

THE MISCONCEPTION OF INDUSTRIALIZED CONSTRUCTION



Sustainable



QUALITY



SPEED



REDUCED WASTE

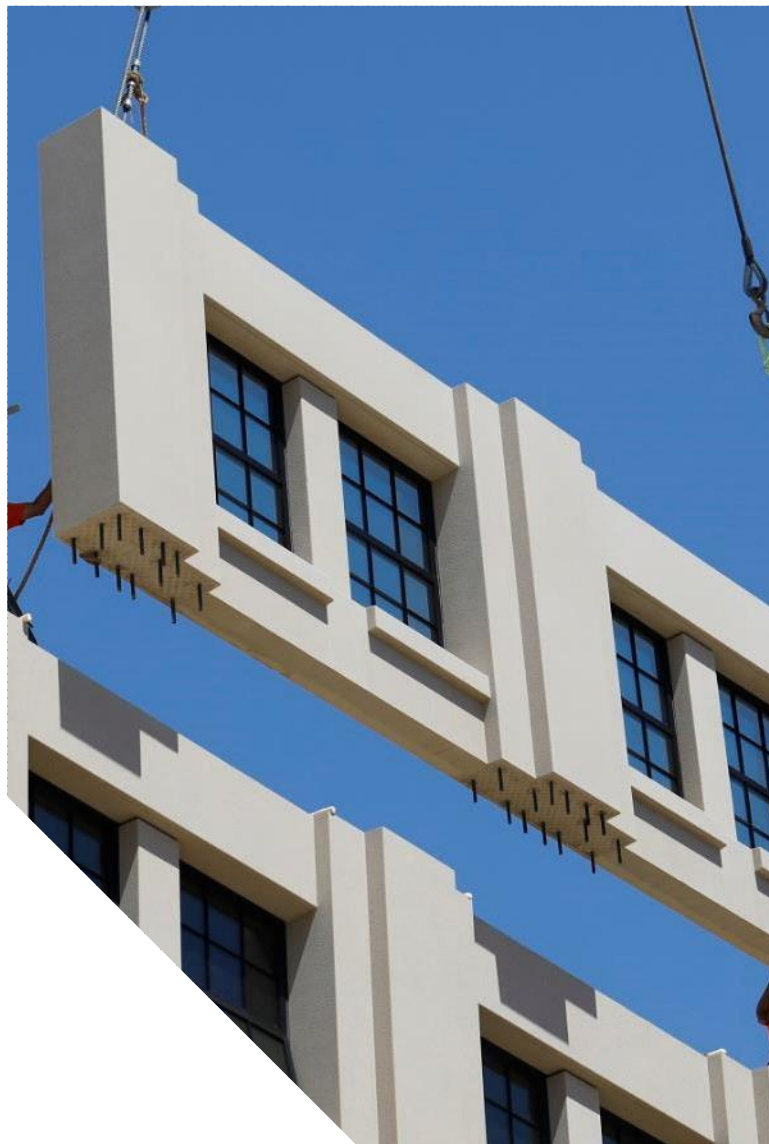
SPEAKER



Jon Mohle, SE

Senior Product Manager

Clark Pacific

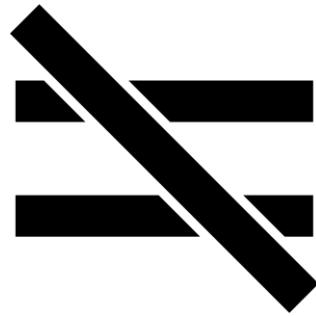


WHAT IS INDUSTRIALIZED CONSTRUCTION?

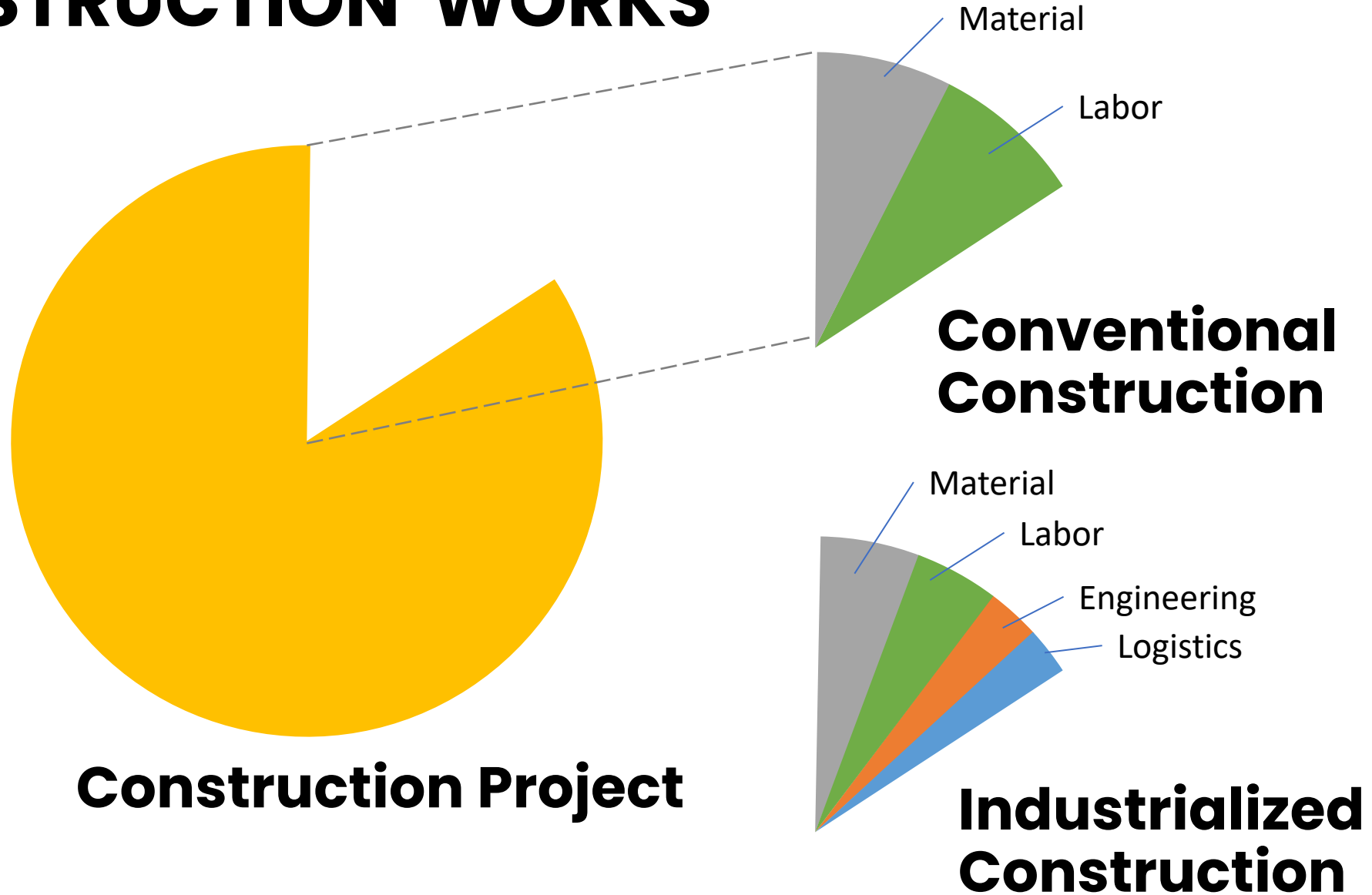
Industrialized construction involves building structures in a factory-like setting by manufacturing pre-engineered products and then transporting them to the construction site for installation.



