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- + Introduction – Why Use Mass Timber?
- + Background – ICC Ad Hoc Committee on Tall Wood Buildings
- + New Type IV Code Provisions – Why Use Mass Timber?
- + Adoption in the Pacific Northwest – And Comparison with BC
- + Case Study – Brock Commons
- + Questions

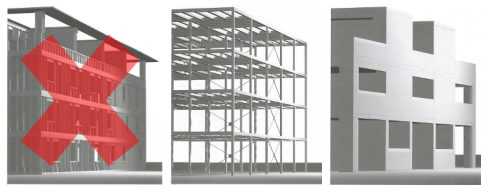
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Introduction



LIGHT WOOD FRAME

POST + BEAM

MASS TIMBER PANELS

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Introduction



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Introduction



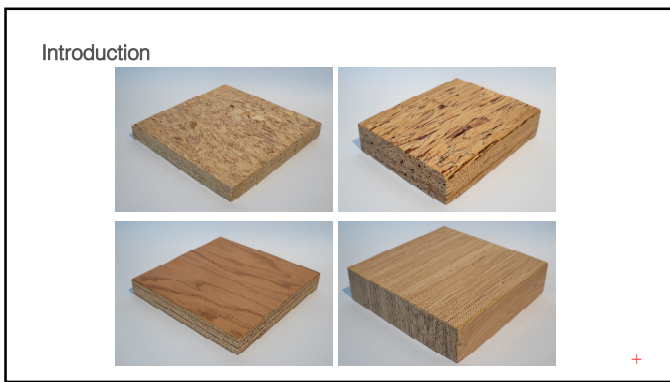
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Introduction



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Introduction

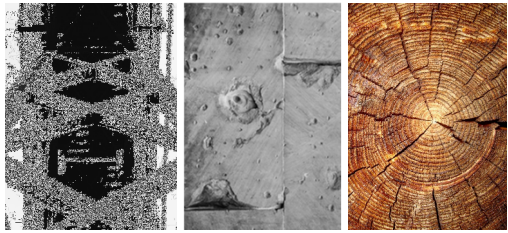
- + renewable resource
- + low embodied energy
- + carbon sequestration

	timber	steel	concrete
material	timber	steel	concrete
volume at 20' (ft³)	26.7	0.90	17.8
weight (lbs)	880	453	2670
CO ₂ emissions (lbs)	502	1810	3070
ratio	1	3.6	6.1

Source: Allen Organochi, Timber City

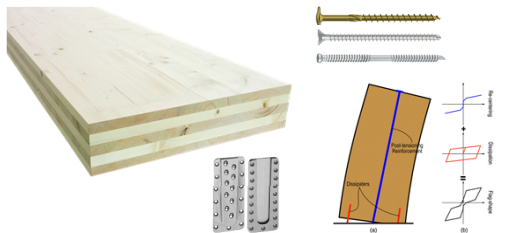
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Introduction



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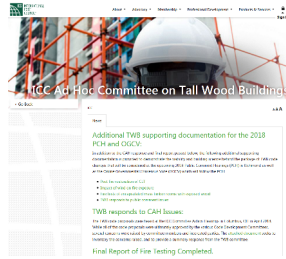
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Background

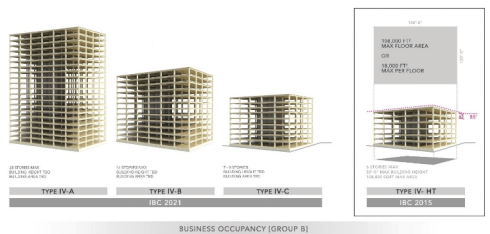
- + ICC Ad Hoc Committee on Tall Wood Buildings
 - Formed in 2016, explored the building science of tall wood buildings
 - Generated technically-substantiated code change recommendations for three new Construction Types



Background

- + ICC TWB Objectives
 - **No collapse under reasonable scenarios** of complete burn-out of fuel without automatic sprinkler protections being considered
 - **No unusually high radiation exposure from the subject building** to adjoining properties to present a risk of ignition under reasonably severe fire scenarios
 - **No unusual response from typical radiation exposure from adjacent properties** to present a risk of ignition of the subject building under reasonably severe fire scenarios
 - **No unusual fire department access issues**
 - **Egress systems designed to protect building occupants** during design escape time, plus a factor of safety
 - **Highly reliable fire suppression systems** to reduce risk of failure during reasonably expected fire scenarios. Degree of reliability proportional to evacuation time (height) and risk of collapse.

