Agenda

- **Opening Remarks**
  - Chuck Hardy, GSA Acting Chief Architect
  - Sonal Larsen, GSA Senior Advisor on Climate
  - Andrew Mayock, Council on Environmental Quality (CEQ) Federal Chief Sustainability Officer

- **Summary of GSA’s New Standards**
  - Walter Tersch, GSA

- **Environmental Product Declarations**
  - Danny Macri, EPA
  - Stacy Smedley, Building Transparency

- **Asphalt Industry**
  - Joseph Shacat, National Asphalt Paving Association (NAPA)
  - Ben Bowers, Auburn University's National Center for Asphalt Technology (NCAT)

- **Concrete Industry**
  - Michelle Wilson, Portland Cement Association (PCA)
  - Tien Peng, National Ready Mixed Concrete Association (NRMCA)

- **Conclusion and Q&A**
Overview of U.S. General Services Administration

- Portfolio of over 8,800 assets
  - 1,600+ owned assets (186+ million square feet)
  - 7,100+ leased assets (184+ million square feet)
- 480+ historic buildings
- House 1.1 million federal employees
- Landlord for over 400 different federal agencies, bureaus and commissions

- Morse U.S. Courthouse, Eugene, OR
- NPS, Omaha, NE
- U.S. Census Bureau, Suitland, MD
- U.S. Courthouse, Bakersfield, CA
- Garcia U.S. Courthouse, San Antonio, TX
Administration and Executive Order Priorities

- Net zero energy owned building portfolio by 2045
- Reduce building energy use, water use, and waste
- 100% carbon pollution-free electricity (CFE) by 2030, including 50% 24/7 CFE; 100% 24/7 CFE by 2035
- Zero-emission fleet (electric vehicles and charging stations)
- **Sustainable procurement (products), supply chain, and vendors (disclosure)**
- Climate adaptation, climate risk management, and resilience
Market Research on Concrete and Asphalt

In February 2022, GSA released two requests for information (RFIs) to gather current marketplace insights from industry on the national availability of concrete and asphalt materials with lighter environmental footprints.

Of the 130+ respondents, 34% of concrete manufacturers, were small businesses, and 61% of asphalt manufacturers

- **Concrete**
  - 80% already produce low embodied carbon concrete, and 60% have developed a product-specific environmental product declaration (EPD)
  - Most say low-embodied-carbon concrete costs about the same, and have used carbon-reducing supplementary cementitious materials

- **Asphalt**
  - 90% use reclaimed asphalt pavement, and over 70% use warm mix technology to reduce environmental impact
  - Over 65% say environmentally preferable asphalt costs the same -- or less -- than conventional equivalents

"Buildings generate nearly 40% of annual global CO₂ emissions.

Of that total, building operations are responsible for 28% annually, while building materials and construction (typically referred to as embodied carbon) are responsible for an additional 11% annually.”

-AIA Architecture 2030
Material Standards for All GSA Projects

GSA.gov/p100 has the new concrete and asphalt standards issued in March. They are being included in solicitations for all GSA building or paving projects that use at least 10 cubic yards of material. In summary:

- Require environmental product declarations (EPDs) and lower-carbon concrete (20% lower global warming potential, vs. limits in proposed code language)
- Asphalt mixes shall provide an EPD, and use two or more of the following:
  - Reclaimed asphalt pavement (RAP) content (over 20%)
  - Warm mix technology
  - Non-paving recycled content
  - Bio-based or alternative binders
  - Improved plant/equipment efficiency OR
  - Other environmentally preferable features or techniques

A P100 waiver process is available where compliance is infeasible.
Collecting this data enables GSA to build its own global warming potential baseline. These material standards complements a whole-building carbon reduction policy.
OVERVIEW OF ENVIRONMENTAL PRODUCT DECLARATIONS

MAY 5, 2022

Danny Macri
U.S. EPA
THE NEED FOR EPDS

Need for:
• Internationally recognized, comprehensive disclosure of a product’s environmental impact.
• Data on impact, not just assurances a product meets minimum criteria

EPDs are disclosure mechanisms for state and federal low-embodied carbon procurement programs and criterion for several ecolabels and standards.
WHAT IS AN EPD

Discloses the “lifecycle” environmental impacts of a product similar to a nutrition label…...but without the “recommended values”

In other words, 281 kg of CO2e were emitted when producing 1 cubic meter of this concrete.

