



Concrete Innovation

Master X-Seed Admixtures: The Solution for Carbon Reduction in Concrete

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MBCC GROUP

Concrete Innovation Solution for Carbon Reduction in Concrete

Your Presenters



**Tyler Grissom – Master Builders Solutions
Product Manager Marketing**

- Master X-Seed
- Master Suna
- Industry Insights



**Chris Eagon – Master Builders Solutions
Strategic Accounts Manager**

- 20 years in the construction materials field
- Member ACI 309 and ACI 329
- Adjunct Professor of Marketing at Walsh University





- Over 110 Year of history
- Recognized market share, service and innovation leader in the concrete construction industry
- Over 250 patents

- » 1930s: Introduced first water-reducing admixture, MasterPozzolith
- » 1980s: MasterPolyheed, first mid-range water; Devlo Stabilizer
- » 1990s: MasterGlenium, polycarboxylate admixture technology
- » 2000s: Invented 4x4 concrete systems for fast track paving; Green Sense Concrete mixture optimization
- » 2020s: Patented Master X-Seed, C-S-H Nano Crystals



In 1909, Chemist and visionary S.W. Flesheim established Master Builders Inc. in Ohio.

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Why is Carbon (CO₂) an Issue?

Main sources of CO₂ emissions

- Respiration (humans/animals)
- Organic decomposition
- Combustion of fossil fuels



CO₂ in the atmosphere traps solar energy or heat which normally escapes into space. The trapped heat causes climate change.



Climate change affects:

- Weather
- Agriculture
- Ocean levels

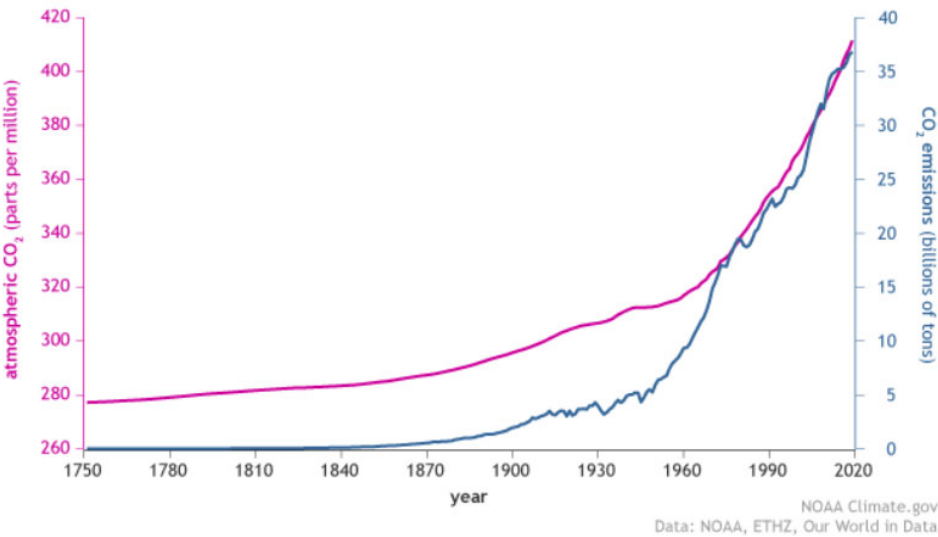


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Global Carbon Dioxide

CO₂ in the atmosphere and annual emissions (1750-2019)

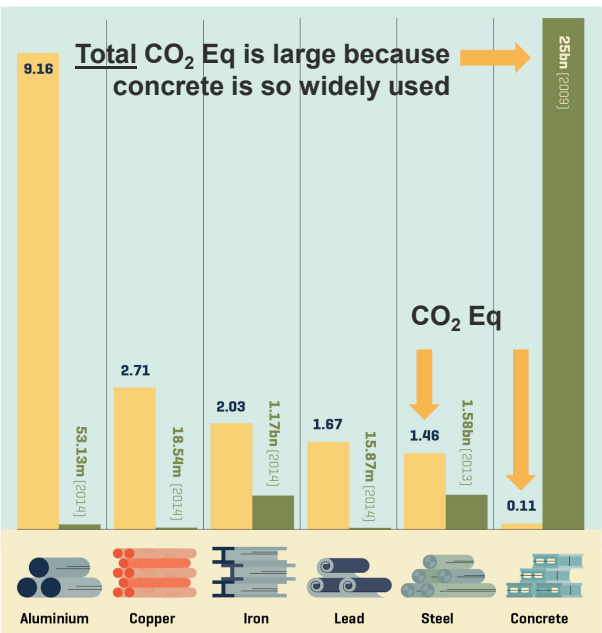


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A Conundrum for Concrete


Today, second only to water, concrete is the most consumed material, with three metric tonnes per year used for every person in the world.




