

WoodWorks

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# EXPLORING MASS TIMBER FOR DATA CENTER DESIGN

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



# Course Description

This session examines the emerging application of mass timber in data centers and similar building typologies, with designers at the forefront of this innovation sharing insights about the benefits, challenges, and design opportunities. The discussion will explore how mass timber can offset some of the environmental impact of data centers, and how the biophilic benefits of exposed wood can contribute to a healthier indoor environment for occupants. Engineers will also explain some of the fundamental differences between data centers and other building types, such as high loading and intensive MEPF systems, which are important design considerations at the start of a project.

# LEARNING OBJECTIVES

- 1. Explore code-compliant design of mass timber systems in data centers and understand how construction type selection impacts design.**
- 2. Understand the environmental benefits of using mass timber, including a lighter embodied carbon footprint.**
- 3. Discuss the speed of construction benefit of mass timber and hybrid systems and how that contributes to efficiency.**
- 4. Identify areas within a data center where mass timber can be exposed and how the biophilic benefits of exposed wood can contribute to a healthy indoor environment for occupants.**

# AGENDA

1. Design Overview
2. Why Mass Timber?
3. Implementation
4. Wrap-Up



# DESIGN OVERVIEW

Demand is accelerating. And expectations are changing.

- AI, cloud, and digital services are increasing demand for compute.
- Power availability, speed-to-market, water use, carbon, and community impact are becoming core project drivers.
- Data centers no longer evaluated only as infrastructure — they are civic, environmental, and real estate assets.
- As operational strategies improve, embodied carbon becomes a more visible design opportunity.

# ARCHITECTURE

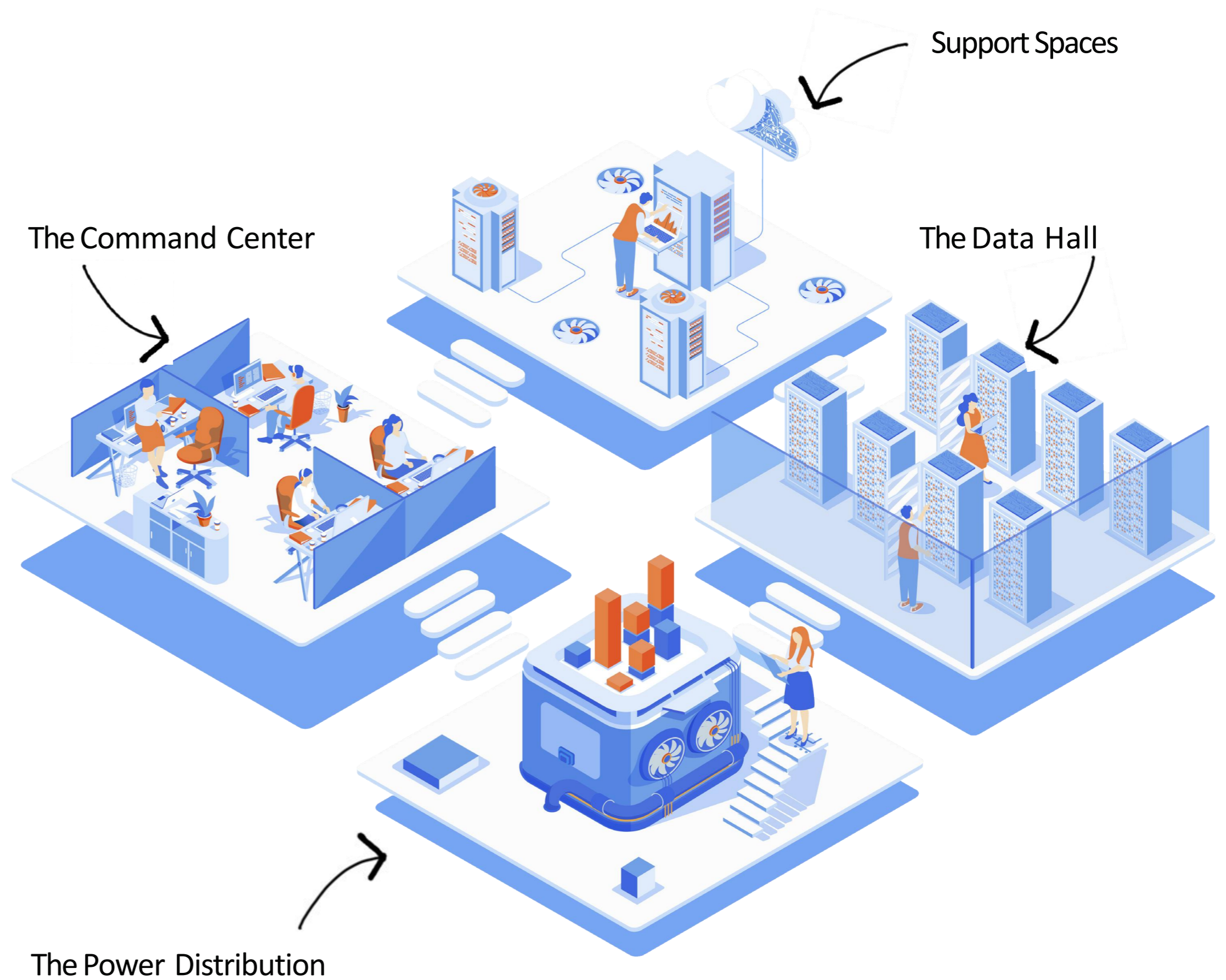
24/7 operations

Efficiencies of scale

Power in - heat out

Redundant systems

Adjacency to fiber networks,  
skilled labor, power &  
customers



# STRUCTURE

Data center structures are driven by performance, repetition, and flexibility

- High floor loads and concentrated equipment loads
- Repeatable planning modules and rack layouts
- Long spans to preserve data hall flexibility
- Tall but congested floor-to-floor zones
- Intensive MEP/FP coordination
- Minimal tolerance for future operational disruption
- Speed-to-market and phased delivery requirements

# STRUCTURE

Large-scale facilities

Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

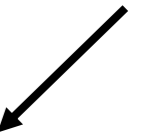
Align repeatable grid module with efficient bay layout



MULTI-STORY

VS

SINGLE-STORY



# STRUCTURE

Large-scale facilities

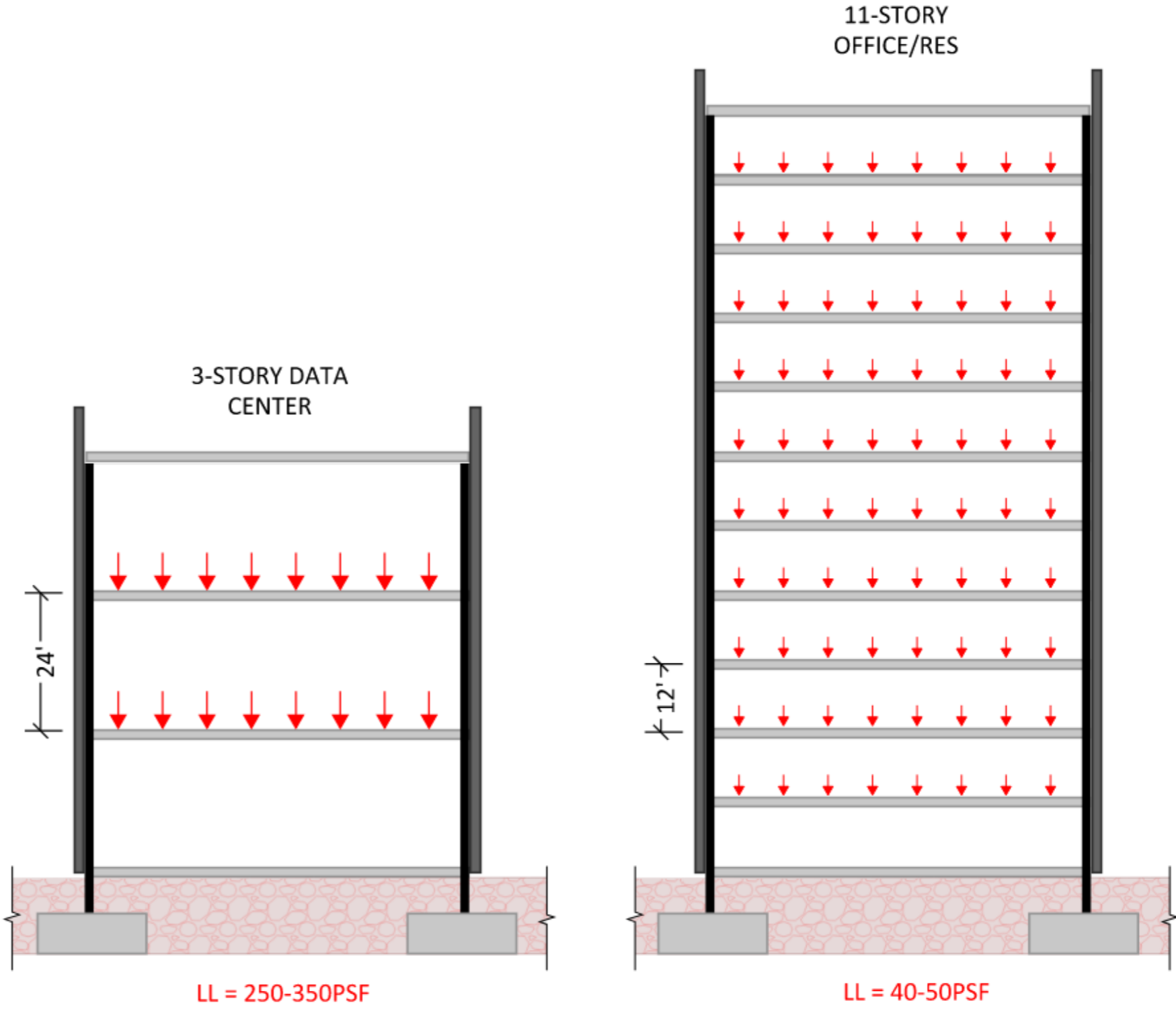
Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

Align repeatable grid module with efficient bay layout



Foundation Load Comparison

# STRUCTURE

Large-scale facilities

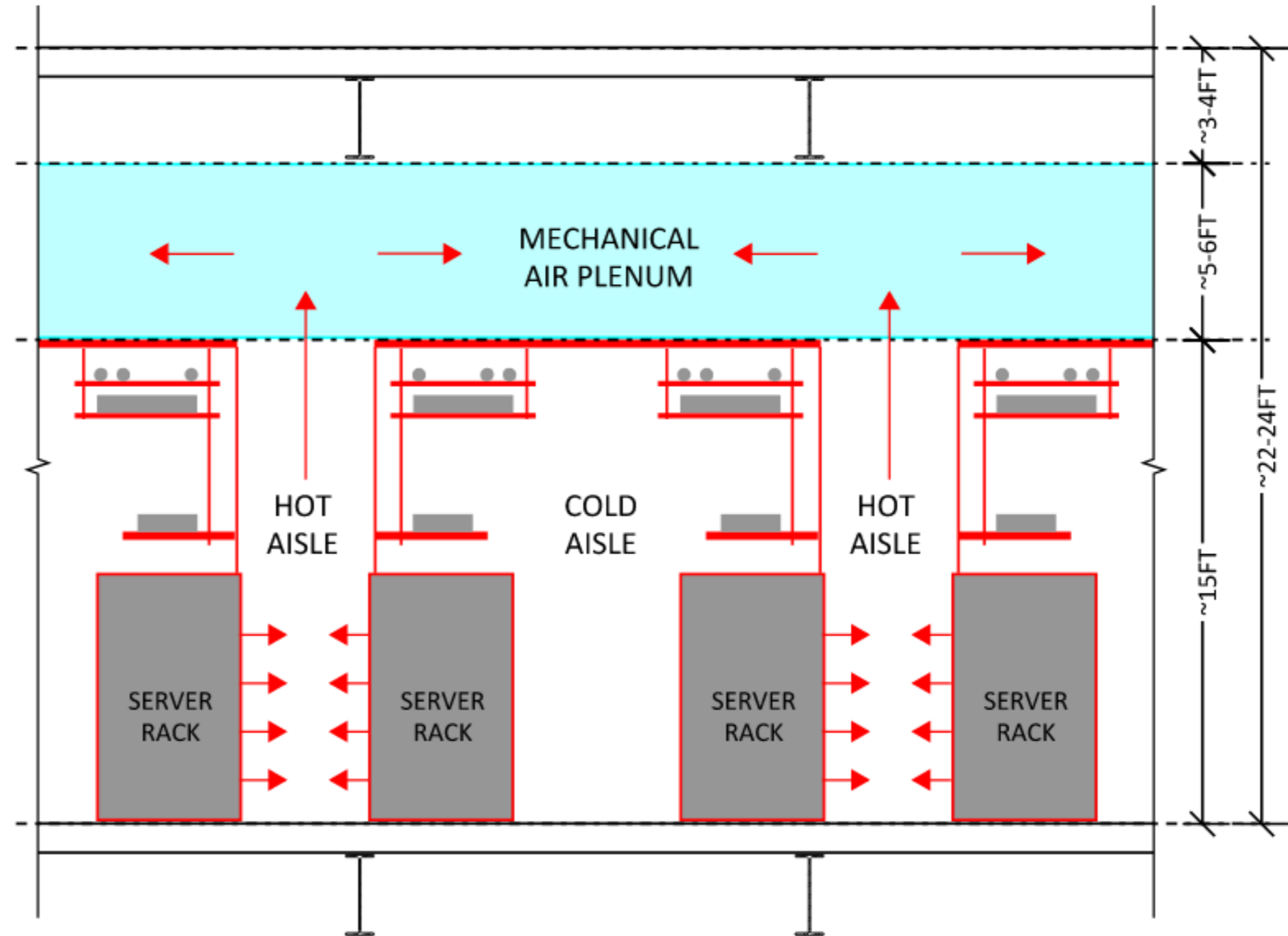
Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