EPDs for construction materials usually only report “Cradle-to-Gate” emissions.

EPDs are just the data
- Don’t require minimum criteria to be met (like Ecolabels)
- Ensure standardization within product category
**WHAT IS AN EPD**

**Types of EPDs**

- **Facility-Specific EPD**
  Represents the impacts of a specific product from a single facility
  Ex: [Company B’s] Fabricated Hot-Rolled

- **Product (Company-Specific) EPD**
  Represents the impacts of a specific product for a single manufacturer across multiple facilities
  Ex: [Company A’s] Merchant Bar and Light Structural Shapes

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
<th>Total (A1-A3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP 100</td>
<td>kg CO₂ eq</td>
<td>748</td>
</tr>
</tbody>
</table>

- **Supply Chain EPD**
  A product EPD that uses actual (instead of generic or average) data from the most impactful area of a product’s lifecycle

- **Industry EPD**
  Represents the average environmental impacts of a product across multiple manufacturing plants and manufacturers in an industry.

**From carbon standpoint the most precise EPDs are those that rely on actual data from facilities upstream in the supply chain, rather than an industry average.**

See Carbon Leadership Forum [EPD Requirements in Procurement Policies](#) for more information.
**STEPS TO CREATE AN EPD**

**Product Category Rules (PCR)**

Guidelines for conducting LCA and developing an EPD of a **specific product category**. Led by Program Operator with input from interested parties

Informed by ISO 14027 *Development of product category rules*

**Lifecycle Assessment (LCA)**

Quantifies environmental impacts of a product based on terms of PCR and other ISO standards.

Informed by ISO 14040 *LCA principles and framework* and ISO 14044 *LCA Requirements and guidelines*

**Environmental Product Declaration (EPD)**

Reports LCA results in standard and comparable format

Informed by ISO 14025 *EPDs Principles and procures* and ISO 21930 *Sustainability in buildings and civil engineering works*

Table 1: Impact assessment results for 1 metric ton of merchant bar

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
<th>Total (A1-A3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP 100</td>
<td>kg CO₂ eq</td>
<td>748</td>
</tr>
</tbody>
</table>
1) Life Cycle Inventory (Cradle-to-Gate)

- Concrete [1 ton]
- Cement [x kg]
- Aggregates [x kg]
- Limestone [x kg]
- Explosives [x kg]
- Electricity [x kg]
- NO₂ [x kg]
- CO₂ [x kg]
- Other
- CO₂ X 1 CO₂e

2) Life Cycle Impact Assessment (Classification & Characterization)

- Global Warming Potential 281 [kg CO₂ eq]
- CH₄ X 25 CO₂e

3) Environmental Product Declaration

Displays illustrative, not comprehensive, inputs and outputs for concrete manufacturing. Each substance can have over a dozen inputs and types of emissions.

Industry-specific tools exist to simplify and streamline the process for creating LCAs and EPDs!
### SUMMARY: WHAT EPDS DO AND DON’T DO

<table>
<thead>
<tr>
<th>Do</th>
<th>Do not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantify impact in terms of environmental performance</td>
<td>Explain how the impact was made (management, technology, electricity grid)</td>
</tr>
<tr>
<td>Typically, use actual data from last leg of chain</td>
<td>Use actual data from entire supply chain</td>
</tr>
<tr>
<td>Rely on established standards for PCR, LCA and EPD generation</td>
<td>Address all questions stakeholders may want considered for procurement</td>
</tr>
</tbody>
</table>
Stacy Smedley, Building Transparency

**How do I add an EPD?**

- You can
  - (a) email the PDF to epd-uploads@buildingtransparency.org, or
  - (b) upload it directly to https://cqd.app.box.com/folder/49153084885 (if you have access), or
  - (c) Enter the values via the web interface at https://buildingtransparency.org/dashboard/epds
Asphalt Industry Overview

Low Carbon and Sustainable Asphalt Pavements

May 5, 2022

Joseph Shacat
Director of Sustainable Pavements
jshacat@asphaltpavement.org
• Trade Association representing asphalt industry

• NAPA’s Mission
  • Support
  • Advocate
  • Advance

What Is NAPA?
**Vision:** Sustainable communities and commerce, connected by net zero carbon emission asphalt pavements

**Mission:** Engage, educate, and empower the U.S. asphalt community to produce and construct net zero carbon emission asphalt pavements

