



**CONCRETE**  
STRATEGIES

**LJC**  
DESIGN & ENGINEERING

## **Navigating Sustainable Concrete**

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# AGENDA

**Pop Quiz!**

**What is Embodied Carbon & why does it matter?**

**Specifications/General Notes**

Designer perspective

Concrete contractor perspective

**Tools for meeting client specification requirements**

**Pilot tests / lessons learned**

**Takeaways**



# POP QUIZ

**Q: Type 1L blended cement is WHAT ASTM specification?**

- a) ASTM C595
- b) ASTM C150
- c) ASTM C1157

## POP QUIZ

**Q: What % of Ground Limestone material is allowed in IL cement within ASTM C595?**

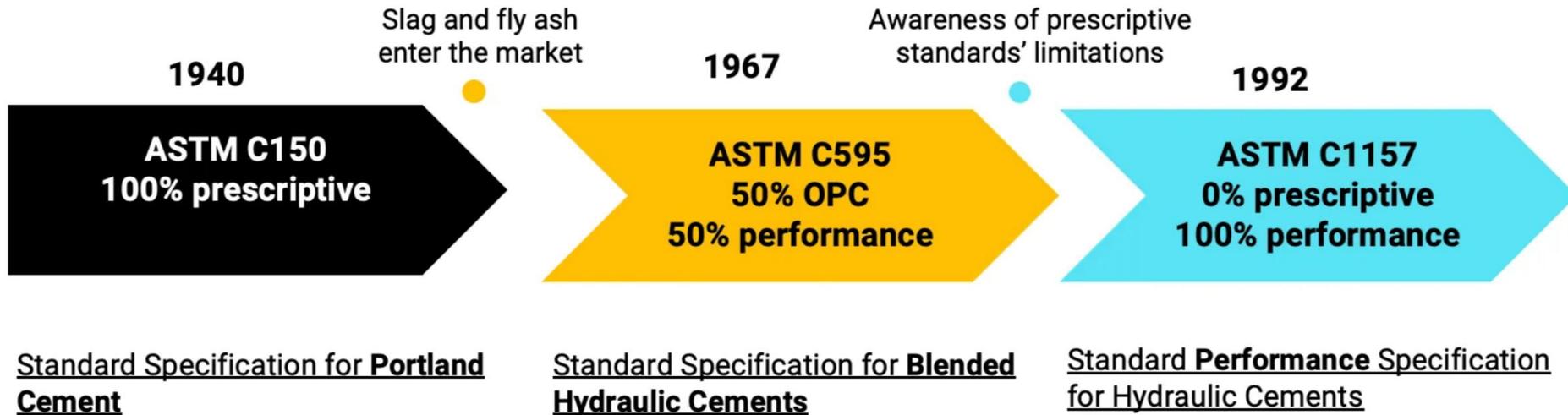
- a) 5-10%
- b) 5-15%
- c) 10-20%

**Q: What % of OVERALL SCMs are allowed with ASTM C595?**

- a) 20%
- b) 35%
- c) 50%

# POP QUIZ

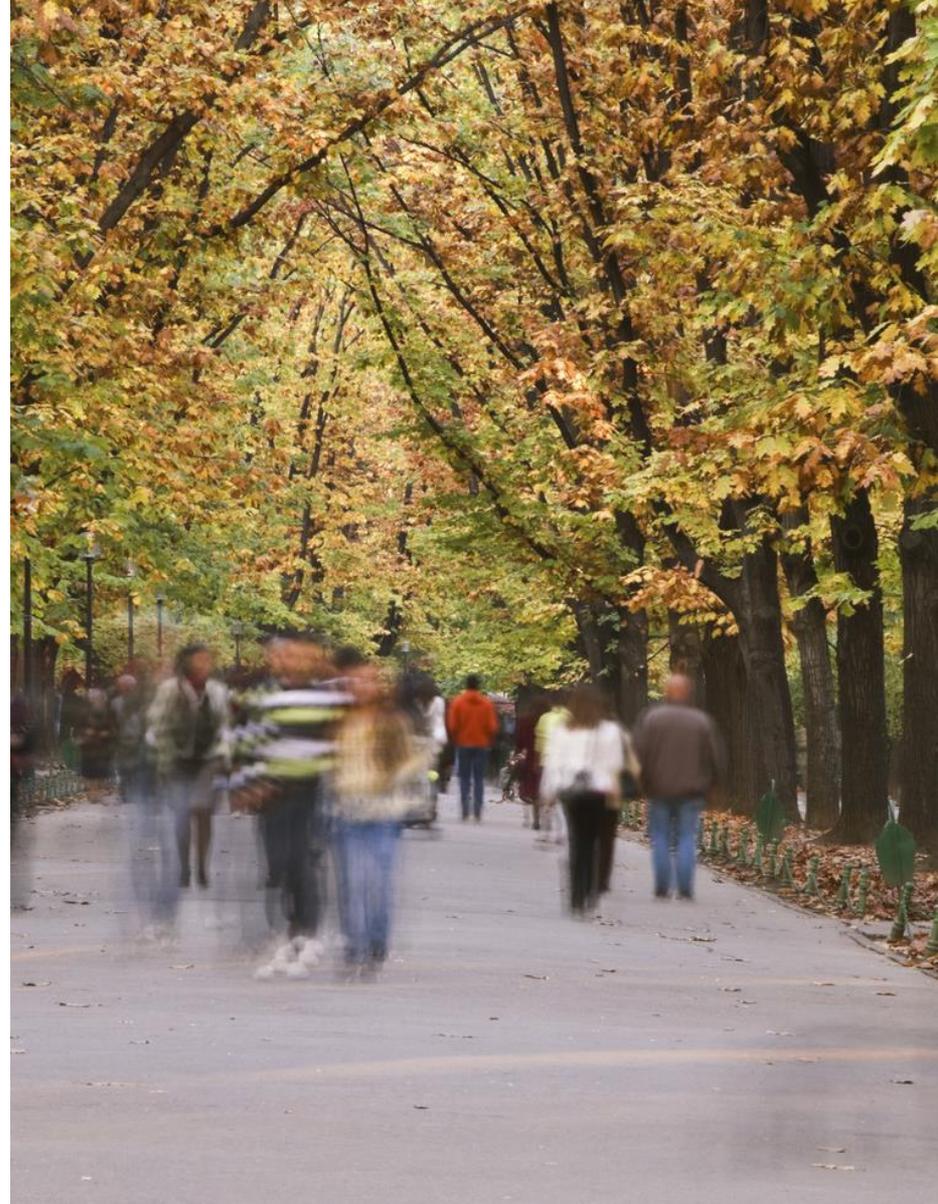
Q: What if I want to include >50% SCM material OR specify purely through performance?





