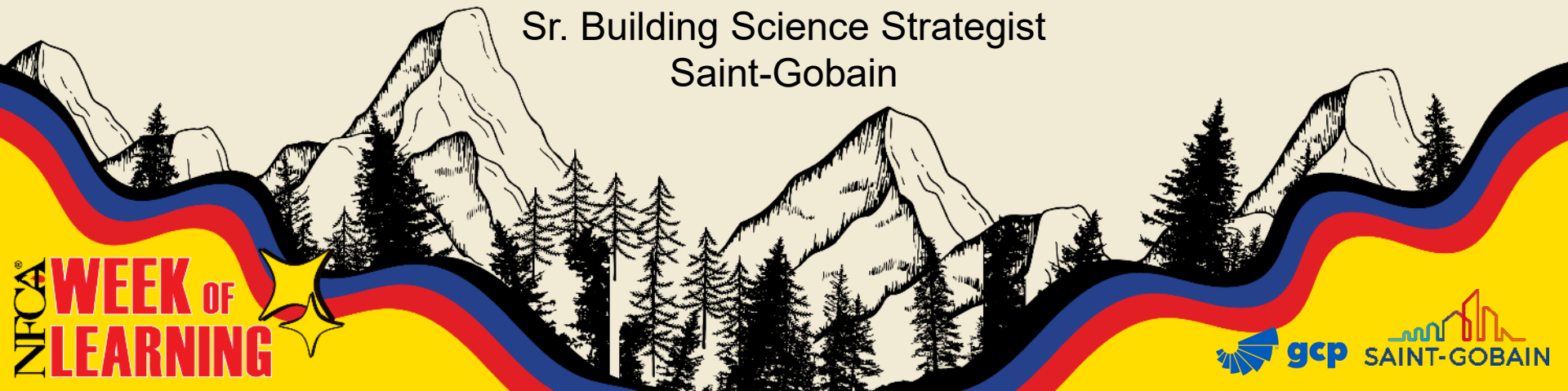
Growing the Available Market While Unlocking Carbon Savings in Steel Buildings

Galen Burrell
Sr. Building Science Strategist
Saint-Gobain



NFCA WEEK OF LEARNING

gcp SAINT-GOBAIN


Bigger Contracts.
More Steel Construction.
Less Carbon.

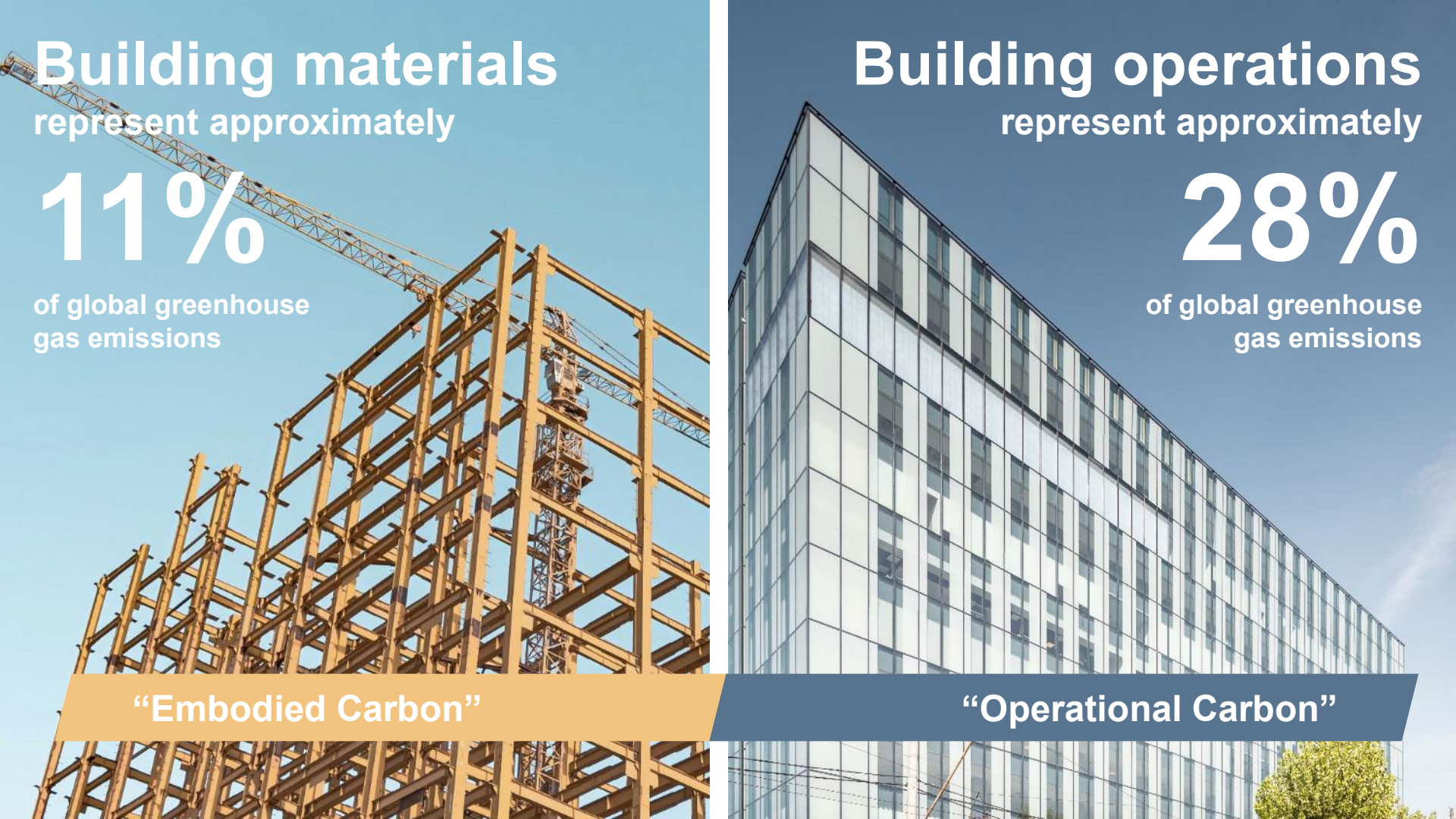
Buildings

are responsible for approximately

39%

of global greenhouse gas emissions

Source: UN Environment Program


Building materials
represent approximately
11%
of global greenhouse gas emissions
“Embodied Carbon”
Building operations
represent approximately
28%
of global greenhouse gas emissions
“Operational Carbon”

Building materials

represent approximately

11%

of global greenhouse gas emissions

“Embodied Carbon”

Steel & Concrete

together represent approximately

50%

of a typical commercial building’s embodied carbon

Source: New Buildings Institute

WHAT IS THE INDUSTRY DOING ABOUT IT?