Background



BUSINESS OCCUPANCY (GROUP B)
*MAXIMUM FLOOR TO FLOOR HEIGHTS ARE LIMITED TO 12 FT FOR ALL CONSTRUCTION TYPES EXCEPT TYPE IV-HT WHICH IS LIMITED TO 18 FT

credit: steeljones

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New Type IV Code Provisions

- + **Type IV-A**
Max 18 stories or 270ft
Fully encapsulated
Fully sprinklered
- + **Type IV-B**
Max 12 stories or 180ft
Partially encapsulated
Fully sprinklered
- + **Type IV-C**
Max 9 stories or 85ft
Fully exposed, 2hrs
Fully sprinklered
- + **Type IV-HT**
Max 6 stories or 85ft
Fully exposed
(Traditional Type IV)



Credit: Michael Ekan



Credit: DLR Group



Credit: Path Architecture



Credit: Ensa Peter



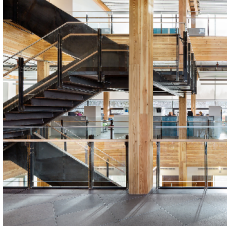
New Type IV Code Provisions

- + Anything structural?
Not really...use NDS 2018
- + Let's talk about:
 - Minimum Member Sizing
 - Exposed Wood and Fire Ratings
 - Floor Assemblies
 - Concealed Spaces
 - Shaft Enclosures



New Type IV Code Provisions

+ Minimum Member Sizing (see IBC 2018 2304.11 or IBC 2015 602.4 for more information)



Credit: Ed White

ELEMENT		SOLID SAWN (nominal size)	GLULAM (net size)	SCL (net size)
FLOOR	COLUMN	8' x 8'	6 3/4' x 8 1/4'	7' x 7 1/2'
	BEAM	8' x 10'	8' x 10 1/2'	8 1/4' x 9 3/4'
ROOF	COLUMN	6' x 8'	5' x 8 1/4'	5 1/4' x 7 1/2'
	BEAM	4' x 6'	3' x 6 3/4'	3 1/4' x 5 1/2'

+

New Type IV Code Provisions

+ Minimum Member Sizing (see IBC 2018 2304.11 or IBC 2015 602.4 for more information)



ELEMENT	CLT (actual size)	NLT/DLT/GLT* (nominal size)	DECKING* (nominal size)
FLOOR DECK	4" thick	4" thick	3" thick
ROOF DECK	3" thick	3" thick	2" thick

* plus flooring as per IBC

+

New Type IV Code Provisions

+ Fire Resistance Ratings (see Table 601 for more information)

ELEMENT	I-A	I-B	IV-A	IV-B	IV-C	IV-HT
ROOF	1 1/2	1	1 1/2	1	1	HT
FLOOR	2	2	2	2	2	HT
PRIMARY FRAME	3	2	3	2	2	HT
EXTERIOR BEARING WALLS	3	2	3	2	2	2
INTERIOR BEARING WALLS	3	2	3	2	2	HT or 1

+

New Type IV Code Provisions

+ Fire Resistance Ratings (see Table 601 for more information)

ELEMENT	I-A	I-B	IV-A	IV-B	IV-C	IV-MT
ROOF	1 1/2	1	1 1/2	1	1	HT
FLOOR	2	2	2	2	2	HT
PRIMARY FRAME	3	2	3	2	2	HT
EXTERIOR BEARING WALLS	3	2	3	2	2	2
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New Type IV Code Provisions

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INTERIOR BEARING WALLS	3	2	3	2	2	HT or 1

+

New Type IV Code Provisions

- + Where Noncombustible Protection (NCP) is required, at least 2/3 of FRR to be from NCP
- + 5/8" Type X Gypsum Board - 40 mins

Req'd FRR	Minimum Rating from NCP
1 hr.	40 mins (1 layer)
2 hr.	80 mins (2 layers)
3 hr.	120 mins (3 layers)

+ Remainder of FRR to be from mass timber

+

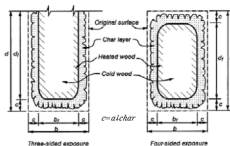
New Type IV Code Provisions

- + Example: 2 hr FRR floor (120 min)
- + 3 layers 5/8" Type X (3 x 40 min) or 2 layers 5/8" Type X (2 x 40 min) + 40 min MT FRR

+

New Type IV Code Provisions

- + Example: 2 hr FRR floor (120 min)
- + 3 layers 5/8" Type X (3 x 40 min) or 2 layers 5/8" Type X (2 x 40 min) + 40 min MT FRR
- + Fire tested assembly or char calculation (+/- 1.5" per hr)



+

New Type IV Code Provisions

- + Connections to be protected with FRR of the element(s) supported

Concealed beam hanger



Credit: Martin/Martin

Bearing



Credit: naturally wood

- Covered
- Fire-rated
- Others?