# WHAT IS EMBODIED CARBON & WHY DOES IT MATTER?

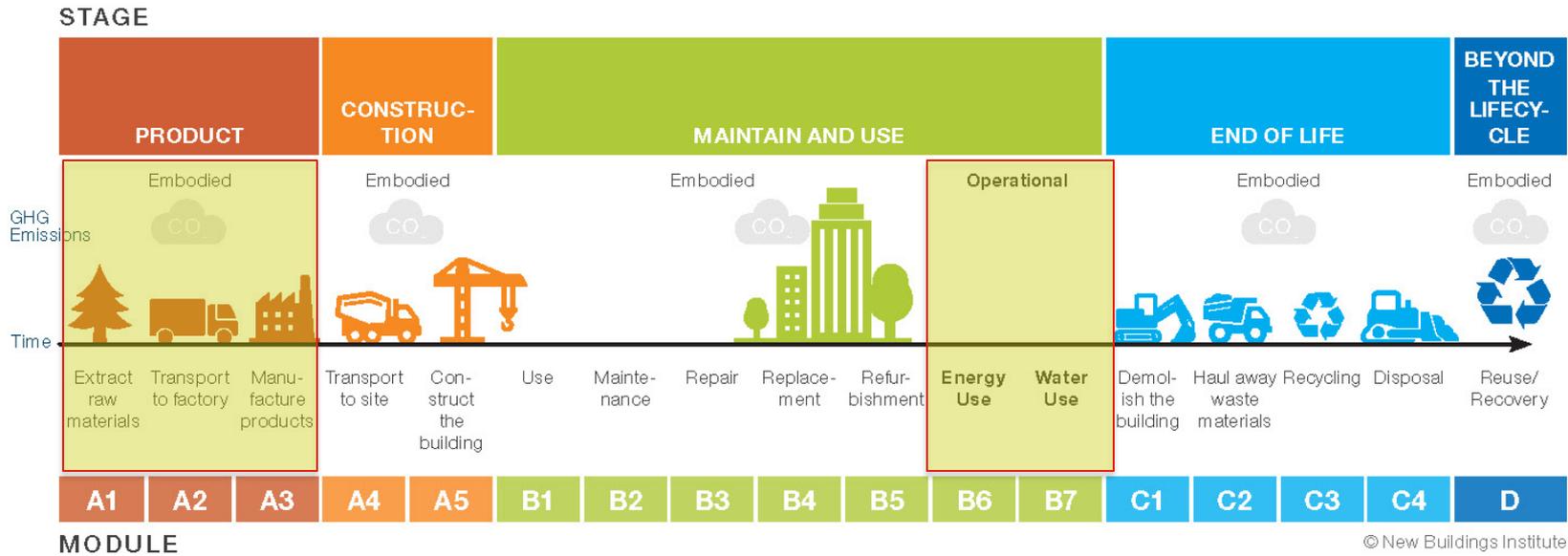
# SUSTAINABILITY



# WHAT IS EMBODIED CARBON?

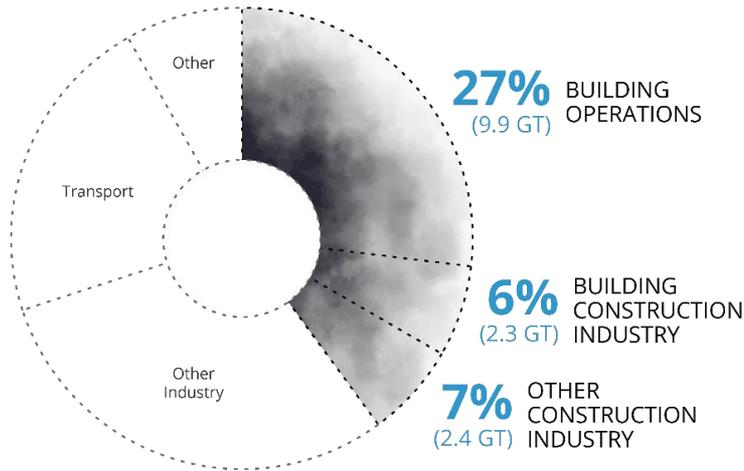
**FIGURE 1: LIFECYCLE STAGES**

Data source: BS EN 15978:2011



# WHY IS TRACKING EMBODIED CARBON URGENT?

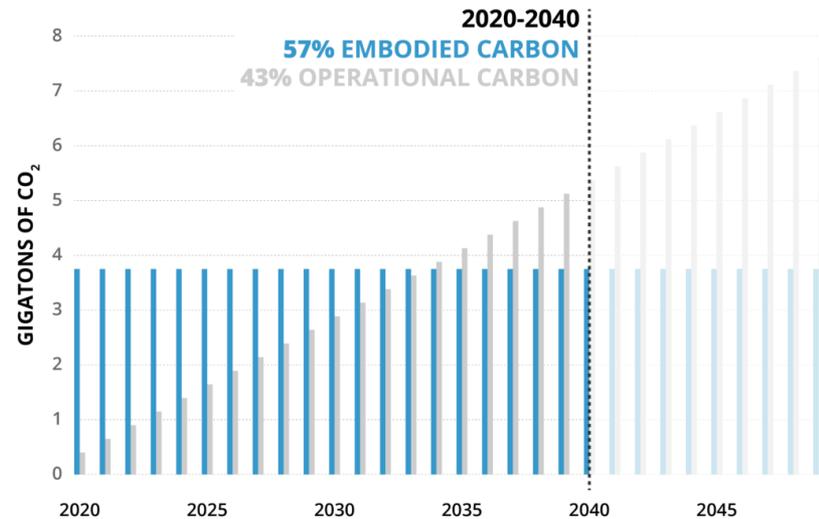
Annual Global CO<sub>2</sub> Emissions



© Architecture 2030. All Rights Reserved. Data Source: IEA (2022), Buildings, IEA, Paris

*Building Construction Industry and Other Construction Industry represent emissions from concrete, steel, and aluminum for buildings and infrastructure respectively.*

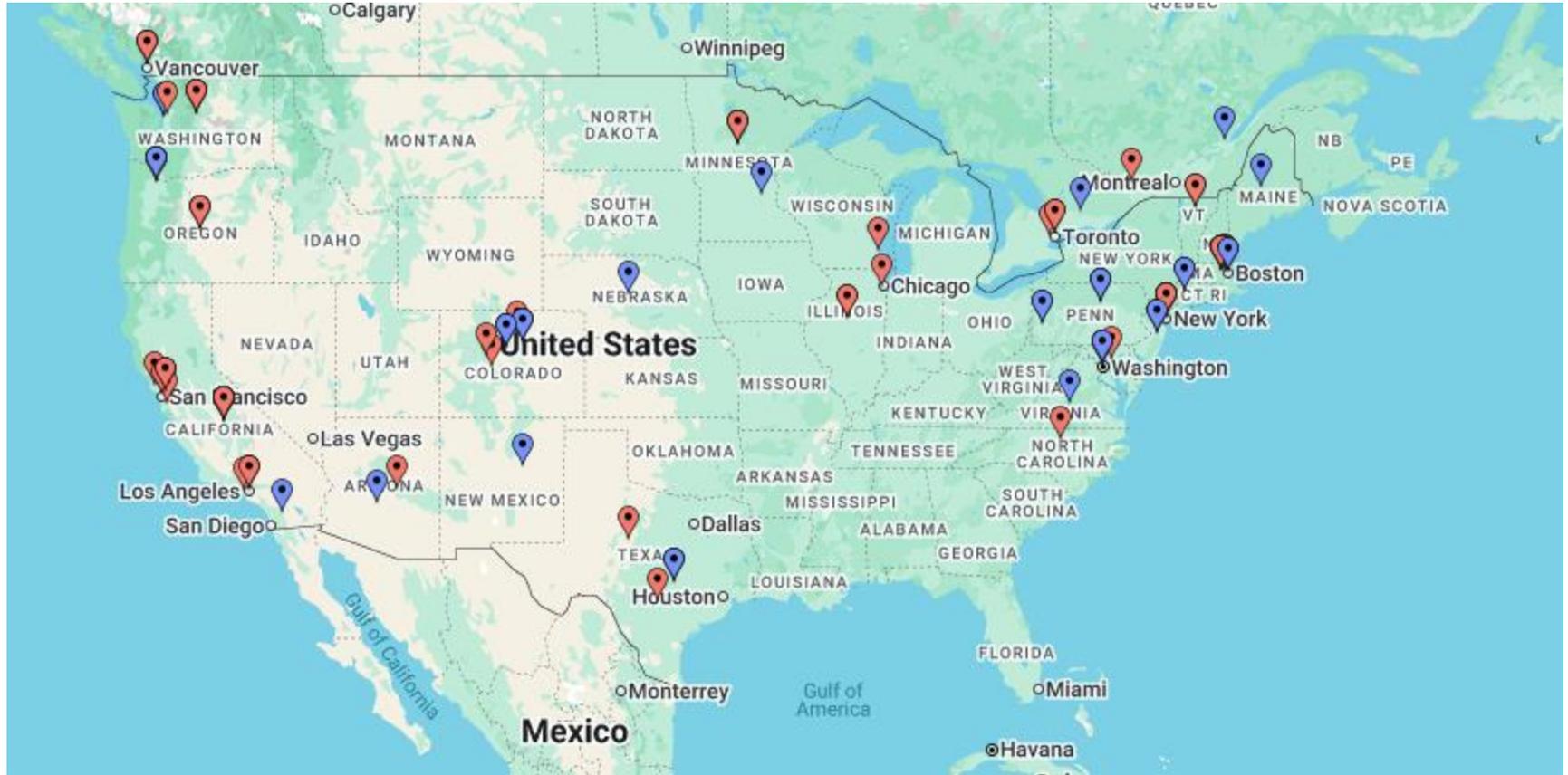
Total Carbon Emissions of **Global New Construction**  
*with no building sector interventions*



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Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