Building Science

Microsoft

amazon

SENECA | GROUP

PROLOGIS®

Trammell Crow Company

Sellen

ada

MAERSK

SAINT-GOBAIN

WHAT IS THE INDUSTRY DOING ABOUT IT?

Building Science

THE CLIMATE PLEDGE

Net Zero Carbon by 2040

Microsoft

amazon

SENECA | GROUP

PROLOGIS

Trammell Crow Company

Sellen

ada

MAERSK

45%

Fortune 500 companies plan to be net zero by 2050[1]

2.5B SF

Real estate occupied by Fortune 50 alone[2]

[1]Source: Climate Impact Partners
[2]Source: Custom data form CoStar

WHAT ARE DESIGNERS & ENGINEERS DOING?

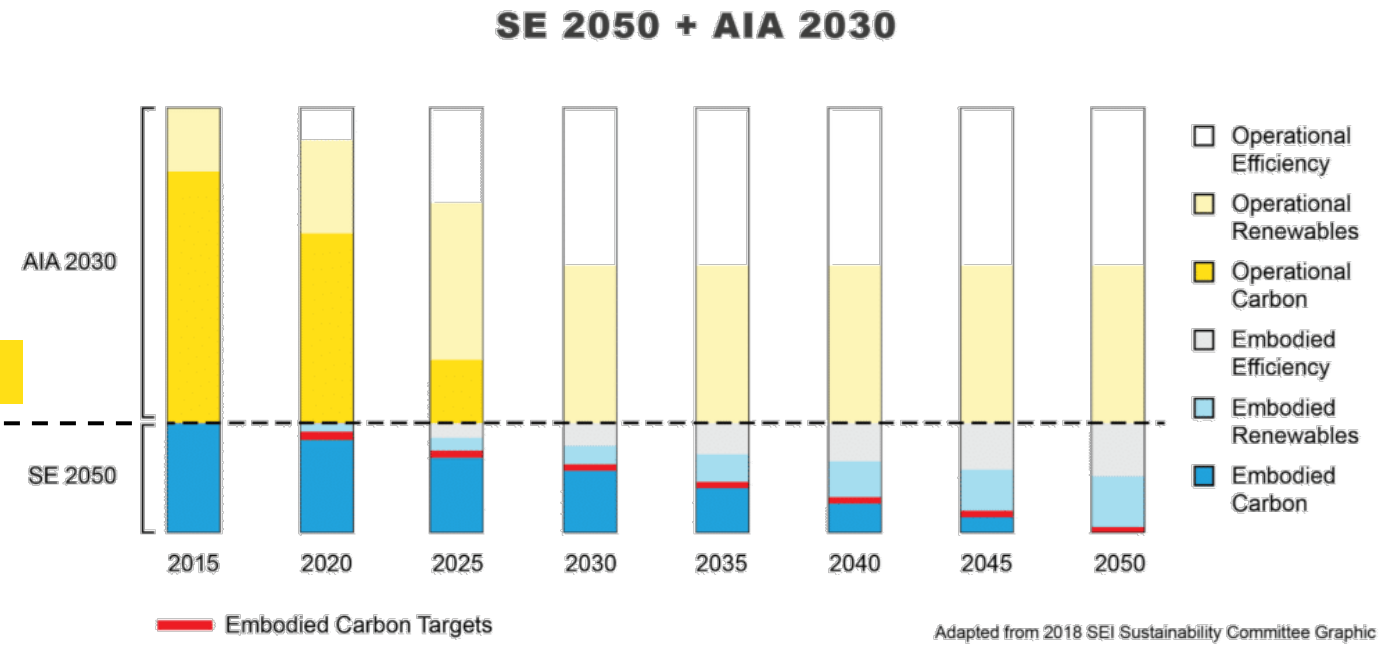
Building Science

architecture 2030

Net Zero Emissions by 2030

SE2050 COMMITTING TO NET ZERO

