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.

7. Provide separate estimates for phased work, or bid alternates/options.

8. To ensure the project is developing on-budget, provide a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.

9. Verify that the final concept submissions can be constructed within the project budget.

A life-cycle cost analysis of three options that have been modeled should be included with this submittal.

## DESIGN DEVELOPMENT

### SITE PLANNING AND LANDSCAPE DESIGN

1. Calculations

a. Storm drainage and sanitary sewer calculations

b. Storm water detention facility calculations, if applicable

c. Parking calculations, if applicable

2. Narrative

a. Site circulation concept, explaining:

i. Reasons for site circulation design and number of site entrances

ii. Reasons and/or calculation for number of parking spaces provided

iii. Reasoning for design of service area(s), including description of number and sizes of trucks that can be accommodated

iv. Proposed scheme for waste removal

v. Proposed scheme for fire apparatus access (including aerial apparatus), roads, and fire lanes

b. Site utilities distribution concept

c. Drainage design concept

d. Landscape design concept, explaining:

i. Reasoning for landscape design, paving, site furnishings, and any water features

ii. Reasoning for choice of plant materials

iii. Proposed landscape maintenance plan

iv. Brief operating description of irrigation system

v. Summarize water conservation opportunities that have been studied

vi. Brief description of fire protection water supplies

vii. Brief description of fire hydrant locations

viii. Reasoning for urban design choices and their relation to local urban design goals

e. Site construction description

i. Brief description of materials proposed for pavements and utilities

f. Code analysis

i. Analysis of applicable local zoning and building code requirements

3. Drawings

a. Demolition plans (when applicable)

b. Preliminary site layout plan, showing:

i. Roads, walks, parking, and other paved areas (including type of pavement). Show access route for the physically disabled from parking and from public street to main entrance.

ii. Fire apparatus access (including aerial apparatus) and fire lanes

c. Preliminary grading and drainage plan, showing:

i. Preliminary site grading, storm drainage inlets, including detention facilities

d. Preliminary site utilities plan, showing:

i. Sizes, inverts, and locations of domestic and fire protection water supply lines, sanitary sewer lines, gas lines, steam/condensate lines and chilled water supply and return lines, if applicable

e. Preliminary landscape design plan, showing:

i. Preliminary hardscape design, including site furniture, water features, etc.

ii. Preliminary planting scheme

iii. Preliminary irrigation design

## ARCHITECTURAL

1. Narrative

a. Building concept, explaining:

i. Entrance locations and service locations

ii. Building circulation and arrangement of major spaces

iii. Interior design

iv. Adherence to the historic building preservation plan, if applicable

b. Building construction description, explaining, if applicable:

i. Exterior materials, waterproofing, air barriers/vapor retarders and insulation elements

ii. Roofing system(s)

iii. Exterior glazing system

iv. Interior finishes, with detailed explanation for public spaces

v. Potential locations for artwork commissioned under the Art in Architecture program,

if applicable, as determined by the collaboration of the artist, architect, and Art in Architecture Panel

2. Drawings

a. Demolition plans

b. Building floor plans, showing:

i. Spaces individually delineated and labeled

ii. Enlarged layouts of special spaces

iii. Dimensions

iv. Accessible routes for the physically disabled as well as other compliance requirements regarding signage, toilets, etc.

c. Building roof plan, if applicable, showing:

i. Drain

ii. Dimensions

iii. Membrane and insulation configuration of the roofing system

d. Elevations of major building facades (if changes to the exterior are proposed), showing:

i. Existing and new fenestration

ii. Existing and new exterior materials

iii. Cast shadows

e. Two building sections (of renovated areas only), showing:

i. Accommodation of structural systems

ii. Mechanical penthouses, if any

iii. Floor to floor and other critical dimensions

iv. Labeling of most important spaces

f. Exterior wall sections, showing:

i. Materials of exterior wall construction, including flashing, connections, and method of anchoring

ii. Vertical arrangement of interior space, including accommodation of mechanical, fire protection, and electrical services in the floor and ceiling zones

g. Proposed room finish schedule, showing:

i. Floors, base, walls, and ceilings

ii. Finish schedule may be bound into narrative

## HISTORIC PRESERVATION

8.5 in. x 11 in. report, signed by qualified preservation architect, including:

1. Narrative

a. Cover

i. Building name, address, project title, project control number, author (preservation architect), preservation architect's signature, date of submission

b. General: Project purpose, scope, groups, and individuals involved, substantive changes to approach described in concept submission

c. Existing conditions, describing:

i. Overall building size, configuration, character

ii. Project location

iii. Existing original materials and design, alterations

iv. New findings from testing or analysis in concept phase

d. Preservation solutions explored, how resolved, and why, including:

i. Location of new work: visual impact, protection of ornamental finishes

ii. Design of new work/installation: visual and physical compatibility with existing original materials and design; materials/finishes proposed (as specified)

iii. Methods of supporting new work/installation

iv. Preservation and protection of historic materials during construction through tenant move-in

e. Effects, describing:

i. How project will affect the building's architecturally significant qualities

ii. Measures proposed to mitigate any adverse effects on historic materials or design

2. Photographs

a. General and detail views showing existing conditions at affected preservation zones, keyed to plan showing location and orientation of each photo view

b. Captions identifying location, subject, condition shown

3. Drawings

a. Reduced to 8.5 in. x 11 in., 11 in. x 17 in. foldout or placed in cover pocket:

b. Site and floor plans, as applicable

c. Elevations, plans, and section details showing preservation design solutions for each issue identified, as approved by Regional Preservation Officer

## STRUCTURAL

1. Calculations For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output. A narrative of the input and results should be contained in the calculations as well.

a. Gravity load calculations

b. Lateral load calculation

c. Foundation calculations

d. Calculations showing that system is not vulnerable to progressive collapse

e. Vibration calculations

f. Results of any other studies necessary for the project design

2. Narrative

a. Description of structural concept, including:

i. Choice of framing system, including lateral load resisting elements

ii. Proposed foundation design

iii. Verification of adequacy of all assumed dead and live loads

b. Code analysis

i. Building classification, required fire resistance of structural elements, identification of seismic zone, wind speed, etc.

ii. Identification of special requirements, such as high-rise

iii. Summary of special requirements resulting from applicable local codes

c. Proposed methods of corrosion protection, if applicable

d. Geotechnical engineering report, including boring logs (if part of scope of work). See Section A.5 for specific requirements.

e. Geologic hazard report

3. Drawings

a. Demolition plans (where applicable)

b. Preliminary framing plans and key details

i. Include column locations, bay sizes, and location of expansion and seismic joints

c. Preliminary schedules, including:

i. Column, beam, slab, metal deck, and wood framing schedules, as applicable

ii. Preliminary seismic details

## MECHANICAL

In addition to the design development submission of the demolition plan, drawings, narrative, and calculations and analysis must be provided as described in Chapters 1, 3, 5 and Sections A.3 and A.7.

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate Fire Protection section as outlined in this document.

1. Calculations

a. Occupant load and egress calculations

b. Fire protection water supply calculations

c. Fire pump calculations where applicable

d. Smoke control calculations where applicable (e.g., atrium)

e. Stairway pressurization calculations where applicable

f. Calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

2. Narrative

a. Building egress system

i. Includes egress calculations and stairway exit capacities, remoteness, exit discharge, etc.

b. All building fire alarm and suppression systems

c. Smoke control system(s), where applicable

d. Special fire protection systems (e.g., kitchen extinguishing system), where applicable

e. Fire resistance rating of building structural elements

i. Coordinate with structural engineer

f. Fire alarm system

g. Interface of fire alarm system with BAS and security systems

h. Review of building for compliance with life safety requirements and building security requirements

i. Interior finish requirements as they pertain to the life safety requirements

3. Drawings

a. Floor Plans showing:

i. Equipment spaces for fire protection systems (e.g., fire pump, fire alarm)

ii. Fire protection water supply lines, fire hydrant locations, fire apparatus access roads, and fire lanes

iii. Standpipes and sprinkler risers

iv. Riser diagrams for sprinkler system

v. Riser diagram for fire alarm system

vi. Remoteness of exit stairways

vii. Location of firewalls and smoke partitions

viii. Identification of occupancy type of every space and room in building

ix. Calculated occupant loads for every space and room in the building

x. Location of special fire protection requirements (e.g., kitchens, computer rooms, storage)

## ELECTRICAL

1. Calculations

a. Lighting calculations for a typical 186 $m^2$ (2,000 sq. ft.) open plan office with system furniture

b. Lighting calculations for a typical one person private office

c. Power calculations from building entry to branch circuit panel

d. Load calculations

e. Life cycle cost analysis of luminaire/lamp system

f. Life cycle cost study on the options to integrate related building systems

2. Narrative

a. Proposed power distribution scheme

i. Provide a detailed description and justification for the selected scheme

b. Interface with BAS

i. Methods proposed for energy conservation and integration with BAS

c. Engineering analysis for demand limit controls

d. Description of each proposed signal system

e. Description of proposed security systems features and intended mode of operation

i. Proposed zone schedule

ii. Proposed card access controls, CCTV assessment and intrusion protection system, if applicable

3. Drawings

a. Demolition plans

b. Site plan

i. Proposed site distribution for power and communications, proposed service entrance and location of transformers, generators, and vaults, etc.

c. Floor plans

i. Proposed major electrical distribution scheme and locations of electrical closets

d. Floor plans

i. Major routing of communications system, communications equipment rooms, and closets

e. Underfloor distribution system

i. Show typical detail for power and communications services

f. One-line diagram

g. Typical lighting layout

i. Include lighting for special areas

h. Exterior lighting scheme

i. Layout of electrical room

i. Show locations of major equipment

j. One-line diagrams of other signal systems

k. Security system site plan

i. Location for CCTV, duress alarm sensors and access control locations for parking lots shown. If the system is not extensive, these locations may be shown on the electrical site plan.

l. Security system floor plans

i. Access controls, intrusion detection devices, and CCTV locations shown. Preliminary local panel locations shown.

