



Transforming Construction

OSC in High-Rise Residential

20 February 2025

BDP. Quadrangle

Built Original

Agenda

- ***Who is BDP.Q?***
- ***Why OSC?***
- ***Case Studies***
- ***Next Steps***



Who is BDP Quadrangle?

Our studios.

19
Studios

12
Countries

6
Regions



N America New York Toronto	S America Lima	UK Birmingham Bristol Cardiff Edinburgh Glasgow	Europe Dublin Rotterdam	MENA Abu Dhabi	Asia Pacific New Delhi Shanghai Singapore
		Leeds Liverpool London Manchester Sheffield			

Across truly varied sectors.







Gap House, UK.



80 Atlantic Avenue, Canada.

Workplace.



Everton F.C. Stadium, UK.

Sport and Entertainment.



AstraZeneca Global R&D Headquarters, UK.

Science and Technology.



BOXPARK, UK.

Retail.



Alderhey Children's Hospital, UK.

Healthcare.



Various Multi-unit Residential Projects, Canada.

Housing.

Why *Off-Site Construction?*

Key trends.



***Affordability
Crisis***



***Housing
Crisis***



***Climate
Crisis***



***Productivity
Issues***



***Technology
Revolution***



***Supply Chain
Volatility***



***Circular
Economy***

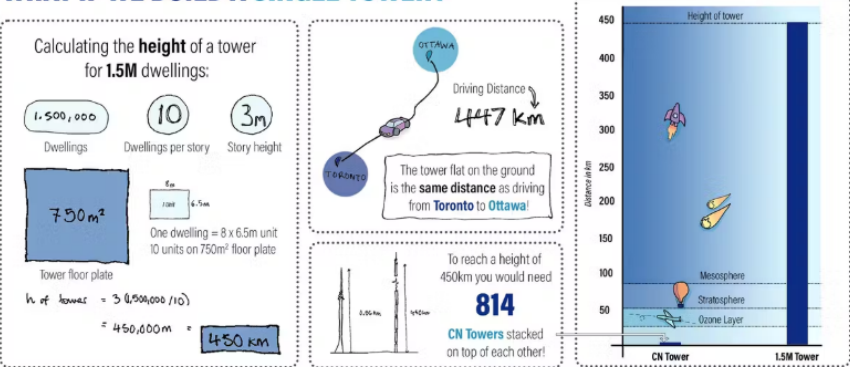


***Assembly and
Disassembly***

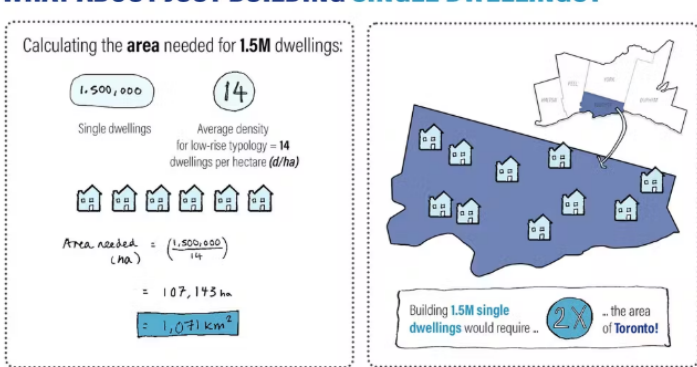
Collaborating Across Studios

WHAT DOES 1.5M HOMES LOOK LIKE?

WHAT IF WE BUILD A SINGLE TOWER?

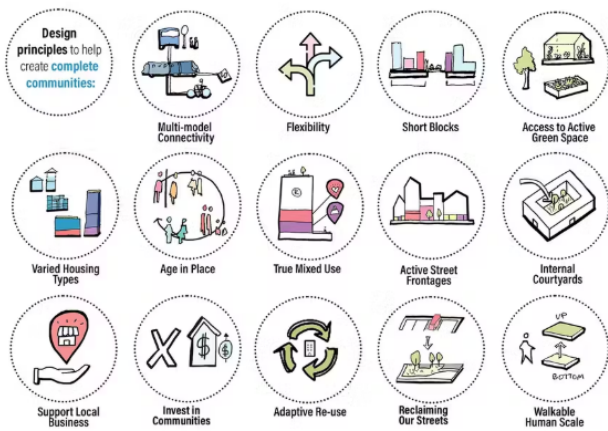
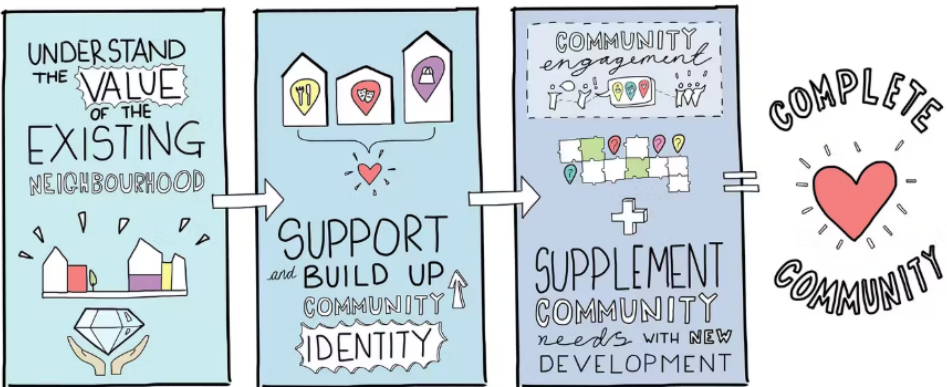


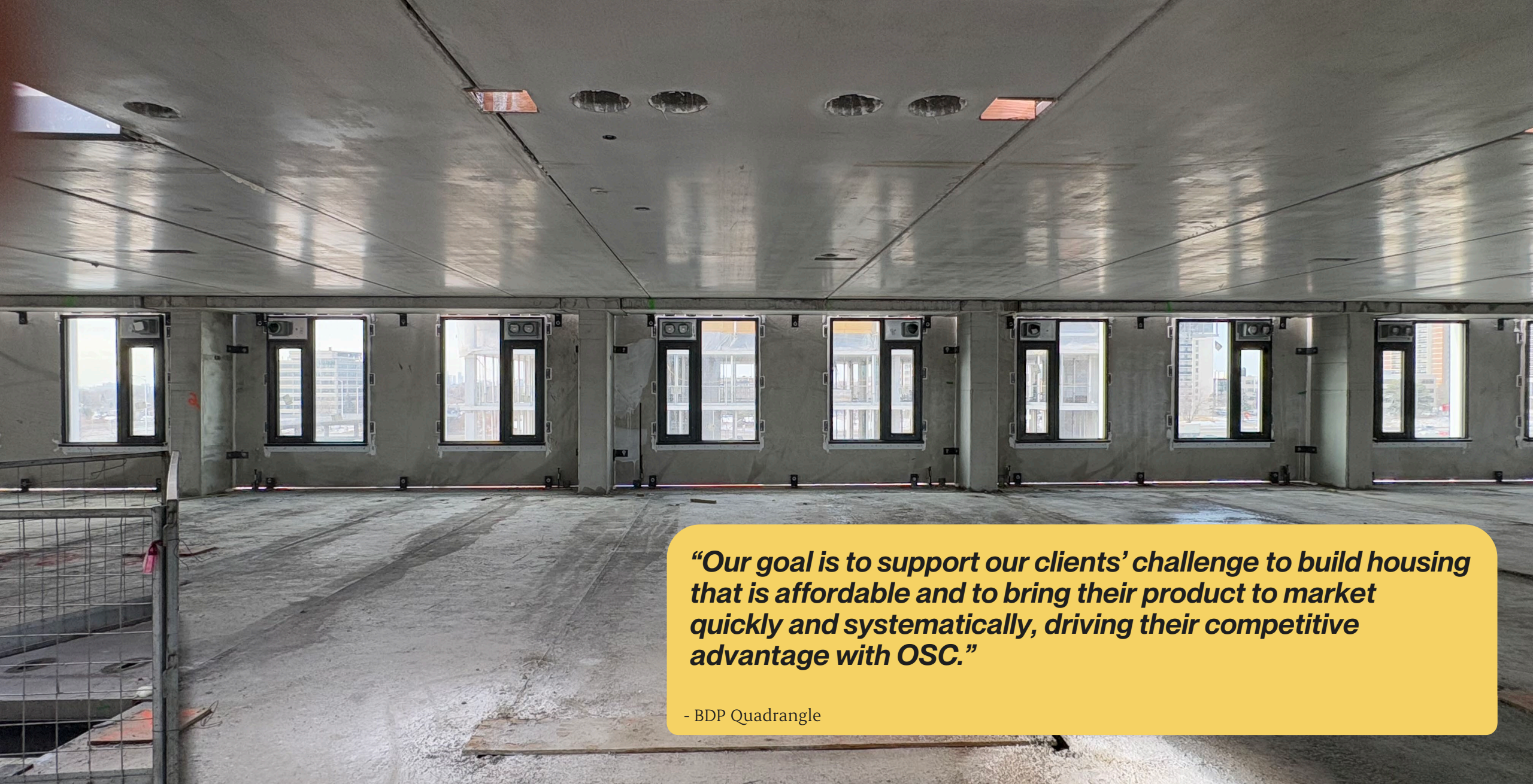
WHAT ABOUT JUST BUILDING SINGLE DWELLINGS?



WHAT IF WE TOLD YOU THERE WAS A BETTER SOLUTION?

IT'S NOT JUST ABOUT **QUANTITY** IT'S ABOUT **QUALITY OF LIFE!** ...





“Our goal is to support our clients’ challenge to build housing that is affordable and to bring their product to market quickly and systematically, driving their competitive advantage with OSC.”

- BDP Quadrangle

Collaborating Across Studios

BDP.

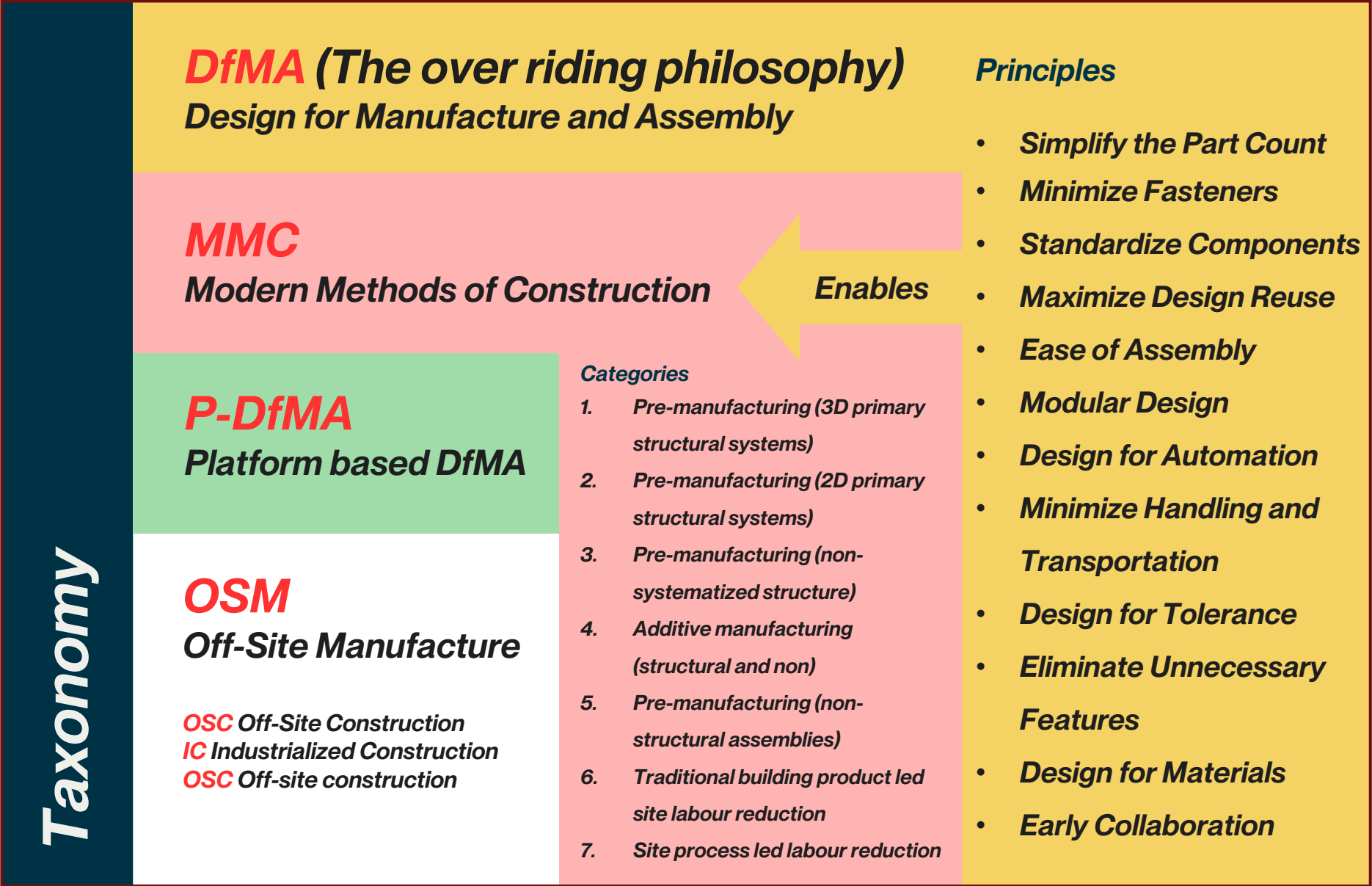


DfMA
Design for Manufacture and Assembly

Neil Hayward

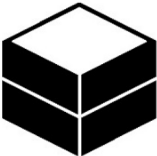

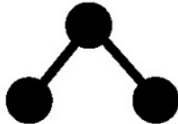


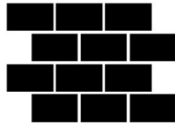

For internal use only – not for external distribution

Acronyms, acronyms, acronyms....



Adapted from Ron Lang of Construction Innovation Hub Offsite Alliance

MMC Categories

<div>1</div> <div></div> <div><p>Pre-manufacturing</p><p>3D Primary Structural Systems</p></div>	<div>2</div> <div></div> <div><p>Pre-manufacturing</p><p>2D Primary Structural Systems</p></div>	<div>3</div> <div></div> <div><p>Pre-manufacturing Components</p><p>Non-systematized Structural Systems</p></div>	<div>4</div> <div></div> <div><p>Additive manufacturing</p><p>Structural and Non- Structural</p></div>	<div>5</div> <div></div> <div><p>Pre-manufacturing</p><p>Non-structural Assemblies</p></div>	<div>6</div> <div></div> <div><p>Traditional Building Product Led</p><p>Site Labour Reduction/ Production Improvement</p></div>	<div>7</div> <div></div> <div><p>Site Process Led</p><p>Site Labour Reduction/ Production Improvement</p></div>
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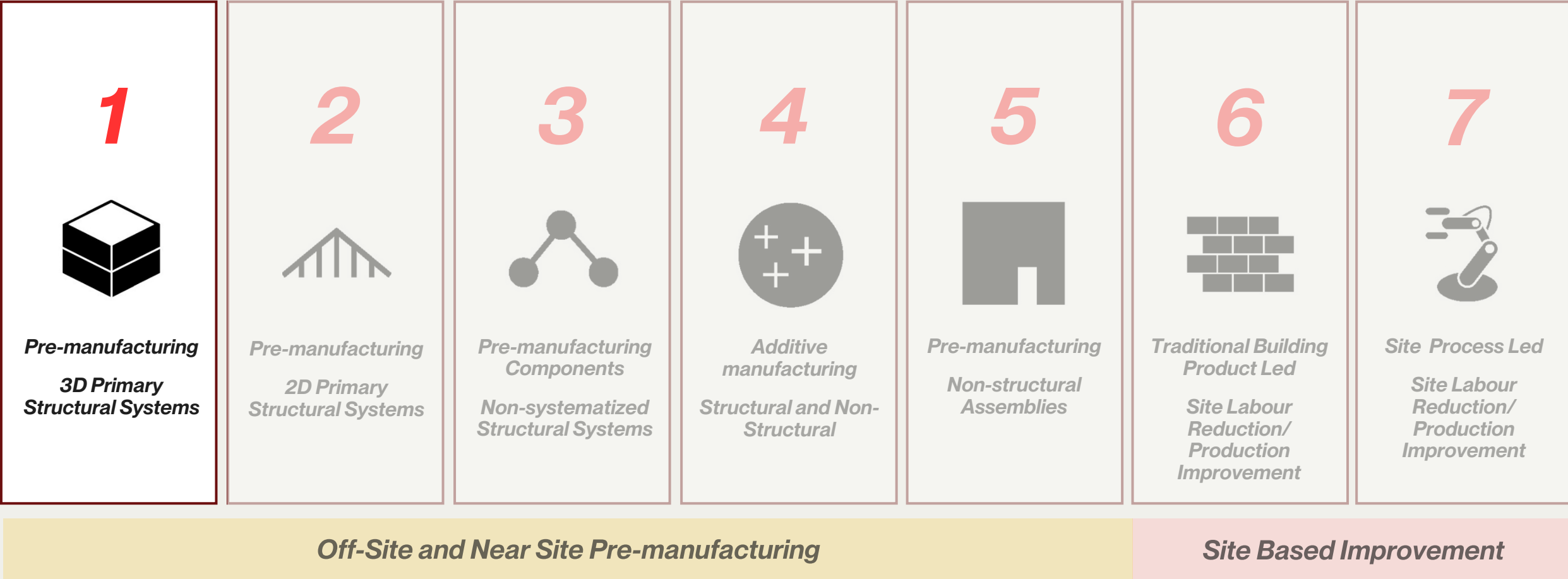
<p>Off-Site and Near-Site Pre-manufacturing</p>	<p>Site Based Improvement</p>
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Adapted from the UK Ministry of Housing, Community and Local Government, MMC Definition Framework

Precedents

What is being built?

MMC Categories





Boxpark

Croydon, UK

Completed

MMC Category Pre-manufactured 3D Primary Structural System

1

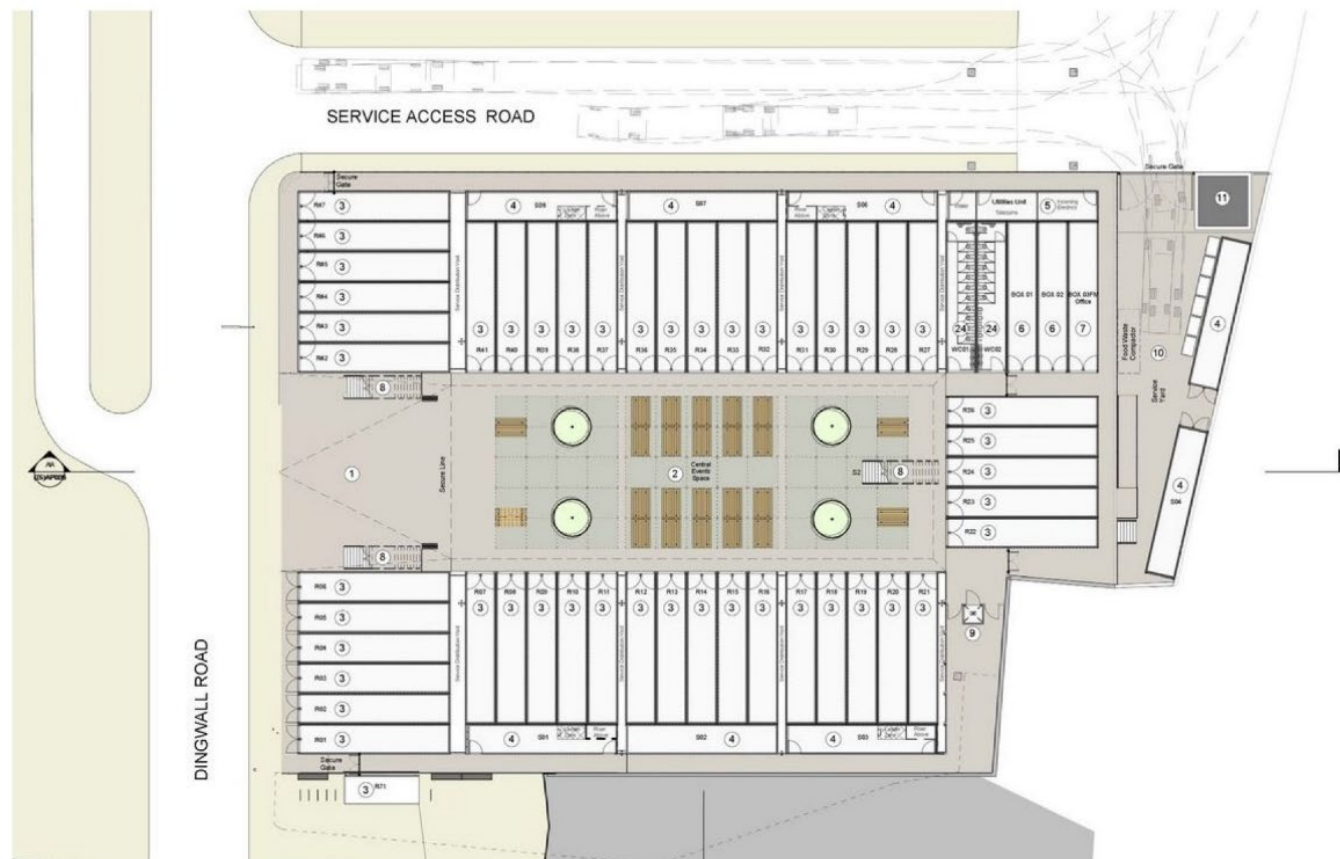
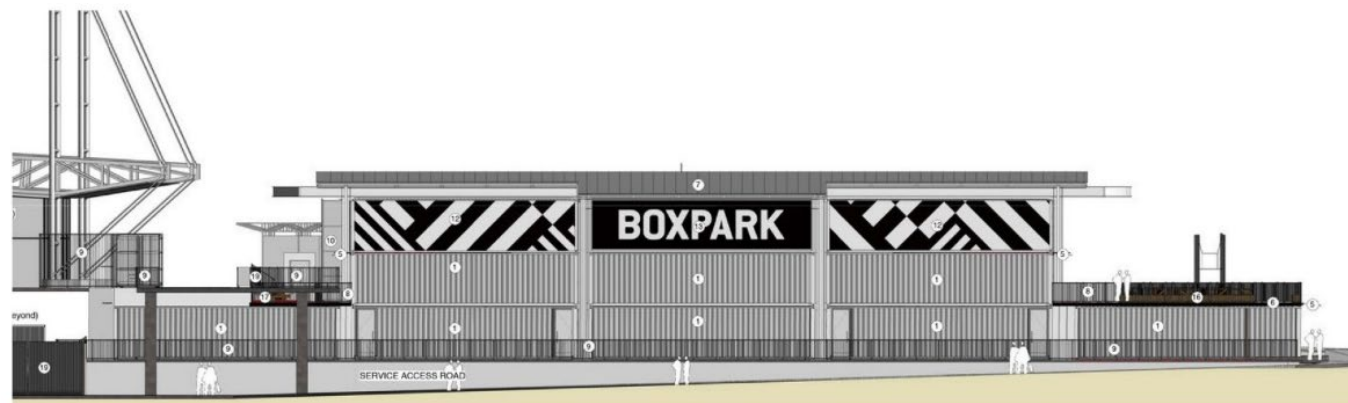
Product:
TEU Shipping Container

Client:
Boxpark

Contractor:
Randall Contracting

Manufacturer:

-



Other Examples

461 Dean Street

Brooklyn, NY
SHoP Architects

DfMA Manufacturer:



Developer:



General Contractor:

SKANSKA



Alt Hotel

Calgary, AB
Lemay Michaud Architecture

DfMA Manufacturer:



Other Examples

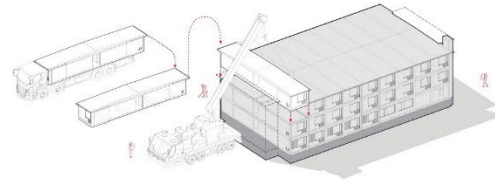
321 Dovercourt Road

Toronto, ON
Montgomery Sisam

DfMA Manufacturer:



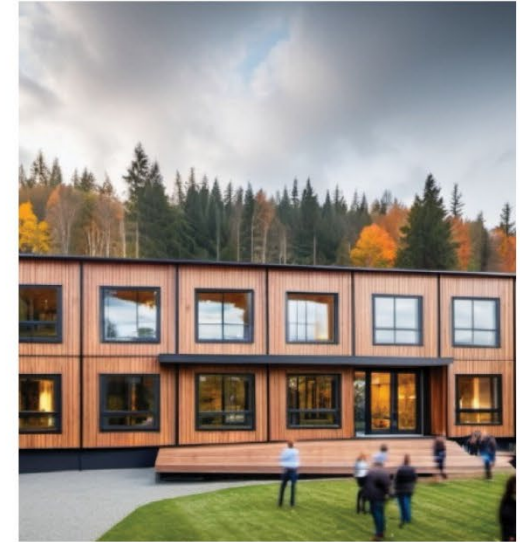
Developer:



Local Manufacturers

Fero International Inc.

Greater Toronto Area



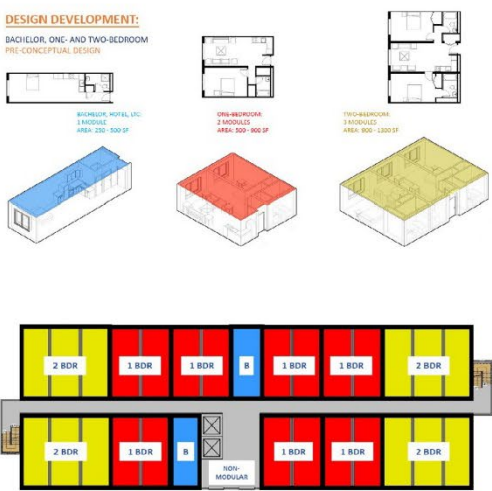
Other Examples

Stack Modular
Greater Toronto Area



Local Manufacturers

BECC Modular Homes
Ancaster, ON



Other Examples

College Road

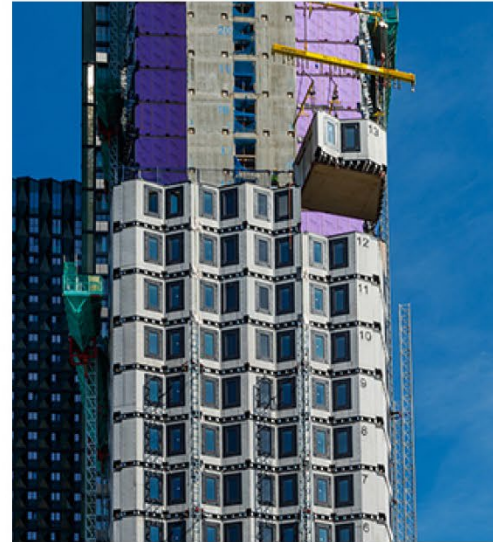
Croydon London. UK

HTA Design

DfMA Manufacturer:



Developer:



50 storey, 817 units
plus 35 storey 120 affordable units
Tallest volumetric in Europe
73% of the floorplate built in 32% of the
schedule, 28 month schedule

Other Examples

Ten Degrees

Croydon London. UK
HTA Design

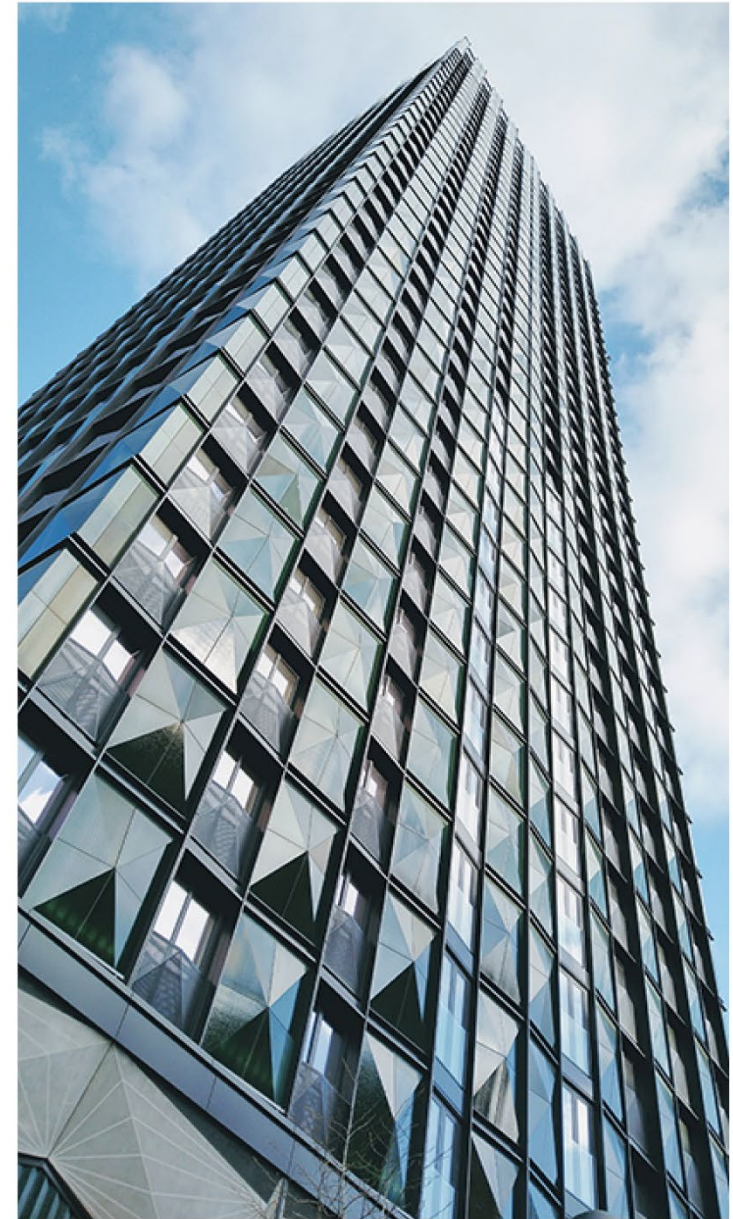
DfMA Manufacturer:



Developer:



Rental Operators:



Other Examples

Mapleton Crescent

Wandsworth London, UK
Metropolitan Workshop

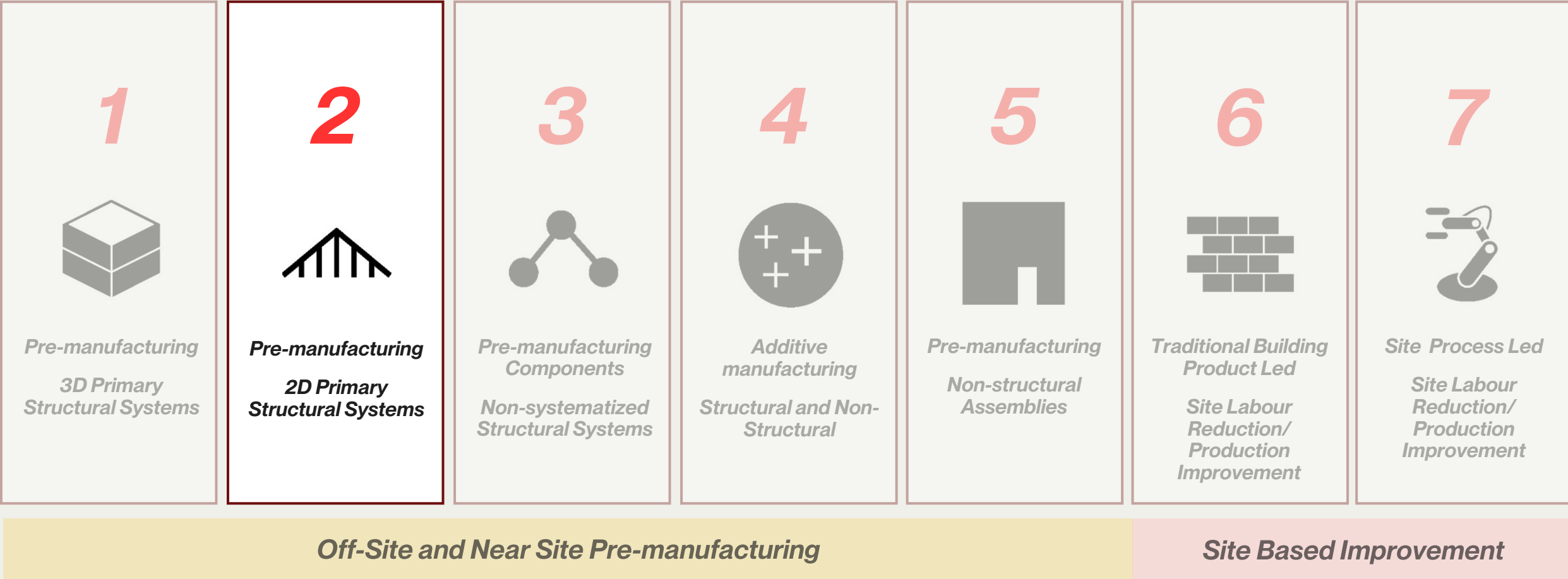
DfMA Manufacturer:



Developer:



MMC Categories





MV1

19027 | Milton, ON

In Construction (90%)

MMC Category Pre-manufactured
2D Primary Structural System

2

Product:
**Pre-fabricated Structural Wall,
Floor, Core Components,
Balconies and Demising Walls**

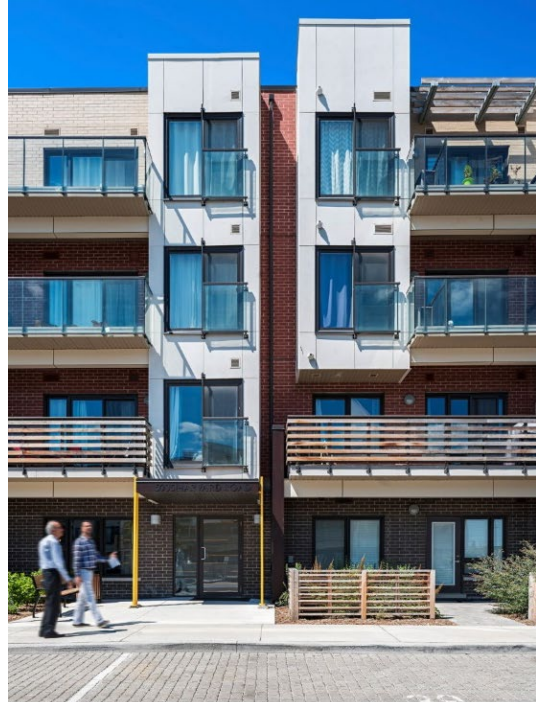
H+ME
TECHNOLOGY









Client:
Great Gulf

Contractor:
Great Gulf

Manufacturer:
Home Technology





- 1  Concrete Underground Garage Structure
- 2  Concrete Slab
- 3  Prefabricated Structural Wall Components
- Corridor and exterior wall
- 4  Prefabricated Structural Floor Components
- 5  Elevator Core Components
- Utilizing cross laminated timber
- 6  Non-Structural Demising Walls
- For maximum unit size flexibility
- 7  Bay Windows
- To create unique Architectural expression
- 8  Prefabricated Balcony Components
- Supported by independent wooden post

Hot Condos

09038 | Mississauga, ON

Completed

MMC Category Pre-manufactured 2D Primary Structural System

2

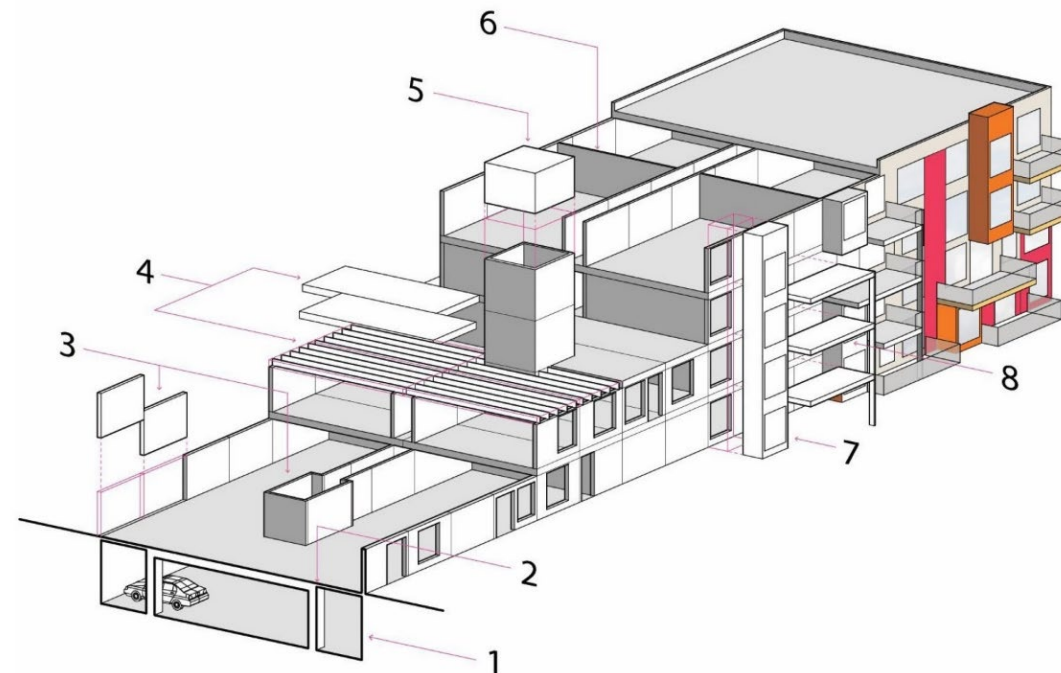
Product:
**Pre-fabricated Structural Wall,
Floor, Core Components,
Balconies and Demising Walls**

H+ME
TECHNOLOGY

Client:
Great Gulf

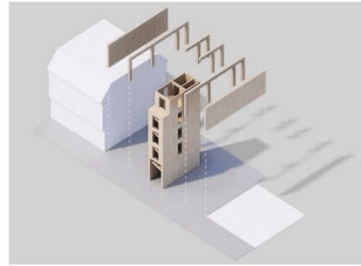
Contractor:
Great Gulf

Manufacturer:
Home Technology



Local Manufacturers

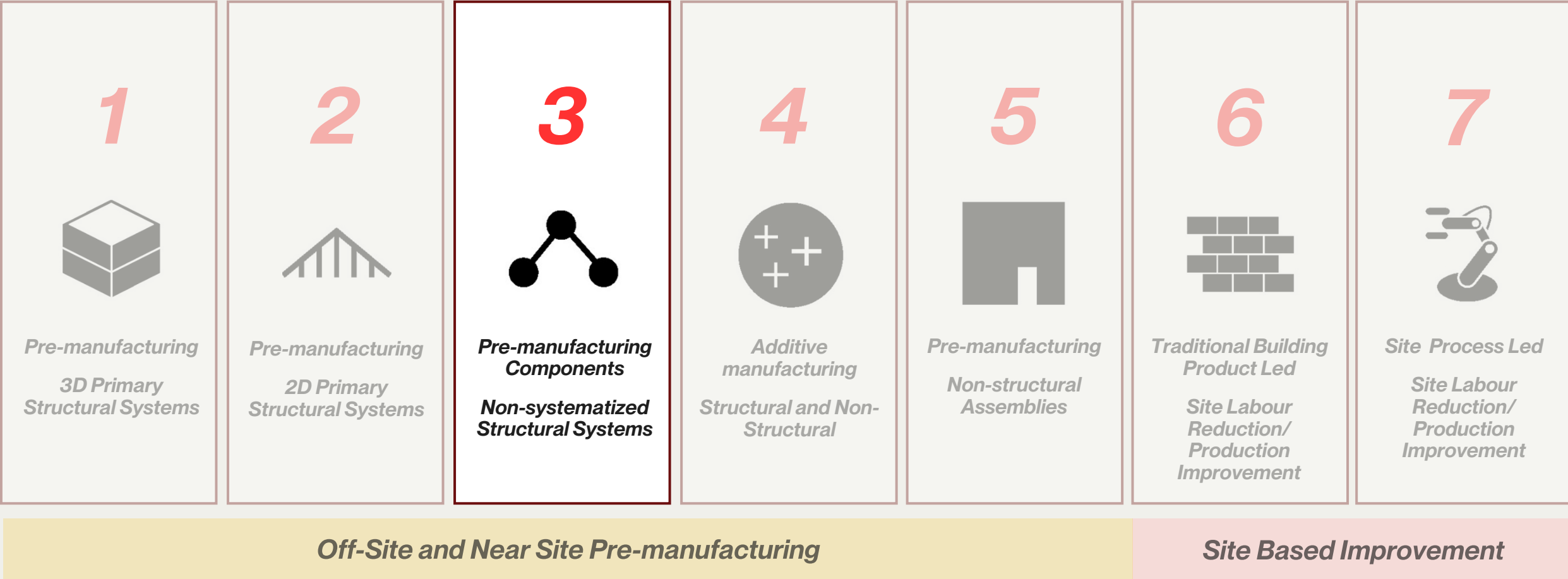
Assembly Corp (formerly R-Hauz)
Greater Toronto Area



Panelized Building Solutions
Greater Toronto Area



MMC Categories





3526 Lake Shore

20032 | Toronto, ON

Design in Progress

MMC
Category

Pre-manufactured Primary
Structure

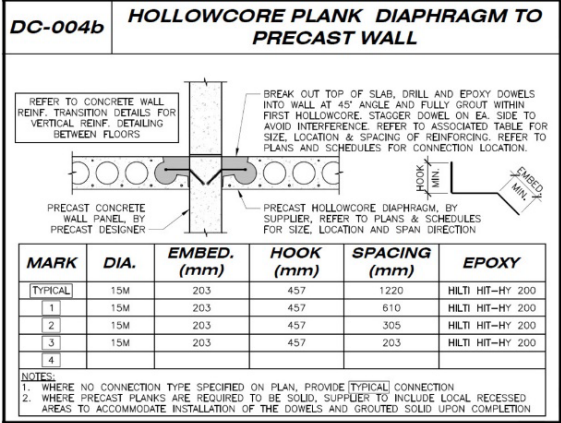
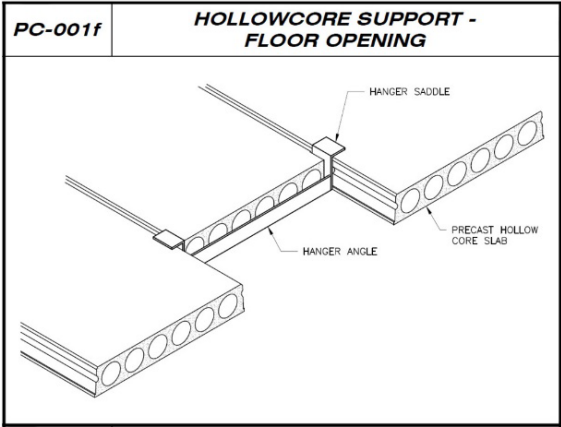
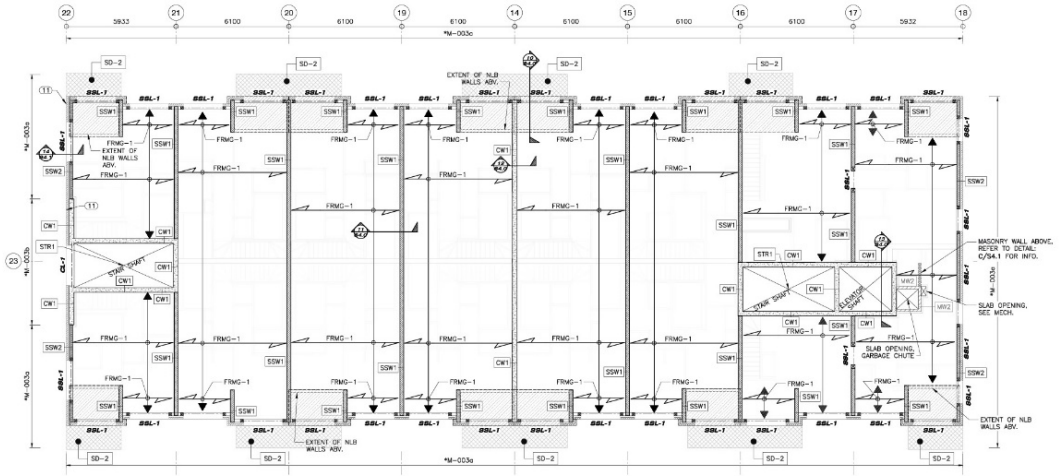
Product:
**200 mm
Hollowcore Slab with
Cold Formed Steel Stud Wall**



Client:
Minto Group

Contractor:
Magest

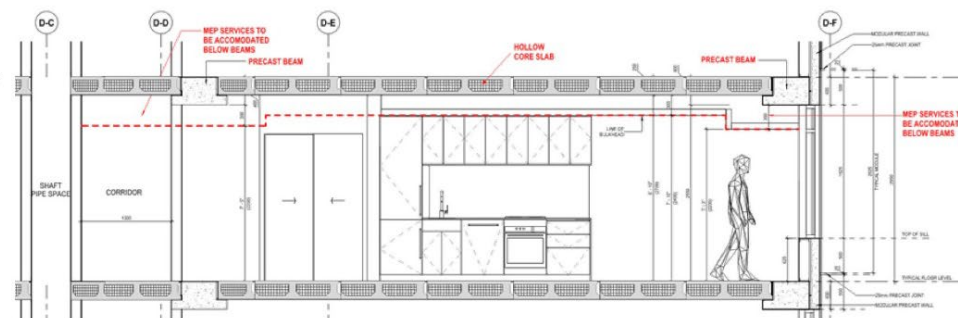
Manufacturer:
Stubbe's Precast Commercial





└ Precast Structure Marked in Red

precast system is 10' in height but the system can go up to 12' without any joints in between



Valhalla Village, Tower D

18008 | Toronto, ON

In Construction (30%)

MMC Category	Pre-manufactured Primary Structure
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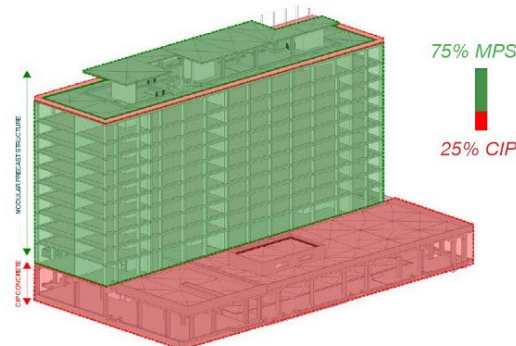
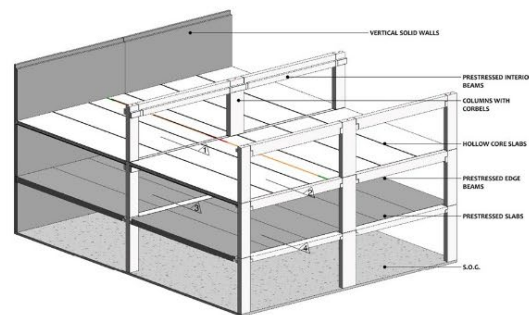
3 Product: Precast Wall Panels for Core, Precast Columns, Precast Hollowcore Floor Slabs



Client:
KingSett Capital

Contractor:
Reliance Construction Group

Manufacturer:
Modular Precast Systems





80 Atlantic

12106 | Toronto, ON

Completed

MMC
Category

Pre-manufactured Primary
Structure

3

Product:
**Glulam columns, Glulam
beams, NLT floor panels**

TIMMERMAN
TIMBERWORKS

x

NORDIC
STRUCTURES

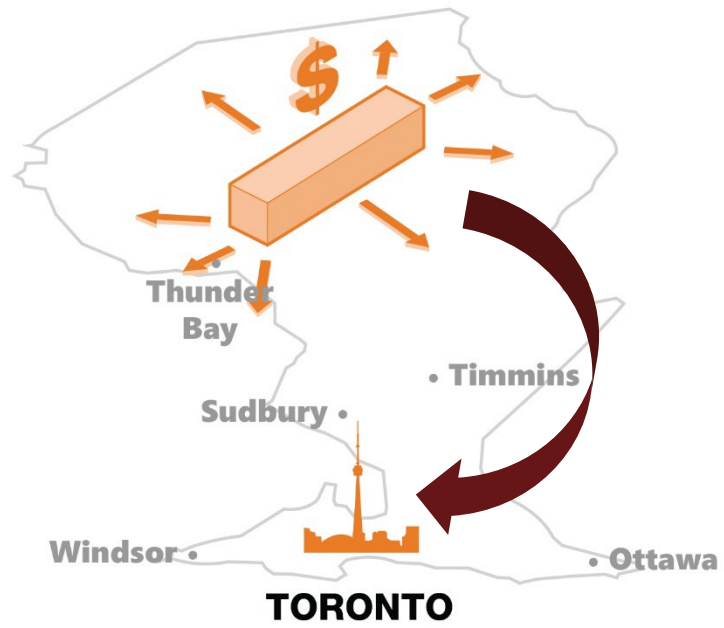
Client:
Hullmark

Mass Timber Installer:
Timmerman Timberworks

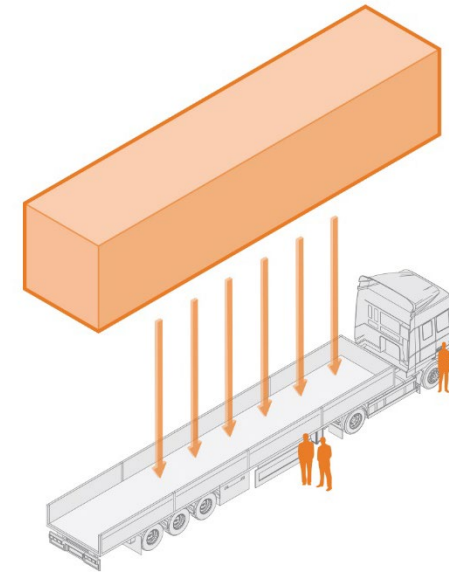
Contractor:
Eastern Construction

Mass Timber Manufacturer:
Nordic Structures





Prefabrication



Just-in-Time Delivery









80 Atlantic



Distillery Ribbon



Bathurst & Richmond



33-39 Davies



77 Wade



George Brown College



T3 Bayside



T3 Sterling Road



TRCA Headquarters



OSSTF Headquarters



Centennial College



Victoria College Learning Centre



CAMH Research Centre



UofT Academic Wood Tower



Residential?



1598-1604 Queen East



1113-1125 Dundas West



60 Bowden



1650 Dupont



215 Wellesley East



1120 Ossington



1240 Weston Road



2217 Kingston Road



Lawson Centre for Sustainability



Humber Cultural Hub Residence



230 Royal York



1925 Victoria Park



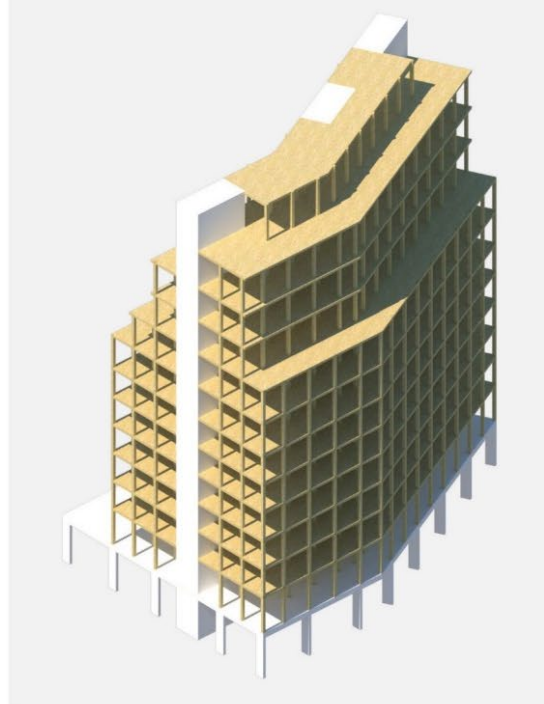
Quayside Timber House



2453-2469 Bloor West



What's Next?



2453 - 2469 Bloor St W

22021 | Toronto, ON

Design in Progress

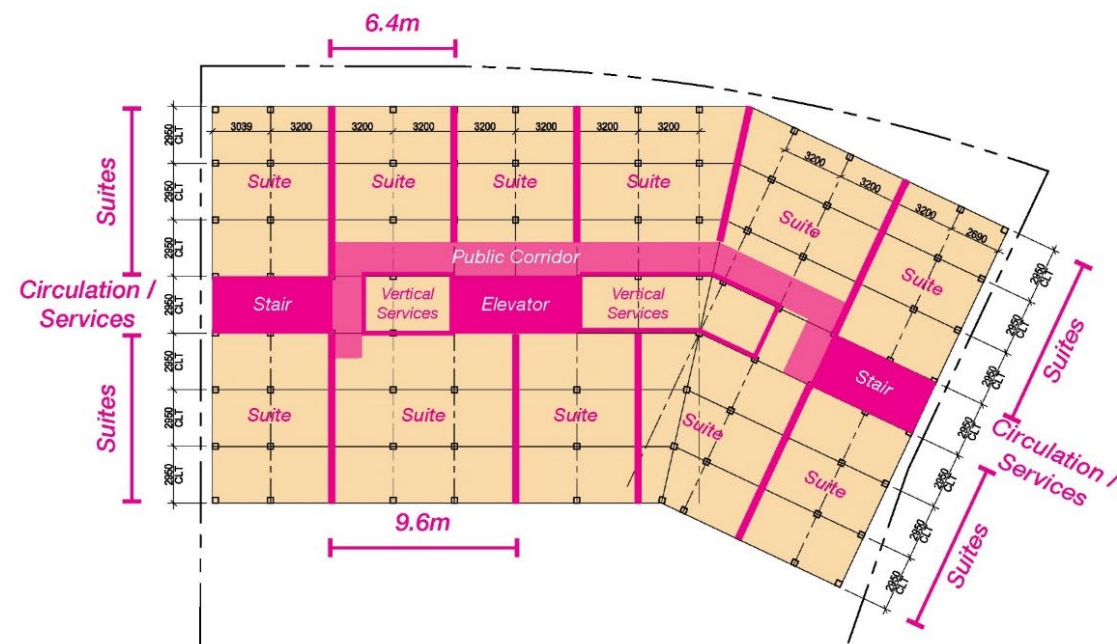
MMC Category	Pre-manufactured Primary Structure
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3 Product:
**Glulam columns, Glulam
beams, NLT floor panels**

Client:
Leader Lane Developments
Windmill Developments

Mass Timber Installer:

Mass Timber Manufacturer:





Understand Available Products

Mass Timber Supply Chain

North American Timber Manufacturers

NOTE:
Manufacturer information changes often. Information provided is current as of March 2024.

Western Archrib

Boissevain, MB (± 2,300km)
Edmonton, AB (± 3,450km)

Kalesnikoff

Castlegar, BC (± 3,700km)

FraserWood Timber

Squamish, BC (± 4,420km)

StructureCraft

Abbotsford, BC (± 4,300km)
Seattle, WA (± 4,150km)

Mercer Mass Timber

Penticton, BC (± 4,050km)
Spokane Valley, WA (± 3,700km)

Freres Engineered Wood

Lyon, OR (± 4,200km)

Vaagen Timbers

Colville, WA (± 3,800km)

SmartLam

Columbia Falls, MT (± 3,400km)

Variables between timber suppliers:

- Products Offered (NLT/CLT/GLT/DLT, etc.)
- Product Maximum / Minimum Dimensions
- Production Capacity (Volume & Production Queue)

Location-based Considerations:

- Transportation Logistics and Maximum member sizes
- Transportation-related Embodied Carbon

And European Suppliers Too...

Nordic Structures

Chibougamau, QC (± 1,235km)

Art Massif

Saint-Jean-Port-Joli, QC (± 895km)

Sterling Structural

Phoenix, IL (± 800km)

Element 5

St. Thomas, ON (± 196km)

SmartLam

Dothan, AL (± 1,235km)

Binderholz

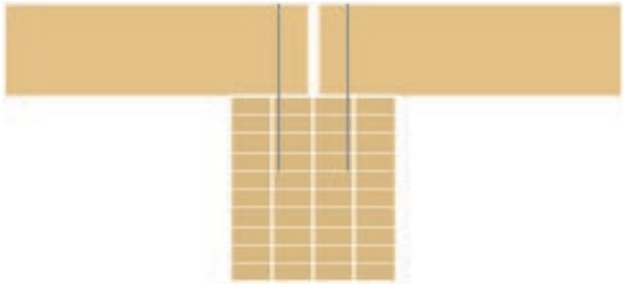
Enfield, NC (± 1,100km)
Live Oak, FL (± 1,975km)

Mercer Mass Timber

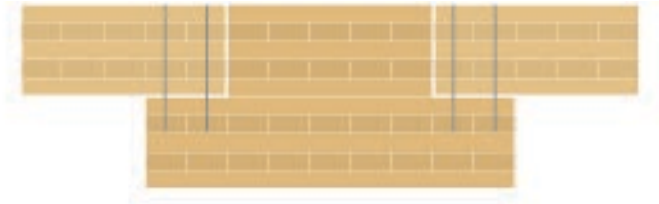
Conway, AR (± 1,800km)

• Toronto, ON

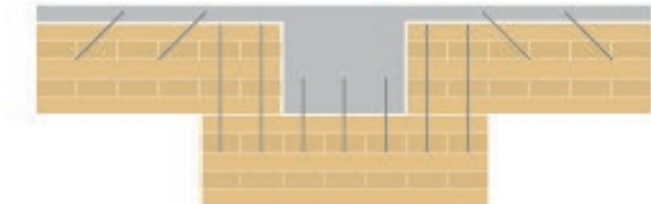
Mass Timber Systems



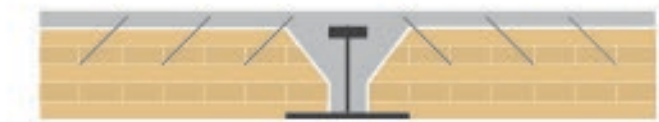
Post & Beam



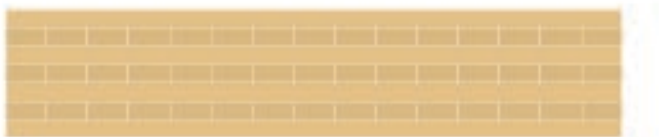
Timber Slab Bands



Timber-Concrete Composite (TCC)

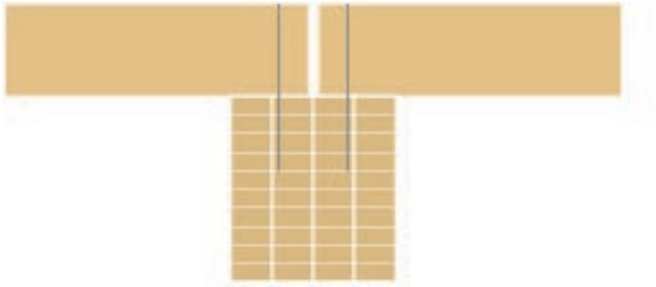


*Asymmetrical Flanged Beam
Or DELTABEAM®*

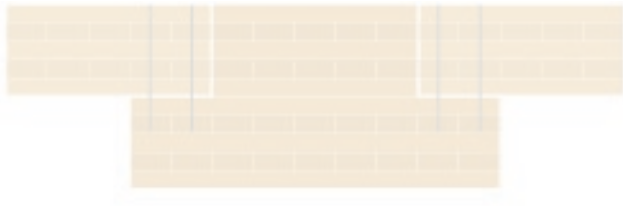


Flat Plate CLT

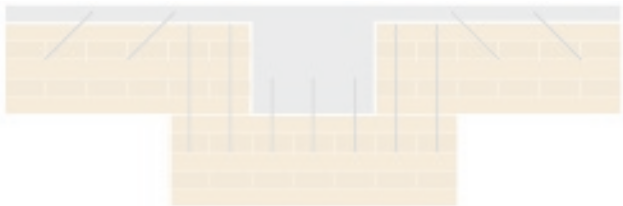
Mass Timber Systems



Post & Beam



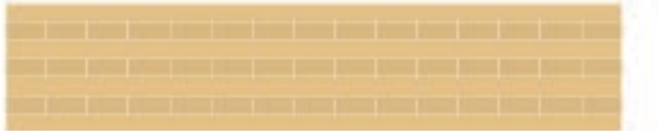
Timber Slab Bands



Timber-Concrete Composite (TCC)