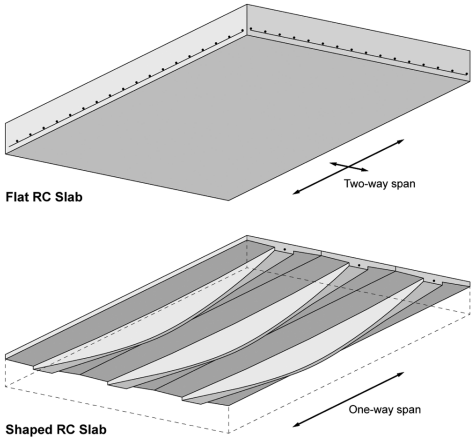
Net Zero Embodied Carbon by 2050



SAINT-GOBAIN

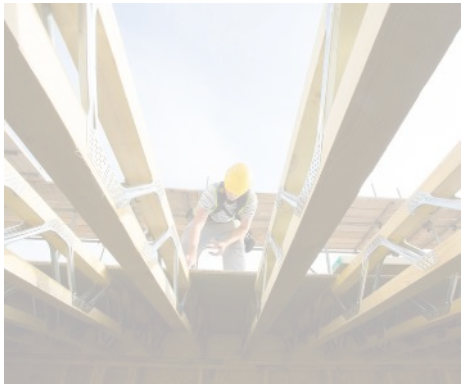
STATEGIES FOR REDUCING EMBODIED CARBON

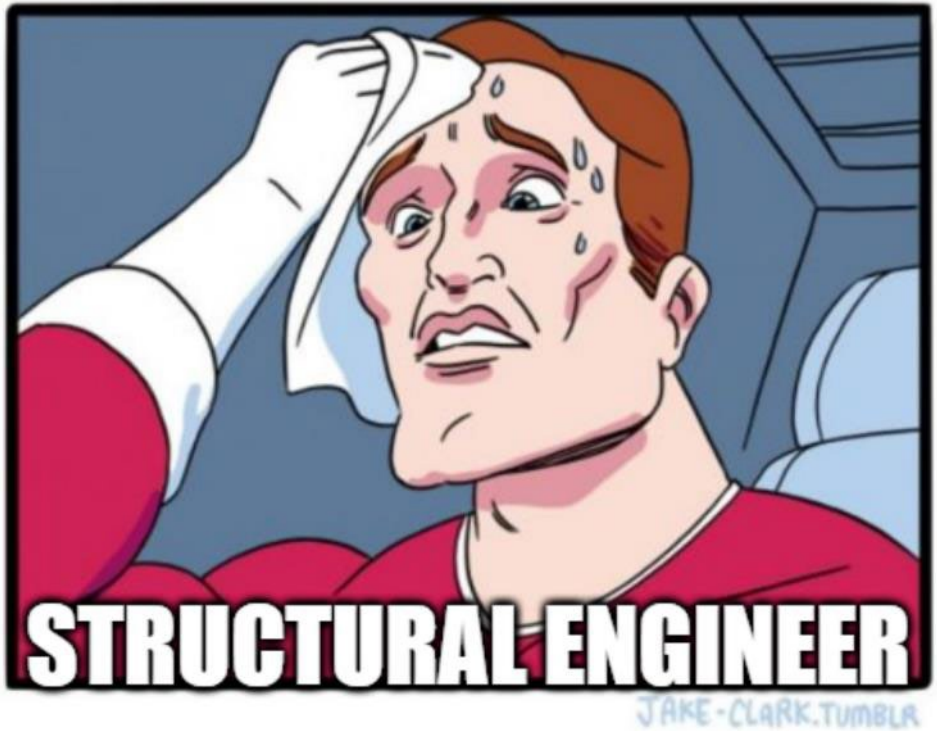
DESIGN OPTIMIZATION



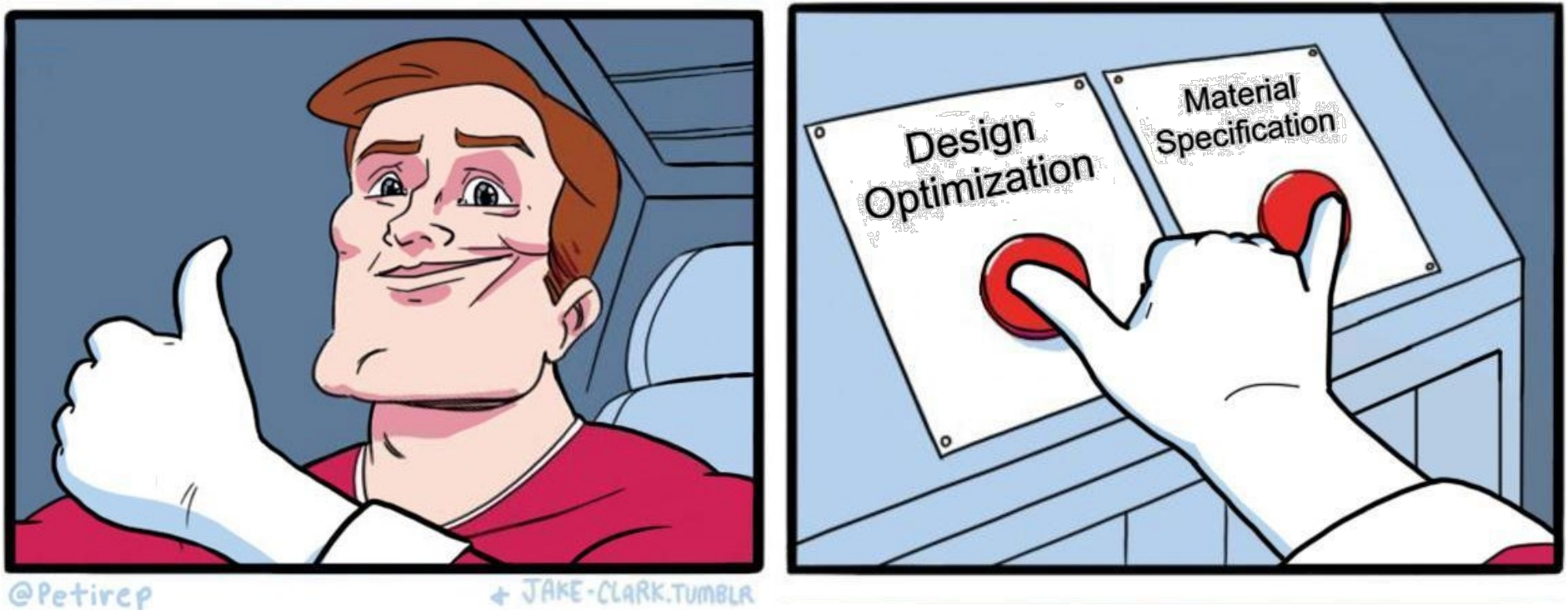
MATERIAL SPECIFICATION

STRUCTURAL SYSTEM SUBSTITUTION




STRUCTURAL ENGINEER
JAKE-CLARK.TUMBLR

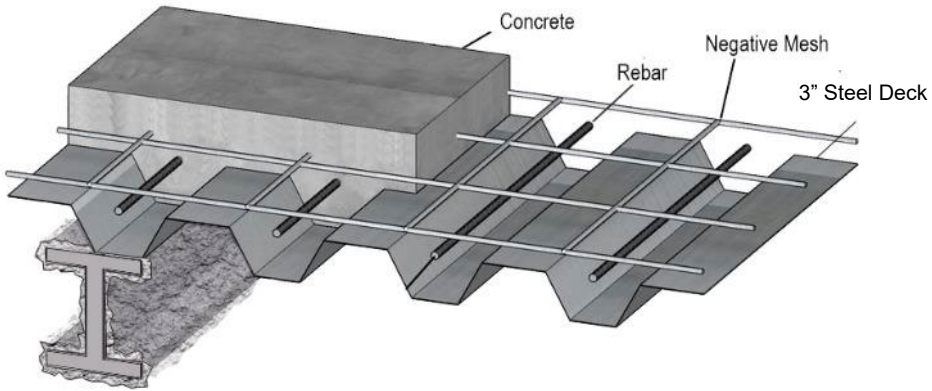

Design Optimization
Material Specification


Design Optimization
Material Specification
@Petirep
+ JAKE-CLARK.TUMBLR

BUSINESS AS USUAL APPROACH

In steel framed buildings, the concrete topping slab is typically used to achieve both structural **and** fire rating requirements.