Align repeatable grid module with efficient bay layout



Typical Air-Cooled Data Hall Floor Section

# STRUCTURE

Large-scale facilities

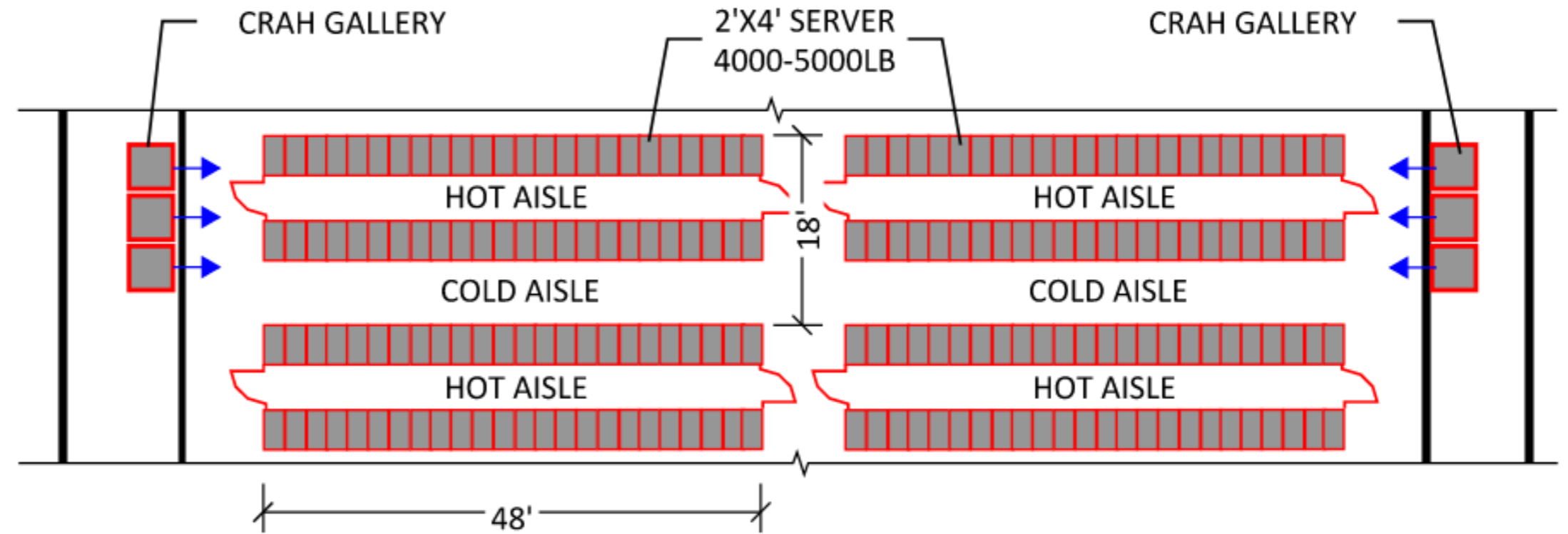
Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

Align repeatable grid module with efficient bay layout



Typical Data Hall Rack Module

# STRUCTURE

Large-scale facilities

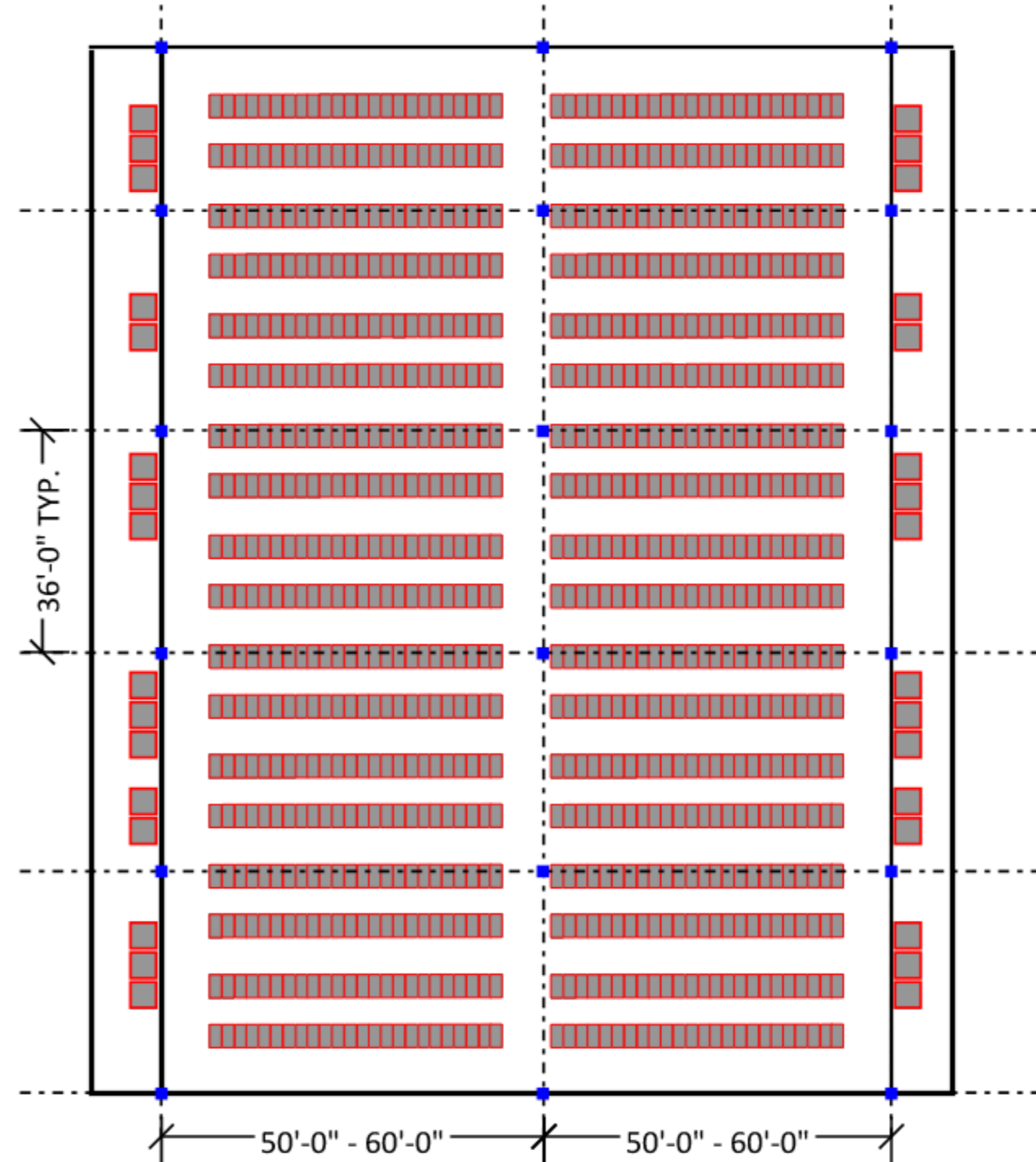
Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

Align repeatable grid module with efficient bay layout



Typical Data Hall Grid Module - Long Span

# STRUCTURE

Large-scale facilities

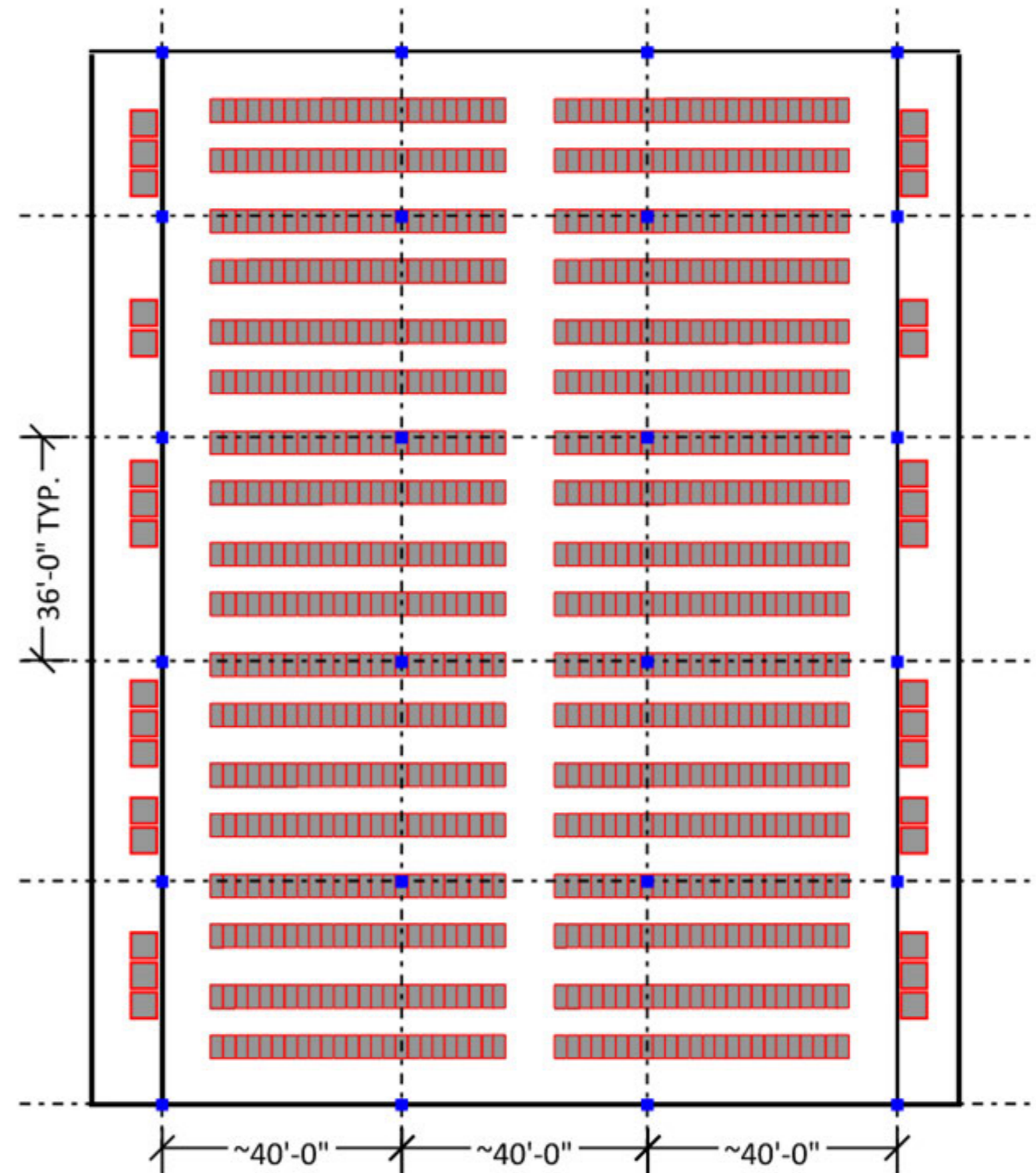
Single-story vs Multi-story

Support high floor loads

Tall but congested floor-to-floor heights

Limit structural impacts to operations of building

Align repeatable grid module with efficient bay layout



Typical Data Hall Grid Module - Short Span

# WHY MASS TIMBER?

Operational carbon is dominant — but embodied carbon is actionable

- **Data centers are energy-intensive buildings with significant long-term operational impacts.**
- **Project teams may have limited control over future IT loads, grid carbon intensity, and power procurement.**
- **Design and construction teams can directly influence structure, foundations, enclosure, material sourcing, and construction methods.**
- **Mass timber should be considered one strategy within a broader low-carbon construction toolkit.**

# THE PRACTICAL VALUE PROPOSITION

Mass Timber can contribute value in multiple ways

- **Lower embodied carbon in selected structural assemblies**
- **Reduced foundation demand through lighter floor and roof systems**
- **Prefabrication and potential schedule compression**
- **More predictable erection and reduced on-site labor intensity**
- **Biophilic benefits in staff-facing environments**
- **Improved architectural expression for community-facing facilities**

# IMPACT

High energy demand and associated carbon emissions

Dense server layouts with limited lifespan

Carbon footprint of structural materials

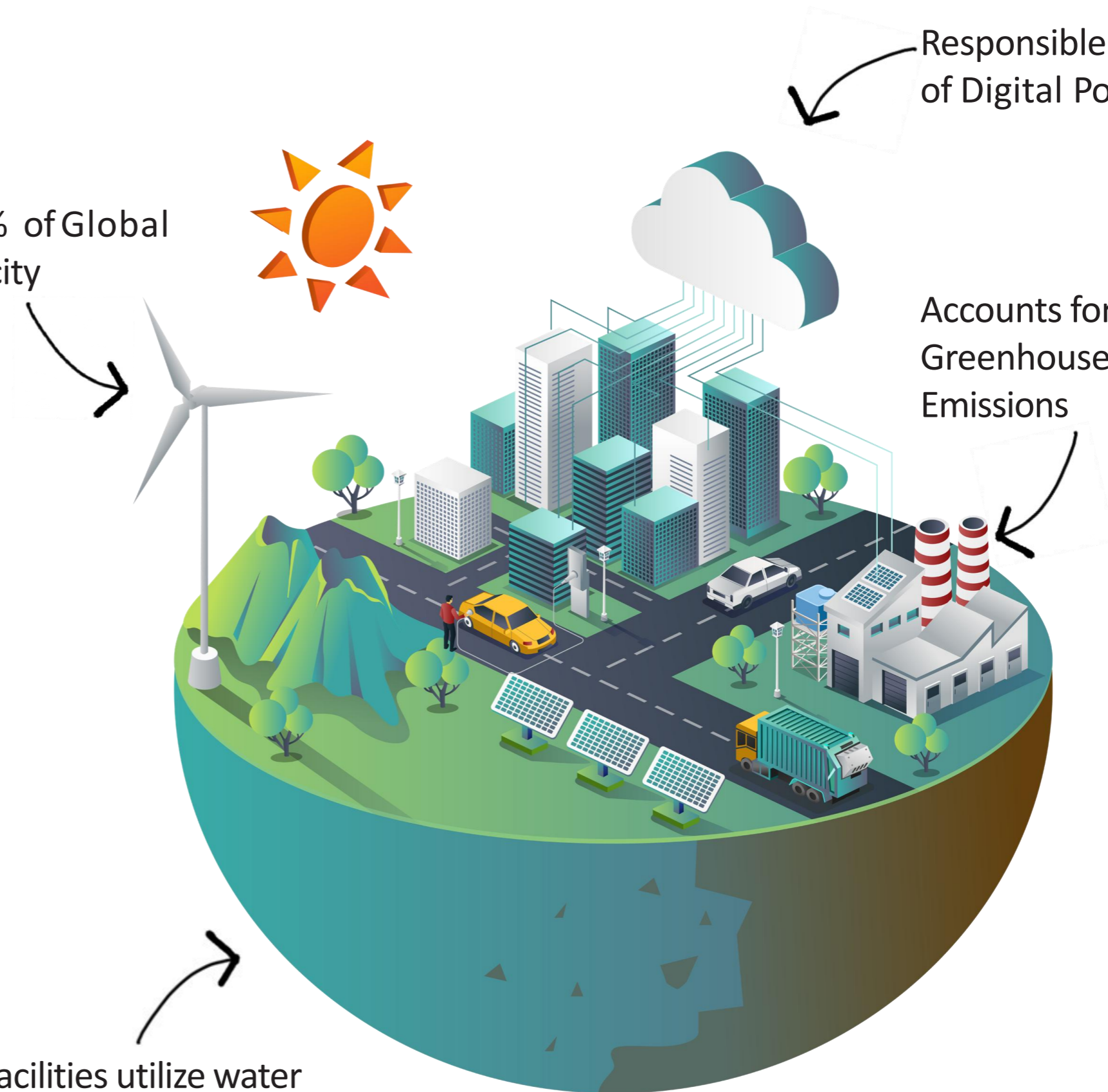
Potential high water use, depending on technology