## DESIGN DEVELOPMENT COST ESTIMATE

The Design Development Phase Estimate submissions must include all requirements of the PBS P-120 as well as the following:

1. Executive Summary

2. Basis of Estimate, Rationale, Assumptions and Market Analysis as required in P-120

3. GSA Report 3474, GSA Report 3473

4. Summary Reports (ASTM UNIFORMAT II, Work Item and CSI MasterFormat formats as applicable)

5. Detail Line Item Cost Reports

6. Core/Shell and Tenant Improvement Cost Estimate, as per GSA Pricing Policy. TI estimates must be prepared for each tenant.

7. Provide separate estimates for phased work, or bid alternates/options

8. To ensure the project is developing on-budget, provide a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget.

9. Verify that the Design Development Phase Submissions can be constructed within the project budget.

## CONSTRUCTION DOCUMENTS

The construction documents must be complete, coordinated between disciplines, biddable, readable and buildable, with no room for unreasonable additional interpretation.

The A/E firm must provide a signed and dated professional seal on all final contract documents. The cover sheet should also include a statement by the design A/E certifying the design meets the listed design criteria. Exceptions and waivers to the design criteria should also be listed on the cover sheet of the contract documents, including the name and date of the individual providing authorization.

## SITE PLANNING AND LANDSCAPE DESIGN

1. Cover Sheet

a. Provide code clarification statement for compliance with specified codes and standards by each discipline with professional seals and signatures. In addition, include a drawing index.

2. Drawings, General: The plans listed below, except the demolition plans, may be combined on small projects.

a. Demolition plans

b. Site layout plan

i. Location of all buildings, roads, walks, accessible routes, parking, and other paved areas and planted areas

ii. Limits of construction

iii. Locations of fire protection water supply lines, fire hydrants, fire apparatus access roads, and fire lanes

c. Grading and drainage plan, showing:

i. Existing and new contours [use 500 mm (2 ft.) interval minimum in area around buildings]

ii. Spot elevations at all entrances and elsewhere as necessary

iii. Elevations for walls, ramps, terraces, and plazas

iv. All surface drainage structures

d. Site utilities plan, showing:

i. All underground utilities, including inlets, manholes, clean-outs, and invert elevations

e. Planting plan, showing:

i. Building outline, circulation, parking, and major utility runs

ii. Size and location of existing vegetation to be preserved (include protection measures during construction)

iii. Location of all new plant material (identify function, such as windbreak or visual screen where appropriate)

f. Planting schedule, showing:

i. Quantity of plants, botanical names, planted size, and final size

g. Irrigation plan, if applicable

i. Include schematic of irrigation control system

h. Construction details, profiles, and sections and notes as necessary to fully describe design intent

i. Construction phasing, if part of project

3. Calculations

a. Final drainage calculations, including stormwater detention

b. Final parking calculations, if applicable

c. Pipe sizing calculations for water and sewer pipes

d. Pavement design calculations

## ARCHITECTURAL

1. Drawings

a. Demolition plans

b. Floor plans

i. Show planning grids and raised access floor grid, if applicable

c. Reflected ceiling plans

i. Show ceiling grid and location of all elements to be placed in the ceiling

d. Building sections

i. Vertical zoning for electrical and mechanical utilities must be indicated on sections

e. Roof plans

i. Roof plans must show slopes, low points, drains, and scuppers, if applicable

f. Exterior elevations

g. Wall sections

h. Interior elevations

i. Details

j. Schedules

2. Specifications

a. Instructions to bidders

b. Division 1, edited to suit specific GSA requirements

c. Room finish, color, and door schedules can be incorporated into either the specifications or drawings

## HISTORIC PRESERVATION

1. Specifications Division 1

a. Competency of bidder and restoration specialist qualification requirements, cross referenced in material specifications

2. Technical specifications for repair and restoration of historic materials, including:

a. Specialized materials and procedures for repair and restoration of historic materials

b. Procedures for protecting historic materials in areas being altered

c. Sample review requirements of repair and restoration procedures

d. Sample submittal requirements for replacement materials and new installations in preservation zones

## STRUCTURAL

1. Drawings

a. Demolition plans (where applicable)

b. Full set of structural construction drawings

i. Drawings must be fully dimensioned, noted and detailed for accurate bidding and construction.

ii. Load criteria for all floor live load, roof live load, roof snow load, wind load, earthquake design data, and special loads must be shown on drawings. Live load reduction of the uniformly distributed floor live loads, if used in the design, must be indicated.

iii. Basic wind speed (3-second gust), miles per hour (km/hr), wind importance factor, I, and building category, wind exposure, and the applicable internal pressure coefficient must be indicated.

iv. Seismic design criteria, such as seismic use group, spectral response coefficients SDS and SD1, site class, basic seismic-force-resisting system, design base shear, and analytical procedure must be indicated. Additional information may be required by the local building official.

v. Soil bearing pressure and lateral earth pressure must be indicated

c. Schedules

i. Schedules for foundations, columns, walls, beams, slabs, and decks, as applicable

d. Structural details. (All typical details must be shown on the drawings.)

i. Include details for steel connections

ii. Include details for all fire-rated assemblies, indicating Underwriters Laboratories Inc. or other nationally recognized testing laboratory fire resistance directory design numbers

iii. Include details indicating if the assembly is restrained or unrestrained in accordance with Appendix X to ASTM E119 (the classification must be determined by a licensed structural engineer)

iv. Include details for anchorage of nonstructural building elements

2. Calculations For any computer-generated results, submit a model of the input data and all pertinent program material required to understand the output. A narrative of the input and results should be contained in the calculations as well.

a. Final structural calculations, including:

i. Gravity loads

ii. Lateral loads

iii. Foundations

iv. Thermal loads where significant

v. Vibration propagation

vi. Progressive collapse

vii. Supports for nonstructural elements, including mechanical and electrical equipment

viii. Steel connections

## MECHANICAL

In addition to the construction documentation submittal for the demolition plan, drawings, narrative, and calculations and analysis must be provided as described in Chapters 1, 3, 5, and Sections A.3 and A.7.

## FIRE PROTECTION

Fire protection and life safety submission requirements must be identified as a separate fire protection section as outlined in this document.

1. Drawings

a. Demolition plans

b. Full set of fire protection construction drawings

i. Drawings must be carefully dimensioned noted and detailed for accurate bidding and construction

c. Fire protection details (all typical details must be shown on the drawings)

i. Building construction

(1) Building's construction type (e.g., 443, 222)

(2) Firewalls and smoke partitions

(3) Panel and curtain walls

(4) Fire-stopping configurations. Include details of all openings between the exterior walls (including panel, curtain, and spandrel walls) and floor slabs, openings in floors, and shaft enclosures.

ii. Life safety

(1) Each stair

(2) Horizontal exits

(3) Each required fire door

(4) Stairway pressurization fans

(5) Security door hardware, including operation procedures

iii. Water supply

(1) Fire pump configuration

(2) Anchorage of underground fire protection water supply line

(3) Standpipe riser

iv. Water-based fire extinguishing systems

(1) Installation of waterflow switches and tamper switches

(2) Sprinkler floor control valves, sectional valves, and inspector text assembly

v. Non-water-based fire extinguisher systems

(1) Special fire extinguishing systems (e.g., wet chemical)

vi. Fire Alarm System

(1) Fire alarm riser

(2) Typical firefighter telephone station

(3) Typical firefighter telephone jack

(4) Electrical closets for fire alarm system panels

(5) Fire alarm telephone panel (includes voice paging microphone and firefighter telephone system)

(6) Visual indicating device control and power detail, typical for floors (state location)