THE MISCONCEPTION



HOW INDUSTRIAL CONSTRUCTION WORKS



HOW TO LEVERAGE INDUSTRIALIZED CONSTRUCTION IN YOUR PROJECT

Small Project

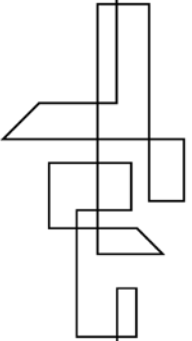
- Follow the system standards
- Do not customize

Medium/Large Project

- Follow the system standards
- Can perform some customization

Mega Project

- Project can create its own standards
- Adhere to the project standards
- avoid customization



REDUCING CARBON BY USING LESS

Embodied Carbon

- Reduce Material (use less)
- Select lower carbon alternatives

Operational Carbon

- Move to all electric
- Use higher efficiency systems
- High performance façade with passive features

**INDUSTRIALIZED CONSTRUCTION OPTIMIZES
MATERIAL AND LABOR NATURALLY**

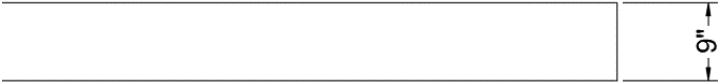
MATERIAL OPTIMIZATION

WHERE TO FOCUS

Component	Concrete Volume	Concrete Strength	2021 NRMCA (kgCO2e/cy)	Clark Pacific (kgCO2e/cy)
Floor Planks	35%	7000 psi	357.6	186.9
Hollow Core	3%	6000 psi	314.1	366.8
Exterior Beams	7%	7000 psi	357.6	216.5
Interior Beams	8%	7000 psi	357.6	216.5
Columns	3%	9000 psi	381.7	186.9
Shear Walls	8%	9000 psi	381.7	216.5
Topping	7%	5000 psi	314.1	281.1
Foundation	25%	5000 psi	314.1	160.8
Slab On Grade	4%	5000 psi	314.1	281.1

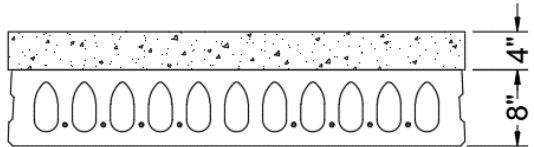
2021 NRMCA Average based on the NRMCA Industry Wide LCA Project Report – V3.0 using values from the Pacific Southwest Region. Clark Pacific mix impacts are estimated using the ZGF Concrete LCA Tool and Clark Pacific concrete mix designs

REDUCE CONCRETE



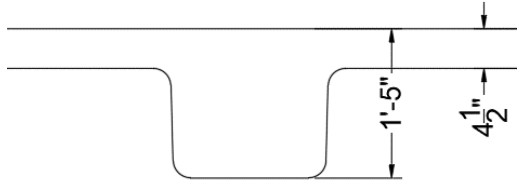
CIP – 2-Way Flat Plate

Equivalent Thickness: 8.0”–9.0”



Topped Precast

Equivalent Thickness: 9.5”

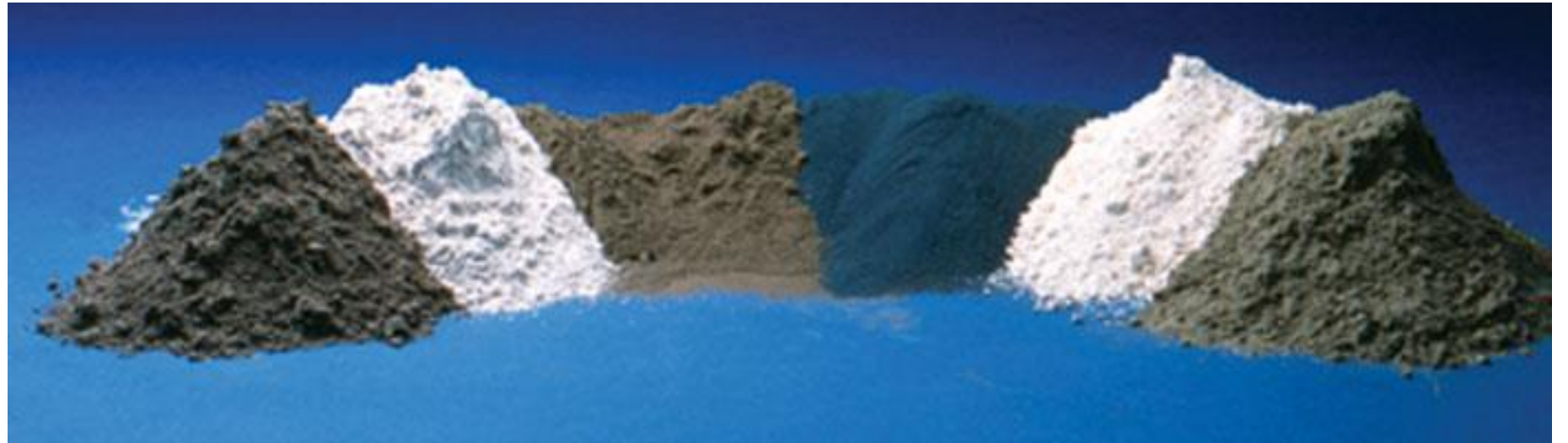


Precast Ribbed Floor

Equivalent Thickness: 6.35”

HOW TO ELIMINATE CEMENT FROM CONCRETE

Supplemental Cementitious Materials (SCM)