Use 3% of Global Electricity

Responsible for 18% of Digital Pollution

Accounts for 2% of Greenhouse Gas Emissions

Some facilities utilize water to cool chiller systems



# IMPACT



Data Centers are supported by over 2 GW of renewable energy projects



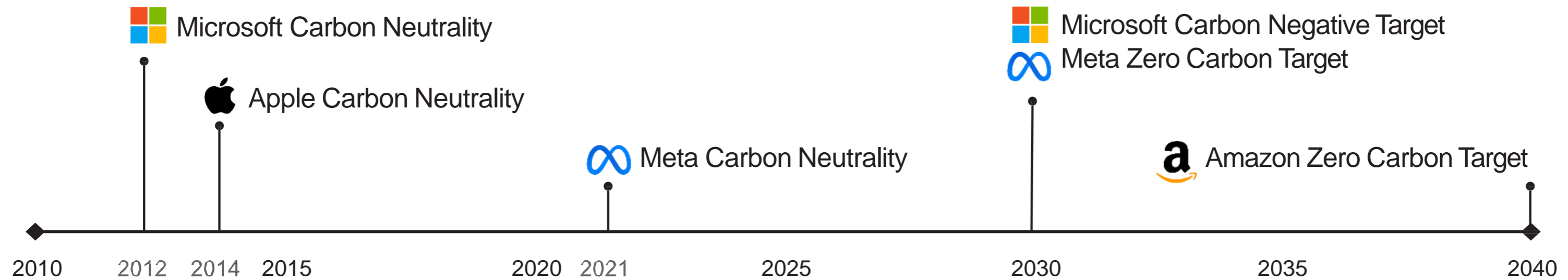
Partnering with local renewable utilities, including wind and solar farms



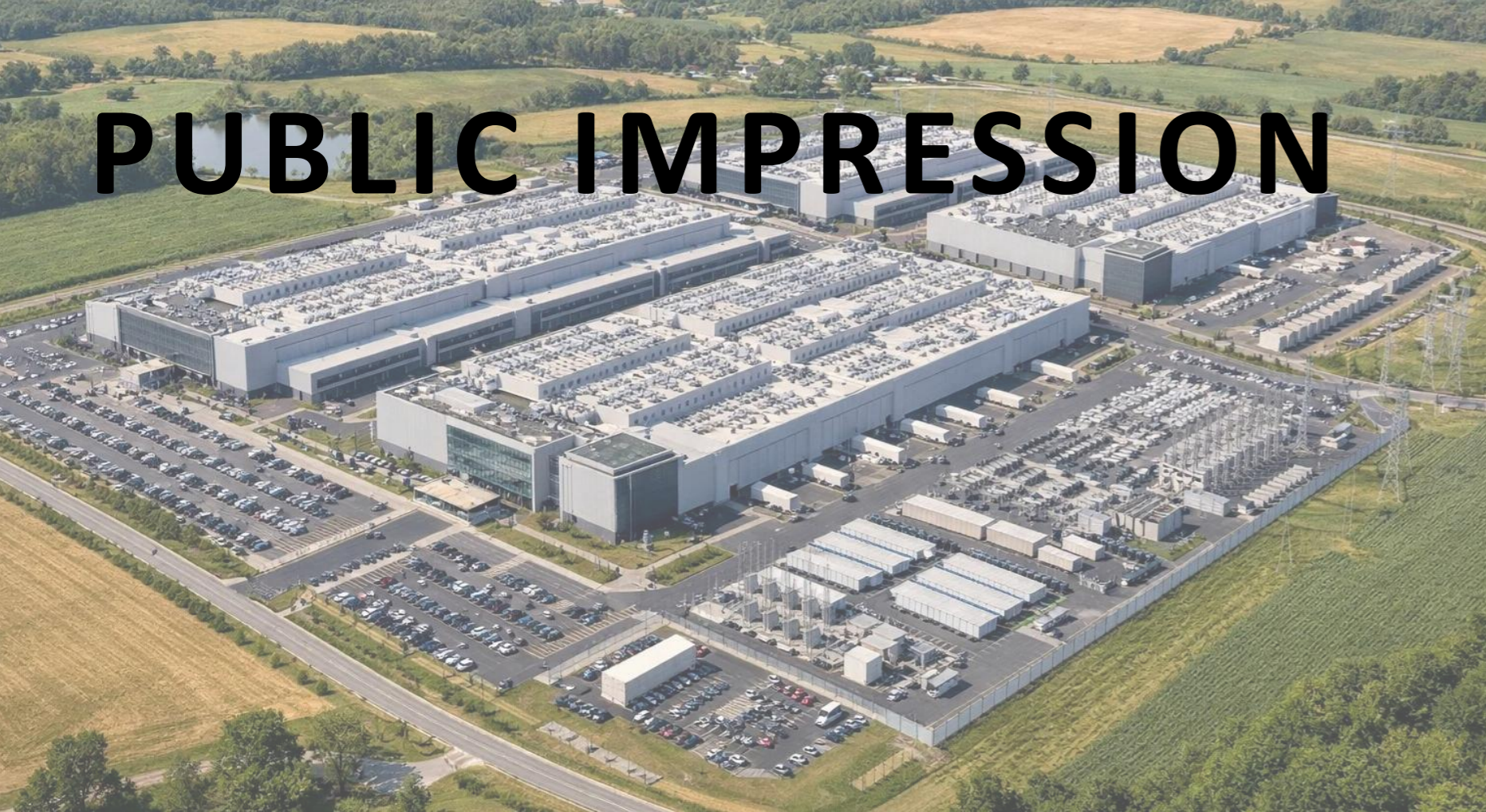
Data centers are supported by 100% renewable energy through a strategy of adding renewables to the local grids



In 2023 achieved goal to match 100% of the electricity they use, including data centers, with renewable energy



# PUBLIC IMPRESSION



# CHANGING NARRATIVE

## The good employer

The Lighthouse  
Amenity Center

What talent attraction and retention challenges are you facing? Choose all that apply.

58%

We are having difficulty finding qualified candidates for open jobs

55%

We are having difficulty retaining staff

40%

Staff being hired away by competitors (doing data center work)

15%

Staff being hired away by non-competitors (doing non-data center work)

Source: Uptime Institute Staffing Survey



# CHANGING NARRATIVE

## The good employer



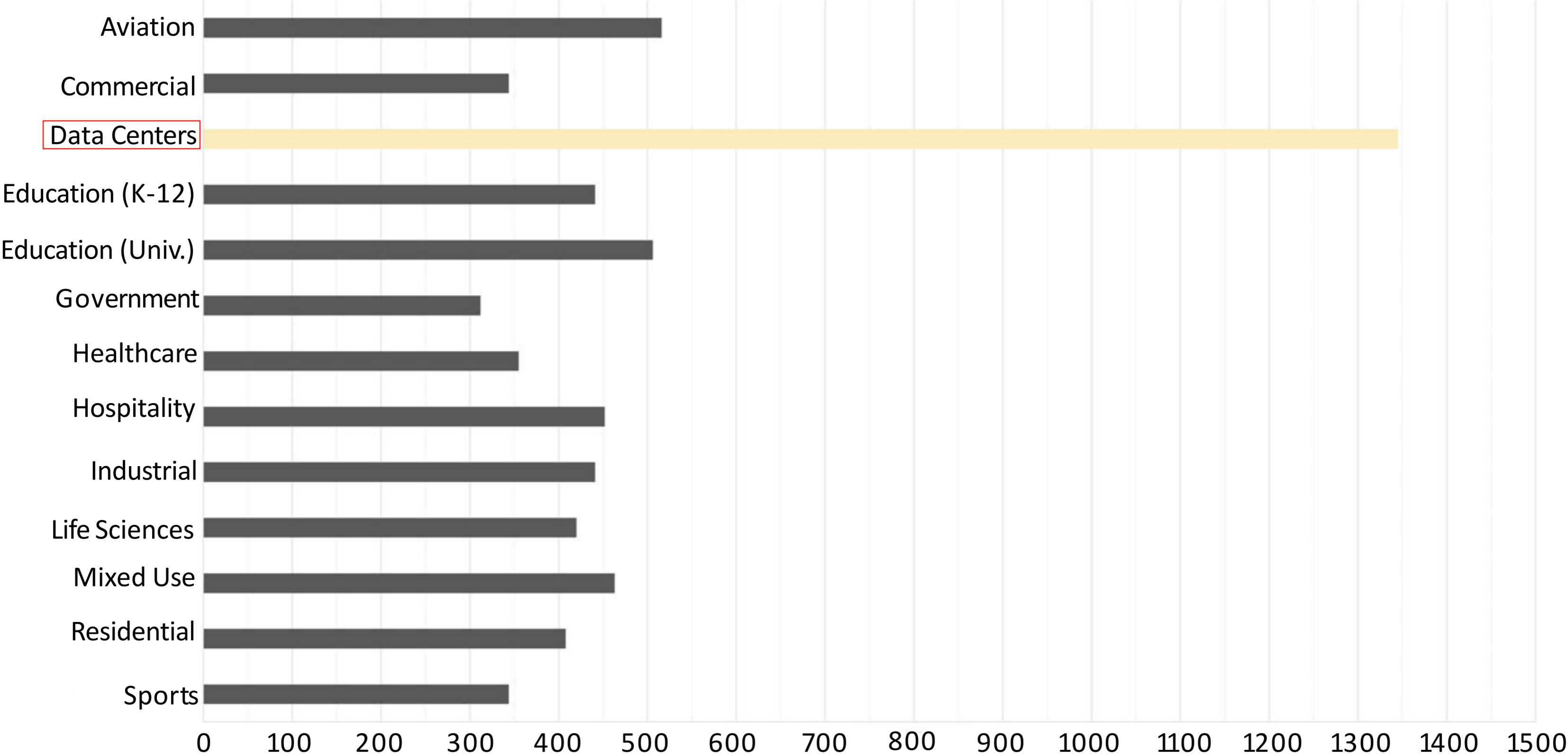
Comarch Data Center



First United Bank

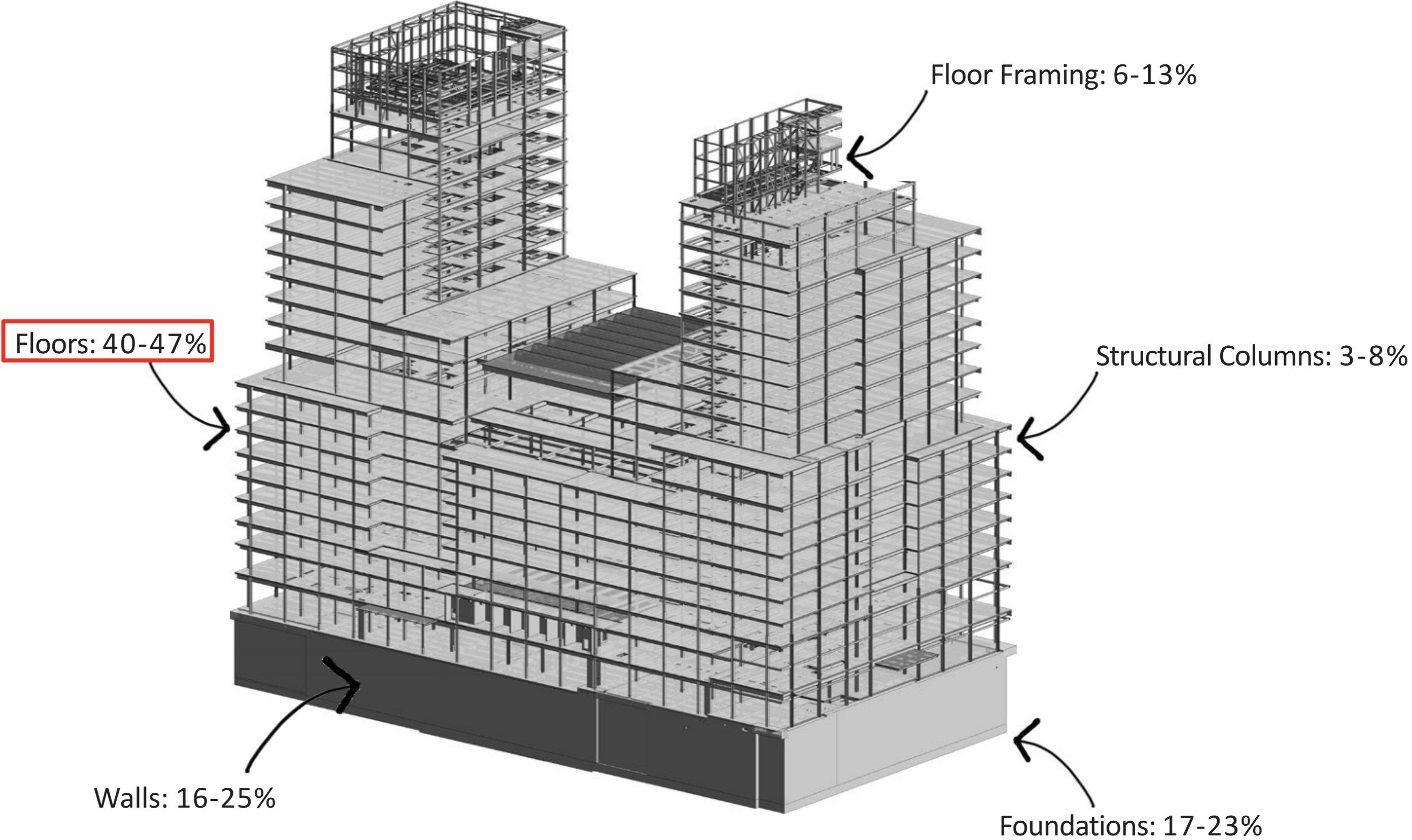
# EMBODIED CARBON BY BUILDING USE – CO<sub>2</sub>e/m<sup>2</sup>