+

New Type IV Code Provisions

+ Exposed Mass Timber (see 602.4)

Type IV-A – Fully Encapsulated

Type IV-B – Partially Exposed

- MT ceilings/beams up to 20% in dwelling unit or fire area
- MT walls/columns up to 40% in dwelling unit or fire area
- Combination of the above as per 602.4
- MT beams/columns not an integral part of walls/ceilings
- Minimum 15 feet (horizontal) between unprotected areas



Credit: Ed White

Type IV-C – Fully Exposed

(except shafts, concealed spaces, exterior side of walls)

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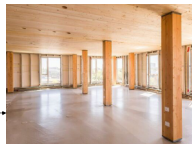
New Type IV Code Provisions

+ Exposed Mass Timber (see 602.4)

Type IV-A – Fully Encapsulated

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- MT ceilings/beams up to 20% in dwelling unit or fire area
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- Combination of the above as per 602.4
- MT beams/columns not an integral part of walls/ceilings
- Minimum 15 feet (horizontal) between unprotected areas



Credit: naturally.wood

Type IV-C – Fully Exposed

(except shafts, concealed spaces, exterior side of walls)

+

New Type IV Code Provisions

+ Floor Assemblies of Type IV-A and IV-B to have minimum 1" NCP material over MT floor (see 602.4)

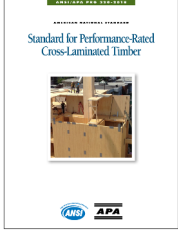


Credit: naturally.wood

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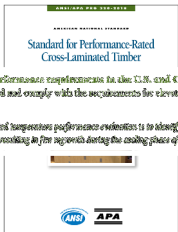
New Type IV Code Provisions

+ CLT to conform to PRG 320-18 as per 2021 IBC Section 2303.1.4



New Type IV Code Provisions

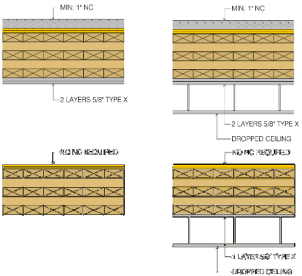
+ CLT to conform to PRG 320-18 as per 2021 IBC Section 2303.1.4



New Type IV Code Provisions

+ Concealed Spaces

- For Type IV-A and IV-B protect as per 602.4 (2 layers 5/8" Type X)
- For Type IV-C protect with minimum 40 minutes NCP (1 layer 5/8" Type X)



New Type IV Code Provisions

+ Shaft Enclosures

- Type IV-A and IV-B – May be MT with minimum 80 minutes NCP on inside and outside faces
- Except – For Type IV-A over 12 storeys or over 180 ft, must be non-combustible (no MT)
- Type IV-C – Minimum 40 minutes NCP inside and outside faces
- Type IV-HT – No NCP required



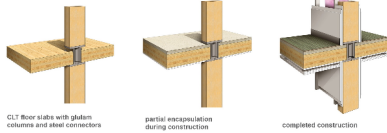
Credit: Martin/Martin



New Type IV Code Provisions

+ A Few Other Considerations

- Panel edge sealants
- Protection at occupancy separations
- Fire safety during construction – Non-combustible protection when over 4 floors below active MT construction



CLT floor slabs with gulfam columns and steel connectors

partial encapsulation during construction

completed construction

Credit: Acorn Oaky Architects



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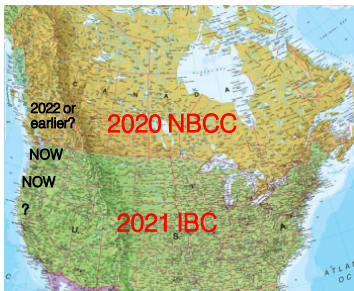
Adoption in the Pacific Northwest