Learn more at asphaltpavement.org/climate
What is Asphalt Pavement

- 75% virgin aggregates
- 5% asphalt binder
- 20% reclaimed asphalt pavement (RAP)

Asphalt mix is produced at an asphalt plant

And paved at elevated temperature
Asphalt by the Numbers

• Approximately 3,600 asphalt plants in the U.S.¹

• 94% of U.S roads are surfaced with asphalt²

• 408 million tons of asphalt mixture produced in 2020³
  • Average reclaimed asphalt pavement (RAP) content 21.3% = 87 million tons
  • Use of RAP in 2020 reduced upstream GHG emissions by 2.3 MMT CO₂e while saving $3 billion
  • Equivalent to emissions from 510,000 passenger vehicles

³https://www.asphaltpavement.org/expertise/sustainability/sustainability-resources/recycling
Asphalt Mix and RAP Tonnage
Total Production and Use in the U.S.
Warm Mix Asphalt (WMA) Technologies

Percentage of Total Asphalt Production in the U.S.
Key Components of NAPA’s EPD Program

- **General Program Instructions**
  - **Underlying Life Cycle Assessment**
  - **Product Category Rules (PCR)**
  - **EPD Software**

Learn more at [www.asphaltpavement.org/epd](http://www.asphaltpavement.org/epd)
Key Aspects of Emerald Eco-Label Software

• Digital platform
• Independently verified
• All EPDs expire with the PCR
• Designed for asphalt mix producers
  • Low cost and easy to use

Published EPDs available at https://asphaltepd.org/published/
Thank You!

Joseph Shacat
jshacat@asphaltpavement.org
Environmentally Preferable Asphalt examples and opportunities

Benjamin F. Bowers, PhD, PE
Assistant Professor
Auburn University
WHAT WILL WE DISCUSS?

1. Solutions for *today*
2. Solutions for *tomorrow*
3. *Combined* solutions
Solutions for [today]

High Reclaimed Asphalt Pavement (RAP) content

• Defined as >20% RAP
  • Some states routinely use 30%+ in their mix designs
  • Research ongoing into 40 and 50%+ mixes
• Replacement for both binder and aggregate
• How do we do this?
  • Balanced Mix Design - Balancing cracking potential with rutting potential)
  • Rejuvenating agents – Return the binder to an earlier, or like-earlier form
  • Virginia DOT and others are placing pilot projects with approach this now!
Solutions for [today]

Warm Mix Asphalt

• Lowers asphalt temperatures by 25F to 90F
  • Resulting in less energy for production
  • Less emissions from plant
  • Increased density (long term performance)
• Has been used successfully since the early 2000’s
• Numerous studies show success:
  • NCHRP Report 691
  • NCHRP Report 779

HMA (above) and WMA (below) at the asphalt plant.

Images courtesy of FHWA
Solutions for [today]

Cold Recycling Techniques

• A set of cost-effective and environmentally sensitive techniques for pavement rehab
  • Cold In-place Recycling
  • Cold Central Plant Recycling

• Advantages
  • 30 to 50 percent cost savings
  • 50 percent less greenhouse gases emitted
  • Fix deterioration causes rather than symptoms

• Used since the 1970s. Significant recent research at NCAT, Virginia, Minnesota, California, Nevada, and elsewhere.
Solutions for [today]

Recycled Tire Rubber

• Dry blend
  • Ground tire rubber added to the aggregate mixture during production at the asphalt plant
  • Aggregate replacement (1-3%)

• Wet blend
  • Ground tire rubber blended with the asphalt binder
  • Increased elasticity of the asphalt binder
  • Replacement for polymer modifiers

Photo Citation: http://www.asphaltroads.org/assets/control/content/files/tire-rubber-modified-asphalt.pdf; http://www.calrecycle.ca.gov/Tires/Products/Types/images/CrumbRubber.jpg
Some solutions for the future

Bio-binders

• Can we replace the asphalt binder with a bio-based binder?
• Full replacement or partial replacement
• Research ongoing in this area

Recycled plastics

• May be added in “wet” form to binder or “dry” form to mix
• Work is ongoing in this area, so the jury is still out on long-term performance
[Combined] solutions

• Full depth reclamation
  • Fixes deep deterioration (bound and unbound layers)
  • Uses foamed asphalt, asphalt emulsion, or cement
  • Can be used with cold central plant recycled mix or other environmentally preferable asphalt mixture
Thank you!
Questions?