*Asymmetrical Flanged Beam
Or DELTABEAM[®]*

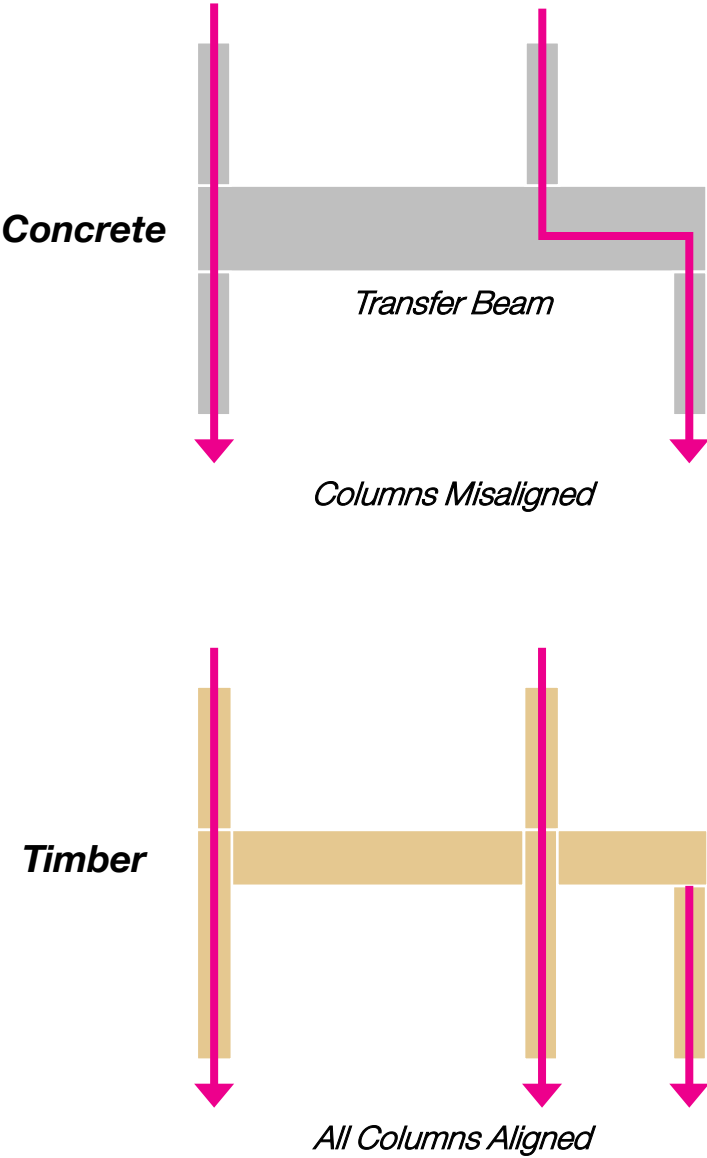


Flat Plate CLT

Mass Timber Systems – *Post and Beam*



Carbon 12, Kaiser + Path, Portland, OR



Mass Timber Systems – *Post and Beam*



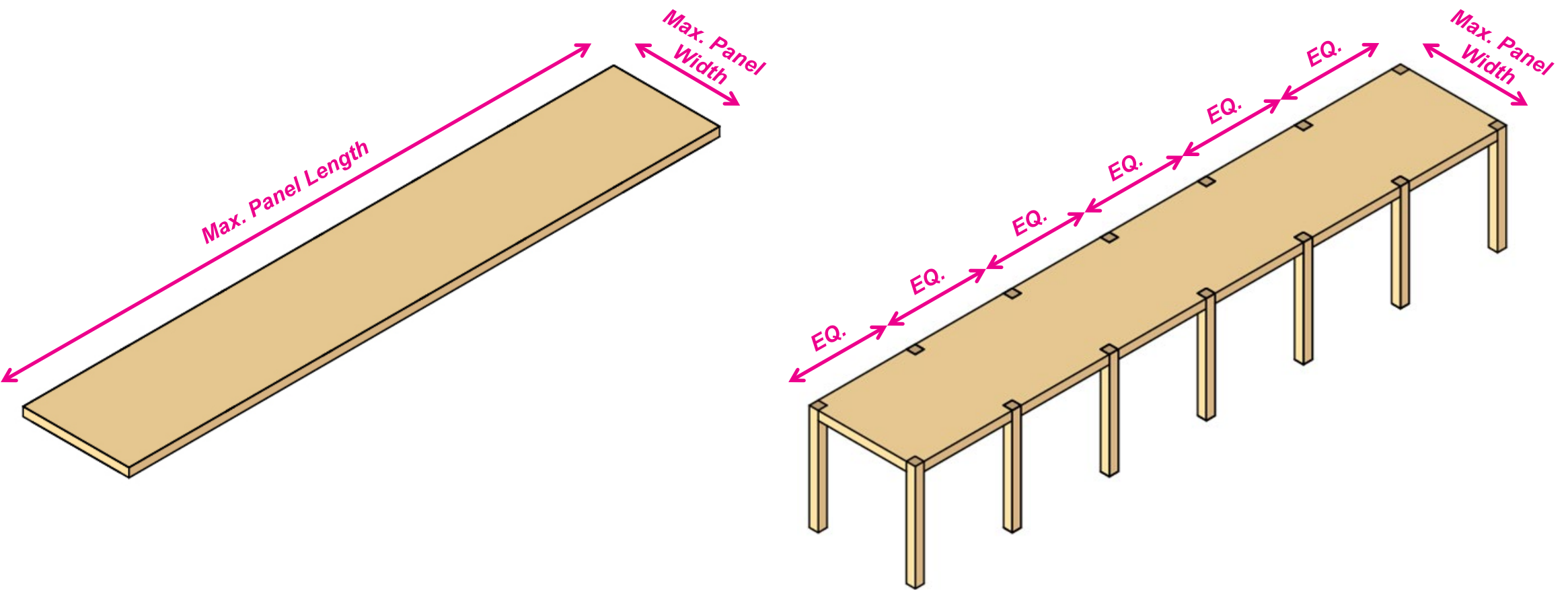
The Ascent,
Korb + Associates,
Milwaukee, WI

Mass Timber Systems – *Flat Plate CLT*



*Brock Commons,
Acton Ostry Architects,
Vancouver, BC*

Mass Timber Systems – *Flat Plate CLT*

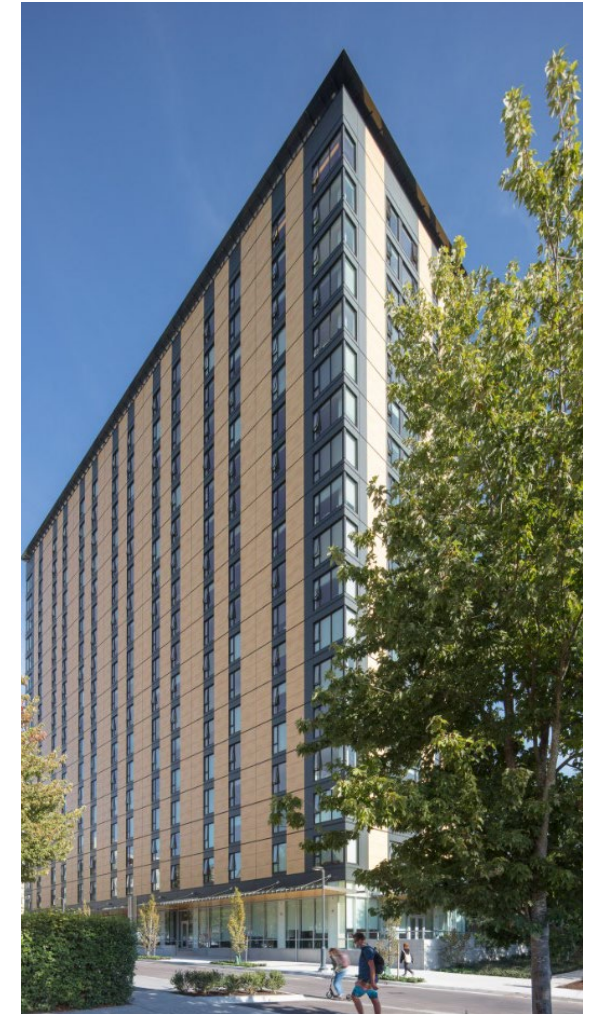


Mass Timber Systems – *Flat Plate CLT*



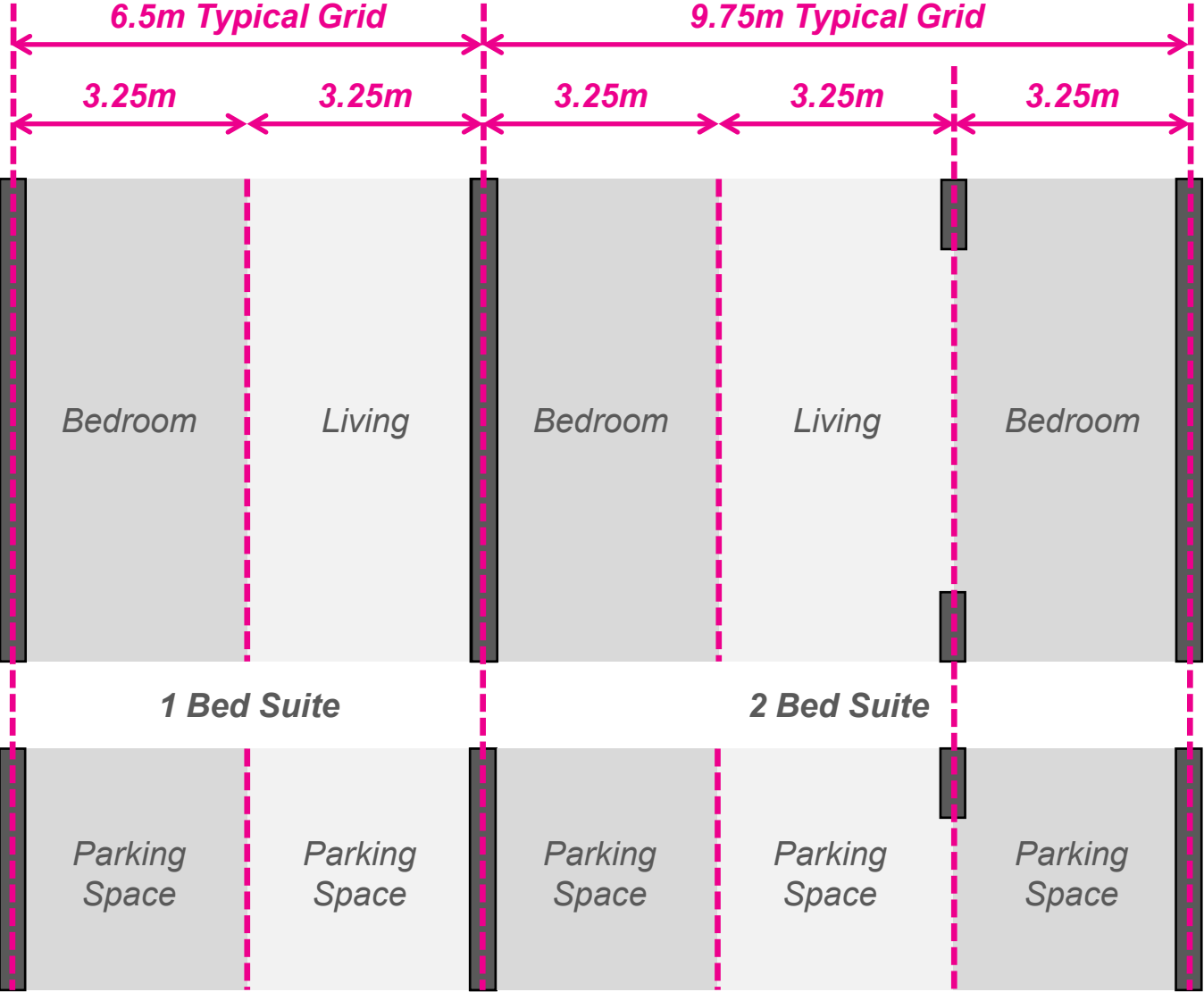
*Brock Commons,
Acton Ostry Architects,
Vancouver, BC*