Fly Ash (Class C) - Metakadin - Fly Ash (Class F) - Silica Fume - Slag - Calcined shale

PRODUCT BASED CARBON REDUCTION

Building Component: Ribbed Floor System



Characteristics

- High impact potential
- 35% of the structural concrete

Set Some Goals

- 70% cement reduction
- 3500 psi overnight
- Slabs thinner than concrete over metal deck

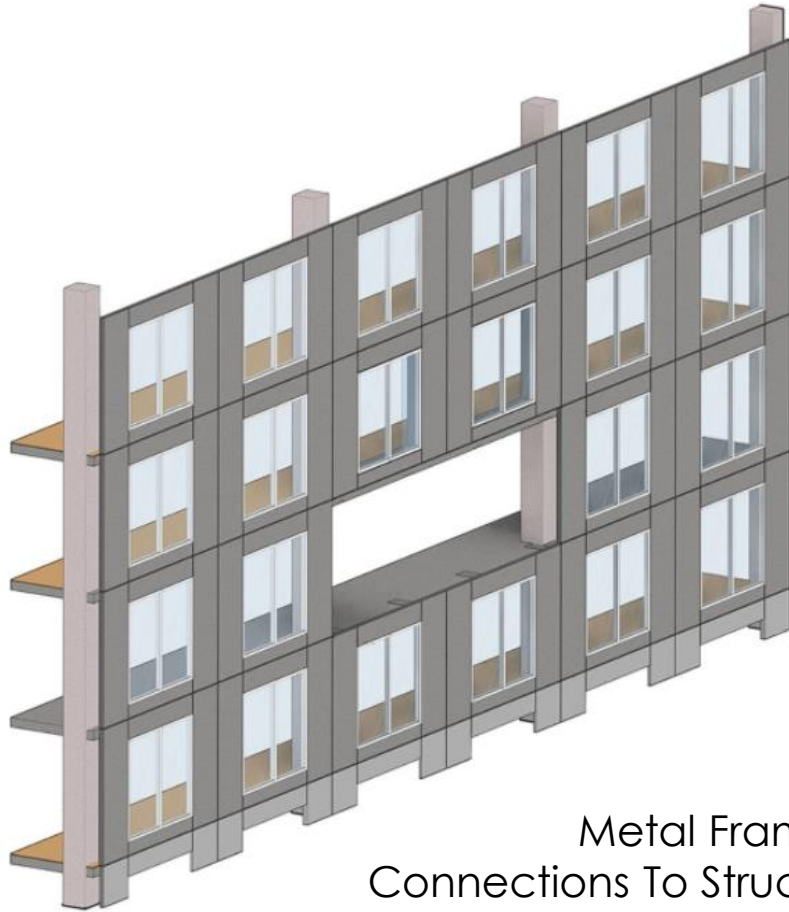
Initiatives

- Leverage Shape: Reduced concrete volume and reinforcing
- Pre-topped system: Reduced concrete volume and reinforcing
- UL Fire testing: specialty mix to achieve 2-hour rating with ½" less concrete
- Heated Forms: Allow overnight release strength with 70% Cement Replacement

