Brock Commons Student Residence
The University of British Columbia

ROBERT JACKSON, PROJECT ENGINEER, FAST + EPP

CREDIT: SEAGATE

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

STUDENT RESIDENCE AT BROCK COMMONS

- Project Background
- Design Context
- Design Approach
- Building Overview
- Key Analysis / Design Issues
- Construction
- Conclusion

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DESIGN TEAM

THE UNIVERSITY OF BRITISH COLUMBIA

UBC PROPERTIES TRUST

ACTON OSTRY ARCHITECTS INC

Architekten Hermann Kaufmann ZT GmbH

Fast + Epp

GHL CONSULTANTS LTD
Building Codes & Fire Science

RDH

RWDI

EnerSys

Stantec

Canadian Wood Council
Conseil canadien du bois

Coordinate. Create. Innovate
CadMakers Inc.

HAPA

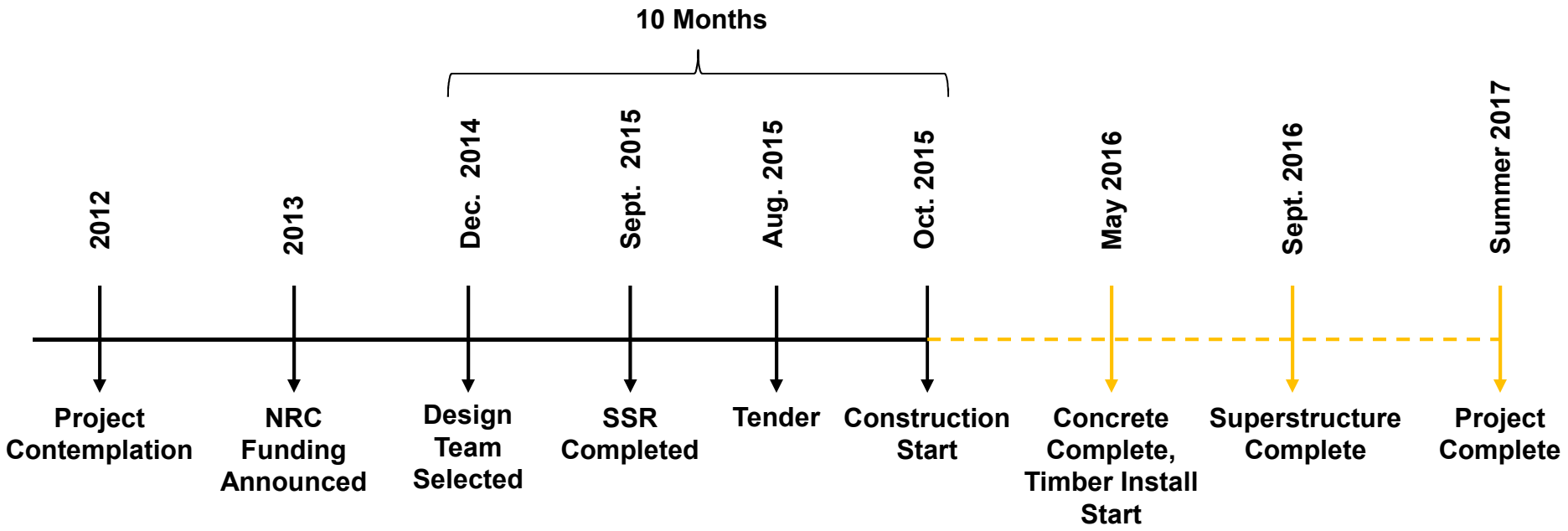
URBAN ONE builders

SEAGATE Structures
QUALITY + INTEGRITY

WHITEWATER CONCRETE LTD.

Zenith Commissioning Consulting

TIMELINE


10 Months
2012
Project Contemplation
2013
NRC Funding Announced
Dec. 2014
Design Team Selected
Sept. 2015
SSR Completed
Aug. 2015
Tender
Oct. 2015
Construction Start
May 2016
Concrete Complete, Timber Install Start
Sept. 2016
Superstructure Complete
Summer 2017
Project Complete

EXTERNAL FUNDING

- National Resources Canada (NRCan)
- Forestry Innovation Investment
- Ministry of Forests, Lands, And Natural Resource Operations
- Binational Softwood Lumber Council

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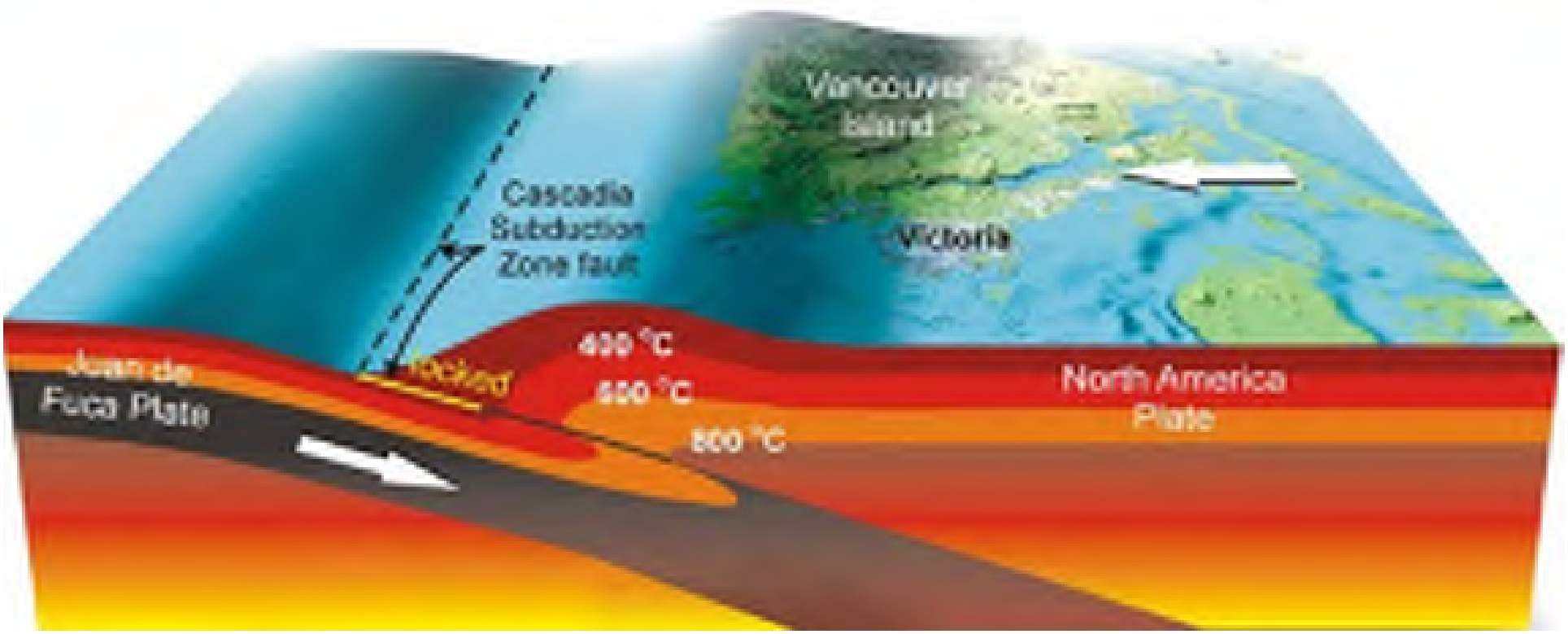
LOCATION/CLIMATE

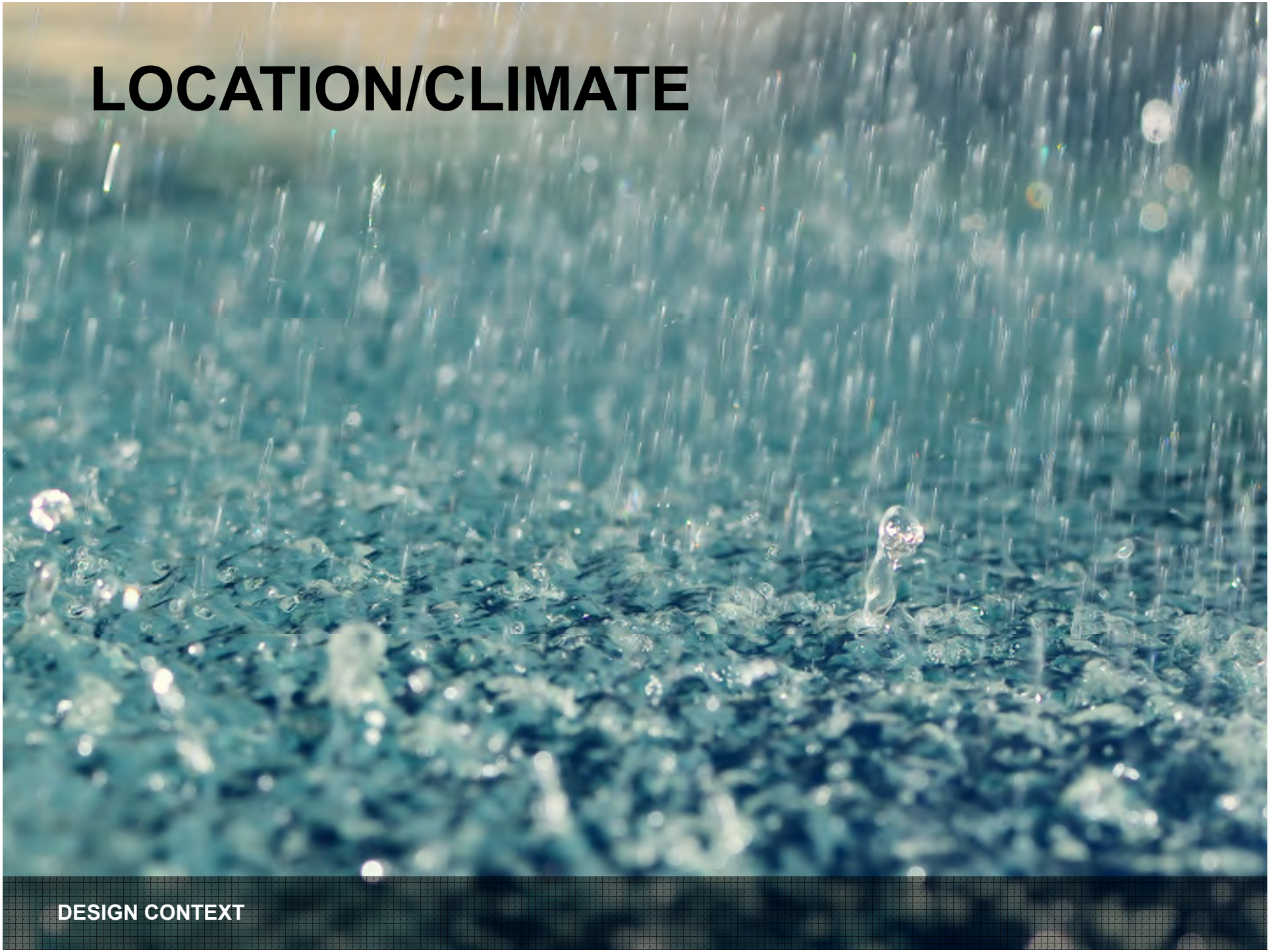
DESIGN CONTEXT

LOCATION/CLIMATE

LOCATION/CLIMATE



LOCATION/CLIMATE



COST

TIMBER
192 $/ft²

BUILDING CODES & MATERIAL STANDARDS

BRITISH COLUMBIA
BUILDING CODE 2012

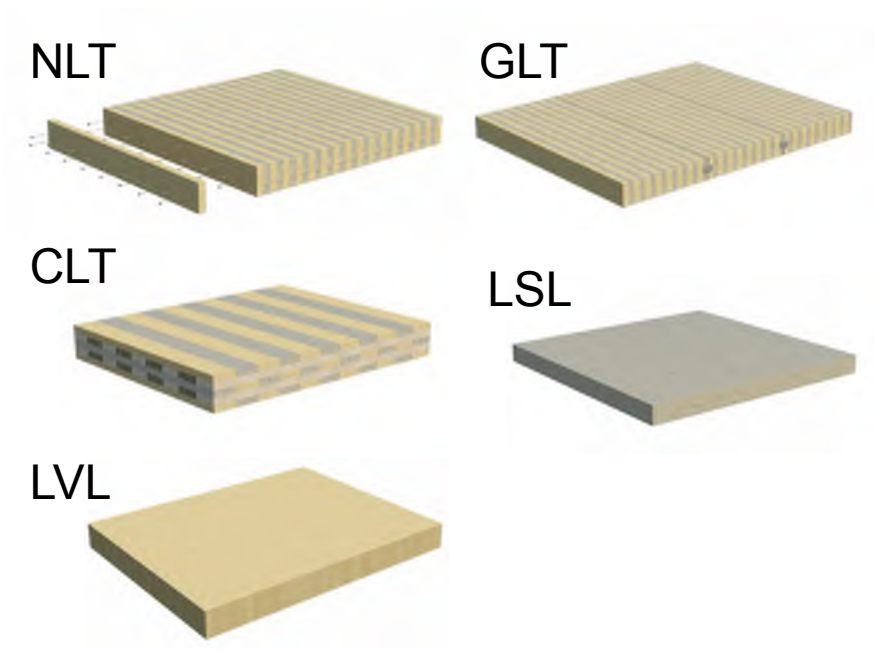
ENGINEERING DESIGN IN
WOOD

PROCUREMENT

SUPPLIERS

SUPPLIERS

CAPACITY



STARTING POINT

$$\left\{ 0.25 \frac{m^3 \text{ WOOD}}{m^2 \text{ FLOOR}} \right\} \times \left\{ \sim 14570 \ m^2 \right\}$$

= 3640 m^3 OF MASS TIMBER

SUPPLIERS

CAPABILITY

SUPPLIERS

AVAILABILITY

DESIGN CONTEXT

STUDENT RESIDENCE AT BROCK COMMONS

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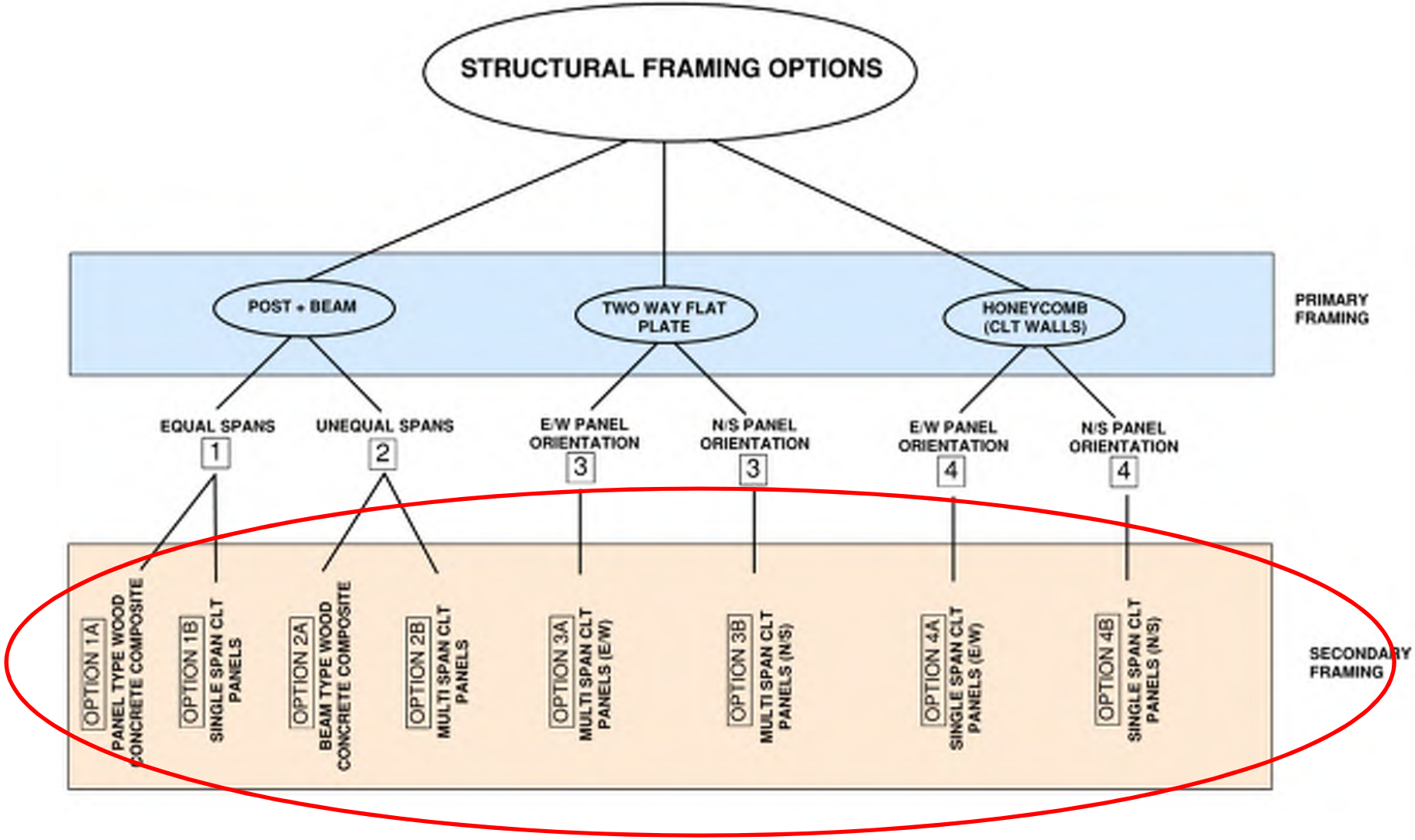
DESIGN APPROACH