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Concrete Production – Core Components




Cement




Stone




Sand



Water



Admixtures

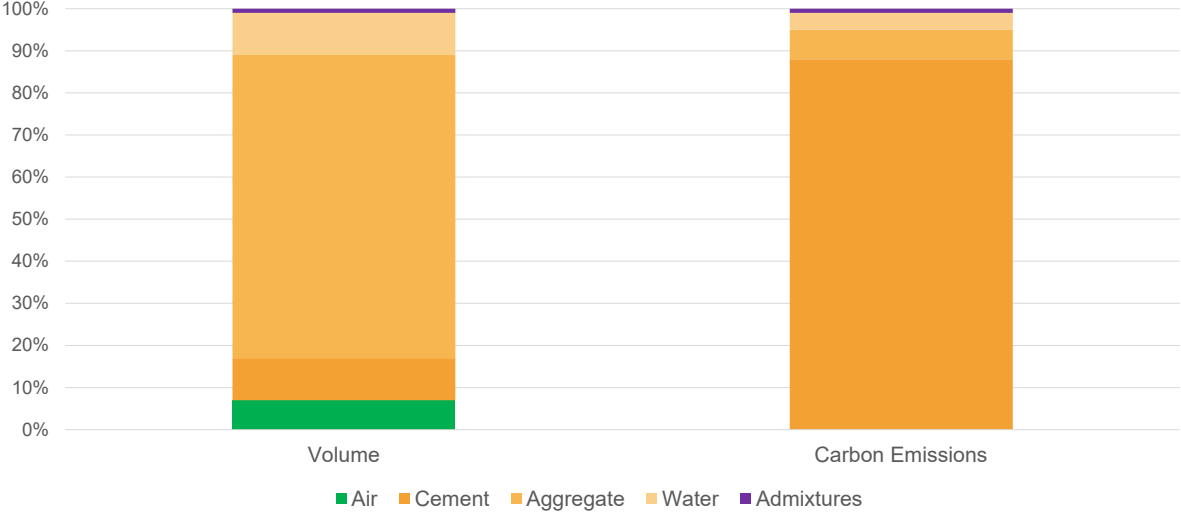


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Carbon in Cement vs Concrete

Cement consists of 7 to 15 percent of concrete's volume but is responsible for ~90 percent of the carbon emissions.



The chart displays two stacked bars. The left bar, labeled 'Volume', shows the composition of concrete by volume: Air (green, ~7%), Cement (orange, ~15%), Aggregate (yellow-orange, ~65%), Water (light orange, ~12%), and Admixtures (purple, ~1%). The right bar, labeled 'Carbon Emissions', shows the carbon footprint: Cement (orange, ~90%), Aggregate (yellow-orange, ~10%), and Water (light orange, ~1%). Air and Admixtures contribute negligible carbon emissions.

Component	Volume (%)	Carbon Emissions (%)
Air	~7	~0
Cement	~15	~90
Aggregate	~65	~10
Water	~12	~1
Admixtures	~1	~0

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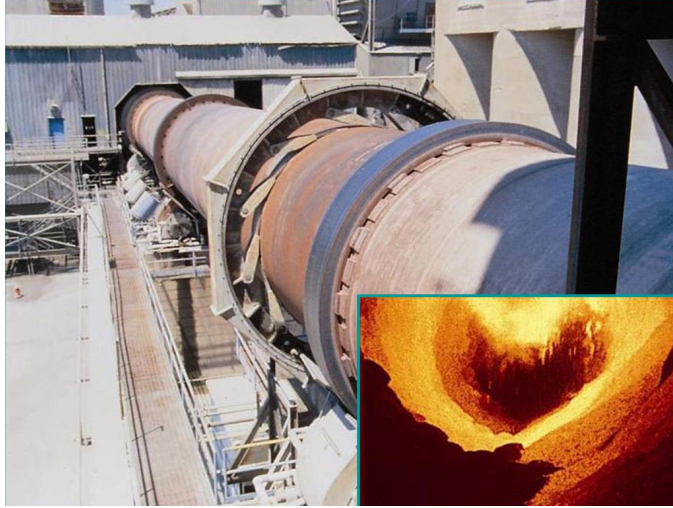
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© National Ready Mixed Concrete Association

