

Mass Timber Shafts and Shaft Wall Solutions for Mass Timber Buildings

Presented by

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

ACME Timber Lofts

Case Study



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Design + Development Team

Developer	ACME Timber LLC / Spiritos Properties LLC
Architect	Gray Organschi Architecture
Structural Engineer	Odeh Engineers
MEP Engineer	Acorn Engineers
Fire Engineer	Arup
Construction Manager	LaRosa Building Group



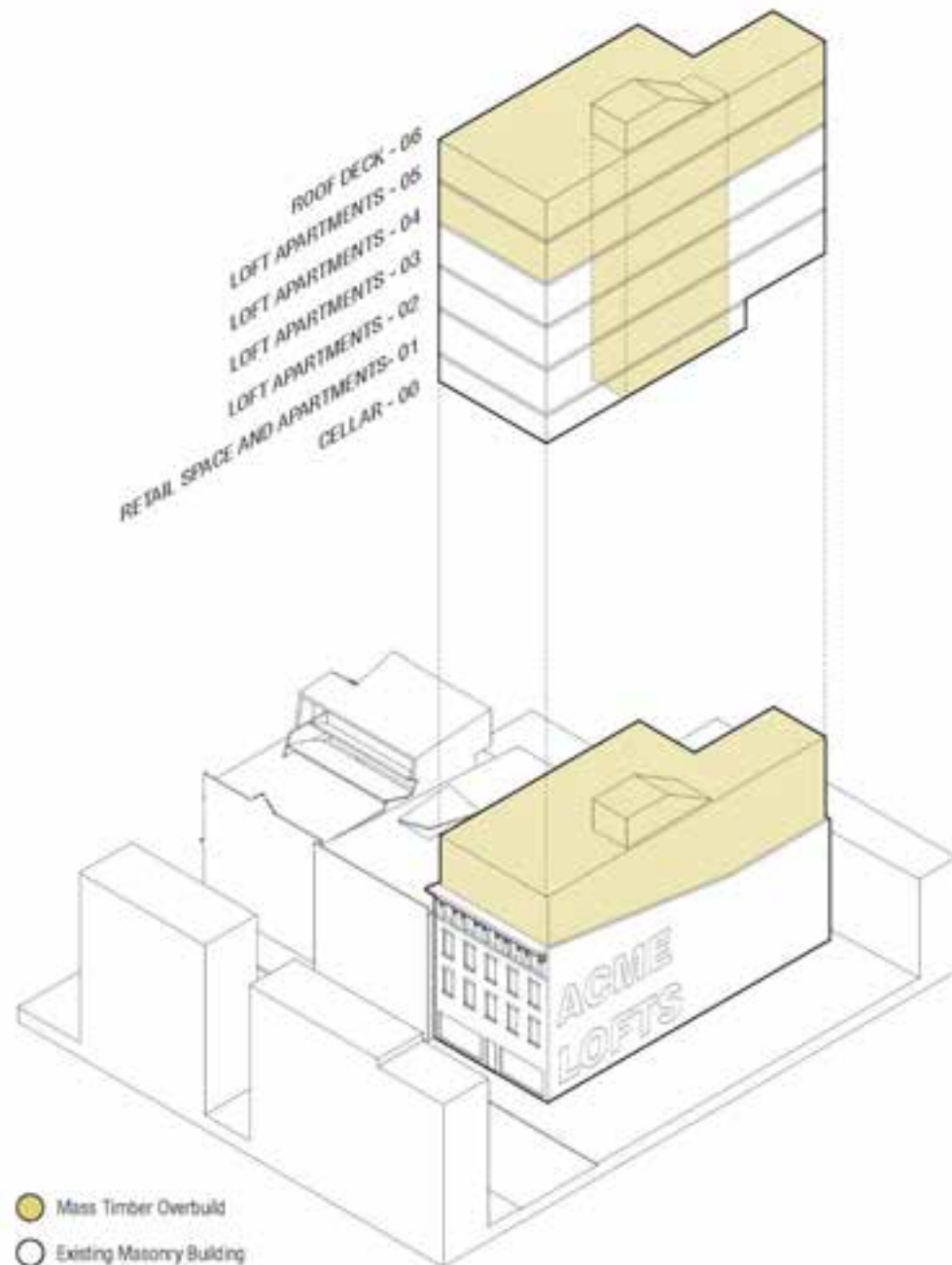
*Special thanks to the USDA Forest Service
Wood Innovations Program for their support*



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Project Information

Location	New Haven, Connecticut, USA
Building Type	Mixed-use Multifamily (R-2)
Construction Type	Type III – B (Existing) Type IV-HT (Vertical Addition)
Building Code	2018 CT Building Code (2015 IBC) 2021 IBC Code Modification
Existing Height	3.5 Stories +35' Above Grade
New Height	5 Stories + Basement + Roof +73'-7" Above Grade