- + IBC 2021 to include Type IV-A, IV-B, and IV-C construction types
- + Early Adoption – Oregon Structural Specialty Code Statewide Alternate Method (No. 18-01)
- + Early Adoption – Washington State Building Code Amendment (Bill 5450)
- + NBCC 2020 to include mass timber up to 12 storeys
- + British Columbia Building Code – 2022 adoption anticipated
- + Local governments regulated under BCBC are invited to adopt earlier



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Adoption in the Pacific Northwest



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Adoption in the Pacific Northwest

- + Brock Commons
- + Student residence at the University of British Columbia (Vancouver, BC)
- + Acton Ostry Architects
- + Completed in May, 2017



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Adoption in the Pacific Northwest



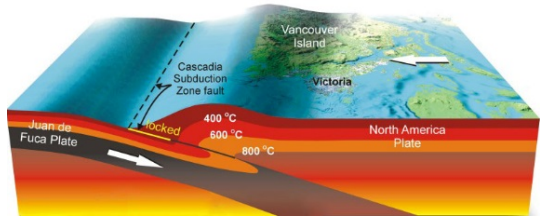
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Adoption in the Pacific Northwest



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Adoption in the Pacific Northwest



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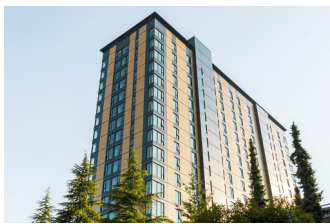
Adoption in the Pacific Northwest



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Adoption in the Pacific Northwest

- + Tall Wood – Key Points
- Code Limitations
- Gravity System
- Vertical Shrinkage/Settlement
- Lateral System
- Fire
- Benefits of Using MT



+

Adoption in the Pacific Northwest

- + Code Limitations
- Site-Specific Regulation (18 storeys)
- Structural peer review
- Fire peer review
- Testing



+

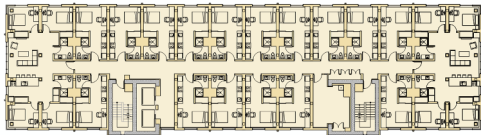
Adoption in the Pacific Northwest

- + Gravity System
- Regular grid
- Stacked floor plans
- Point-supported CLT



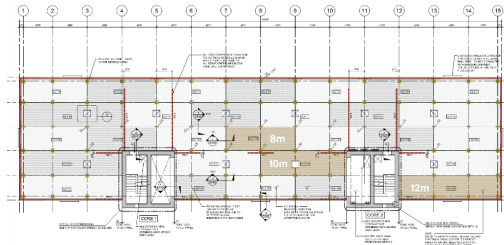
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Adoption in the Pacific Northwest



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Adoption in the Pacific Northwest



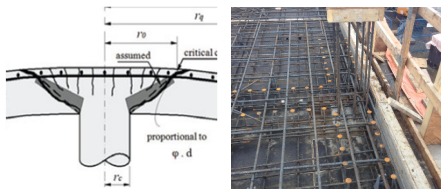
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Adoption in the Pacific Northwest



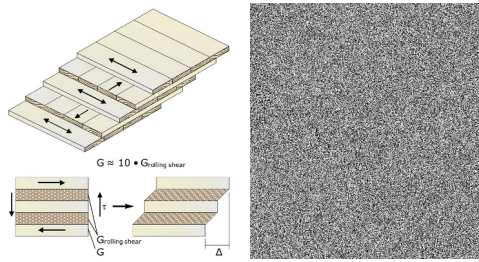
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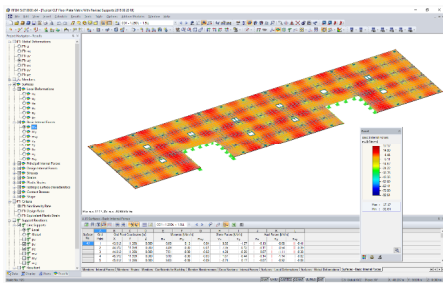
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Adoption in the Pacific Northwest



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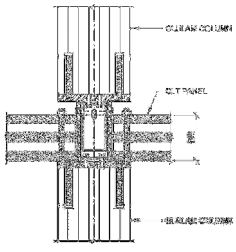
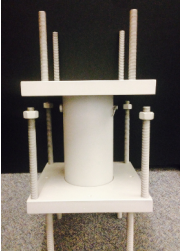
+ Vertical Shrinkage/Settlement