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Portland Cement Production

Carbon emissions is a result of both fuel combustion and process-related emissions



Carbon Emissions in Cement:

- Burning fuels in the cement kiln at 1300-1450 °C (2372- 2642 °F)
- CO₂ is emitted when calcium carbonate (CaCO₃) is calcinated and converted to lime (CaO)

Source: PCA

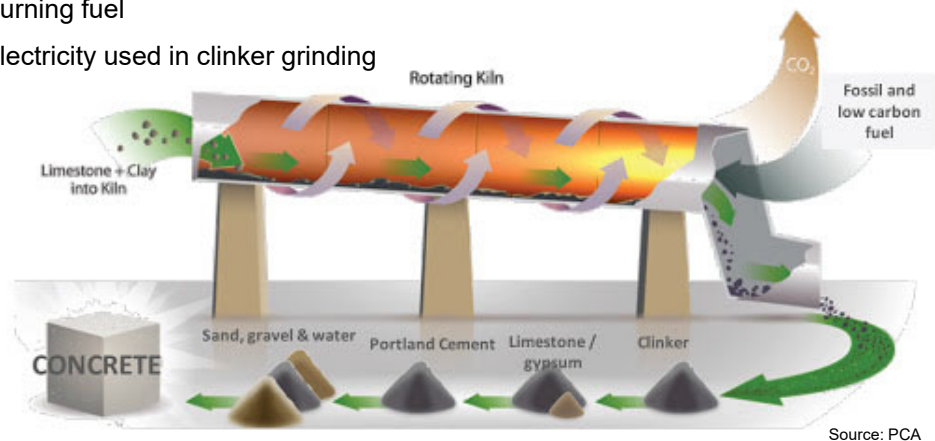
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Portland Cement – Embodied Carbon Emissions

» CO₂ is from combustion and process-related emissions

- 50 percent from chemical process to create clinker
- 40 percent from burning fuel
- 10 percent from electricity used in clinker grinding



Source: PCA

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What can we do to reduce embodied carbon in concrete?

Cement Production:

- Lower carbon footprint fuels
- Reducing the clinker-to-cement ratio (blended cements – Type IL / Type GUL)
- Deploying carbon capture technologies



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What can we do to reduce embodied carbon in concrete?

Concrete Production:

- Water-Reducing Admixtures
- Supplementary Cementitious Materials
- Strength Enhancing admixtures
- Portland limestone cements (Type IL / Type GUL)
- Recycled aggregates
- Reduce carbon footprint in concrete production and transportation



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The Path Toward ‘Net Zero’ Carbon Emissions in Concrete

Utilizing multiple technologies provide greatest option for CO₂ reduction.

Embodied Carbon Reduction Technologies	Potential Embodied Carbon Reduction
Water-Reducing Admixtures	5-30%
Strength-Enhancing Admixtures	5-20%
Supplementary Cementitious Material	20-90%
Portland Limestone Cements	10-15%
Recycled Aggregate	5-30%
Carbon Capture Technologies -- <i>Point of Cement Production Capture / Combined with Atmospheric Capture</i>	5-200%



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Master X-Seed – Carbon Reduction Admixture Crystalline Calcium Silicate Hydrate (CSH) Nanoparticles



Admixture for Carbon Reduction

- Reduce the embodied carbon in concrete mixtures by 5-20 percent.