# REGULATORY COMPLIANCE

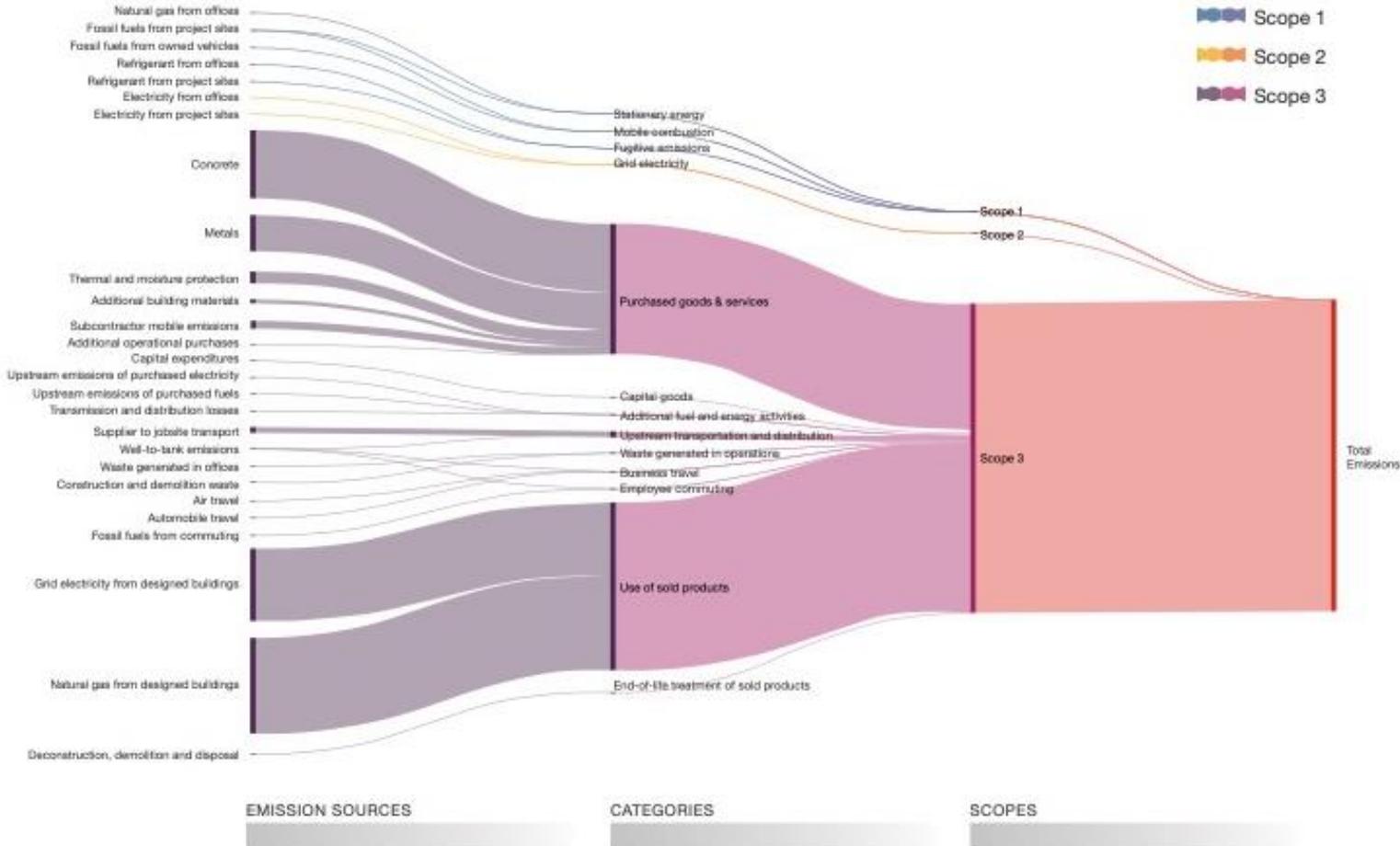


<https://carbonleadershipforum.org/clf-policy-toolkit/#map>

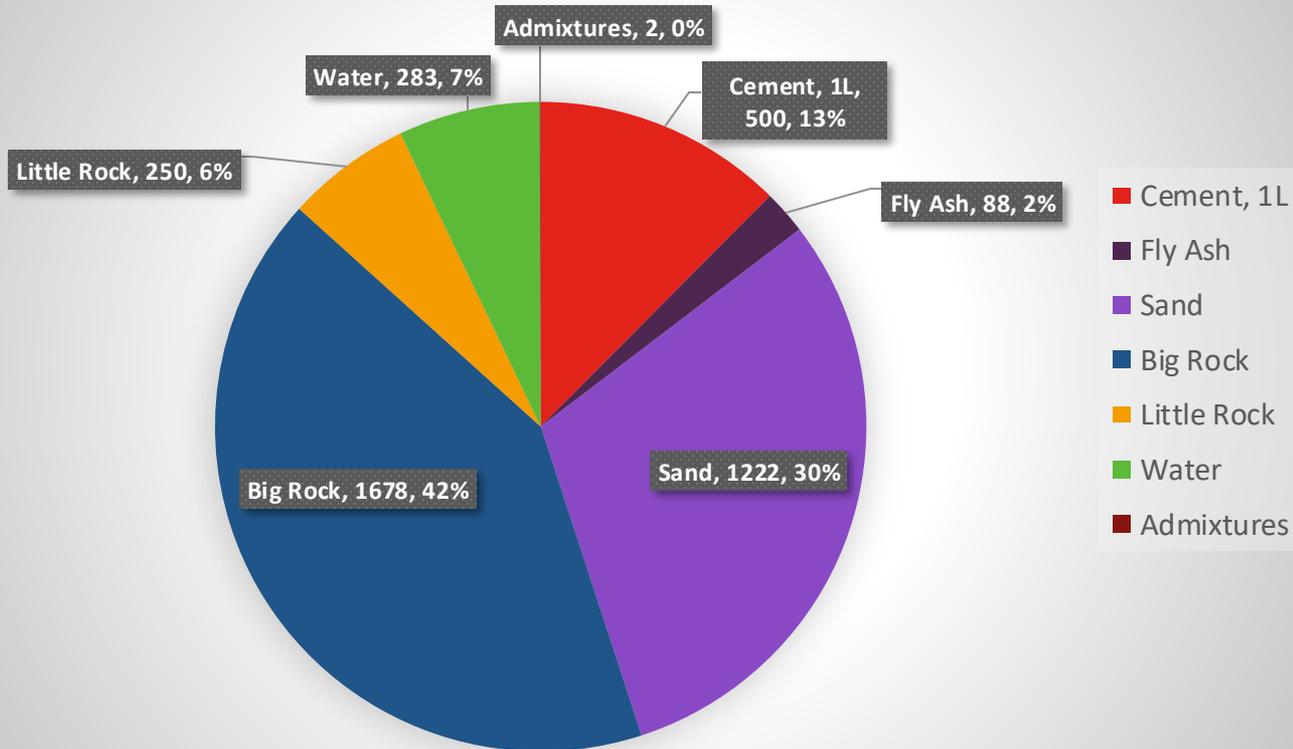
# WHY IS EMBODIED CARBON BEING TRACKED?



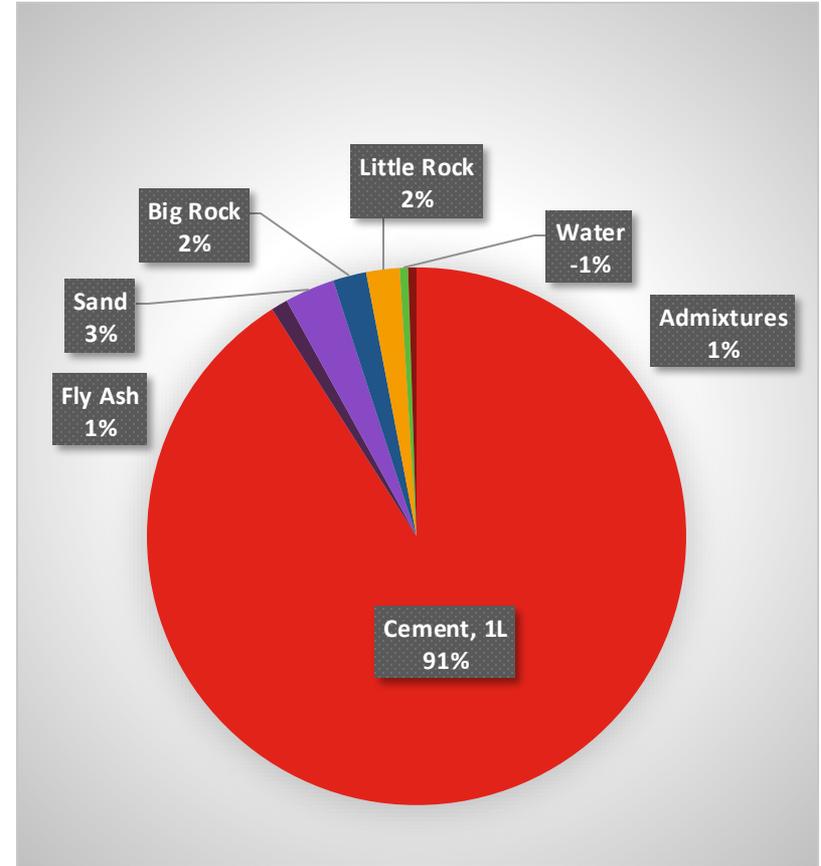
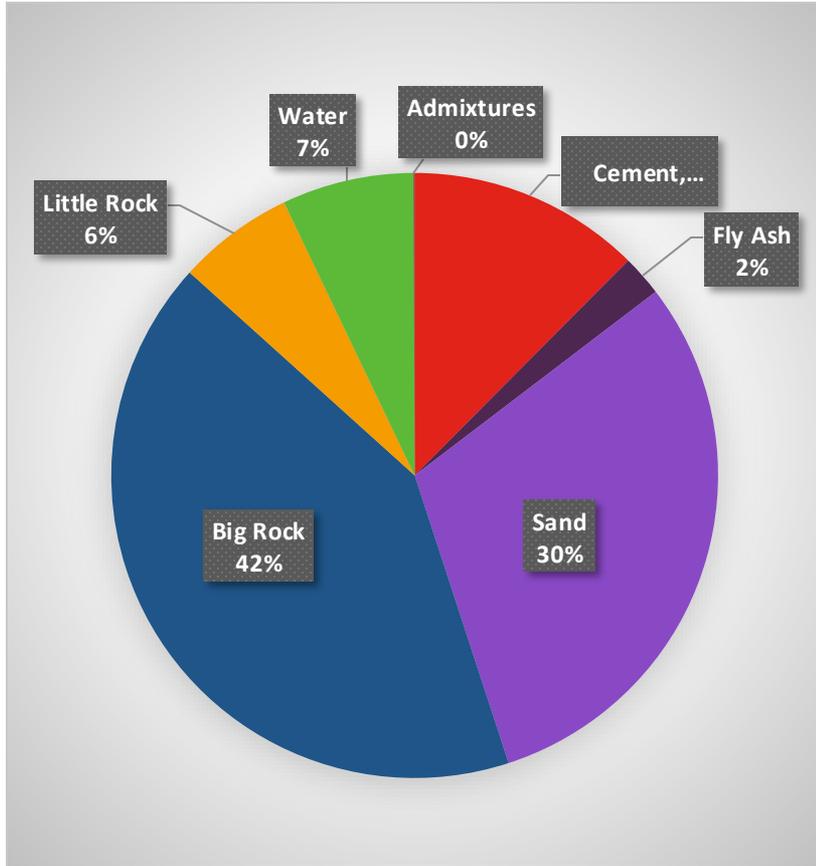
# EMISSIONS ACCOUNTING – CLAYCO ENTERPRISE (2024)