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Building Construction Type

2021 IBC: 602.4.4 Type IV-HT

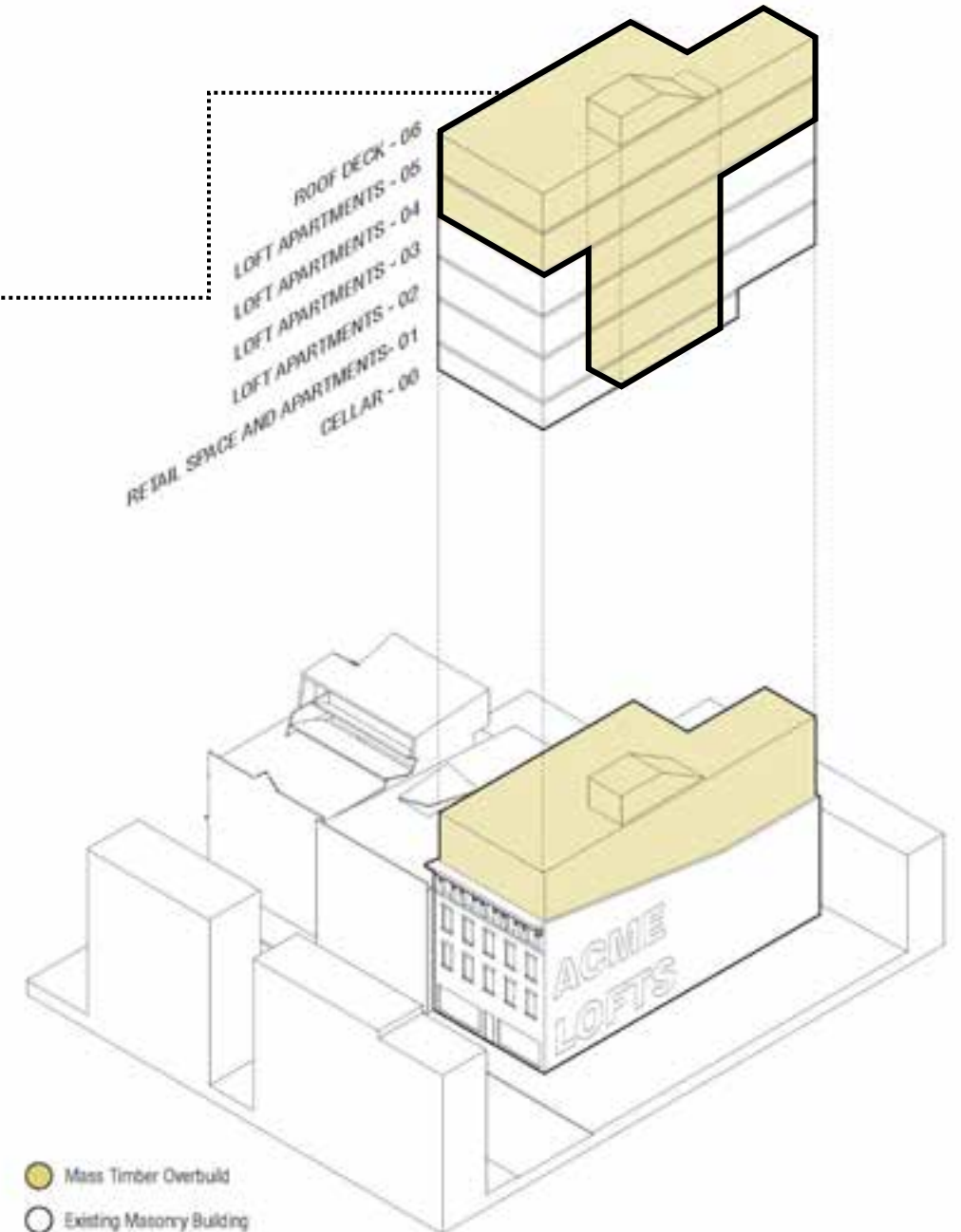
Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3.

The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross-laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of this section and Section 2304.11.

Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

2015 IBC: 602.3 Type III

Type III construction is that type of construction in which the exterior walls are of noncombustible material and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.