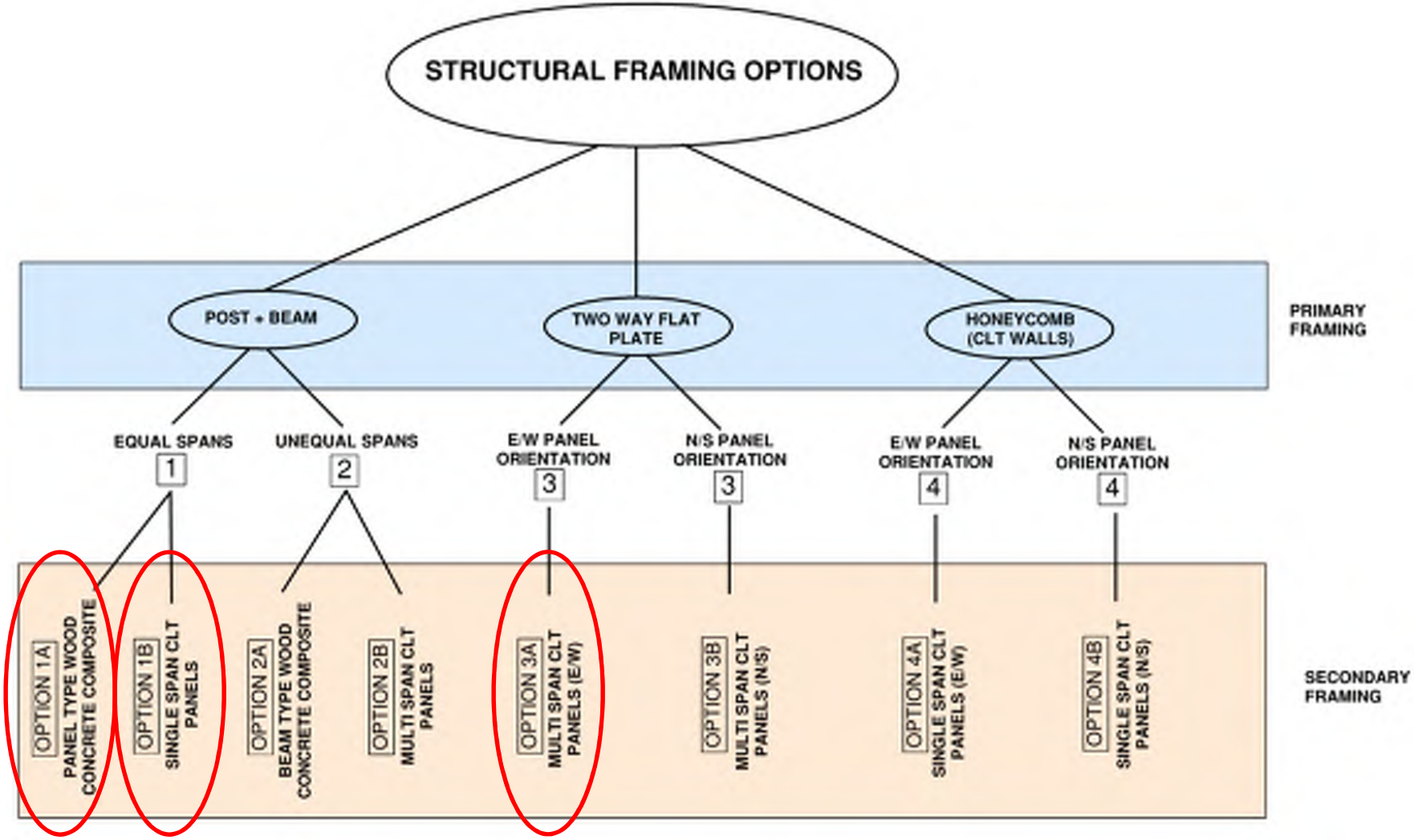
SIMPLE KIT-OF-PARTS PREFABRICATION

CREDIT: SEAGATE

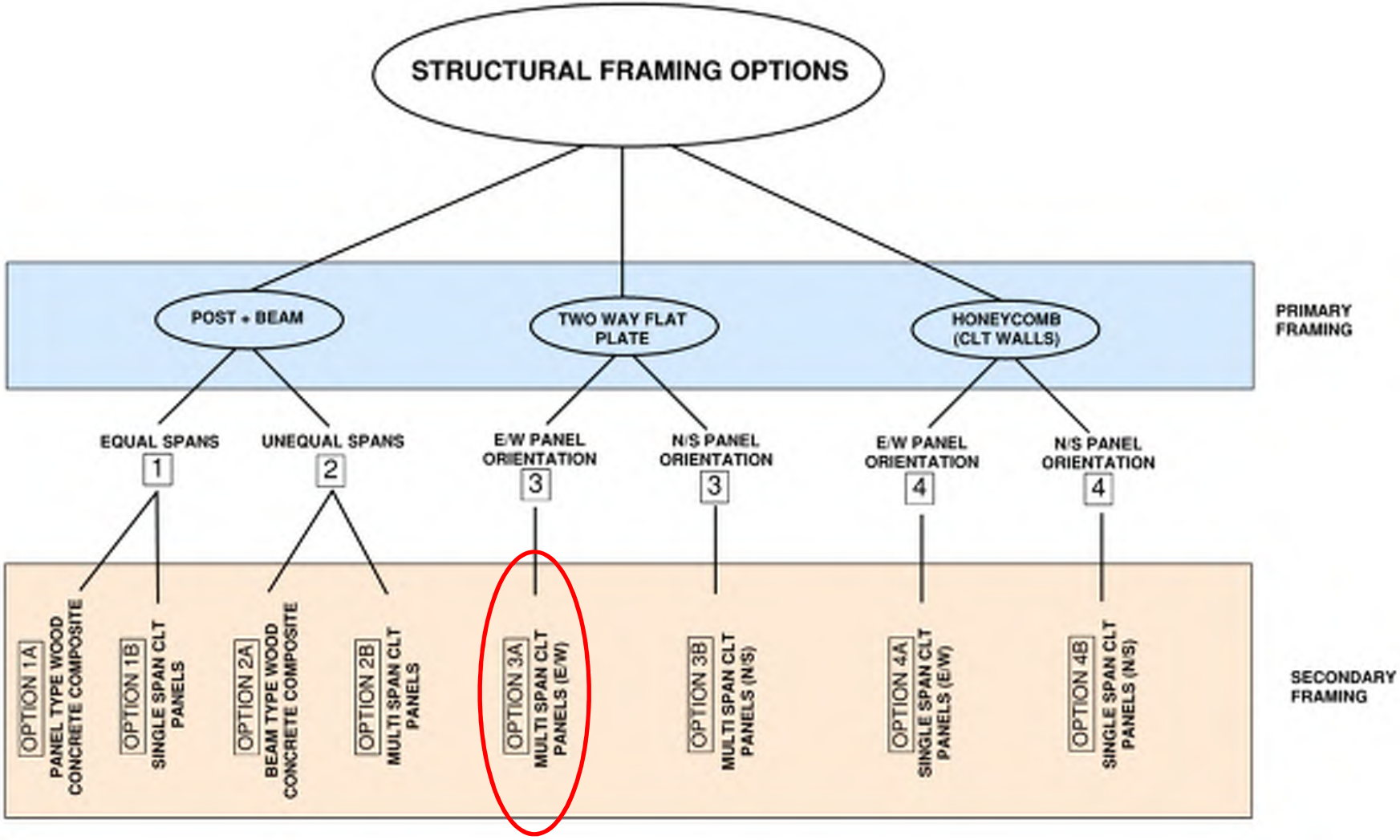
DESIGN APPROACH



DESIGN APPROACH



DESIGN APPROACH



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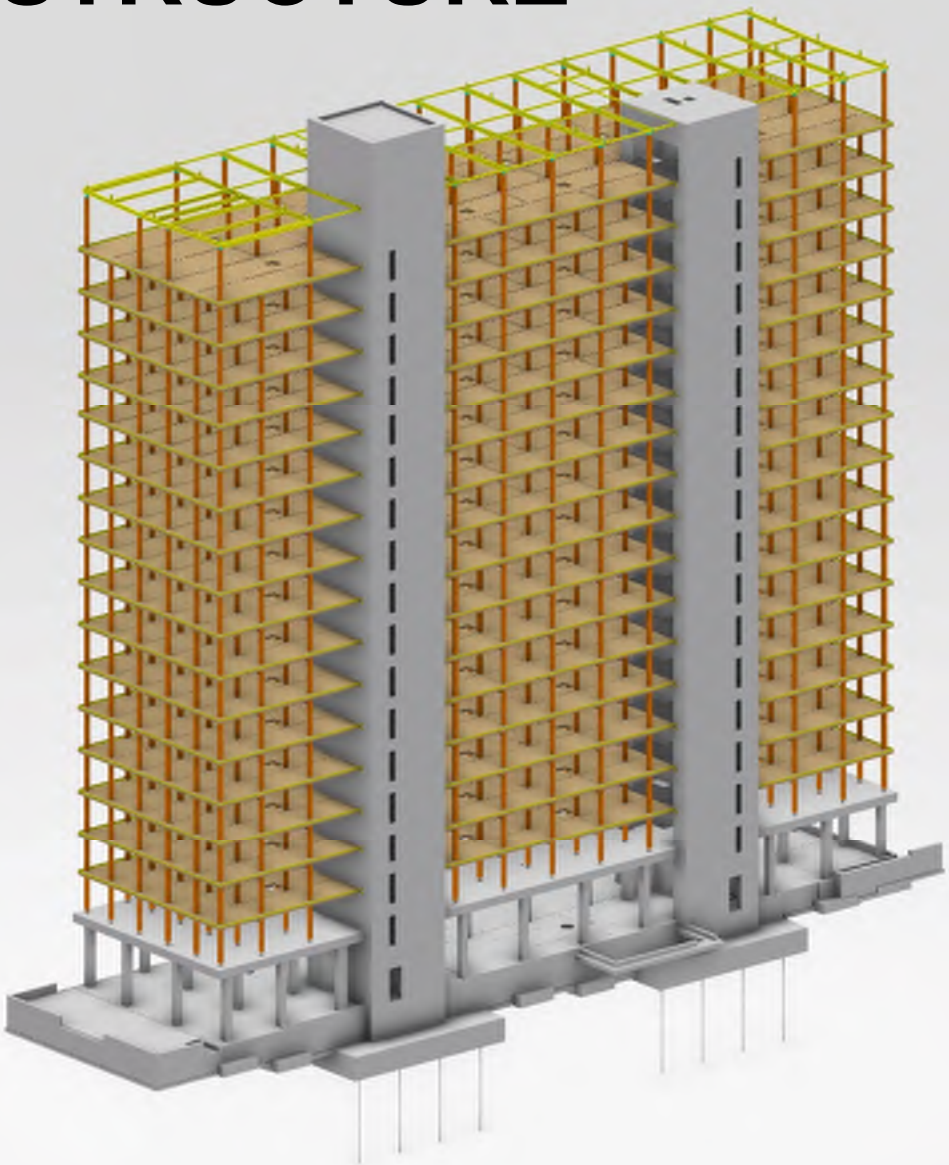
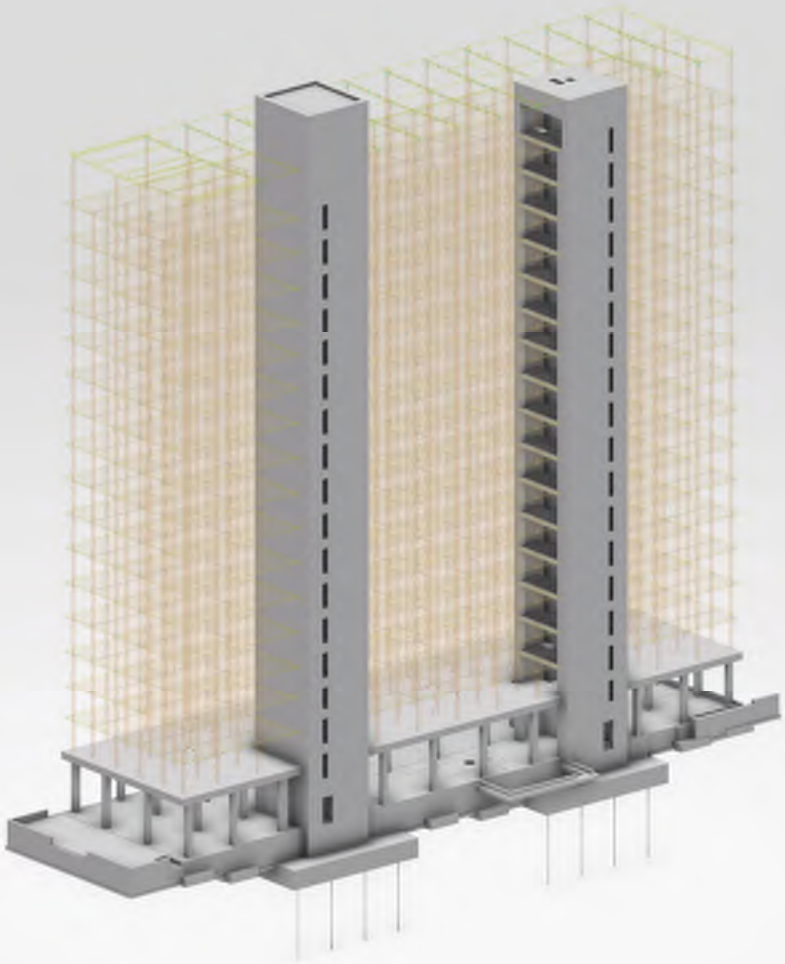
SUPERSTRUCTURE