Mass Timber Systems – *Flat Plate CLT*

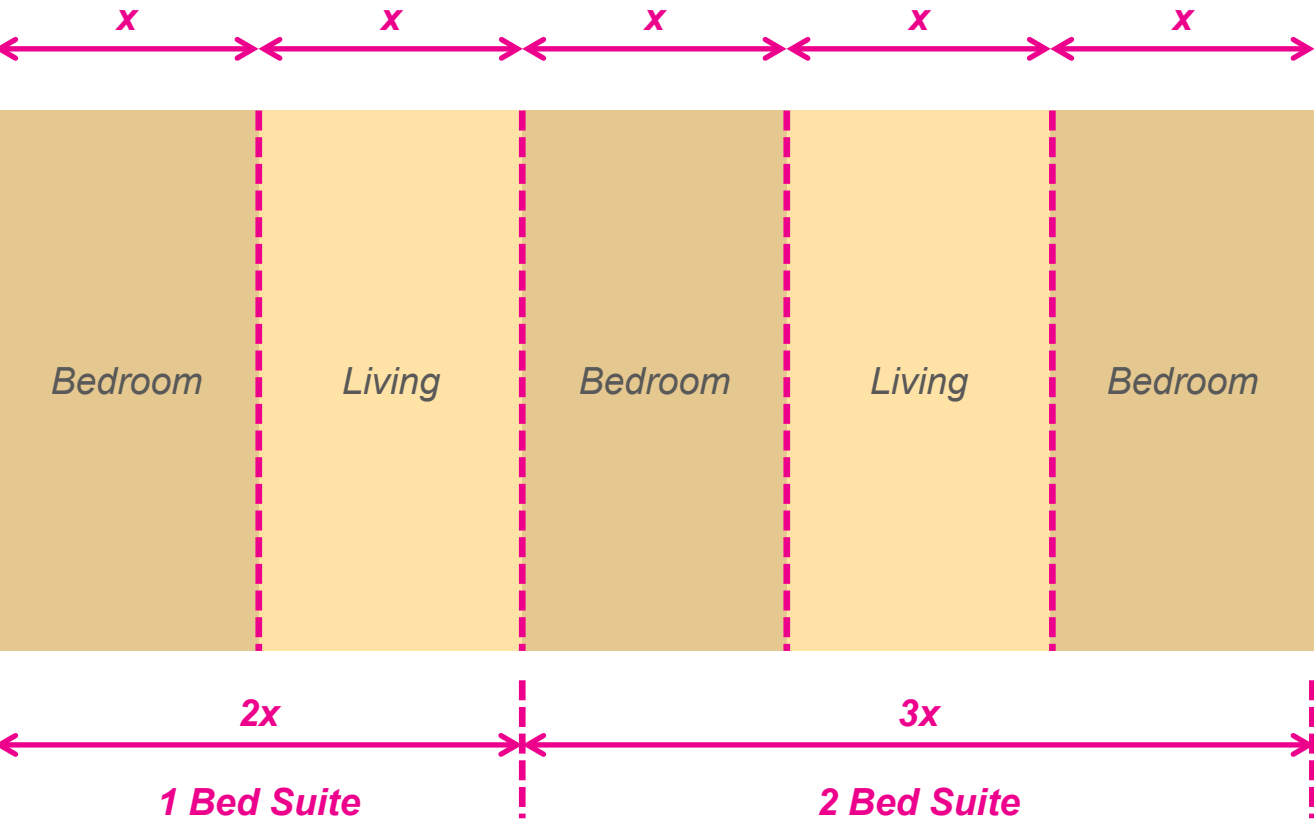


*Brock Commons,
Acton Ostry Architects,
Vancouver, BC*

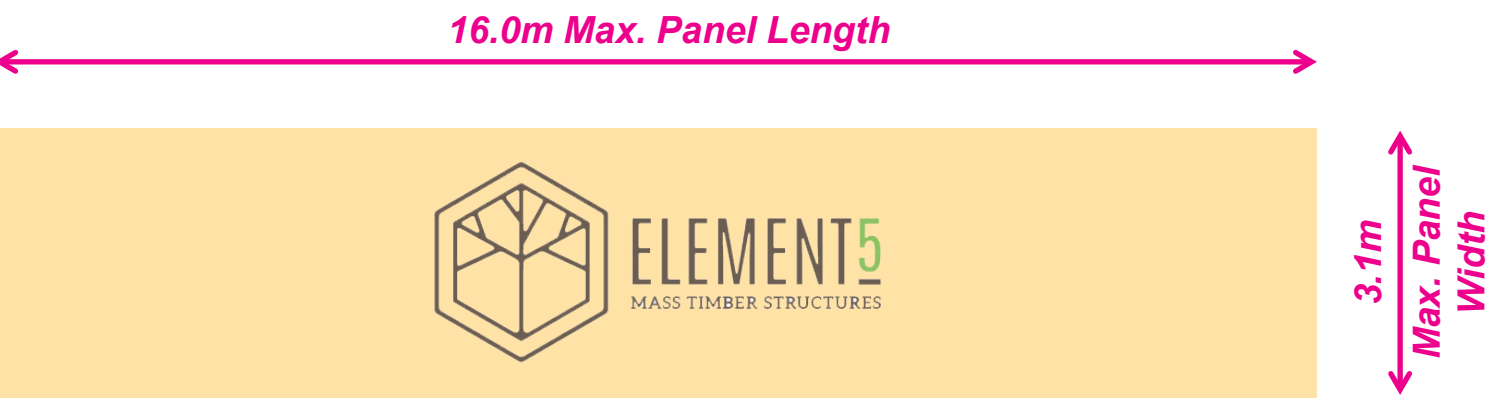
The Typical Suite Module



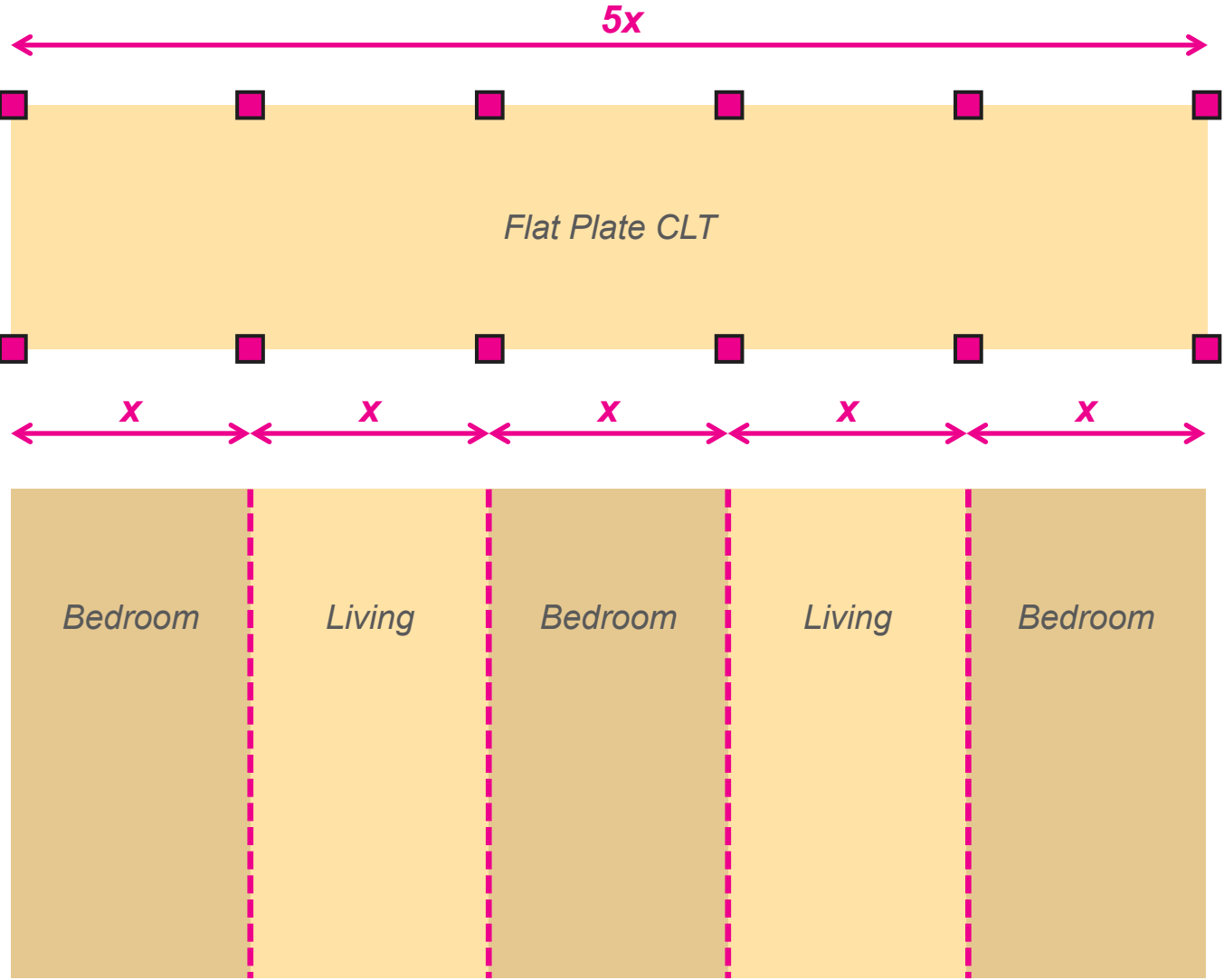
Defining a Suite Module



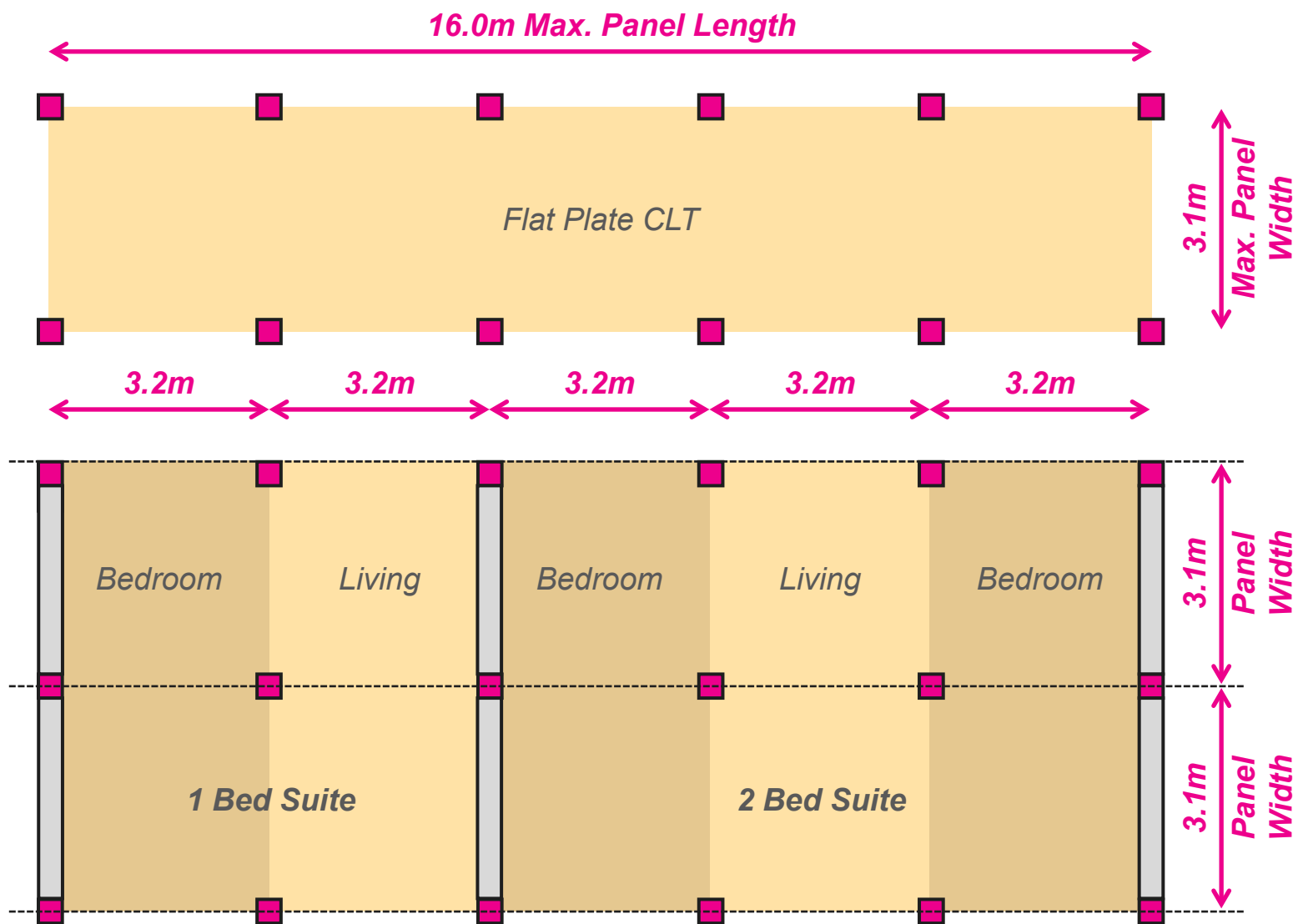
Defining a Suite Module



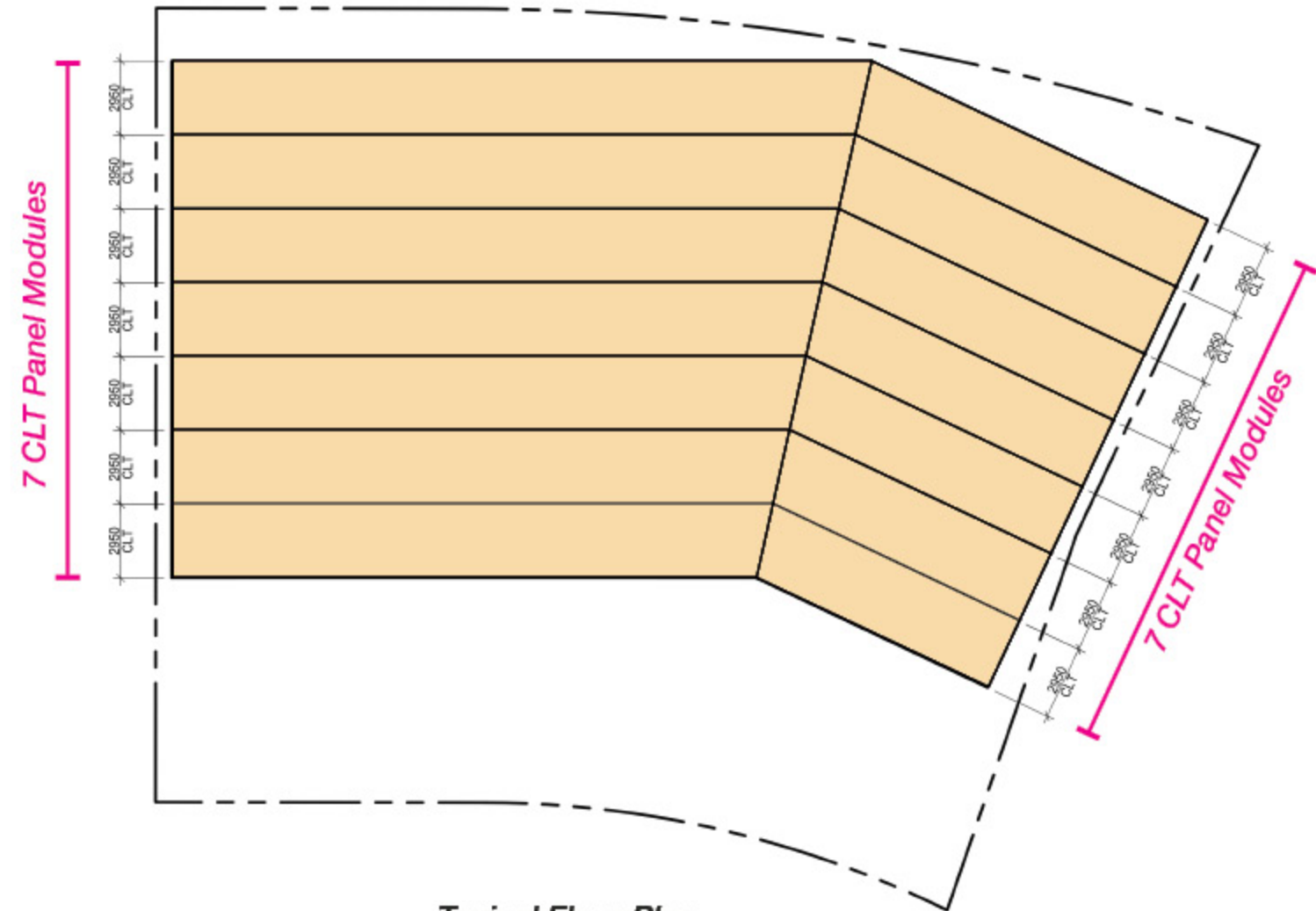
Defining a Suite Module



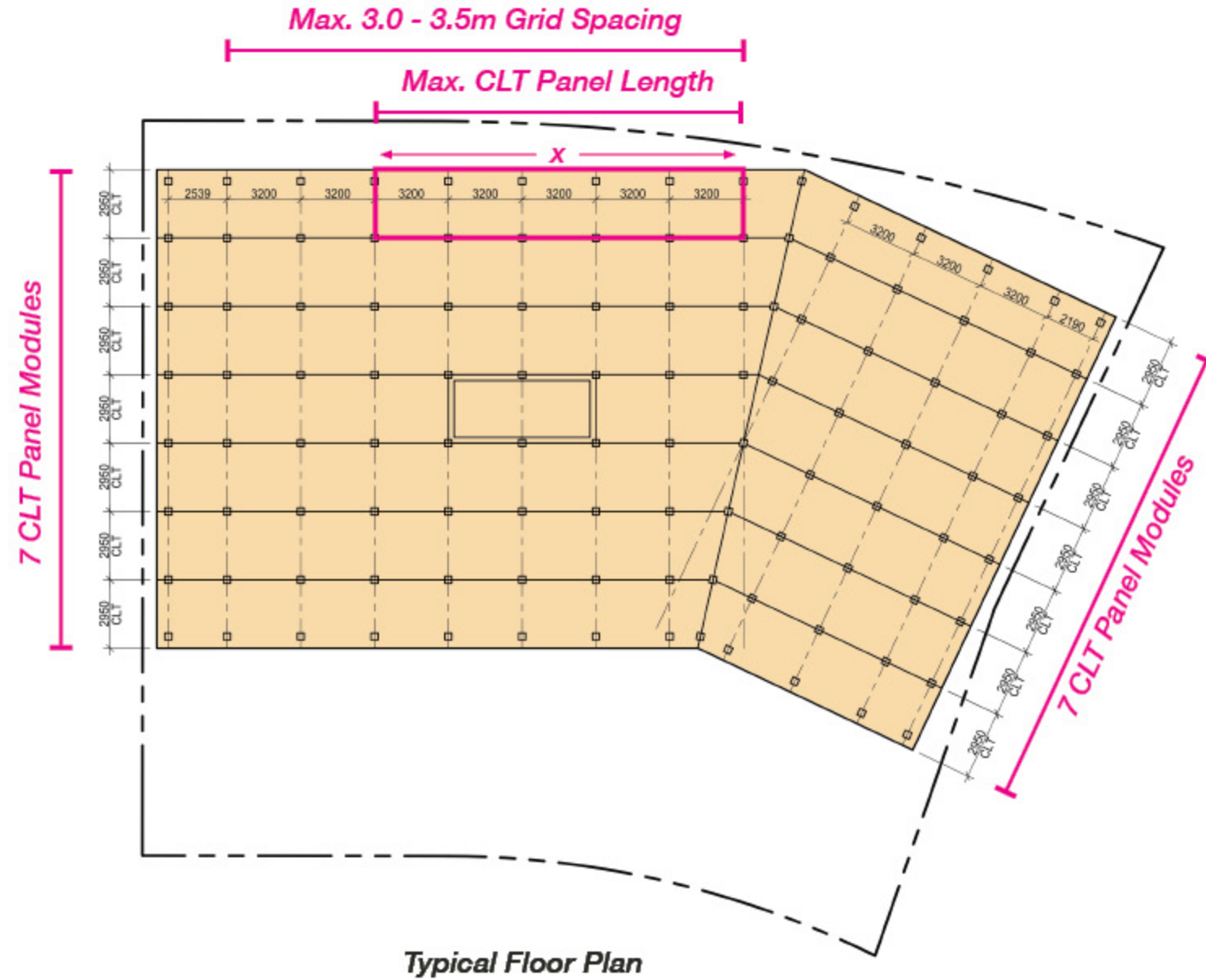
Defining a Suite Module



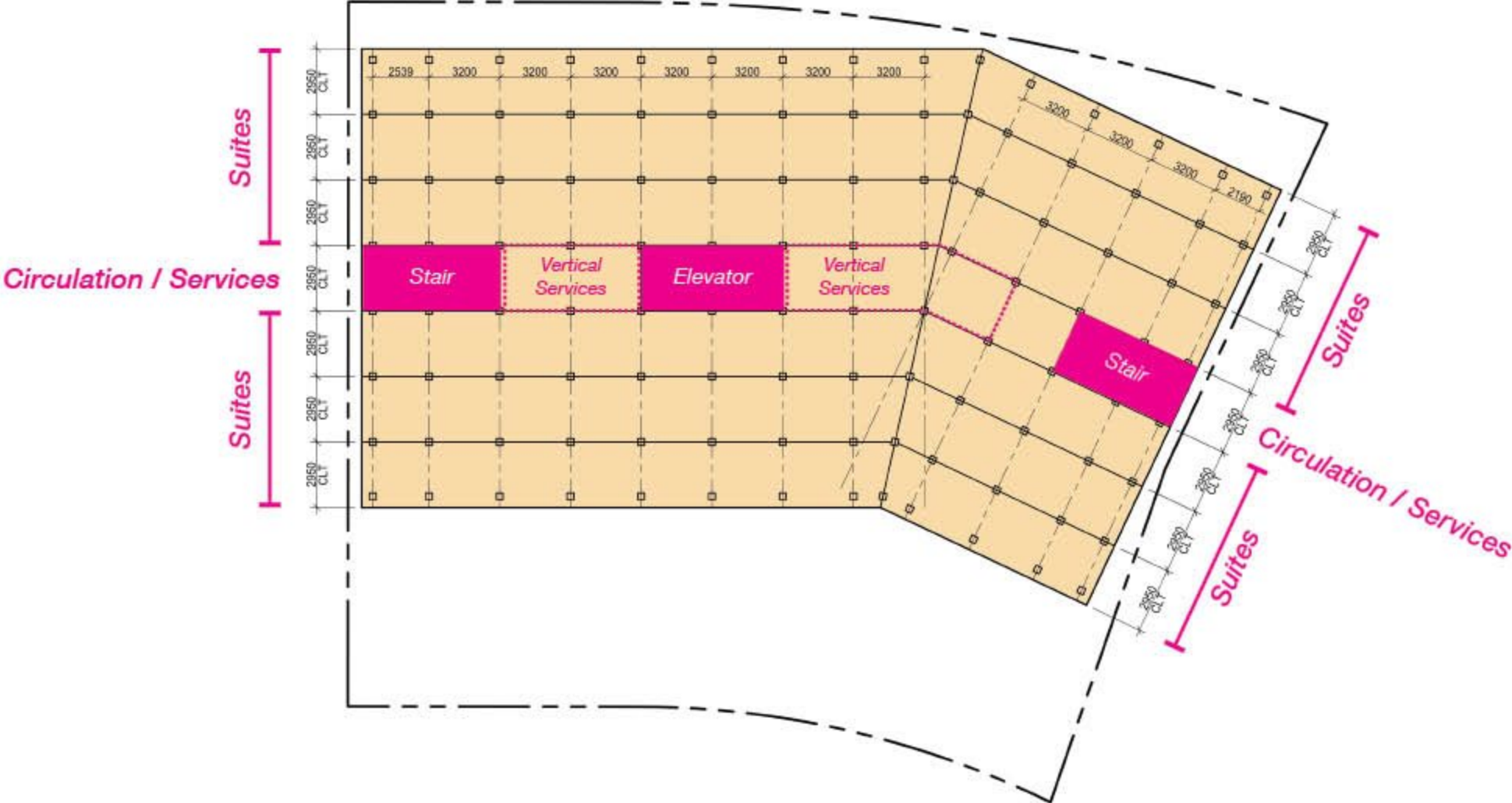
Flat Plate CLT



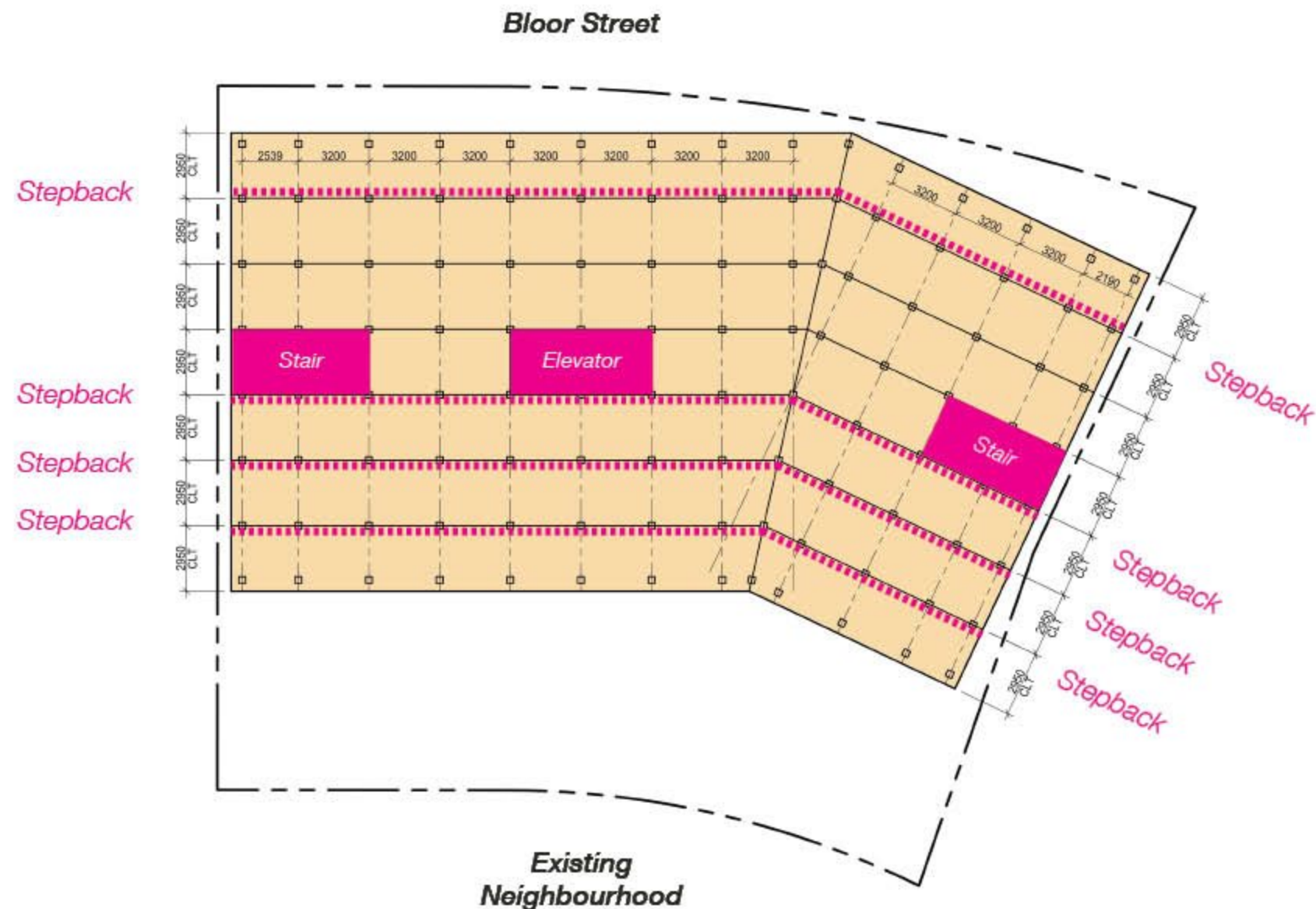
Flat Plate CLT



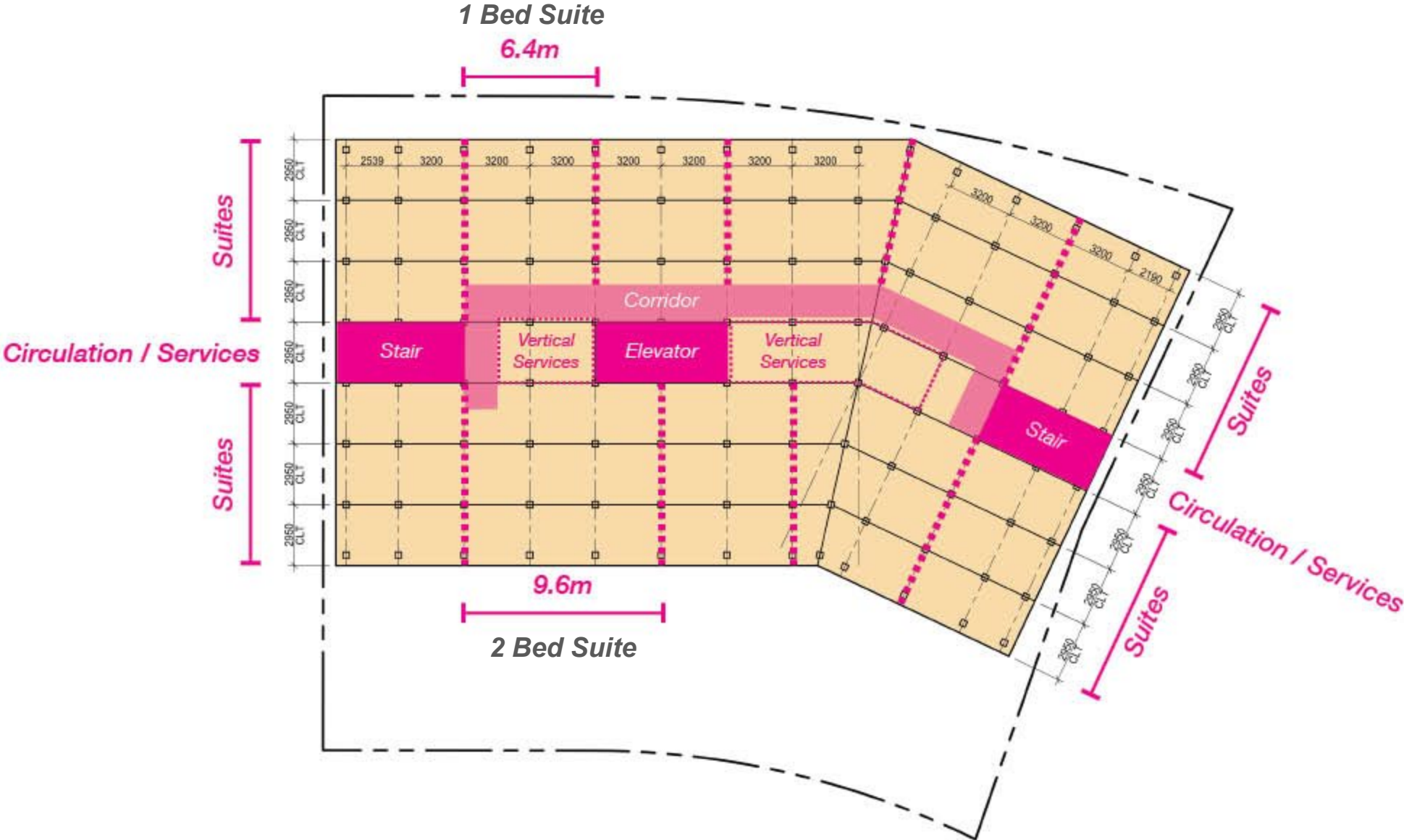
Flat Plate CLT



Flat Plate CLT



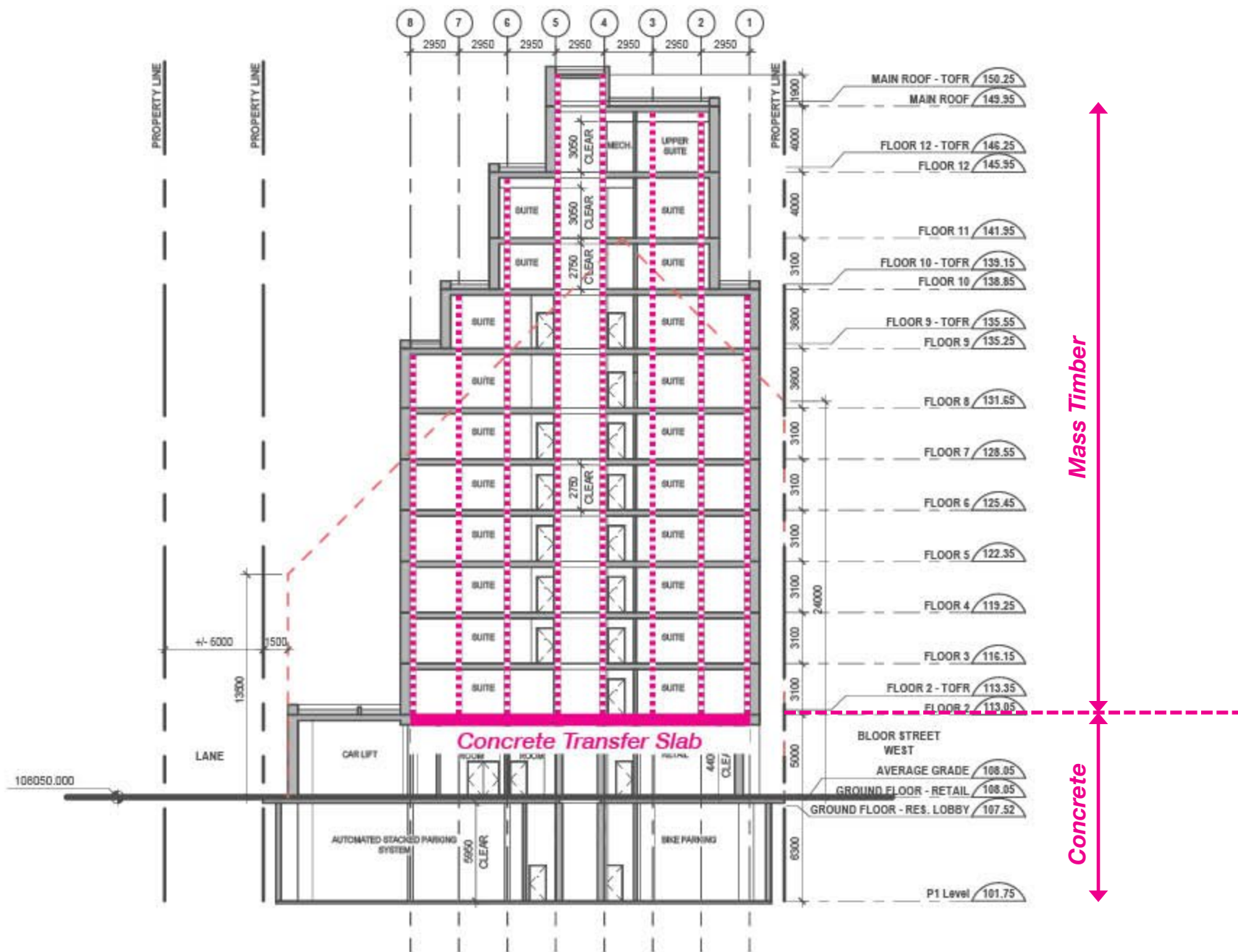
Flat Plate CLT

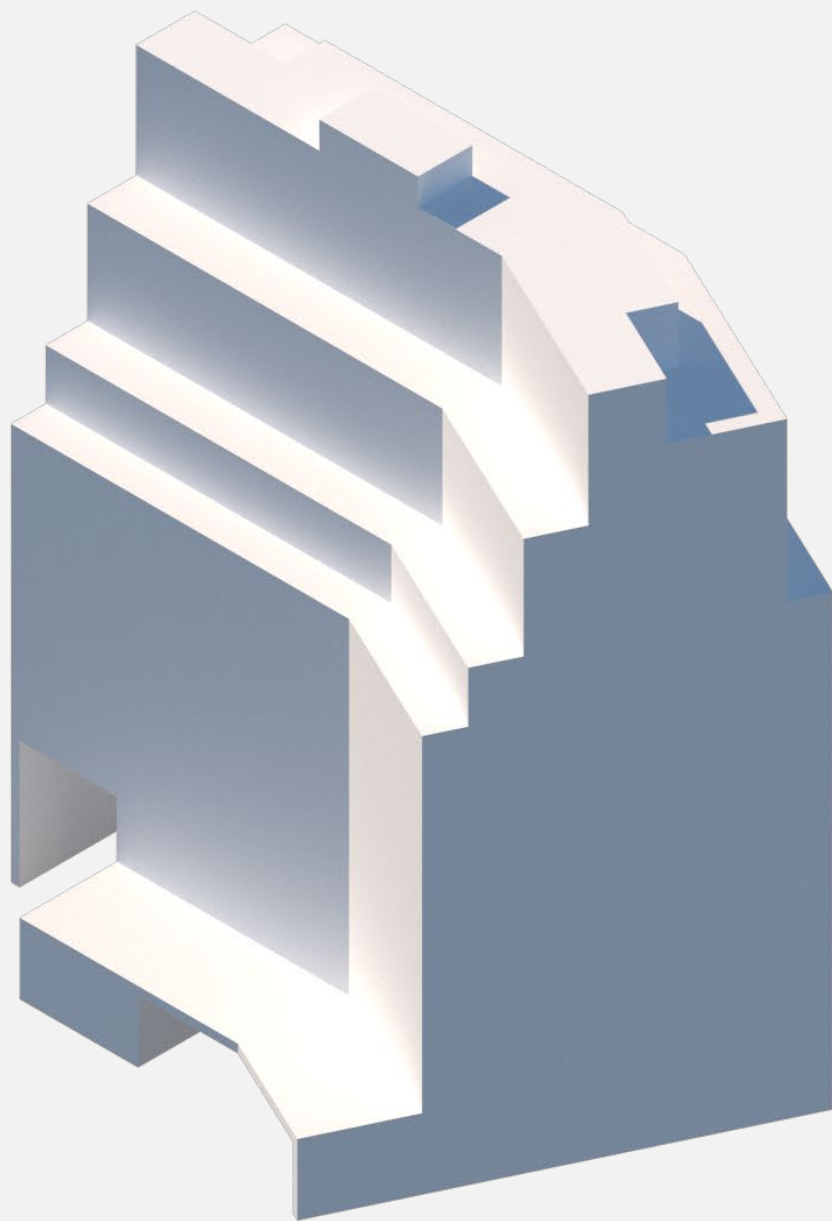


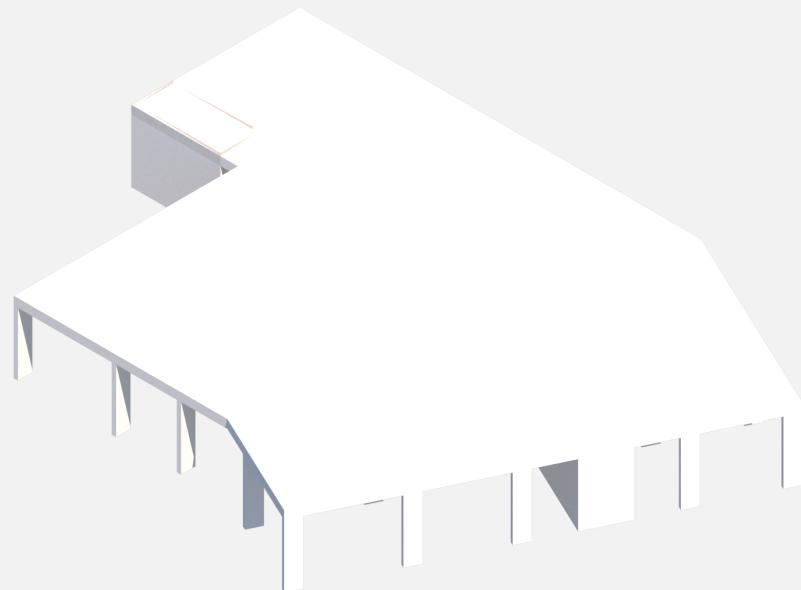
Flat Plate CLT



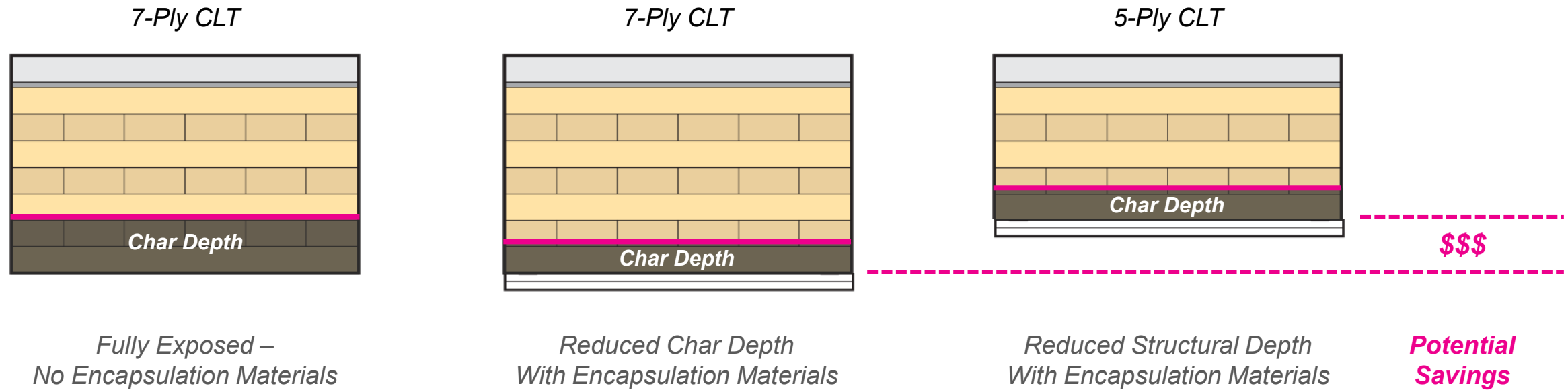
Flat Plate CLT



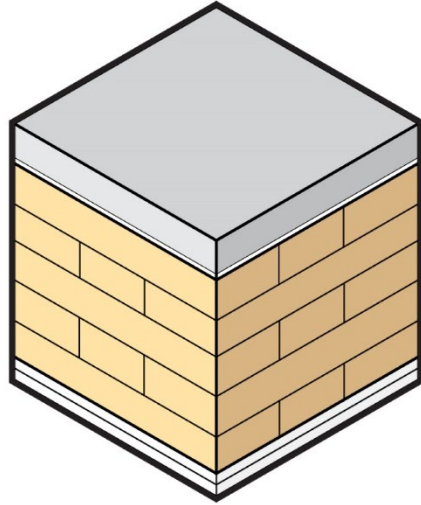




Encapsulation Strategy



Wood Volume

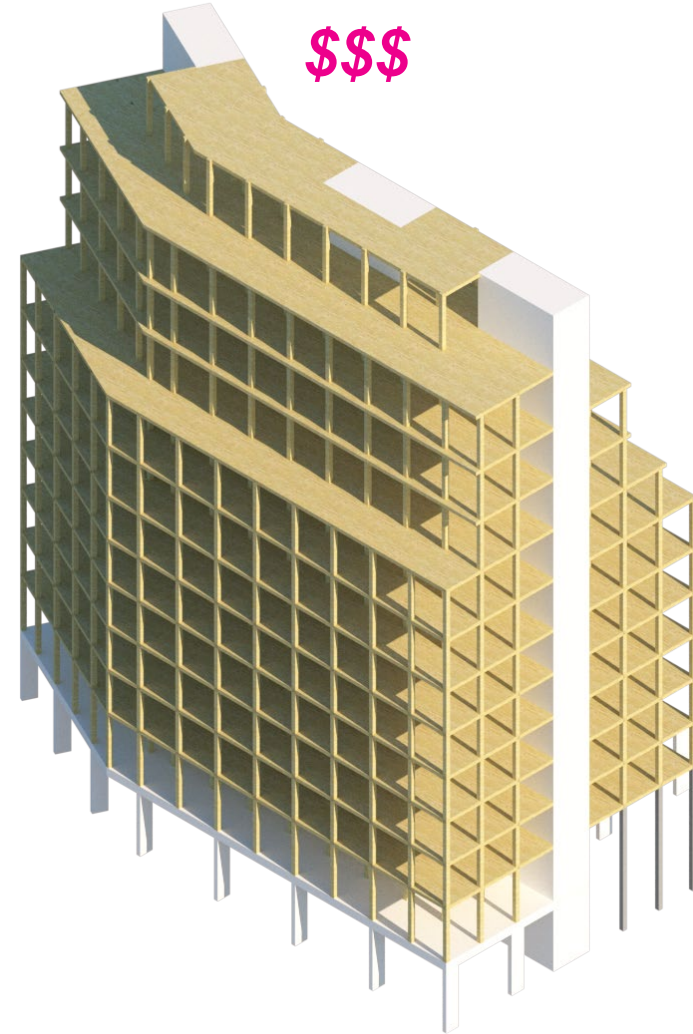


**x 12
Storeys**

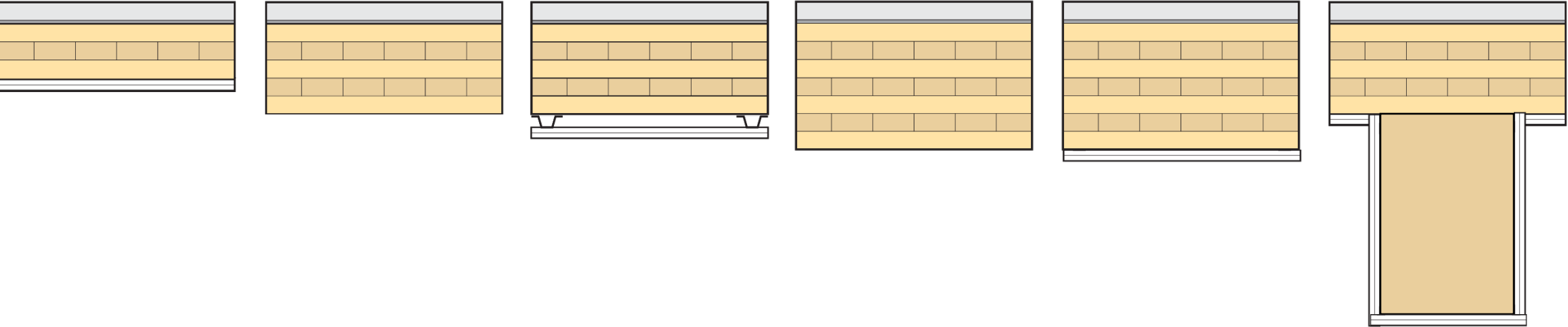
7-Ply: 245mm > 5-Ply: 175mm

=

**+/- 30% Reduction in Wood
Volume Required**



Mass Timber System Depths



Midrise Guidelines – The “Prototypical Midrise”

Performance Standard #1:

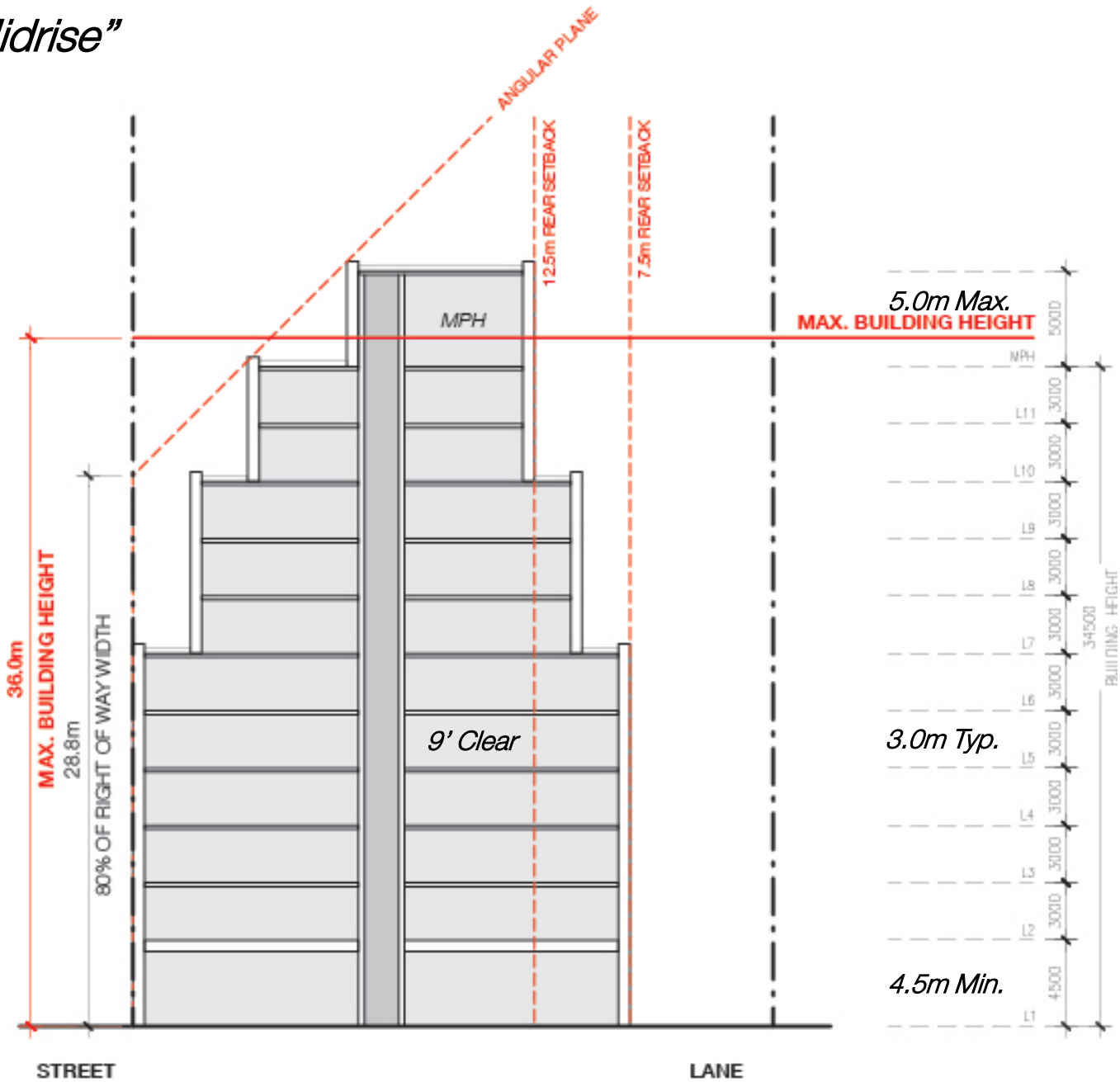
The maximum allowable height of buildings on the Avenues will be no taller than the width of the Avenue right-of-way, up to a maximum mid-rise height of 11 storeys (36 meters).