(7) Amplifier rack (state location)

(8) Typical location of duct smoke detectors

(9) Outdoor fire alarm speaker

(10) Wall-mounted cone fire alarm speaker

(11) Typical terminal cabinet

(12) Lay-in ceiling-mounted fire alarm speaker

(13) Lay-in ceiling-mounted fire alarm combination speaker/strobe

(14) Wall-mounted strobe device

(15) Typical manual fire alarm box installation

(16) Fire alarm system input/output matrix

(17) Graphic annunciator panel

(18) Installation of the graphic annunciator

(19) Fire command center showing the locations of each panel to be installed

2. Calculations For any fire modeling generated results, submit a copy of the input data and all pertinent program material and assumptions required to understand the output and the analysis. A narrative of the input and results must be part of the calculations.

a. Final occupant load and egress calculations

b. Final fire protection water supply calculations

c. Includes water supply flow testing data

d. Final fire pump calculations where applicable

e. Final smoke control calculations where applicable (e.g., atrium)

f. Final stairway pressurization calculations

g. Fire modeling

h. Final calculations contained in The SFPE Handbook of Fire Protection Engineering for calculating sound attenuation through doors and walls for placement and location of fire alarm system audible notification appliances

## ELECTRICAL

1. Drawings

a. Demolition plans

b. Floor plans

i. Show lighting, power distribution, and communications raceway distribution

c. Single-line diagram of primary and secondary power distribution

i. Include normal power, emergency power, and UPS

d. Single-line diagram of fire alarm system

e. Single-line diagram of telecommunications system

f. Circuit layout of lighting control system

g. Details of underfloor distribution system

h. Site plan

i. Indicate service locations, manholes, ductbanks, and site lighting

i. Layout of electrical equipment spaces

i. Show all electrical equipment. Include elevations of substation transformers and disconnect switches

j. Schedules for switchgear, switchboards, motor control centers, panelboards, and unit substations

k. Grounding diagram

l. Complete phasing plan (if required) for additions and alterations

m. Security systems site plan

i. Final locations of all security devices and conduit runs

n. Security system floor plans

i. Layout of all security systems

o. Storage areas for electrical equipment/spare parts

2. Calculations

a. Illumination level calculations

b. Short circuit calculations

c. Voltage drop calculations

d. Overcurrent coordination study

e. Generator calculations

f. Include starter loads

g. UPS calculation (if UPS provided)

3. Code criteria should be reviewed by each discipline to the degree of detail necessary to ensure that tasks

accomplished in this phase meet the code requirements.

### CONSTRUCTION DOCUMENTS SPECIFICATIONS

1. Instructions to bidders

2. Division 1, edited to suit specific GSA requirements

3. Technical specifications sections, organized according to CSI format

4. Specifications must be fully edited, typed, and bound. Room finish, color, and door schedules can be incorporated into either the specifications or drawings.

### CONSTRUCTION DOCUMENTS COST ESTIMATE

The construction documents cost estimate submissions must include all requirements of the PBS P-120 as well as the following:

1. Executive summary

2. Basis of estimate, rationale, assumptions, and market analysis as required in P120

3. GSA Report 3474, GSA Report 3473

4. Summary reports (ASTM UNIFORMAT II, Work Items and CSI MasterFormat formats as applicable)

5. Detail line item cost reports

6. Core/shell and TI cost estimate, as per GSA pricing policy. TI estimates must be prepared for each tenant.

7. Provide separate estimate for phased work, or bid alternates/options

8. To ensure the project is developing on-budget, a list of cost-saving items that would collectively reduce the project cost to approximately 10 percent below budget

9. Verify that the construction documents submissions can be constructed within the project budget

## A.5 SURVEYS AND GEOTECHNICAL REPORTS

### SITE SURVEY

Site surveys are generally prepared for GSA projects involving sitework. The survey may be contracted separately by GSA or may be included in the scope of the A/E for the project. The guidelines given here apply in either case. In cases where GSA contracts for the survey directly, the A/E may be requested to review the scope of work for the survey and recommend modifications to the technical requirements to suit the specific project site. The geotechnical report must be available to all contractors so that there will be a common reference on which to base their bids. Also, the report would subsequently function as the basic reference for evaluating "changed conditions" or "differing site conditions" during construction and, therefore, need be of sufficient detail, number of borings, groundwater, and contamination evaluations to support the design and mitigate large changed conditions issues.

The criteria listed here are not absolute; they should be modified by the civil engineer to suit the particular conditions of the project. All surveys should be prepared and sealed by a surveyor licensed in the state where the project is located.

### GENERAL REQUIREMENTS

Surveys should generally contain the following information:

- Locations of all permanent features within limits of work, such as buildings, structures, fences, walls, concrete slabs and foundations, above-ground tanks, cooling towers, transformers, sidewalks, steps, power and light poles, traffic control devices, manholes, fire hydrants, valves,

culverts, headwalls, catch basins or inlets, property corner markers, and benchmarks.

- Location of all adjacent and abounding roads or streets and street curbs within limits of work, including driveways and entrances. Type of surfacing and limits should be shown. For public streets, right-of-way widths and centerlines should also be shown.
- Location of all trees, shrubs, and other plants within limits of work. For trees, caliper size should be shown; dead trees should be indicated.
- Location of all overhead telephone and power lines within the limits of work and their related easements.
- Based on existing records, location of underground utilities, such as gas, water, steam, chilled water, electric power, sanitary, storm, combined sewers, and telephone, should be shown. Sizes of pipes (I.D.), invert elevations, inlet, or manhole rim elevations should be indicated. Where appropriate, information should be verified in the field.
- Based on existing records, location of underground storage tanks or other subsurface structures.
- Topography field criteria should include such items as 300 millimeter or 600 millimeter (1 to 2 ft.) contour intervals plotted on a grid system appropriate to the scale of the survey; elevations at top and bottom of ditches and at any abrupt changes in grade; periodic top-of-curb and gutter elevations, as well as street centerline elevations; elevations at all permanent features within the limits of work; ground floor elevations for all existing buildings.
- Bearings and distances for all property lines within the limits of work.
- Official datum upon which elevations are based and the benchmark on or adjacent to the site to be used as a starting point.
- Official datum upon which horizontal control points are based.
- If there are not already two benchmarks on the site, establish two permanent benchmarks.
- Elevations of key data points of all building structures and improvements directly adjacent and across the street from the project site during both wet and dry season.
- Delineate location of any wetlands or floodplains, underground streams, or water sources.

## GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT

On most GSA projects geotechnical investigations will take place at three separate stages: during site selection, during building design, and during construction. The requirements for geotechnical work during site selection and during construction are described in other GSA documents. The requirements for geotechnical work for the building design are defined here. They apply whether GSA contracts for geotechnical work separately or includes the geotechnical investigation in the scope of the A/E services.

### PURPOSE

The purpose of the geotechnical investigation during building design is to determine the character and physical properties of soil deposits and evaluate their potential as foundations for the structure or as material for earthwork construction. The investigation must also determine the hydrological capacities of the soil. The type of structure to be built and anticipated geologic and field conditions have a significant bearing on the type of investigation to be conducted.

The investigation must therefore be planned with knowledge of the intended project size and anticipated column loads, land utilization, and a broad knowledge of the geological history of the area.

The guidelines given here are not to be considered as rigid. Planning of the exploration, sampling and testing programs, and close supervision must be vested in a competent geotechnical engineer and/or engineering geologist with experience in this type of work and licensed to practice engineering in the jurisdiction where the project is located.