# SLAB ON GRADE MIX, BY WEIGHT (~4000LBS/CY)

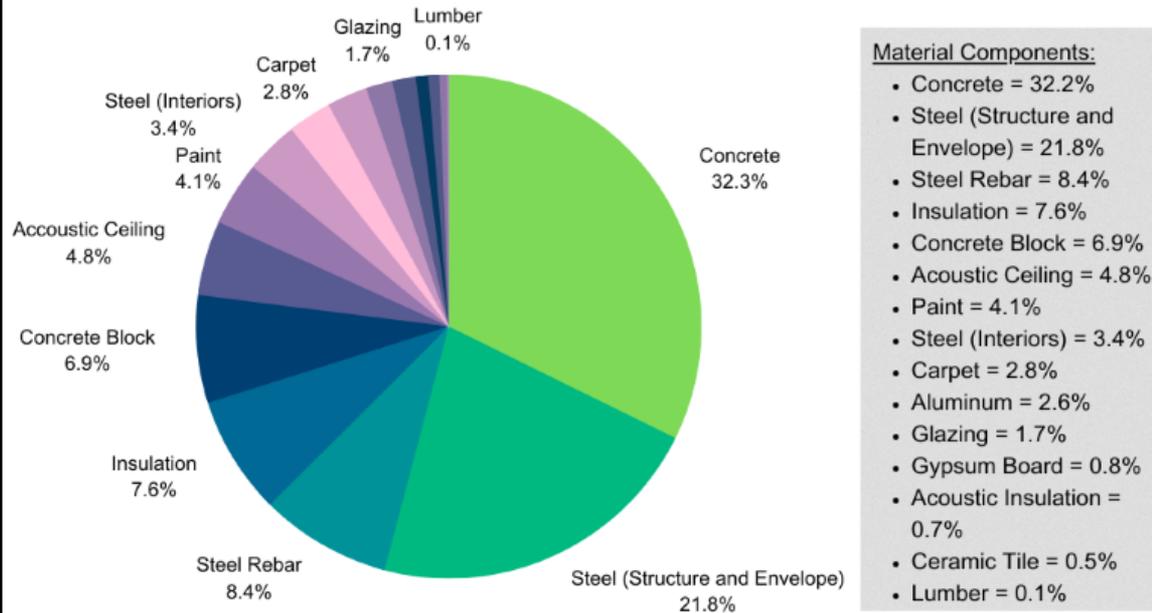


# WEIGHT VS CARBON EMISSIONS



# WHY IS STRUCTURE IMPORTANT?

## Estimated Carbon Emissions Distribution of Common Building Materials for a Generic Office Building





# **SPECIFICATIONS & GENERAL NOTES**

- DESIGNER PERSPECTIVE**
- CONCRETE CONTRACTOR PERSPECTIVE**

# CLASSES OF CONCRETE – IN TRANSITION

20. ONLY LOW HYDROGEN ELECTRODES SHALL BE USED ON REINFORCING STEEL AND ASTM A572 STEEL.

## TABLE B1 - CONCRETE MIX PERFORMANCE REQUIREMENTS SCHEDULE

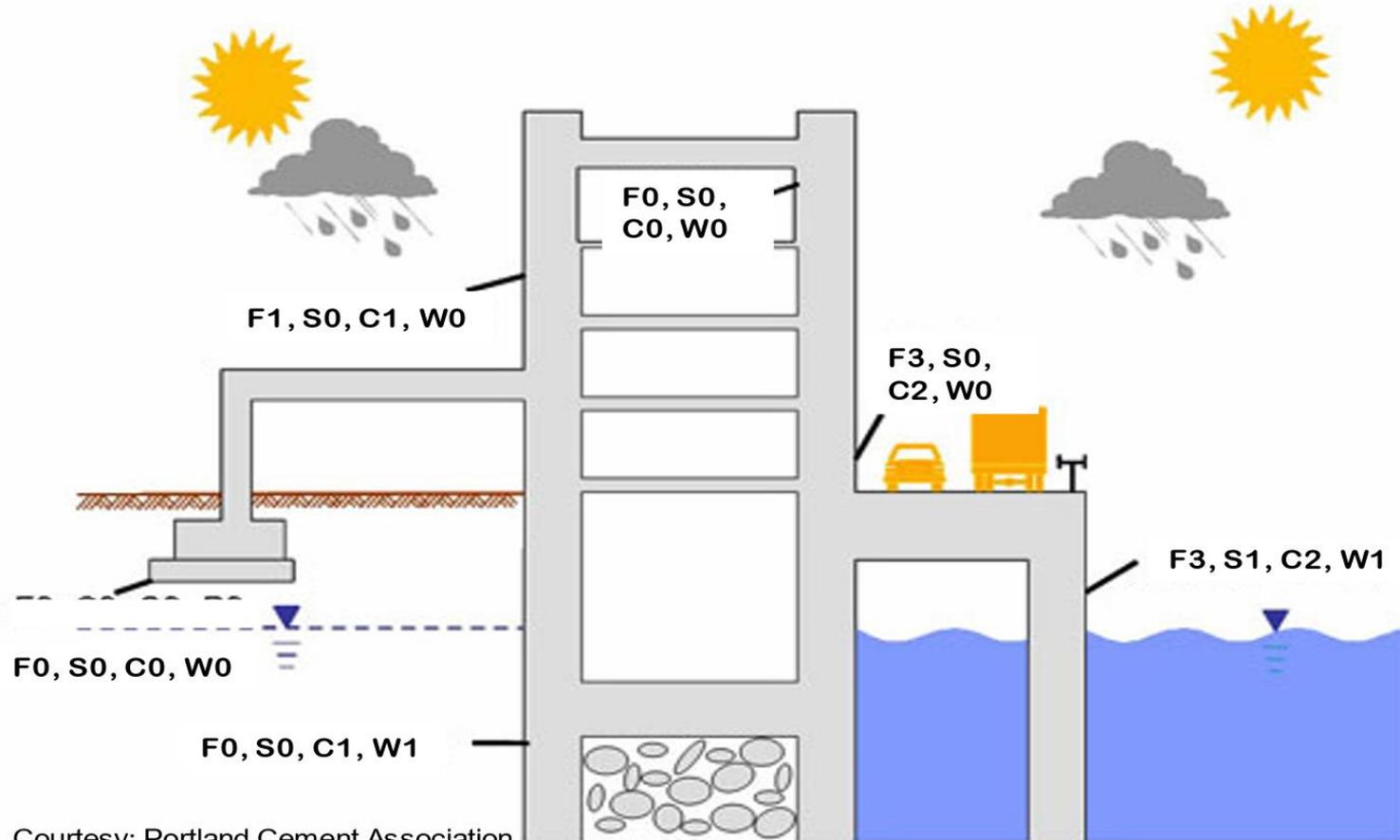
APPLICATION	EXPOSURE CLASS <sup>10</sup>	STRENGTH REQ 1 <sup>1</sup>	STRENGTH REQ 2 <sup>1</sup>	UNIT WEIGHT	MAX AGGREGATE SIZE	ACI SUGGESTED W/CM <sup>2</sup>	AIR %	SLUMP (IN) <sup>9</sup>	SUGGESTED MIN CEMENT REPLACEMENT <sup>3,4,5,6</sup>
INTERIOR FOOTINGS & GRADE BEAMS	F0	3000 AT 56 DAYS		NWC	1"	0.50	. <sup>8</sup>	4 +/- 1	30%
EXTERIOR FOOTINGS & GRADE BEAMS	F1	3500 AT 56 DAYS		NWC	1"	0.50	6 +/- 1.5	4 +/- 1	30%
GRADE BEAMS UNDER TILT/PRECAST	F1	3500 AT 28 DAYS		NWC	1"	0.50	6 +/- 1.5	4 +/- 1	30%
MAT FOOTINGS	F1	4500 AT 56 DAYS		NWC	1"	0.50	. <sup>8</sup>	4 +/- 1	30%
AUGER CAST PILES	F0	3000 AT 56 DAYS		NWC	1"	0.50	. <sup>8</sup>	4 +/- 1	30%
DRILLED PIERS	F0	3500 AT 28 DAYS		NWC	1"	0.50	. <sup>8</sup>	4 +/- 1	30%
BASEMENT WALLS	F1	4500 AT 56 DAYS		NWC	3/4"	0.40	6 +/- 1.5	4 +/- 1	30%
SITE WALLS/RETAINING WALLS, EXTERIOR SLABS	F1	4500 AT 56 DAYS		NWC	3/4"	0.40	6 +/- 1.5	4 +/- 1	30%
TILT-UP WALLS	F0	4000 AT 28 DAYS <sup>7</sup>	2500 AT 7 DAYS <sup>7</sup>	NWC	3/4"	0.40	. <sup>8</sup>	4 +/- 1	20%
COLUMNS/SHEAR WALLS	F0	4000 AT 56 DAYS		NWC	3/4"	0.40	. <sup>8</sup>	4 +/- 1	30%
SLAB ON GRADE <sup>2</sup> , INTERIOR	F0	4000 AT 28 DAYS		NWC	1 1/2"	0.52	. <sup>8</sup>	4 +/- 1	20%
SLAB ON DECK <sup>2</sup>	F0	4000 AT 28 DAYS		NWC	1/2"	0.40	. <sup>8</sup>	4 +/- 1	20%
SLAB ON PAN FORMS/POST-TENSIONING <sup>2</sup>	F0	4000 AT 28 DAYS	2500 AT 3 DAYS	NWC	1/2"	0.40	. <sup>8</sup>	4 +/- 1	20%
TOPPING SLABS (INTERIOR)	F0	4000 AT 28 DAYS		LWC	1/2"	0.40	6 +/- 1.5	4 +/- 1	10%
EQUIPMENT PADS (EXTERIOR)	F2	5000 AT 56 DAYS		NWC	3/4"	0.40	6 +/- 1.5	4 +/- 1	30%
BELOW GROUND ENCASMENT (DUCT BANKS)	F2	3000 AT 56 DAYS		NWC	1"	0.50	. <sup>8</sup>	4 +/- 1	40%