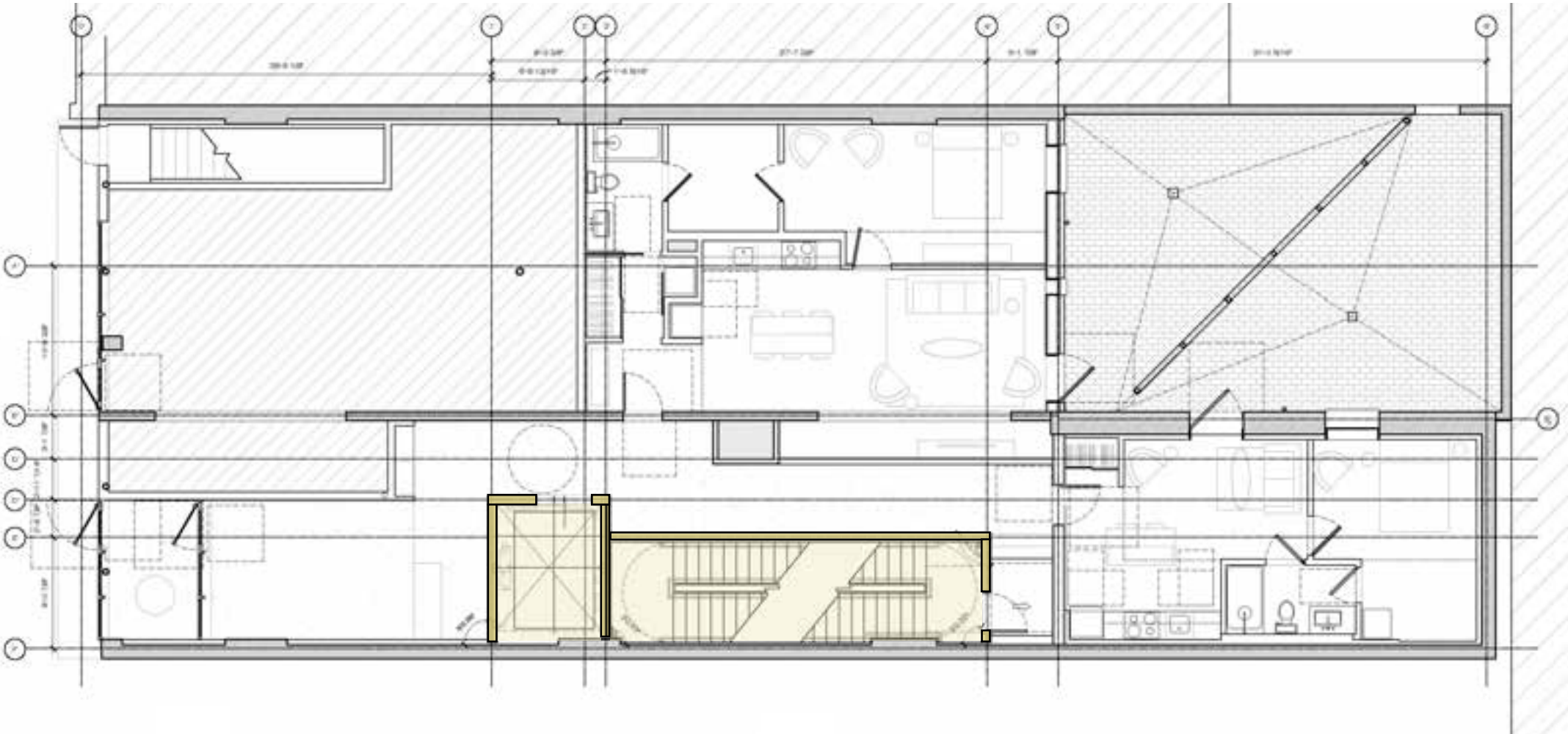
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Level 01

CLT Walls



CLT Core



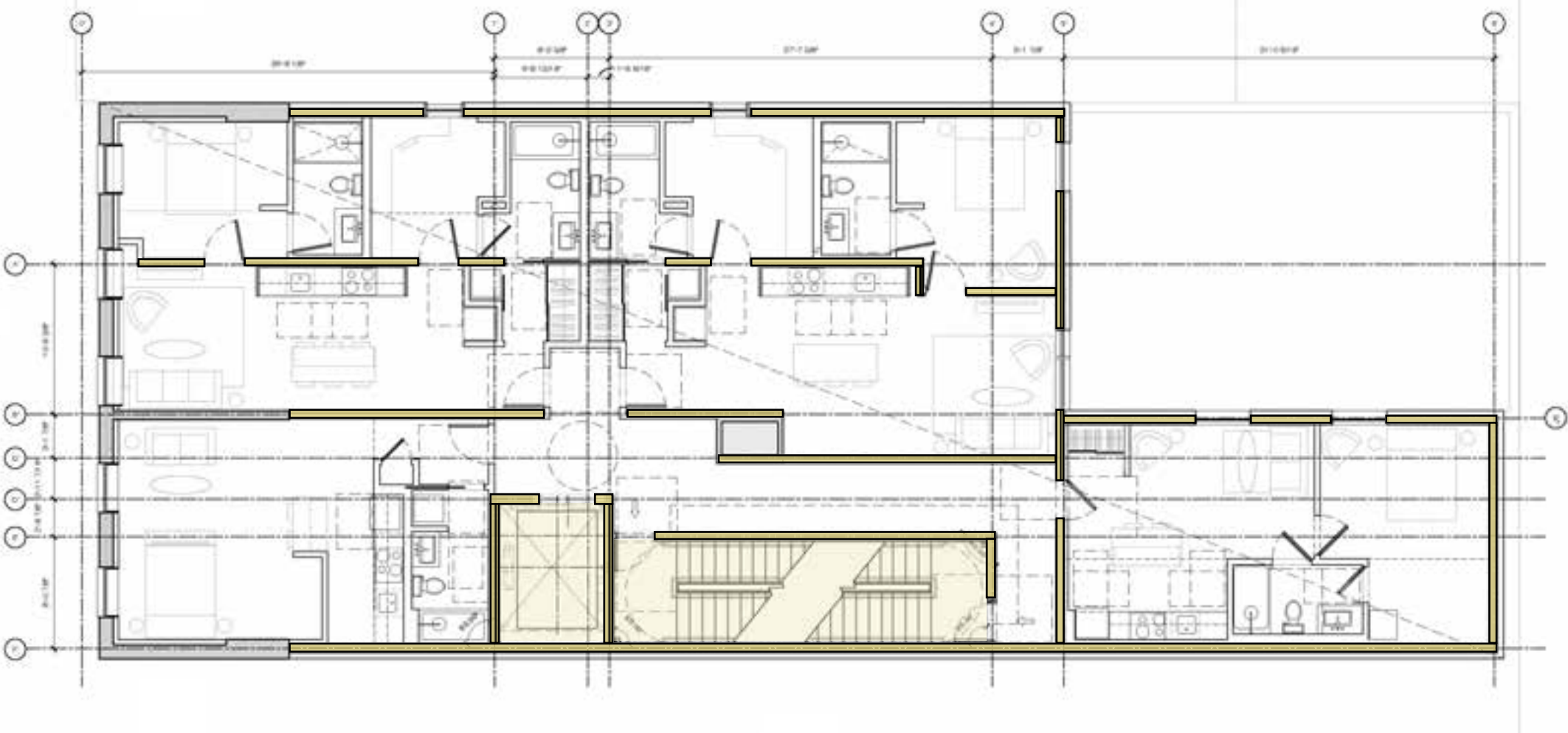
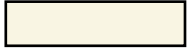
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Level 04