1. Analysis of Existing Conditions The report should address the following:

a. Description of terrain

b. Brief geological history

c. Brief seismic history

d. Surface drainage conditions

e. Groundwater conditions and associated design or construction problems

f. Description of exploration and sampling methods and outline of testing methods

g. Narrative of soil identification and classification, by stratum

h. Narrative of difficulties and/or obstructions encountered during previous explorations of existing construction on or adjacent to the site

i. Description of laboratory test borings and results

j. Plot plan, drawn to scale, showing test borings or pits

k. Radon tests in areas of building location

l. Soils resistivity test, identifying resistivity of soil for corrosion protection of underground metals and electrical grounding design

m. Boring logs, which identify:

i. Sample number and sampling method

ii. Other pertinent data deemed necessary by the geotechnical engineer for design recommendations, such as:

(1) Unconfined compressive strength

(2) Standard penetration test values

(3) Subgrade modulus

(4) Location of water table

(5) Water tests for condition of groundwater

(6) Location and classification of rock

(7) Location of obstructions

(8) Atterberg tests

(9) Compaction tests

(10) Consolidation tests

(11) Triaxial compression test

(12) Chemical test (pH) of the soil

(13) Contamination

2. Engineering Recommendations Engineering recommendations based on borings and laboratory testing should be provided for the following:

a. Recommendations for foundation design, with discussion of alternate solutions, if applicable, include:

i. Allowable soil bearing values

ii. Feasible deep foundation types and allowable capacities, where applicable, including allowable tension (pull-out) and lateral subgrade modulus

iii. Feasibility of slab on grade versus structurally supported floor construction, including recommended bearing capacities and recommended subgrade modulus (k)

b. Discussion of evidence of expansive soils and recommended solutions

c. Lateral earth design pressures on retaining walls or basement walls, including dynamic pressures

d. Design frost depth, if applicable

e. Removal or treatment of contaminated soil

f. Discussion of potential for consolidation and/or differential settlements of substrata, with design recommendations for total settlement and maximum angular distortion

g. Use and treatment of in-situ materials for use as engineered fill

h. Recommendations for future sampling and testing

i. Recommendations for pavement designs, including base and sub-base thickness and subdrains

j. Recommendations for foundation and subdrainage, including appropriate details

k. Discussion of soil resistivity values

l. Discussion of soil hydrological capabilities

m. Discussion of radon values and recommendation for mitigating measures, if required

## GEOLOGIC HAZARD REPORT

A geologic hazard report must be prepared for all new building construction in regions of low, moderate, and high seismicity, except for structures located in regions of low seismicity designed to the life safety performance level. Geologic hazard reports are not required for minor or relatively unimportant facilities for which earthquake damage would not pose a significant risk to either life or property.

### REQUIRED INVESTIGATION

When required by the project scope, a geologic hazard investigation that addresses the hazards indicated below should be performed. Whenever possible, a preliminary investigation should be performed in the planning stage of siting a facility, to provide reasonable assurance that geologic hazards do not preclude construction at a site. During a later stage of geotechnical investigations for a facility at a selected site, supplemental investigations may be conducted as needed to define the geologic hazards in more detail and/or develop mitigating measures. The scope and complexity of a geologic hazard investigation depends on the economics of the project and the level of acceptable risk. In general, major new building complexes, high-rise buildings, and other high value or critical facilities must have thorough geologic hazard investigations. Small, isolated buildings need not have elaborate investigations.

### SURFACE FAULT RUPTURE

For purposes of new building construction, a fault is considered to be an active fault and a potential location of surface rupture if the fault exhibits any of the following characteristics:

- Has had documented historical macroseismic events or is associated with a well-defined pattern of microseismicity
- Is associated with well-defined geomorphic features suggestive of recent faulting
- Has experienced surface rupture (including fault creep) during approximately the past 10,000 years (Holocene time)

Fault investigations must be directed at locating any existing faults traversing the site and determining the recency of their activity. If an active fault is found to exist at a site and the construction cannot reasonably be located elsewhere, investigations must be conducted to evaluate the appropriate set-back distance from the fault and/or design values for displacements associated with surface fault rupture.

### SOIL LIQUEFACTION

Recently deposited (geologically) and relatively unconsolidated soils and artificial fills, without significant cohesion and located below the water table, are susceptible to liquefaction. Sands and silty sands are particularly susceptible. Potential consequences of liquefaction include foundation bearing capacity failure, differential settlement, lateral spreading and flow sliding, flotation of lightweight embedded structures, and increased lateral pressures on retaining walls. The investigation must consider these consequences in determining the size of the area and the depth below the surface to be studied. An investigation for liquefaction may take many forms. One acceptable method is to use blow

count data from the standard penetration test conducted in soil borings. This method is described in publications by H. B. Seed and I. M. Idriss, (1982), Ground Motions and Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, Oakland, CA, Monograph Series, 134 p. and H.B. Seed et al, (1985) "The Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations": Journal of Geotechnical Engineering, ASCE 111(12): pp. 1425-1445.

## LANDSLIDING

New construction must not be sited where it may be within a zone of seismically induced slope failure or located below a slope whose failure may send soil and debris into the structure. Factors that affect slope stability include slope angle, soil type, bedding, ground water conditions, and evidence of past instability. The geologic hazard investigation must address the potential for seismically induced slope deformations large enough to adversely affect the structure.

## DIFFERENTIAL SETTLEMENT

Loosely compacted soils either above or below the water table can consolidate during earthquake shaking, producing surface settlement. The potential for total and differential settlements beneath a structure must be assessed. If liquefaction is not expected to occur, then in most cases, differential settlement would not pose a significant problem to construction.

## FLOODING

Earthquake-inducing flooding can be caused by tsunamis, seiches, and dam and levee failures. The possibility of flooding must be addressed for new construction located near bodies of water.

## DURATION OF STRONG GROUND SHAKING

Estimates of the duration of strong ground shaking at a site are defined by earthquake magnitude and must be used to assess geologic hazards such as liquefaction and slope failure. Strong motion duration is strongly dependent on earthquake magnitude. Estimates of the duration of strong ground shaking must be based on the assumption of the occurrence of a maximum considered earthquake generally accepted by the engineering and geologic community as appropriate to the region and to the subsurface conditions at the site.

## MITIGATIVE MEASURES

A site found to have one or more geologic hazards may be used, provided the hazards are removed, abated, or otherwise mitigated in the design, or if the risk is judged to be acceptable. Examples of mitigative measures include: removal and recompaction of poorly compacted soils; use of special foundations; stabilizing slopes; and draining, compaction, or chemical treatment of liquefiable soils. The geological hazard report must identify feasible mitigative measures.

## REQUIRED DOCUMENTATION

Investigations of geologic hazards must be documented. As noted in the paragraph entitled "Required Investigation" above, a preliminary geologic hazard investigation must be conducted and a report issued during the siting phase for a facility. However, unless the geologic hazard investigations have been documented in a stand-alone report, they must be addressed in a section of the geotechnical engineering report prepared during the design phase of a project. The geologic hazard report, whether it is a separate report or a section of the geotechnical engineering report, must at a minimum contain the following:

- List of hazards investigated, which must include the five described earlier in this section
- Description of the methods used to evaluate the site for each hazard
- Results of any investigations, borings, etc.
- Summary of findings
- Recommendations for hazard mitigation, if required
- In some cases, estimates of site ground motions may be needed for assessment of geologic hazards such as liquefaction and slope failure.

## A.6 GSA STORMWATER MANAGEMENT SUBMISSION

See GSA's landscape architecture website: https://www.gsa.gov/real-estate/design-construction/landscape-architectural-program

## A.7 ENERGY ANALYSIS INPUT AND OUTPUT

This Appendix defines the procedures to achieve compliance with the requirements in Section 5.3 (Energy Analysis).

### PROCEDURES

The A/E must reference and utilize the following format for building input parameters, schedules of building operations, and categories for reporting results for the baseline and alternate building models. These procedures must be consistent throughout the design process. Input parameters and output data must be provided in all document submissions (see Section 5.3).

At each phase of the design process (i.e., conceptual design, design development, and construction documentation), the A/E must provide inputs as indicated in this appendix, if they are not otherwise defined in the program requirements (see P100 Section 5.3). The A/E must refer to ASHRAE Standard 90.1 (including addenda) documents for climate zone and other pertinent information as may be required. If any changes are required to these input values due to special field conditions, the A/E must adjust the inputs giving an explanation in the beginning of the energy analysis report.

The analysis must document the sources of input data and all assumptions.

### CONCEPTUAL DESIGN

The A/E must conduct a baseline and proposed (30% better than ASHRAE 90.1) energy analysis for each of the three preliminary concepts (see Section A.3), using approved simulation software (See P100 Section 5.3). The primary variables in these analyses are orientation and massing. For the conceptual design, the baseline performance parameters for the envelope, which include glazing, must be equal to the prescriptive minimum values listed in the applicable sections of ASHRAE Standard 90.1. All other baseline parameters and input values as may be necessary to complete the model must be the minimum compliance values listed in the applicable sections of ASHRAE Standard 90.1. For the conceptual design analyses, glass and wall ratios and the shape must be configured to achieve the requirements of Chapters 1, 2, 3, 5, and 6 of P100.

Building site-energy and property site-energy consumption rates must be calculated for each of the three concepts using at a minimum the following categories (Output in Btu/GSF/year): Equipment, Lighting, Task Lighting, Space Heating, Space Cooling, Heat Rejection, Pumps and Auxiliary, Domestic Hot Water, IT Room/Mini Data Center, External usage, Renewables and others as deemed necessary to accurately model energy consumption. For comparison purposes, all energy system alternatives for each concept must be adjusted to equivalent building site-energy consumption rates.

For the final concept submission, the energy analysis must provide output data to indicate optimization of the envelope, massing, and orientation that minimize the annual building or property site-energy consumption rates. This energy analysis report must include a statement summarizing the optimization findings and comparing the results with the energy target (see Chapter 1).