Benjamin F. Bowers, PhD, PE
Assistant Professor | Auburn University
✉ bfbowers@auburn.edu | ☑ aub.ie/bfbowers
THE VALUE CHAIN

The binder

Clinker

Cement

Concrete

Construction

Carbonation

Service life / use phase impacts

Key chemically reactive ingredient

Critically useful material to society

Concrete is a CO₂ sink
CaCO$_3$ $\rightarrow$ CaO + CO$_2$
C + O$_2$ $\rightarrow$ CO$_2$

U.S. Cement Industry contribution:
• Global GHG = 0.17% CO$_2$eq
• U.S. GHG = 1.25% CO$_2$eq
OPTIMIZING CLINKER

AT THE CEMENT PLANT

- Increase the use of decarbonated raw materials
- Decrease the use of traditional fossil fuels by 5X
- Increase the use of alternative fuels
- Push efficiency and decrease energy intensity for one metric ton of clinker
- Utilize carbon capture to avoid the release of CO₂ emissions
- Reduce clinker production emissions
AT THE PLANT: CARBON CAPTURE
INFRASTRUCTURE NEEDS - Pipeline Capacity
INFRASTRUCTURE NEEDS - ENERGY

- Energy consumed by CCUS
- Energy delivered by On-site Power Generation
- Energy from Renewable Sources
OPTIMIZING CEMENT

- Right sizing the amount of clinker in cement
- Using more non-gypsum additions
- Choosing the right cement specification for specific application
- Zero emissions bulk transportation (rail/truck)
PORTLAND-LIMESTONE CEMENT

- 4 Million Metric Tons of PLC used in US from 2012-2018 = 325,600 MMT CO₂ Savings.

greenercement.org
CONCRETE AND $\text{CO}_2$

(after Ashby 2009)
OPTIMIZING CONCRETE MIXTURES

- Shift from Prescriptive to Performance
- Incentivize Innovation
- Design Concrete Mixtures Intentionally for Each Application to Achieve Performance
OPTIMIZING CONSTRUCTION

- Optimize and Avoid Over-design
- Leverage Construction Technologies
- Incentivize energy efficient buildings
- Increase Recycled Materials
- Decrease Maintenance
- Use Renewable Fuels
CONCRETE AS A CARBON SINK

Clinker phases containing CaO

Hydration

Ca(OH)₂

Production

CO₂

Carbonation

CaCO₃

+ Other hydrates

CO₂
THE IMPORTANCE OF LIFE CYCLE

• Completed January 1943
• 435,000 cubic yards of concrete
• 43,000 tons of steel
• 680,000 tons of sand and gravel
• Still absorbing CO$_2$ after nearly 80 years
SOCIETY NEEDS CONCRETE…
AND CONCRETE NEEDS SOCIETY
THE BIG TEN - IMPLEMENTATION

- Research, Development & Innovation
- Regulations, Permitting & Guidance
- Financial Incentives & Support
- Performance-Based Material Standards
- Market-Based Carbon Pricing
- Market Acceptance
- Community Acceptance
- Cradle to Cradle Life Cycle-Based Procurement
- Low-Carbon Infrastructure
- Level Playing Field
Available At:
cement.org/sustainability/roadmap-to-carbon-neutrality
ABOUT THE PORTLAND CEMENT ASSOCIATION

PCA, founded in 1916, is the premier policy, research, education, and market intelligence organization serving America’s cement manufacturers. PCA member companies represent the majority of U.S. cement production capacity, having facilities across the country. PCA promotes safety, sustainability, and innovation in all aspects of construction; fosters continuous improvement in cement manufacturing and distribution; and promotes economic growth and sound infrastructure investment.

For more information, visit www.cement.org and shapedbyconcrete.com.
Strategies to Reduce Concrete’s Carbon Footprint NOW

GSA May 5, 2022

Tien Peng
SVP, Sustainability, Codes and Standards
Industry Progress Towards Carbon Neutrality

2009 ➤ 2012 ➤ 2014 ➤ 2016 ➤ 2021

THE 2030 CHALLENGE FOR PRODUCTS

35% ➤ 40% ➤ 45% ➤ 50% ➤ 75% ➤ ZERO EMBODIED CARBON

CARBON FOOTPRINT OF CONCRETE

GWP (kg/yd³)

*Projected

Roadmap to Carbon Neutrality
A more sustainable world is Shaped by Concrete
Industry-Wide + Product Specific EPDs