R.O.W. Width ¹	Mixed-Use		Commercial	
	storeys	height (m) ²	storeys	height (m) ³
20m	6	19.5	5	18.9
27m	8	25.5	7	26.1
30m	9	28.5	8	29.7
36m	11	34.5	9	33.3

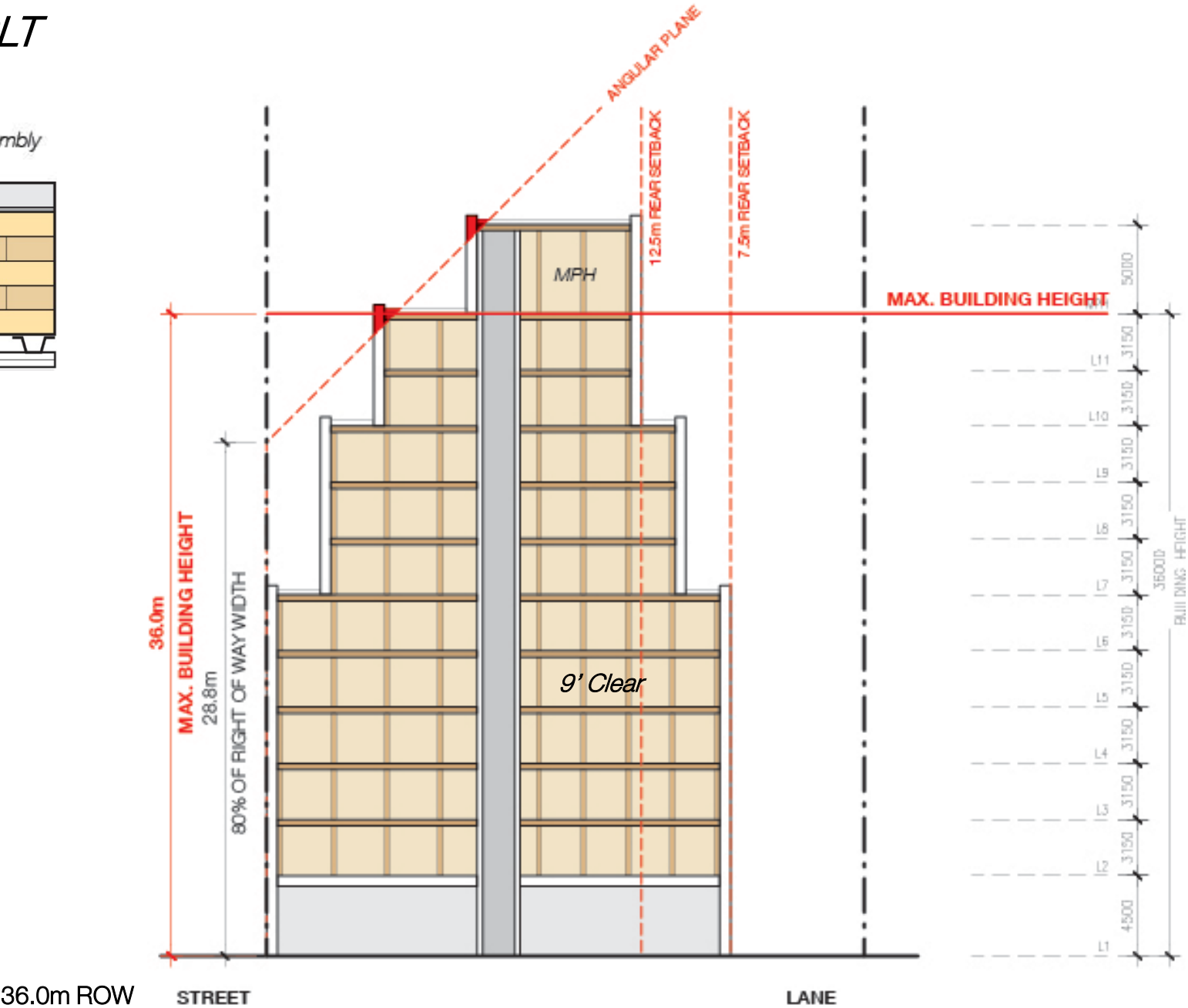
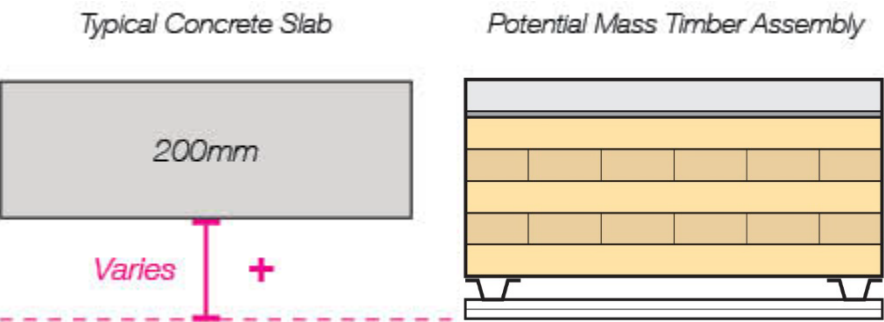
Assumptions

- 1 - R.O.W. widths as identified in Official Plan Map 3
- 2 - Mixed Use heights assume 4.5m for ground floor and 3.0m for all floors above
- 3 - Commercial heights assume 4.5m for ground floor and 3.6m for all floors above

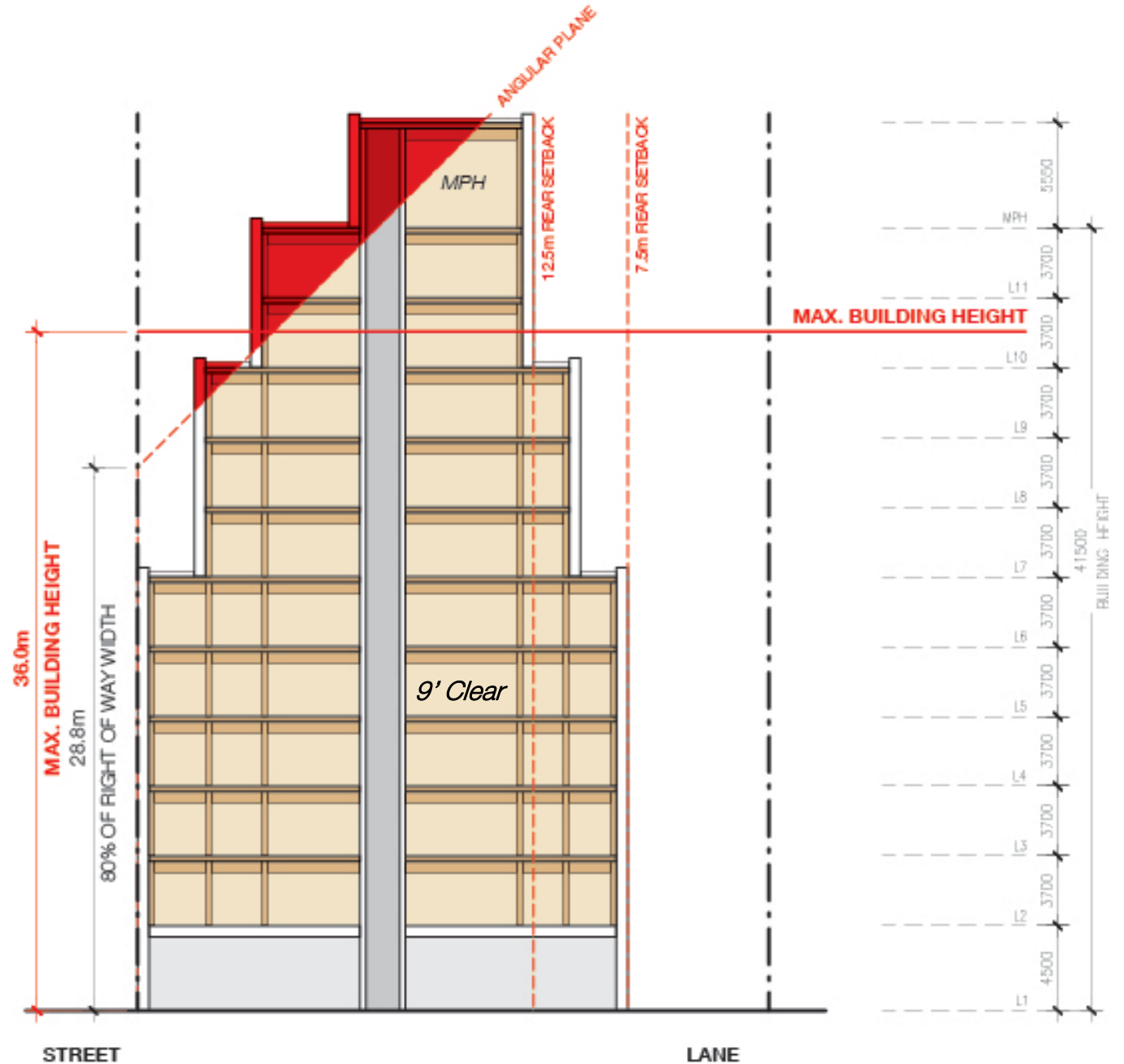
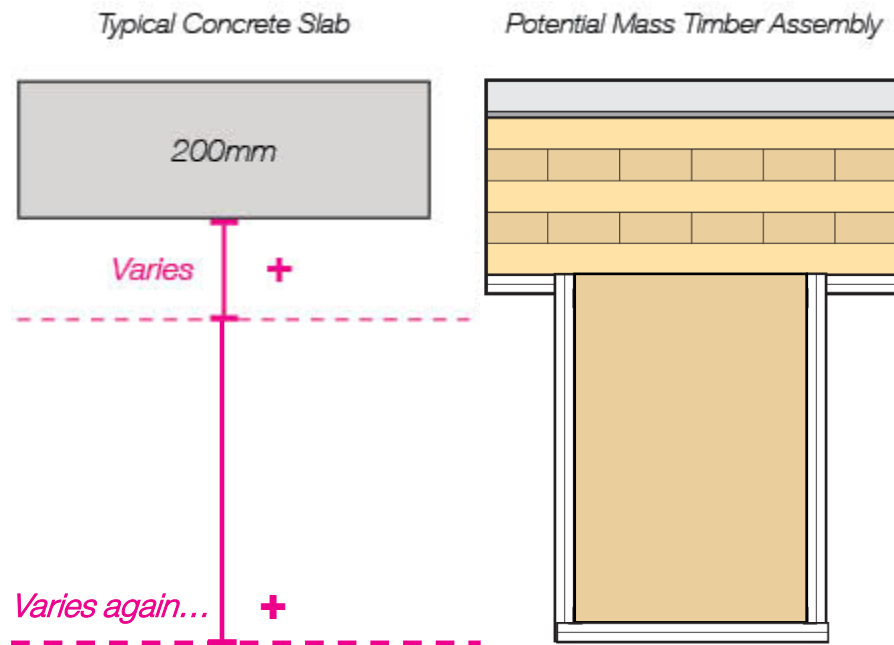
36.0m ROW



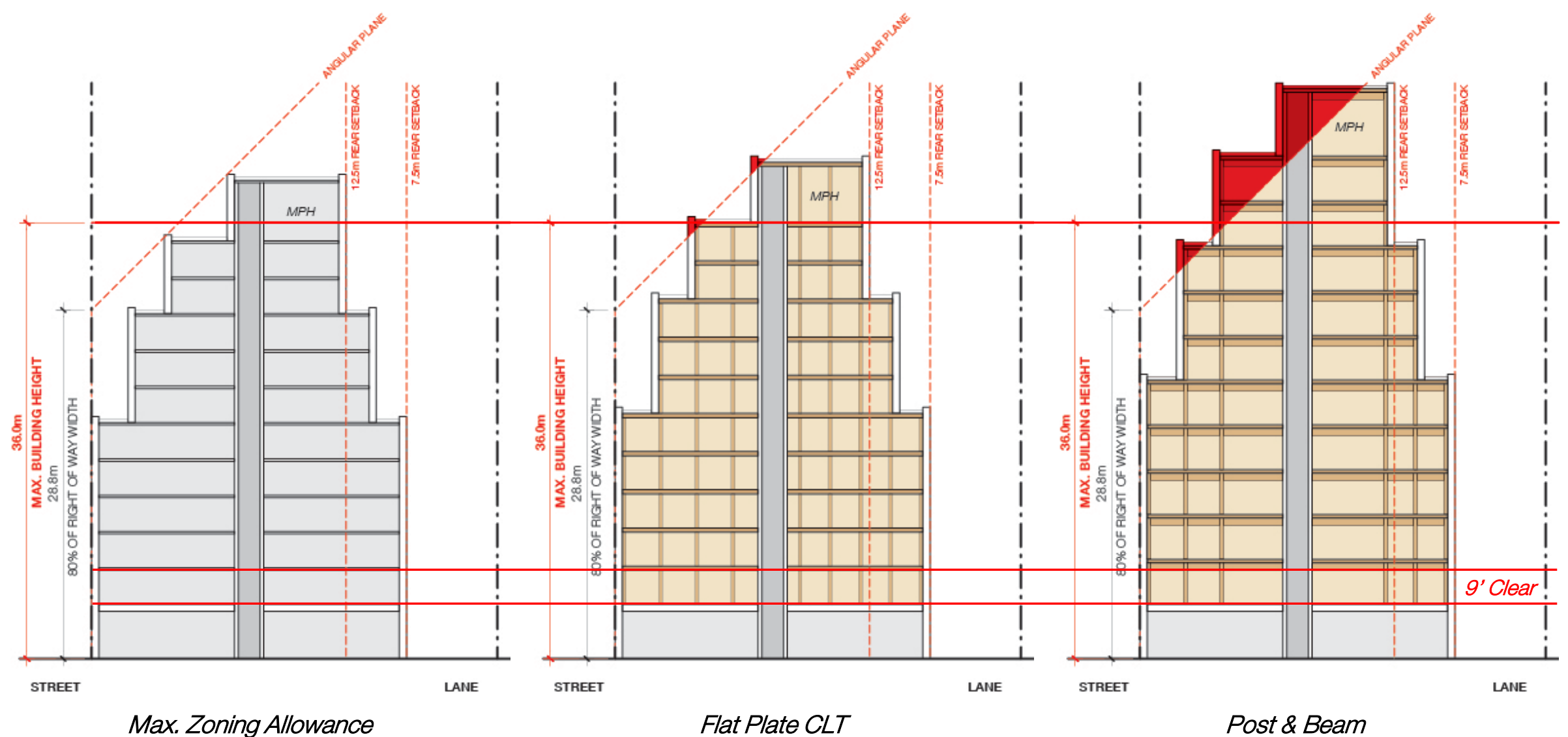
Midrise Guidelines – Flat Plate CLT



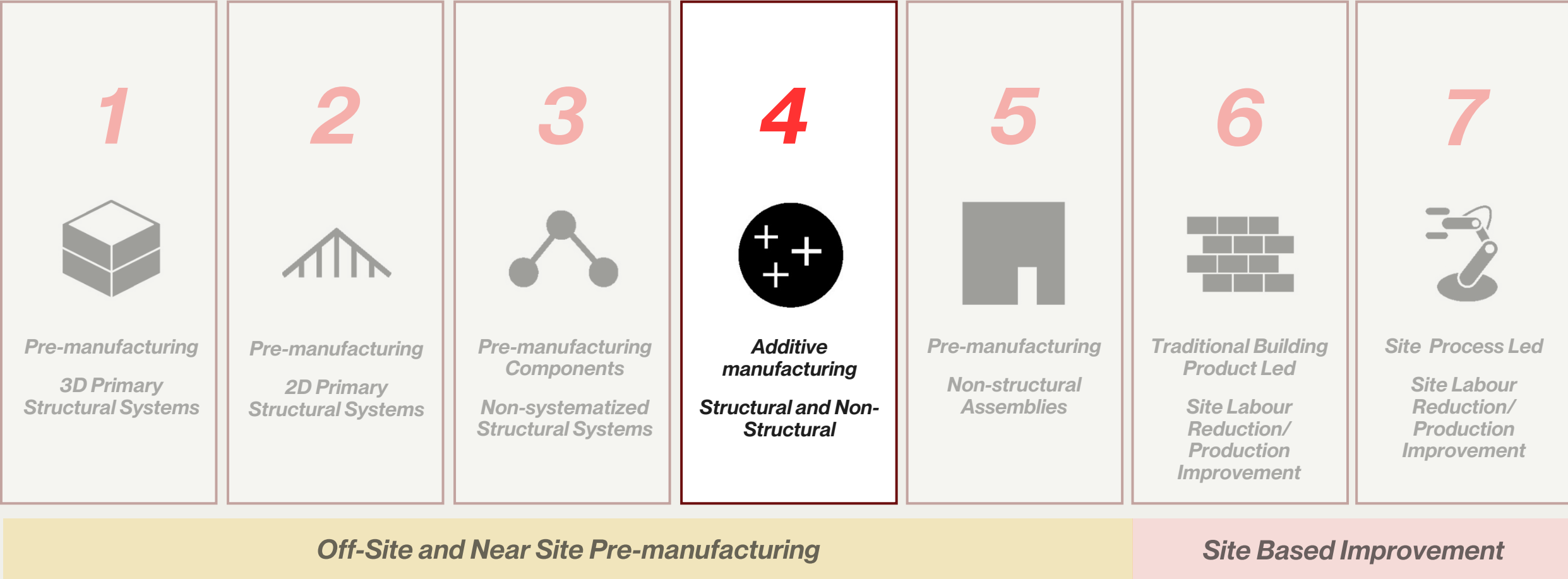
Midrise Guidelines – *Post & Beam*



Midrise Guidelines – A Structural Comparison



MMC Categories



Local Manufacturers

Horizon Legacy
Greater Toronto Area



nidus3D
Kingston, ON



Other Examples

House Zero

Austin, TX
Lake Flato Architects

DfMA Manufacturer:

ikón



A&D

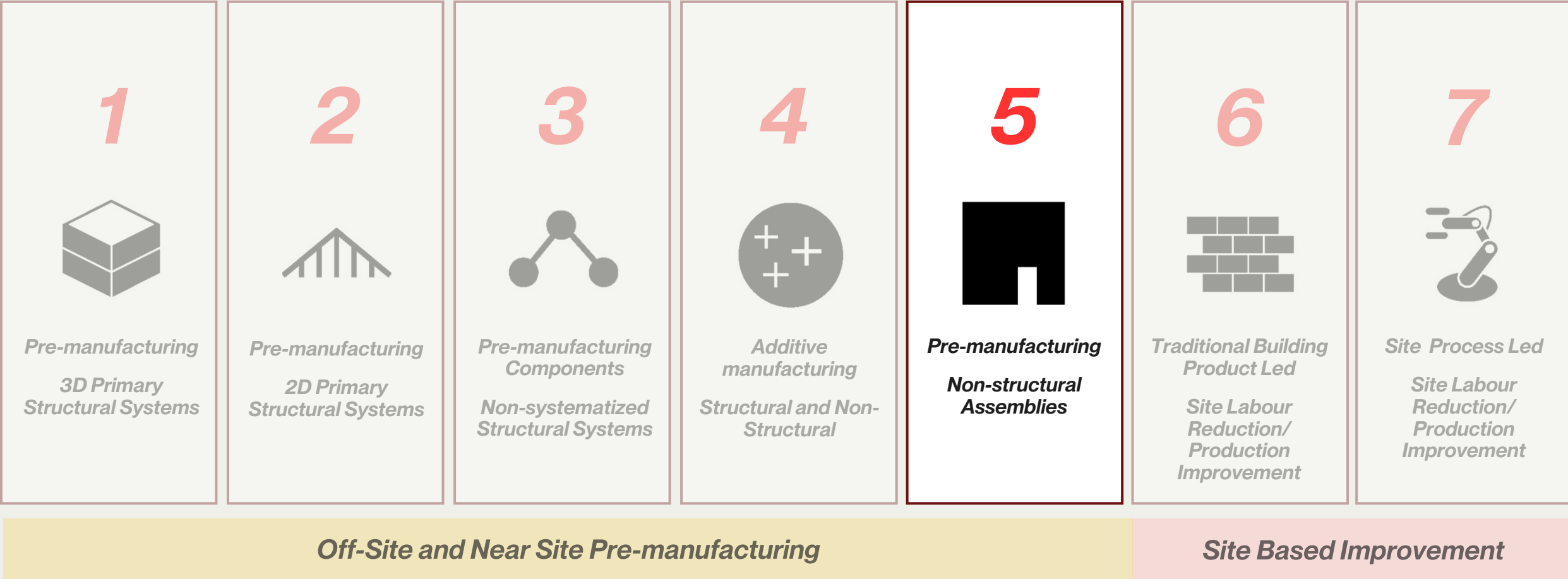
Ontario
nidus3D

DfMA Manufacturer:

nidus3D



MMC Categories





CG Tower

17079 | Vaughan, ON

In Construction (60%)

MMC
Category

Pre-manufactured
Non-Structural Assembly

5

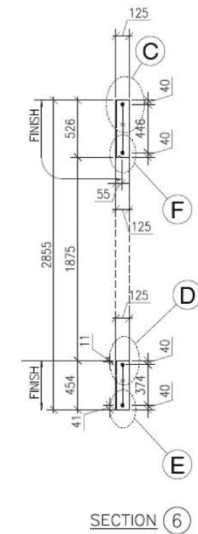
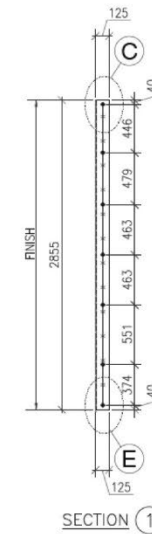
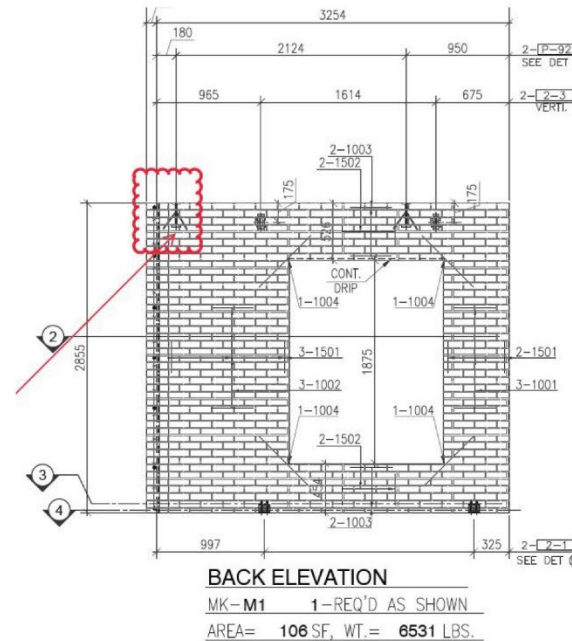
Product:
**125 mm Precast Panel with
Pre-installed Windows**

GP
GLOBAL PRECAST

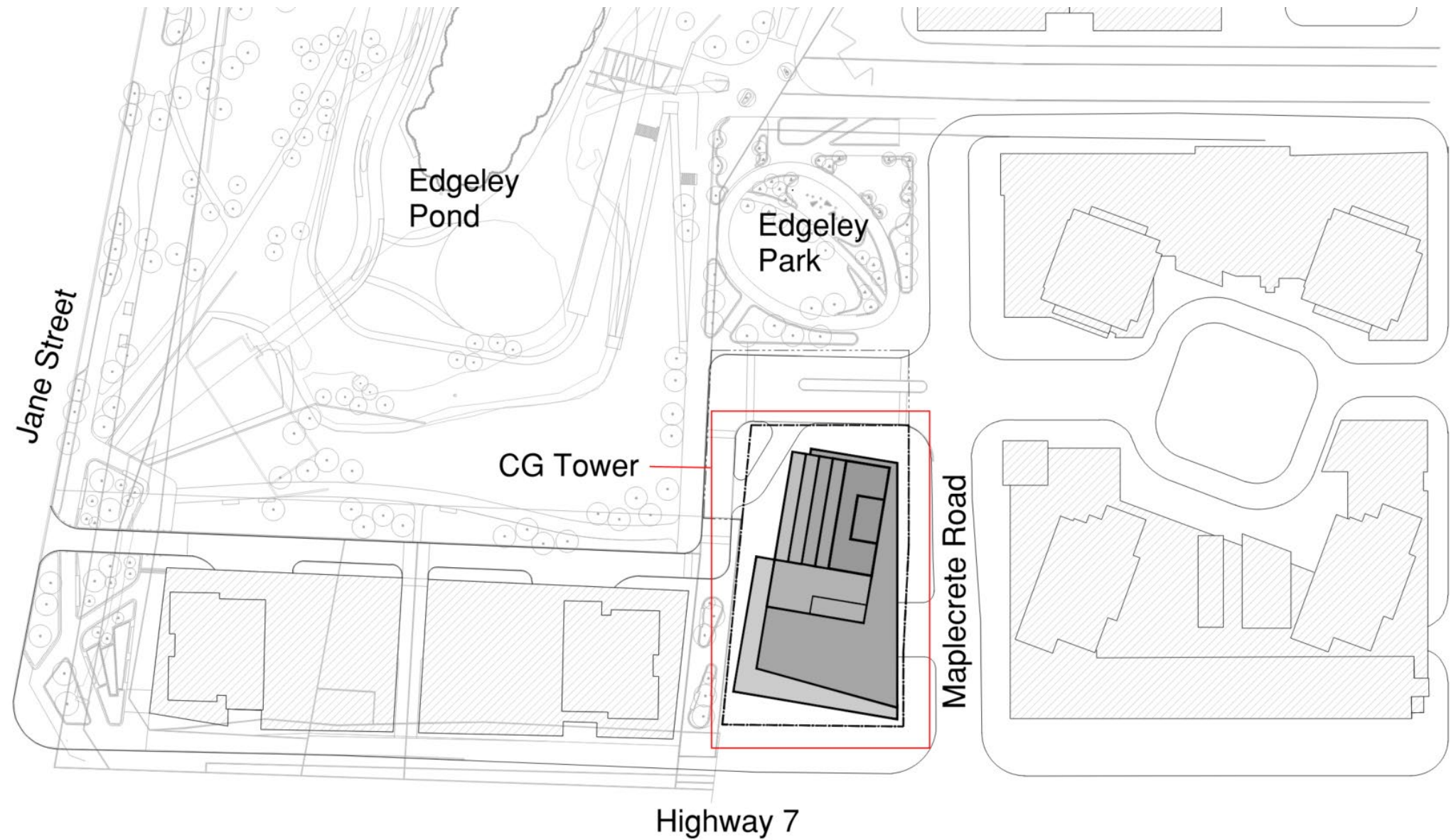
Client:
Royal 7 Developments

Contractor:
Cortel Group

Manufacturer:
Global Precast



Site Plan



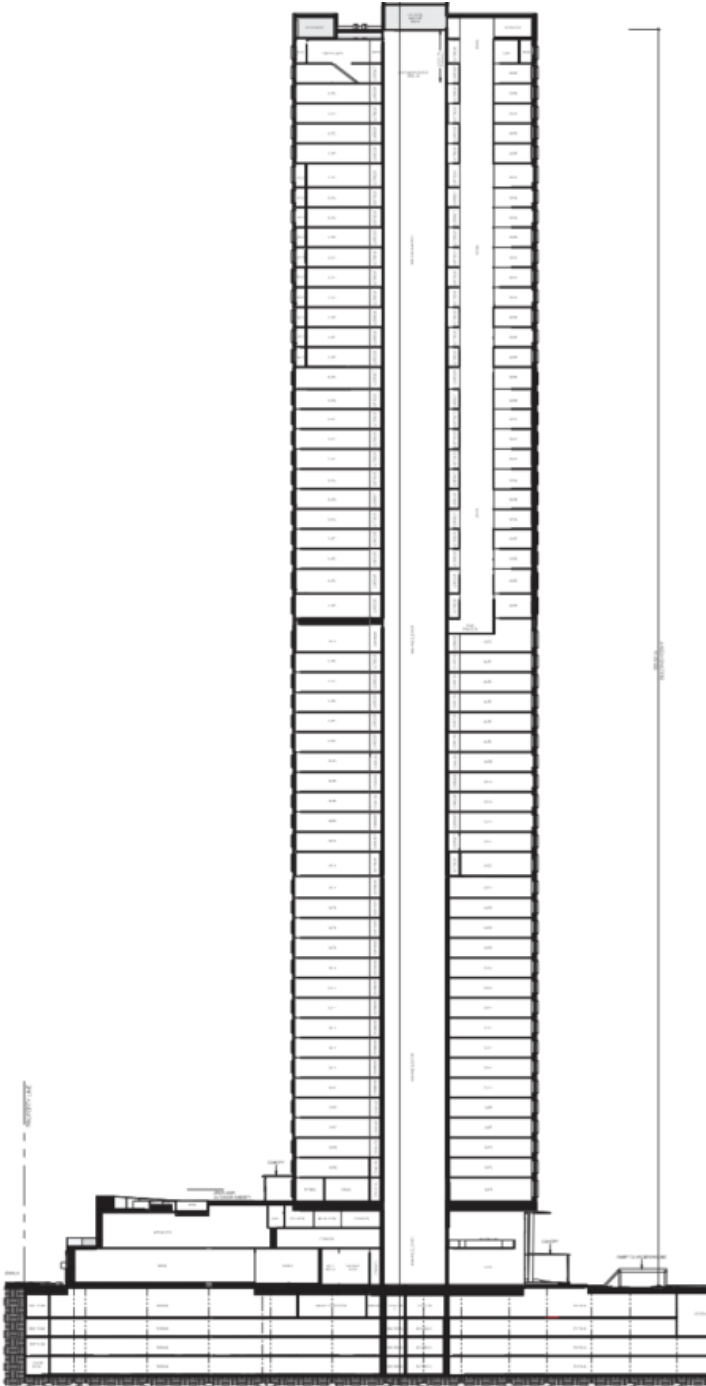
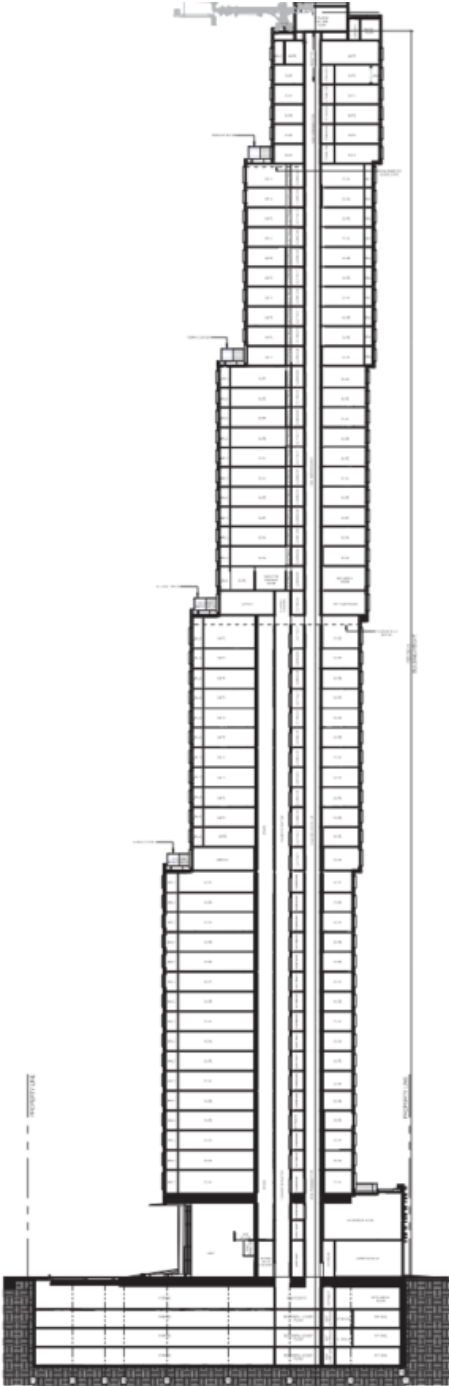
Rendering