CREDIT: CADMAKERS

SUPERSTRUCTURE - LATERAL



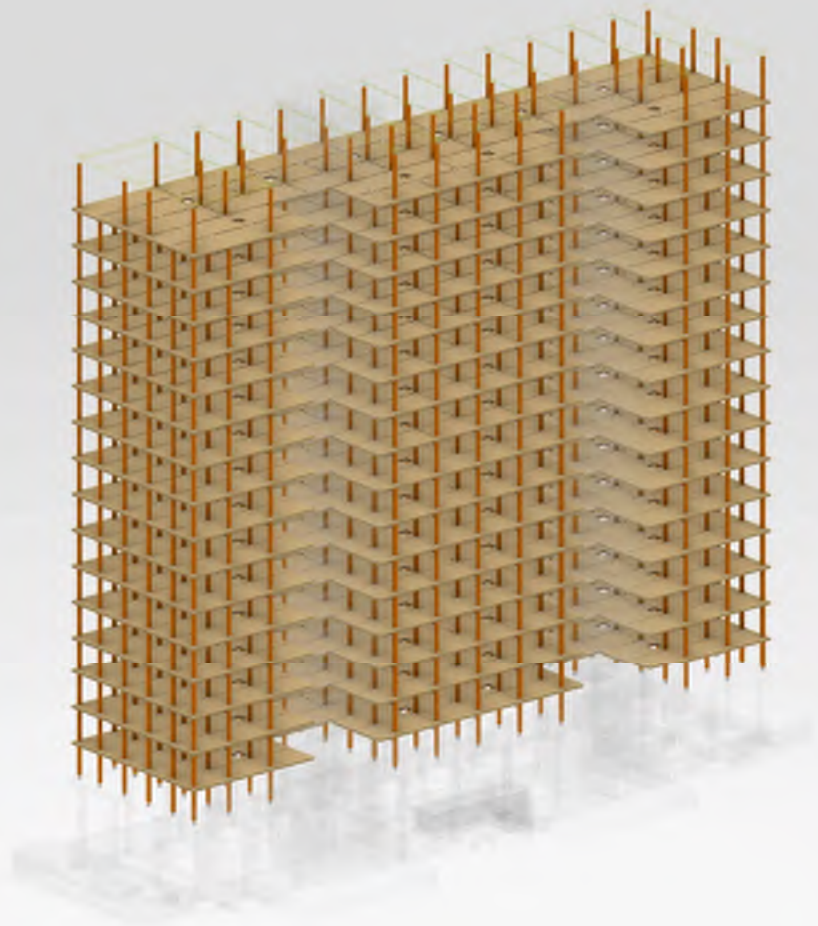
CREDIT: CADMAKERS

SUPERSTRUCTURE - LATERAL

BUILDING OVERVIEW

CREDIT: SEAGATE

SUPERSTRUCTURE - GRAVITY



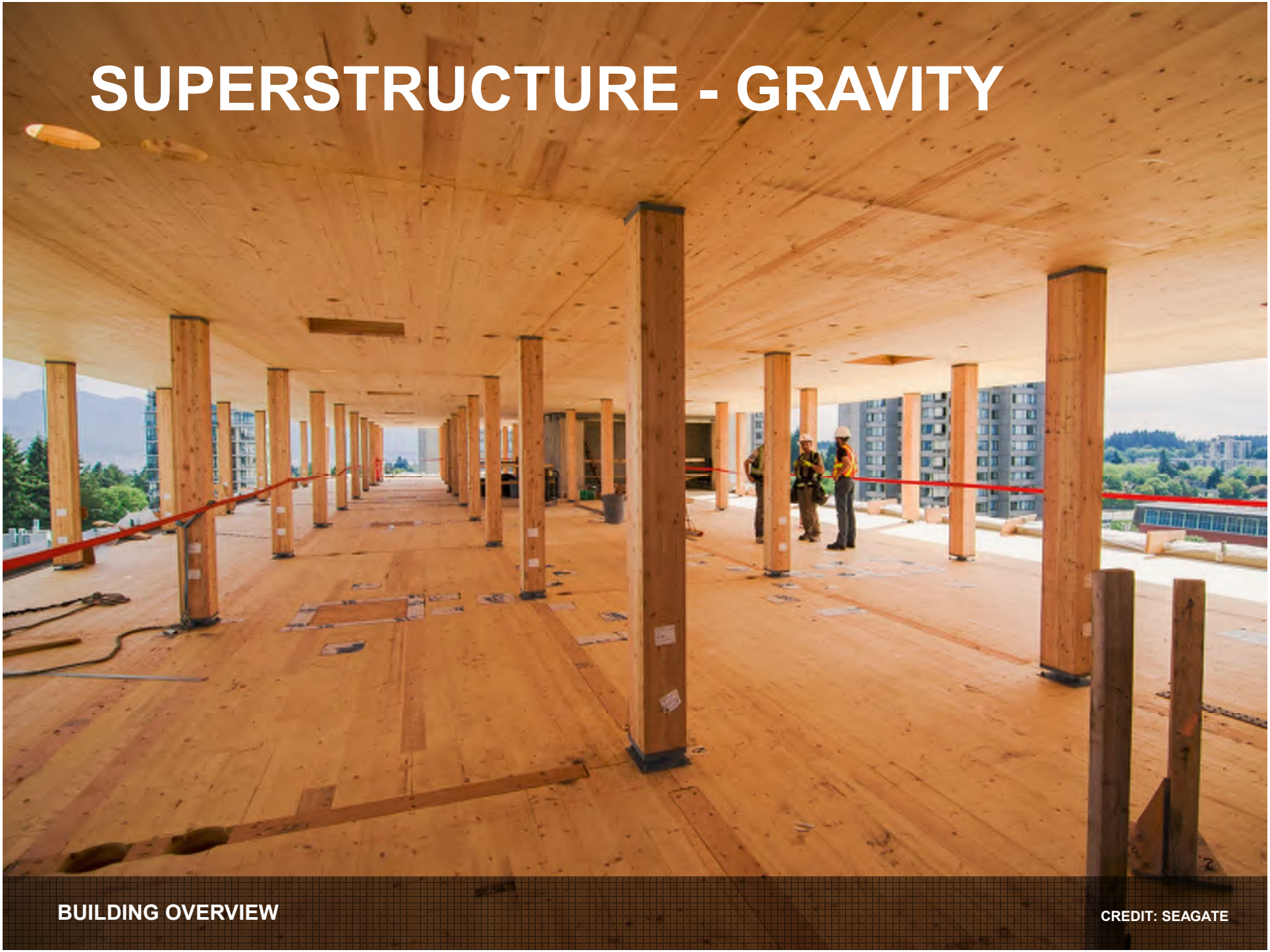
CREDIT: CADMAKERS

SUPERSTRUCTURE - GRAVITY

BUILDING OVERVIEW

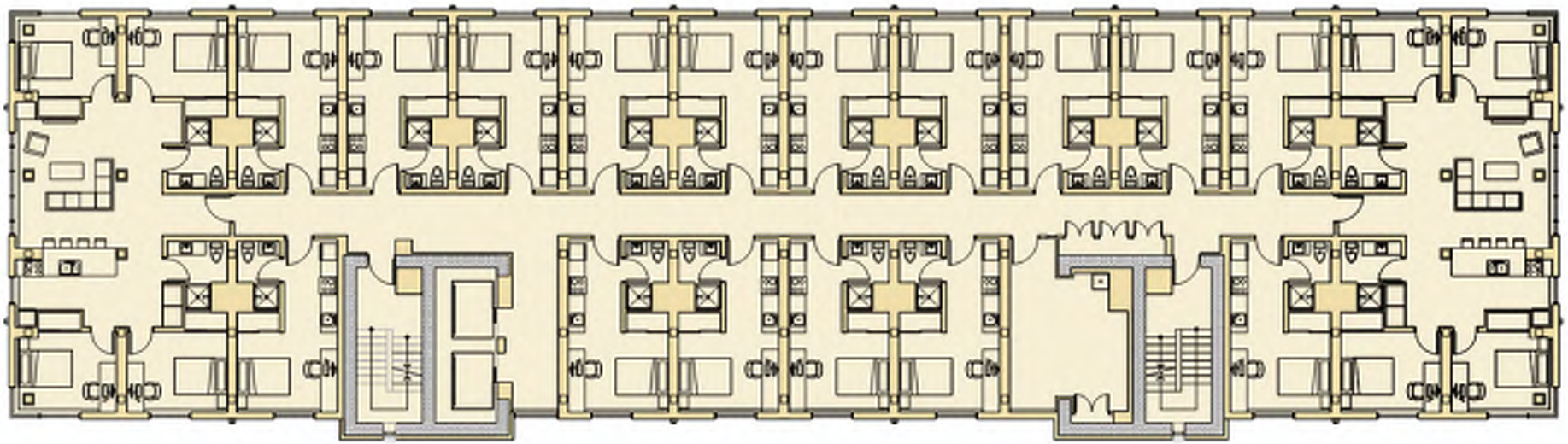
CREDIT: KK LAW

SUPERSTRUCTURE - GRAVITY



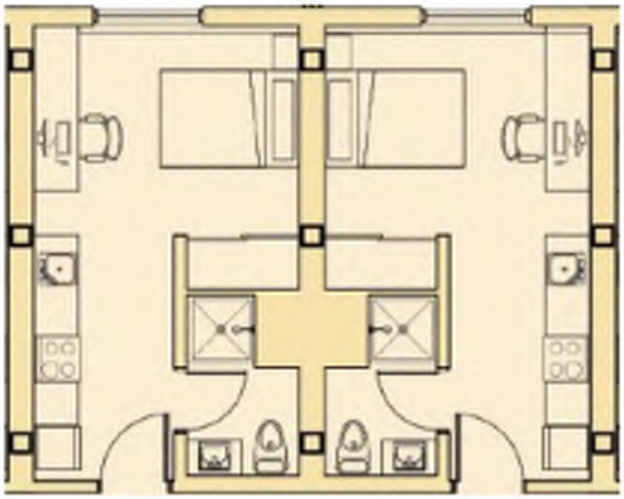
CREDIT: SEAGATE

ARCHITECTURE



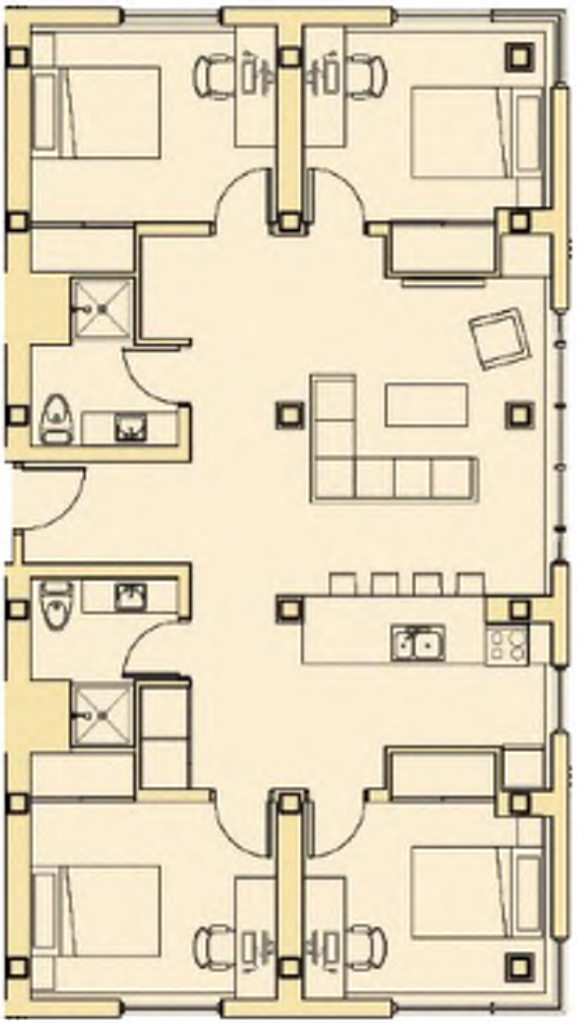
CREDIT: ACTON OSTRY

ARCHITECTURE



studio units

quad unit



CREDIT: ACTON OSTRY

ENVELOPE

BUILDING OVERVIEW

CREDIT: ACTON OSTRY

STUDENT RESIDENCE AT BROCK COMMONS

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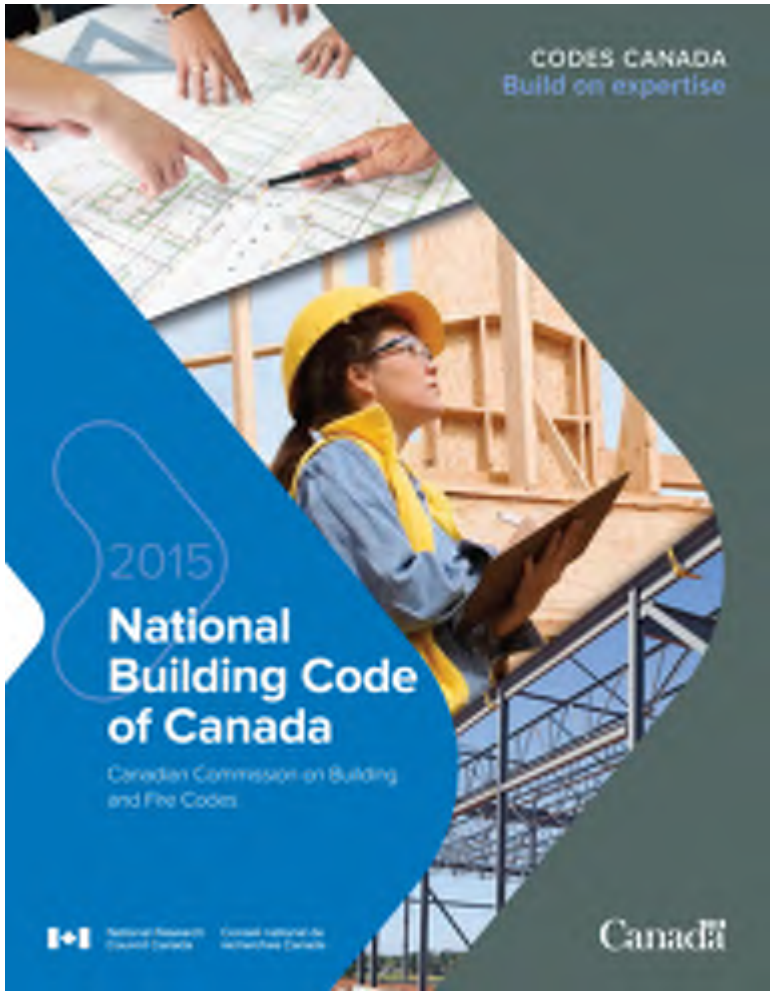
BUILDING CODES & MATERIAL STANDARDS

BCBC 2012 limited to 6-storeys → UBC an Independent Jurisdiction → British Columbia Safety Standards Branch → Site Specific Regulation → Building Permit

BUILDING CODES & MATERIAL STANDARDS

NBCC 2015



BCBC 2012	**NBCC 2015**
Vancouver	**Vancouver**
Sa(0.2) = 0.950	Sa(0.2) = 0.863
Sa(0.5) = 0.650	Sa(0.5) = 0.765
Sa(1.0) = 0.340	Sa(1.0) = 0.432
Sa(2.0) = 0.170	Sa(2.0) = 0.261
PGA = 0.470	PGA = 0.375

BUILDING CODES & MATERIAL STANDARDS

KEY ANALYSIS/DESIGN ISSUES

MICHAEL GREEN ARCHITECTURE

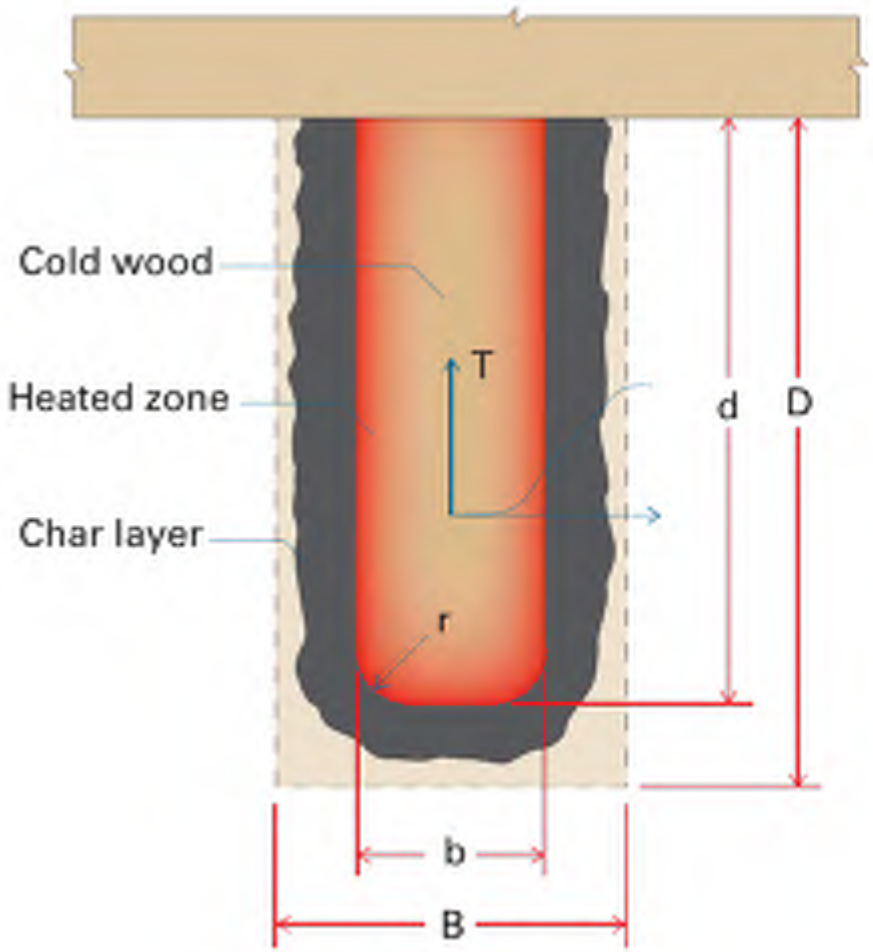
FIRE

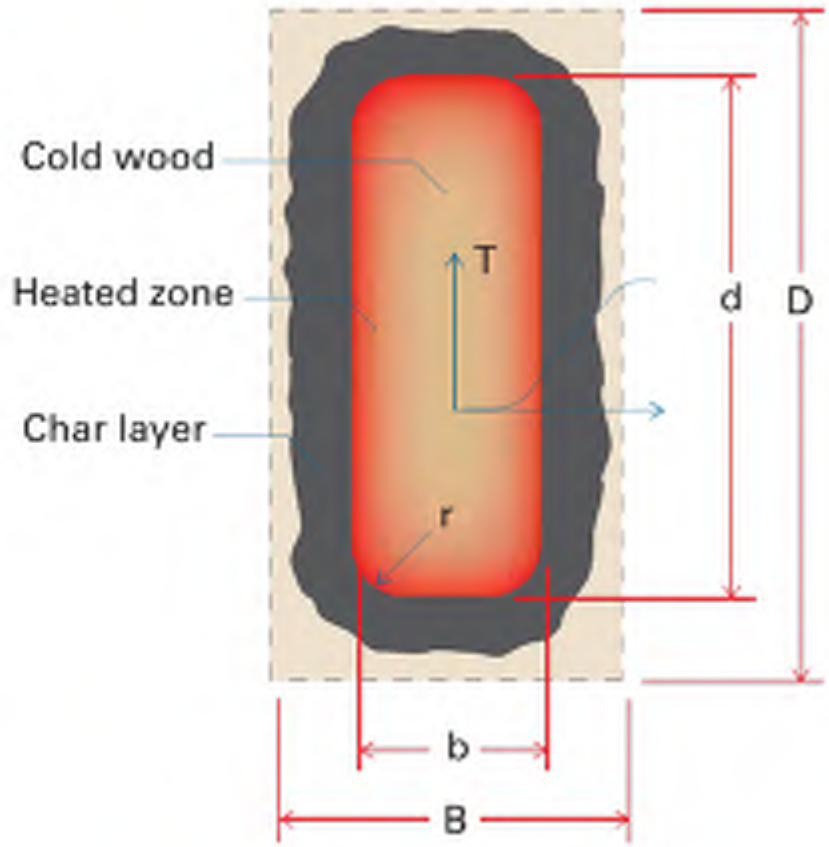
KEY ANALYSIS/DESIGN ISSUES

FIRE

KEY ANALYSIS/DESIGN ISSUES

FIRE


Cold wood
Heated zone
Char layer
T
r
d
D
b
B


Cold wood
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T
r
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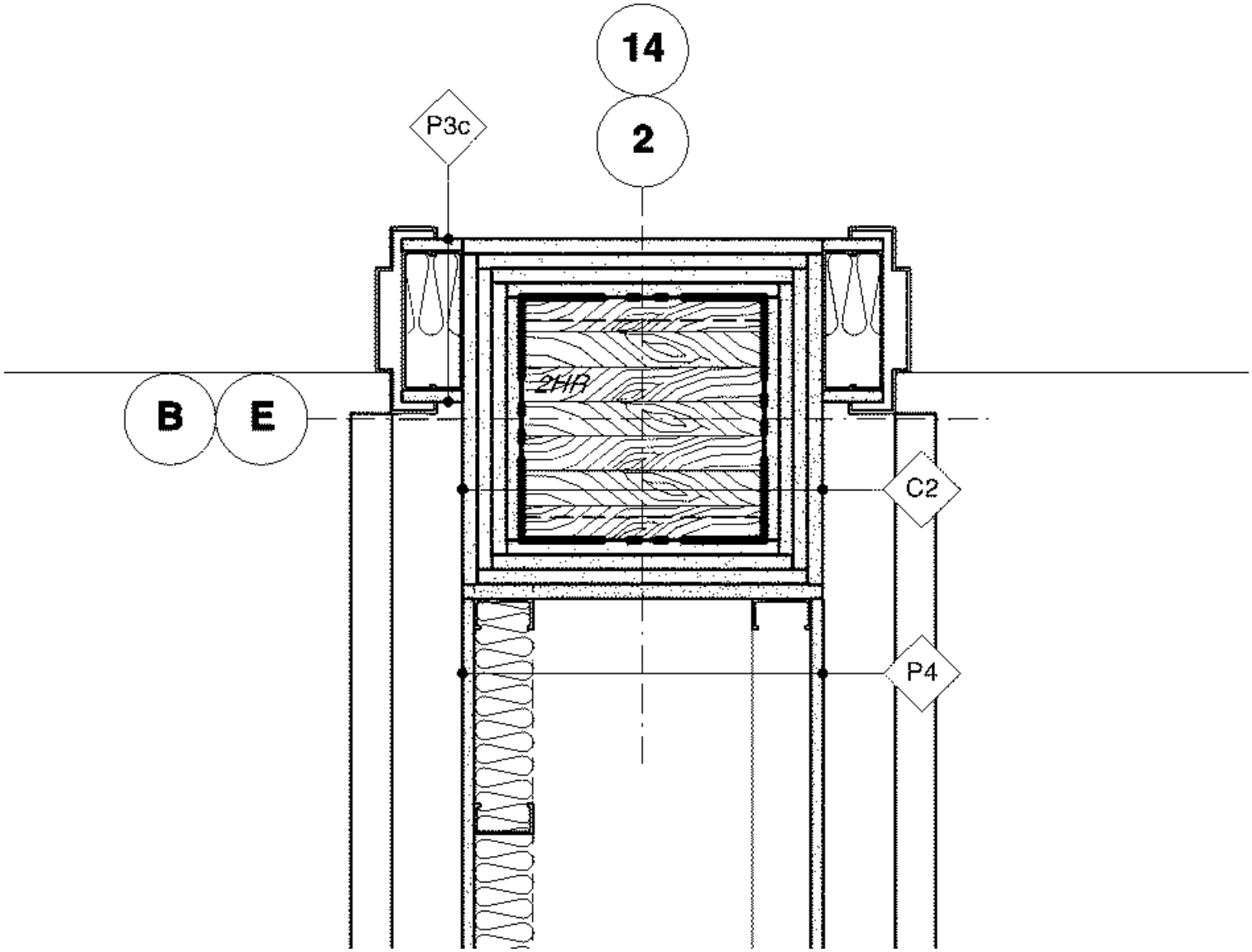
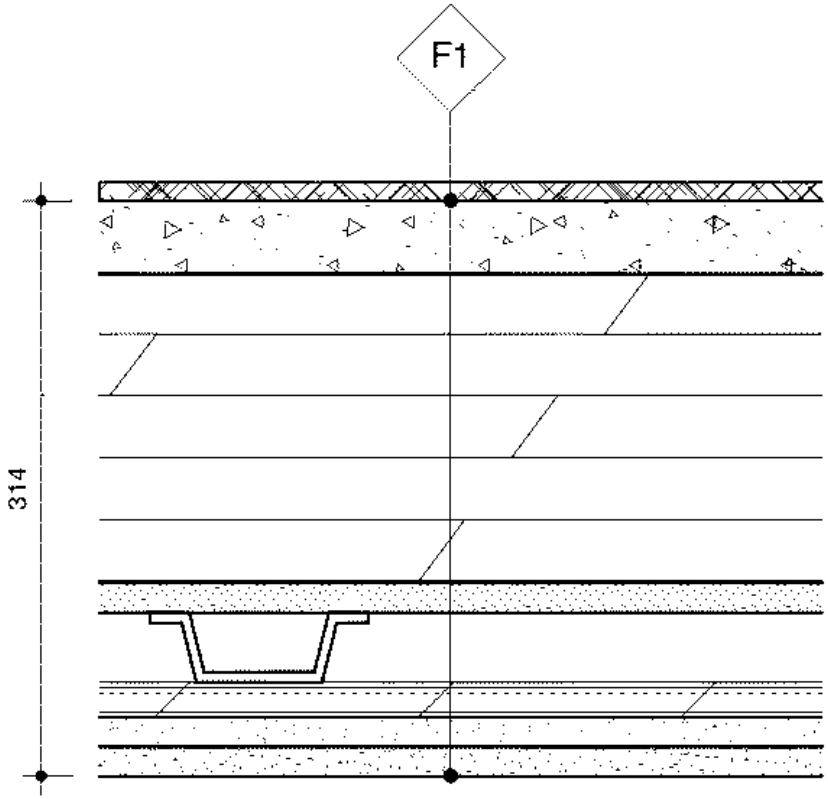
b
B

FIRE



FIRE



F1 - Typical Floor

Assembly

- floor finish
- 40mm concrete topping
- CLT slab panel (refer to struct.)
- 16mm GWB type "X" - moisture resistant (non-paper faced)
- 38mm steel hat track
- 19mm steel res bar @ 400mm o.c.
- 16mm GWB type "X"
- 16mm GWB type "X"
- interior finish