NRMCA MEMBER INDUSTRY-AVERAGE EPD FOR READY MIXED CONCRETE

Appendix D: NRMCA Member National and Regional LCA Benchmark (Industry Average) Report – V 3.0

Summary: Appendix D is intended for use by NRMCA members who participated in the IW-EPD that have developed product specific third-party verified LCAs and/or EPDs to compare the environmental impacts of their products with industry average impacts.
## GSA Embodied Carbon Limits for Concrete

<table>
<thead>
<tr>
<th>Specified compressive strength (f'c in PSI)</th>
<th>Standard Mix</th>
<th>High Early Strength</th>
<th>Lightweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 2499</td>
<td>242</td>
<td>326</td>
<td>462</td>
</tr>
<tr>
<td>2500-3499</td>
<td>306</td>
<td>413</td>
<td>462</td>
</tr>
<tr>
<td>3500-4499</td>
<td>346</td>
<td>466</td>
<td>501</td>
</tr>
<tr>
<td>4500-5499</td>
<td>385</td>
<td>519</td>
<td>540</td>
</tr>
<tr>
<td>5500-6499</td>
<td>404</td>
<td>546</td>
<td>N/A</td>
</tr>
<tr>
<td>6500 and up</td>
<td>414</td>
<td>544</td>
<td>N/A</td>
</tr>
</tbody>
</table>

These numbers reflect a 20% reduction from GWP (CO₂e) limits in model code language: “Lifecycle GHG Impacts in Building Codes” by the New Buildings Institute, January 2022.
Comparison Risk: Application NOT Reported in EPDs

These mixes with same PSI all have different performance requirements.

<table>
<thead>
<tr>
<th>Mix Code</th>
<th>Plant</th>
<th>Perf.</th>
<th>CS</th>
<th>TPE</th>
<th>CWB</th>
<th>CWW</th>
<th>GWP</th>
<th>ODP</th>
<th>AP</th>
<th>EP</th>
<th>POCP</th>
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<td></td>
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<tr>
<td>minimum</td>
<td></td>
<td>2,000</td>
<td></td>
<td>2.155E+03</td>
<td>6.871E-02</td>
<td>4.504E-03</td>
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<tr>
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<td>1.106E-01</td>
<td>3.085E+01</td>
</tr>
</tbody>
</table>

Impacts vary by 1.5X
Concrete Climate Solution

**Aligned Purpose**
1) Communicate Goals
2) Set Footprint Targets
3) Optimize Volume
4) Don’t Limit Ingredients
5) Use “SCMs”
6) Include Alternate Cements
7) Use Admixtures

**Smart Design**
8) Sequester CO2 in Concrete
9) Good Quality Control
10) Encourage Innovation

**Partner for Success**
1. Clearly & Frequently Communicated Goals

Concrete Specs: “This project has a goal of reducing the embodied carbon footprint over a typical project by 30%”

Design: Project collaboration

Pre-Bid Meeting: Re-state the carbon reduction goals and encourage innovation.
2. Set Carbon Footprint Targets

**EPD:** Use industry average Environmental Product Declarations (EPDs) to help set specific reduction target.

**Specification Example:** Supply concrete mixtures such that the total Global Warming Potential (GWP) of all concrete on the project is less than or equal to 4,298,000 kg of CO2 equivalents.
Schedule, Not Technology, is the Challenge

Mat Slabs, Footings
56 or 90 day strength
control heat of hydration
More SCMs

Equation:

\[ \sum (GWP_1 V_1) + (GWP_2 V_2) + \ldots + (GWP_n V_n) \leq 0.9 \left( (GWPA_1 V_1) + (GWPA_2 V_2) + \ldots + (GWPA_n V_n) \right) \]
3. Optimize Volume

Sustainable Solutions

- Less concrete ≠ weaker build
- Efficient structural systems
- High-performance concrete
- Dense rebar design
- Maximize value
4. Don’t Limit Ingredients

- Maximum w/cm ratio
- Min / Max cement content
- Min / Max slag / fly ash
- Potable water
- High Air content
- Branded admixtures
- Strength gain times

Specify the required performance...