Average Embodied Carbon - By Building Use

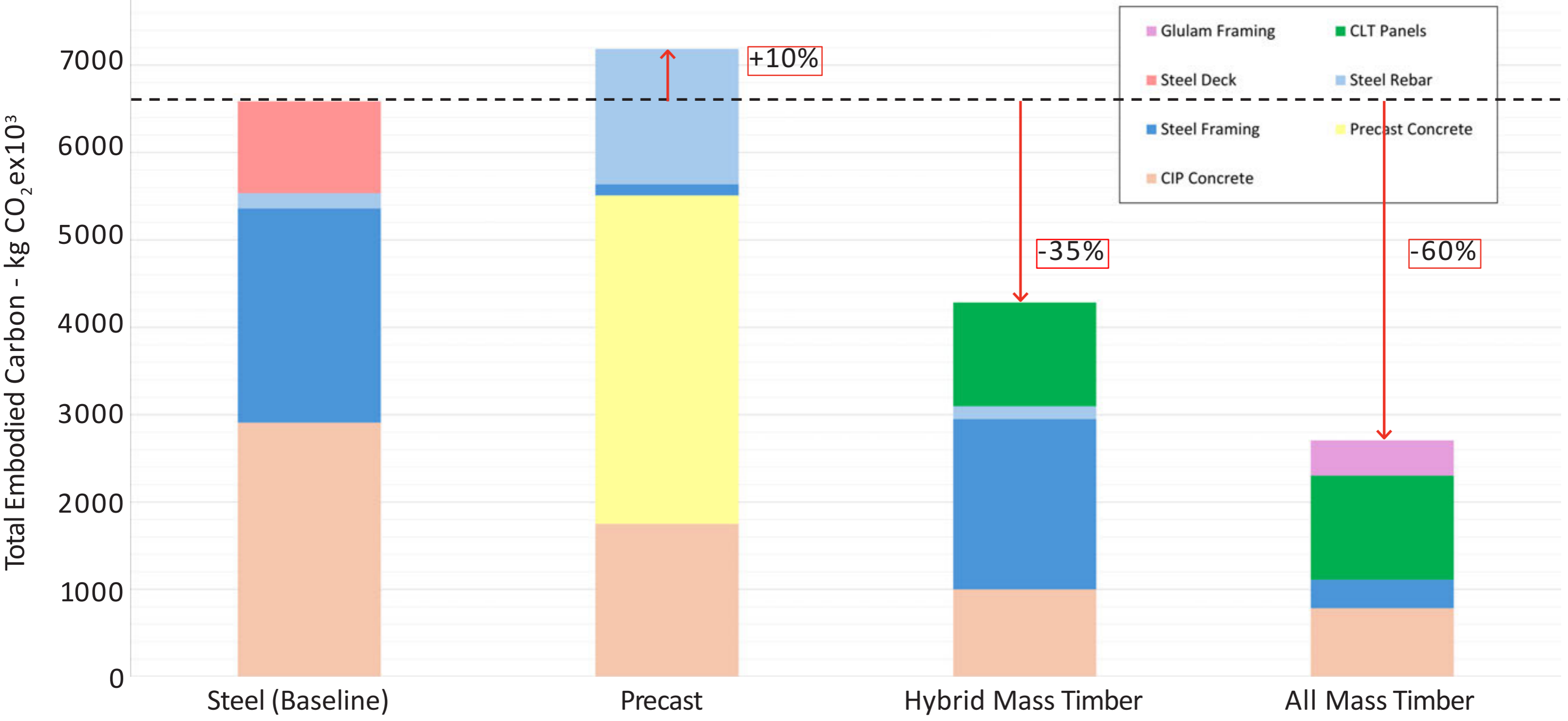


Data developed with Thornton Tomasetti's Core Studios based on past project statistics with confidential client information.

# EMBODIED CARBON BY STRUCTURAL ELEMENT



# EMBODIED CARBON BY MATERIAL – MULTI-STORY

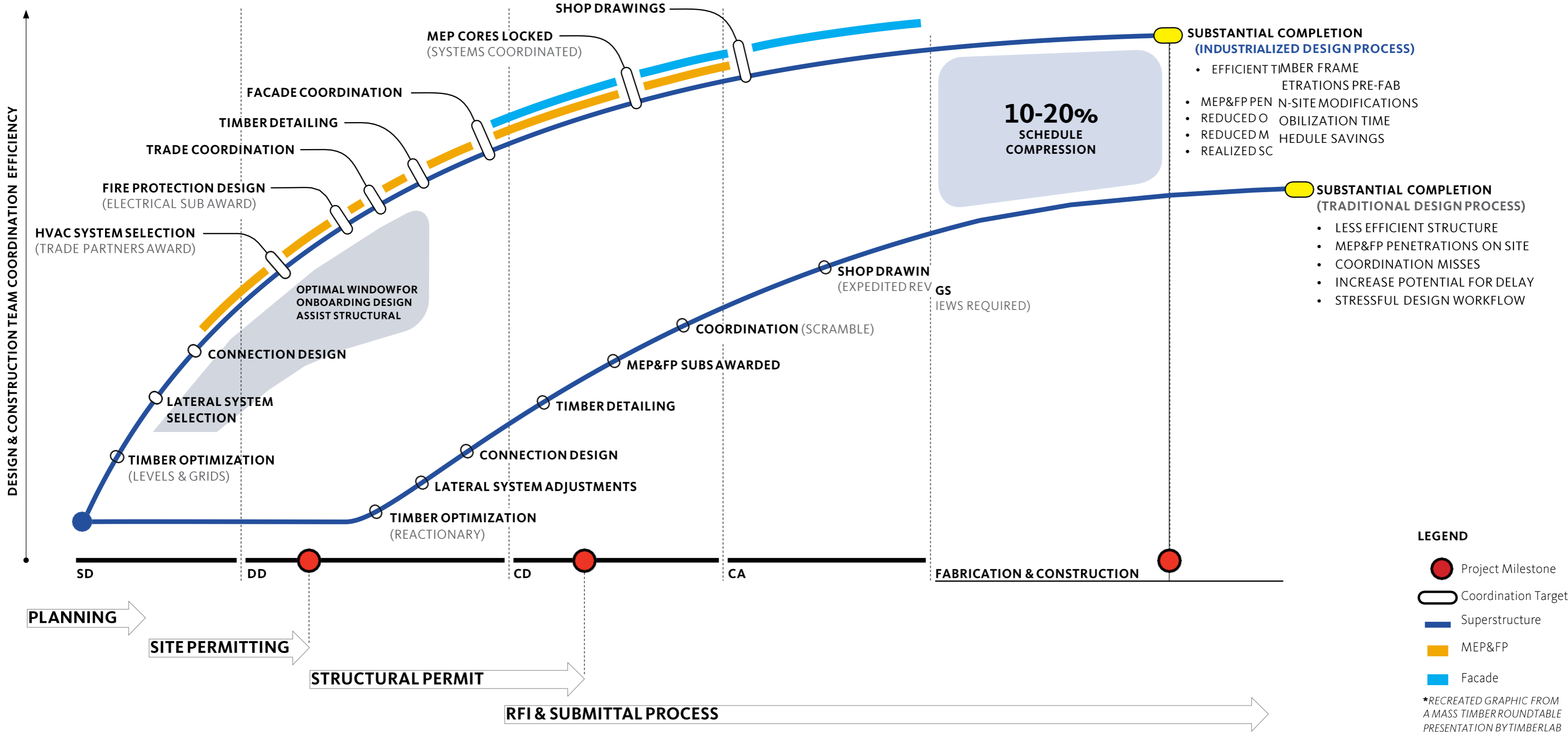


Data developed with Thornton Tomasetti's Core Studios based on past project statistics with confidential client information.

# PROJECT APPROACH

## Delivery: Earlier Decisions, Better Outcomes

The schedule benefit depends on early coordination



PLANNING

SITE PERMITTING

STRUCTURAL PERMIT

RFI & SUBMITTAL PROCESS

SD

DD

CD

CA

FABRICATION & CONSTRUCTION

FACADE COORDINATION

TIMBER DETAILING

TRADE COORDINATION

FIRE PROTECTION DESIGN

(ELECTRICAL SUB AWARD)

HVAC SYSTEM SELECTION

(TRADE PARTNERS AWARD)

CONNECTION DESIGN

LATERAL SYSTEM SELECTION

TIMBER OPTIMIZATION

(LEVELS & GRIDS)

TIMBER OPTIMIZATION

(REACTIONARY)

CONNECTION DESIGN

LATERAL SYSTEM ADJUSTMENTS

TIMBER DETAILING

MEP&FP SUB AWARDED

COORDINATION (SCRAMBLE)

SHOP DRAWING

(EXPEDITED REVIEWS REQUIRED)

MEP CORES LOCKED

(SYSTEMS COORDINATED)

SHOP DRAWINGS

SUBSTANTIAL COMPLETION

(INDUSTRIALIZED DESIGN PROCESS)

SUBSTANTIAL COMPLETION

(TRADITIONAL DESIGN PROCESS)

# IMPLEMENTATION

Mass Timber Is a Strategy, Not a Shortcut

- Mass timber does not reduce IT power demand.
- It does not eliminate the need for resilient cooling, power, and fire protection systems.
- Concealed spaces, penetrations, moisture, and firestopping require early coordination.
- The most successful timber strategies are selected early — not substituted late.
- The right question is not “Can we use timber?” but “Where can timber add value without compromising operations?”

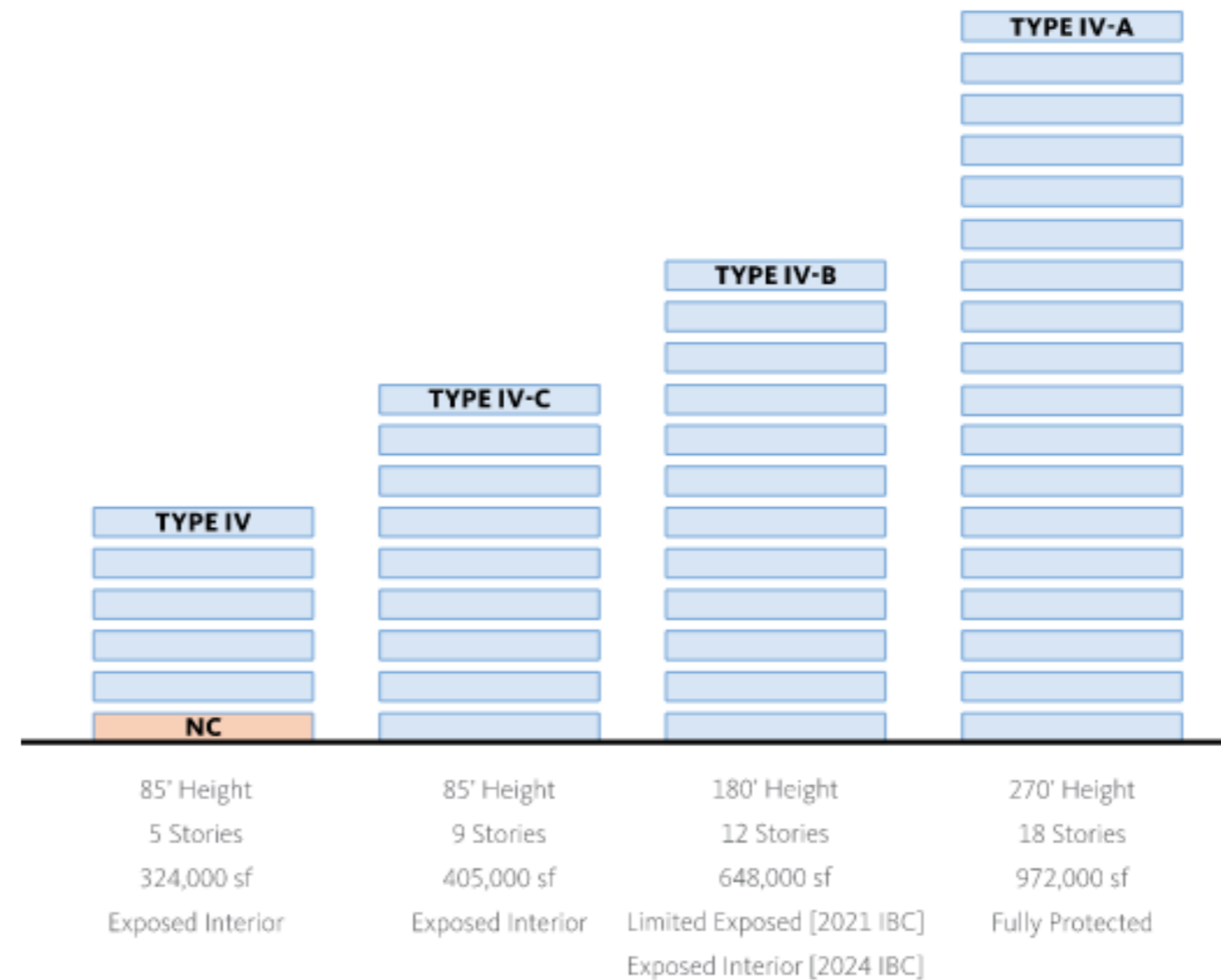
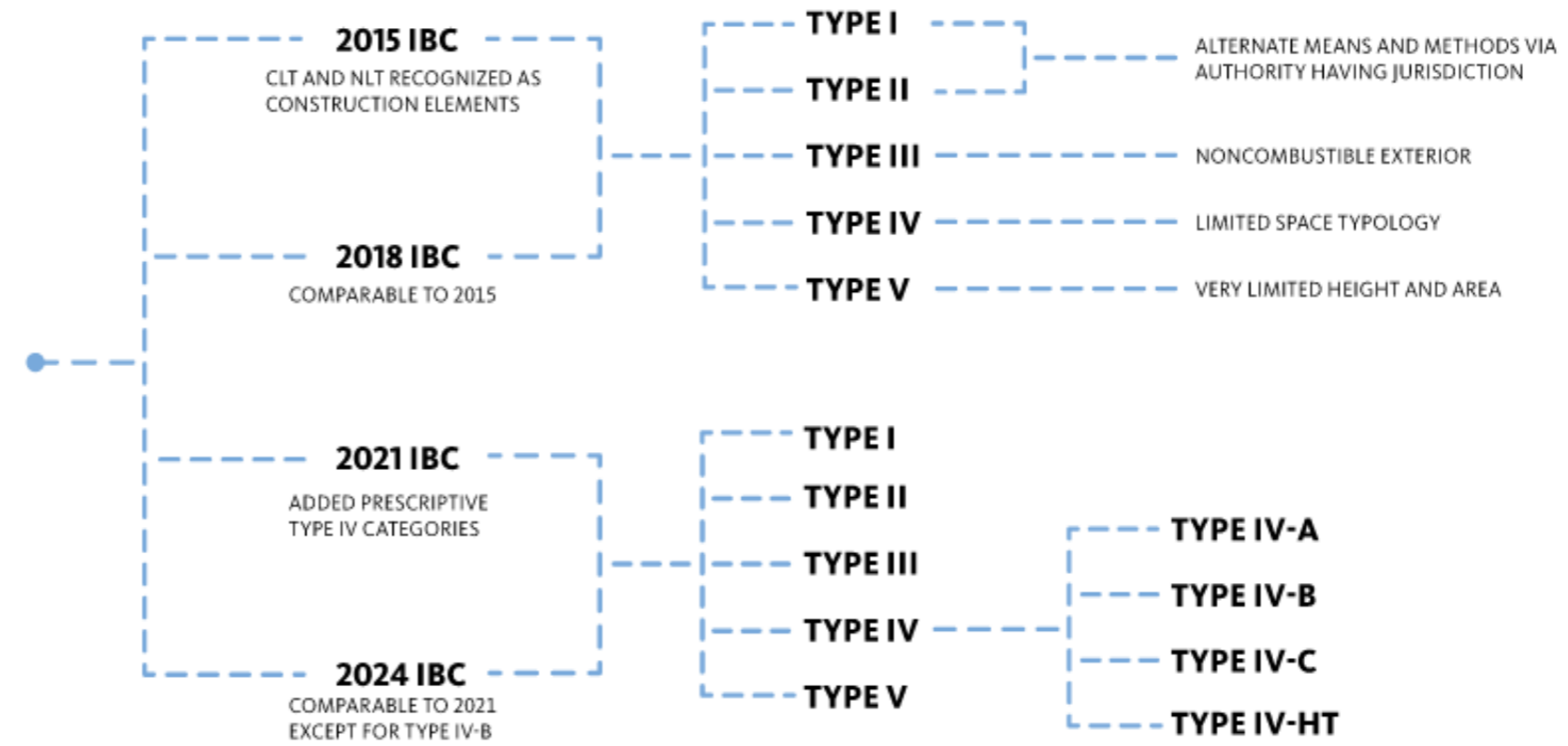
# MASS TIMBER DATA CENTERS