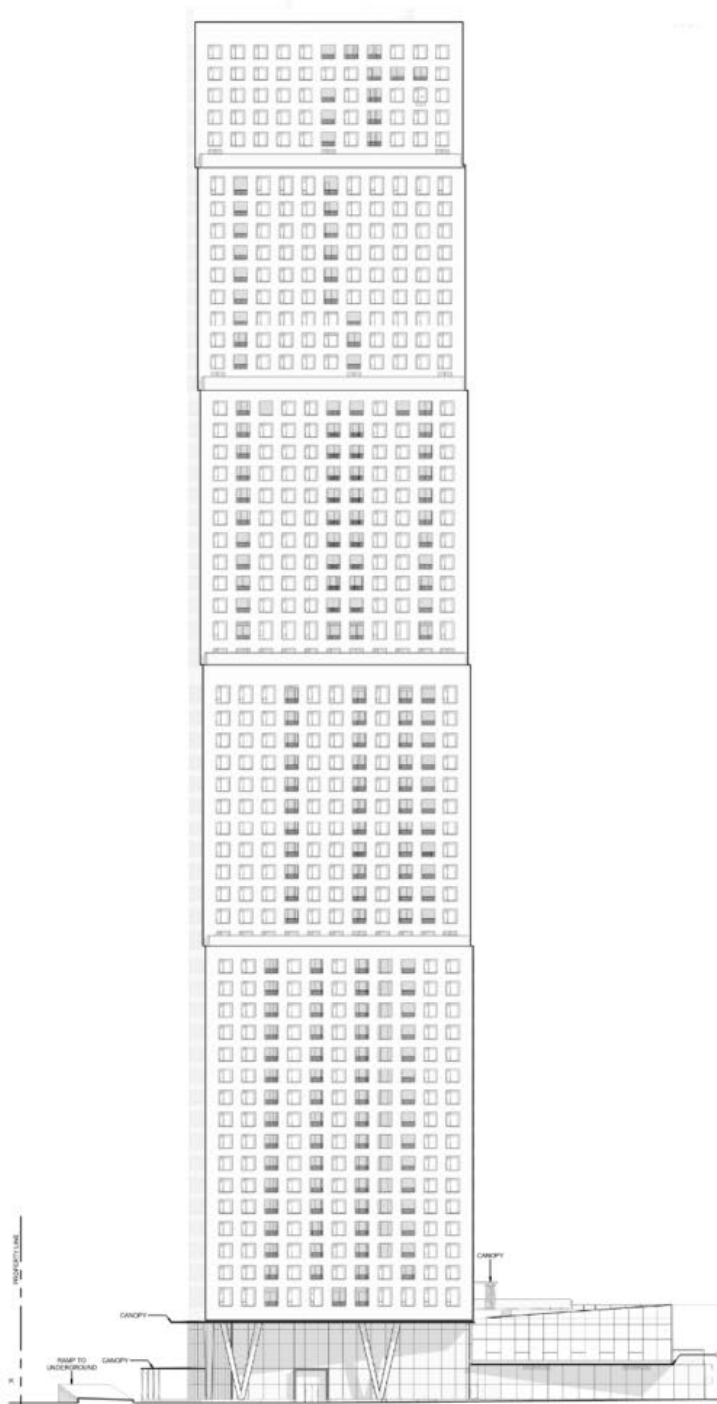
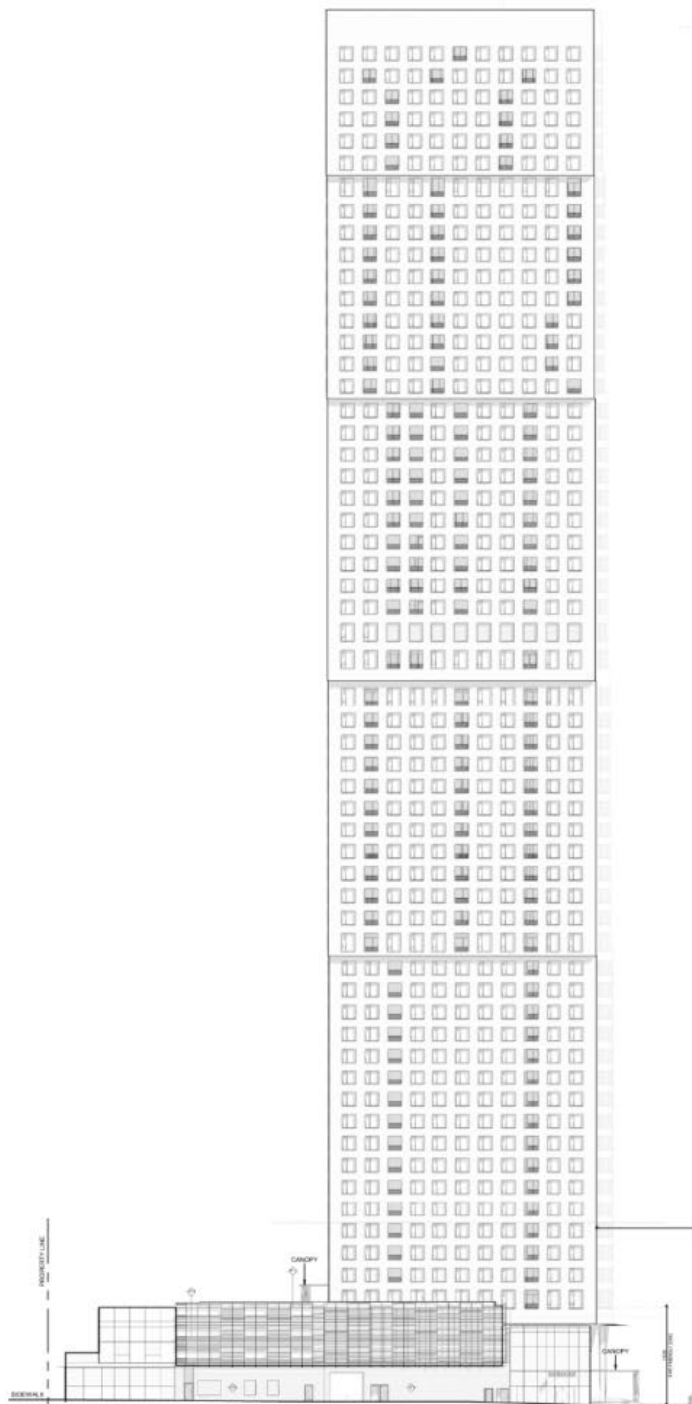
Context



Sections



Elevations



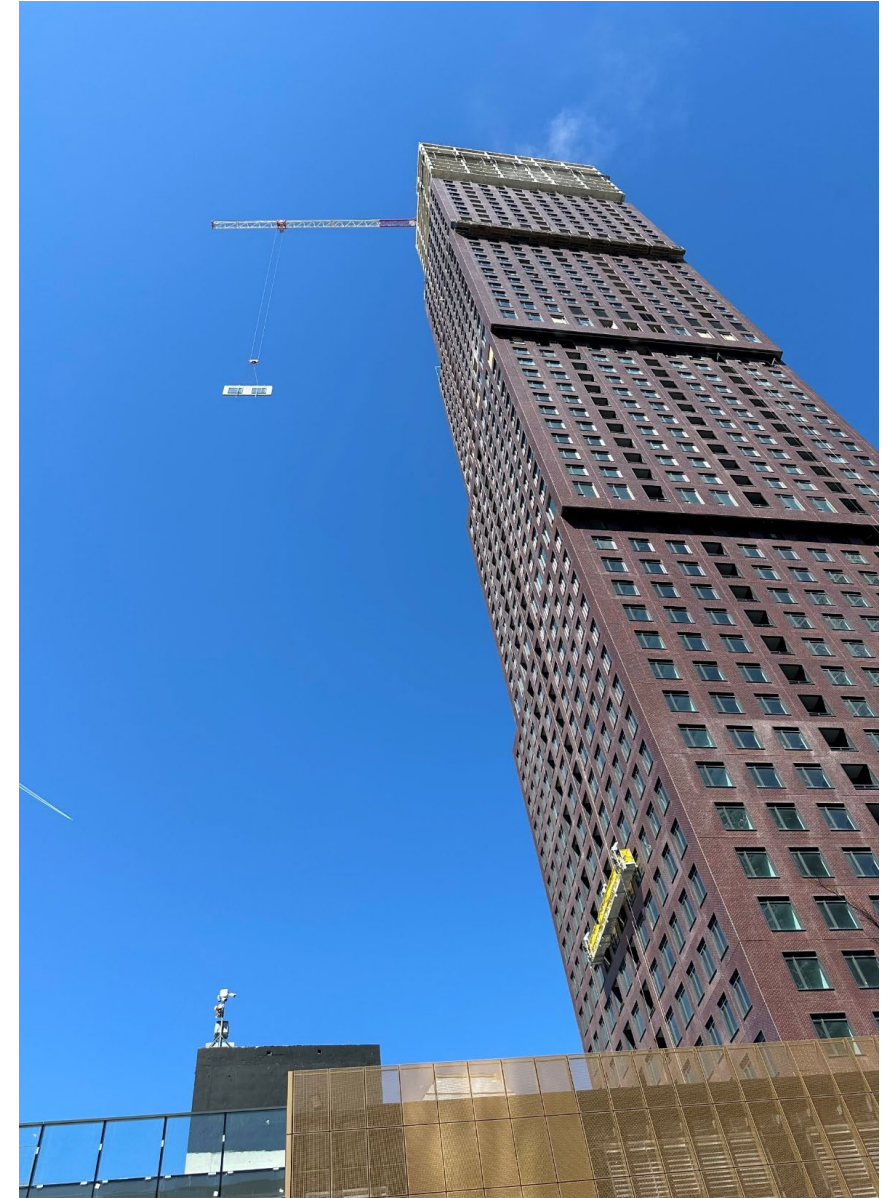
The Mock-up



Air and Water Testing



Transportation and Installation



The Details



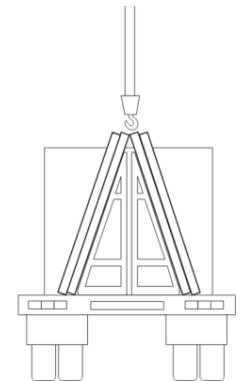
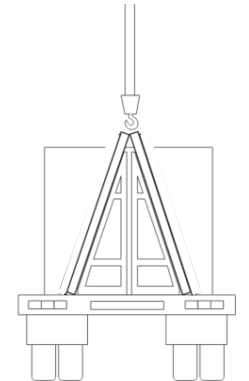
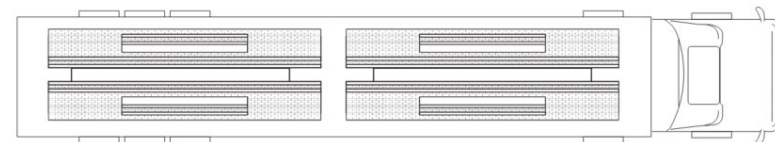
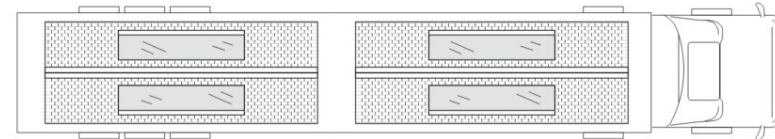
Client Post Mortem

“The system benefits outweigh the challenges”

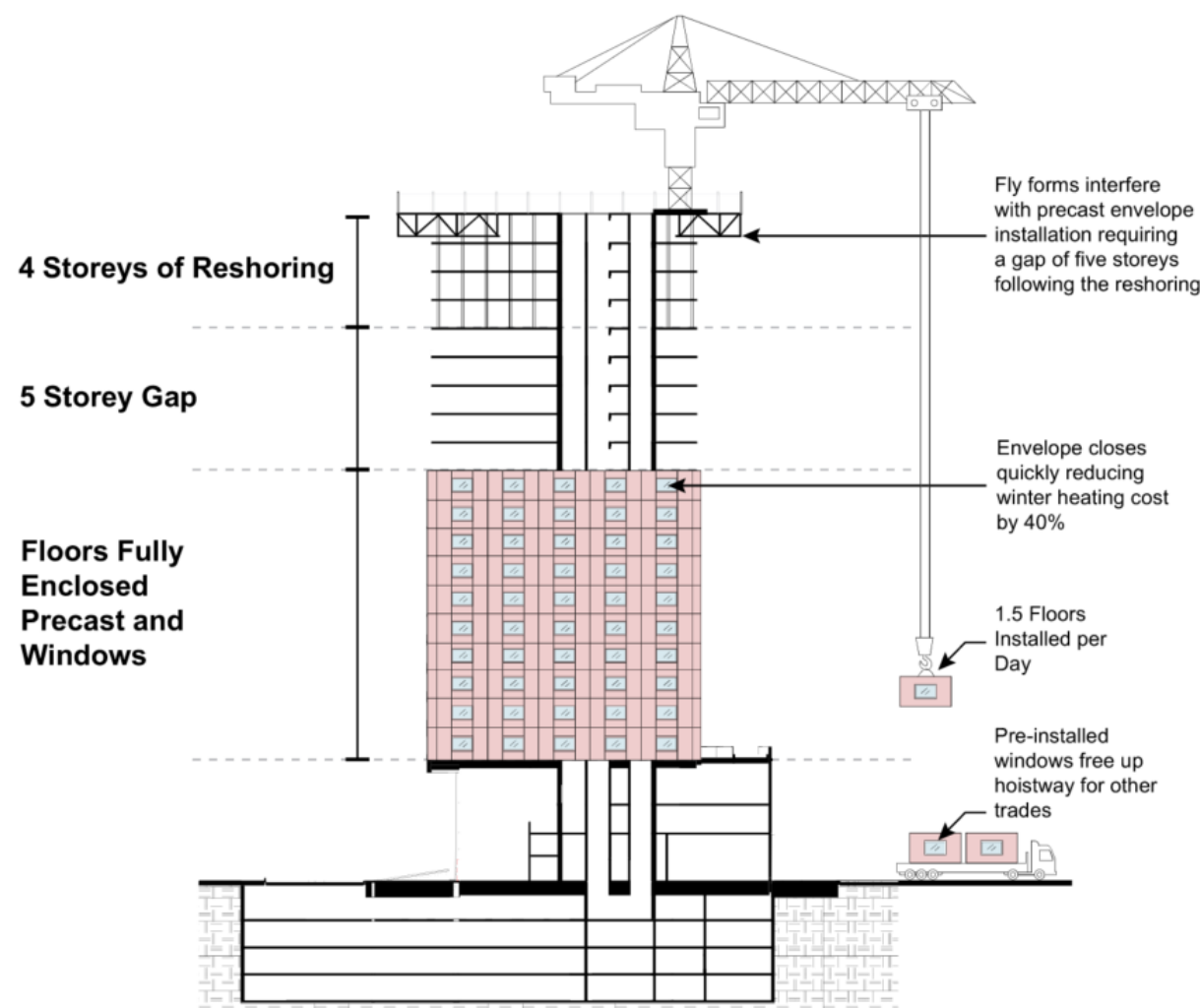
- Coordination of manufacturing timing and installation logistics was challenging
- No hoist required for windows, less hoist congestion
- 30-40% savings on winter heat
- No damage to panels or windows
- Cost savings the next time they follow this strategy
- More trucks for panel transportation

“Crane time is king!”

- Cortel Group

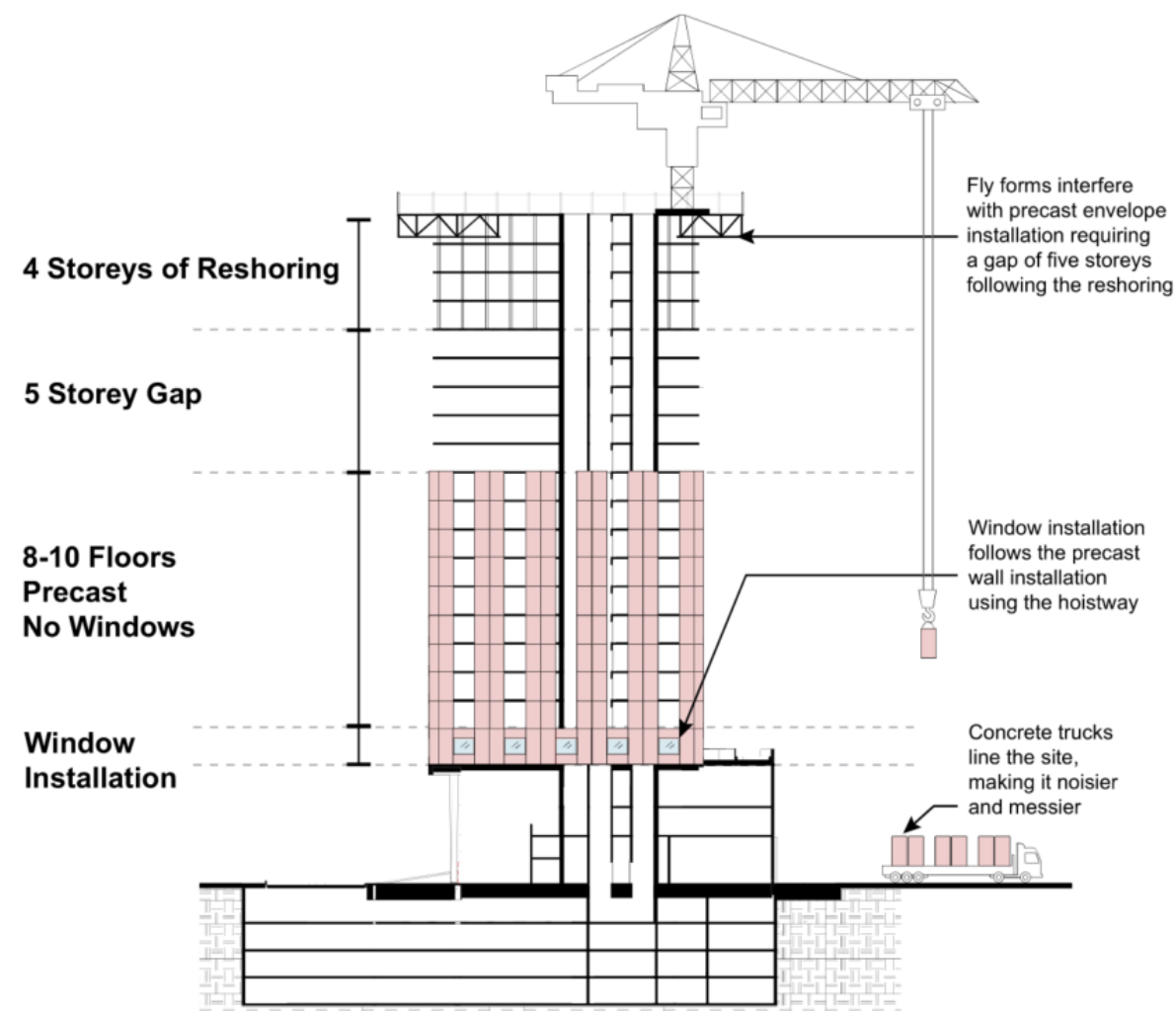


Comparing Systems



Precast with Windows Installed Off Site

Cast in Place Concrete Structure
8-10 Weeks Schedule Savings

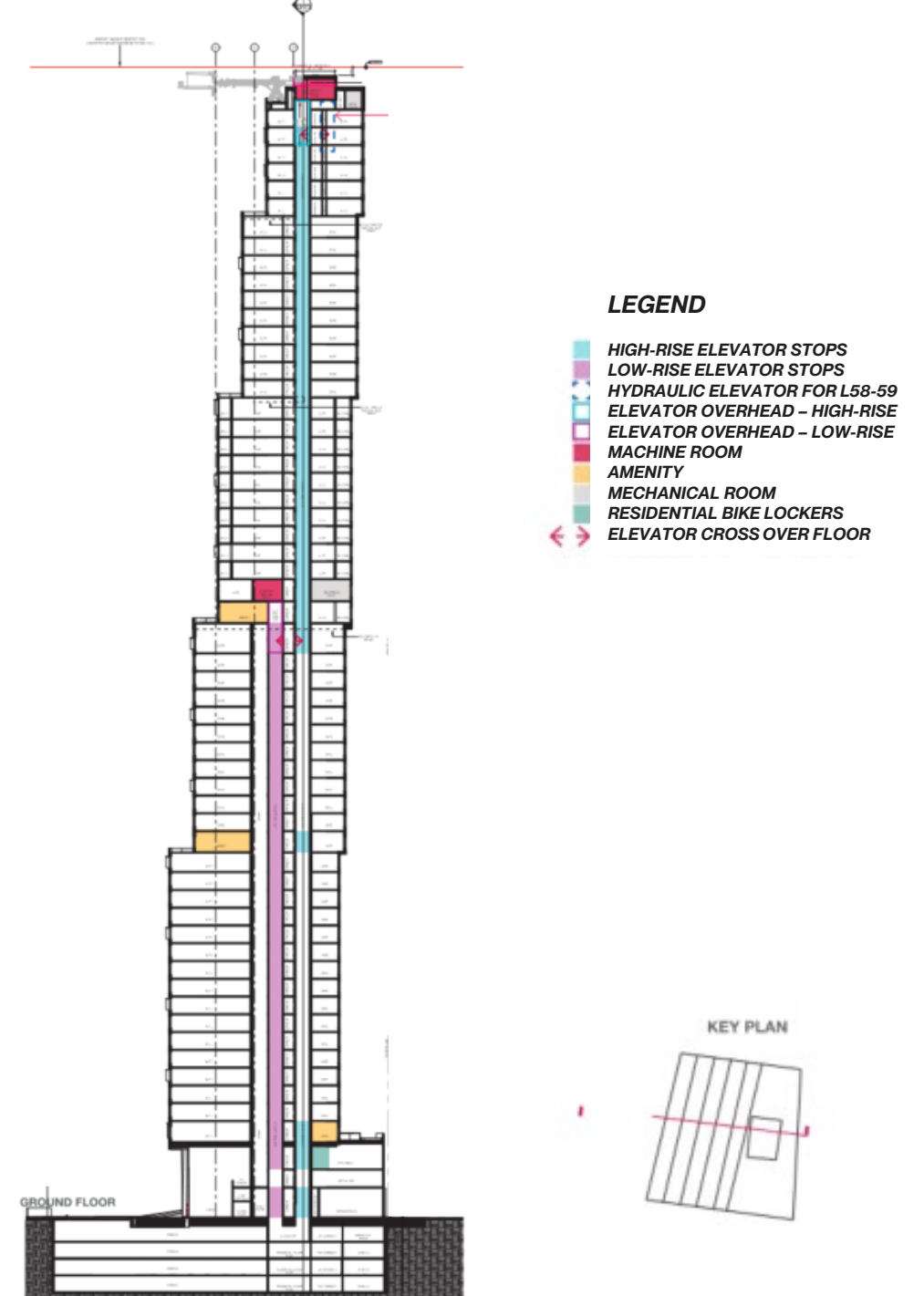


Precast with Windows Installed On Site

Cast in Place Concrete Structure
Hoist Required On-Site for Window Installation

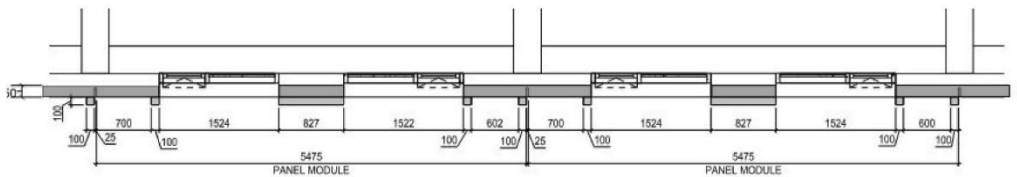
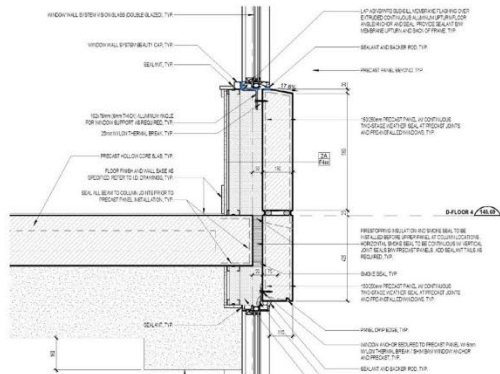
Elevator Strategy

- The elevator is critical path. 16-22 weeks from completion of the midlevel roof to make the elevators operational
- Mid-level MPH makes sense over 55 storeys, early occupancy of lower floors (Schedule G), 2 months saving
- When crane size increases, crane speed slows, big impact over construction schedule



Design and Reality





- 125mm - 150mm PRECAST
- 100mm PRECAST PROTUSION

Valhalla Village, Tower D

18008 | Toronto, ON

In Construction (30%)

MMC
Category Pre-manufactured
Non-Structural Assembly

5
Product:
**125/250 mm Precast Panel
with Pre-installed Windows**



Client:
Kingsett Capital

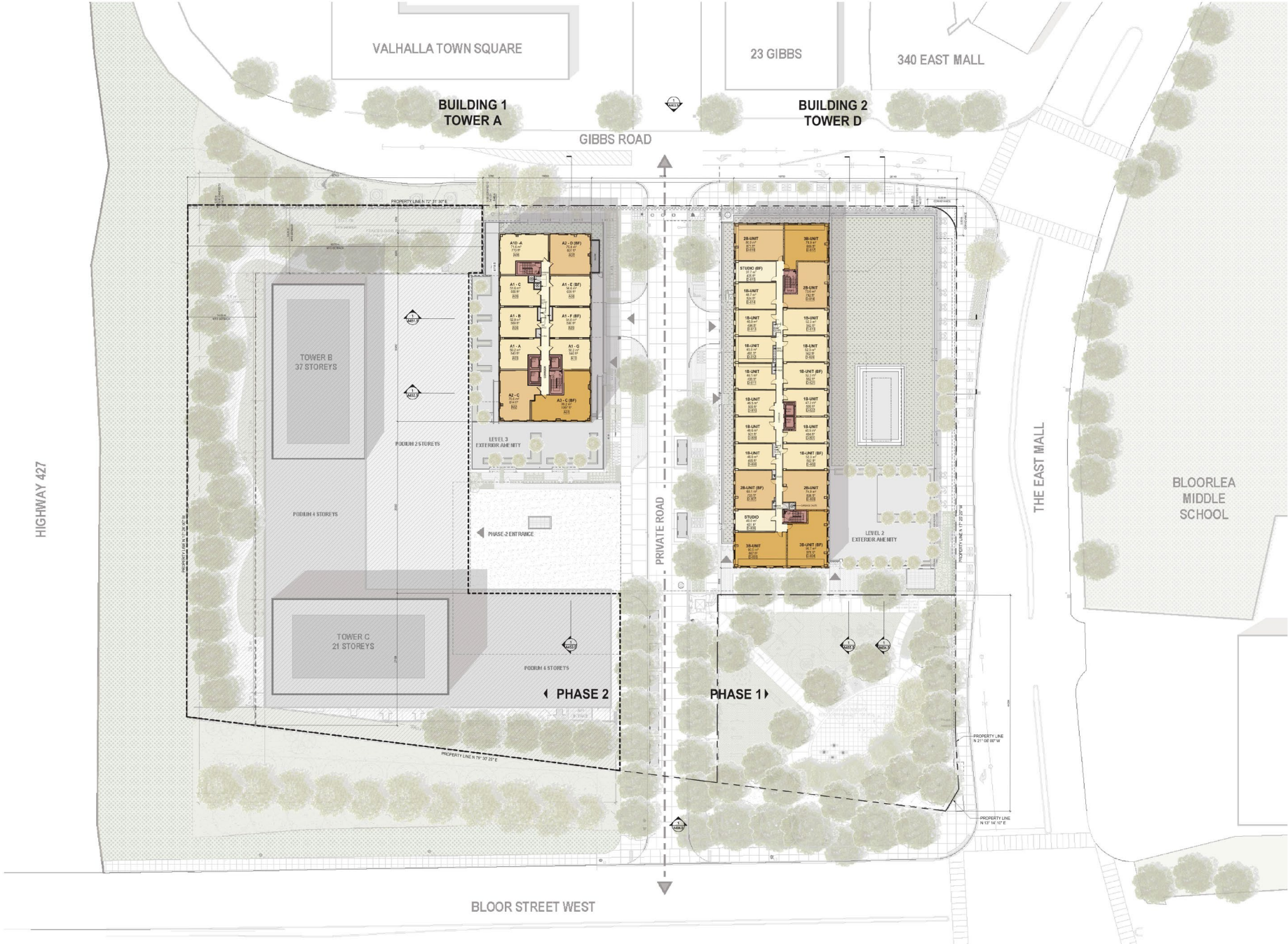
Contractor:
Reliance Construction Group

Manufacturer:
Modular Precast Systems (MPS)

CAGBC | Canada Green
Building Council
Zero Carbon Building Certified (ZCB-D)