<table>
<thead>
<tr>
<th>Class</th>
<th>Location</th>
<th>Nominal Max. Aggregate Size</th>
<th>Exposure Class</th>
<th>F’c, Psi @ Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mat Foundation</td>
<td>3”</td>
<td>F0, S1, W0, C0</td>
<td>6,000 at 90 days</td>
</tr>
<tr>
<td>2</td>
<td>Basement Walls</td>
<td>1-1/2”</td>
<td>F0, S1, W0, C0</td>
<td>4,000 at 56 days</td>
</tr>
<tr>
<td>3</td>
<td>Shear Walls</td>
<td>3/4”</td>
<td>F0, S0, W0, C0</td>
<td>6,000 at 56 days</td>
</tr>
<tr>
<td>4</td>
<td>Columns Level B2-L6</td>
<td>3/4”</td>
<td>F0, S0, W0, C0</td>
<td>6,000 at 28 days</td>
</tr>
<tr>
<td>5</td>
<td>Columns Level L7-L12</td>
<td>3/4”</td>
<td>F0, S0, W0, C0</td>
<td>4,000 at 28 days</td>
</tr>
<tr>
<td>6</td>
<td>Slabs</td>
<td>3/4”</td>
<td>F0, S0, W0, C0</td>
<td>5,000 at 28 days</td>
</tr>
<tr>
<td>7</td>
<td>Exterior Pavements</td>
<td>3/4”</td>
<td>F3, S1, W0, C0</td>
<td>4,000 at 28 days</td>
</tr>
</tbody>
</table>
5. Use Supplementary Cementitious Materials

Global Warming Potential:
- **Cement US Standard**: 922 kg CO₂eq
- **Slag Standard**: 140 kg CO₂ eq
- **Fly Ash Standard**: 0 kg CO₂ eq

SCM Specifications:
- **Hydraulic Cement**: ASTM C150, ASTM C595, or ASTM C1157
- **Fly Ash or Natural Pozzolan**: ASTM C618
- **Slag Cement**: ASTM C989
- **Silica Fume**: ASTM C1240
- **Glass Pozzolan**: ASTM C1866

The chart shows the greenhouse gas emissions due to the use of SCM (Supplementary Cementitious Materials) vs 100% cement: 45% reduction for 60% cement use, and 60% reduction for 45% cement use.
6. Include Alternate Cements

Embodied Carbon of Cement

Hydraulic Cement for Concrete

- ASTM C150
- ASTM C595
- ASTM C1157

www.greenercement.org
7. Use Admixtures

Chemical Admixtures
1. Air-Entraining Admixture:
   ASTM C 260/C 260M
2. Water-Reducing Admixture
   ASTM C 494/C 494M Type A
3. High-Range Water-Reducing
   Admixture: ASTM C 494/C 494M
   Type F or G
4. Accelerating Admixture:
   ASTM C 494/C 494M Type C or E
5. Retarding Admixture: ASTM C 494/
   C 494M Type B or D
6. Hydration Control Admixture:
   ASTM C 494/C 494M Type B or D
8. Sequester CO$_2$ in Concrete
9. Good Quality Control

Manufacturer
• NRMCA Certified Concrete Production Facility
• NRMCA Concrete Technologist Level 2

Installer
• ACI Flatwork Finisher

Testing Agency
• Meets ASTM C1077
• ACI Concrete Field Testing Technician Grade I
• ACI Concrete Laboratory Testing Technician Level I
• Results certified by a registered design professional
10. Encourage Innovation

Aggregate Quality Impact on Cement

- Piles (5 ksi): Local Aggregate 560, High Performance 470
- Foundations (5 ksi): Local Aggregate 560, High Performance 470
- SOG (2 ksi): Local Aggregate 319, High Performance 319
- PT Slabs (3 ksi / 5 ksi): Local Aggregate 752, High Performance 595
- Columns (5 ksi): Local Aggregate 639, High Performance 499
- Core Shear Wall (5 ksi): Local Aggregate 639, High Performance 499
Concrete Climate Solution

Aligned Purpose
1) Communicate Goals
2) Set Footprint Targets
3) Optimize Volume
4) Don’t Limit Ingredients
5) Use “SCMs”
6) Include Alternate Cements
7) Use Admixtures

Smart Design
8) Sequester CO2 in Concrete
9) Good Quality Control
10) Encourage Innovation

Partner for Success
Questions

https://www.nrmca.org/association-resources/sustainability/
Portland Cement Association, May 2021 letter to GSA:

“GSA has a unique opportunity to influence the sustainability of federal operations for decades to come, as well as those of states, localities, and the private sector. To do so, it should embrace procurement practice grounded in whole-life cycle product performance, robust data and methodologies, and policies that allow building materials and manufacturers to compete on a level playing field. PCA and NRMCA look forward to working with GSA and its sister agencies to achieve these shared goals.”
Embodied Carbon Reduction Measure: GSA’s new construction and major modernization designs must target a 20% reduction in their buildings' embodied carbon, compared to a project-specific standard baseline designs, as determined by the architect. Active FY22 measure.