1. TO ACHIEVE ENVIRONMENTALLY RESPONSIBLE MIX DESIGNS IT IS IMPERATIVE TO UNDERSTAND SCHEDULE REQUIREMENTS OF PROJECT ELEMENTS. STRENGTH REQUIREMENTS 1 AND 2 REPRESENT REQUIREMENTS AS COMMUNICATED WITH THE EOR. SHOULD REQUIREMENTS CHANGE FROM WHAT IS LISTED CONSULT EOR FOR GUIDANCE.

# NCSEA – CLASSES OF CONCRETE TABLE (2025)

<b>Concrete Class Table</b>									
Intended Use	Compressive Strength f'c (psi), at 28 days, uno	Exposure Class				Maximum w/cm ratio	Maximum Aggregate Size	Target Air Content	Global Warming Potential Target (kgCO2e/yd3)
		F	S	W	C				
Drilled Piers	4000psi NWC at 56 days	F0	S0	W0	C0	--	1 1/2"	--	240
Spread Footings	4000psi NWC at 56 days	F0	S0	W0	C0	--	1 1/2"	--	240
Foundation Walls	4000psi NWC at 56 days	F0	S0	W0	C0	--	3/4"	--	240
Grade Beams and Stem Walls	4500psi NWC at 56 days	F2	S0	W1	C1	0.45	3/4"	6%	290
Core, Shear and Bearing Walls	5000psi NWC at 56 days	F0	S0	W0	C0	--	3/4"	--	290
Interior SOG	3000psi NWC at 56 days	F0	S0	W0	C0	--	1"	--	205
Exterior/ Garage SOG	5000psi NWC at 56 days	F3	S0	W1	C2	0.40	1"	6%	330
Interior PT Elevated Slab	5000psi NWC at 28 days (3000psi at stressing)	F0	S0	W0	C0	--	3/4"	--	429
Exterior/ Garage PT Elevated Slab	5000psi NWC at 28 days (3000psi at stressing)	F3	S0	W1	C2	0.40	3/4"	6%	429
Columns	7000psi NWC at 28 days	F0	S0	W0	C0	--	3/4"	--	490
Interior Non - PT Elevated Slab	5000psi NWC at 28 days	F0	S0	W0	C0	--	3/4"	--	330
Exterior/ Garage Non - PT Elevated Slab	5000psi NWC at 28 days	F3	S0	W1	C2	0.40	3/4"	6%	330

# EXPOSURE CLASSES OF CONCRETE



Courtesy: Portland Cement Association

# ACI 318-25 Ch 19 Durability

Table 19.3.2.1—Requirements for concrete by exposure class

Exposure class	Maximum $w/cm$ <sup>[1,2]</sup>	Minimum $f_c'$ , psi	Additional requirements			
			Air content			
F0	N/A	2500	N/A			
F1	0.55	3500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			
F2	0.45	4500	Table 19.3.3.1 for concrete or Table 19.3.3.3 for shotcrete			
			Cementitious materials <sup>[3]</sup> —Types			Calcium chloride admixture
			ASTM C150	ASTM C595	ASTM C1157	
S0	N/A	2500	No type restriction	No type restriction	No type restriction	No restriction
S1	0.50	4000	II <sup>[4]</sup>	Types with (MS) designation	MS	No restriction
S2	0.45	4500	V <sup>[5]</sup>	Types with (HS) designation	HS	Not permitted
S3	Option 1	0.45	V plus pozzolan or slag cement <sup>[6]</sup>	Types with (HS) designation plus pozzolan or slag cement <sup>[6]</sup>	HS plus pozzolan or slag cement <sup>[6]</sup>	Not permitted
	Option 2	0.40	V <sup>[7]</sup>	Types with (HS) designation	HS	Not permitted
W0	N/A	2500	None <sup>[8]</sup>			
W1	N/A	2500	26.4.2.2(d)			
W2	0.50	4000	26.4.2.2(d)			

# ALL STRUCTURAL SECTIONS – SUSTAINABLE DESIGN SUBMITTALS

## I. Sustainable Design Submittals

1. Provide as part of product submittal an Environmental Product Declaration (EPD)
  - a. Third-party verification
  - b. Valid expiration date
  - c. Conformance with ISO 14025, 14040, 14044 and material-appropriate Product Category Rules (PCRs)
  - d. Preferred EPD Type III facility-specific. Provide industry-wide generic EPD if facility specific data is not available..
  - e. Minimum Global Warming Potential (GWP) for material life-cycle stages A1-A3 (material extraction, manufacturing). Also called “Cradle to Gate”. Indicate if data from other stages is provided.

# ALL STRUCTURAL SECTIONS - DEFINITIONS

- D. Environmental Product Declaration (EPD): A standardized third-party verified document presenting the quantified environmental information of the life cycle of a product to enable comparisons between products fulfilling the same function. It must conform to ISO 14040 series. EPDs may be of Product-specific Type III, or Industry-wide generic, and consist of at least a cradle-to-gate scope (Life cycle stages A1-A3).
  
- E. Global Warming Potential (GWP): Metric to measure and track embodied carbon of a particular product. The metric represents the combined Greenhouse Gas emissions resulting from the extraction, manufacture, and delivery of a material product into its service form. Measured in  $\text{kgCO}_2\text{e}$ . The “e” conveys that other greenhouse gases (e.g. methane) are included alongside  $\text{CO}_2$  and normalized to the equivalent impact of  $\text{CO}_2$ .
  
- F. Product Category Rule (PCR): A set of guidelines that determine what data should be gathered and how it will be evaluated when conducting a life cycle assessment of a product. A PCR sets the framework for the ability to produce consistent EPDs for a common material and enable comparison of data between products.