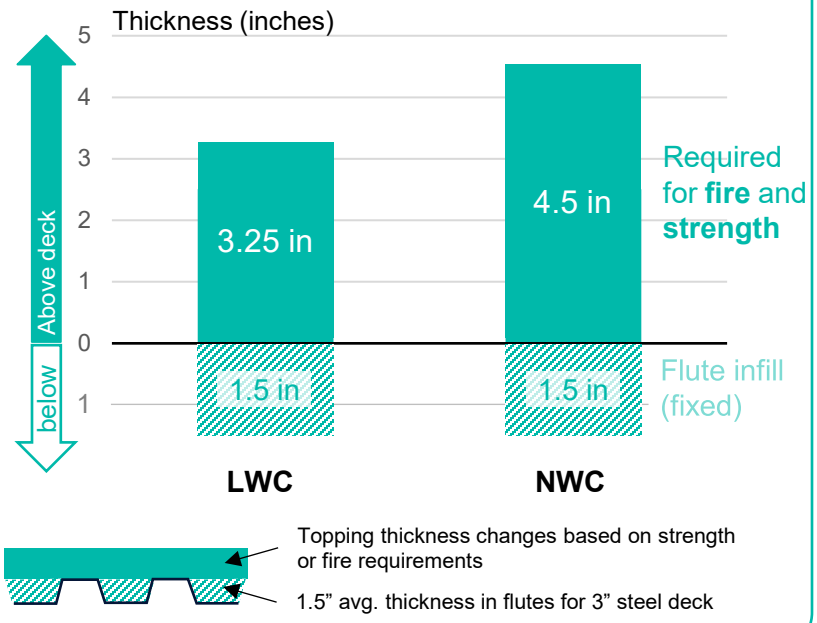
3.25” of LWC or **4.5” of NWC**



2 HOUR
FIRE RATING

LWC vs. NWC

LWC requires less depth to achieve same fire rating and is lighter but has higher embodied carbon.

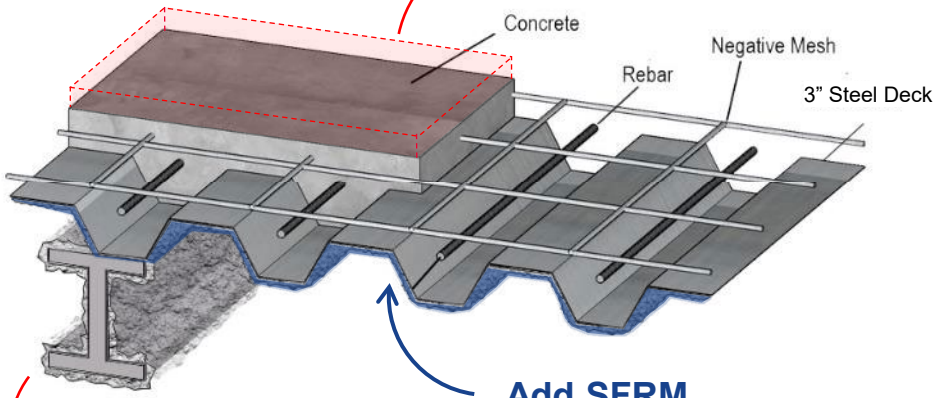


CONCRETE REDUCTION WITH SFRM

By using **SFRM** to satisfy the fire rating of the floor assembly, the **concrete** topping slab can be reduced to the minimum necessary for structural requirements.