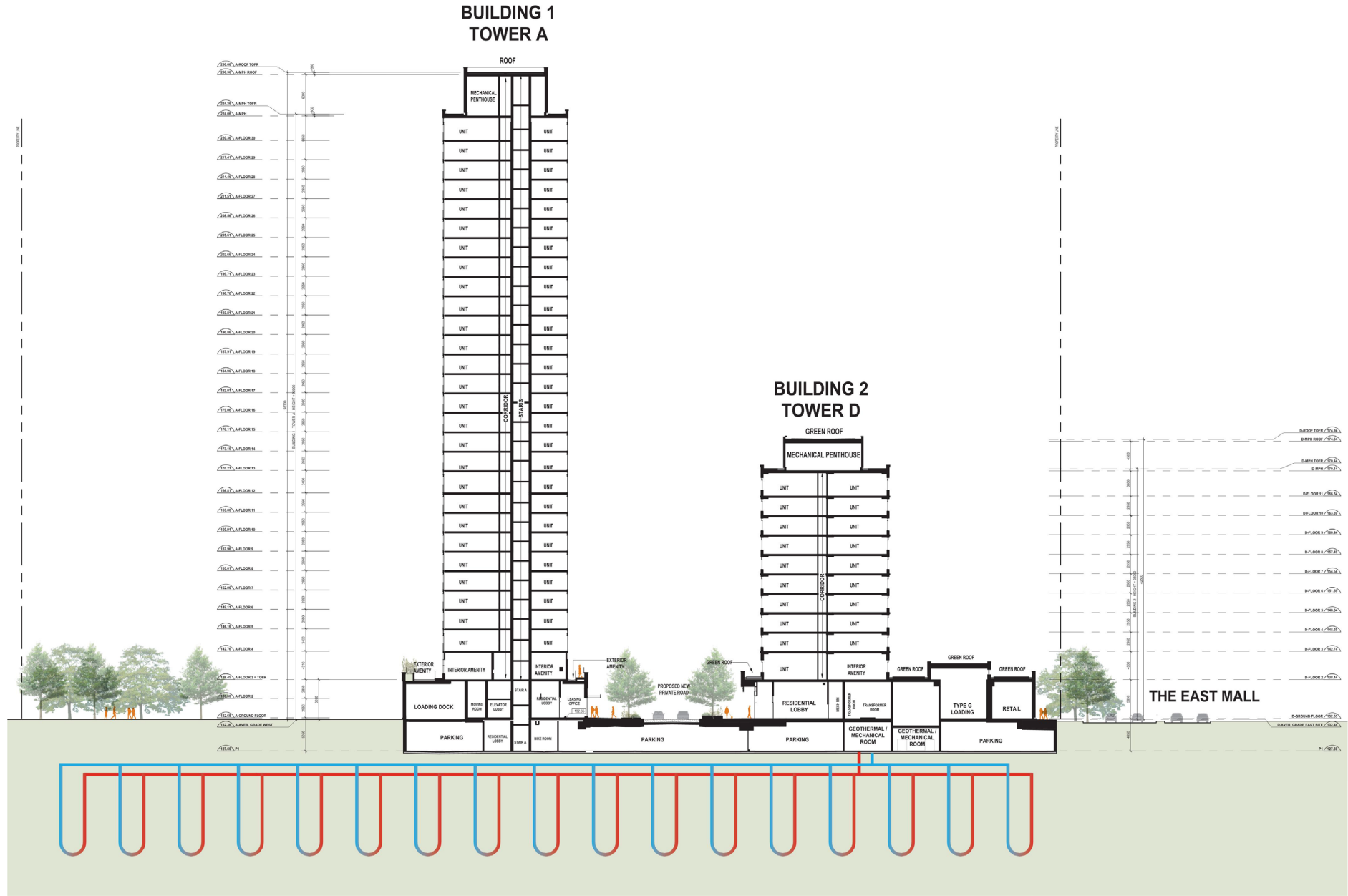
Site Plan



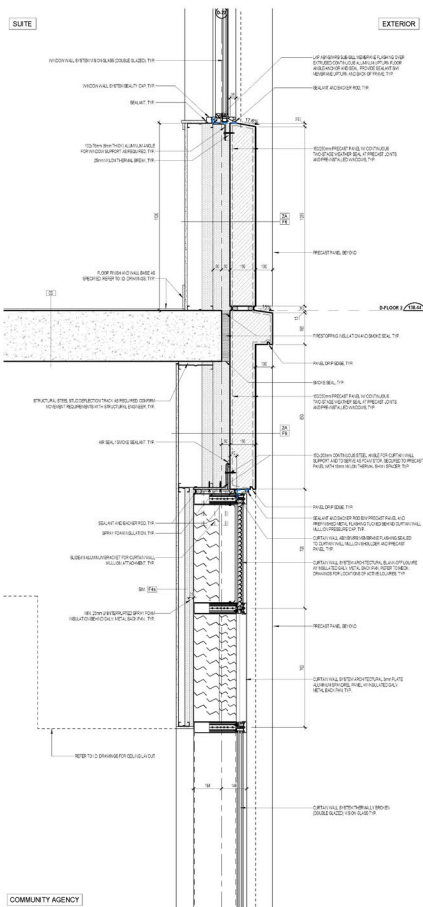
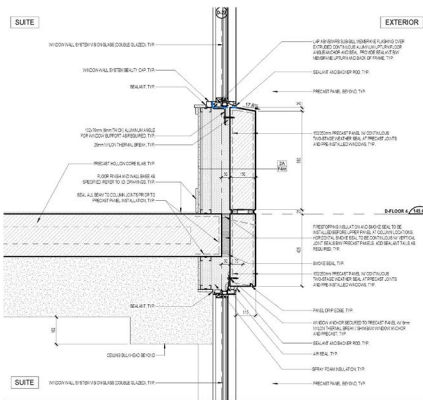
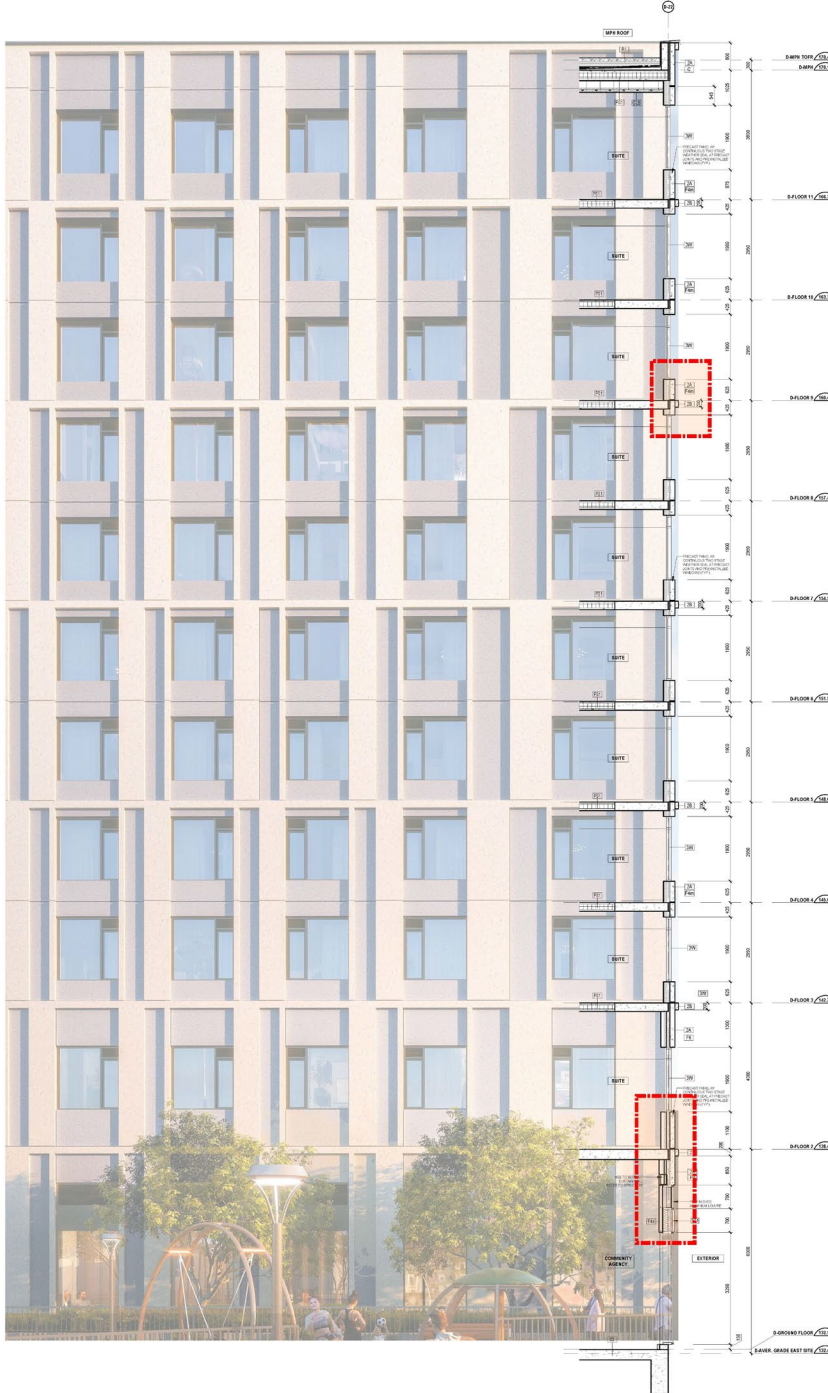
Context



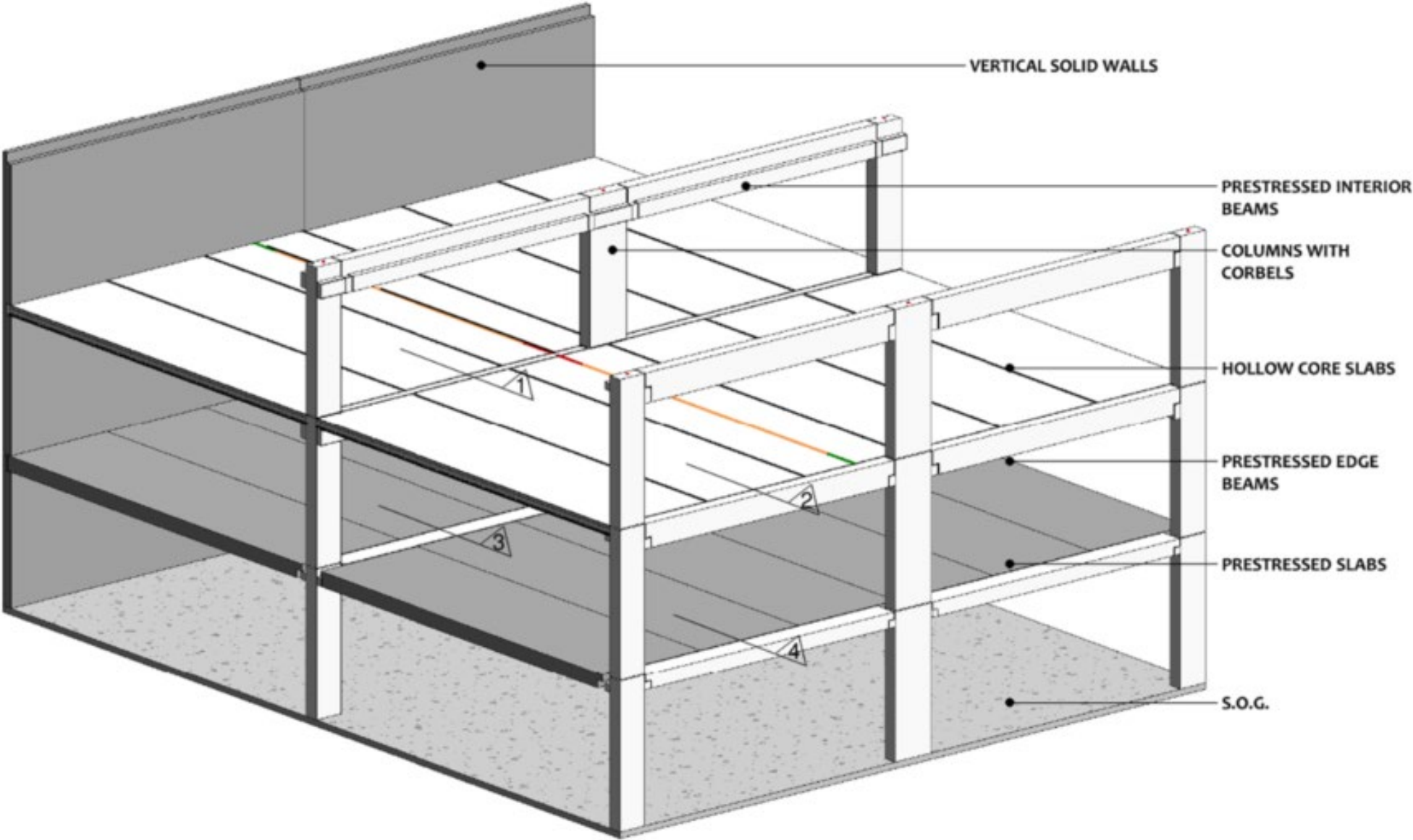
Site Section



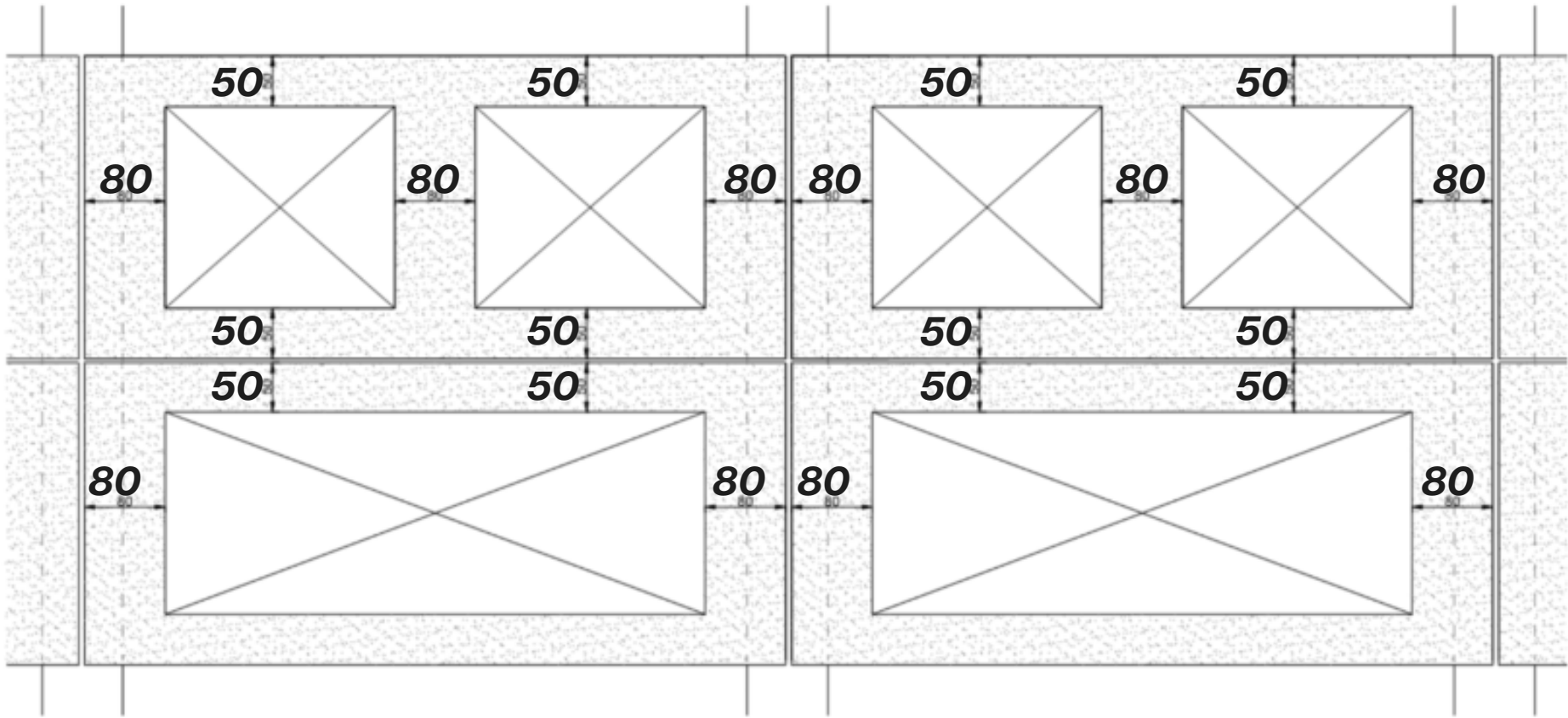
Wall Section



Typical Structural Bay

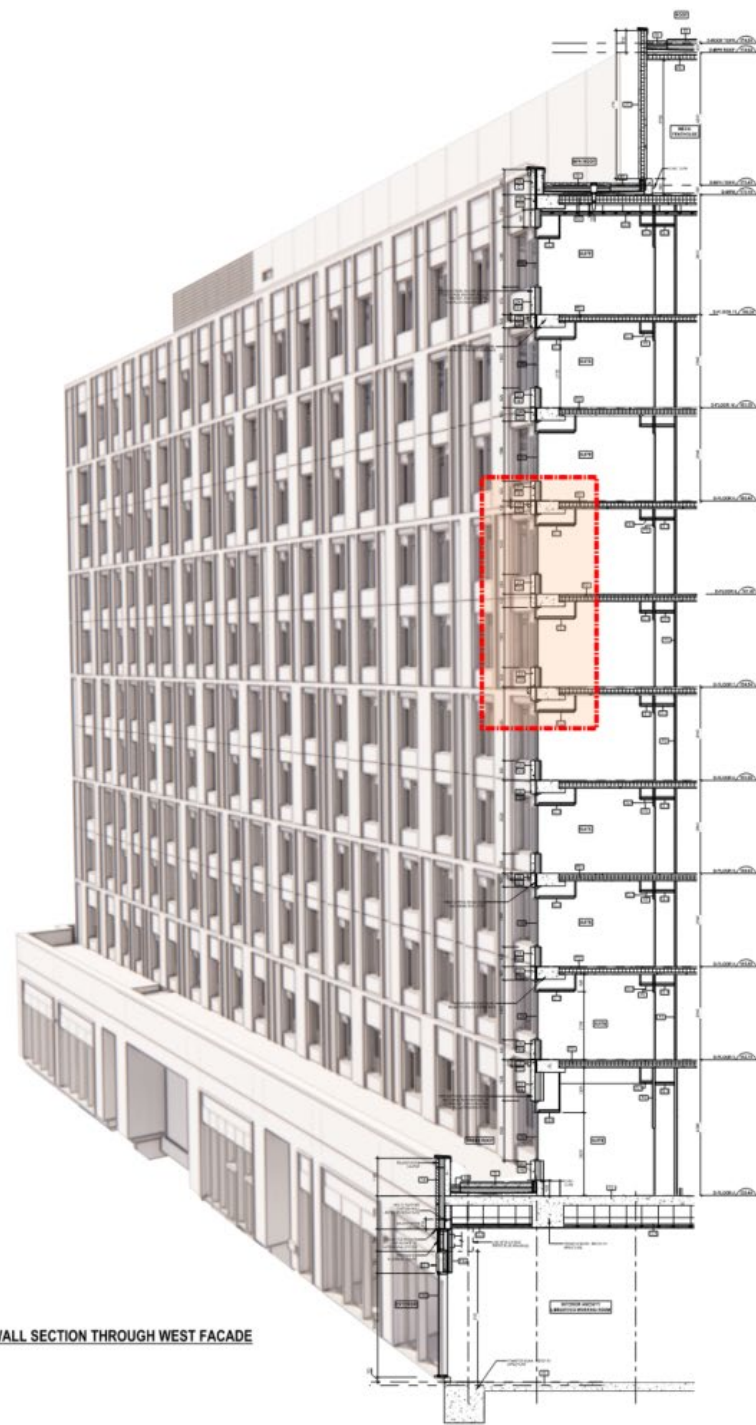


Typical Wall Panel

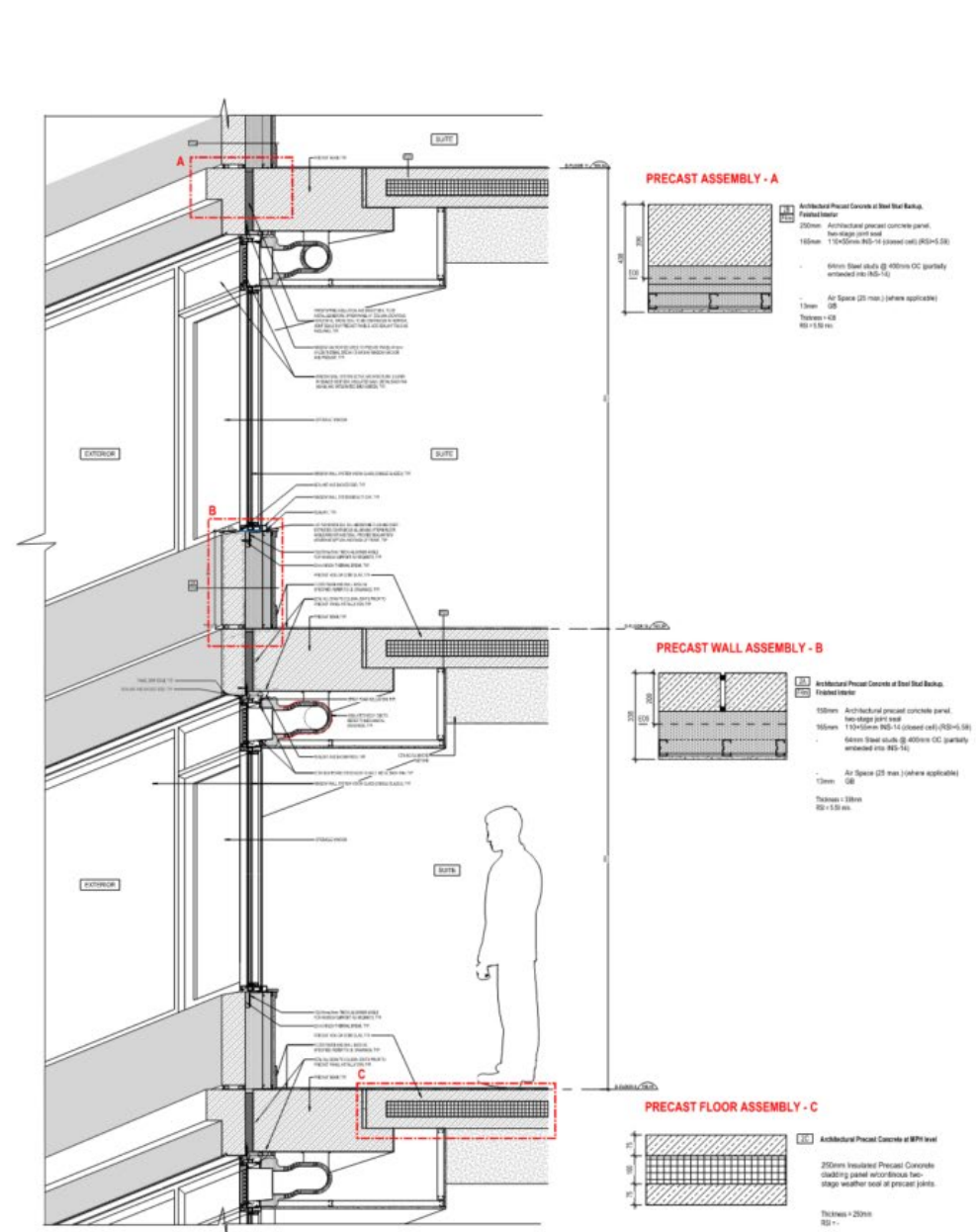


Details

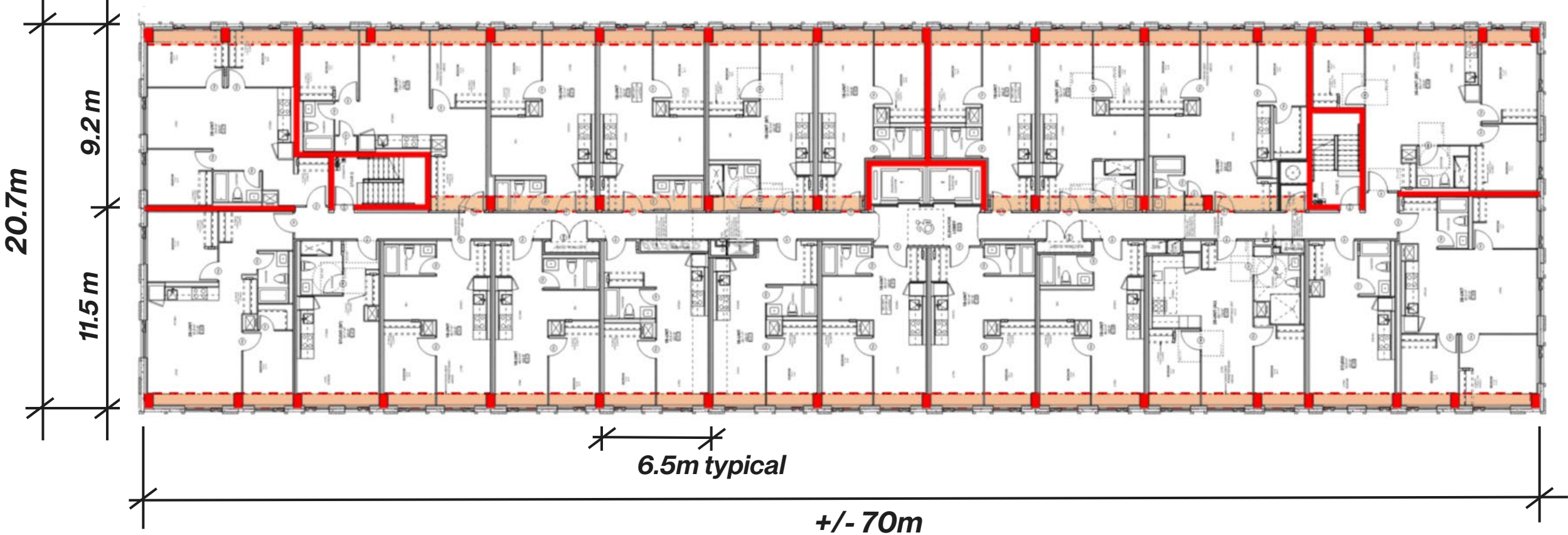
WALL SECTION THROUGH WEST FACADE



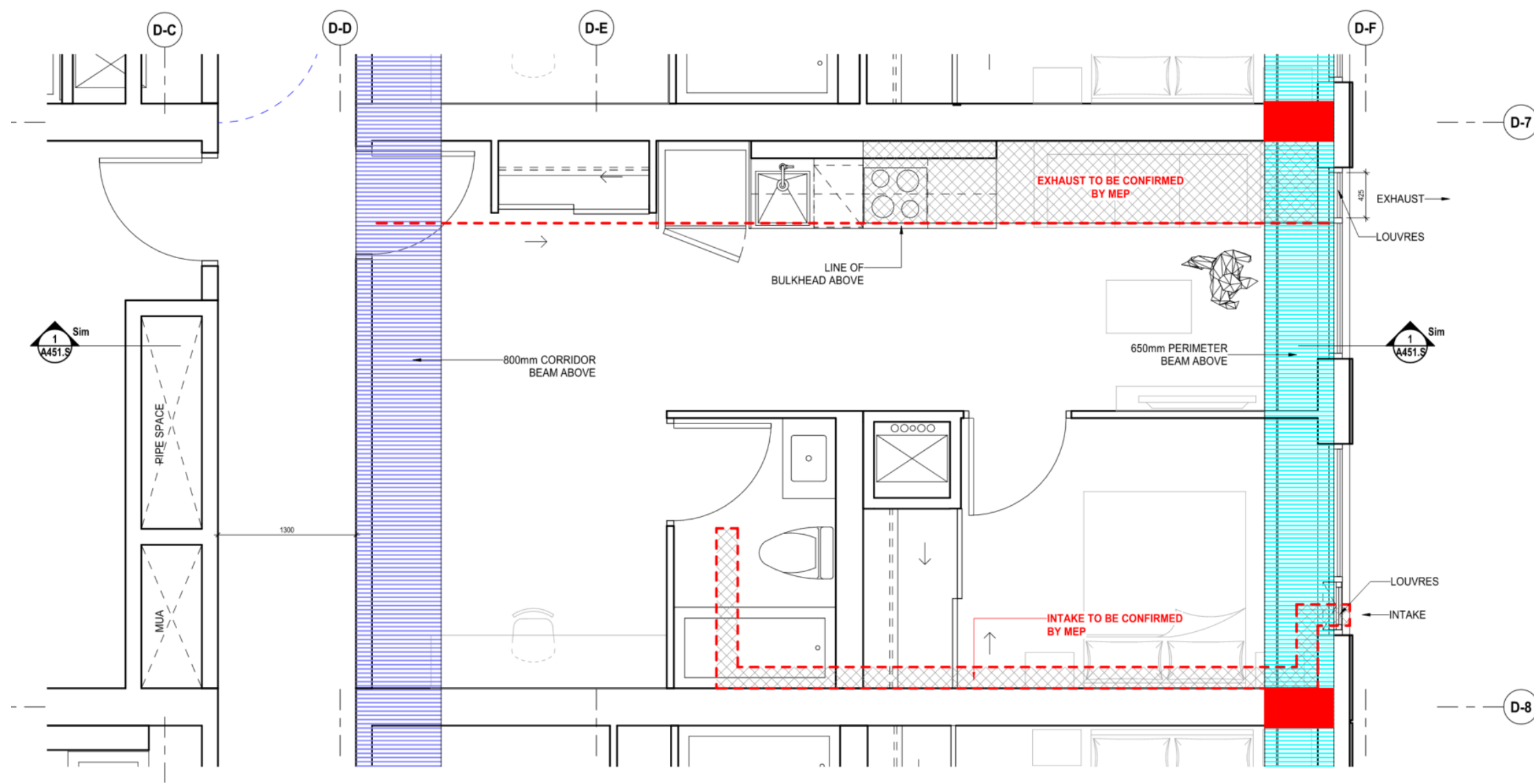
TYPICAL PRECAST DETAIL @ WINDOW AND PERIMETER BEAM



Typical Floor Plan



Suite Layout



Architectural section drawing showing a kitchenette area and a corridor. The drawing includes dimensions and labels for various components:

- Corridor:** Width 1300. Section line D-C is indicated.
- Kitchenette:**
 - Overall width: 8'-10" (2,700mm), 7'-10" (2,400mm), 7'-3" (2,200mm).
 - Section line D-D is indicated.
 - Labels: CORRIDOR BEAM, PERIMETER BEAM, LINE OF BULKHEAD.
- Dimensions:**
 - 250mm, 400, 300, 350, 625, 25, 500, 1925.
 - 2,925 mm typ. module
 - 2,950 mm floor to floor
- Labels:**
 - SHAFT PIPE SPACE
 - CORRIDOR
 - MEP TO CONFIRM THE SPACE FOR SERVICES AT CORRIDOR AND BELOW THE BEAM
 - MODULAR PRECAST WALL
 - 25mm PRECAST JOINT
 - TOP OF SILL
 - TYPICAL FLOOR LEVEL
- Section Lines:** D-C, D-D, D-E, D-F.