# WHAT IS AN EPD?

## NATIONAL READY MIX

ENVIRONMENTAL PRODUCT DECLARATION

Mix S63C650S1 • Vernon Plant



This Environmental Product Declaration (EPD) reports the impacts for 1 m<sup>3</sup> of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
- CSI Division 03-30-00: Cast-in-Place Concrete

## COMPANY

### National Ready Mix

15821 Ventura Boulevard, Suite 475  
Encino, CA 91436

## PLANT

### Vernon Plant

2626 26th Street  
Vernon, CA 90058

## EPD PROGRAM OPERATOR

### ASTM International

100 Barr Harbor Drive  
West Conshohocken, PA 19428



## DATE OF ISSUE

04/03/2020 (valid for 5 years until 04/03/2025)

## ENVIRONMENTAL IMPACTS

### Declared Product:

Mix S63C650S1 • Vernon Plant

Description: 1 4000PSI PU PL

Compressive strength: 4000 PSI at 28 days

### Declared Unit: 1 m<sup>3</sup> of concrete

Global Warming Potential (kg CO <sub>2</sub> -eq)	247
Ozone Depletion Potential (kg CFC-11-eq)	8.67E-6
Acidification Potential (kg SO <sub>2</sub> -eq)	1.12
Eutrophication Potential (kg N-eq)	0.31
Photochemical Ozone Creation Potential (kg O <sub>3</sub> -eq)	20.7
Abiotic Depletion, non-fossil (kg Sb-eq)	2.64E-6
Abiotic Depletion, fossil (MJ)	397
Total Waste Disposed (kg)	1.85
Consumption of Freshwater (m <sup>3</sup> )	3.06

**Product Components:** natural aggregate (ASTM C33), slag cement (ASTM C989), Portland cement (ASTM C150), admixture (ASTM C494), batch water (ASTM C1602)

Additional detail and impacts are reported on page three of this EPD

CLAYCO

THE ART & SCIENCE OF BUILDING

# Pain Points from the Dumb Contractor

- Copy paste
  - I/II vs IL
  - w/c
  - Air content
  - SCM's allowed/not allowed/limited
- Sustainability goals without perspective
- We need TIME!
- Unwillingness to try new things (With the right information)



## Refocus on Performance



- Air entrainment in an F0?
  - Phoenix Example
- Limiting w/c arbitrarily?
  - Jacksonville Example
- Cap on SCM's?
  - Arlington VA Example
- Focus on what you really need.
  - Strength?
  - Shrinkage?
  - ASR resistance?
  - w/c
- Where you pull one thing, often you have to push another...don't let unnecessary (CTRL+V) specification language handcuff quality or sustainability.

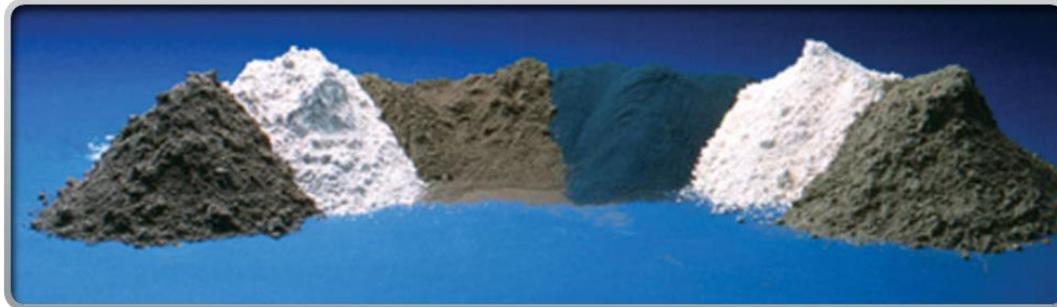
## Be Calm and Design On

- Let the Materials Engineering happen!
- The local people usually know their materials better than the rest of us.
- Ask for more testing if you need to!
- Who is reviewing your submittals?



# SCM Advantages

- SCMs in many cases produce more durable concrete
- Lower Heat of Hydration (mostly)
- Higher Ultimate Strengths (56 day and beyond)
- Increased workability (mostly)
- Reduced Permeability
- Chemical resistance
- Rates from 10% up to 85%?
- Ternary Blends
- Sustainability



# Different things are different

**If you judge a fish by its ability to climb a tree, it will spend its whole life believing it is a failure.**

- There is no one solution for all the requirements
- All materials have strengths and weaknesses
- Have different options...a golf bag with different clubs
- Sometimes using more than 1 in tandem can work even better!

**A**  $\neq$  **B**



# MIX COMPARISON TABLE

Constituent	Units	Typical	1157	Calcined Clay	Ternary	Pro-Zero	Pozzotive	C-Crete
Cement	Lbs/Yd <sup>3</sup>	1L - 580	1157 - 750	1L - 425	1L - 345	I/II - 324	1L - 178	--
SCM	Lbs/Yd <sup>3</sup>	--	--	CC - 105	Slag – 105 CC - 80	P-0 – 216	Pozz – 207 Slag – 207	C-Crete – 700
Coarse Agg	Lbs/Yd <sup>3</sup>	1880	1740	1900	1900	1820	1666	1580
Fine Agg	Lbs/Yd <sup>3</sup>	1184	1240	1193	1190	1100	1493	1550
Water	Lbs/Yd <sup>3</sup>	300	237	300	302	270	260	265
MRWR	Oz/Cwt	4	--	4	4	--	7	7
HRWR	Oz/Cwt	--	4 (+44)	2	2	5	--	--
Target Air	%	0-3	0-3	0-3	0-3	0-3	0-3	0-3
Target w/c	--	.52	.34	.57	.57	.50	.44	.37

# DESIGN OPTIMIZATION

- Is it all about the powder?
- Do you need a 6" Thick Sidewalk?
- Air
- How thick is your paving?
- Can you leverage optimized designs using other materials to reduce the overall amount of concrete?
  - Fibers
  - Shrinkage Compensating admixtures
- Performance enhancing admixtures
- Tilt-up vs Precast or CIP
- Full life cycle analysis?

# Early Involvement and Collaboration

LOCATION	Atlanta	Des Moines	Phoenix	N. Virginia	San Antonio
<b>Per Building Price</b>	<b>20,000 CY Single Building and Paving</b>				
Cement Cost	Below Avg	Below Avg	Above Avg	Avg	Above Avg
Slag Cost	Avg	Above Avg	Problematic	Below	Avg
Aggregate Cost	Avg	Avg	Avg	Avg	Avg
Operational Costs	Avg	Avg	Above Avg	Above Avg	Below Avg
<b>Total Average CY Price</b>	<b>\$213</b>	<b>\$213</b>	<b>\$230</b>	<b>\$218</b>	<b>\$268</b>

- Concrete contractors have no direct line to the EOR or Owner most of the time
- The earlier we can get involved, the more effective we can be in trying to achieve Performance and Sustainability goals
- Local Ready Mix Involvement
- Local industry organizations

# New materials coming up?

C618 – beneficiated fly ash

C1157 – performance hydraulic cement

Fiberglass rebar?

C1866 – Ground Glass Pozzolan

Algae based concrete

ASTM C595 – 1L??? Try 1P, 1S or 1T? More than 15%? 25...35%?

ASTM C1157 – Performance Based

Carbonate based cement.

Magnesium based cement

Internal Curing

Performance Enhancing admixtures

# Where to go for more info?

ACI 301 – Specifications for concrete construction

ACI 318 – Structural Concrete Building Code

ACI 323 – CODE like 318 Low Carbon Concrete published 2024

NEU – ACI Center of Excellence for Carbon Neutral Concrete

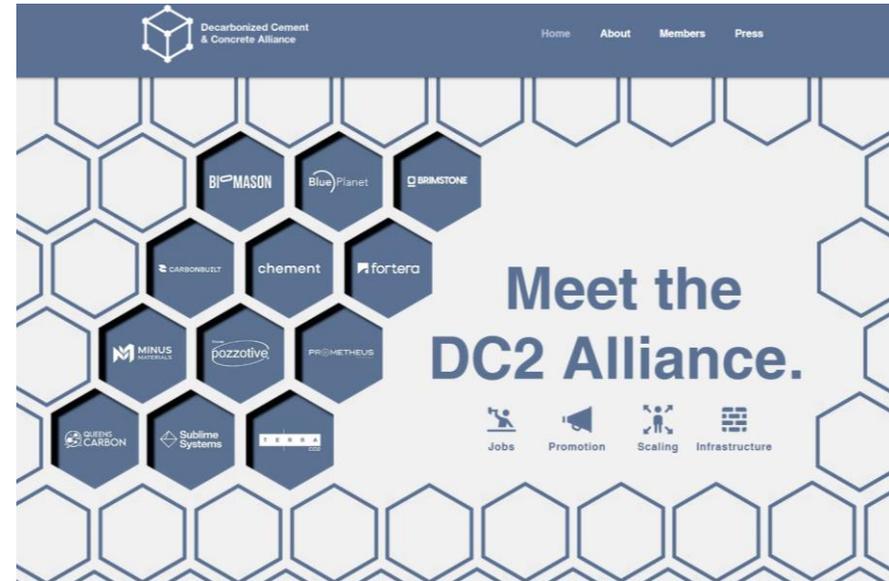
ASCC Sustainability Resource Center (Coming soon)

ACA – American Cement Association

<https://www.decarbonizedconcrete.org/>

Your Friendly neighborhood contractors!

Local Industry groups (ACI, AGC, ASCC, etc...)





**PROVE IT!  
AKA HOW TO  
DOCUMENT  
CLIENT  
REQUIREMENTS**

# REVIEW THE SPECS, INCLUDING DIVISION 1

## C. Sustainable Design Documentation Submittals:

1. Environmental Product Declarations complying with LEED requirements.
2. Documentation of embodied carbon.
  - a. Report the proposed Project Embodied Carbon and Embodied Carbon Reduction using EC3 prior to subcontract awards. Normalize the results by kilograms CO2e/square foot of built area and kilograms CO2e/total materials cost (USD).
  - b. Provide the cost premium or cost savings to achieve the minimum Embodied Carbon Reduction (30%) and the cost premium or cost savings for the maximum

## 1.3 SUSTAINABILITY REQUIREMENTS

- A. The total A1-A3 Global Warming Potential (GWP) of the project's concrete (**Project GWP**) must achieve an overall reduction of 35% below the **Baseline GWP**. This overall reduction is calculated on a volume-weighted basis, with each mix measured against its respective NRMCA regional baseline, and averaging across all concrete poured.