## Code Analysis

Type III is most ideal for hybrid multi-story data centers; however, it limits combustible exterior walls

Type IV in datacenter design creates difficulty due to concealed air plenums

Type IV or V is more ideal for full mass timber and/or single-story data centers



# MASS TIMBER DATA CENTERS

## Code Analysis

New requirements for datacenters in the 2024 IBC will **require type F1 or F2 occupancy in lieu of B or S occupancy** per AHJ interpretation

**Recommendation for 60' perimeter public way around entire facility** to maximize for unlimited area per 507

Per 602.4.2, in **Type IV permits exterior walls with CLT** (min 4" thick) with a protected exterior surface

## Critical Coordination Issues

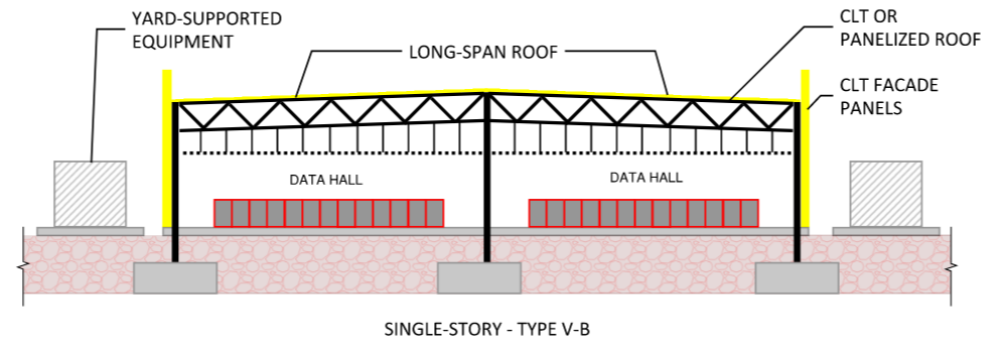
Early alignment is essential

- AHJ and fire marshal interpretation
- Occupancy classification and construction type
- Allowable area, frontage, and perimeter access
- Exposed timber and concealed space limitations
- Sprinkler, detection, and fire-resistance strategy
- Rated penetrations and firestopping
- Moisture protection during construction and operations
- Insurance, risk review, and owner operations requirements

# DESIGN SCENARIOS

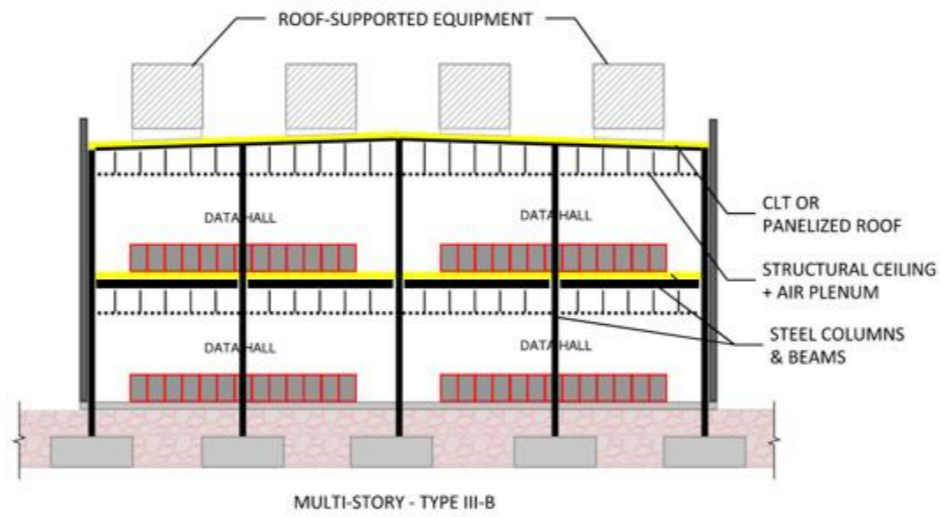
## SCENARIO 01

- SINGLE STORY
- TYPE V-B CONSTRUCTION
- AIR PLENUM SPACE
- CLT WALLS & TIMBER ROOF
- TIMBER CLADDING



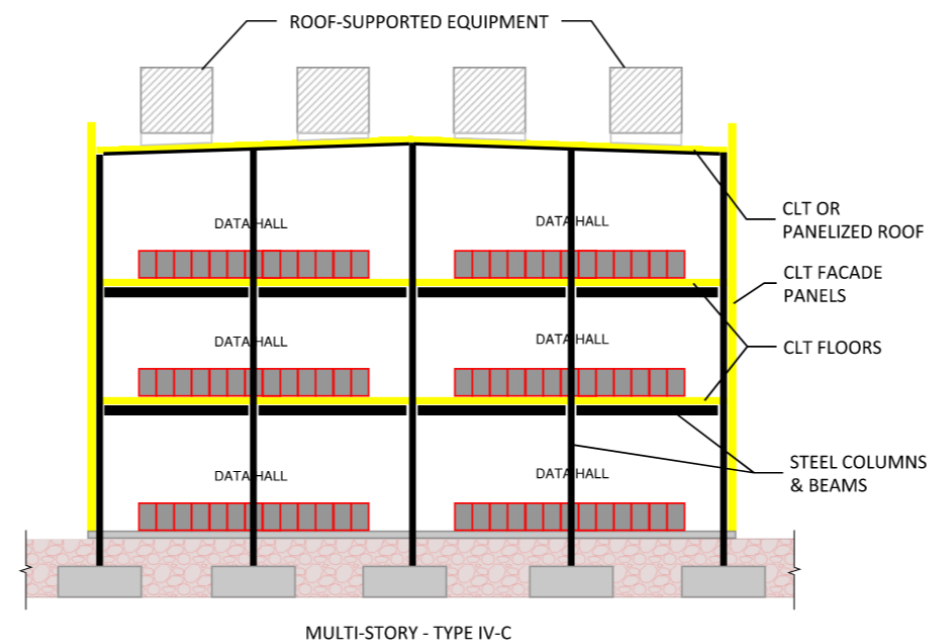
## SCENARIO 02

- TWO STORIES
- TYPE III-B CONSTRUCTION
- AIR PLENUM SPACE
- CLT FLOORS & TIMBER ROOF
- NONCOMBUSTIBLE ENVELOPE



## SCENARIO 03

- THREE STORIES
- TYPE IV-C CONSTRUCTION
- NO CEILING AIR PLENUM CAVITY
- CLT WALLS, FLOORS, AND ROOF
- NONCOMBUSTIBLE CLADDING



# SCENARIO 01

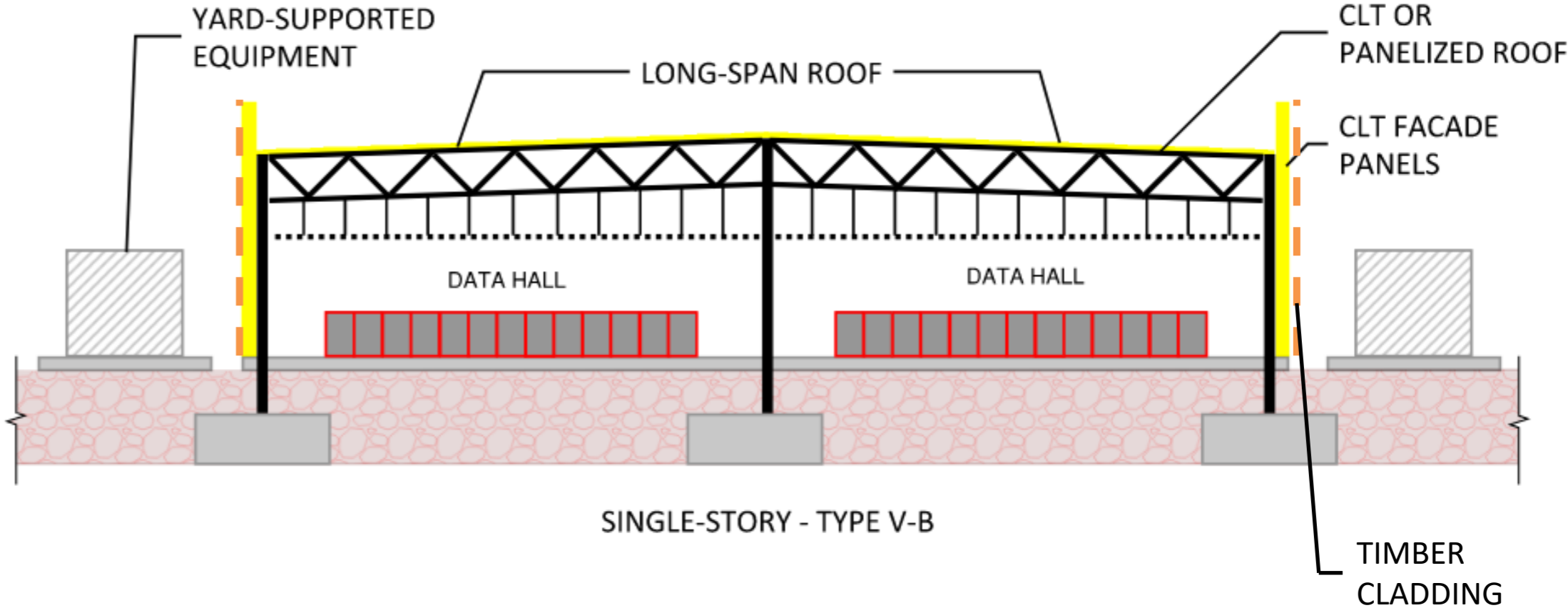
Single-Story, Type V-B

CLT roof maximizes span & hung load capacity in exchange for added weight

Panelized roof offers largest embodied carbon savings

Vertically spanning CLT panels at façade (3-5 ply)

Timber cladding system



# SCENARIO 01

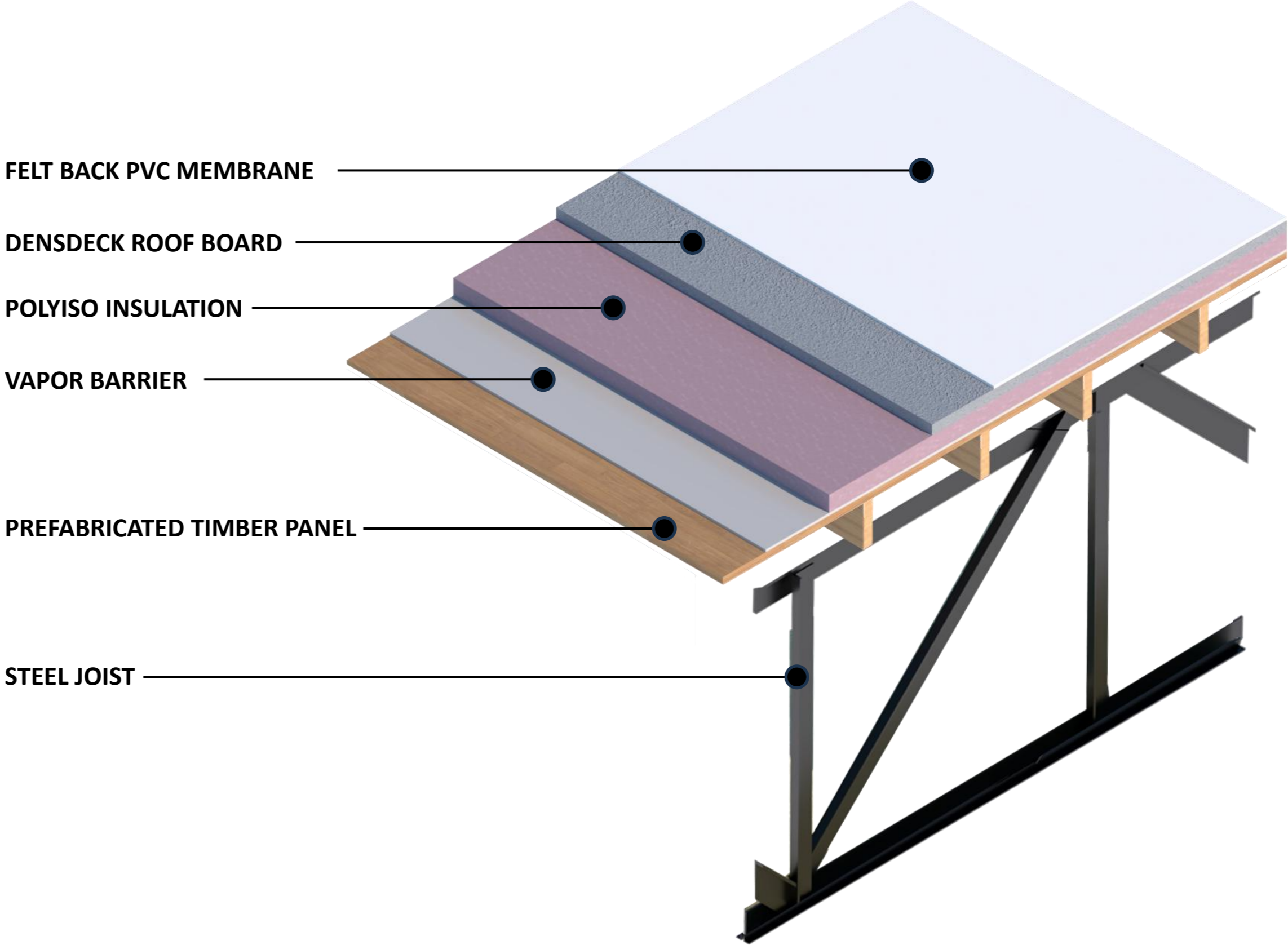
## Roof Assembly

### Design and Assembly

The assembly consists of a prefabricated panels of plywood and dimensional lumber, vapor barriers, 5" Polyiso insulation, 80 mil felt back PVC membrane and 5/8" DensDeck roof board.