~~3.25~~" **2.5" of LWC** or ~~4.5~~" **2.5" of NWC**

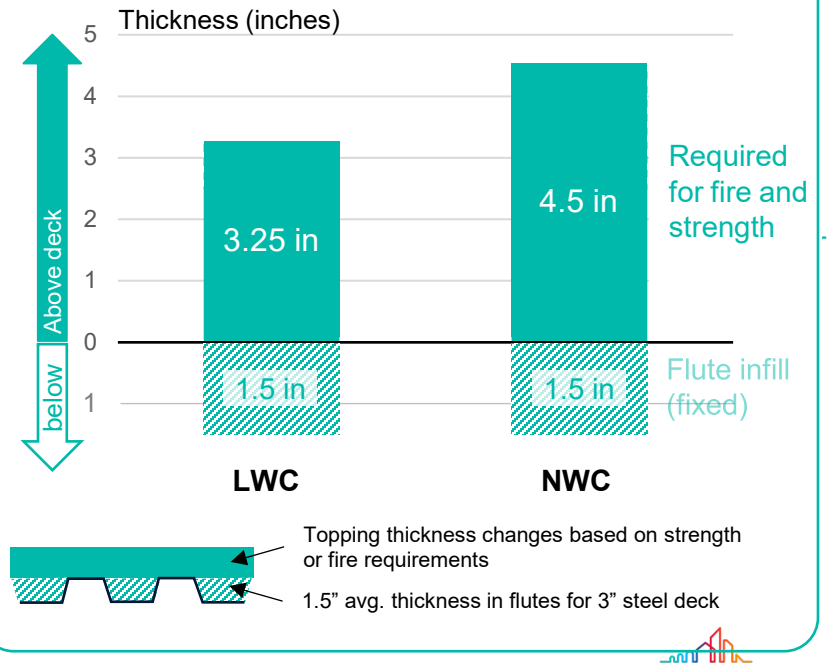
0.75" to 2" less concrete



Add SFRM

Smaller beams, columns, and foundation

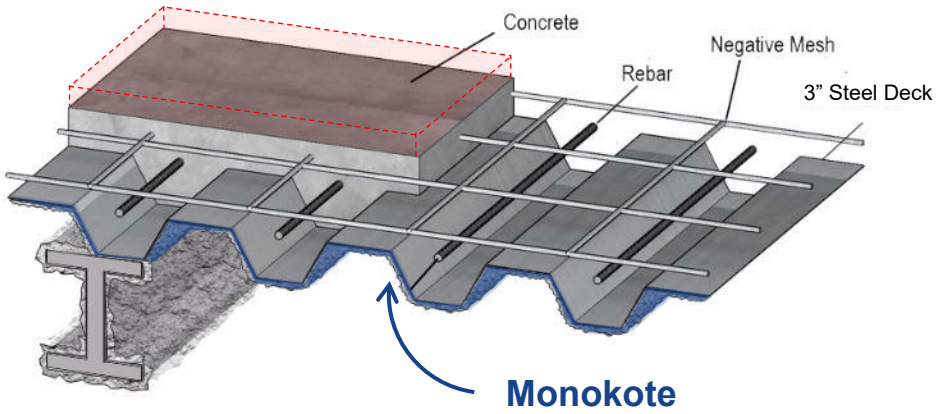
LWC vs. NWC

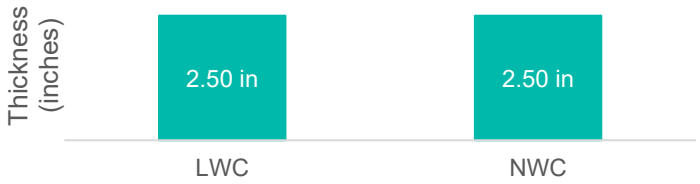


UNLOCKING ADDITIONAL CARBON SAVINGS

SFRM unlocks the opportunity to consider NWC (and other novel mixes) to further reduce the embodied carbon of the concrete.

2.5” of LWC or **2.5” of NWC**





1. **At equal thickness, <u>NWC has ~40% lower embodied carbon.</u>**

2. **And the cost premium for novel, low carbon mixes will be reduced.**

[1] Density: 115 pcf for LWC vs. 150 pcf for NWC
[2] NRMCA Pacific Southwest Regional Industry Avg (2022)

THE BUILDING AS A SYSTEM

Live loads

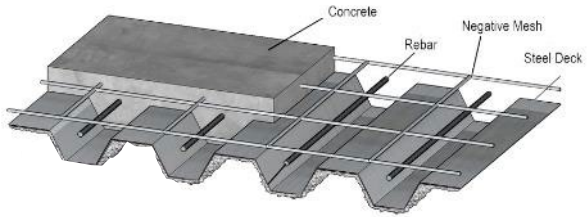
Seismic loads

Wind loads

Dead loads

Building codes

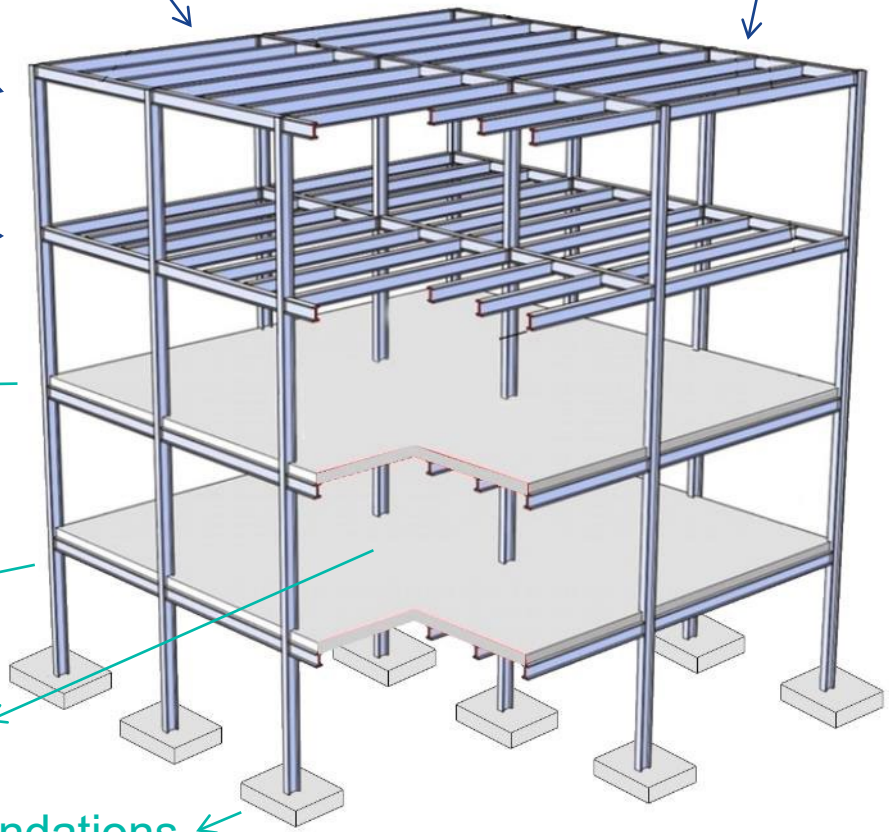
Floor assembly



Framing

Core walls

Foundations

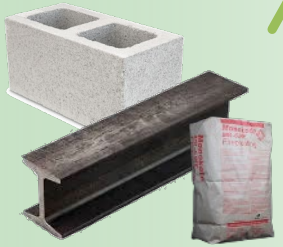


WHOLE BUILDING LIFE CYCLE ASSESSMENT

Embodied Carbon

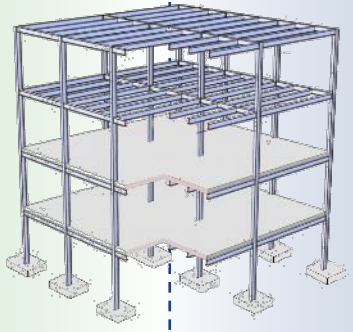
Construction

- Transportation
- Installation



Raw Materials

- Extraction
- Manufacturing
- Transportation



Operational Carbon

Operations

- Energy consumption
- Maintenance
- Repair & replacement

End of Life

- Demolition
- Waste Disposal
- Transportation

ARUP IS A GLOBAL COLLECTIVE OF DESIGNERS, ENGINEERS AND TECHNICAL EXPERTS.