FYI heat removes 110 kg CO₂/cy

heat adds back 12 kg CO₂/cy
without solar

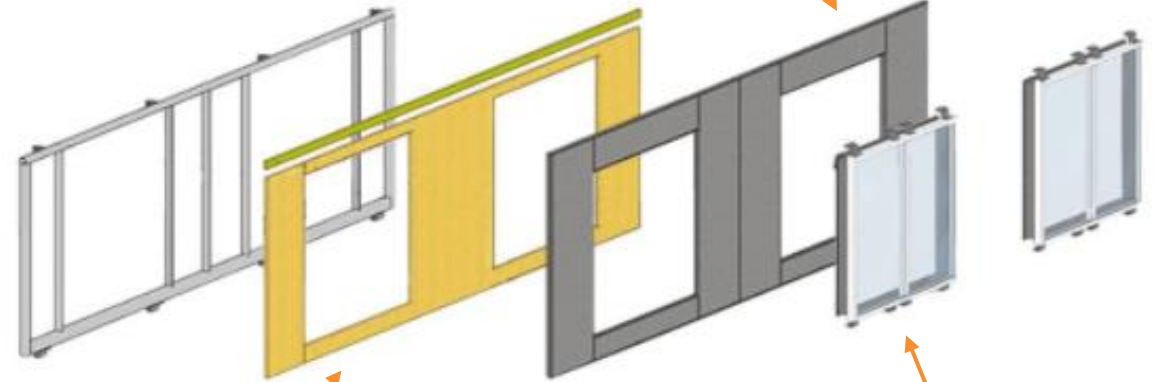
INFINITE FACADE



Metal Frame &
Connections To Structure

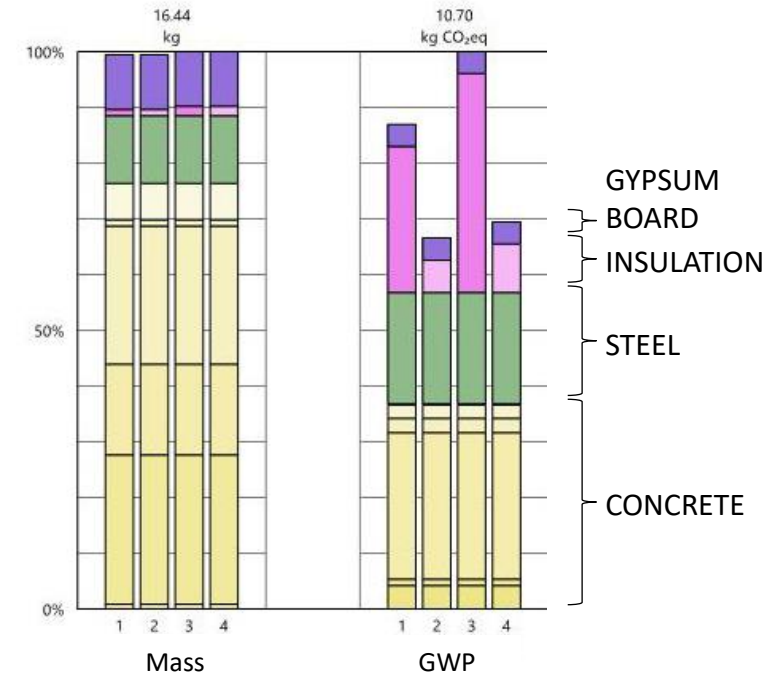
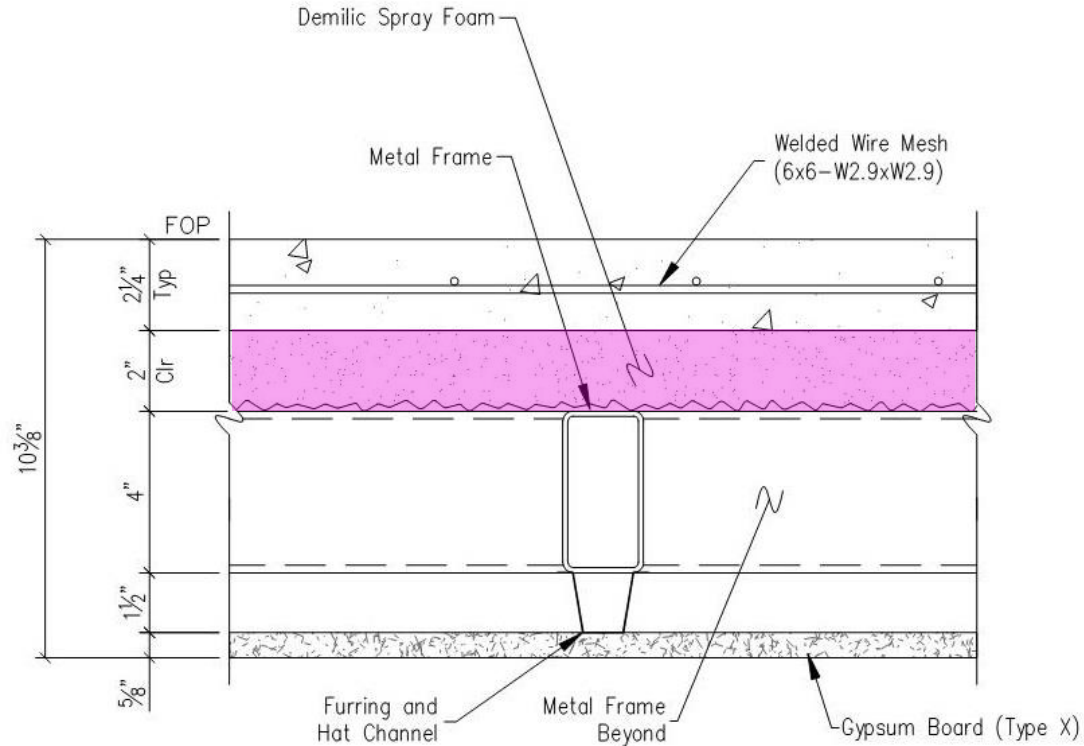
Closed Cell HFO Spray Applied
Polyurethane Foam Insulation
Preinstalled in Factory Controlled Environment
UL & NFPA 285 Tested
R-Value of 7.4 Per Inch

Concrete or GFRG Exterior Skin
Wide Variety of Colors, Textures
and Materials that can be Cast
into the Exterior Veneer such as
Brick, Terracotta, Stone, Etc.



Factory Installed Windows
Window Testing is Performed in
Factory Prior to Arriving On Site

REDUCING EMBODIED CARBON OF THE FAÇADE

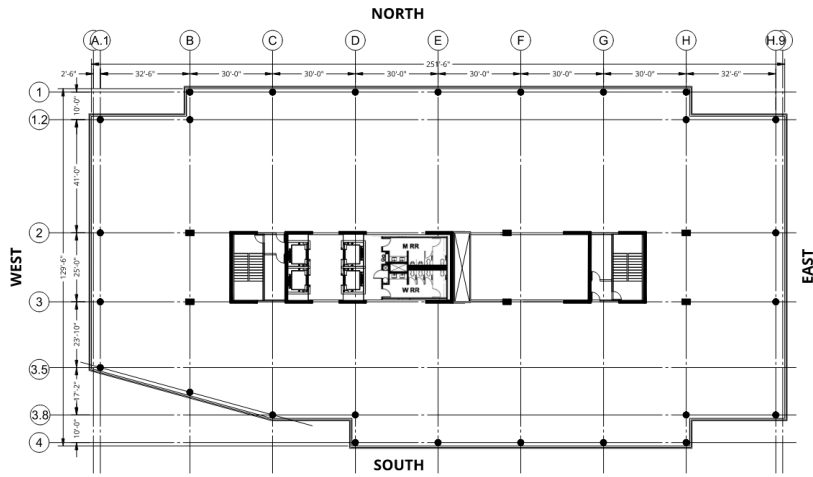


23.4% Total System Reduction!

Option 1	2" Spray Foam, HFC Blowing Agent	9.30 kgCO ₂ eq/sf
Option 2	2" Spray Foam, HFO Blowing Agent	7.12 kgCO₂eq/sf
Option 3	3" Spray Foam, HFC Blowing Agent	10.70 kgCO ₂ eq/sf
Option 4	3" Spray Foam, HFO Blowing Agent	7.43 kgCO ₂ eq/sf

all other variables are identical

CARBON REDUCTION RESULTS



BUILDING FLOOR PLAN

Prototype Building:

- 30,000 SF Floor
- 8-Story

23% LESS CONCRETE

47% LESS CO₂ IN MIX

(relative to 2021 NRMCA Regional Average)

**THAT'S 46 kgCO₂/m²
FROM CONCRETE ALONE!**

CONCRETE VOLUME IN SYSTEM

	Banded CIP	Topped Precast	NetZERO
Superstructure	10561 CY	9551 CY	8101 CY
Substructures	4210 CY	3922 CY	3345 CY
Reduction	-	9%	23%