Fire-Resistance Rsting

2hr - refer to code report

Acoustic Performsnce

54 STC (estimated INSUL rating)

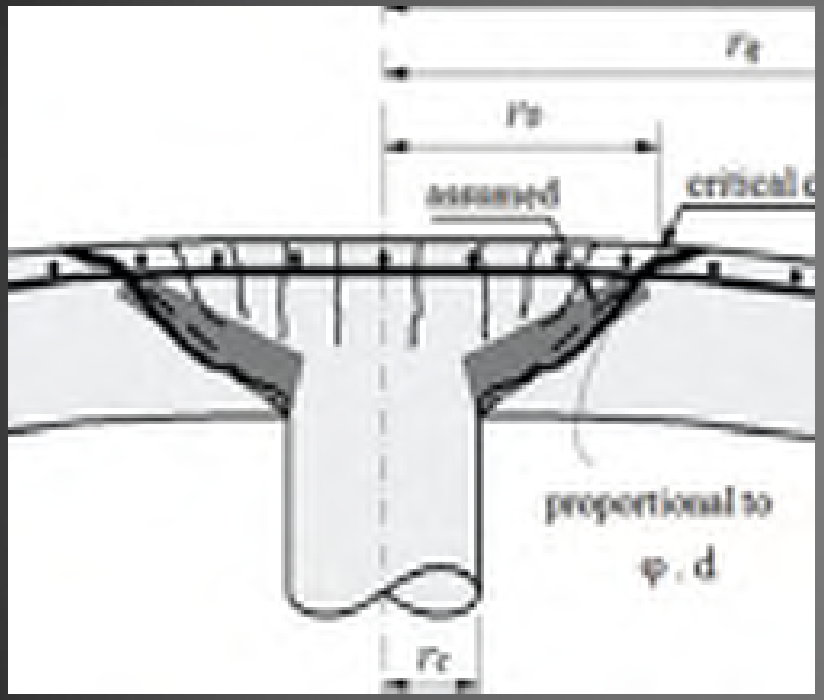
POINT SUPPORTED CLT

KEY ANALYSIS/DESIGN ISSUES

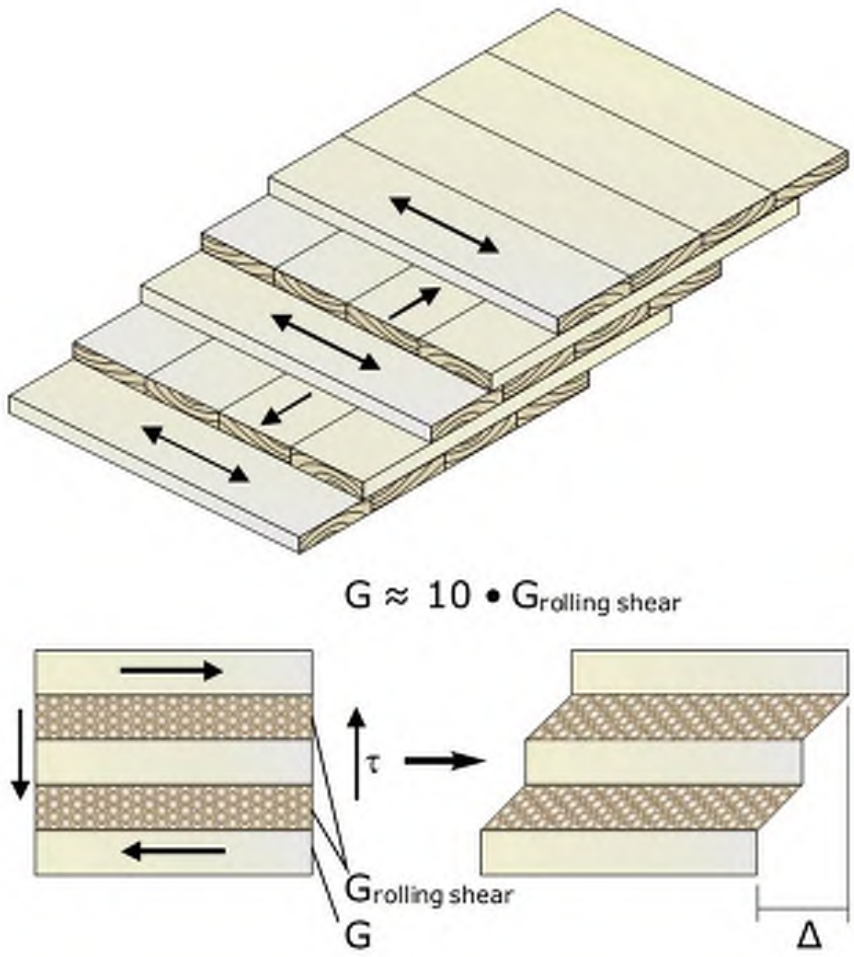
POINT SUPPORTED CLT

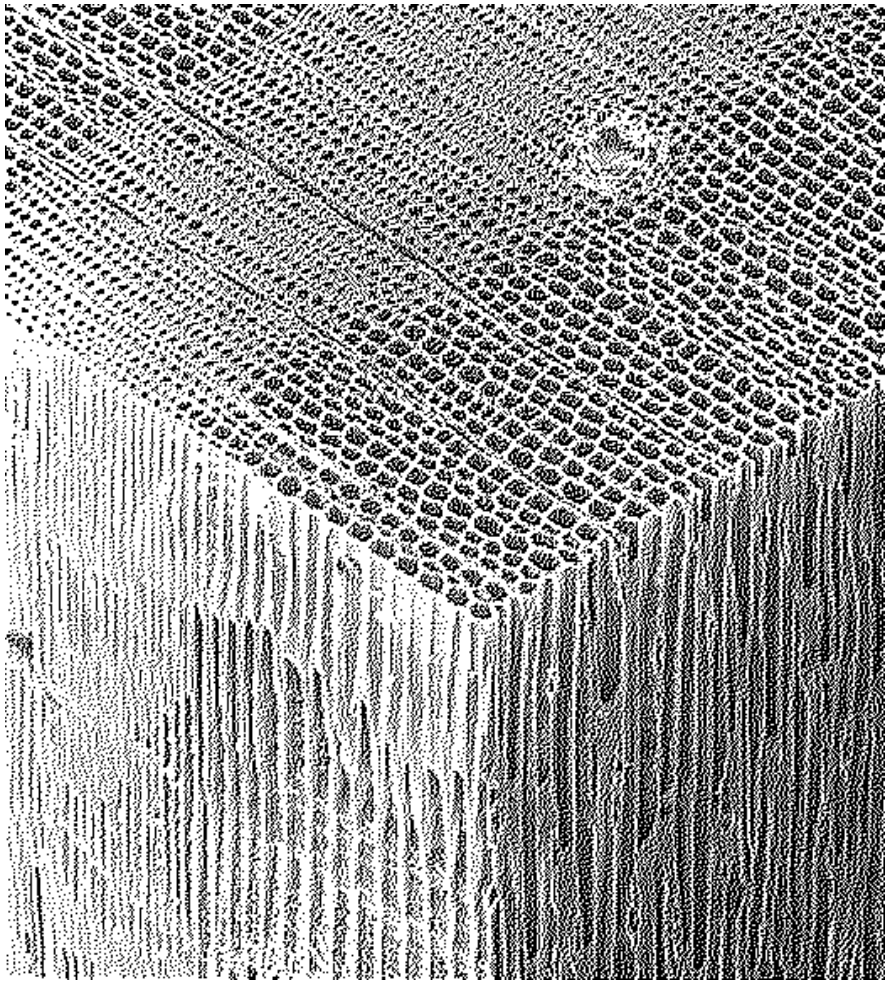
KEY ANALYSIS/DESIGN ISSUES

POINT SUPPORTED CLT



POINT SUPPORTED CLT





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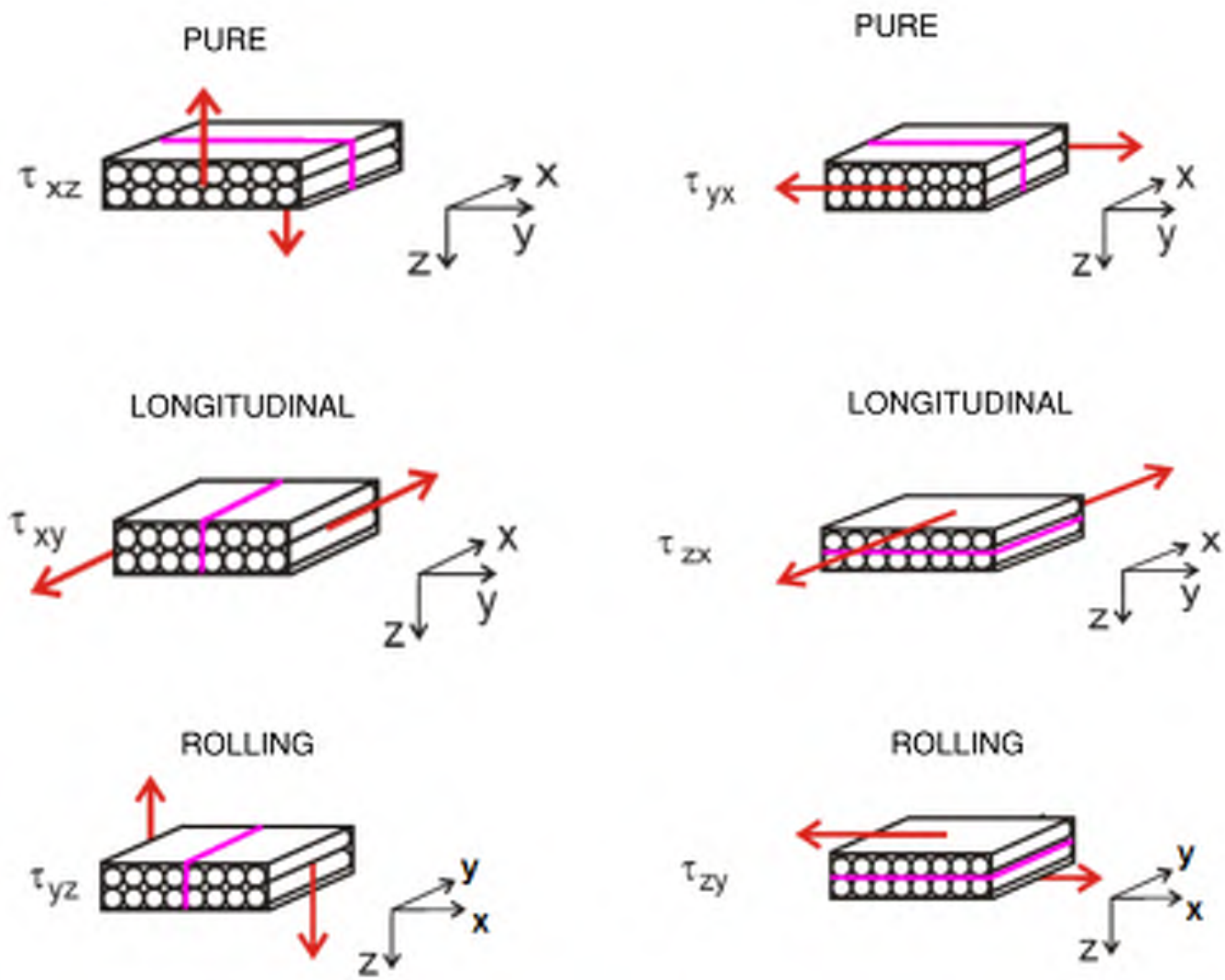

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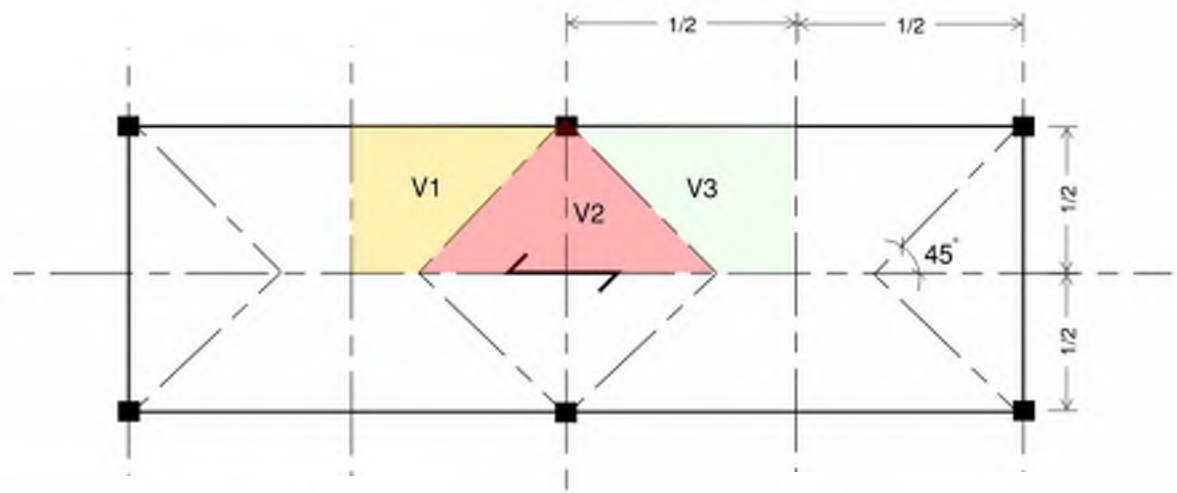
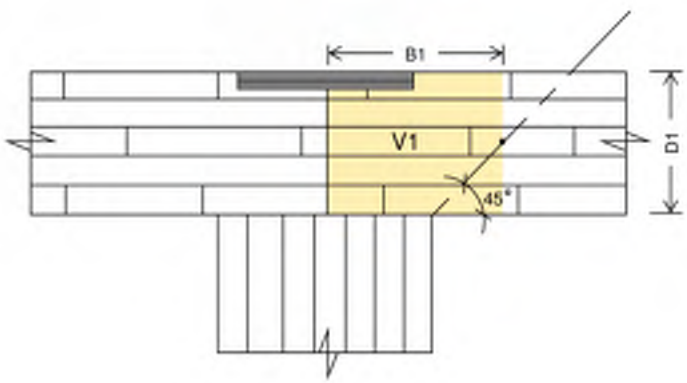
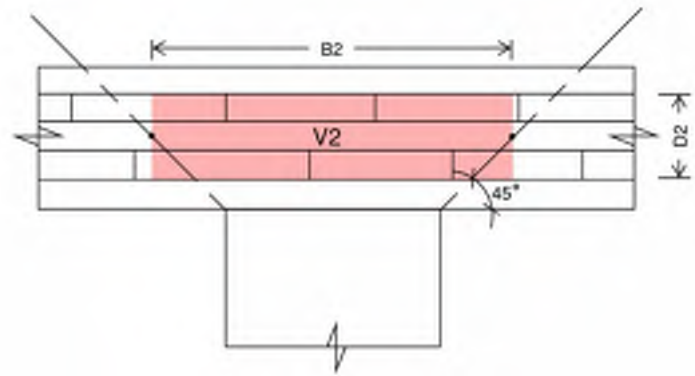