CLT Walls



CLT Core

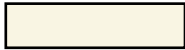


ACME Timber Lofts Section

CLT Walls



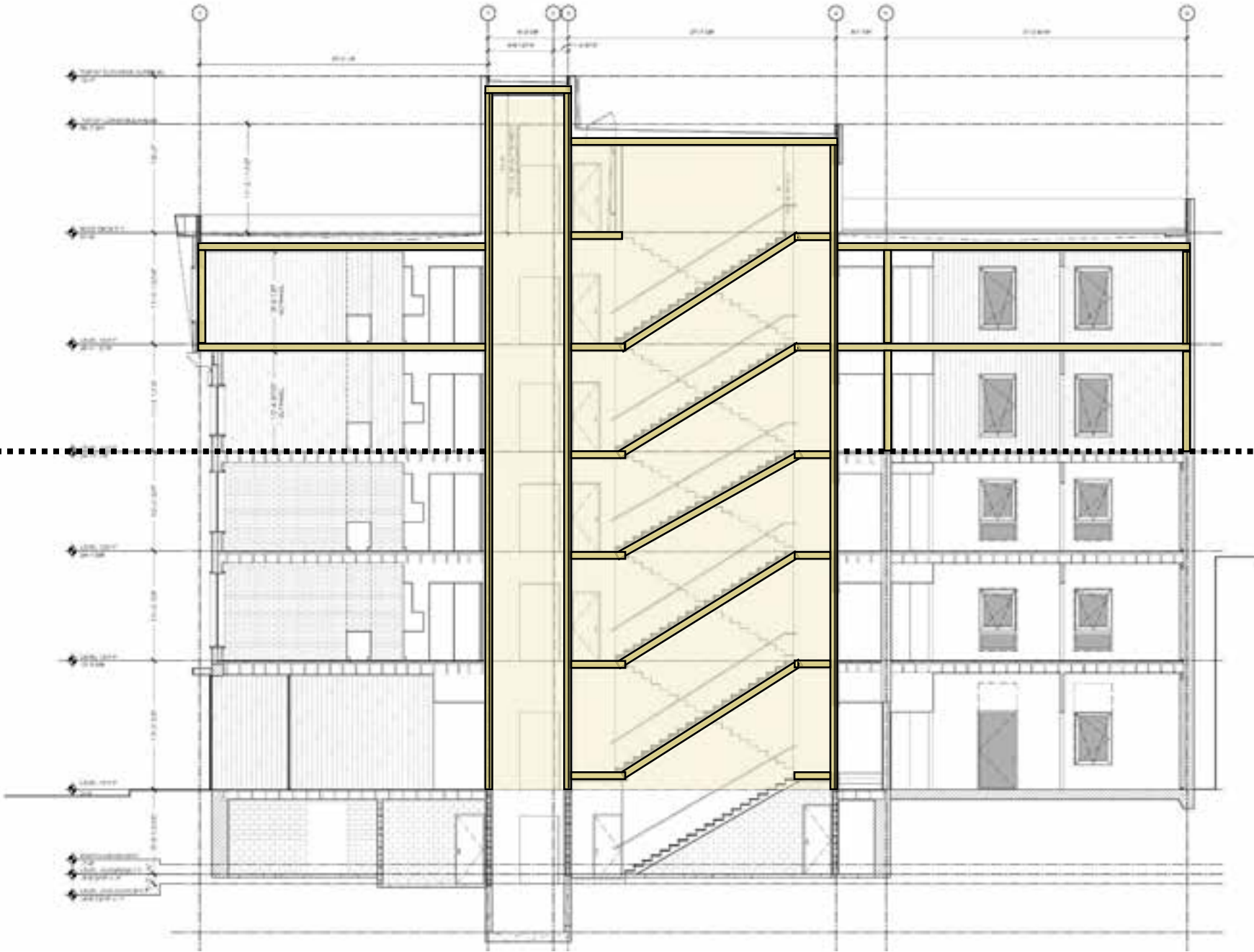
CLT Core



Type IV-HT



Type III-B



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Shaft Enclosure Code Path

2018 CT Building Code (2015 IBC)

Section 722.6 Wood Assemblies

This section contains procedures for calculating the fire-resistance ratings of walls, floor/ceiling and roof/ceiling assemblies based in part on the standard method of testing referenced in Section 703.2.

722.6.1.1 Maximum Fire-Resistance Rating

Fire-resistance ratings calculated for assemblies using the methods in Section 722.6 shall be limited to a maximum of 1 hour.

722.6.2.1 Fire-Resistance Rating of Wood Frame Assemblies

The fire-resistance rating of a wood frame assembly is equal to the sum of the time assigned to the membrane on the fire-exposed side, the time assigned to the framing members and the time assigned for additional contribution by other protective measures such as insulation. The membrane on the unexposed side shall not be included in determining the fire resistance of the assembly.