### DESIGN DEVELOPMENT

The A/E must optimize system performance using simulation software (See P100, Section 5.3) to minimize annual building site-energy and property site-energy consumption rates. All other parameters and input values as may be necessary to complete the model must be obtained from those used in the final concept simulations.

Project-specific envelope construction details must be applied as determined and detailed on the project submission drawings by the A/E. These analyses must be performed for the HVAC system as approved in the Final Concept submittal, in accordance with P100.

If alternative HVAC systems and components are to be considered (see Section 5.5), energy analyses must be conducted and compared to the results from the analysis of the reference system that has the lowest first cost of the alternatives being considered, in accordance with P100, Sections 1.10 and 5.3. These results must also be used as the input data to the life-cycle analysis required in P100, Section 1.10.2.8. At completion of the DD phase, the system selection must be completed from which annual building site-energy and property site-energy consumption rates must be calculated.

For the 100 percent DD submission, the energy analysis must provide output data to indicate optimization of the baseline reference system and any cost-effective alternatives that minimize the annual building or property site-energy consumption.
This energy analysis report must include a statement summarizing the optimization findings and comparing the results with the final concept results. Additionally, this analysis must continue to document the sources of input data and all assumptions, and refinements to the assumptions made in the concept phase.

Equipment performance capacities and full- and part-load efficiencies must be substantiated by including representative equipment selections from manufacturers forming the basis of design. At least two additional simulations must be conducted to determine this impact of the input assumptions, which are to be varied to their maximum, or worst-case minimum, limits.

## CONSTRUCTION DOCUMENTS

The A/E must refine the optimized results from the 100 percent DD submission by using the actual input values rather than the assumed input values for the envelope, lighting, and power wattage, assumed pump heads and fan static pressures, HVAC and thermal zoning criteria, and schedules of operation

For the 90 percent construction document (CD) submission, the energy analyses must provide updated listings of input values including schedules of operation, and output data to indicate refinements in the optimization of the baseline and any cost-effective alternatives in the 100 percent DD analysis that minimize the annual building or property site-energy consumption rate. The 90 percent CD energy analysis report must include a statement summarizing the refined optimization findings and comparing the results with the 100 percent DD results.

# B.1 REFERENCES

## LIST OF REFERENCE PUBLICATIONS AND WEBSITES

All references are to the edition in effect at the time of execution of the A/E contract for the project, unless noted otherwise.

### INTRODUCTION

The following references apply to all P100 chapters.

### PUBLICATIONS

- Guiding Principles of Federal Architecture
- Hallmark of the Productive Workplace
- 42 U.S.C. 4151 et seq., Architectural Barriers Act Accessibility Standard (ABAAS)

### WEBSITES

- www.gsa.gov/firstimpression (First Impressions Program)
- www.gsa.gov/portal/category/101130 (Total Workplace Program)
- www.gsa.gov/bim (3D-4D Building Information Modeling)
- www.gsa.gov/portal/category/21595 (Building Commissioning Guide)

## CHAPTER 1 GENERAL REQUIREMENTS

### GENERAL REQUIREMENTS

The following references apply to all P100 chapters.

### PUBLICATIONS—GENERAL FEDERAL

- 40 U.S.C. 581(h), Public Buildings Cooperative Use Act of 1976
- Energy Policy Act of 2005
- National Historic Preservation Act of 1966 as amended (NHPA)
- 40 CFR, Protection of Environment
- Federal Management Regulation (FMR), based on the Public Buildings Amendments of 1988, Title 40, Subtitle II, Part A, Chapter 33, Section 3312
- 36 CFR 67, Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings
- 29 CFR 1926, Safety and Health Regulations for Construction, Section 1926.62, Lead (including lead-based paint)
- 29 CFR 1910 Occupational Safety and Health Standards, Section 1910.146(b)—Definition of "Confined space"
- Executive Order 13502, Use of Project Labor Agreements for Federal Construction Projects, February 6, 2009 http://edocket.access.gpo.gov/2009/pdf/E9-3113.pdf
- Planning for Federal Sustainability in the Next Decade EPA Comprehensive Procurement Guidelines (CPG) (recycled products) https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program

- USDA BioPreferred Program www.biopreferred.gov
- DOE Guidance for Electric Metering in Federal Buildings DOE/EE 0312
- Food, Conservation and Energy Act of 2008
- Farm Security and Rural Investment Act of 2002
- Architectural Barriers Act Accessibility Standard (ABAAS)
- FMR Part 102-76 (Design and Construction), Subpart C (Architectural Barriers Act)
- 36 CFR Part 1191 Appendices C and D (ABA Chapters 1-10)

## PUBLICATIONS RELATED TO SPECIFIC GSA PBS PROGRAMS

### GENERAL

- PBS Pricing Desk Guide
- GSA BIM Guide Series www.gsa.gov/bim
- PBS National Business Space Assignment Guide www.gsa.gov/sdm
- GSA 3490.2 on Document Security for Sensitive But Unclassified Building Information
- Agency Space Allocation and Reduction Policies

### ACCESSIBLE DESIGN

- 42 U.S.C. 4151 et seq., Architectural Barriers Act Accessibility Standard (ABAAS)
- Federal Courthouses
- GSA Courthouse Visitor's Guide, February 2003
- GSA Courthouse Project Handbook, August 2004
- U.S. Courts Design Guide
- U.S. Marshals Service Judicial Security Systems Requirements and Specifications, Volume 3, Publication 64, 2005
- U.S. Marshals Service Requirements and Specifications for Special Purpose and Support Space, Volume One: Architectural & Engineering, 2007; Volume Two: Electronic Security & Hardware, 2007

### ART IN ARCHITECTURE AND FINE ARTS

- GSA PBS Art in Architecture Program, Policies and Procedures
- GSA PBS Fine Arts Program Policies and Procedures
- Office of Design and Construction
- GSA PBS Project Management Guide
- GSA PBS Project Planning Guide
- GSA PBS Project Estimating Requirements Guide
- GSA PBS Building Commissioning Guide
- GSA PBS Site Selection Guide

### CHILDCARE CENTERS

- Child Care Center Design Guide (PBS-P140)
- Accreditation Criteria and Procedures of the National Association for the Education of Young Children (NAEYC)

### DESIGN EXCELLENCE

- GSA PBS Design Excellence Policies and Procedures
- GSA PBS Design Excellence in Leasing Guide

# APPENDIX B: RESOURCES

## LAND PORTS OF ENTRY

- United States Land Port of Entry Design Guide 2014

## SECURITY

- The Risk Management Process: An Interagency Security Committee Standard, and the General Services Administration Facility Security
- GSA's Interpretation of the Interagency Security Committee (ISC) Risk Management Process
- GSA Alternate Path Analysis and Design Guidelines for Progressive Collapse Resistance

## SUSTAINABILITY

- Guiding Principles for Sustainable Federal Buildings—https://www.gsa.gov/portal/category/21083

## PUBLICATIONS FROM INDUSTRY

- American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA):
- Z10-2005, American National Standard—Occupational Health and Safety Management Systems
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
- Standard 62.1-2004—Ventilation for Acceptable Indoor Air Quality
- ASHRAE Fundamentals Handbook
- International Code Council (ICC)
- International Building Code (IBC)
- International Fire Code (IFC)
- International Green Construction Code (IGCC)
- International Mechanical Code (IMC)
- International Plumbing Code (IPC)
- International Property Maintenance Code (IPMC)
- International Fuel Gas Code (IFGC)
- International Private Sewage Disposal Code (IPSDC)
- International Zoning Code (IZC)
- International Wildland-Urban Interface Code (IWUIC)
- International Energy Conservation Code (IECC)
- International Existing Building Code (IEBC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)
- National Fire Protection Association (NFPA) www.nfpa.org
- NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 101: Life Safety Code
- NFPA 70: National Electrical Code
- American Institute of Architects (AIA) www.aia.org
- AIA Document E202 – Building Information Modeling Protocol Exhibit

## ADDITIONAL WEBSITES

- www.iccsafe.org (International Code Council)
- www.wbdg.org (Whole Building Design Guide)

- www.sftool.gov/nze (Sustainable Facilities Tool)

## CHAPTER 2 SITE ENGINEERING AND LANDSCAPING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 2.

### PUBLICATIONS

- 33 U.S.C. 1251 Federal Water Pollution Control Act (Clean Water Act)
- GSA PBS The Site Selection Guide
- GSA ADM 1095.6, Consideration of Floodplains in Decision Making
- GSA PBS Wetlands Impact Management Desk Guide
- GSA PBS NEPA Desk Guide
- GSA PBS Sustainability Matters www.gsa.gov/sustainabledesign
- U.S. Army Corps of Engineers
  Wetlands Delineation Manual
- American National Standards Institute (ANSI)
- American Standard for Nursery Stock/American National Landscape Association (ANLA)
- EPA Document No. EPA-832-R-92-005

### ADDITIONAL WEBSITES

- www.gsa.gov/enviroprograms (Environmental Program)
- www.access-board.gov (Access Board)
- www.gsa.gov/nepa (NEPA)
- www.epa.gov/owow/nps/lid/lidlit.html
  (EPA Low Impact Development (LID) Literature Review and Fact Sheets)
- www.invasivespeciesinfo.gov (USDA Invasive Species)
- http://www.cpted.net/ (Crime Prevention Through Environmental Design—CPTED)
- https://www.usgbc.org/resources/synergies-between-sites-and-leed (SITES/LEED Synergies)

## CHAPTER 3 ARCHITECTURE AND INTERIOR DESIGN

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 3.