**60% CO₂ REMOVED
FROM CONCRETE**

INDUSTRIALIZED CONSTRUCTION TO REDUCE ENERGY CONSUMPTION

In-Slab Radiant

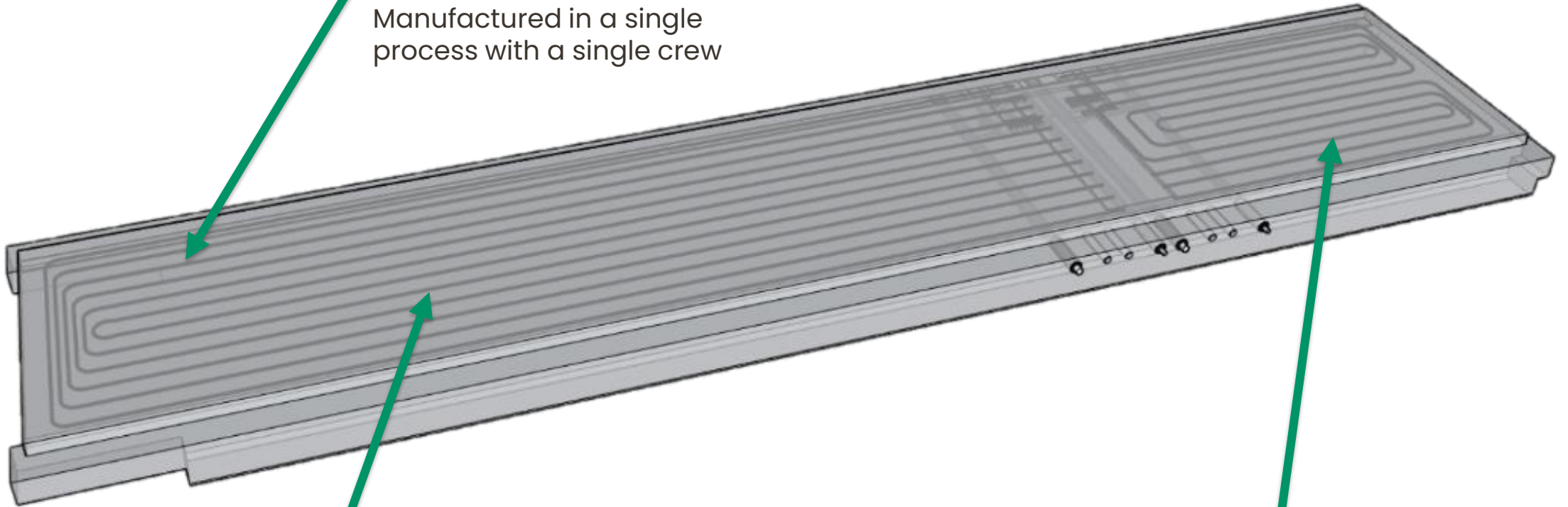
Manufactured in a single process with a single crew

Inner Control Zone

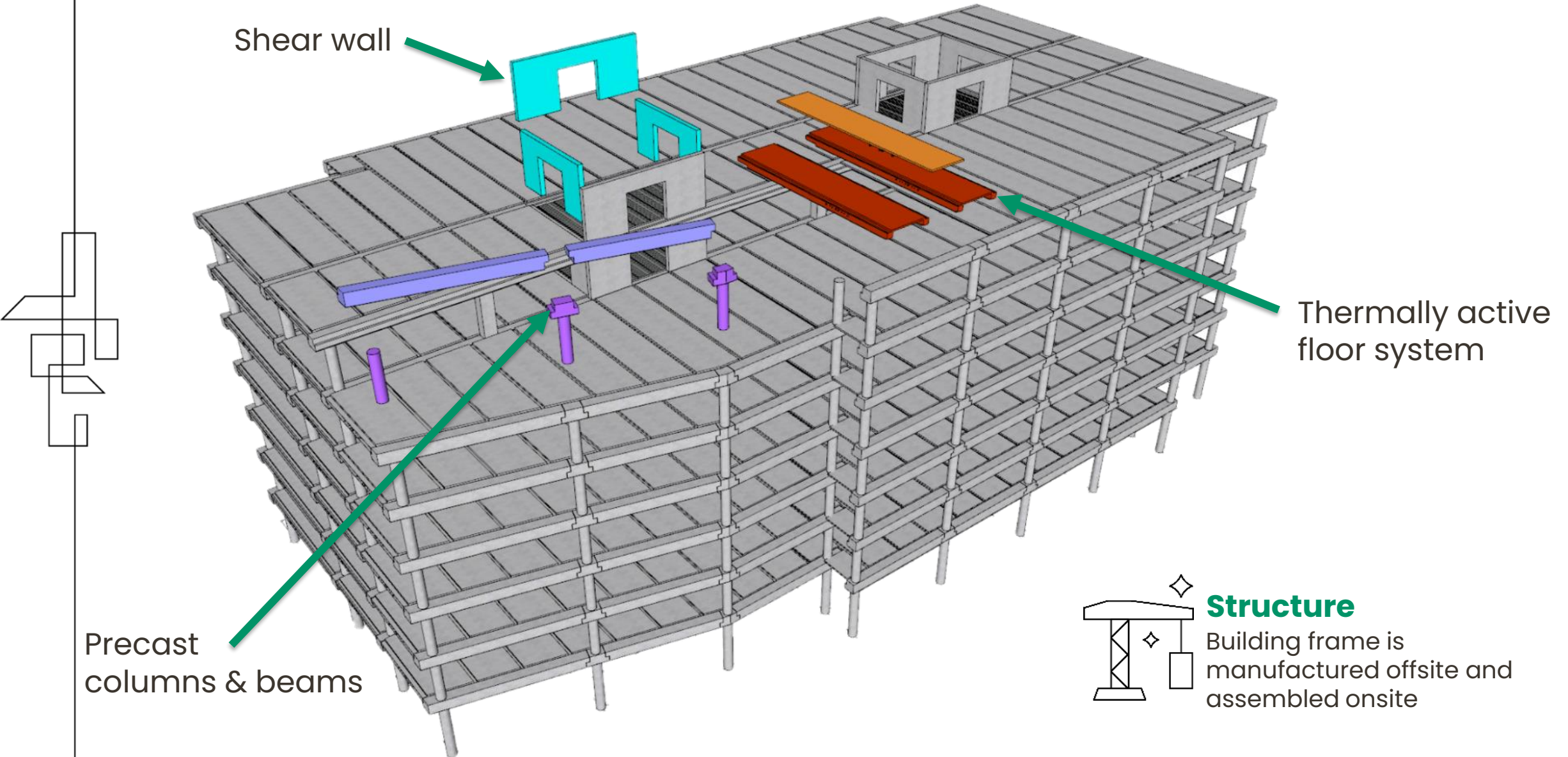
Inner radiant zone is controlled independently from outer zone

Outer Control Zone

Outer radiant zone can heat or cool near the edge of the building where demands are the most dynamic



PUTTING IT ALL TOGETHER



Optimized shape for minimum materials. Optimized mix for lowest embodied carbon.