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Shaft Enclosure Code Path

2018 CT Building Code (2015 IBC)

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2021 IBC

722.7 Fire-Resistance Rating for Mass Timber

The required fire resistance of mass timber elements in Section 602.4 shall be determined in accordance with Section 703.2. The fire-resistance rating of building elements shall be as required in Tables 601 and 705.5 and as specified elsewhere in this code. The fire-resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

722.7.1 Minimum Required Protection

Where required by Sections 602.4.1 through 602.4.3, noncombustible protection shall be provided for mass timber building elements in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the noncombustible protection of mass timber building elements, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement where installed and fastened in accordance with Section 722.7.2.

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Shaft Enclosure Code Path

TABLE 722.7.1(1)

PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL	
REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER TABLE 601 AND TABLE 705.5 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)

PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL	
NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

2021 IBC

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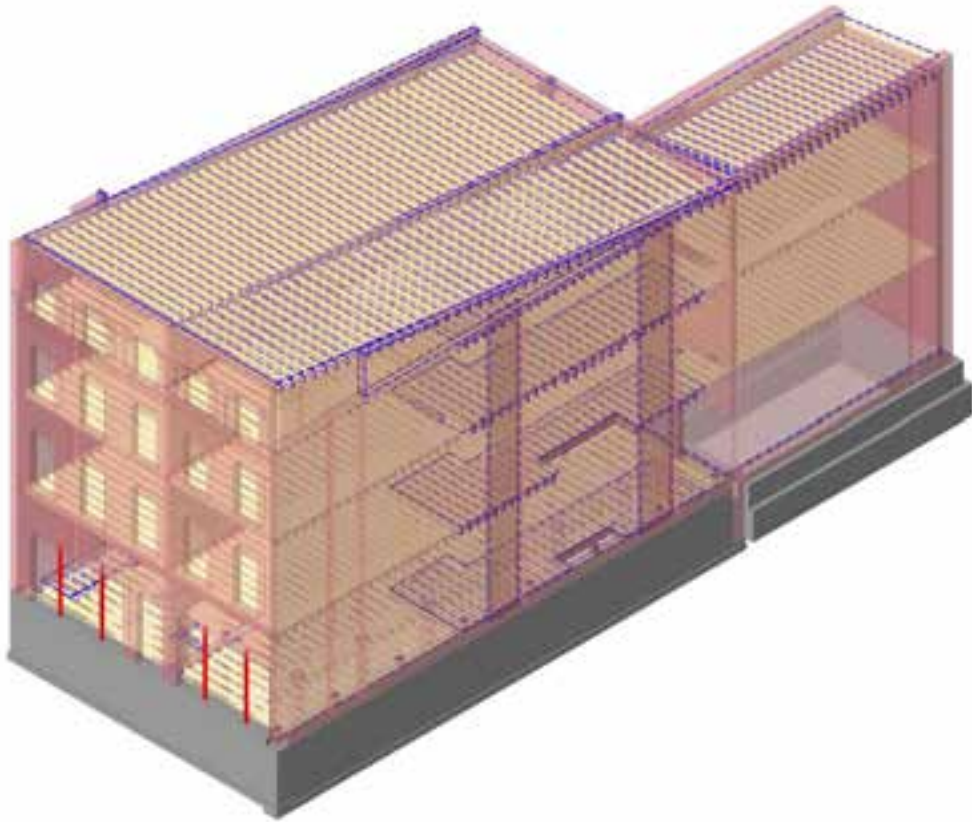
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Shaft Conditions