### PUBLICATIONS

- Fine Arts Policies and Procedures, Appendix F
- PBS Order No. 3490.2, Document Security for Sensitive but Unclassified Paper and Electronic Building Information, Section 7.d.(1.)

### PUBLICATIONS FROM INDUSTRY

- American Architectural Manufacturers Association (AAMA)
- 1502.7, Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections
- 101/I.S.2/A440-05, Standard/Specification for Windows, Doors, and Unit Skylights (includes AAMA/WDMA 101/I.S.2/NAFS)
- 1600 Voluntary Specification for Skylights

- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- American Society of Mechanical Engineers (ASME)
- A17.1 Safety Code for Elevators and Escalators
- A18.1 Safety Standard for Platform Lifts and Stairway Chairlifts
- American Society of Testing and Materials (ASTM)
- C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
- C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
- C645, Standard Specification for Nonstructural Steel Framing Members
- C1371, Standard Test Method For Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- C1396, Standard Specification for Gypsum Board
- E90, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building
- E336, Standard Test Method for Measurement of Airborne Sound Insulation in Buildings
- E903, Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- E1007, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures
- E1130, Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
- E1414, Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
- E1918, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1946, Standard Practice for Measuring Cost Risk of Buildings and Building Systems
- E1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque
- E2396, Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Roof Systems
- E2397, Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems
- E2398, Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
- E2399, Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
- E2400, Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
- American National Standards Institute (ANSI)
- ANSI/ASSE Provision of Slip Resistance on Walking/Working Surfaces
- Architectural Woodwork Institute (AWI)
- Architectural Woodwork Quality Standards (for grades of interior architectural woodwork, construction, finishes, and other requirements)
- Brick Industry Association

- Technical Notes on Brick Construction
- Indiana Limestone Institute (ILI)
- ILI Handbook
- Marble Institute of America
- Dimension Stone Design Manual
- National Concrete Masonry Association (NCMA)
- TEK Manual for Concrete Masonry Design and Construction
- Annotated Design and Construction Details for Concrete Masonry
- National Roofing Contractors Association (NRCA)
- Roofing Manual: Membrane Roof Systems
- Roofing and Waterproofing Manual
- Steep-Slope Roofing Manual
- Architectural Metal and Sheet Metal Roofing Manual
- Precast/Prestressed Concrete Institute
- Architectural Precast Concrete
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- Architectural Sheet Metal Manual
- Steel Door Institute (SDI)
- SDI 122-99 Installation and Troubleshooting Guide for Standard Steel Doors and Frames
- Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)
- TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces

## CHAPTER 4 STRUCTURAL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 4.

### PUBLICATIONS

- Interagency Committee on Seismic Safety in Construction (ICSSC)
- American Society of Civil Engineers
  - ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
  - ASCE/SEI 41 Seismic Evaluation and Retrofit of Existing Buildings

## CHAPTER 5 MECHANICAL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 5.

### PUBLICATIONS

- American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
- Handbook of Fundamental
- Handbook of Refrigeration
- Handbook of HVAC Applications
- Handbook of HVAC Systems and Equipment
- Standard 15: Safety Code for Mechanical Refrigeration

- Standard 52.2: Method of Testing: General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- Standard 55: Thermal Environmental Conditions for Human Occupancy
- Standard 62.1: Ventilation for Acceptable Indoor Air Quality
- Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings
- Standard 100-2006: Energy Conservation in Existing Buildings
- Standard 105-1999: Standard Method of Measuring and Expressing Building Energy Performance
- Standard 111-1988: Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC Systems
- Standard 113-2005: Method of Testing for Room Air Diffusion
- Standard 135-2004: BACnet: A Data Communication Protocol for Building Automation and Control Networks
- Guideline 0-2005: The Commissioning Process
- Guideline 4-2008: Preparation of Operating and Maintenance Documentation for Building Systems
- Guideline 12-2000: Minimizing the Risk of Legionellosis Associated with Building Water Systems
- Guideline 29-2007: Guideline for Risk Management of Public Health and Safety in Buildings
- American National Standards Institute (ANSI)
- ANSI Z 223.1., National Fuel Gas Code
- American Society of Plumbing Engineers (ASPE)
- ASPE Data Books
- American Society for Testing and Materials (ASTM)
- ASTM E-84, Surface Burning Characteristics of Building Materials
- Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA)
- HVAC Duct Construction Standards: Metal and Flexible HVAC Air Duct Leakage Test Manual
- Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
- Seismic Restraint Manual Guidelines for Mechanical Systems
- National Fire Protection Association (NFPA)
- NFPA 70, National Electrical Code
- NFPA 101, Life Safety Code
- EIA/TIA Standard 569
- Commercial Building Standard For Telecommunications Pathways and Spaces (and related bulletins)
- Underwriters Laboratories (UL)
- UL 710, Standard for Exhaust Hoods for Commercial Cooking Equipment

### WEBSITES

- www.energystar.gov/products/certified-products (ENERGY STAR Certified Products)
- https://energy.gov/eere/femp/search-energy-efficient-products
- (FEMP Designated Products)

## CHAPTER 6 ELECTRICAL ENGINEERING

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 6.

### PUBLICATIONS

- ANSI/NETA ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

- ANSI/NETA ECS, Standard for Electrical Commissioning Specifications for Electrical Power Equipment and Systems
- ANSI/NETA ETT, Standard for Certification of Electrical Testing Technicians
- ANSI/NETA MTS, Maintenance Testing Specifications for Electrical Power Equipment and Systems
- ASME: American Society of Mechanical Engineers
- ASME A17.1, Safety Code for Elevators and Escalators
- ASTM: American Society for Testing and Materials
- ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- BICSI, (Building Industry Consulting Service International) Telecommunications Distribution Methods Manual
- BICSI, Wireless Design Reference Manual
- California Energy Commission
- , Building Energy Efficiency Standards (Title 24) (most current edition)(for California projects only)
- ETL: Electrical Testing Laboratories
- FAA: Federal Aviation Agency
- Federal Information Processing Standard 175, Federal Building Standard for Telecommunication Pathways and Spaces
- IEEE Standard 1789, IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers
- IES: Illuminating Engineering Society of North America
- IES Lighting Handbook
- IES G-1 Guideline for Security Lighting for People, Property, and Public Spaces
- IES RP-1, American National Standard Practice of Office Lighting
- IES RP-5, Recommended Practice for Daylighting
- IES RP-8, Roadway Lighting
- IES RP-20, Lighting for Parking Facilities
- IES LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IES LM-80, Measuring Lumen Maintenance of LED Light Sources
- IES LM-83, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)
- IES TM-15, Luminaire Classification System for Outdoor Luminaires
- IES TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources
- IEEE: Institute of Electrical and Electronics Engineers
- ICEA: Insulated Cable Engineers Association
- NEMA: National Electrical Manufacturers Association
- NETA: International Electrical Testing Association
- NETA/ANSI EIT , Standard for Certification of Electrical Testing Technicians
- NETA/ANSI ECS, Standard Electrical Commissioning Specifications for Electrical Power Equipment and Systems
- NETA/ANSI ATS, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- NFPA: National Fire Protection Association
- NFPA 70, National Electrical Code
- NFPA 70E, Standard for Electrical Safety in the Workplace
- NFPA 101, Life Safety Code
- NFPA 110, Standard for Emergency and Standby Power Systems
- NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems

- NFPA 780, Standard for the Installation of Lightning Protection Systems
- UL: Underwriters' Laboratories
- UL50, Enclosures for Electrical Equipment for Types 12, 3, 3R, 4, 4X, 5, 6, 6P, 12, 12K, and 13
- UL67, Panelboards
- UL 96 , Marking and Application Guide Lightning Protection
- UL1558, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- UL1598C, Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
- 10 CFR 431 part 196 Transformer Efficiencies

### WEBSITES

- https://www.energystar.gov/products/certified-products (ENERGY STAR Certified Products)

## CHAPTER 7 FIRE PROTECTION

In addition to references cited for the Introduction and Chapter 1, the following are relevant to Chapter 7.