### Building Code and Performance Standards

Construction **Type V-A** requires a 1-hour fire resistance rating for the primary structural frame, floor, and roof construction. Construction **Type V-B** does not require a fire-resistance rating, unless required by other specific code requirements, such as those for occupancy or use separations.



# SCENARIO 01

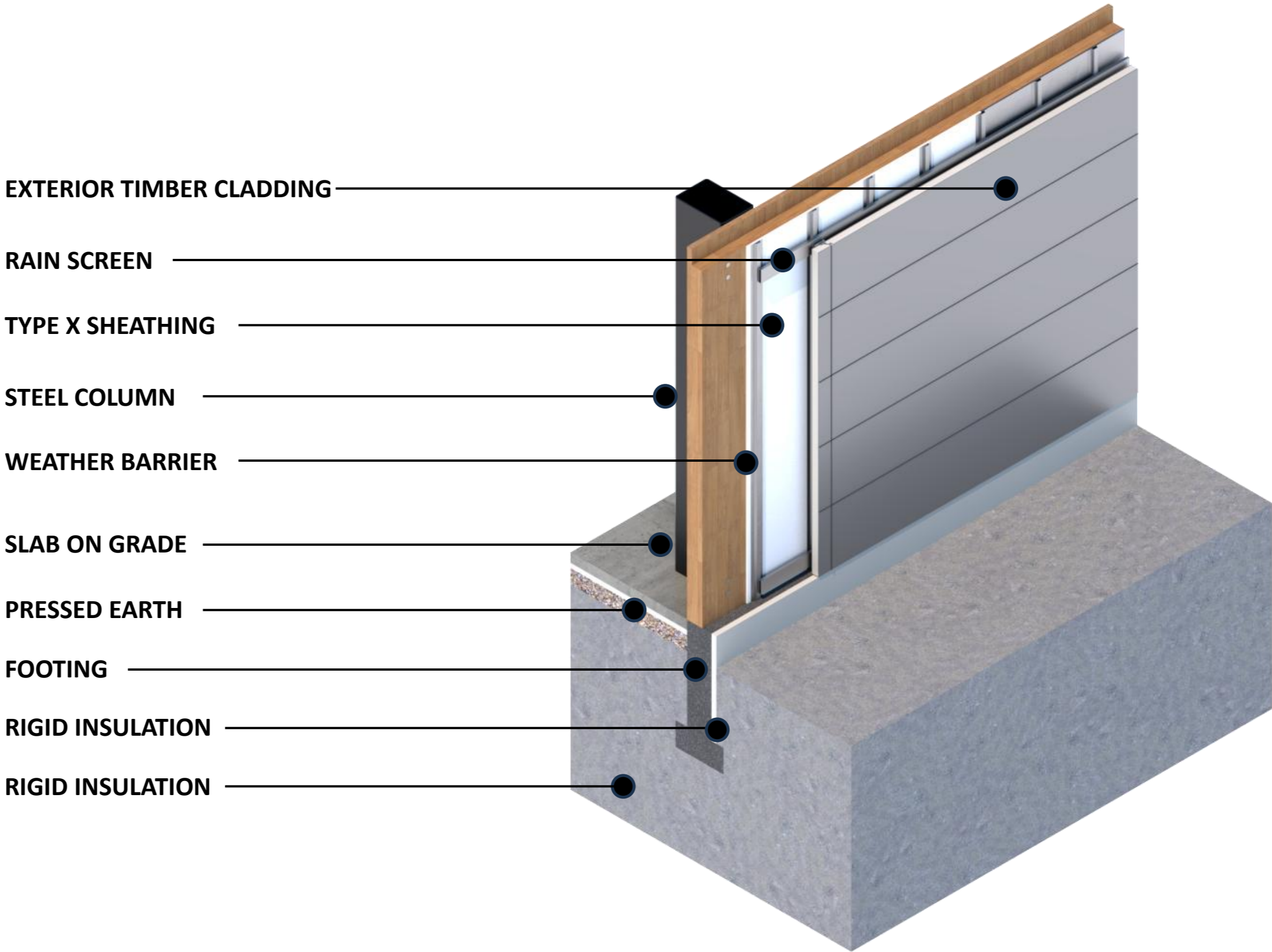
## Wall Assembly

### Design and Assembly

The assembly consists of 10' high x 30' wide 3 or 5 ply CLT panels with Type X gypsum sheathing attached directly to the CLT panels. Timber cladding or other exterior wall cover will be attached through furring strips.

### Building Code and Performance Standards

**Type V-B**, as defined in the 2024 International Building Code (IBC), is a classification under the broader category of Type V construction where the building elements are allowed to be mass timber or non-combustible. Generally, CLT and Glulam elements are considered combustible and may require additional protection.



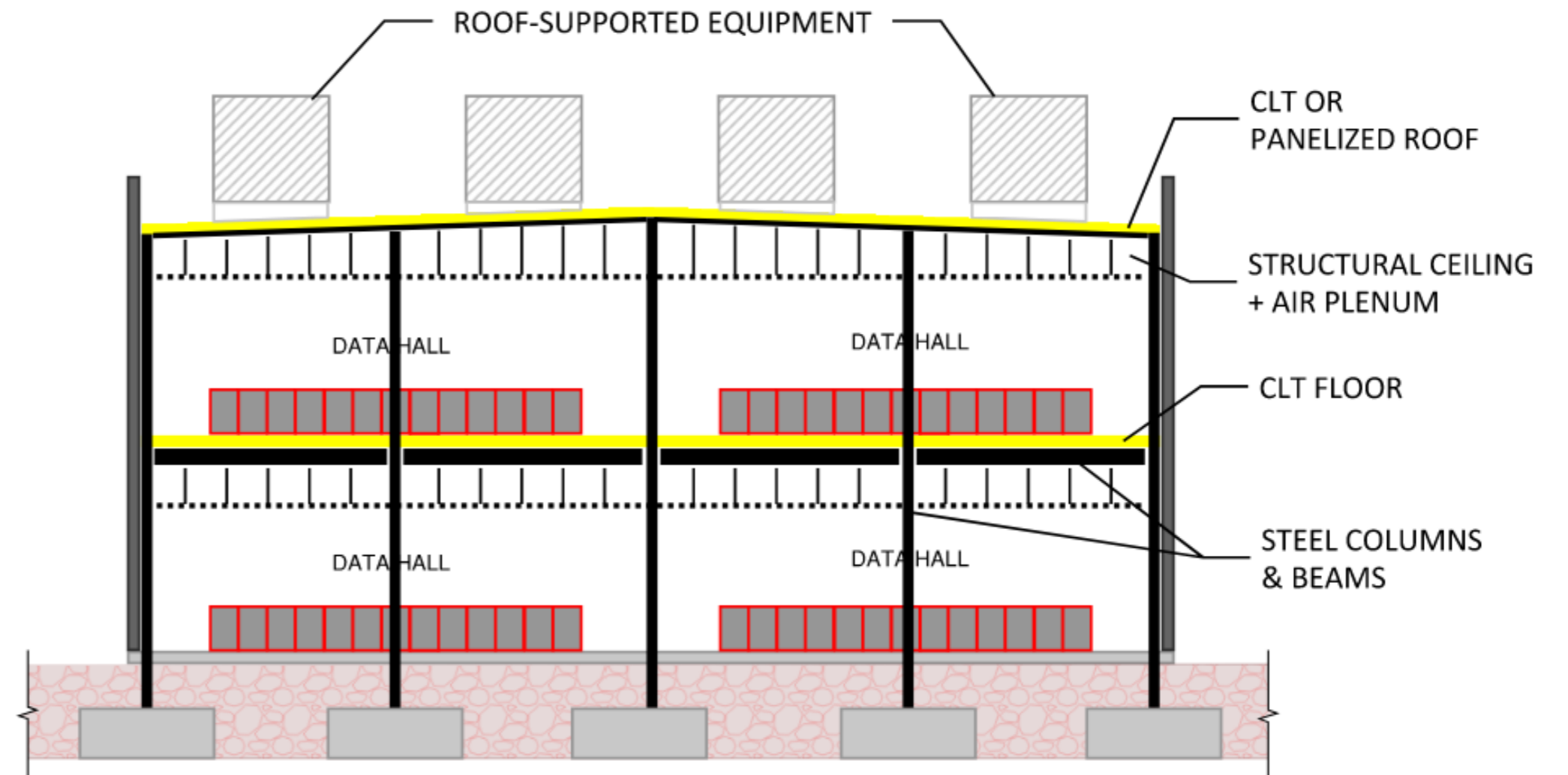
# SCENARIO 02

## Two-Story Type IIIB

Hybrid Steel + CLT:

Maximize framing spans to preserve flexibility and functionality of data halls

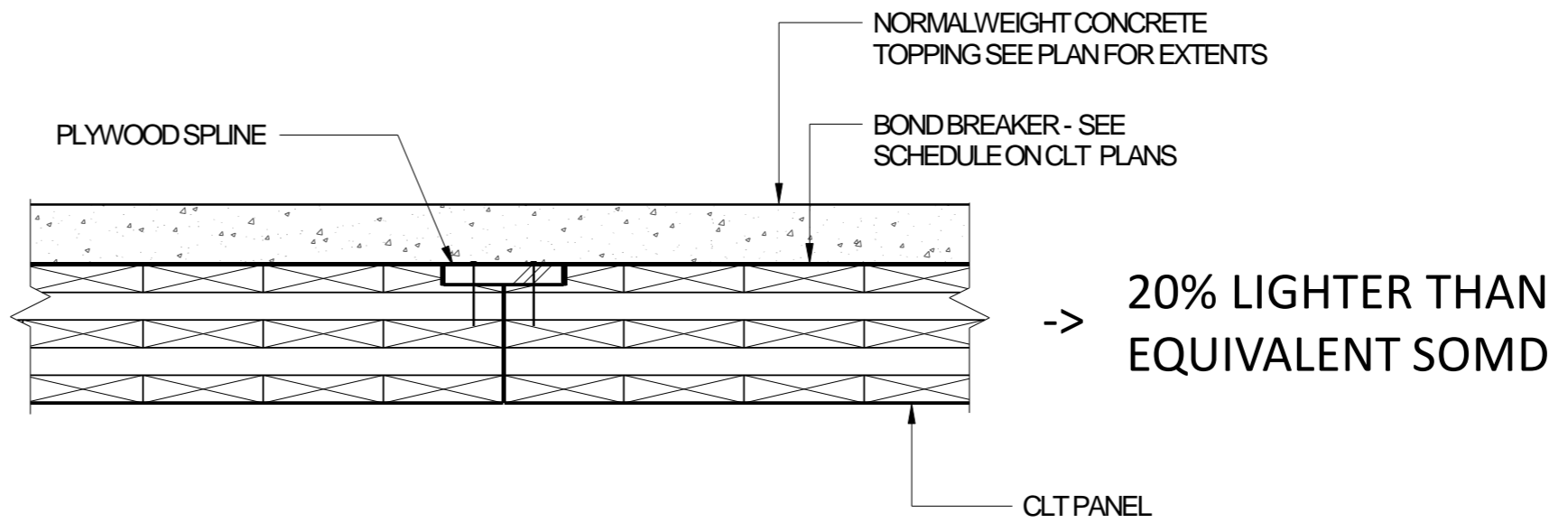
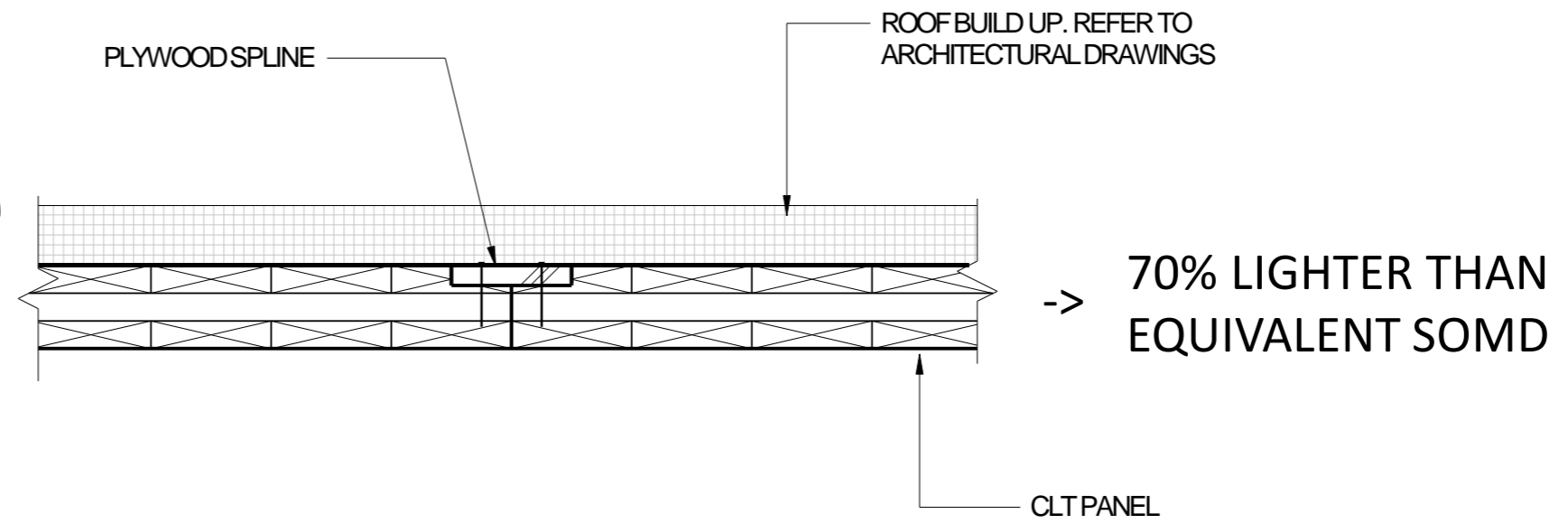
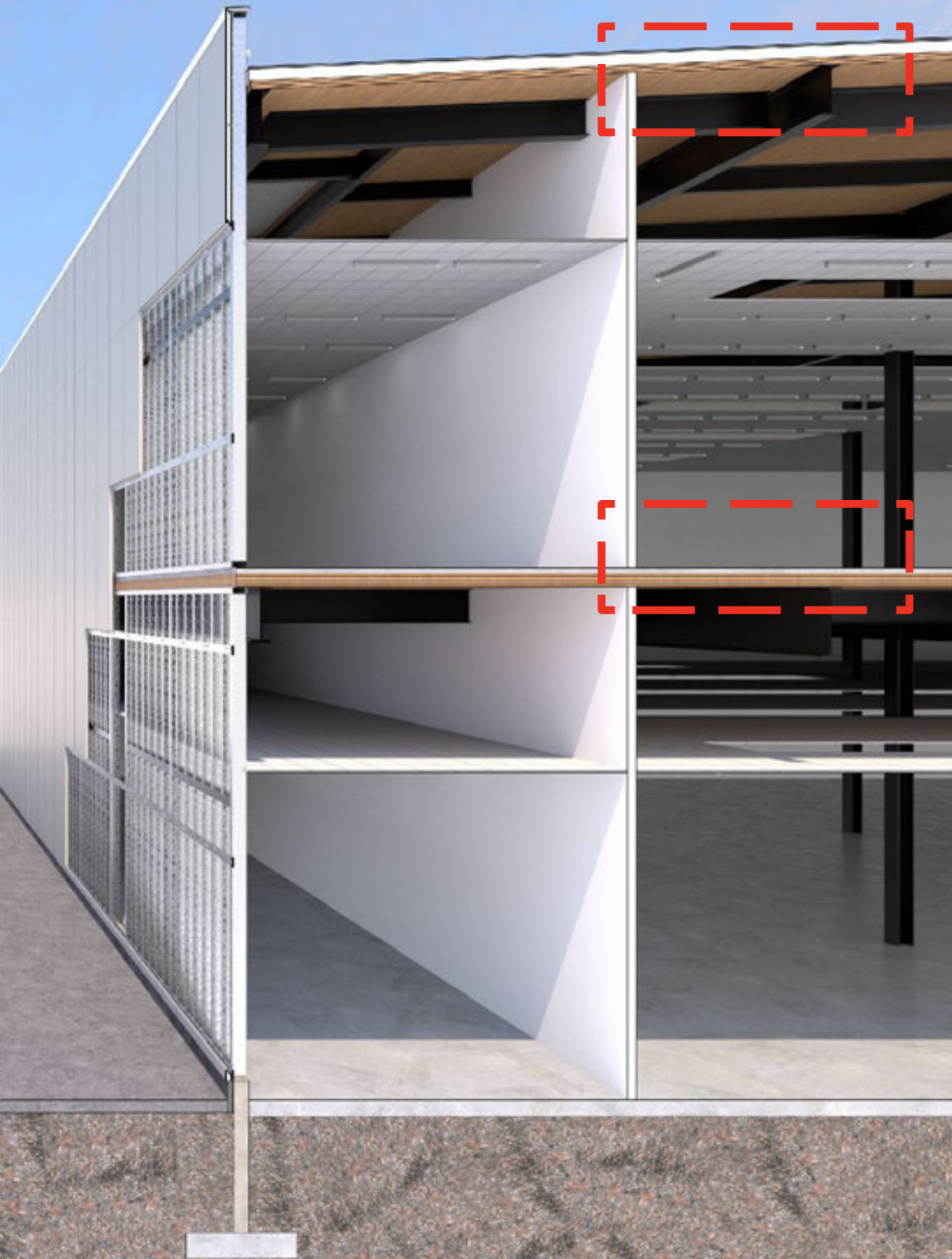
Drastically reduce the embodied carbon content of concrete contained within floor assembly