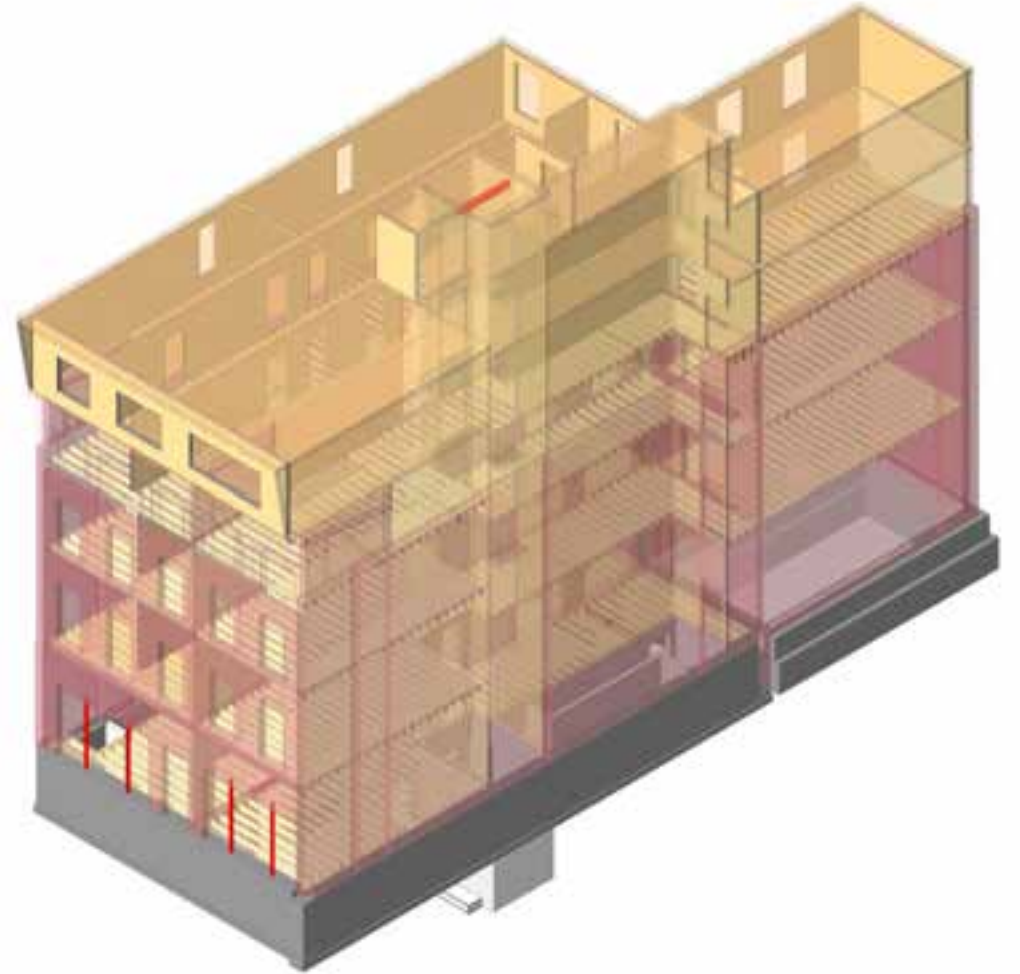


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Structural System Overview



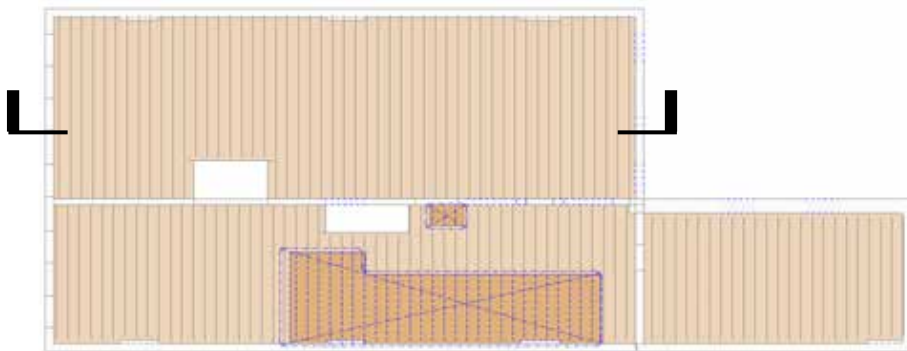
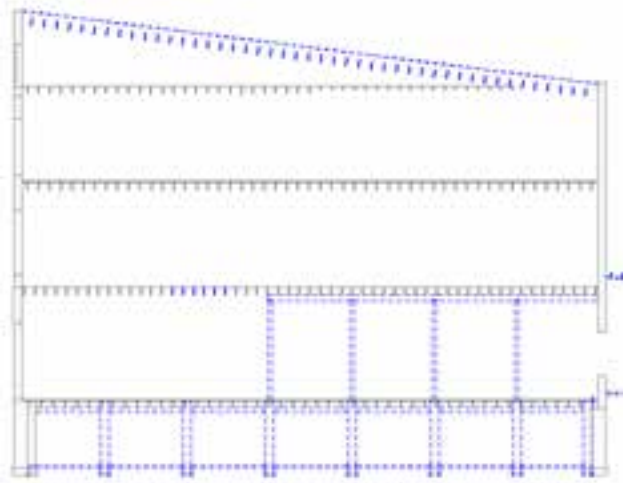
Existing Conditions



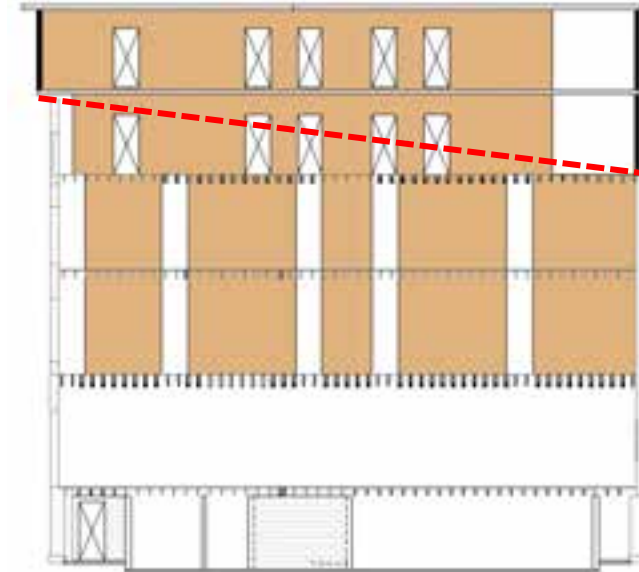
New Construction

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Structural System Overview



Existing Conditions



New Construction

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Code Path

2015 IEBC

[BS] 1103.3 Lateral force-resisting system. The lateral force-resisting system of *existing buildings* to which additions are made shall comply with Sections 1103.3.1, 1103.3.2 and 1103.3.3.