### PUBLICATIONS

- American Society of Mechanical Engineers (ASME)
- ASME A17.1, Safety Code for Elevators and Escalators
- American Society for Testing Materials (ASTM)
- ASTM E-2073, Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings
- Code of Federal Regulations (CFR)
- CFR 36 Part 1228, Subpart K—Facility Standards or Record Storage Facilities
- International Code Council (ICC)
- International Building Code (IBC)
- International Fire Code (IFC)
- International Residential Code (IRC)
- International Code Council Performance Code (ICCPC)
- National Archives and Records Administration (NARA)
- NARA Directive 1571
- National Fire Protection Association (NFPA)
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
- NFPA 14, Standard for the Installation of Standpipe and Hose Systems
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 75, Standard for the Protection of Information Technology Equipment
- NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
- NFPA 101, Life Safety Code

## APPENDIX B: RESOURCES

- NFPA 170, Standard for Fire Safety Symbols
- NFPA 214, Standard on Water-Cooling Towers
- NFPA 232, Standard for the Protection of Records
- NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- NFPA 914, Code for Fire Protection of Historic Structures
- Society of Fire Protection Engineers (SFPE)
- SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design for Buildings
- SFPE Handbook of Fire Protection Engineering
- Underwriters Laboratories (UL)
- UL 1994 Standard for Luminous Egress Path
- Marking Systems

Figure 21: U.S. Coast Guard Headquarters Fountain, Washington, DC

## B.2 ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A/E | Architect/Engineer |
| AAMA | American Architectural Manufacturers Association |
| ABA | Architectural Barriers Act of 1968 |
| ABAAS | Architectural Barriers Act Accessibility Standard |
| ACM | Asbestos-Containing Material |
| AHJ | Authority Having Jurisdiction |
| AHU | Air-Handling Unit |
| AIHA | American Industrial Hygiene Association |
| AISC | American Institute of Steel Construction |
| ALS | Assisted Listening System |
| ANLA | American National Landscape Association |
| ANSI | American National Standards Institute |
| ASHRAE | American Society of Heating, Refrigerating, and Air-Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASPE | American Society of Plumbing Engineers |
| ASTM | American Society of Testing and Materials |
| ATS | Automatic Transfer Switch |
| AWI | Architectural Woodwork Institute |
| BAS | Building Automation System |
| BICSI | Building Industry Consulting Service International |
| BIM | Building Information Modeling |
| BIS | Building Information Specialist |
| BIMr | Regional BIM Manager |
| BLCC | building life-cycle cost |
| BOMA | Building Owners and Managers Association International |
| BPP | Building Preservation Plan |
| CATV | cable television |
| CCMG | Central Courthouse Management Group |
| CCT | Correlated Color Temperature |
| CD | construction document |
| CFR | Code of Federal Regulations |
| CPG | Comprehensive Procurement Guidelines |
| CPTED | Crime Prevention through Environmental Design |
| CRI | color rendering index |
| CSC | Court Security Committee |
| DC | direct current |
| DD | design development |
| DDC | direct digital control |
| DNL | day-night average noise level |
| ECS | Electrical Commissioning Specifications |
| EIA | Electronic Industries Alliance |
| EISA | Energy Independence and Security Act of 2007 |
| EPAct | Energy Policy Act of 2005 |
| EPR | ethylene propylene rubber |
| FAR | Federal Acquisition Regulation |

| | |
|---|---|
| FAS | Federal Acquisition Service |
| FC | Foot-candle |
| FCxA | fire commissioning agent |
| FEMP | Federal Energy Management Program |
| FIIC | field impact isolation class |
| FMR | Federal Management Regulation |
| FPS | Federal Protective Service |
| FPT | functional performance test |
| FSC | Facility Security Committee |
| FTE | full-time equivalent |
| GFI | ground fault interrupt |
| GSA | General Services Administration |
| Gsf | gross square feet |
| HB | heat balance |
| HET | high efficiency toilet |
| HEU | high efficiency urinal |
| HVAC | heating, ventilating, and air conditioning |
| IBC | International Building Code |
| ICC | International Code Council |
| ICSSC | Interagency Committee on Seismic Safety in Construction |
| IEBC | International Existing Building Code |
| IESNA | Illuminating Engineering Society of North America |
| IG | isolated ground |
| ILI | Indiana Limestone Institute |
| IMC | intermediate metallic conduit |
| IRC | international residential code |
| IRMA | inverted membrane roof assembly |
| ISC | Interagency Security Committee |
| ISO | International Organization for Standardization |
| LCC | life-cycle costing |
| LED | light-emitting diode |
| LEED | Leadership in Energy and Environmental Design |
| LID | Low impact development |
| LPD | lighting power density |
| LPW | lumen per watt |
| LRFD | load resistance factor design |
| MCC | motor control center |
| MERV | minimum efficiency reporting value |
| MRL | machine-roomless |
| NAEYC | National Association for the Education of Young Children |
| NARA | National Archives and Records Administration |
| NC | noise criteria |
| NCMA | National Concrete Masonry Association |
| NEII | National Elevator Industries, Inc. |
| NEPA | National Environmental Policy Act |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NETA | International Electrical Testing Association |
| NFPA | National Fire Protection Association |

| | |
|---|---|
| NHPA | National Historic Preservation Act |
| NIC | noise isolation class |
| NIST | National Institute of Standards and Technology |
| NRCA | National Roofing Contractors Association |
| OAVS | outdoor air ventilation system |
| OMB | Office of Management and Budget |
| OSHA | Occupational Health and Safety Administration |
| P100 | Public Buildings Service PBS 100 |
| PBS | Public Buildings Service |
| PBS -P140 | Child Care Center Design Guide |
| PCI | Precast Concrete Institute |
| PDU | power distribution unit |
| PF | power factor |
| PV | photovoltaic system |
| PWM | pulse width modulation |
| R&A | repairs and alterations |
| RAF | raised access floor |
| RC | room criteria |
| RH | relative humidity |
| ROD | record of decision |
| RTS | radiant time series |
| SAA | sound absorption average |
| SBU | sensitive but unclassified |
| SCAQMD | South Coast Air Quality Management District |
| SDI | Steel Door Institute |
| SDM | Spatial Data Management |
| SFO | solicitation for offers |
| SFPE | Society of Fire Protection Engineers |
| SLC | signaling line circuits |
| SMACNA | Sheet Metal and Air Conditioning Contractors' National Association |
| STC | sound transmission class |
| TAB | testing, adjusting, and balancing |
| TBC | Total Building Commissioning |
| TDS | total dissolved solid |
| TFM | transfer function method |
| THD | total harmonic distortion |
| TI | tenant improvement |
| TIA | Telecommunications Industry Association |
| TTY | text telephone |
| UL | Underwriters Laboratory |
| UPS | uninterruptible power supply |
| USCDG | U.S. Courts Design Guide |
| USMS | U.S. Marshals Service |
| UST | underground storage tank |
| VAV | variable air volume |
| VFD | variable frequency drive |
| VM | Value Management |
| VOC | volatile organic compound |
| XLP | cross-linked polyethylene |

## C.1 SUMMARY OF CHANGES FOR P100 2018 VERSION

| Section Number | Section Title | Summary of Change |
|---|---|---|
| Throughout | N/A | Introduction of images |
| Throughout | N/A | Changed all references to lease construction to **Lease construction facilities that the Government intends to own or has an option to purchase** |
| Throughout | N/A | Introduced tech tips as described in 1.7.2.3 |
| Throughout | N/A | Removed text following performance tables that was a copy of the information in the table |
| Throughout | N/A | Removed all references to ASHRAE 90.1 dates and instead reference the Secretary of Energy ASHRAE rule. |
| N/A | Introduction | Clarified the application of the performance levels and requires the use of the P100 Performance Matrix |
| 1.2 | Application of P100 | Clarified the use of P100 for all projects |
| 1.2.1, 1.2.2, 1.2.3, 1.2.4 | Varies | Updated and clarified language |
| 1.3.2, 1.3.4, 1.3.11 | Varies | Updated and clarified language |
| 1.3.12 | Facility Definitions | New Section |
| 1.4.2, 1.4.5 | Varies | Updated and clarified language |
| 1.7.1 | Key Sustainable Products | This section was removed |
| 1.7.1 | LEED Certification | Updated references |
| 1.7.2.1, 1.7.2.2 | Varies | Updated and clarified language |
| 1.10.3 | Building Information Modeling | Updated requirements |
| 1.10.5 | Building Operations and Maintenance | Updated requirements |
| 1.10.5.1 | Worker Access | New Section |
| 1.10.5.2 | Removal and Replacement | New Section |
| 1.10.5.3 | Verification | New Section |
| 1.10.5.4 | Turn-Over | New Section |
| 1.10.7 | Resilience Management of Climate Related and Extreme Weather Risk | Updated requirements |
| 2.2 | Urban Planning | Updated requirements |
| 2.5.4 | Parking Fields | Updated requirements |
| 3.2.1.3 | Flood Resistant Design and Construction | Updated requirements |