"We use imagination, technology and rigour to shape a more sustainable world"

Beijing International Airport

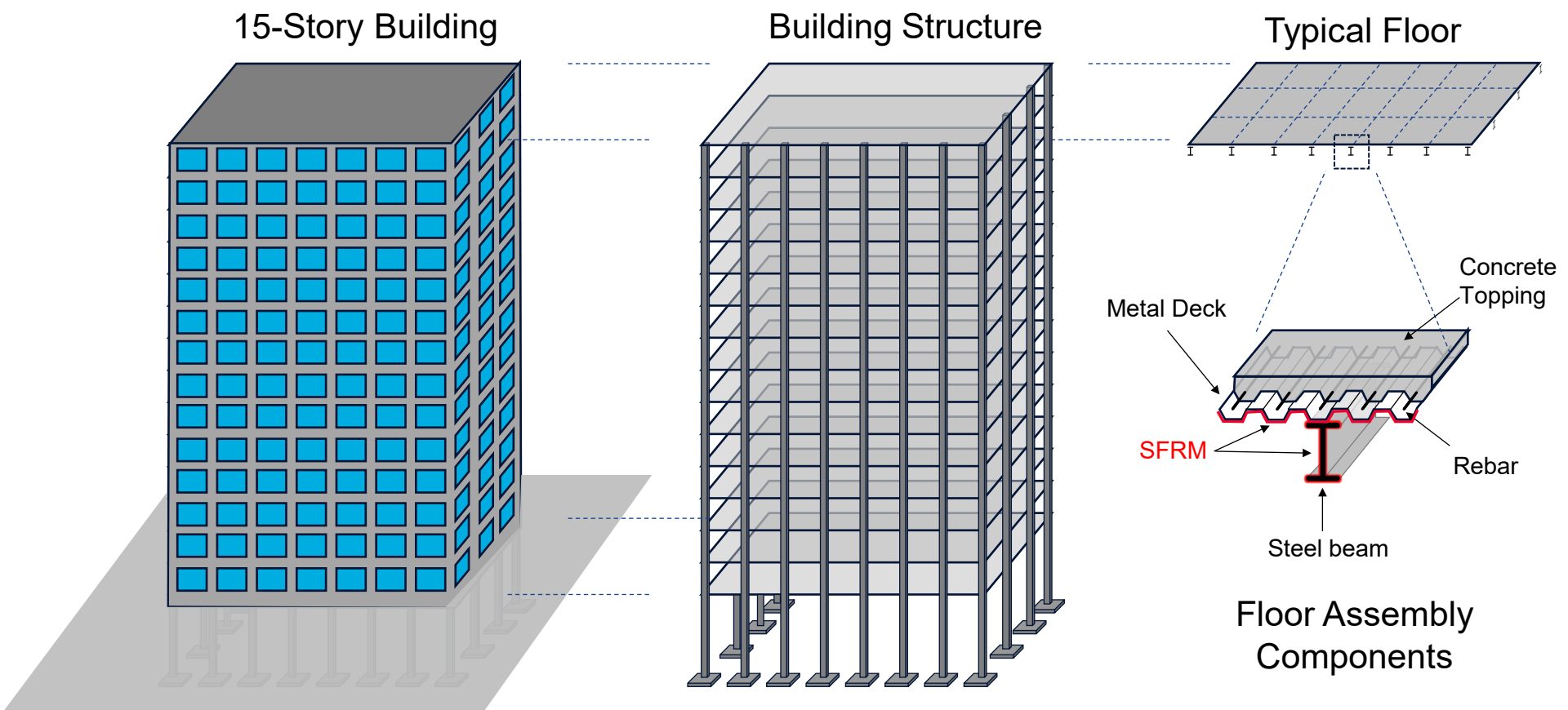
Sydney Opera House

Apple Park

Birds Nest Stadium

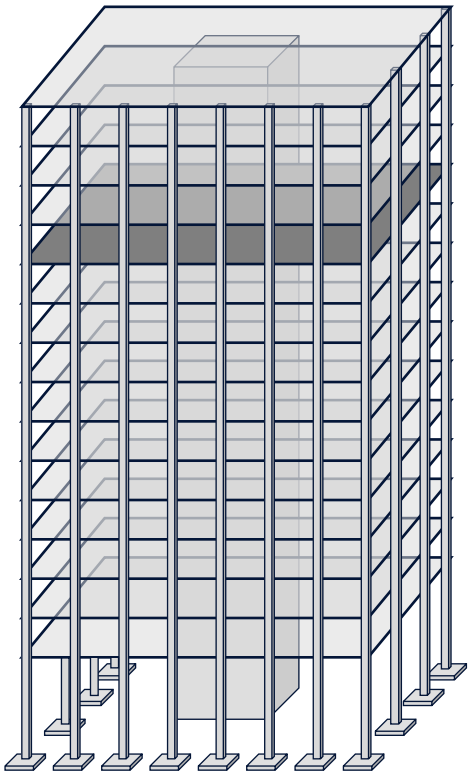
LCA CASE STUDY WITH ARUP

OVERVIEW OF BUILDING COMPONENTS



KEY RESULTS – CONCRETE SLAB

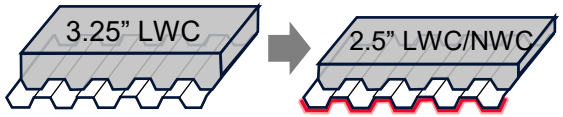
SEISMIC DESIGN

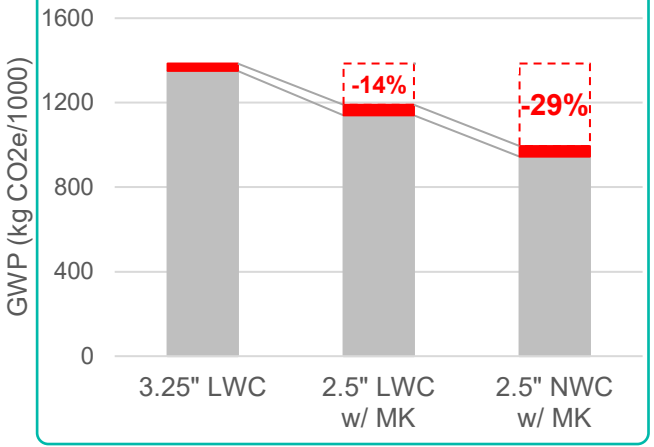


3.25” Lightweight Concrete Baseline

14-29%

GWP Savings with SFRM

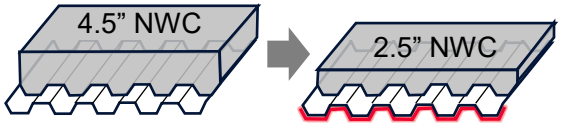


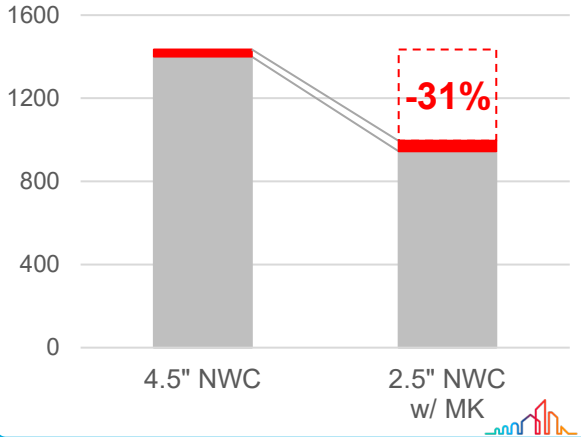


4.5” Normal Weight Concrete Baseline

31%

GWP Savings with SFRM



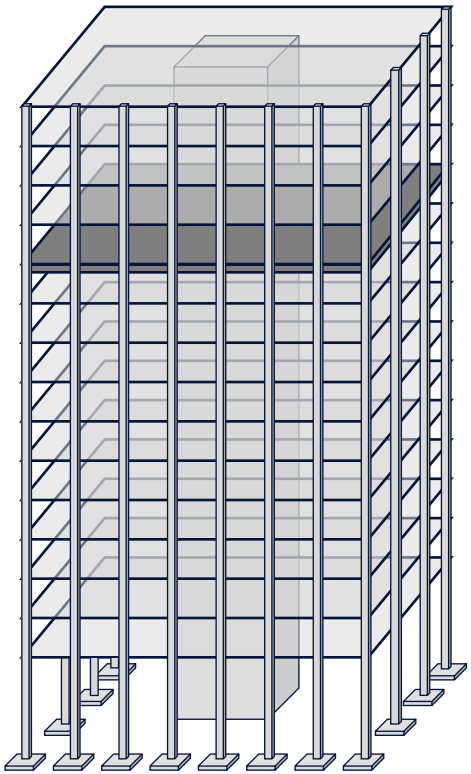


Graphs show the GWP for concrete on all 15 floors

Concrete SFRM Savings

KEY RESULTS – FLOOR ASSEMBLY

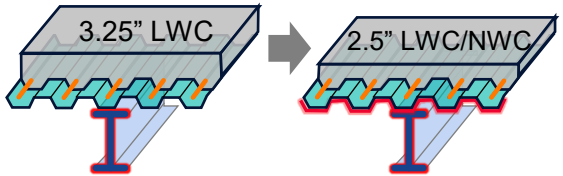
SEISMIC DESIGN

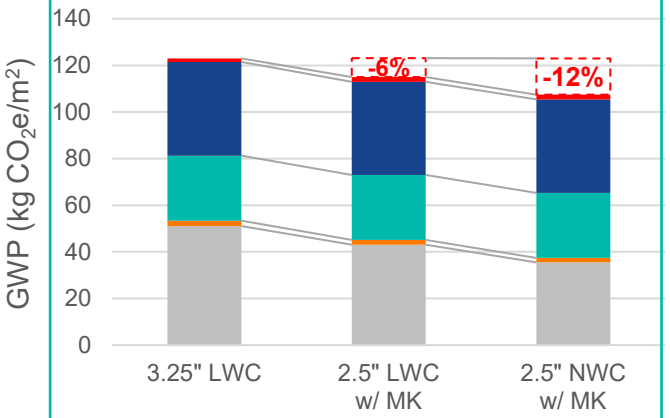


3.25” Lightweight Concrete Baseline

6-12%

GWP Savings with SFRM

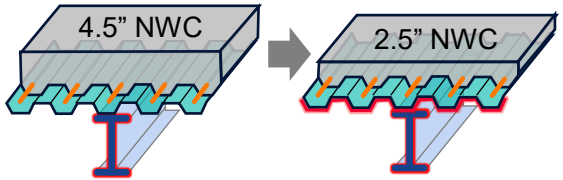


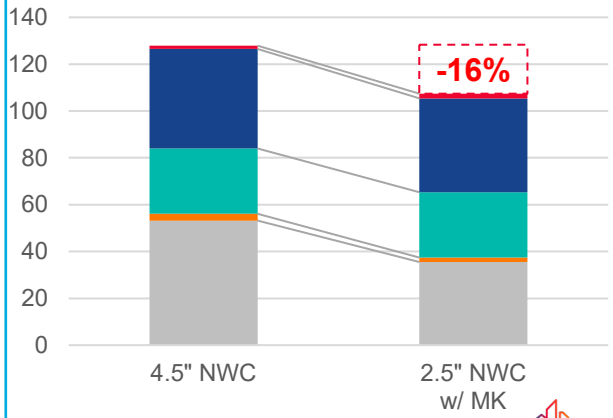


4.5” Normal Weight Concrete Baseline

16%

GWP Savings with SFRM