Exceptions:

- 1. Buildings of Group R occupancy with no more than five dwelling or sleeping units used solely for residential purposes where the *existing building* and the *addition* comply with the conventional light-frame construction methods of the *International Building Code* or the provisions of the *International Residential Code*.
- 2. Any existing lateral load-carrying structural element whose demand-capacity ratio with the addition considered is not more than 10 percent greater than its demand-capacity ratio with the addition ignored shall be permitted to remain unaltered. For purposes of this exception, comparisons of demand-capacity ratios and calculation of design lateral loads, forces and capacities shall account for the cumulative effects of additions and alterations since original construction. For purposes of calculating demand-capacity ratios, the demand shall consider applicable load combinations involving *International Building Code*-level seismic forces in accordance with Section 301.1.4.1.

ASCE 7-10

12.2.3 Combinations of Framing Systems in the Same Direction

Where different seismic force-resisting systems are used in combination to resist seismic forces in the same direction, other than those combinations considered as dual systems, the most stringent applicable structural system limitations contained in Table 12.2-1 shall apply and the design shall comply with the requirements of this section.

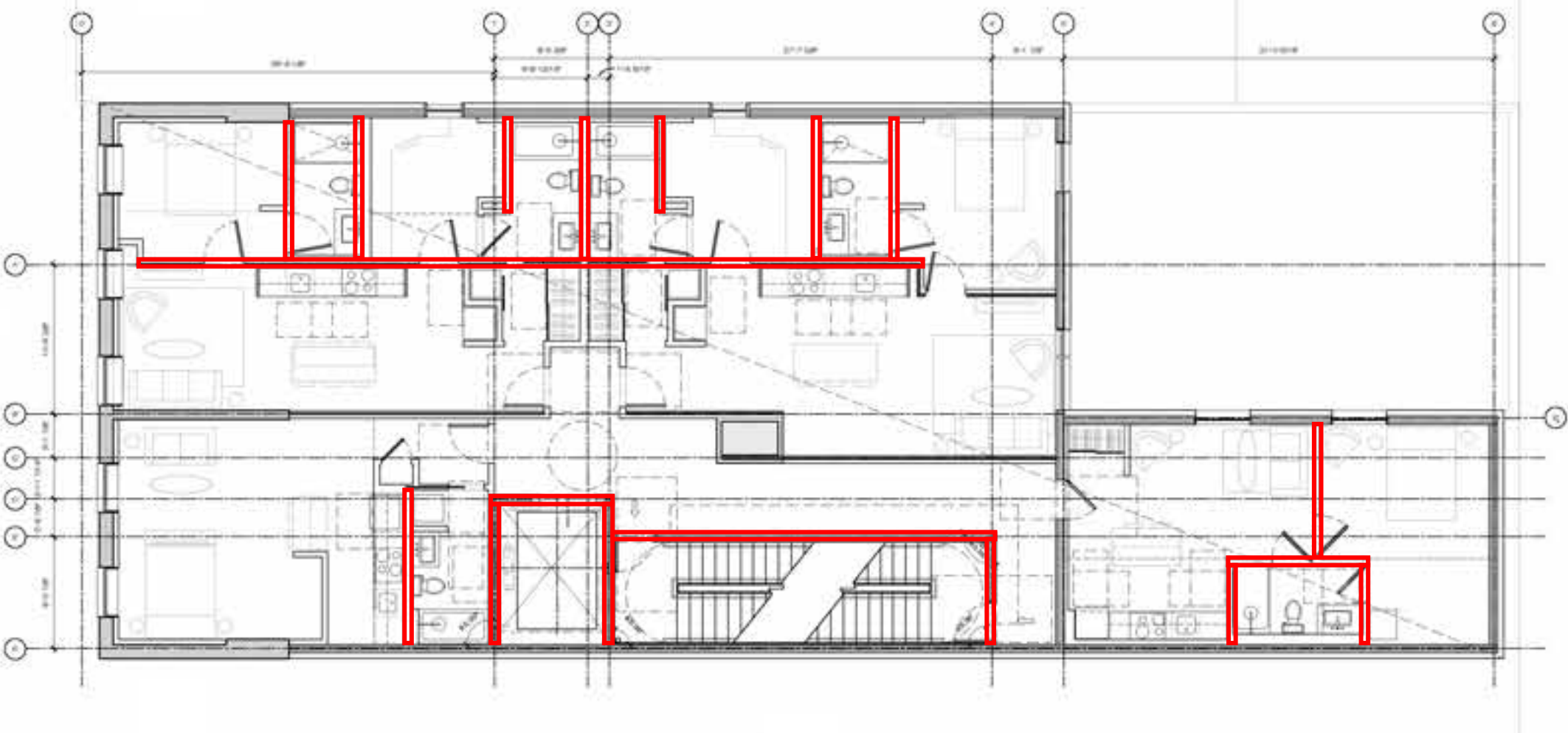
Table 12.2-1 Design Coefficients and Factors for Seismic Force-Resisting Systems

Seismic Force-Resisting System	ASCE 7 Section Where Detailing Requirements Are Specified	Response Modification Coefficient, R ^a	Overstrength Factor, Ω_o ^b	Deflection Amplification Factor, C _d ^c
A. BEARING WALL SYSTEMS				
11. Ordinary plain masonry shear walls	14.4	1½	2½	1¼