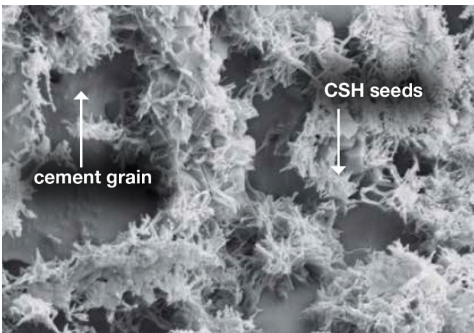
Unmatched Strength Enhancement

- Improves strength development



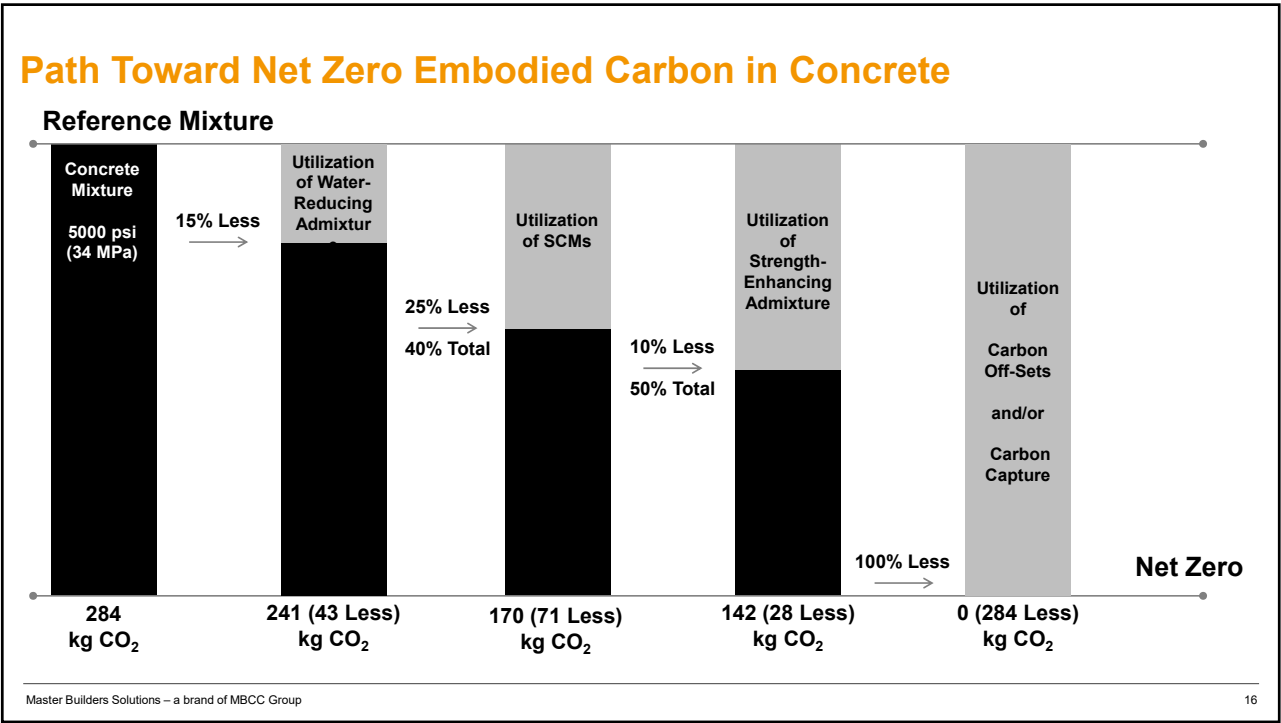
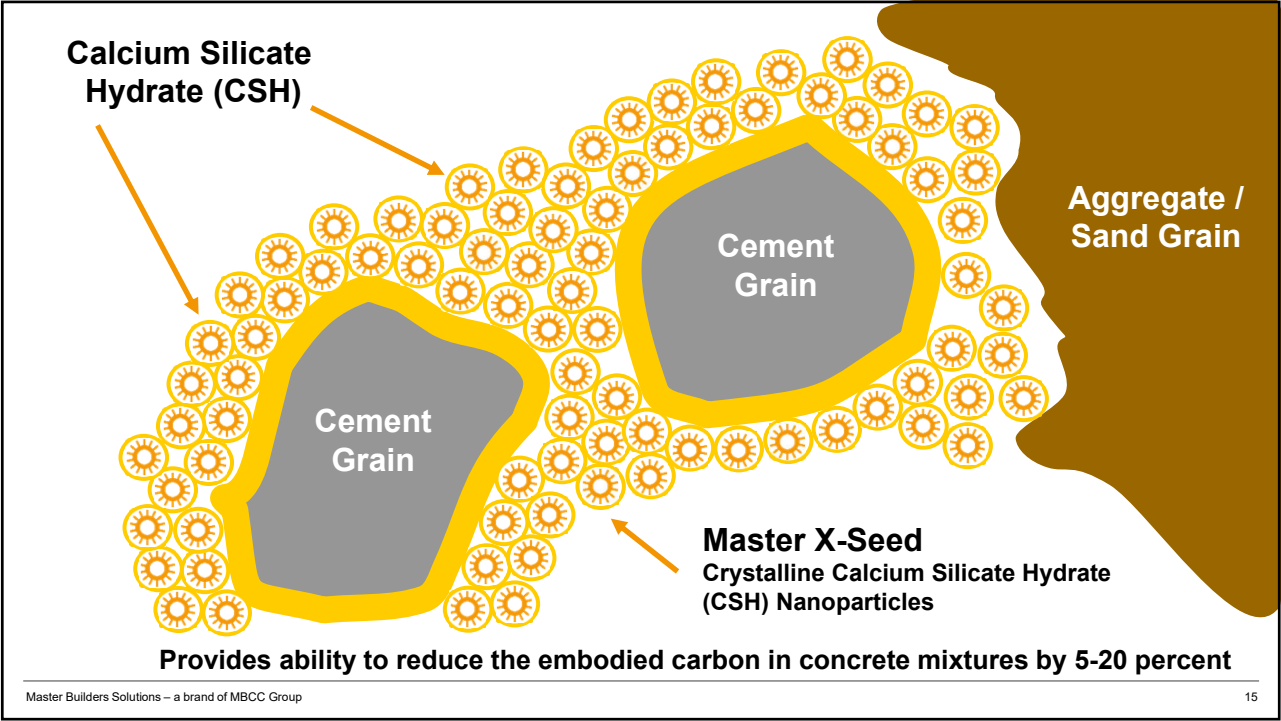
Improving Concrete Performance