- Compare embodied carbon footprints for at least the structure and enclosure of a comparable standard baseline design, and the proposed facility, using a GSA-approved estimation tool.

- Earn LEED’s Building Life-Cycle Impact Reduction credit using Whole-Building Life-Cycle Assessment option.

Embodied carbon estimation tools include:
(a) Tally (from Building Transparency)
(b) EC3 (Embodied Carbon in Construction Calculator)
(c) One Click LCA
(d) Athena’s Impact Estimator for Buildings
(e) AutoDesk’s Insight 360
Applicability

- GSA.gov/p100 contains GSA issuance memo and the new concrete and asphalt standards. They apply to:
  - All projects (incl. repairs) that use at least 10 cubic yards of material, including onsite mobile batch plants
  - Design and construction contract awards for all GSA projects, both capital and small, regardless of funding source: paving upgrades, modernizations, new construction, customer-funded projects through BA80 Reimbursable Work Authorizations, privately-financed projects such as Energy Savings Performance Contracts, and all Bipartisan Infrastructure Law projects

- These do NOT apply to:
  - Leased space except lease-construct
  - Precast concrete panels or bricks that were fabricated off-site
### Frequently asked questions (1/2)

#### Achievability?

<table>
<thead>
<tr>
<th>Specified compressive strength (in psi)</th>
<th>Standard Mix</th>
<th>High-early Strength</th>
<th>Lightweight concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>f&lt;sub&gt;c&lt;/sub&gt;, psi</td>
<td>f&lt;sub&gt;c&lt;/sub&gt;, psi</td>
<td>f&lt;sub&gt;c&lt;/sub&gt;, psi</td>
<td>f&lt;sub&gt;c&lt;/sub&gt;, psi</td>
</tr>
<tr>
<td>up to 2499</td>
<td>266</td>
<td>242</td>
<td>326</td>
</tr>
<tr>
<td>2500-3499</td>
<td>291</td>
<td>305</td>
<td>413</td>
</tr>
<tr>
<td>3500-4499</td>
<td>342</td>
<td>346</td>
<td>466</td>
</tr>
<tr>
<td>4500-5499</td>
<td>406</td>
<td>385</td>
<td>519</td>
</tr>
<tr>
<td>5500-6499</td>
<td>429</td>
<td>404</td>
<td>546</td>
</tr>
<tr>
<td>6500 and up</td>
<td>498</td>
<td>414</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- GSA's limits are 20% lower than NBI’s proposed [75th percentile of GWPs] code language.
  - **GSA’s Standard Mix GWP limits are on average only 5% lower than industry-standard NRMCA baselines.**

#### Workability?

- RFI respondents reported that potential low carbon concrete challenges -- workability, especially finishability and pumpability, slower early strength development, and availability of raw materials -- can be overcome with mixture optimization and admixtures.
- Quality, workability, or durability challenges with low embodied carbon concrete were “Not [experienced] when the mixture is properly optimized. Many times the results are equal to or better than straight cement mixtures.”
Isn’t this a big change?

- No. Since 2015, P100 has stated that “Concrete ready mix and site mix must have a minimum amount of fly ash equal to or greater than 15%, or ground granulated blast-furnace (GGBF) slag equal to or greater than 25%.” (§ 3.3.5 “Masonry and Concrete Materials”).
- This carbon-lowering standard has also been in GSA’s Key Sustainable Products since 2014.
  - CPG promotes the use of recovered waste materials.

What if one of my mixes complies, but another doesn’t?

- Current standard requires a waiver on a per-mix basis. However, depending on what we learn as more projects apply it, GSA may evaluate a weighted average compliance approach.
Concrete Plants with EPDs, and GSA’s upcoming border station and LPOE paving projects.
Questions and Discussion

- GSA: Chuck Hardy, Sonal Larsen, Walter Tersch
- CEQ: Andrew Mayock
- EPA: Danny Macri
- Building Transparency: Stacy Smedley
- NAPA: Joseph Shacat
- NCAT: Benjamin Bowers
- PCA: Michelle Wilson
- NRMCA: Tien Peng