STRUCTURAL SYSTEM

Any office constructed from a kit of parts

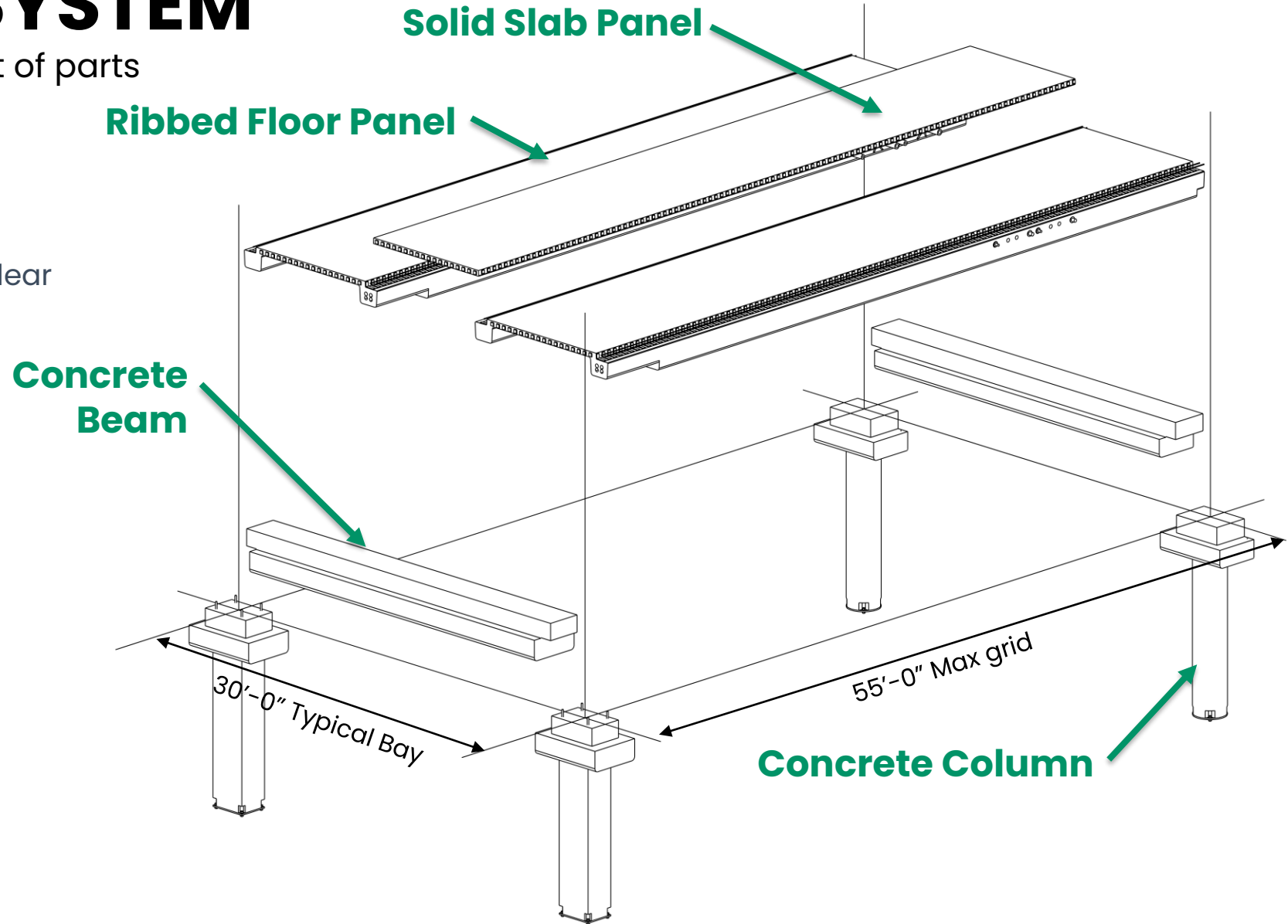
Long Column-Free Spans

Provides programming flexibility and clear sightlines within the space

Floor System	Depth	Max Span
	18 in	36 ft
	24 in	55 ft

Lower Floor-Floor Heights

15% less Façade required



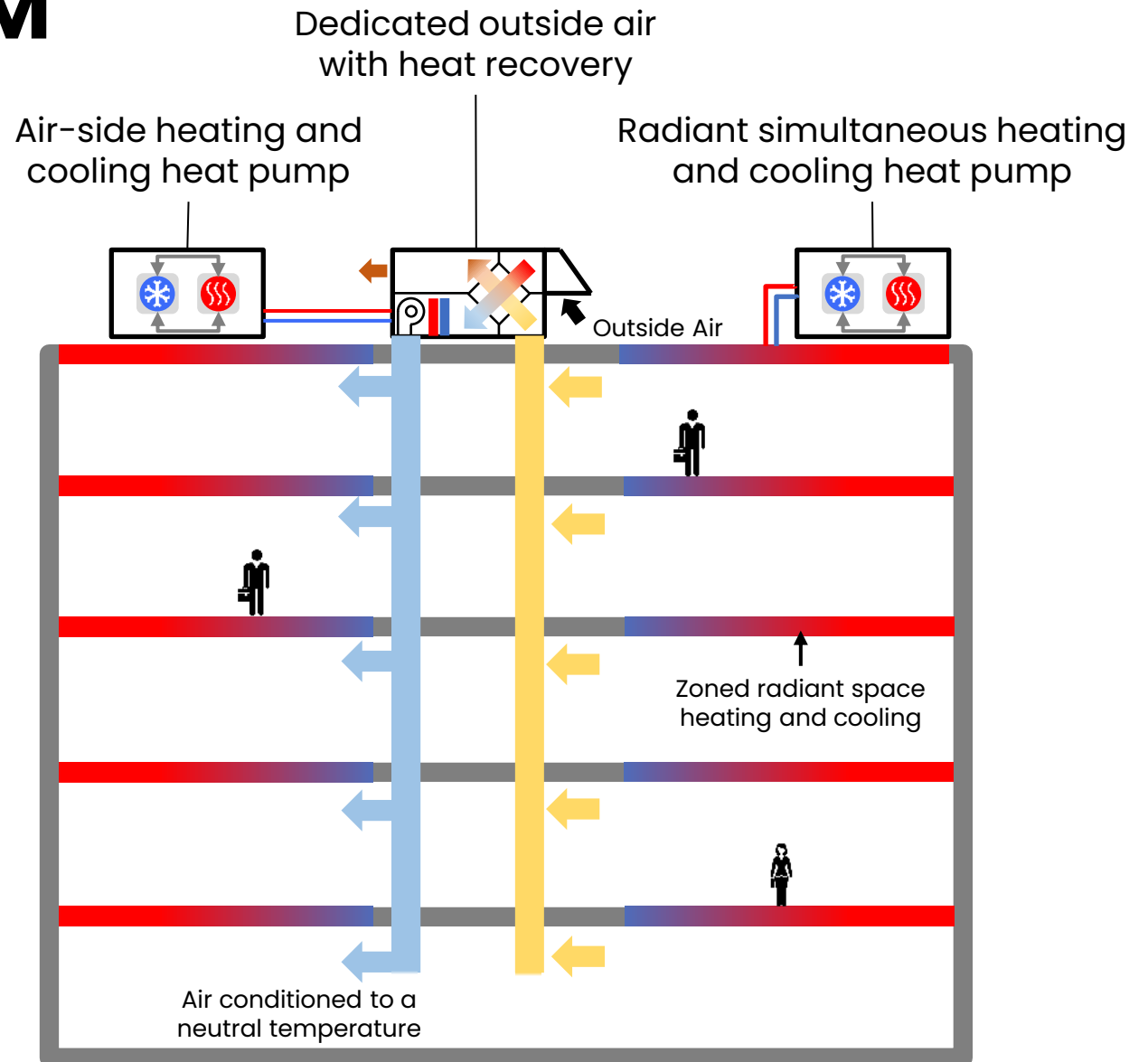
INTEGRATED MECHANICAL SYSTEM

100% Dedicated Outside Air
for a healthy, comfortable workplace

Air to Air Heat Recovery