# BE A RESOURCE TO YOUR PARTNERS

NRMCA v3.0 Region: Eastern  
 NRMCA v3.0 Region: E2

Structural Element	Concrete Quantity	Design strength, f'c (per spec)	Normal Weight or Lightweight Concrete?	Mix Code	Mix Notes (Cement Type, SCM%)	Proposed 7-day design strength, f'c	Proposed 28-day design strength, f'c	Global Warming Potential (GWP): NRMCA Baseline	Global Warming Potential (GWP): Product-Specific EPD	Global Warming Potential (GWP): Product-Specific EPD	GWP Savings	Reduction from Baseline
	yd <sup>3</sup>	psi	(NWC or LWC)	-	-	psi	psi	kgCO <sub>2</sub> e/yd <sup>3</sup>	kgCO <sub>2</sub> e/m <sup>3</sup>	kgCO <sub>2</sub> e/yd <sup>3</sup>	tCO <sub>2</sub> e	%
Foundations & Footings	2,500	4,500	NWC		40% fly ash		4500	294	258	197	-242	-33%
Slab on Grade	5,000	3,500	NWC		40% fly ash		3500	245	222	170	-376	-31%
Tilt Up Wall Panels	0	4,000									0	0%
Slab on Metal Deck	0	4,000	LWC								0	0%
Retaining Walls	0	5,000						-			0	0%
Stair Pans	0	4,000						-			0	0%
Misc (pads, etc)	2,700	4,500	NWC		40% fly ash		4500	294	258	197	-261	-33%
Site	1,700	4,500	NWC		40% fly ash		4500	294	258	197	-164	-33%
								-			0	0%
								-			0	0%
sum =	11,900										-1,044	-32%



## STATISTICS

Product EPDs: 22092

Industry EPDs: 41

Achievable: 217 kgCO<sub>2</sub>e

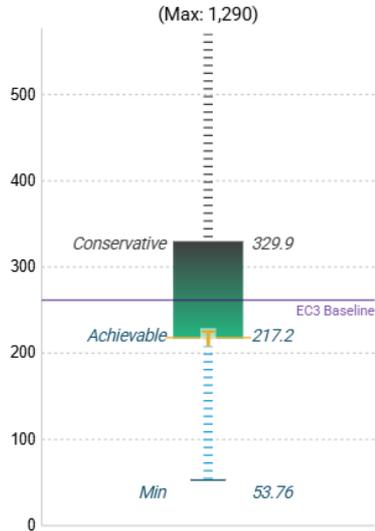
Average: 275 kgCO<sub>2</sub>e ± 0.256%

Conservative: 330 kgCO<sub>2</sub>e

Converted per Unit: 1 yd<sup>3</sup>

### kgCO<sub>2</sub>e embodied per 1 yd<sup>3</sup>

#### ABOUT THIS BOXPLOT DIAGRAM





Product EPDs: 52      Industry EPDs: 5      Achievable: 145 kgCO2e      Average: 196 kgCO2e ± 0.276%      Conservative: 251 kgCO2e      Converted per Unit: 1 yd3

▶ **INDUSTRY EPDS**

**PRODUCT EPDS**

[Download](#)

Subcategory	Manufacturer <a href="#">Compare</a>	Plant or Plant Group <a href="#">Compare</a>	Product <a href="#">Compare</a>	Description	Compressive Strength... <a href="#">Plot</a>	≤ uaGWP / 1 yd3	Columns Manufacturer x Fv
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340A8M14	MD PCCP AE MF TRI-35 M...	4000 psi	193.9 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340A8M12	MD PCCP AE MF TRI-35 W...	4000 psi	194.0 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340A8B04	MB WA552 3/4-4 T	4000 psi	190.2 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340P1P08	4000 AE STR MR PG 0.47	4000 psi	288.0 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	KS4GR40XAR	KDOT 4.0/4.5	4000 psi	222.7 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	KS4GR40XAR	KDOT 4.0/4.5	4000 psi	222.7 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340B5W09	4000 PL 1/2" SLG-30 HR 0...	4000 psi	200.6 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340A5M12	MD PCCP AE MF SLG-25 W...	4000 psi	233.4 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340B1D09	4000 PL 1/2" STR HR 0.48	4000 psi	271.2 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Ash Grove KC Concrete G...	Central Avenue - 351	340A1D08	4000 PL STR MR 0.48	4000 psi	270.9 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	A20C536V444	WA536-3/4-2.44 (456+80C...	4000 psi	263.9 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	A20C536V444	WA536-3/4-2.44 (456+80C...	4000 psi	263.9 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	A40C536V447	WA536-3/4-4.47 (456+80C...	4000 psi	263.6 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>
Ready Mix	Geiger Ready-Mix	KCK	P40C536V450	W536-3/4-4.50 (456+80C) ...	4000 psi	263.9 kgCO2e	<a href="#">Details</a> <a href="#">Open</a>

Search-Results  
52 EPDs

Geiger-Ready-Mix  
34 EPDs

Ash-Grove-KC-Concrete-Group  
15 EPDs

Mid-America-Ready-Mix-LLC  
3 EPDs

# EQUIVALENCIES

The EPA Carbon Equivalency Calculator is the gold standard in evaluating Carbon Emission equivalencies. The avoided emissions from efforts at WUSM total **4.2 million kg CO<sub>2</sub>e**.

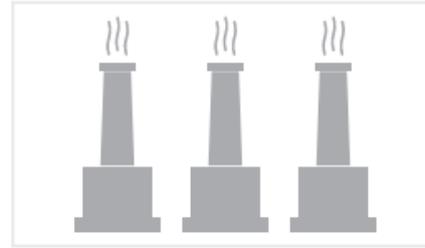
## This is equivalent to CO<sub>2</sub> emissions from:



**935** gasoline-powered passenger vehicles driven for one year



**529** residential homes' total energy use for one year



**4.7M** lbs. of coal burned

## Greenhouse gas emissions avoided by:



**1,453** tons of waste recycled instead of landfilled



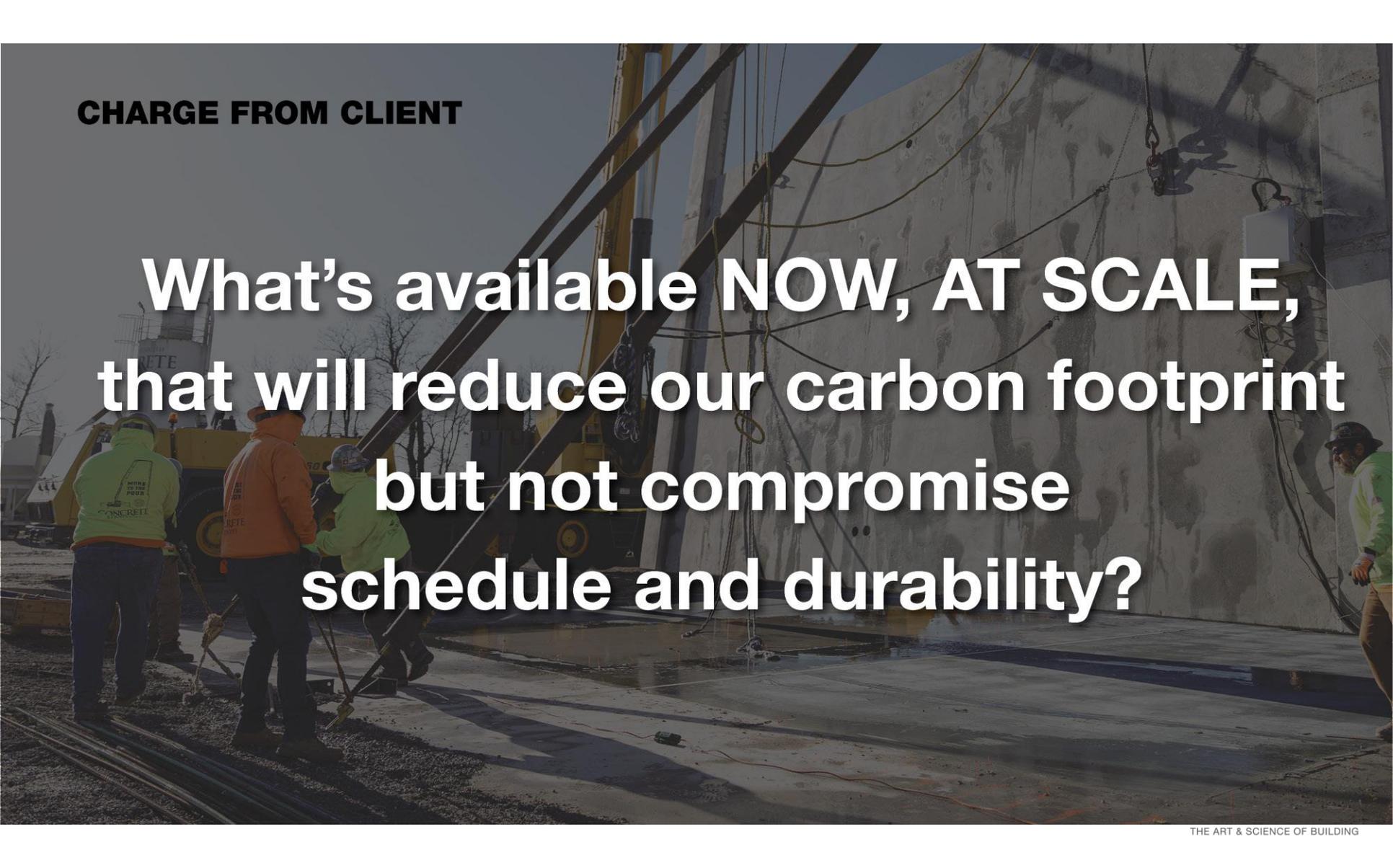
**208** garbage trucks of waste recycled



**1.20** wind turbines running for one year



# PILOT STUDIES AND LESSONS LEARNED

A construction site with workers in high-visibility vests and hard hats. A large crane is lifting a massive concrete slab. The scene is dimly lit, suggesting an overcast day or early morning/late afternoon. The workers are positioned around the base of the slab, and the crane's cables are visible against the sky.