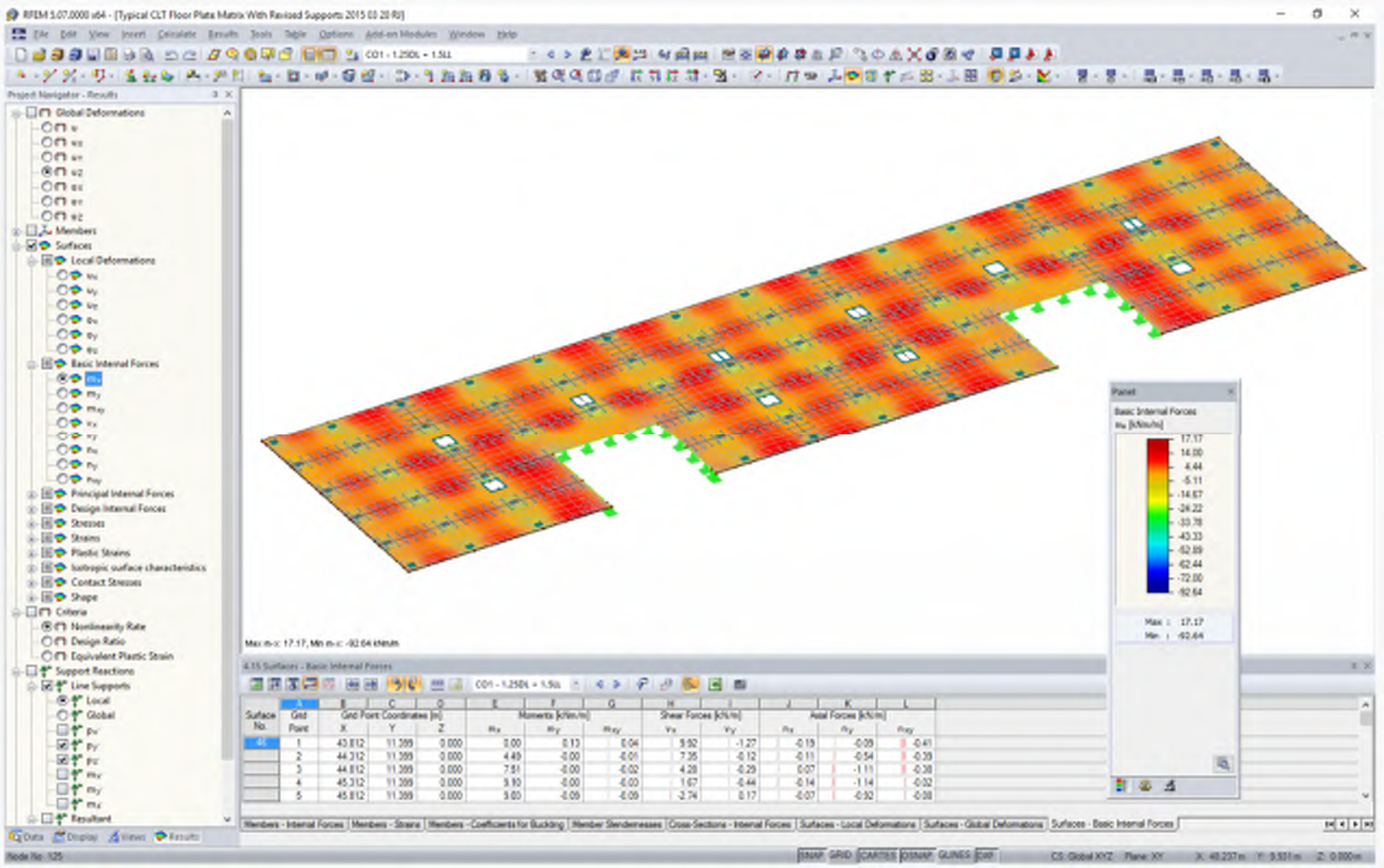




$$\tau_1 = \frac{(1.5)(V_1)}{(B_1)(D_1)}$$

$$\tau_2 = \frac{(1.5)(V_2)}{(B_2)(D_2)}$$

POINT SUPPORTED CLT



KEY ANALYSIS/DESIGN ISSUES

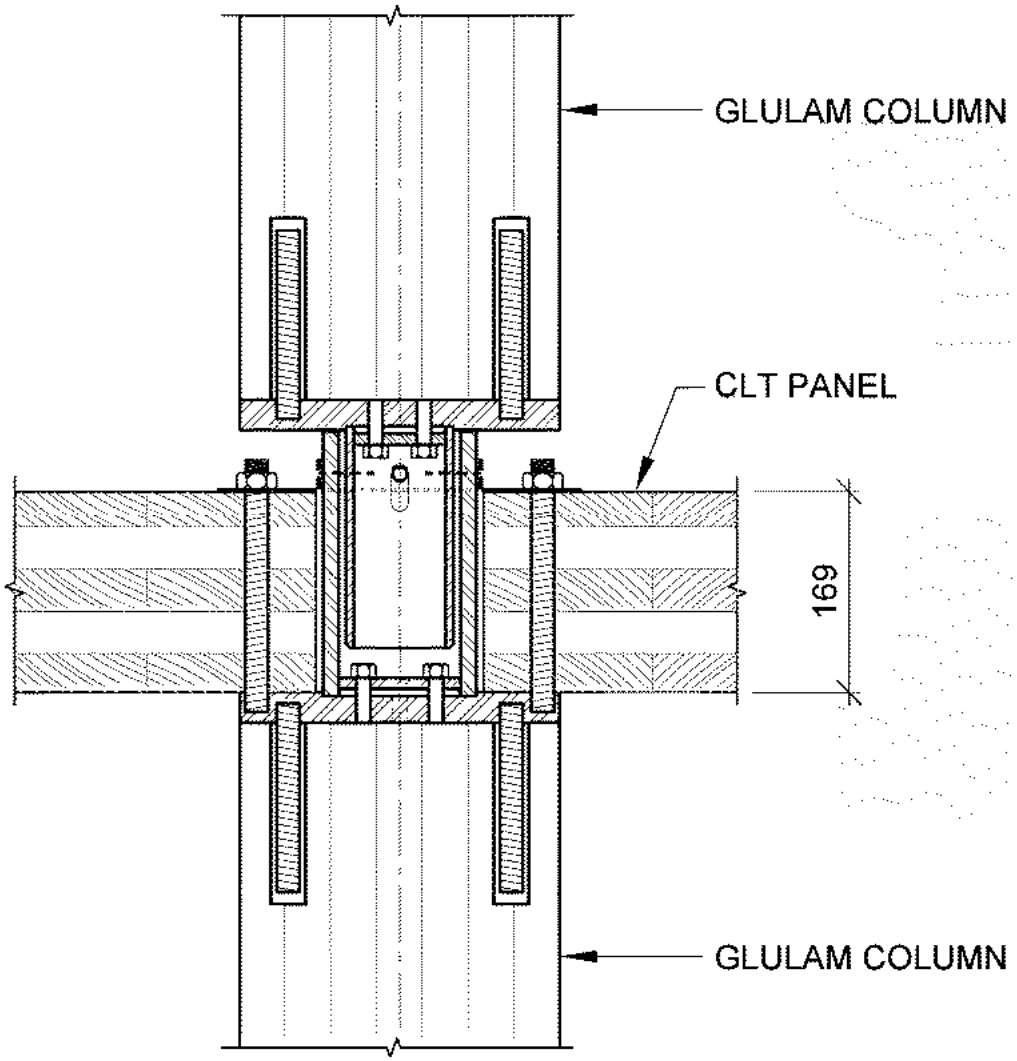
POINT SUPPORTED CLT

KEY ANALYSIS/DESIGN ISSUES

POINT SUPPORTED CLT

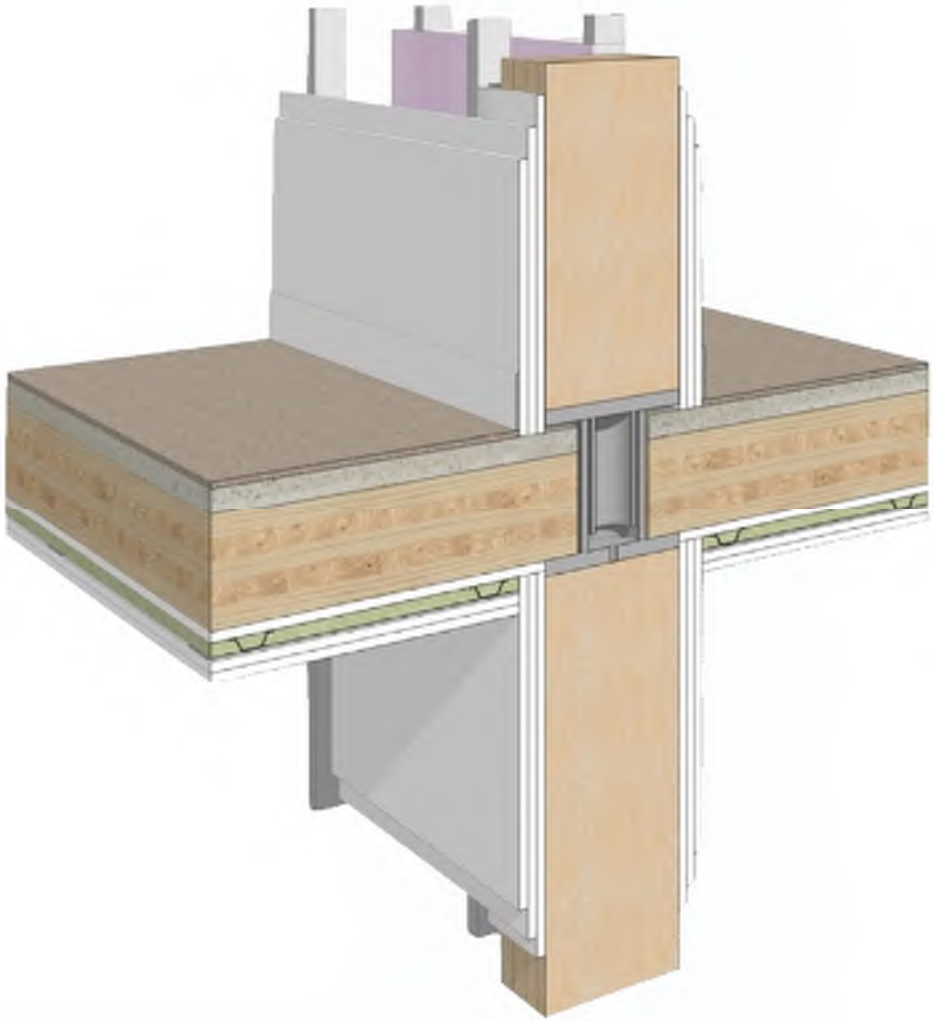
KEY ANALYSIS/DESIGN ISSUES

COLUMN TO COLUMN CONNECTIONS



COLUMN TO COLUMN CONNECTIONS

COLUMN TO COLUMN CONNECTIONS

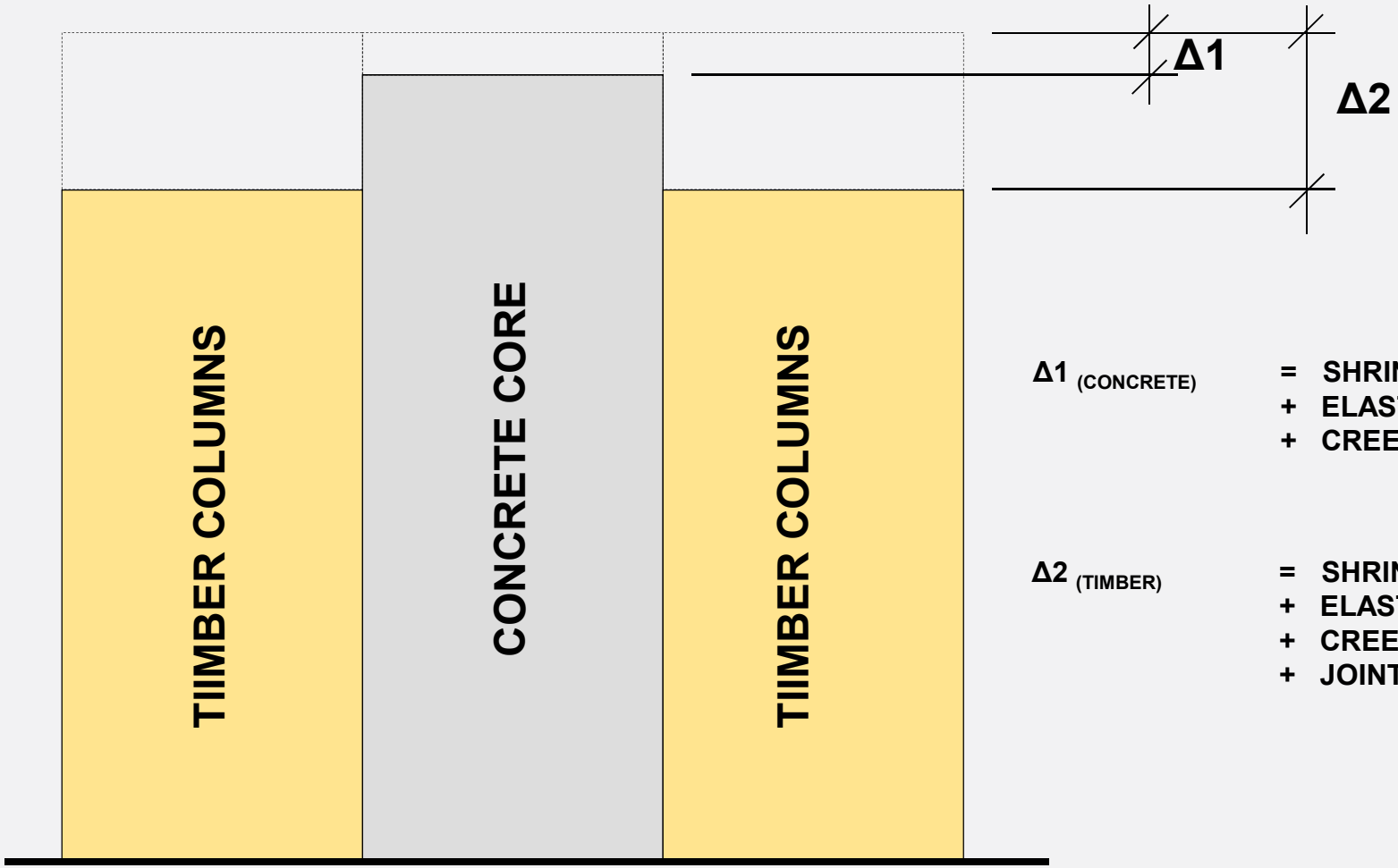


2h glulam column protection

2h steel connector protection

2h CLT slab protection

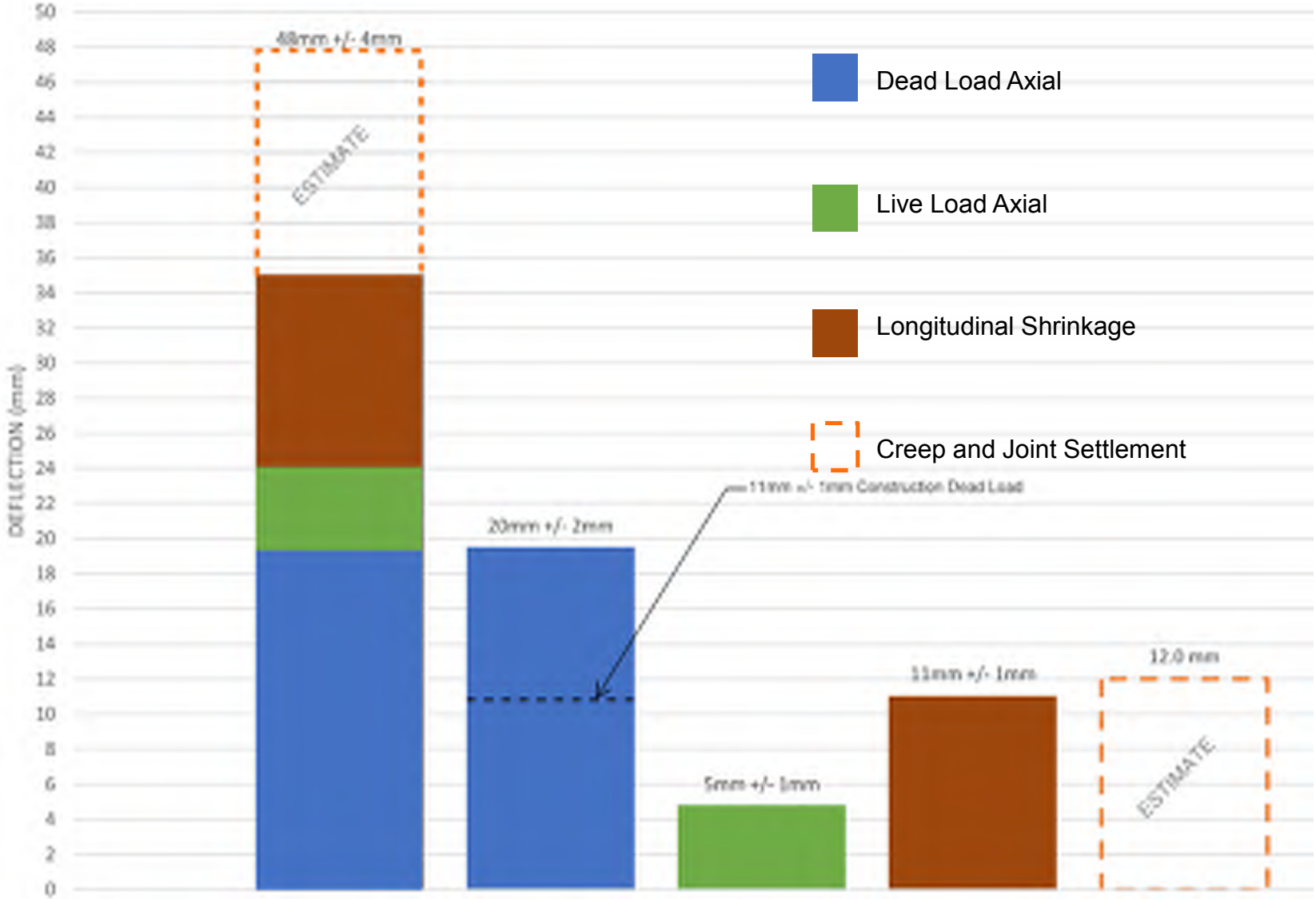
AXIAL COLUMN SHORTENING



$\Delta 1_{\text{(CONCRETE)}}$ = SHRINKAGE
+ ELASTIC SHORTENING
+ CREEP

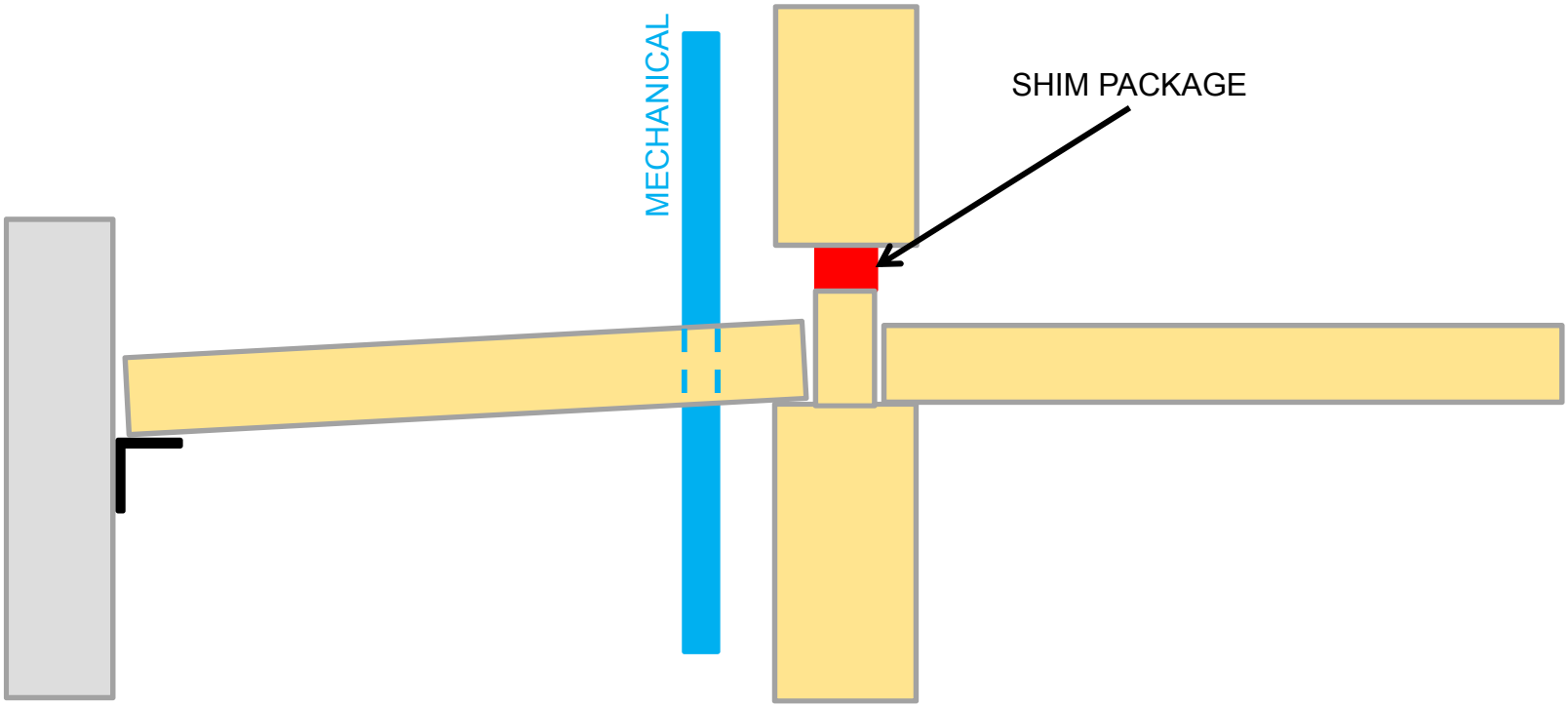
$\Delta 2_{\text{(TIMBER)}}$ = SHRINKAGE
+ ELASTIC SHORTENING
+ CREEP
+ JOINT SETTLEMENT