## APPENDIX C: SUMMARY OF CHANGES

| Section Number | Section Title | Summary of Change |
|---|---|---|
| 3.2.3.5 | Vegetative Roofing Systems | Updated requirements |
| 3.2.3.6 | Testing and Monitoring of Roofing and Horizontal Waterproofing | Updated requirements |
| 3.2.3.7 | Ground Water Control | Updated requirements |
| 3.2.9 | Enclosure Service Life | Updated requirements |
| 3.3.2.6 | Underslab Vapor Barrier | New Section |
| 3.3.4.2 | Materials and organic Content | Updated requirements |
| 3.3.4.3 | Air and Moisture Barrier System | Updated requirements |
| 3.3.7.1 | Roofing Design | Updated requirements |
| 3.3.7.2 | Re-Roofing | Updated requirements |
| 3.3.7.4 | Insulation | Updated requirements |
| 3.3.7.5 | Roof Mounted Equipment | Updated requirements |
| 3.3.7.7 | Skylights and Sloped Glazing | Updated requirements |
| 3.3.8.1 | Mock-ups | Updated requirements |
| 3.3.8.2 | Air Barrier Testing | Updated requirements |
| 3.3.9 | Sun Control Devices | Updated requirements |
| 3.5.1.2 | Hollow Metal Doors | Updated references |
| 3.5.2.1 | Broadloom/Carpet Tile | Updated requirements |
| 3.5.2.2 | Vinyl Composition Tile | Updated requirements |
| 3.5.2.3 | Sheet Vinyl | Updated requirements |
| 3.5.2.4 | Rubber Tile | Updated requirements |
| 3.5.2.5 | Linoleum | Updated requirements |
| 3.5.2.6 | Pressed Floor Tile | Updated requirements |
| 3.5.2.7 | Porcelain tile | Updated requirements |
| 3.5.2.8 | Quarry Tile | Updated requirements |
| 3.5.2.9 | Mosaic Tile | Updated requirements |
| 3.5.2.19 | Interior Coatings | Updated requirements |
| 3.5.2.21 | Wall Covering Type II | Updated requirements |
| 3.5.2.27 | Acoustical Ceilings | Updated requirements |
| Table 3.1 | Acoustical Performance | New table |
| 3.6 | General Architecture | Reorganized existing requirements in new section |

## APPENDIX C: SUMMARY OF CHANGES

| Section Number | Section Title | Summary of Change |
|---|---|---|
| 3.7 | Workplace Performance Requirements | Updated requirements |
| 3.8.7.2 | Wayfinding | New Section |
| 4.2.2.2 | Seismic Resistance of Structure Lateral Force Resisting System | Updated References |
| 4.3.5 | Structural Loads | Updated requirements |
| 4.3.6 | Structural Systems and Elements | Updated requirements |
| 4.3.9 | Seismic Instrumentation | Updated requirements |
| 4.5 | Physical Security Performance Attributes | Updated requirements |
| 5.2.2 | Humidity Control | Updated requirements |
| 5.3.2.5 | Roof Mounted Equipment | Updated requirements |
| 5.3.2.6 | Special Area HVAC Systems | Updated requirements |
| 5.3.3.6 | Hydronic, Steam, Natural Gas and Fuel Oil Piping | Updated requirements |
| 5.3.5.4 | Corrosion Monitoring | New Section |
| 5.3.5.9 | Piping Insulation | Updated requirements |
| 5.3.6.5 | Kitchen Faucets | New Section |
| 5.3.6.8 | Plumbing Piping | Updated requirements |
| 5.3.6.9 | Gas and Fuel Oil Piping | Updated requirements |
| 6 | Electrical Engineering | Updated requirements to entire chapter |
| 7.1.3.1 | Design Team Fire Protection Engineer | Updated requirements |
| 7.1.3.4 | Certificate of Occupancy | Updated requirements |
| 7.3.1 | Fire Safety During New Construction Projects | Updated requirements |
| 7.3.1.1 | Fire Protection Systems | Deleted this section |
| 7.3.2 | Fire Safety During Renovation Projects | New Section |
| 7.3.3 | Fire Safety During Demolition projects | New Section |
| 7.3.4 | Existing Fire Protection Systems | New Section |
| 7.4.1 | Special Requirements | Updated requirements |
| 7.4.2 | Evacuation Route Signage | Updated requirements |
| 7.4.3 | Exit Stair Path Markings | Updated requirements |
| 7.4.4 | Exit Stairway Identification Signage | Updated requirements |
| 7.6 | Fire Alarm and Emergency Communication Systems | Updated requirements |
| 7.6.1 | Manual Fire Alarm Boxes | Updated requirements |
| 7.6.3 | Smoke Detectors | Updated requirements |

## APPENDIX C: SUMMARY OF CHANGES

| Section Number | Section Title | Summary of Change |
|---|---|---|
| 7.6.5 | Visible Notification Appliances | Updated requirements |
| 7.6.6 | Occupant Notification | Updated requirements |
| 7.6.8 | Survivability for Fire Alarm and Emergency Communication Systems | Updated requirements |
| 7.7.1 | Fire Pumps | Updated requirements |
| 7.8 | Automatic Sprinkler and Standpipe Systems | Updated requirements |
| 7.8.2 | Sprinkler Piping | Updated requirements |
| 7.8.3 | Automatic Sprinkler Systems for Remote or Isolated Facilities | Updated requirements |
| 7.10.1 | Fire Service Access Elevators | Updated requirements |
| 7.10.2 | Occupant Evacuation Elevators | Updated requirements |
| 7.11.6 | Residential Dwelling Units | Updated requirements |
| 7.16 | Commissioning Fire Protection and Life Safety Systems | Updated requirements |
| 7.17 | Integrated Fire Protection and Life Safety System Testing | New Section |
| 8.3.6 | Building Enclosure Systems | Updated requirements |
| 8.3.7 | Floor Systems | Updated requirements |
| 8.4 | Structural Systems | Entire chapter updated requirements |
| 8.5.1.2 | General Criteria | Updated requirements |
| 8.5.1.3 | Courtroom/Chambers | Updated requirements |
| 8.5.1.4 | Jury Facilities | Updated requirements |
| 8.5.1.7 | Changes in Building Envelope to Meet Energy Guidelines | Updated requirements |
| 8.7 | Electrical Systems | Updated requirements |
| 8.7.10 | Lighting System | Updated requirements |
| A.1 | Drawing Scale | Updated requirements |
| A.1 | Dimensioning | Updated requirements |
| A.1 | Seals | Updated requirements |
| A.1 | Building Information Modeling | Updated requirements |
| A.1 | DIMENSIONING IN SPECIFICATIONS | Updated requirements |
| A.1 | Building Handover to Operations and Maintenance | New Section |
| A.1 | Cost and Schedule Management Requirements | Updated requirements |
| A.2 | Performance Expectations Matrices | Updated requirements |
| A.3 | Peer Review | Updated requirements |

## APPENDIX C: SUMMARY OF CHANGES

| Section Number | Section Title | Summary of Change |
|---|---|---|
| A.3 | Design Process Definitions | Updated requirements |
| A.3 | Final Concept | Updated requirements |
| A.3 | Design Development | Updated requirements |
| A.3 | Construction Documents | Updated requirements |
| A.4 | Concept | Updated requirements |
| A.4 | Design Development | Updated requirements |
| A.4 | Construction Documents | Updated requirements |
| B.1 | References | Updated references |

# IMAGE CREDITS

Figure 1 Photographer: Bruce Damonte

Figure 2 Photographer: Taylor Lednum/GSA

Figure 3 Photographer: Courtesy of GSA

Figure 4 Photographer: Taylor Lednum/GSA

Figure 5 Photographer: Scott Frances

Figure 6 Photographer: Carol M. Highsmith Photography, Inc.

Figure 7 Photographer: Jeremy Bittermann

Figure 8 Photographer: Jeremy Bittermann

Figure 9 Photographer: Scott Frances

Figure 10 Photographer: Raul Garcia

Figure 11 Photographer: Courtesy of GSA

Figure 12 Photographer: Morgan Sheff Photography

Figure 13 Photographer: Nic Lehoux

Figure 14 Photographer: Lance Davis/GSA

Figure 15 Photographer: Scott Frances

Figure 16 Photographer: Carol M. Highsmith Photography, Inc.

Figure 17 Photographer: Carol M. Highsmith Photography, Inc.

Figure 18 Photographer: Taylor Lednum/GSA

Figure 19 Photographer: Lance Davis/GSA

Figure 20 Photographer: Carol M. Highsmith Photography, Inc.

Figure 21 Photographer: Lance Davis/GSA

**U.S. General Services Administration**
Public Buildings Service
Office of the Chief Architect
1800 F Street NW
Washington, DC 20405