**CHARGE FROM CLIENT**

**What's available NOW, AT SCALE,  
that will reduce our carbon footprint  
but not compromise  
schedule and durability?**

## **BARRIERS TO USING LOW CARBON CONCRETE IN TILT WALL CONSTRUCTION**

- Perceived cost
- Perceived schedule impacts
- “Unknown” factor
- Reliable & available SCMs
- Big picture - is this a worthy effort?



# CEMENT TYPES FOR CONCRETE MIXES EVALUATED

	Cement Type	Embodied Carbon
Baseline	NRMCA V3.2, Great Lakes Region	Baseline
Panel 1	100% type 1L cement, Holcim St. Genevieve Plant	25% reduction
Panel 2	Blended cement - 25% blast furnace slag, 75% type 1L cement, Holcim St. Genevieve Plant	39% reduction
Panel 3	Proprietary blended 1157 cement mix 1	64% reduction



# MIX DESIGNS

Constituent	Description or Source	Units	Mix 1 - 1L St. Gen	Mix 2 - 25%	Mix 3 - C1157
Type IL Cement	St. Genevieve, MO	lbs/yd <sup>3</sup>	564	423	--
Slag Cement	Holcim, Chicago, IL	lbs/yd <sup>3</sup>	--	141	--
C1157 Cement	Ozinga	lbs/yd <sup>3</sup>	--	--	750
Coarse Aggregate	Bluff City Materials, Alton, IL	lbs/yd <sup>3</sup>	1775	1780	1740
Fine Aggregate	Madison County Sand, Collinsville, IL	lbs/yd <sup>3</sup>	1420	1400	1240
Water	N/A	lbs/yd <sup>3</sup>	271	271	237
High-Range Water Reducer	ADVACAST 600, GCP	fl. oz.	26	26	30
Workability Enhancing Admixture	ADVA XT, GCP	fl. oz.	--	--	22
Rheology Modifying Mixture	V-MAR F100, GCP	fl. oz.	--	--	45
Accelerating Admixture	OZ Set	fl. oz.	--	--	262.5
Target Air Content	--	%	1.5	1.5	1.5
W/CM (not including admixtures)	--	--	0.48	0.48	0.32
W/CM (including admixtures)	--	--	0.48	0.8	0.34

## IN THE FIELD

White wire and device  
Smartrock™ in-situ maturity  
sensor installed within panel.



# IN THE FIELD

	TESTING DAYS						
	1	2	3	5 <sup>†</sup>	7 <sup>†</sup>	14	28*
Field-cured Cylinders	X	X	X	X	X	X	X
Lab-cured Cylinders					X		X
Field-cured Beams (Panels 1 & 2)		X	X		X		X
Field-cured Beams (Panel 3)		X	X	X	X		X

**\*Note:** All 28 day actions & testing were performed on day 29 (12/26) due to the holiday.

**†Note:** Panel 3 only.



# TESTING, POURING, FINISHING

## PANEL 2 - FIELD OBSERVATIONS

“25% mix acted similar to standard. Placed, finished and cured the same. Less cracking that straight cement.”

“25% was not bad – placed and finished like straight cement.”

“25% mix gave the crew a bit extra time to finish, which was good. Still set and finished within a reasonable time.”

“A bit sticky and harder to finish.”



*Concrete washout area demonstrating color difference between Panels 1 & 2 (darker) and Panel 3 (lighter).*



## PANEL 3 - FIELD OBSERVATIONS

“Once you used the VibraStrike, it finished well. You need to keep it moving.”

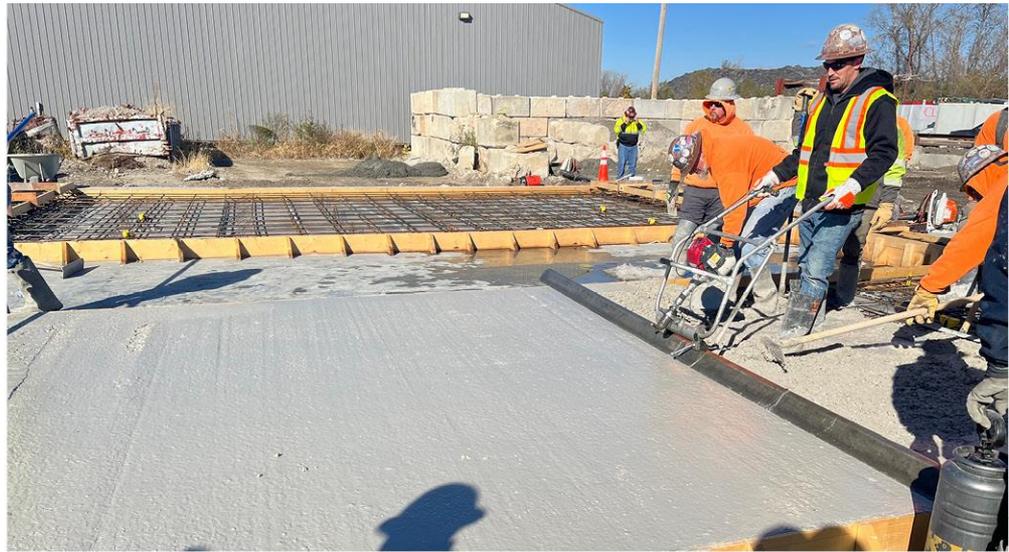
“Would need more moisture to work well in the field.”

“Finished well – final product looked good. Difficult to pour, move around and place.”

“Seemed to set up hard on top but was soft underneath. Top inch was hard but you could put a dent in it.”

“Difficult to place and finish.”







# Erection of Panel 3: 1157 Mix

## RESULTS



	Cement Type	Embodied Carbon
Baseline	Baseline	Baseline
Panel 1	100% Type 1L	25% reduction
Panel 2	25% Slag + 1L	39% reduction
Panel 3	Proprietary 1157	64% reduction

**Panel 2** (25% slag) attained lifting strength and was erected on Day 3. Good to use even in poor weather.

**Panel 3** attained lifting strength at day 3 in lab setting. In cold weather attained strength at 7 days. Further testing to determine “sweet spot” of conditions for use.



**OZINGA**<sup>®</sup>



**C-Crete**  
TECHNOLOGIES





**DO THIS  
NOW**

# WHAT CAN YOU DO?

- Understand that the industry is in a period of rapid change
- Be an expert on what is available in your area
- ASK if there are formal carbon reduction goals (Division 01)
- ADD EPD request to your specifications (*Ready Mix, Steel, Reinforcement, Metal Deck, Mass Timber, Dimensional wood, Light Gage Steel, Deck*)
- Train staff on reviewing EPDs
- Add exposure class to your concrete matrix
- Target small aspect of project for pilot
- Ask ready mix provider for advice on w/cm ratios, aggregate gradations

## **CHECK YOUR SPEC!**

- Do you still list C150 Type I/II Cement?
- Specify  $f'c$  and Exposure
- Remove notes requiring minimum cement
- ADD notes requiring minimum cement replacement
- Add a dedicated “Embodied Carbon” page to your sets (Special Inspection)
- Understand baselines – NRMCA vs CLF vs EC3 etc
- Budget for testing of novel mixes
- Approve back up mixes
- **EXPERIENCED REVIEWERS ON SUBMITTALS!**



# RESOURCES

- [Navigating Sustainable Concrete](#), Structure Magazine, Dec 2024
- [NCSEA Performance Based Concrete Class Table](#), 2025
- [ACI 323-24, Low-Carbon Concrete – Code Requirements & Commentary](#)
- [KC Resource: Concrete Promotional Group](#)
- [Carbon Leadership Forum: Resource Library](#)
- [SE 2050 Challenge](#)
- Case Studies: [lowercarbonconcrete.org](https://www.lowercarbonconcrete.org)
- [Decarbonized Concrete & Cement Alliance \(DC2\)](#)



## **CONTACT US:**

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**Thank You!**

Let us know if you have any questions.

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