- Allows for cement reduction and higher SCMs



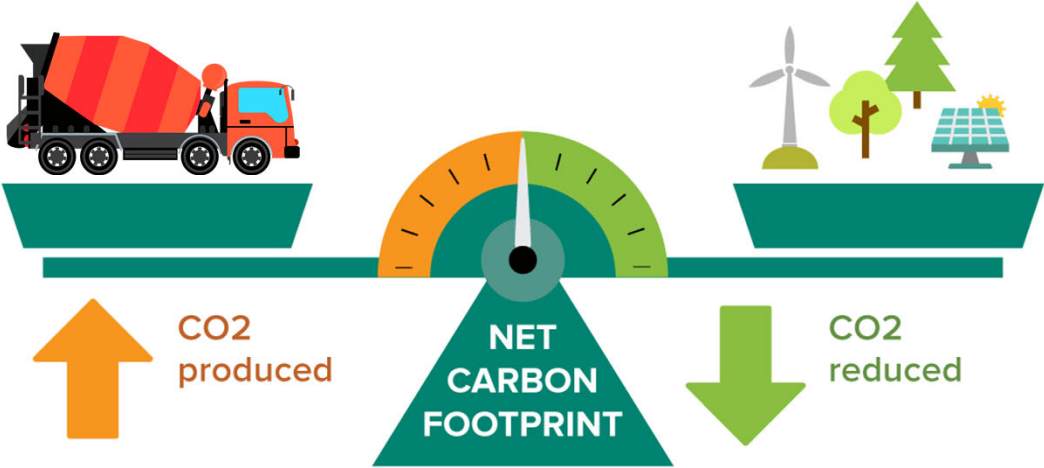
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The Path to Net Zero Embodied Carbon in Concrete

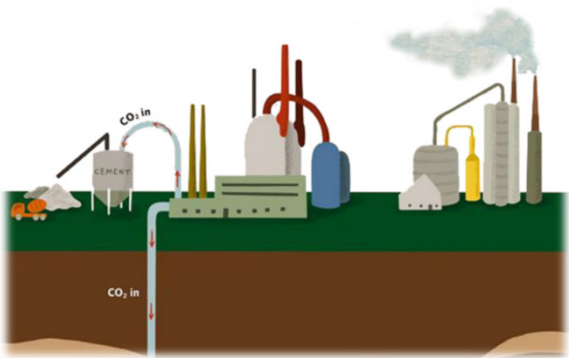
To achieve **‘Net Zero’ Concrete**, requires carbon offsets in concrete production and carbon capture in cement production – which costs a “Green Premium”