The Mock-up



Contrasting Cast-in-place with Precast



Contrasting Cast-in-place with Precast



Contrasting Cast-in-place with Precast



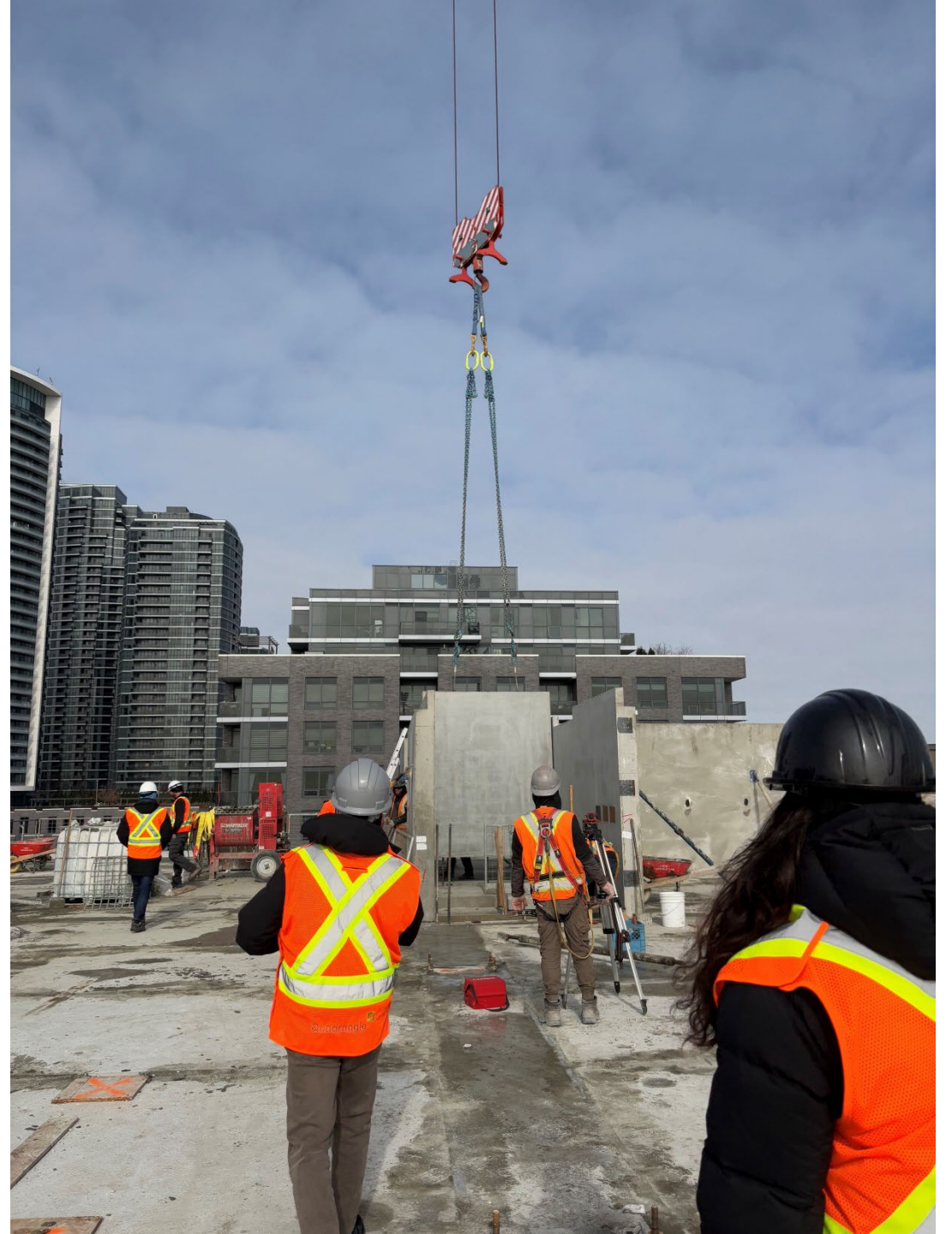
Transportation



Installation









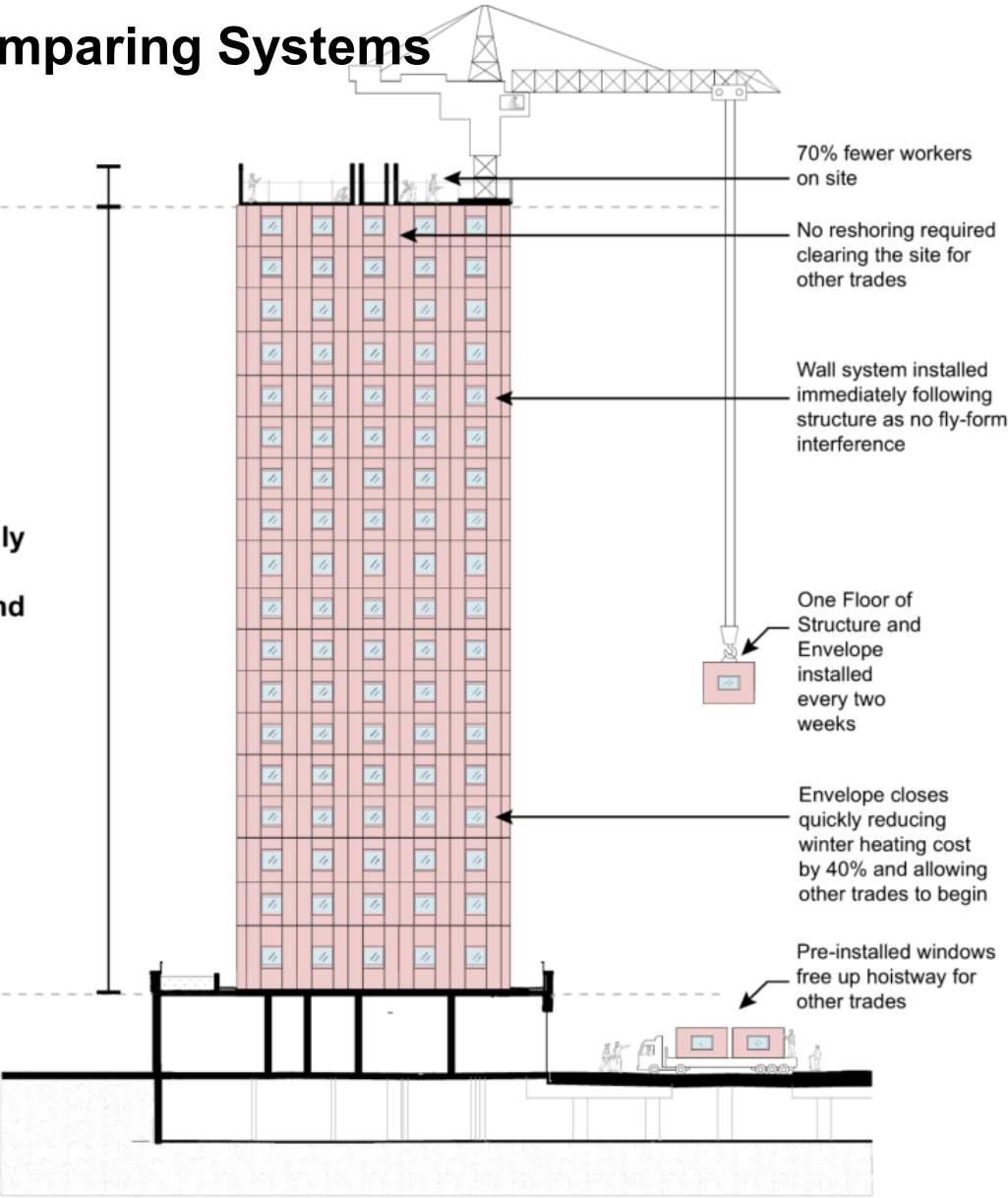
The Details





Comparing Systems

Floors Fully Enclosed Precast and Windows



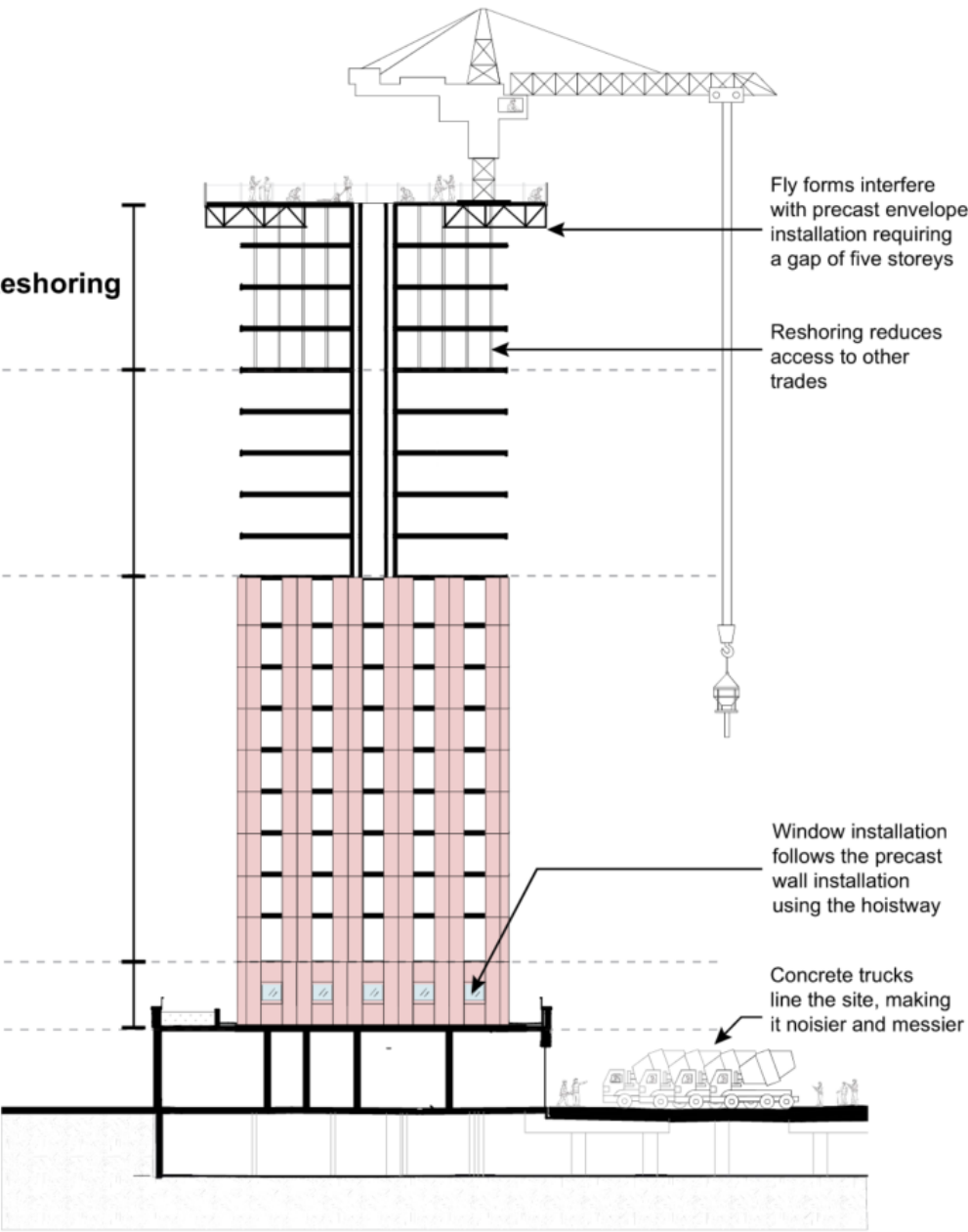
Precast Concrete Structure
18 Weeks Schedule Savings

4 Storeys of Reshoring

5 Storey Gap

8-10 Floors Precast No Windows

Window Installation



Cast in Place Concrete Structure
Hoist Required On-Site for Window Installation

Design and Reality





Lakeview Village

21058 | Toronto, ON

Design in Progress

MMC
Category Pre-manufactured
Non-Structural Assembly

5

Product:
**Sapphire
Clip-on Balcony**



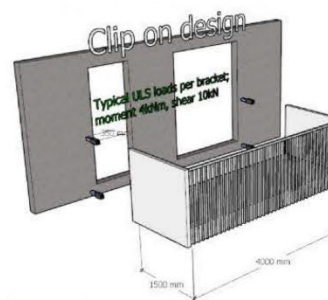
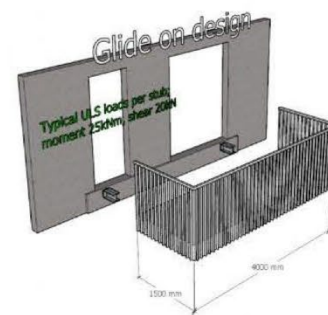
Client:
DECO Homes

Contractor:
Bluescape

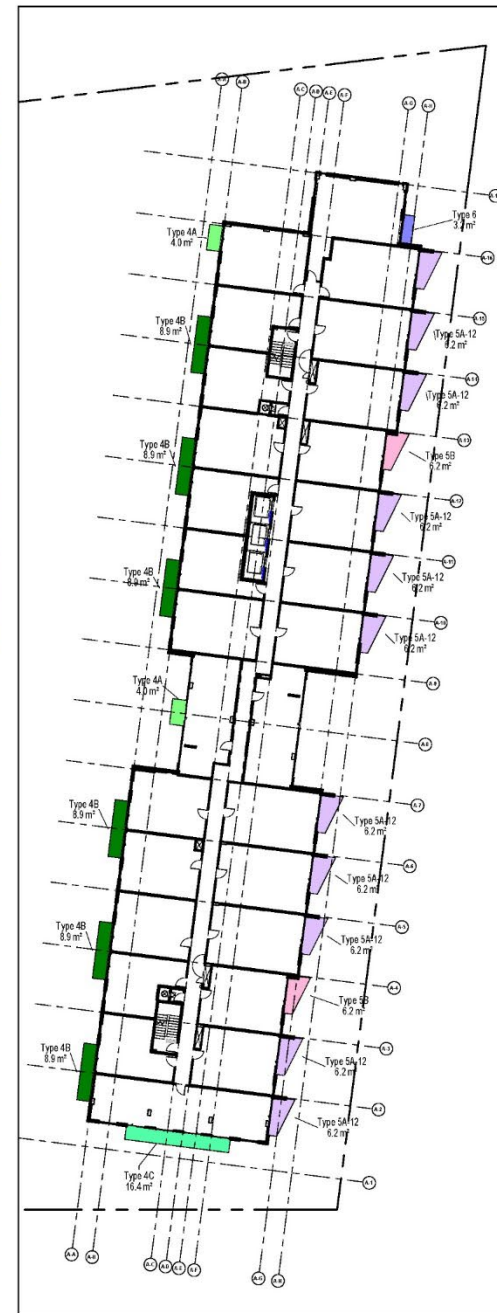
Manufacturer:
Sapphire Balconies



Sapphire
Glide-on
System

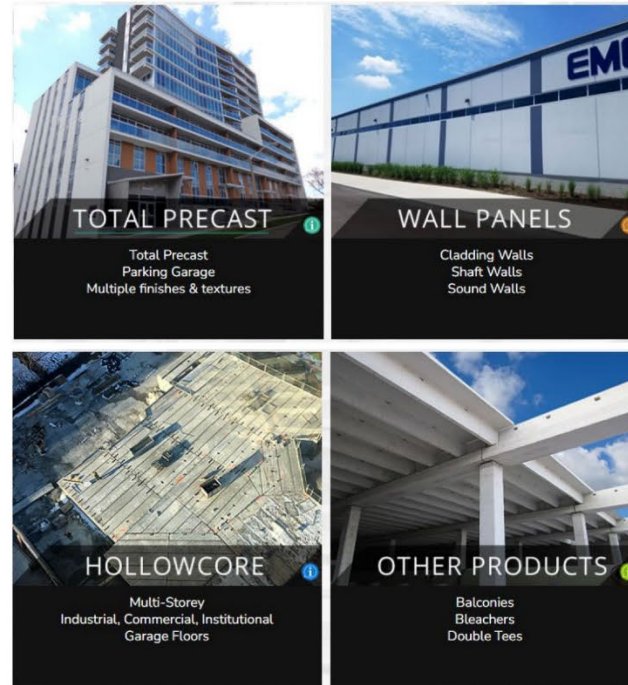


Sapphire
Clip-on
System



Local Precast Manufacturers (Envelope + Structure)

Stubbe's
Greater Toronto Area



Modular Precast Systems (MPS)
Greater Toronto Area



Structural Components

- Columns and Beams
- Prestressed floor slabs
- Balconies

Prestressed Floor Slabs

- Fill-in/hoist slabs
- Solid slabs
- Floor slabs
- Balconies



Architectural Precast

Finishes include: colour stain, white cement, exposed aggregate and formliner (brick, stone, wood and ribbed options available)

Commercial Insulated Precast

- Conventional reinforced and prestressed designs
- Panels can be up to 12' wide and 45' tall
- Insulated with 4" to 8" of rigid XPS for R values up to 30+
- Finishes include colour stain, white cement, exposed aggregate and formliner (brick, stone, wood and ribbed options available)



Local Precast Manufacturers (Envelope Only)

TKL Group
Greater Toronto Area



Res Precast
Greater Toronto Area



Global Precast
Greater Toronto Area



Clip-On Balcony Manufacturer

Sapphire Balconies
Greater Toronto Area



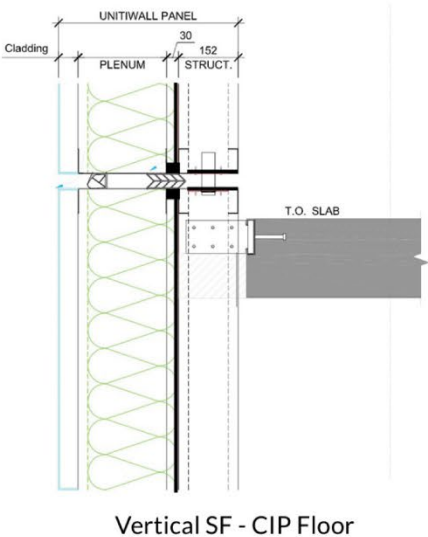
Collaboration

UnitiWall
Greater Toronto Area



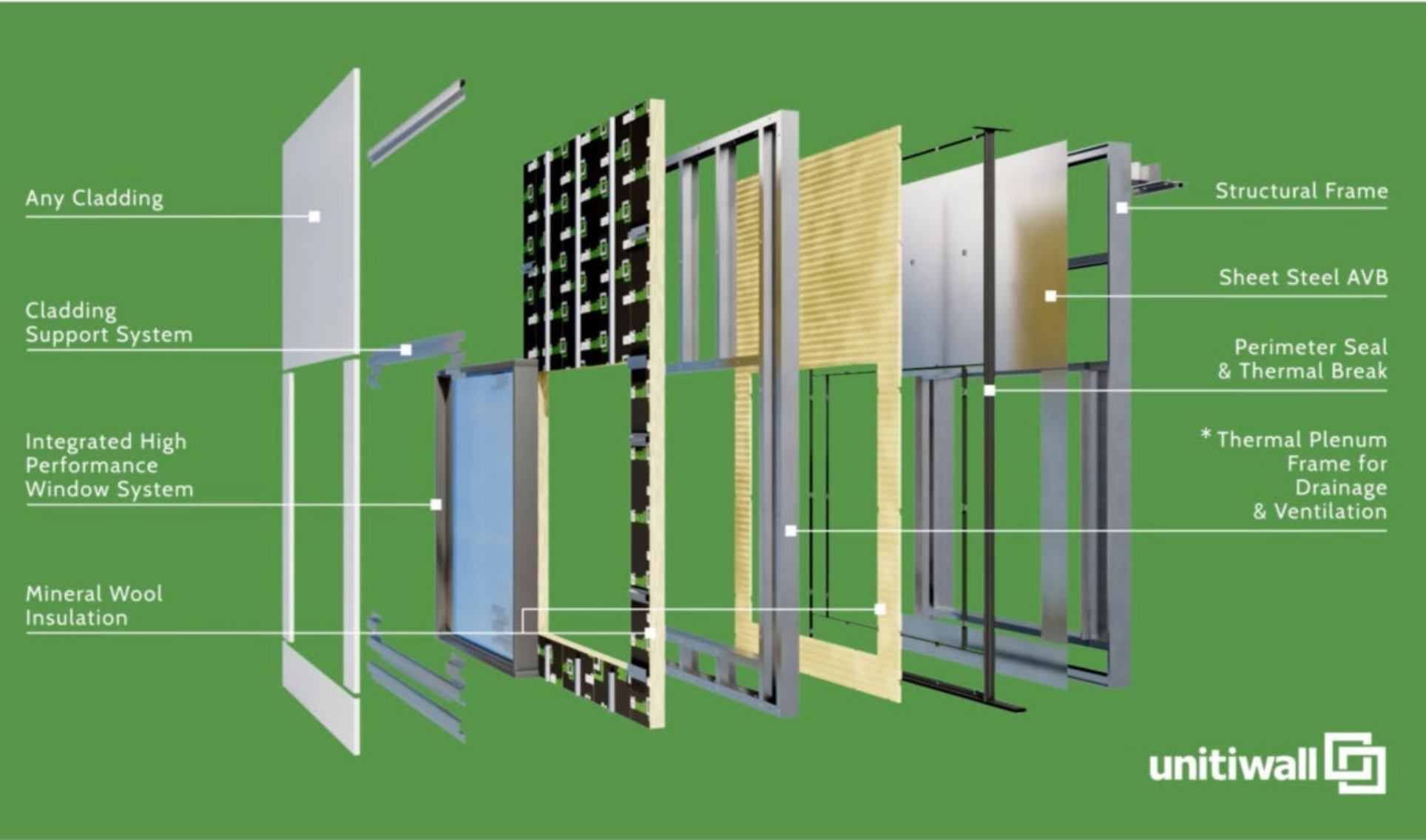
University of Toronto Academic Wood Tower
100 Devonshire Place, Toronto, Ontario
Patkau Architects & MJMA

Contractor:
POMERLEAU



UnitiWall

Greater Toronto Area



Fully Compatible with any
Cladding and Window System



Specialty Metals



Glass



Wood



Phenolic



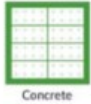
Terracotta



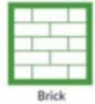
Solar Shading



Fiber Cement



Concrete



Brick



Porcelain



Extruded/Perforated
Metals



Slate

Typical Wall System Thickness 11-15" (plus cladding thickness)

*Patented Techno

Other Products

ModularPods

Greater Toronto Area



Bathroom pods contribute to a cleaner and safer work environment, help reduce labor, materials, waste, and costs, and increase speed to occupancy.

Example

Cortellucci Vaughan Hospital

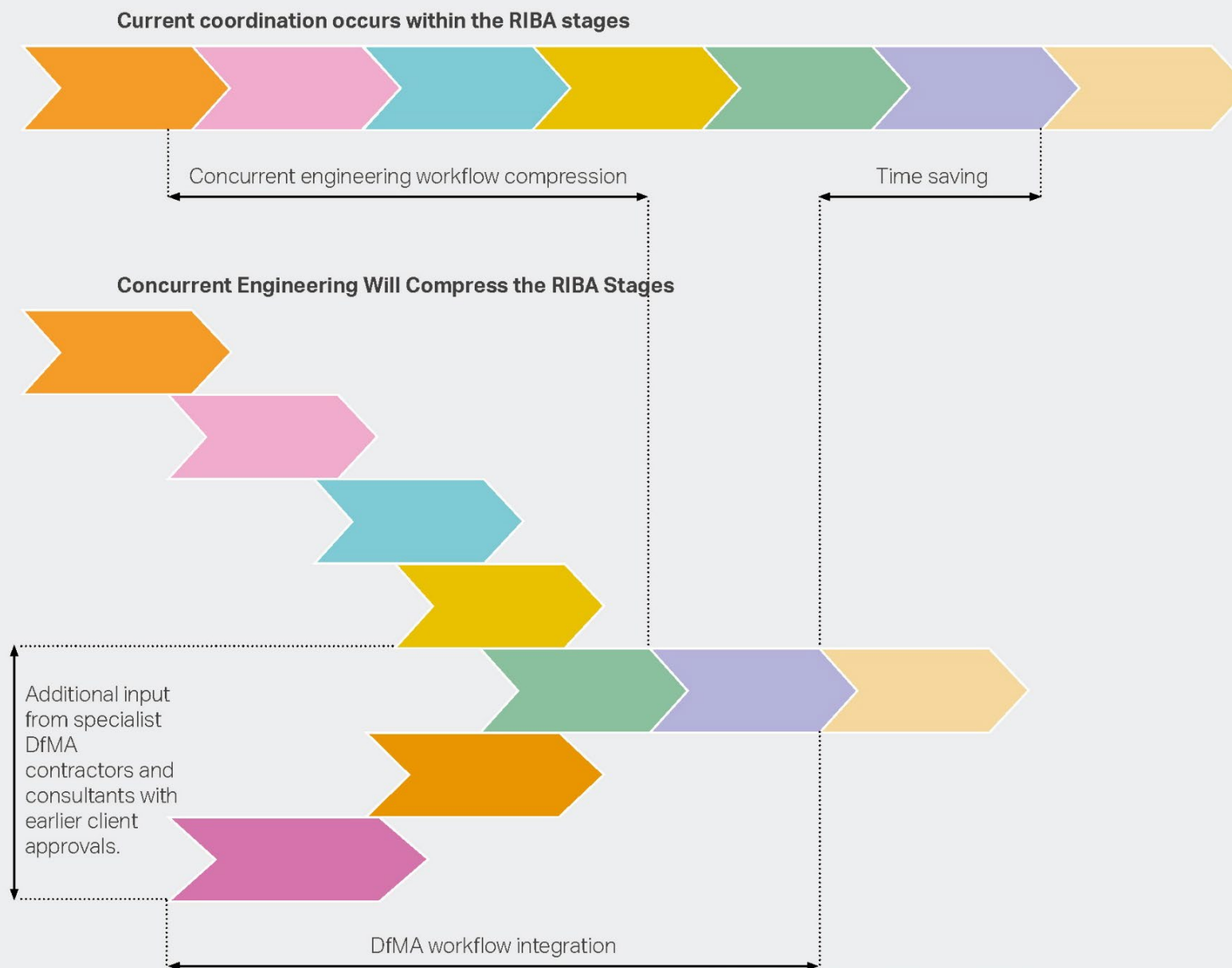
Vaughan, Ontario
PCL



Actions

What's Next?

The power of concurrent engineering

BDP.

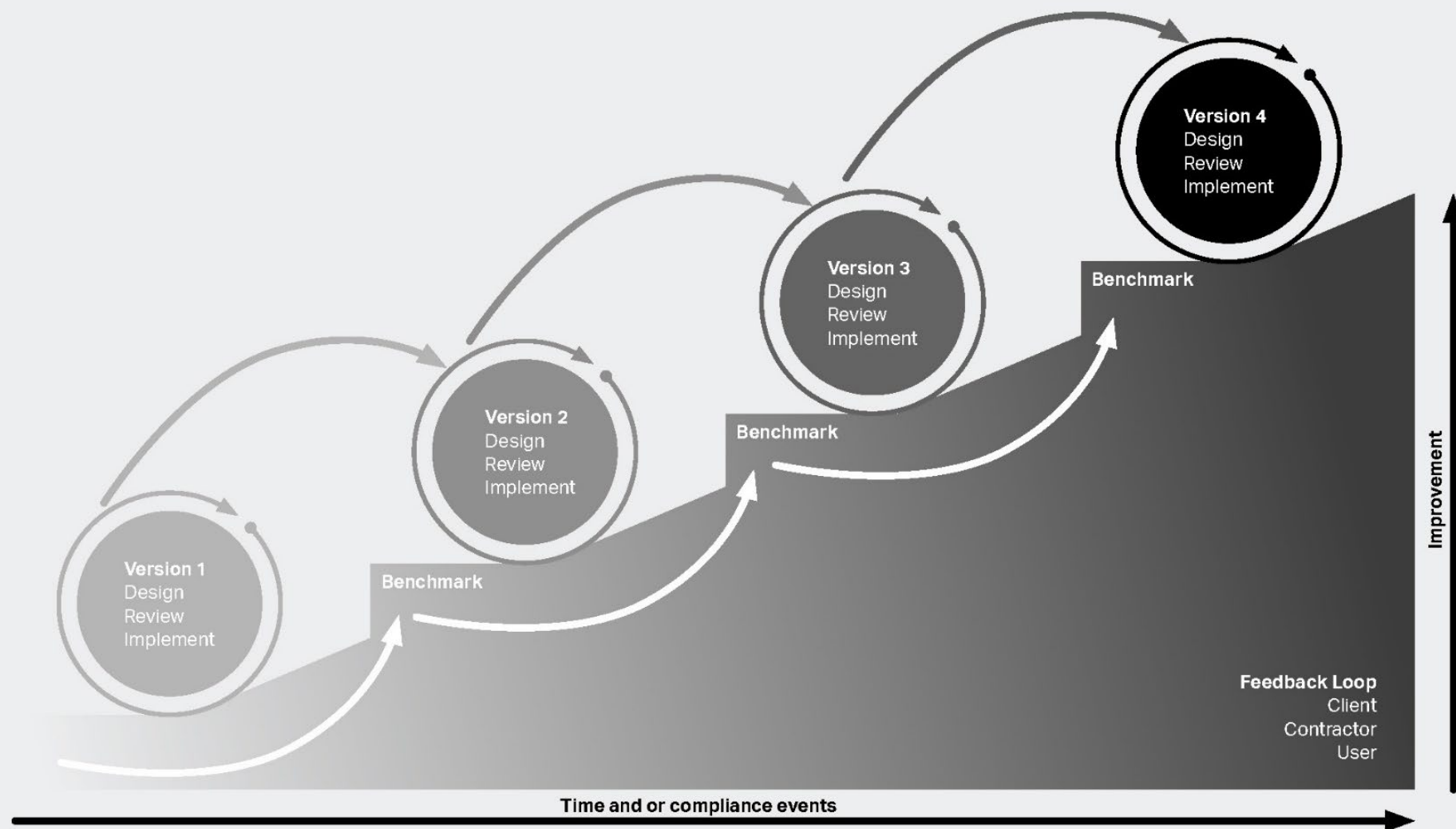
1

2

3

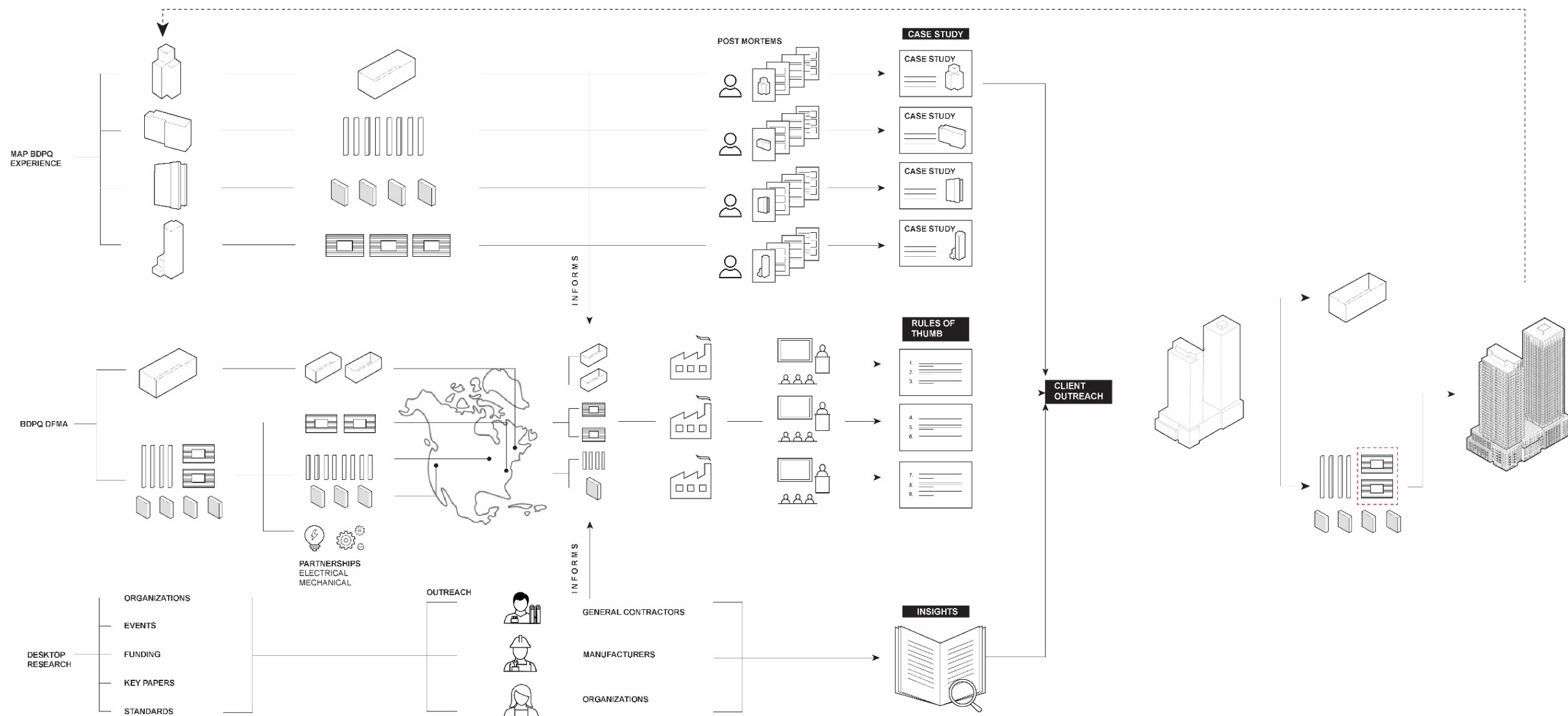
4

Step 3: Unlocking continuous improvement

BDP.

INPUT

OUTPUT



Discussion

Michelle Xuereb, Innovation Director

mxuereb@bdpquadrangle.com