To minimize energy lost through ventilation air

Radiant Heating & Cooling
leverages the mass of the building along with milder water temp to cut HVAC energy in half

Zoned Thermal Control
Self-learning system continuously adjusts to provide optimal comfort



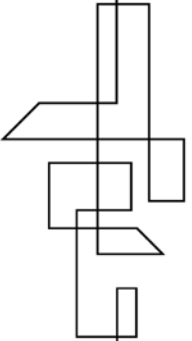
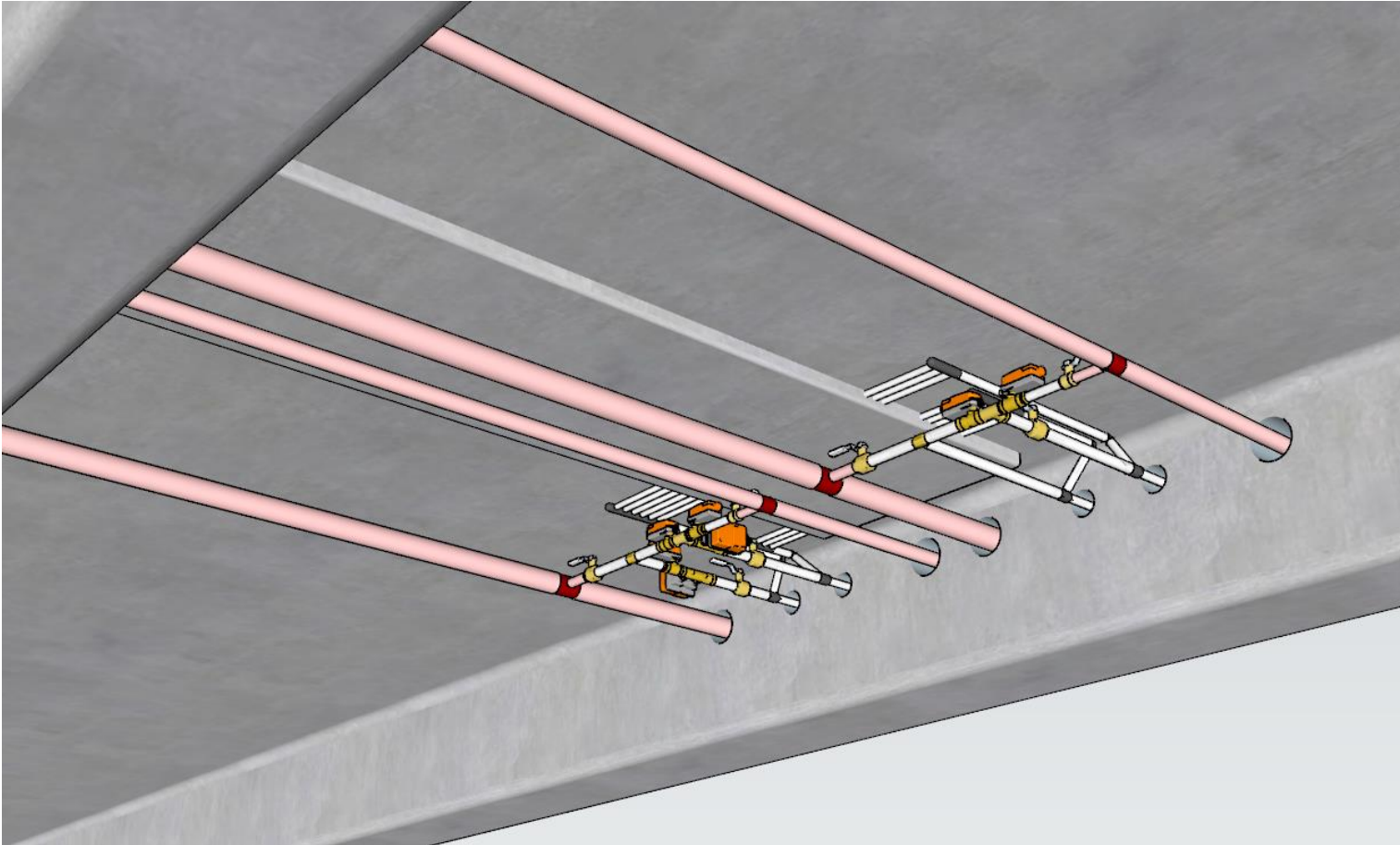
OFFICE – MULTITRADE INTEGRATION

Building system fabricated offsite to deliver premium performance without the premium cost.