Credit: Aston Ostry Architects

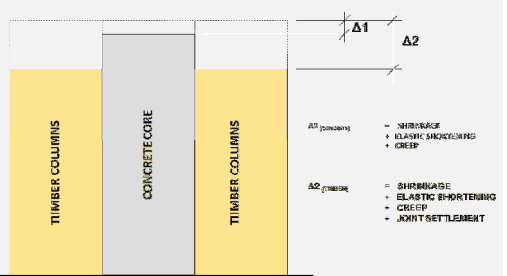
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Adoption in the Pacific Northwest



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Adoption in the Pacific Northwest



TIMBER COLUMNS **CONCRETE CORE** **TIMBER COLUMNS**

$\Delta 1$ $\Delta 2$

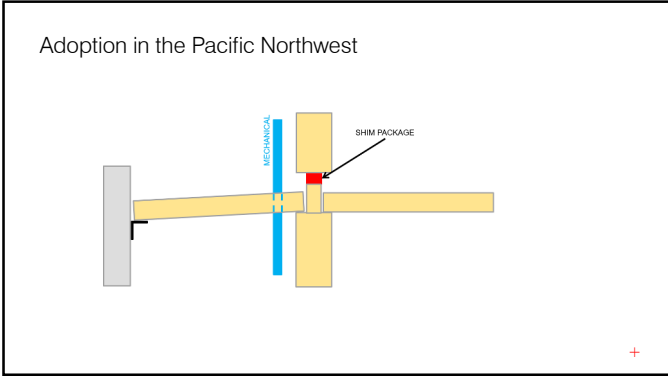
$\Delta 1$ TIMBER

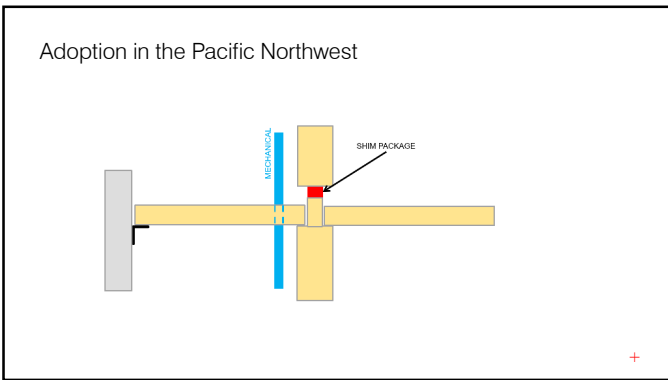
- SHRINKAGE
- + ELASTIC SHORTENING
- + CREEP

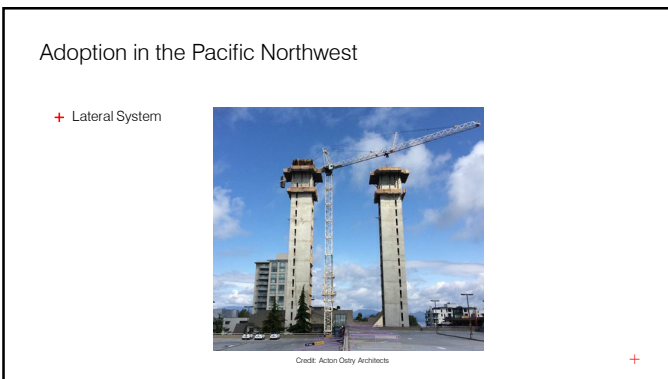
$\Delta 2$ CONCRETE

- SHRINKAGE
- + ELASTIC SHORTENING
- + CREEP
- + JOINT SETTLEMENT

+







Adoption in the Pacific Northwest

+ Lateral System



+

Adoption in the Pacific Northwest

+ Fire



Credit: naturally.wood

+

Adoption in the Pacific Northwest

+ Fire



Credit: naturally.wood

+

Adoption in the Pacific Northwest

+ Benefits – Sustainability



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Adoption in the Pacific Northwest

+ Benefits – Speed of MT installation



Credit: Seagate Structures

+

Adoption in the Pacific Northwest

+ Benefits – Lightweight



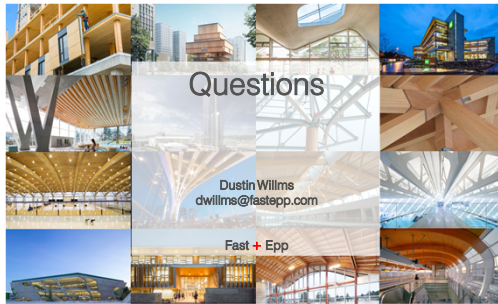
Credit: Seagate Structures

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