AXIAL COLUMN SHORTENING



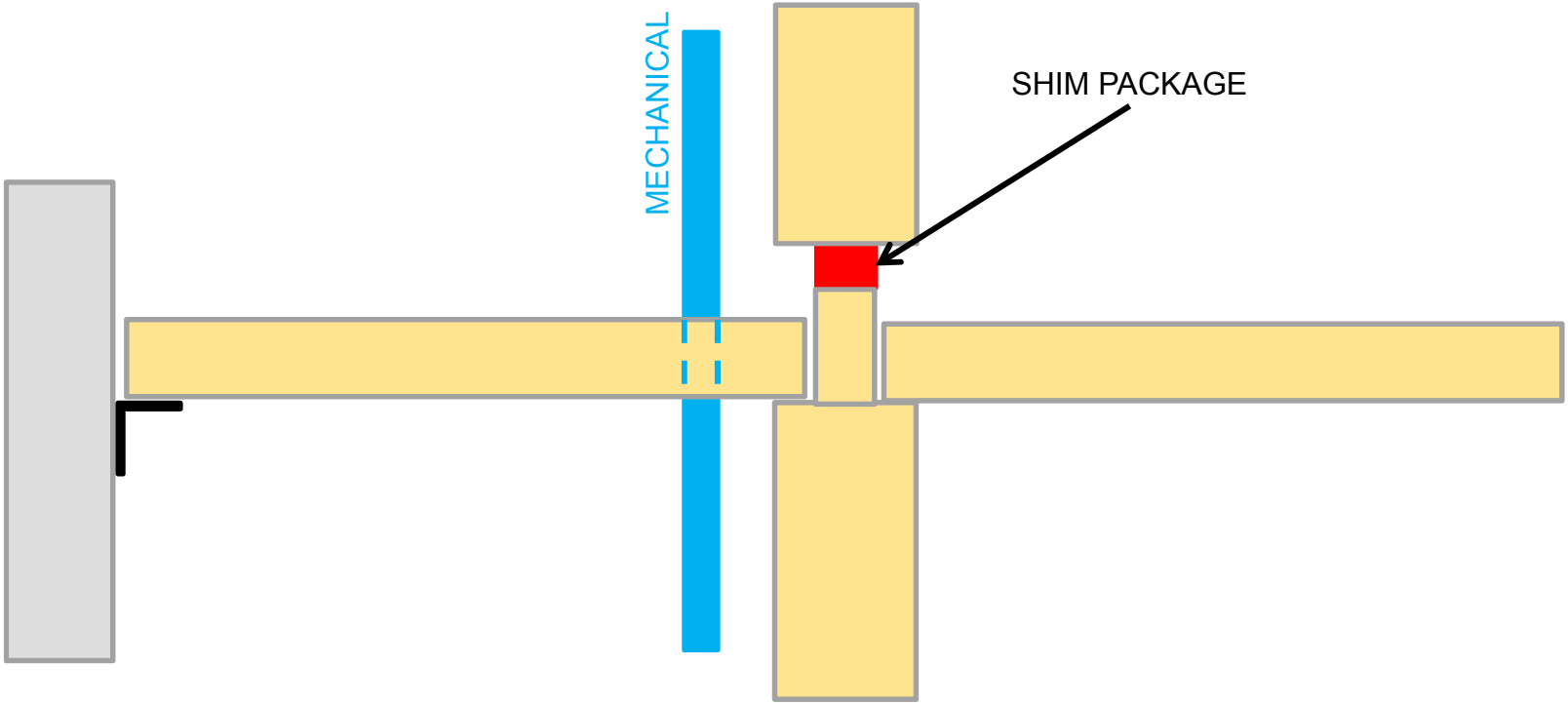
AXIAL COLUMN SHORTENING

TIME OF INSTALL



AXIAL COLUMN SHORTENING

SOME TIME LATER

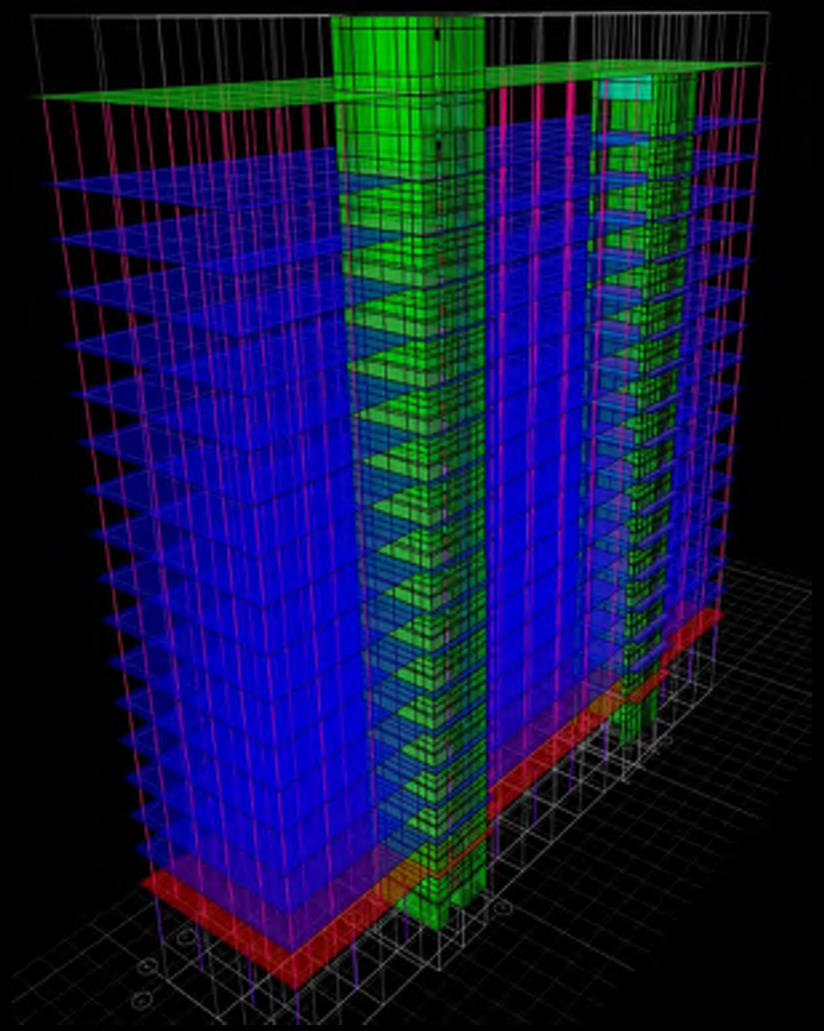


AXIAL COLUMN SHORTENING

LATERAL DESIGN

KEY ANALYSIS/DESIGN ISSUES

LATERAL DESIGN



- RdRo = 3.5 * 1.6 DUCTILE COUPLED CONCRETE SHEARWALLS ~R=5.6
- MODE 1 = E/W ORTHOGONAL,
- T=2.0 SEC.
- MODE 2 = N/S ORTHOGONAL, T = 1.65 SEC.
- MODE 3 = TORSIONAL, T= 1.30 SEC.
- EQ = 4.5% OF WEIGHT

CAPACITY DESIGN

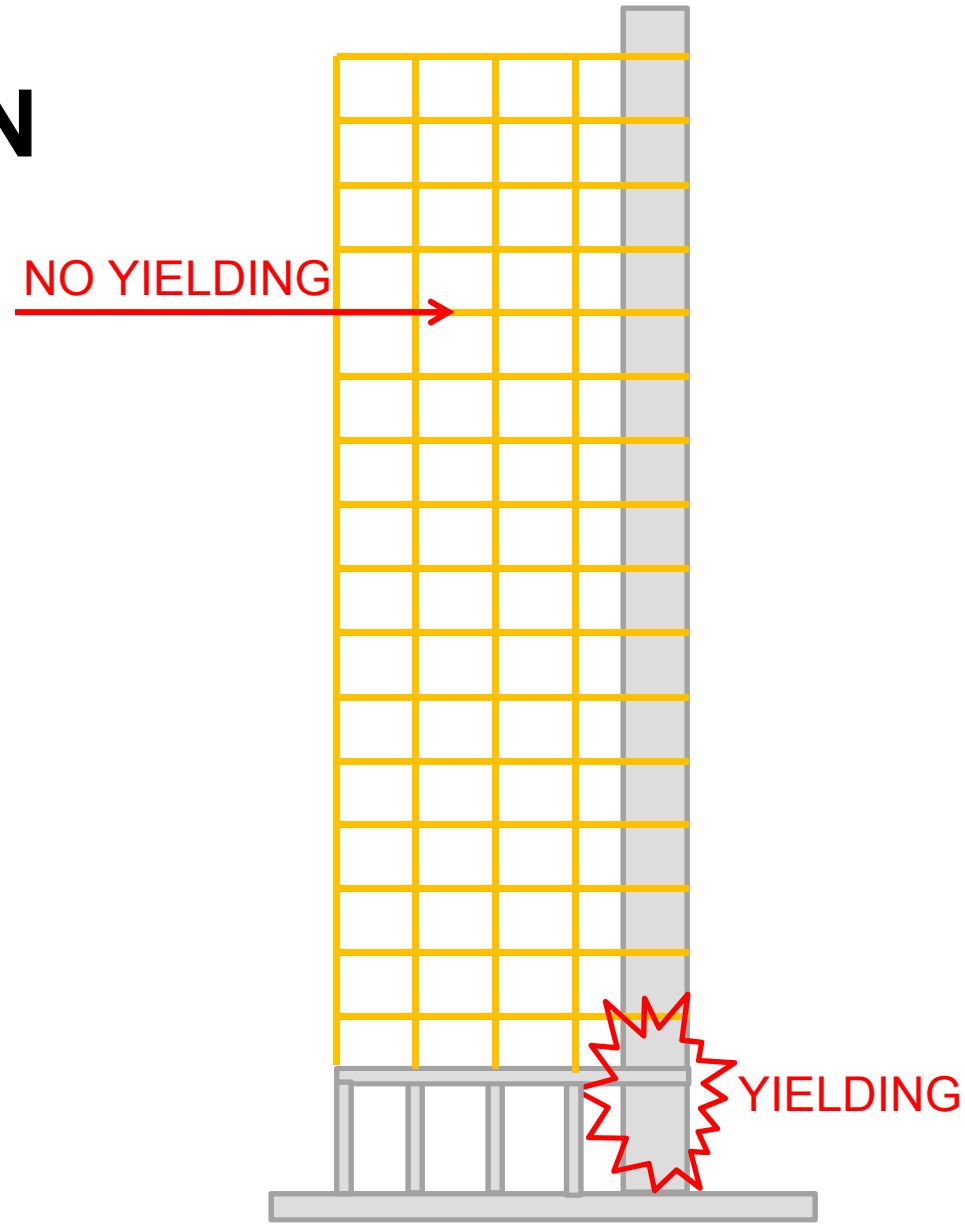
CAPACITY DESIGN

↓

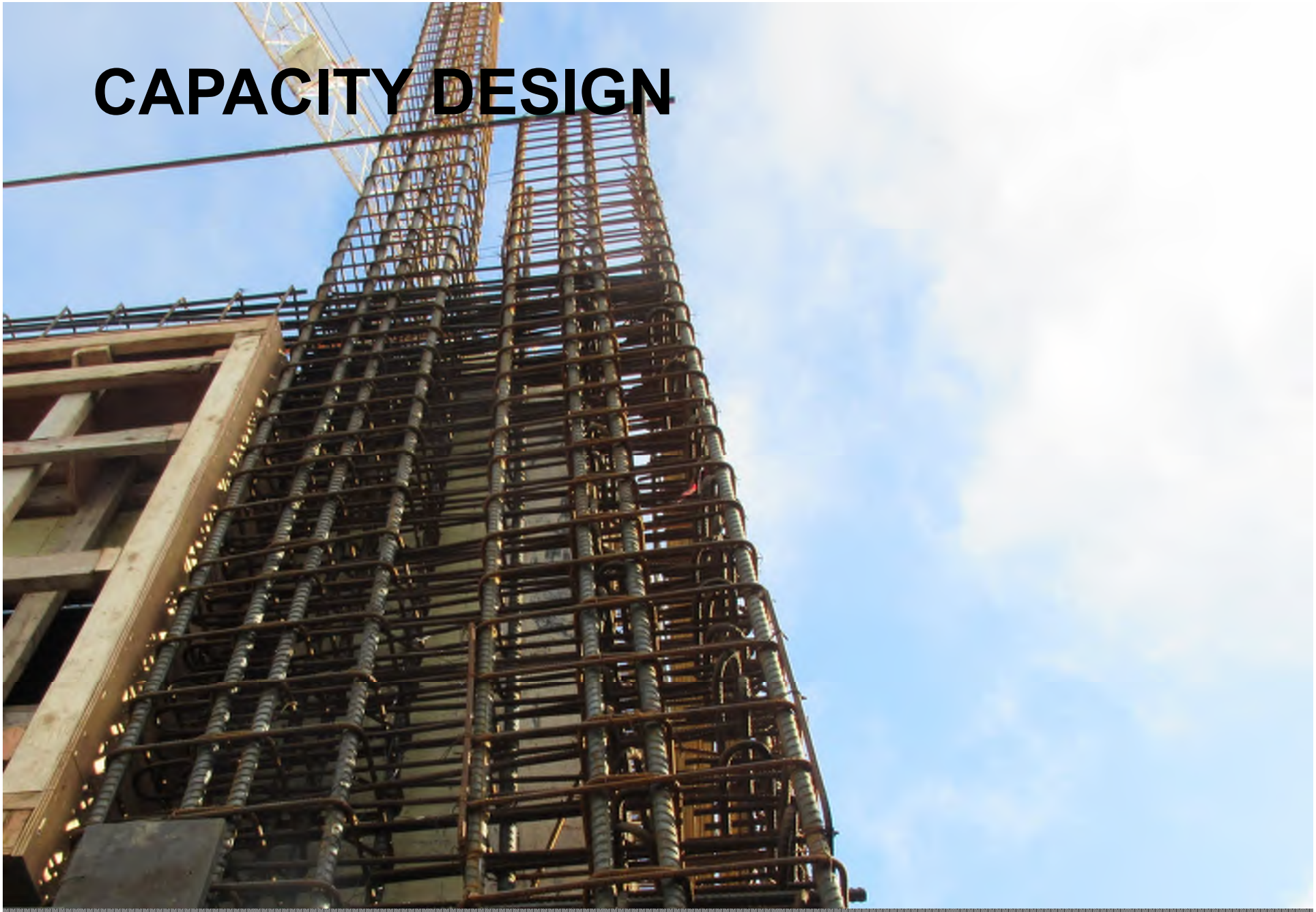
DESIGN DIAPHRAGM
TO FLEXURAL
CAPACITY OF CORES

↓

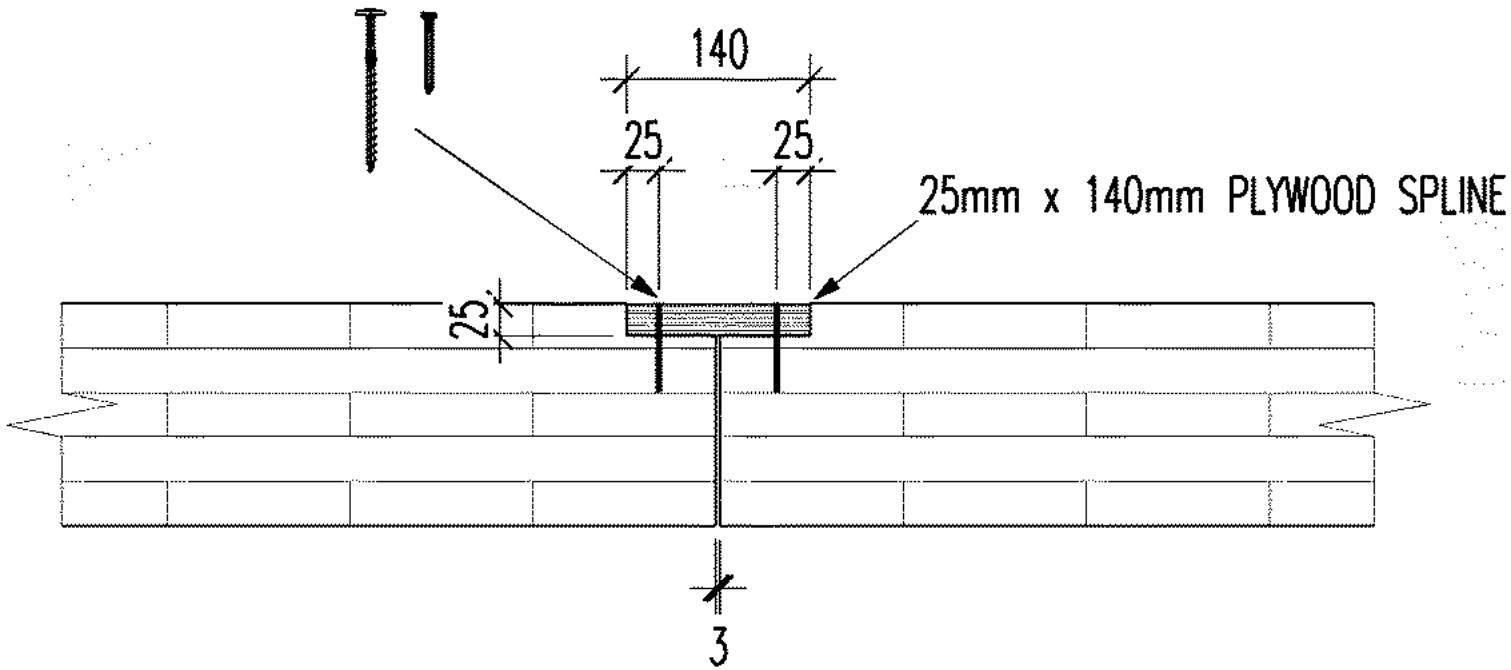
DESIGN CONNECTIONS,
DRAGS, CHORDS,
COLLECTORS WITH
OVERSTRENGTH CAPACITY



CAPACITY DESIGN



DIAPHRAGM DESIGN



DIAPHRAGM DESIGN

KEY ANALYSIS/DESIGN ISSUES

DIAPHRAGM DESIGN

KEY ANALYSIS/DESIGN ISSUES

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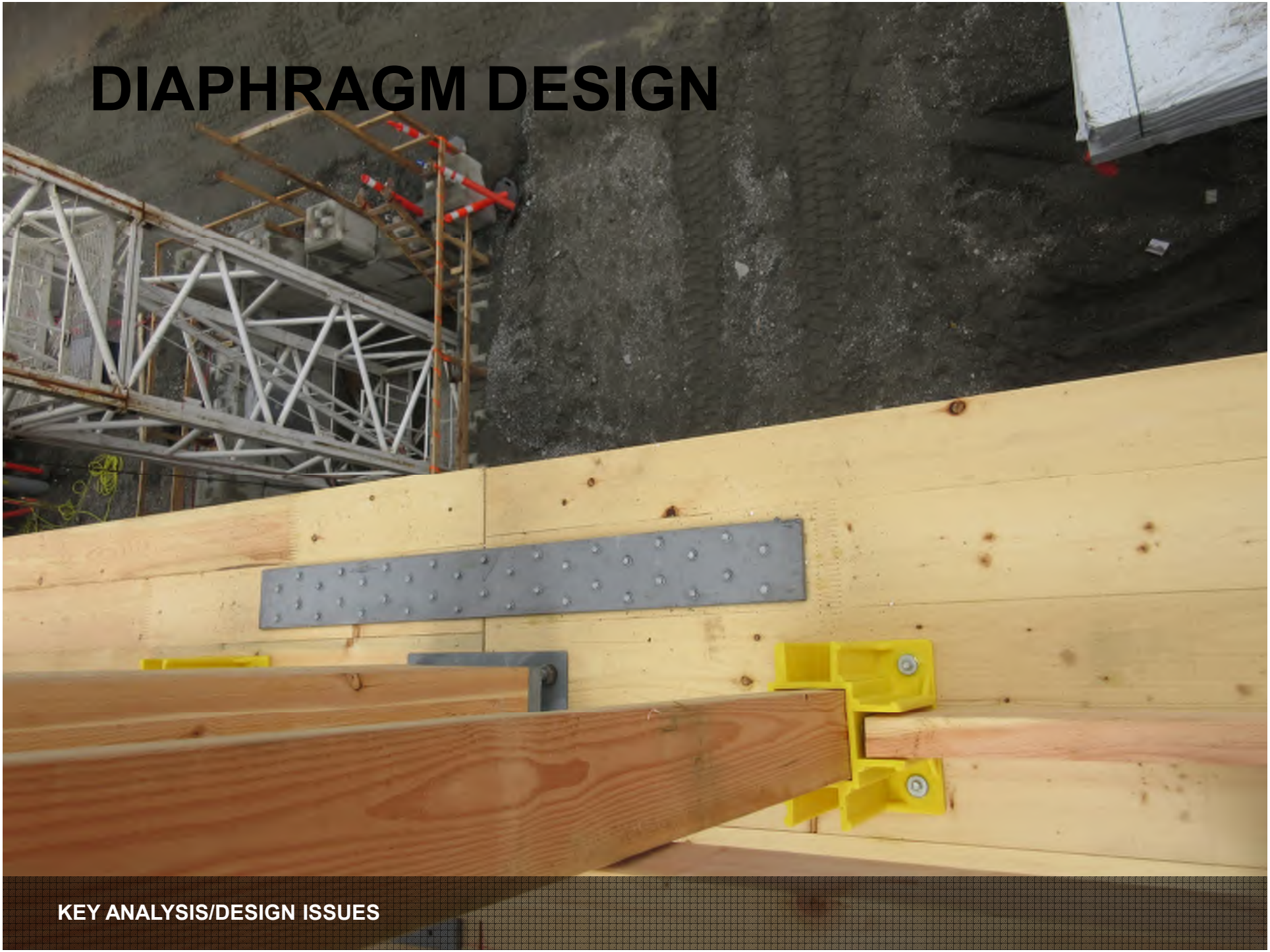
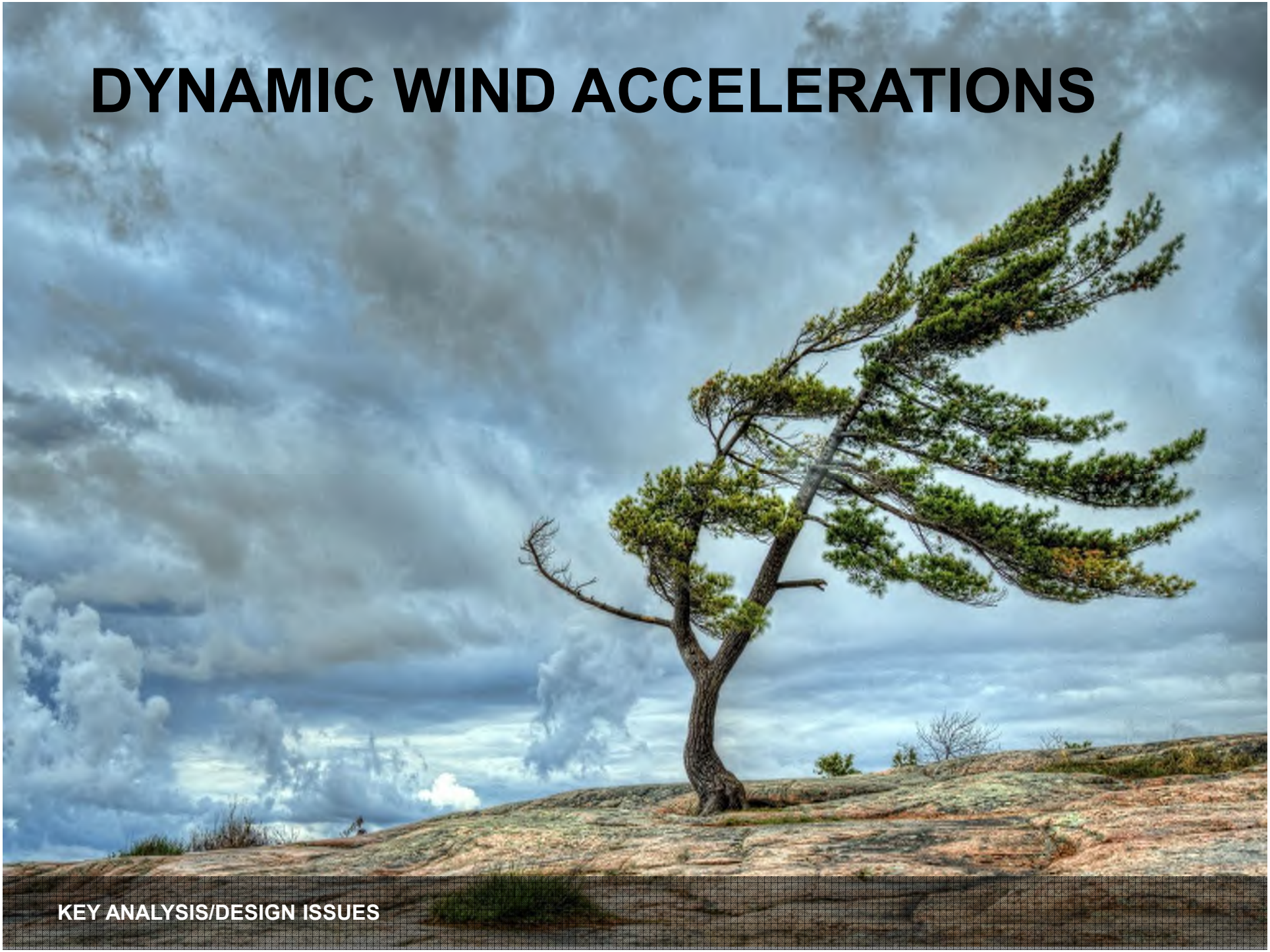
DIAPHRAGM DESIGN