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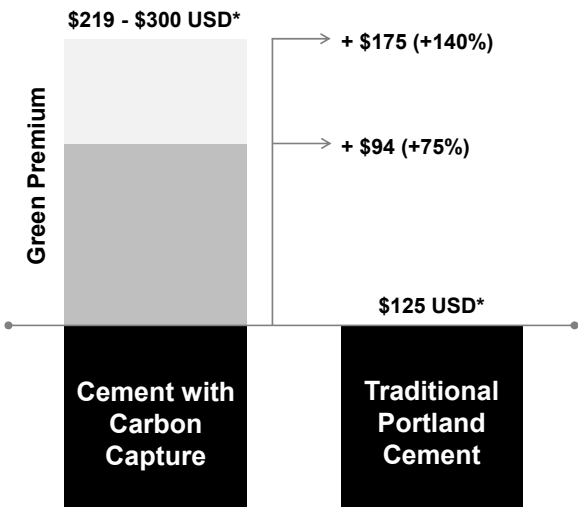
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What is the ‘Green Premium’?



» We don’t yet have a way to completely eliminate CO₂ from the cement production process other than carbon capture technology

Cost of a traditional ton of cement vs. new price after carbon capture



*Source: International Energy Agency

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Specifications to reduce embodied carbon

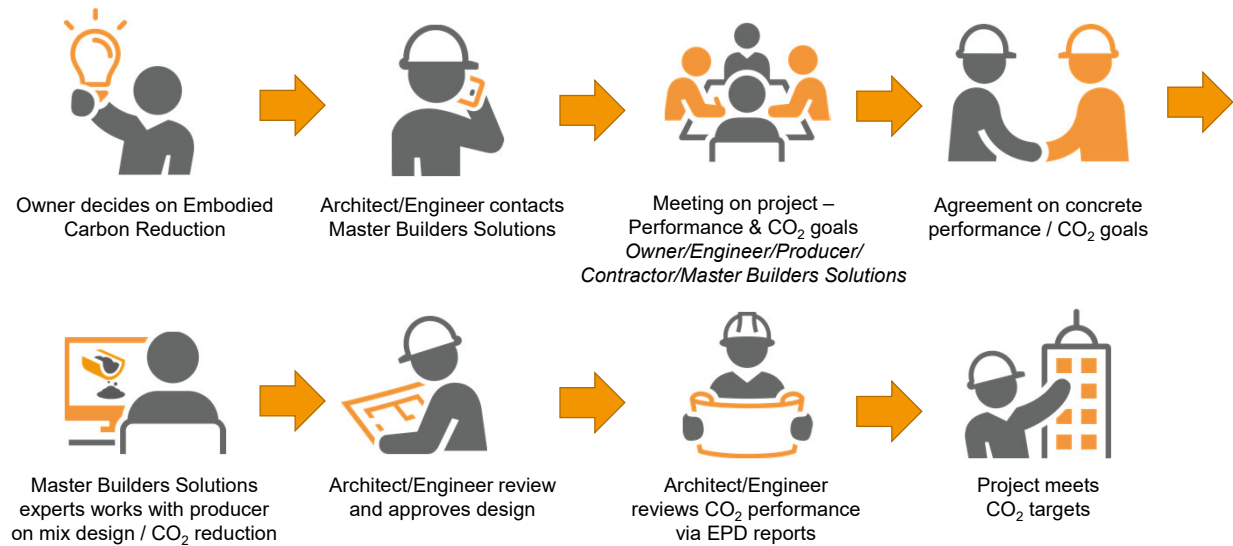
- » Master Builders Solutions experts can assist to review concrete specification language
- » Master Builders Solutions experts can validated concrete performance and carbon reduction goals
- » Master X-Seed admixture can reduce embodied carbon while achieving equivalent strength.



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Methodology for managing the path for carbon reduction in concrete



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