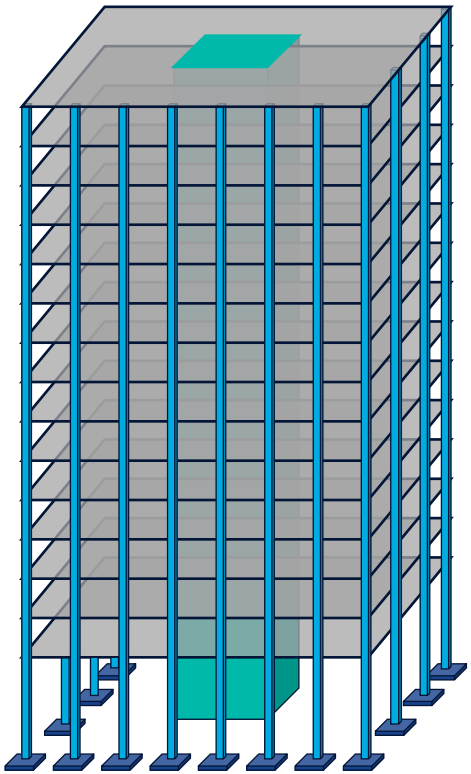




Concrete Fill ■ Rebar ■ Metal Deck ■ Floor Steel ■ SFRM

KEY RESULTS – WHOLE BUILDING STRUCTURE

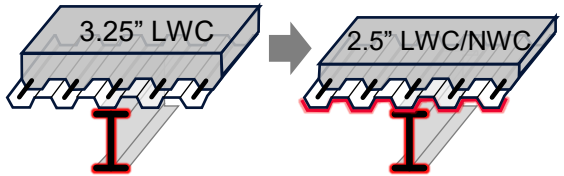
SEISMIC DESIGN

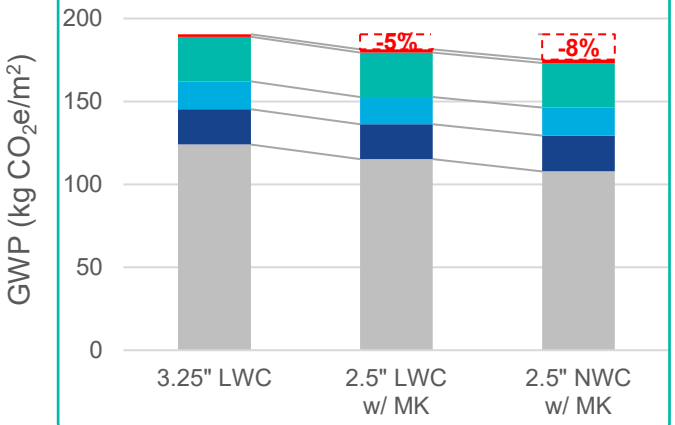


3.25” Lightweight Concrete Baseline

5-8%

GWP Savings with SFRM

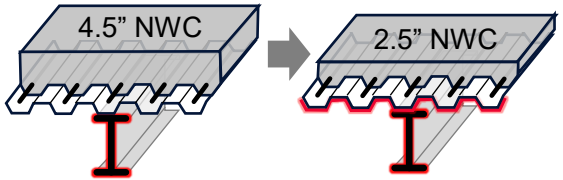


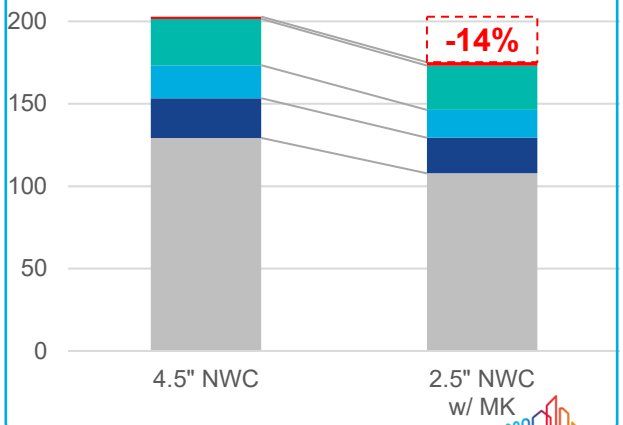


4.5” Normal Weight Concrete Baseline

14%

GWP Savings with SFRM



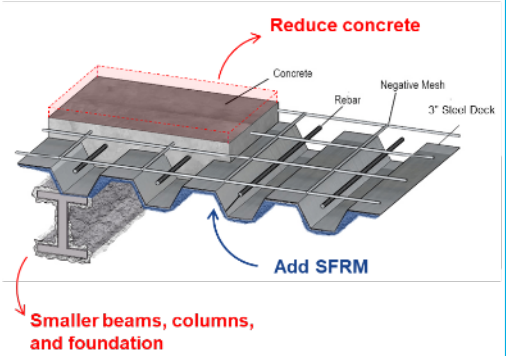


Floor build-up | Foundations | Steel columns | Concrete Core | SFRM

KEY TAKEAWAYS FROM THE STUDY

OPTIMIZE STRUCTURE WITH SFRM

Less concrete, smaller structure



ENABLE THE USE OF NWC

NWC has ~40% less embodied carbon than LWC at equal thickness

UNLOCK CARBON SAVINGS

On the entire structure with SFRM & NWC

up to

14%

Embodied Carbon Savings

Perkins&Will is focused on reducing the carbon footprint of our projects and look for industry partners to work with on creative ways to achieve this goal. The idea of being able to reduce the thickness of concrete floor slabs by increasing the use of lower-carbon SFRM is exactly the kind of innovative and creative thinking we look for. We're very excited to have demonstrable proof of this concept to begin implementing it on projects.

Perkins&Will

– *Mark Walsh, FAIA, Principal*
Perkins & Will Architects

Re-thinking how we achieve fire-proofing of concrete slabs over metal deck in composite steel construction offers an immense opportunity to change the status quo of typical steel building design…

Through utilization of SFRM and reducing the amount of concrete in floor slabs to only what is needed only by strength, we are able to significantly reduce a building's total embodied carbon…

These findings can be applied on almost all steel projects, offering carbon savings for little cost, minimal architectural impact, and standard construction practices…

ARUP

– *Jordan Woodson, Arup Associate*

CONCEPT IN ACTION

Arup projects using SFRM to switch from LWC to NWC and achieve embodied carbon savings

National Geographic Museum

University of Michigan Center for Innovation

BanBajio Corporate HQ


Bigger Contracts.
More Steel Construction.
Less Carbon.

Thank You