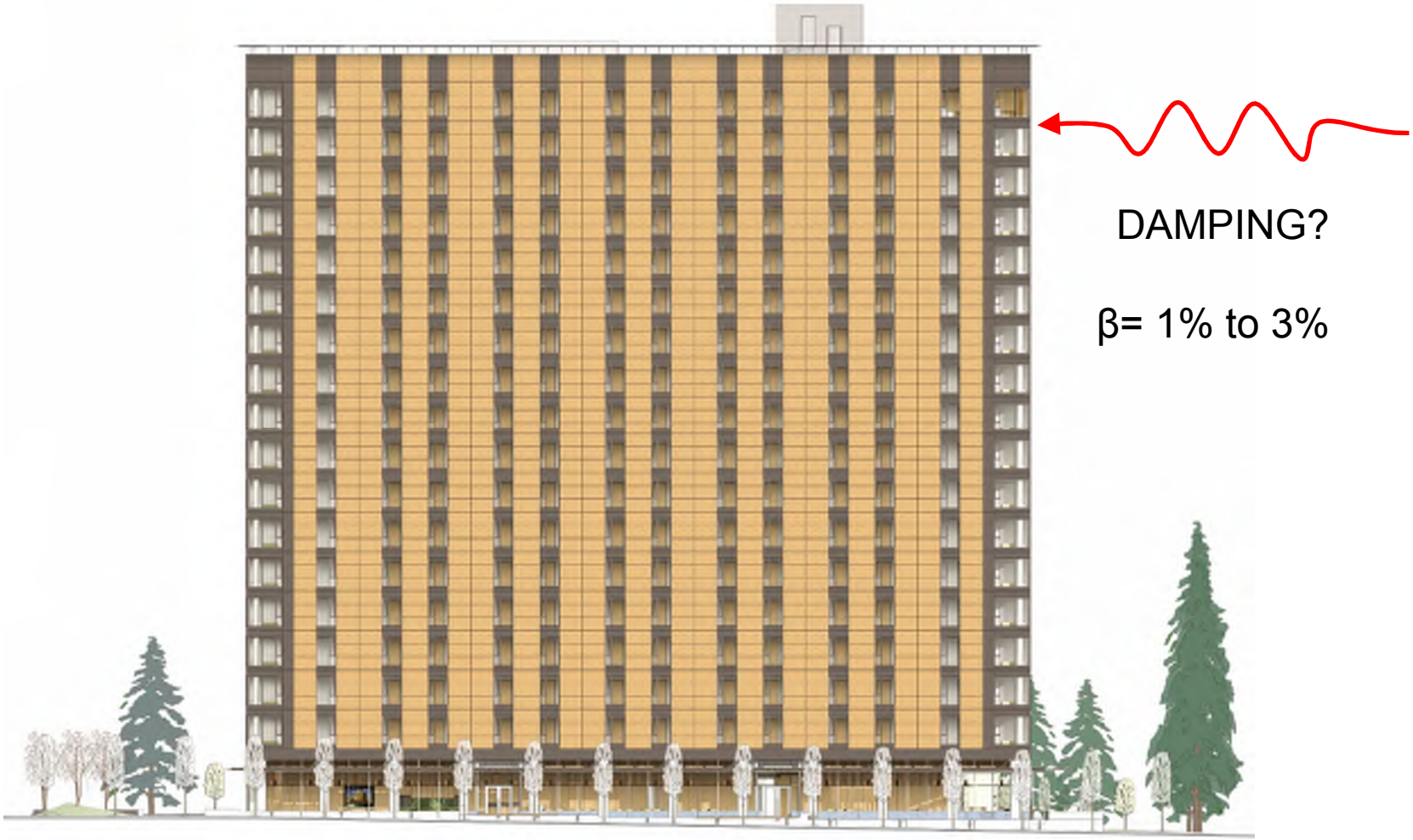
KEY ANALYSIS/DESIGN ISSUES

DYNAMIC WIND ACCELERATIONS



KEY ANALYSIS/DESIGN ISSUES

DYNAMIC WIND ACCELERATIONS



PRE-FABRICATION

3D Model → Customize Data → Material List → Shop Drawings → Material Production

CNC Code → QC/QA → JIT Shipping → Installation

PRE-FABRICATION

3D Model → Customize Data → Material List → Shop Drawings → Material Production

Coordinate.Create.Innovate
CadMakers Inc.

CNC Code → QC/QA → JIT Shipping → Installation

INFORMATION FLOW

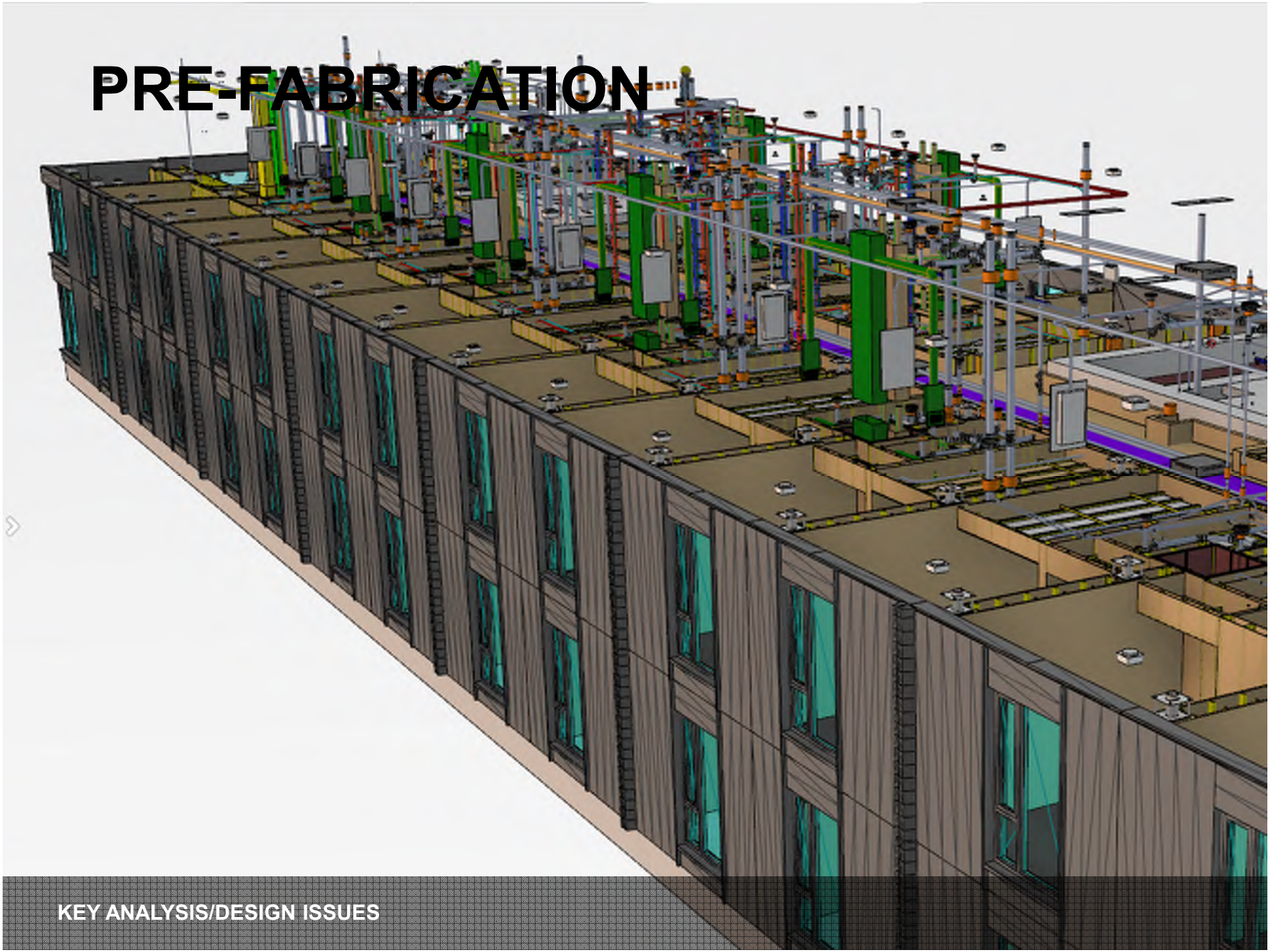
- 3D (.SAT and .IFC) models provided by CadMakers supplies general geometry – including all mechanical penetrations.

- Use of a coordinated single model saved time and reduced confusion between the multiple parties.

PRE-FABRICATION

KEY ANALYSIS/DESIGN ISSUES

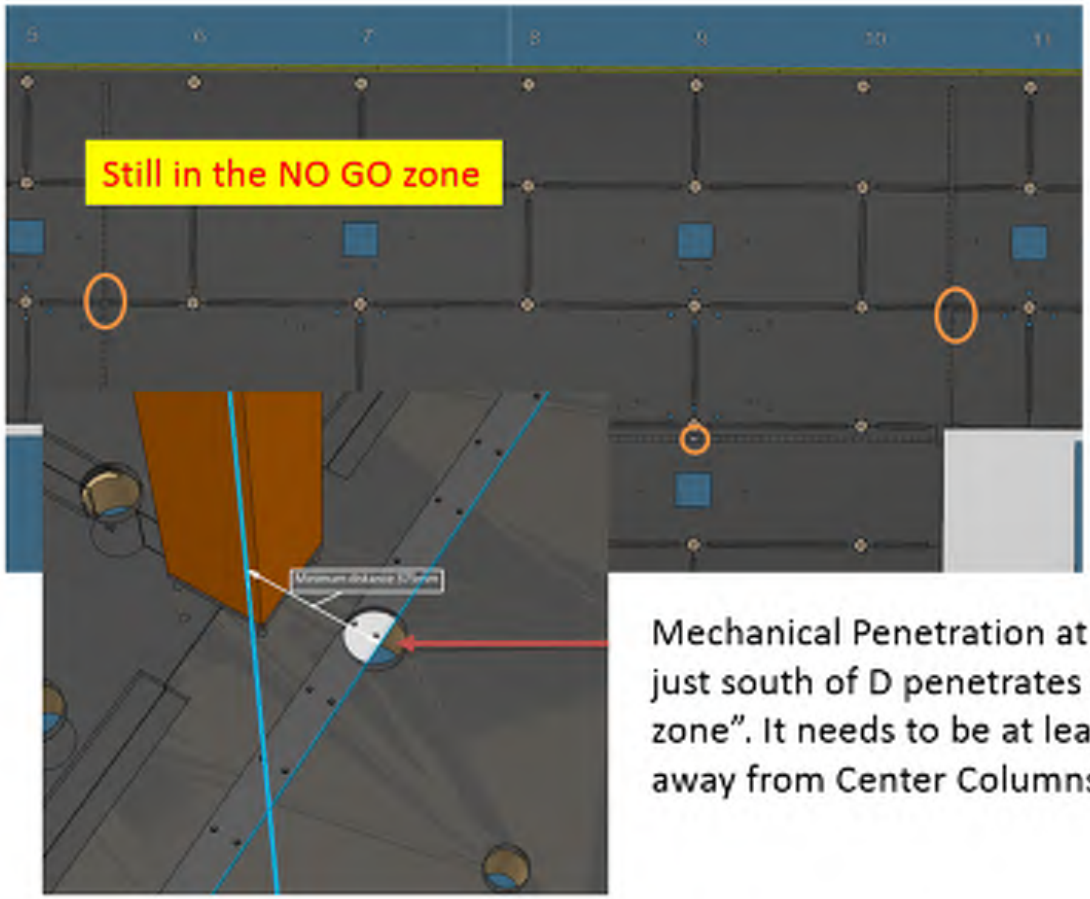
PRE-FABRICATION

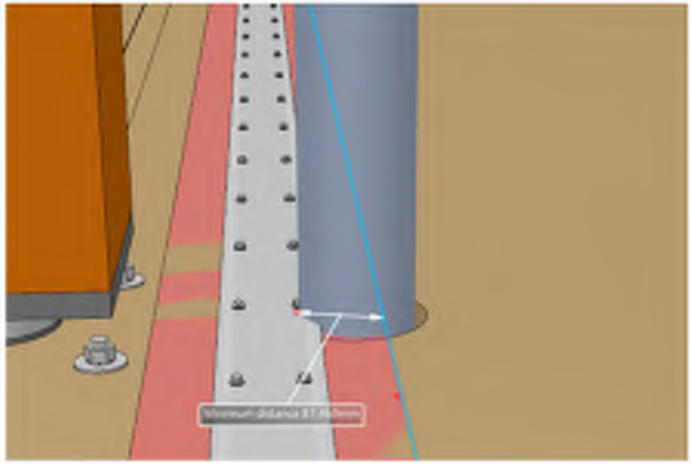


KEY ANALYSIS/DESIGN ISSUES

PRE-FABRICATION

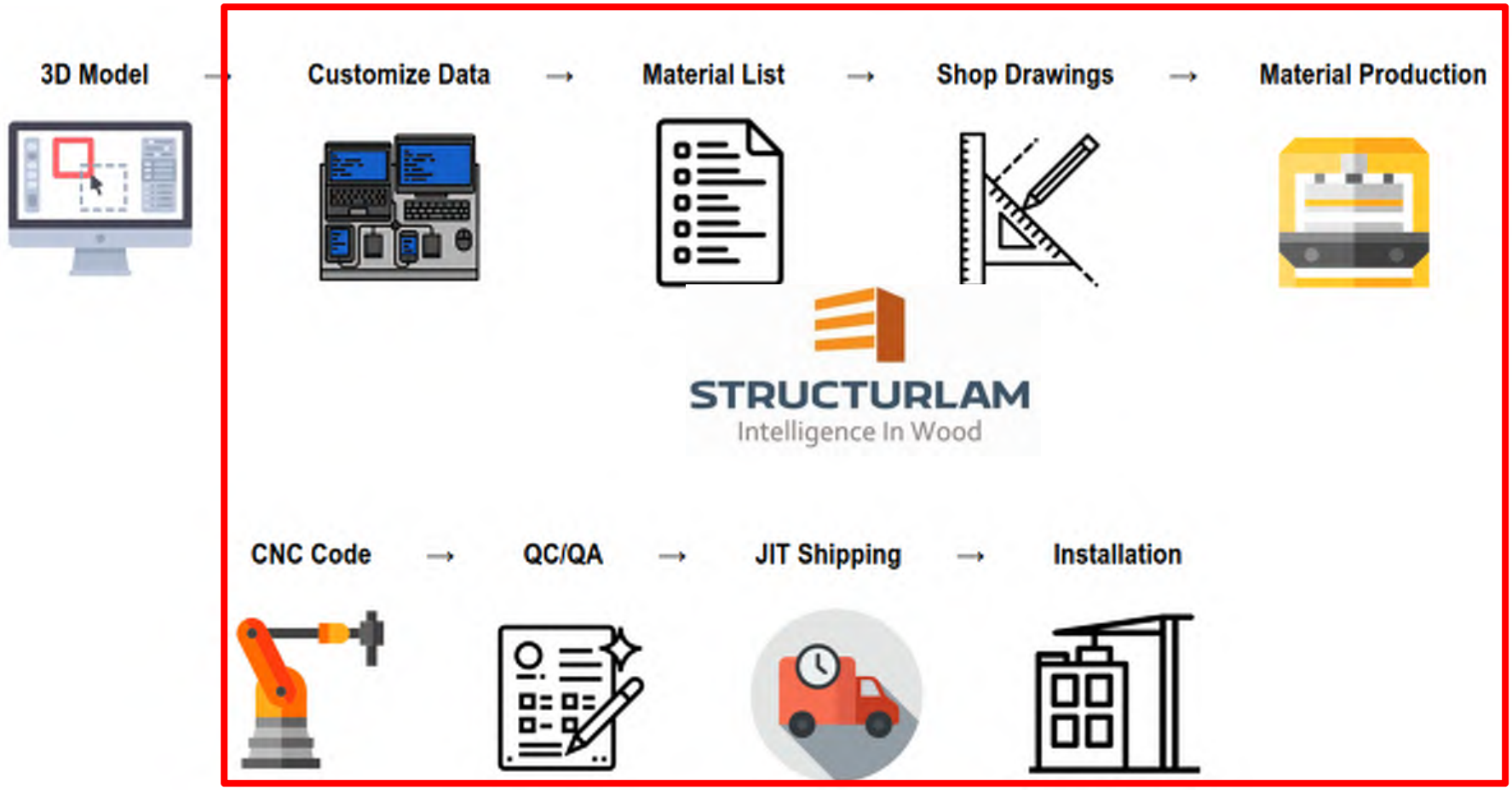
Issue 1.3





Mechanical Penetration at gridline 9 just south of D penetrates the "no-go zone". It needs to be at least 450mm away from Center Columns.

PRE-FABRICATION



PRE-FABRICATION

- ~0.95 mmfbm in 2 months time.

PRE-FABRICATION

- Glulam +/- 1 mm (standard +/- 6 mm)
- Crosslam +/- 1 mm, all directions (standard +/- 2 to 6 mm)
- Steel supplied +/- 0.5 mm

PRE-FABRICATION

- Fabrication arranged in a linear process for just in time delivery.