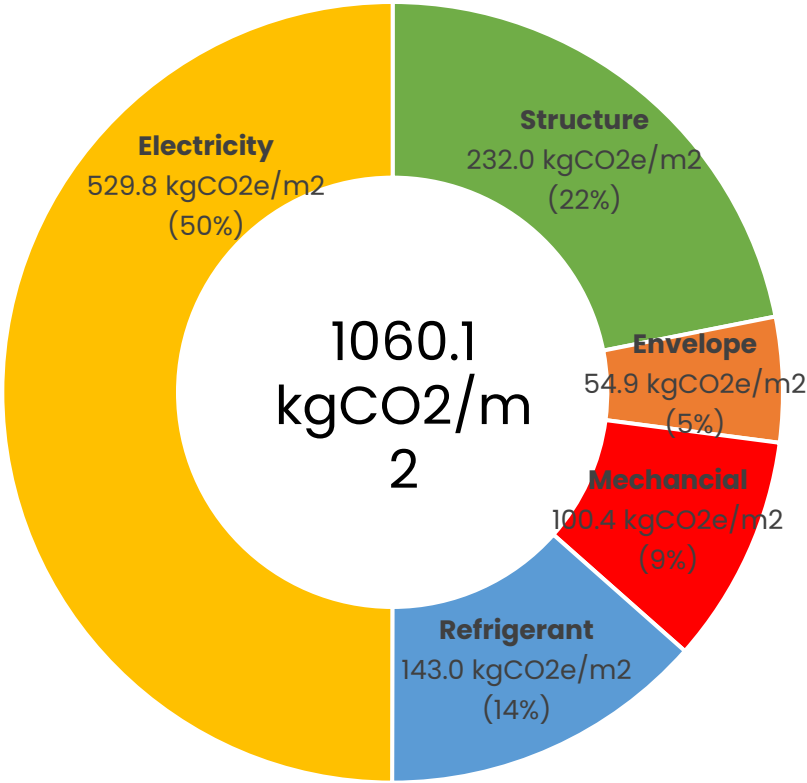
INTEGRATED PANEL CONTROLS

Our system is shipped complete to maximize the benefit of offsite fabrication. Not only is the radiant installed in the panel, but sensors, controls, piping and even a BACnet controller are all installed, tested and calibrated in the factory.

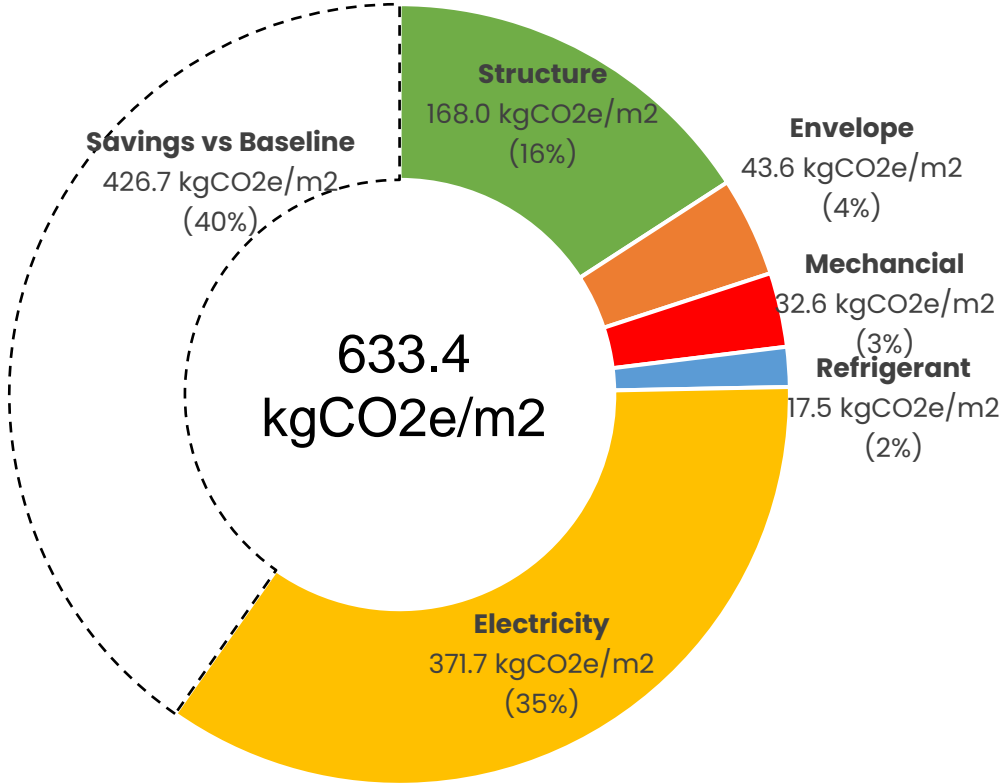


NetZERO BUILDING PLATFORM = 40% LESS CARBON

Baseline Scenario: Steel + VRF

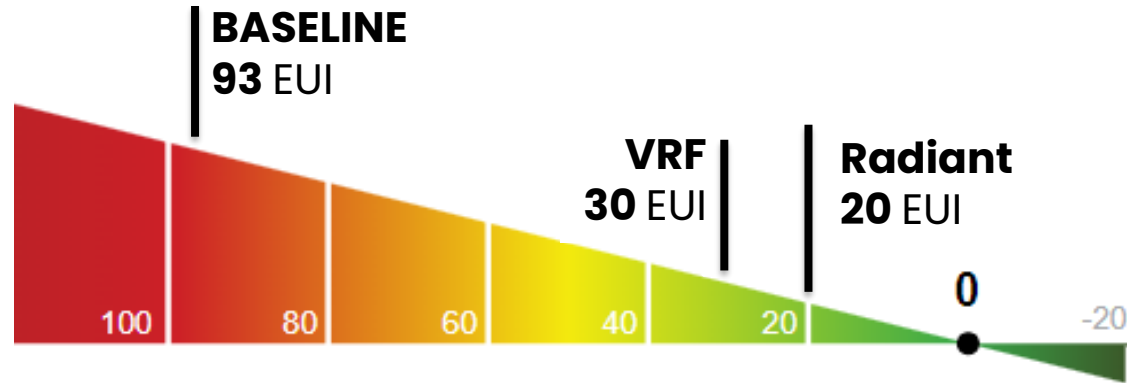


NetZERO Office Building:
Thermally Active Deck



Access ["The Radiant Whole Life Carbon Study"](#) prepared by The Integral Group to learn how NetZERO stacks up to traditional Steel + VRF.

DRAMATICALLY MORE EFFICIENT



89% Below
Energy Baseline

Total Energy Cost:
\$0.98/sf/year

Baseline	93 EUI
VRF	30 EUI
Target (-70%)	28 EUI
Radiant	19.8 EUI

BUILDING SUMMARY

LOCATION	Sunnyvale, CA	94087
USES	Office	240,000 sq.ft (100.0%)

Baseline values calculated using ZeroTool for the baseline structure in Sunnyvale CA. NetZERO Building Platform EUI based on [Radiant Whole Life Carbon Study](#)

HOW TO LEVERAGE INDUSTRIALIZED CONSTRUCTION IN YOUR PROJECT

1. Consider at conceptual design
2. Don't fear proprietary systems



A modern office interior with a green overlay. The text "THANK YOU" is centered in white. The background shows a long wooden reception desk, a white ergonomic chair, and a desk with a laptop. The ceiling has exposed wooden beams and modern lighting fixtures. The floor is dark grey carpeting.

**THANK
YOU**