MULTI-STORY - TYPE III-B

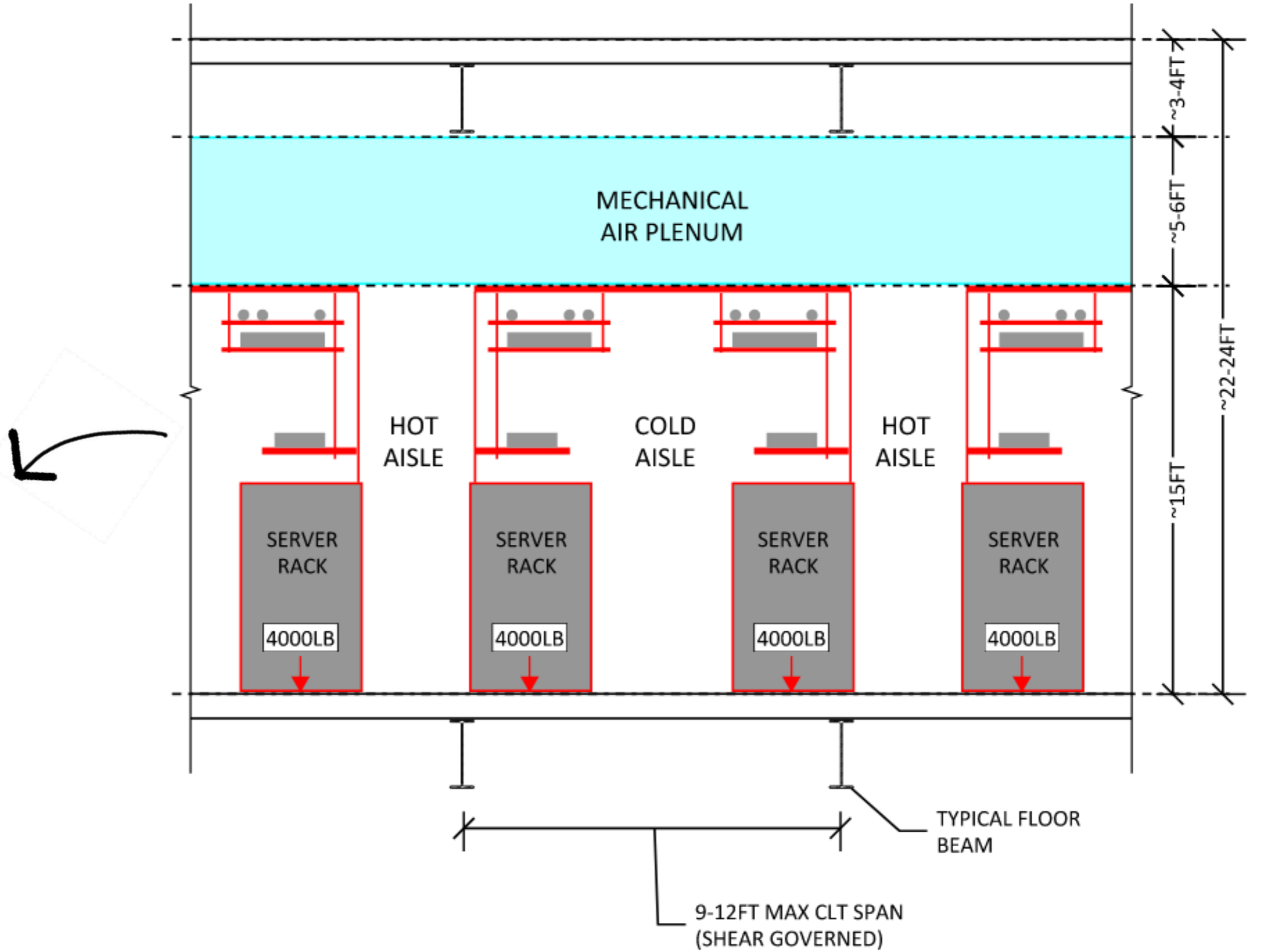
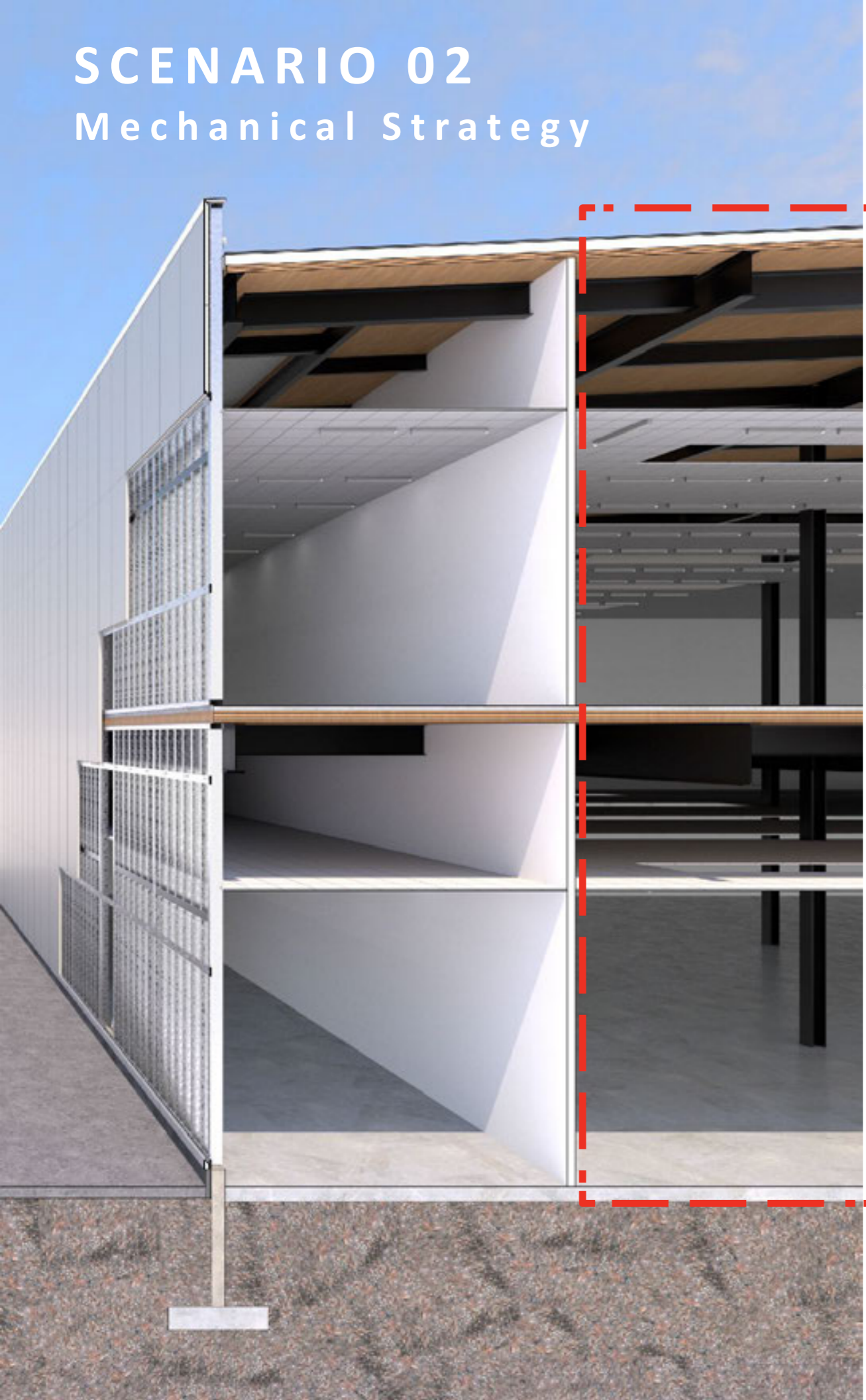
# SCENARIO 02

## Wall & Roof Assemblies



# SCENARIO 02

## Mechanical Strategy



# SCENARIO 02

## Mechanical Strategy



## Cooling Strategy Changes the Timber Strategy

Air-cooled and liquid-cooled facilities create different timber opportunities

- Air-cooled data halls often rely on large air pathways and plenum zones.
- Concealed plenum conditions can complicate mass timber code strategies.
- Liquid cooling may reduce some air-distribution requirements.
- Liquid-cooled environments introduce different risks: leak detection, maintenance access, redundancy, and operational protocols.
- The structural strategy should follow the mechanical concept — not the other way around.

# Scenario 2: Hybrid Steel – Mass Timber Construction Sequencing



Erection of Steel Frame



Delivery of CLT Panels



Storage of CLT Panels



CLT Prep and Inspection



Erection of CLT Panel



Securing of CLT by Steel Erectors



# SCENARIO 03

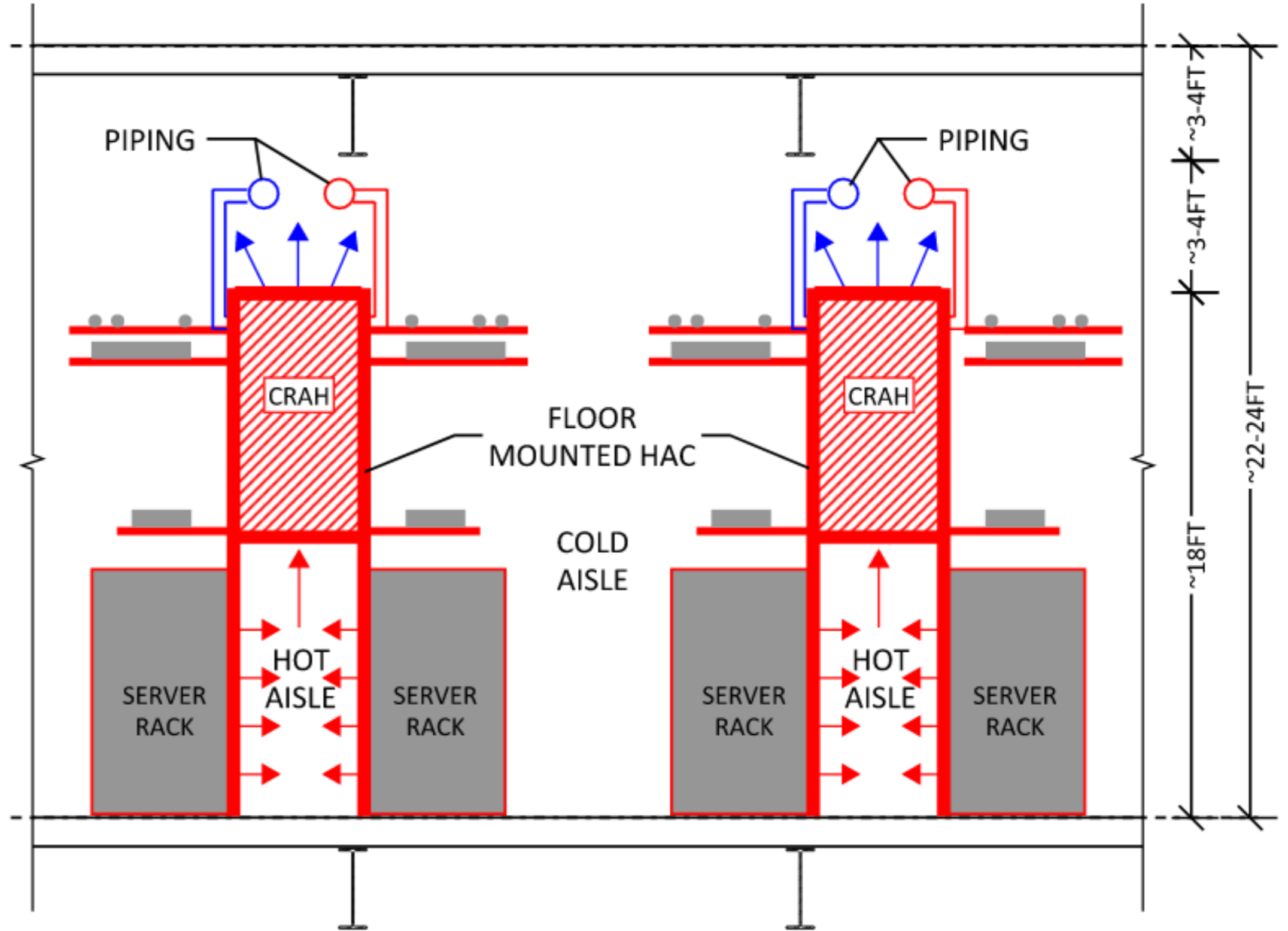
## Mechanical Plenum

Liquid cooled – no air plenum

Floor-mounted HACs  
(Hot Aisle Containment)