- Loads arranged on trucks to perfectly match installation sequence
  - Requires ample preplanning on the part of the project team

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MOCK-UP

CONSTRUCTION

MOCK-UP

CONSTRUCTION

MOCK-UP

CONSTRUCTION

MOCK-UP

SEQUENCING

CONSTRUCTION

CONSTRUCTION

CREDIT: SEAGATE

CONSTRUCTION

CONSTRUCTION

CREDIT: SEAGATE

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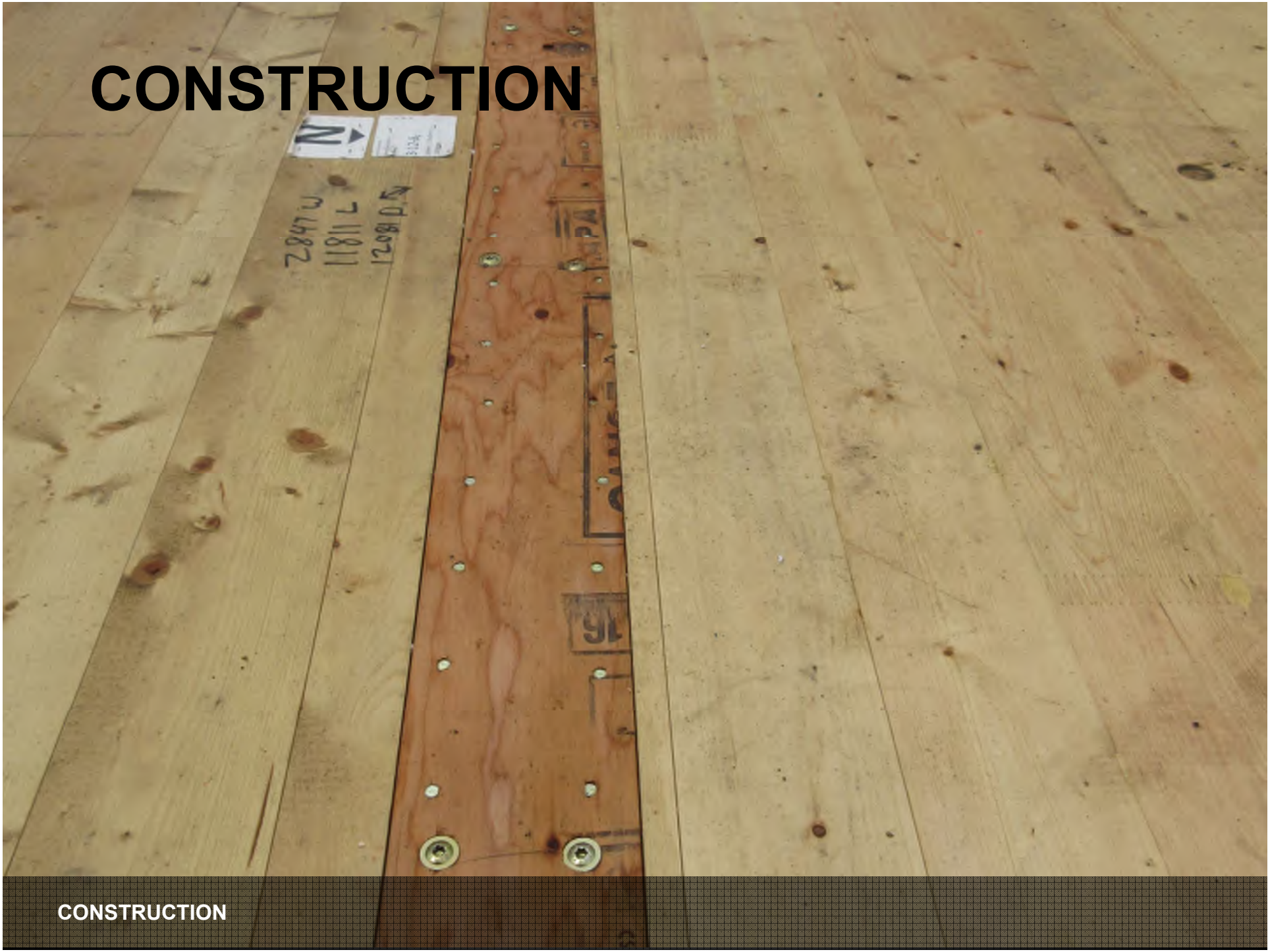

CONSTRUCTION

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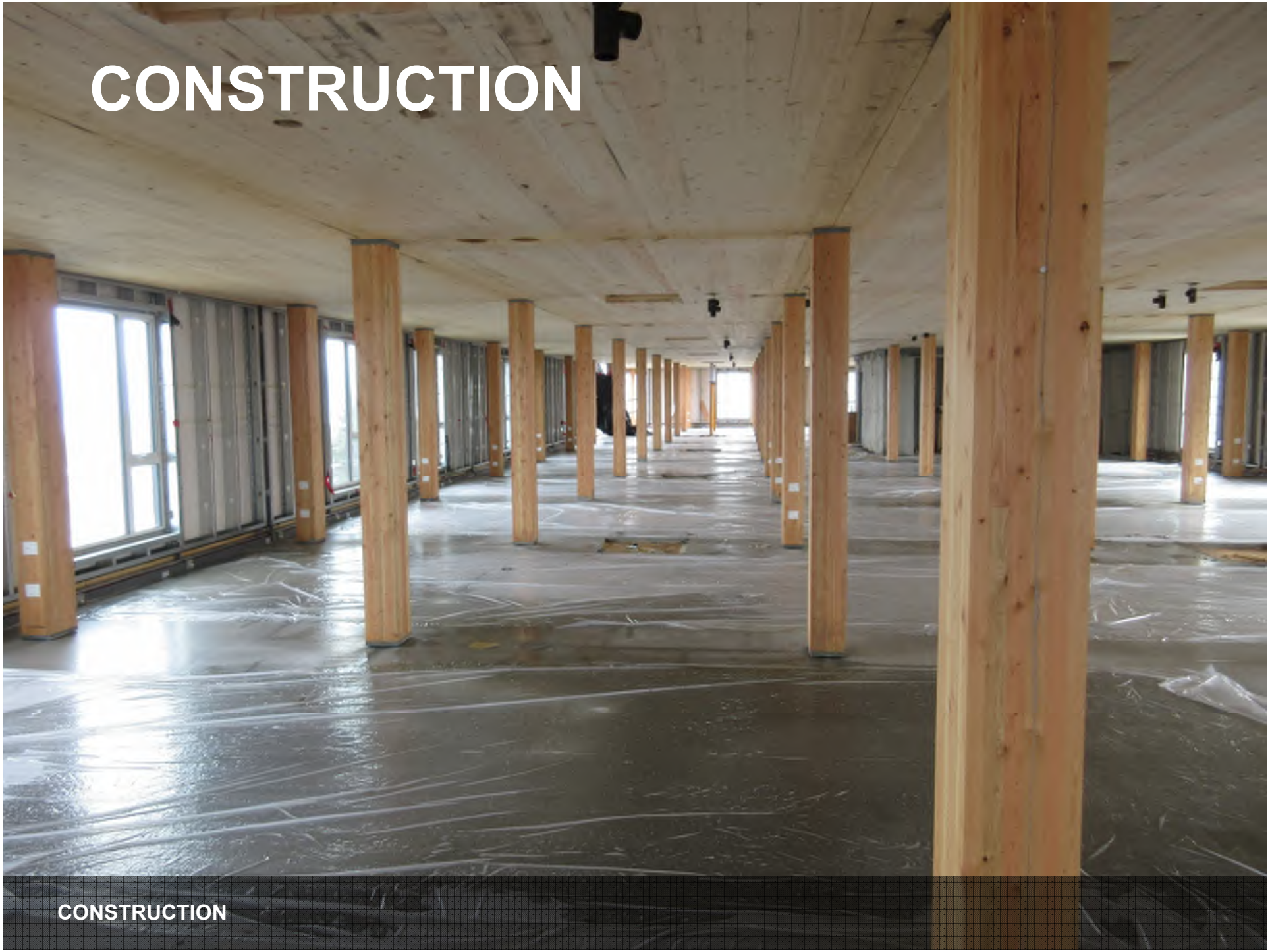
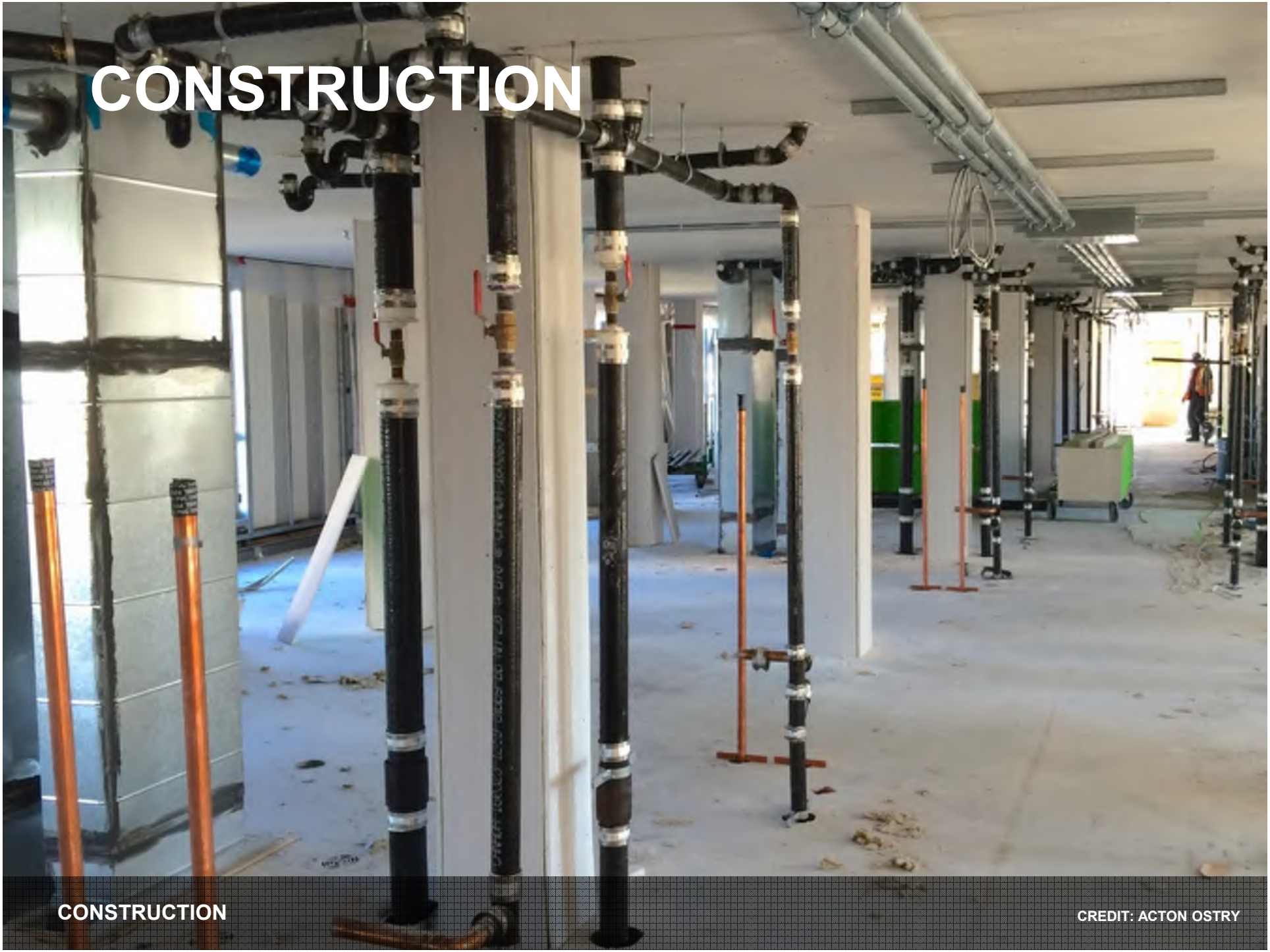


CONSTRUCTION

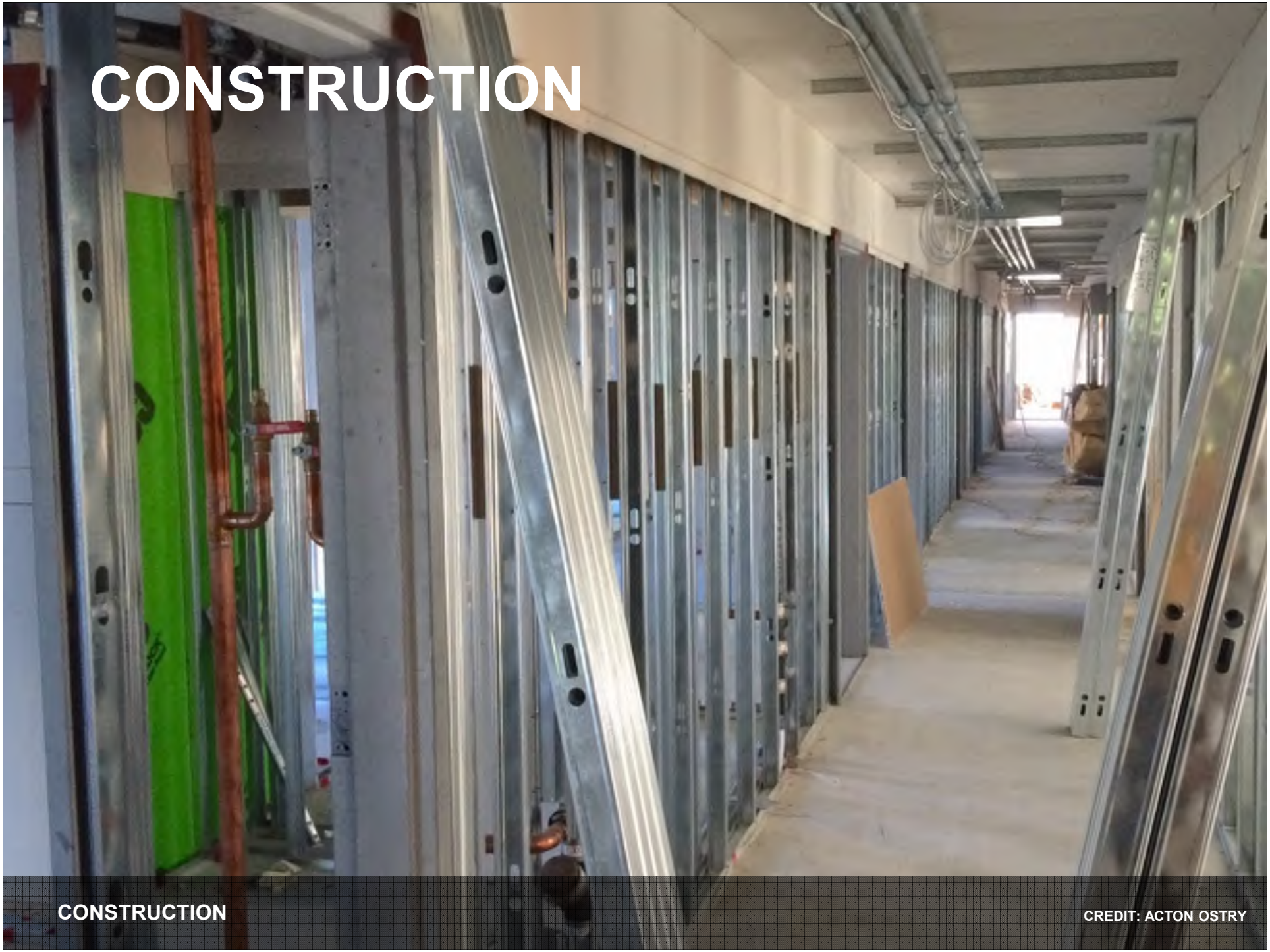
CONSTRUCTION



CONSTRUCTION

CREDIT: ACTON OSTRY

CONSTRUCTION



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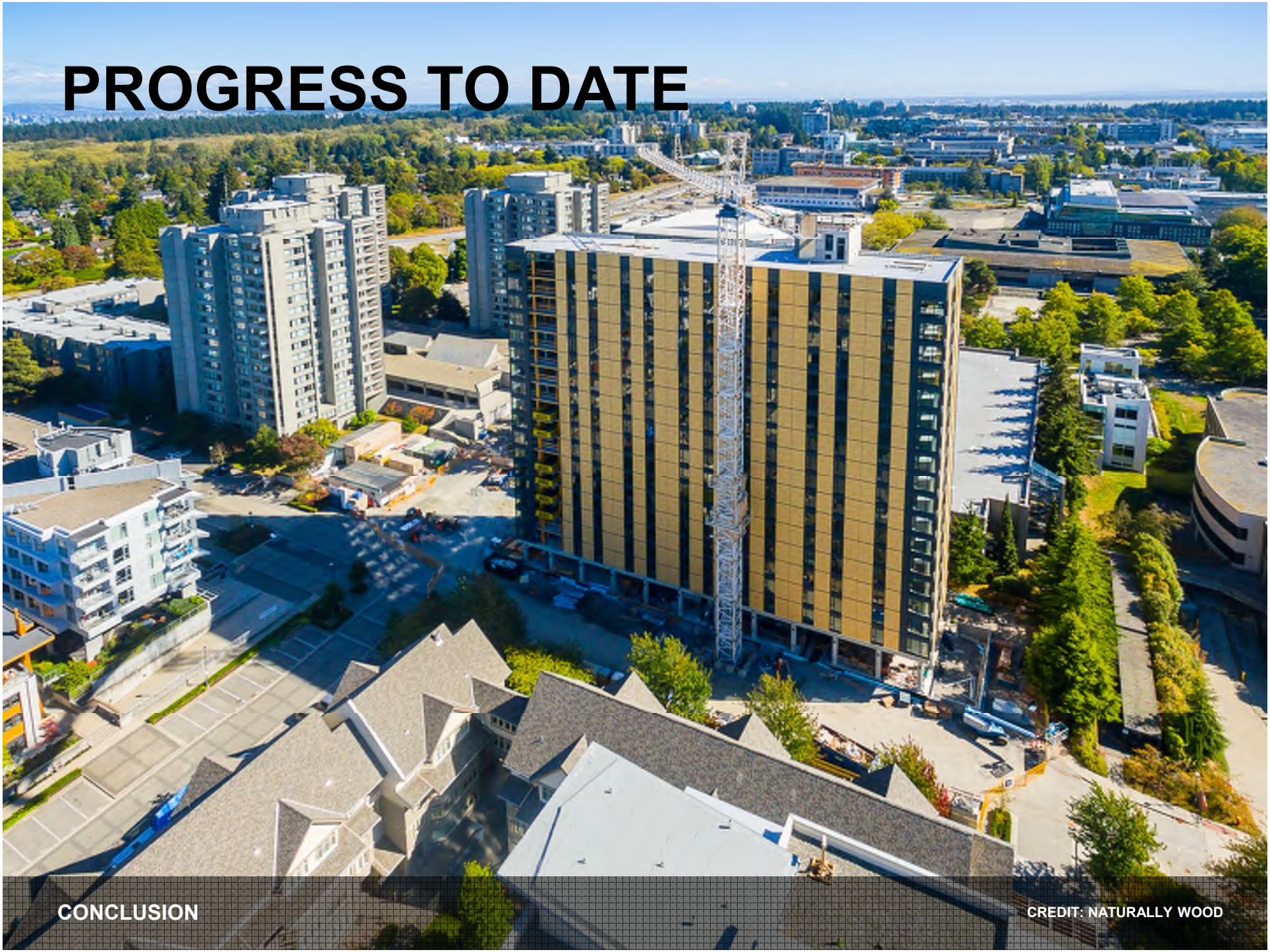
PROGRESS TO DATE



CONCLUSION

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CONCLUSION

- Efficient system suitable for student residences, micro-apartments or hotels
- Wider column grid possible with wider panels
- Structural simplicity = on site efficiency
- Involve your trades early. 3D coordination paid off.
- Kit-Of-Parts prefabrication has significant advantages

THANK YOU