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Structural System Overview

LFRS



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Structural System Overview

Existing Construction

Exterior unreinforced masonry shear wall



Interior unreinforced masonry shear wall



New Construction

Existing unreinforced masonry shear walls



New light-framed wood shear walls

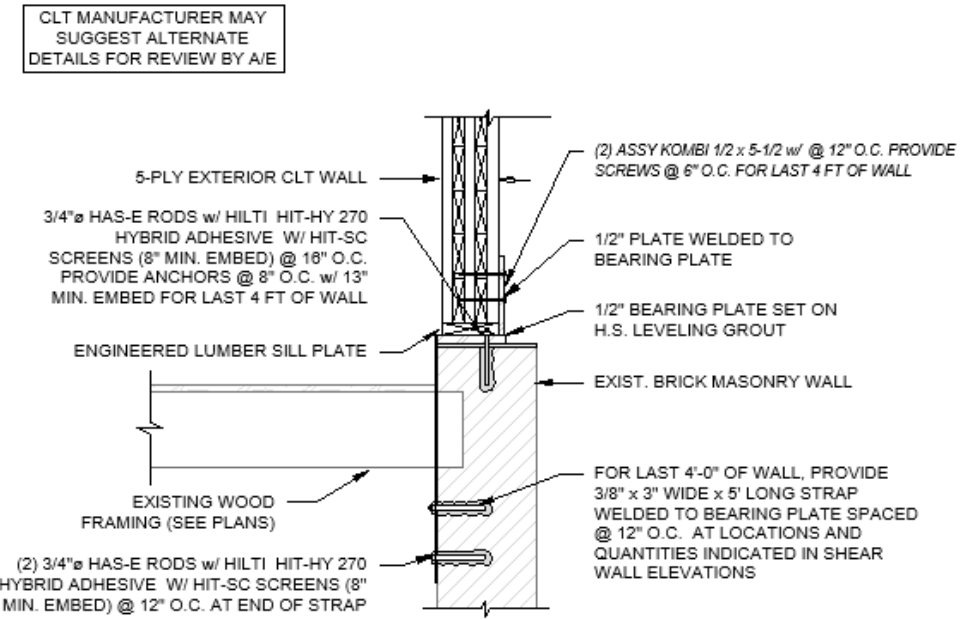


New CLT shear walls



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Attachment to Existing Structure



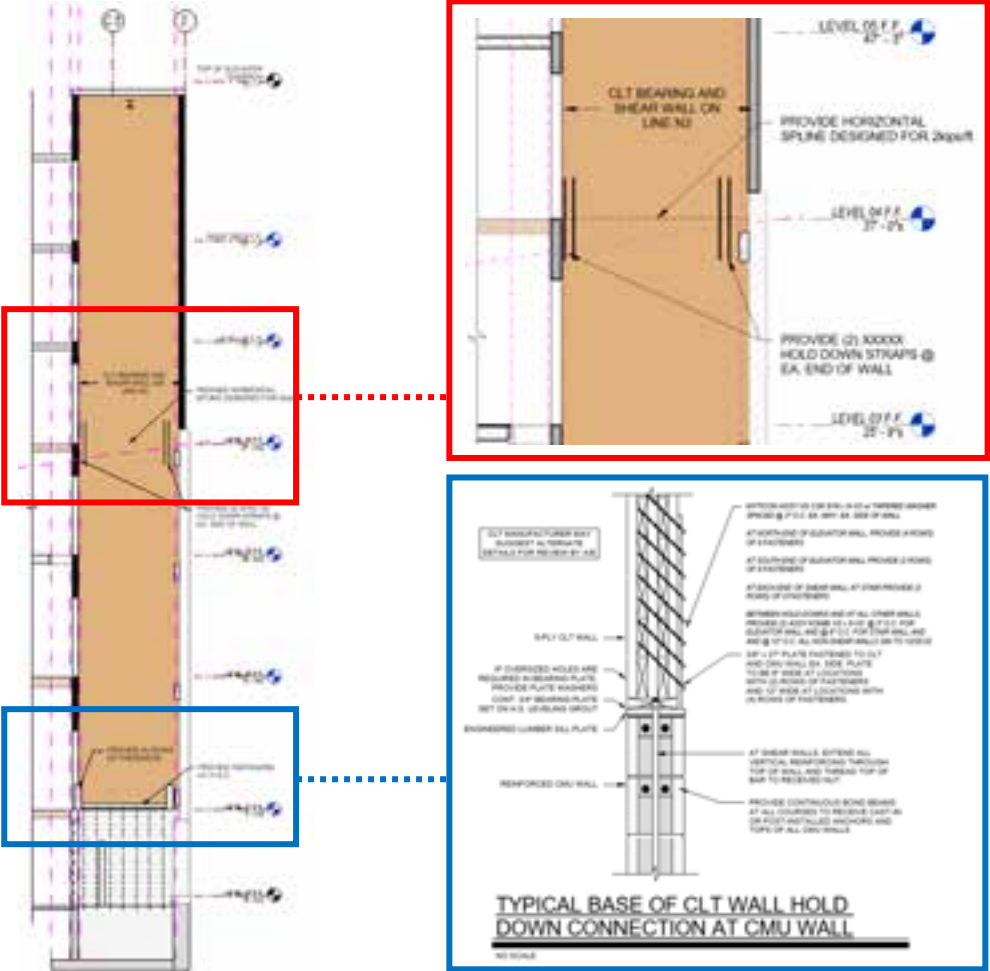
TYPICAL CLT ATTACHMENT AT TOP OF EXISTING BRICK MASONRY WALL

NO SCALE



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CLT Panel Connections



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Elevator Shaft Considerations



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Elevator Shaft Considerations



➤ QUESTIONS?

This concludes The American
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Education Systems Course

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