Floor-mounted / Overhead CRAH  
(Computer Room Air Handler)

Increased design loads



# WRAP UP

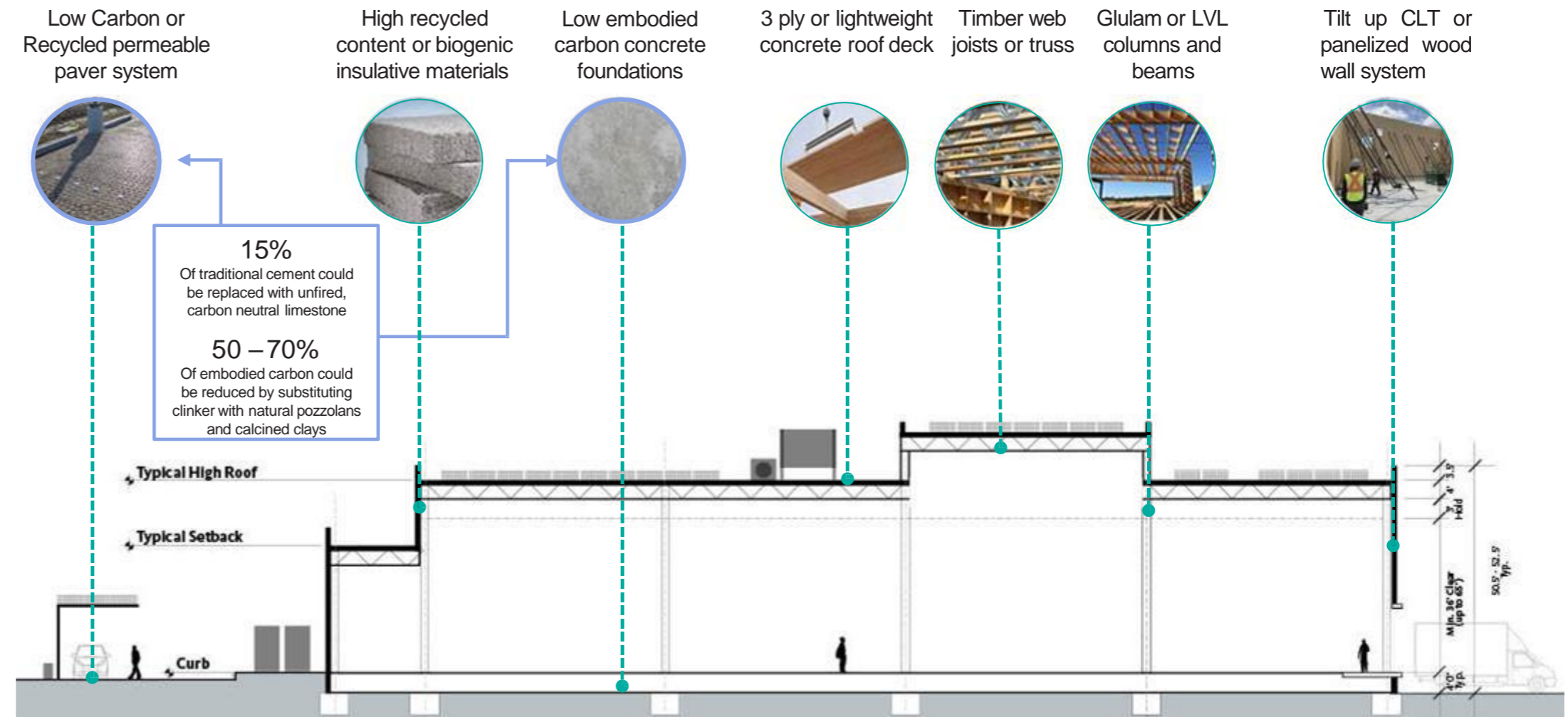
Mass timber works best when it is selective, intentional, and coordinated

- **Data centers are structurally and operationally demanding. Mass timber strategies must respect reliability, flexibility, and maintainability.**
- **Hybrid systems may offer the most practical near-term opportunity. They can reduce embodied carbon while preserving spans, grids, and operations.**
- **Code, fire, plenums, penetrations, and mechanical strategy are early decisions to be resolved before fabrication and procurement.**
- **Cooling evolution may open new timber pathways. Reduced plenum dependency can change what is possible.**
- **Mass timber works best as part of a whole-building strategy. It should be coordinated with broader decarbonization goals.**

# GENERAL COMMENTARY

## Mass Timber Is Part of a Broader Low-Carbon Toolkit

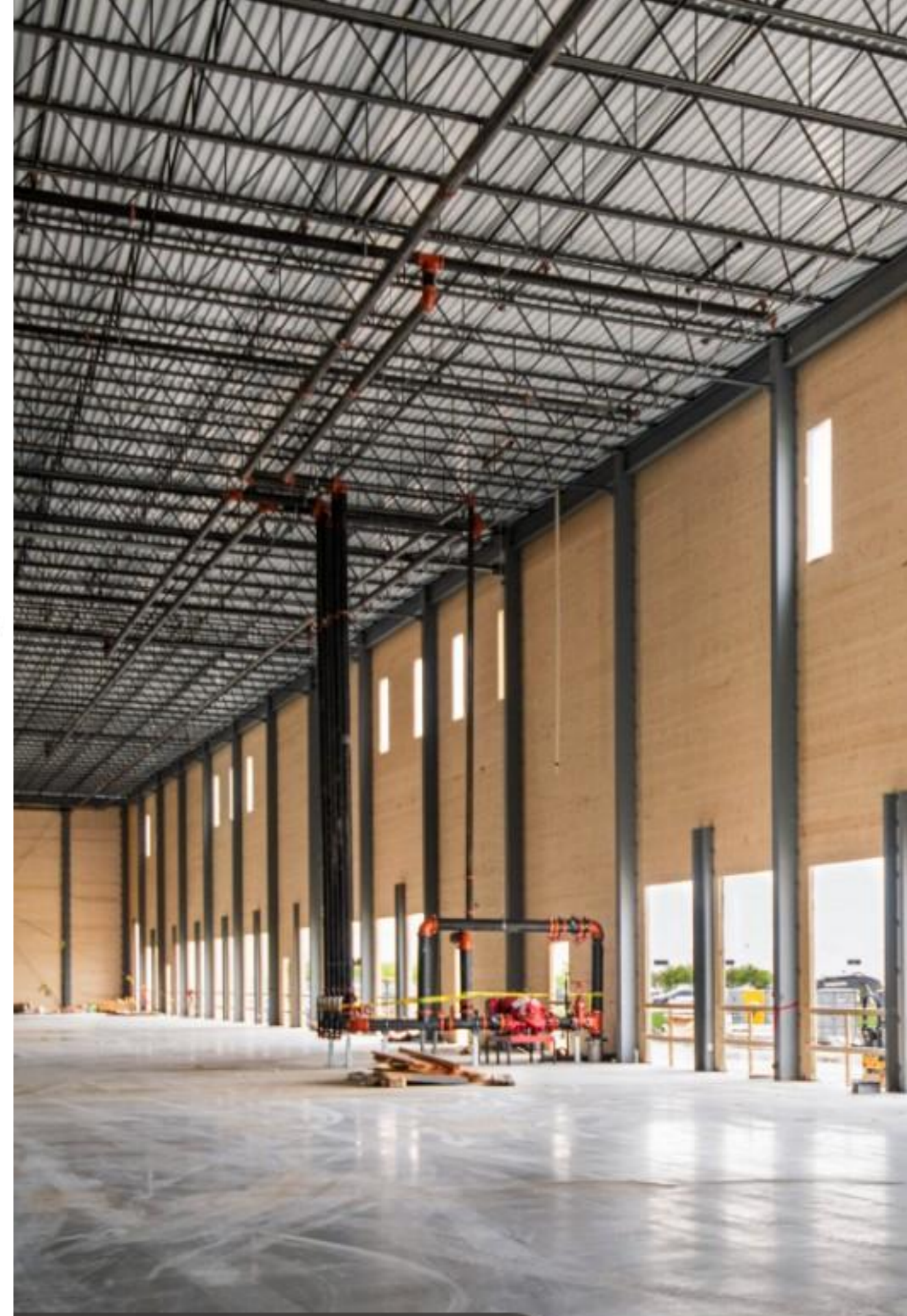
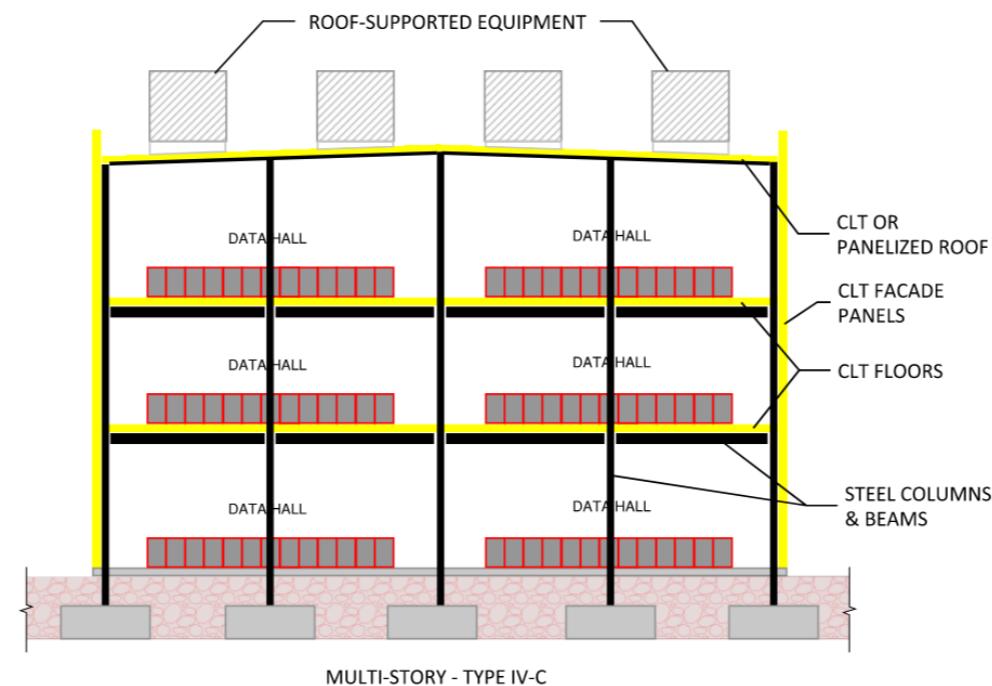
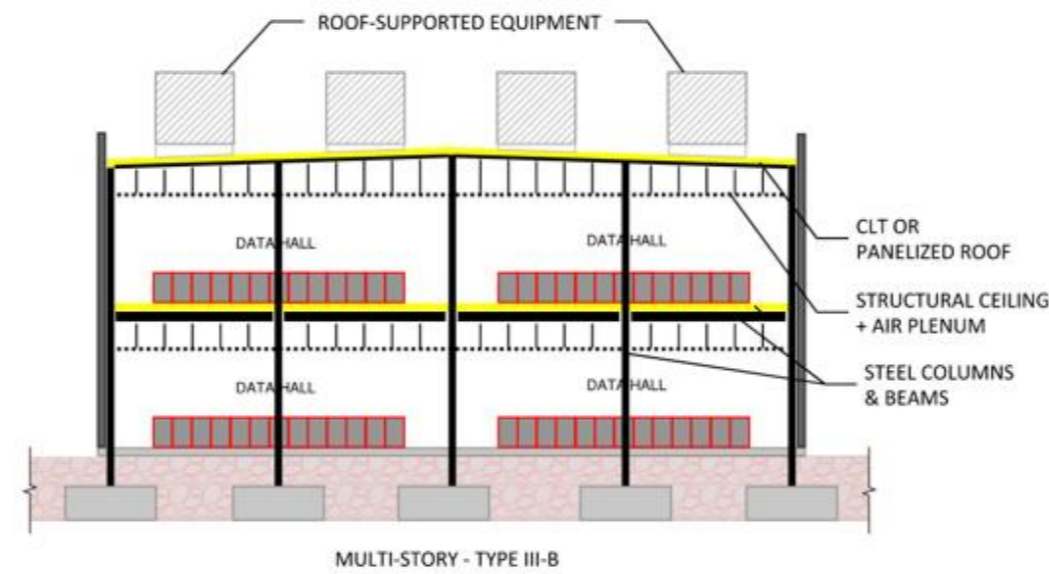
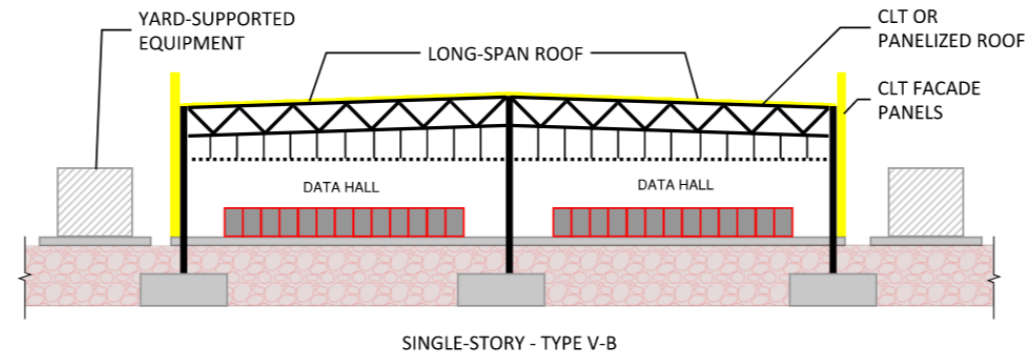
- Low-carbon concrete foundations and topping slabs.
- Efficient structural grids and reduced material quantities.
- Lower-carbon envelope systems.
- Biogenic or recycled-content insulation.
- Low-impact site materials and paving.
- Operational strategies for cooling, water, heat rejection, and energy procurement.



# GENERAL COMMENTARY

What can we extract from this project into the wider industry?

- For many industrial buildings, core & shell is smaller portion of initial costs but is the most enduring portion.
- Similar application for Industrial, logistics, warehousing, manufacturing, & heavy loading as data centers.
- Allows for Modularity & rapid development.
- Has potential for Multi-story designs.



THANK YOU

*This concludes The American Institute of Architects Continuing Education  
Systems Course.*

**Gensler** × **Thornton Tomasetti**