Mass Timber Shafts and Shaft Wall Solutions for Mass Timber Buildings

Presented by:
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Holmes
LEVER

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

Project Information

- Confidential Office Project in the Pacific Northwest
- 6 Stories Type III-A over Type I-A podium
- Team
  - Architect: LEVER
  - Structural Engineer: Holmes
  - Fire & Life Safety Code Consulting: Holmes

Shaft Code Requirements

- IBC Section 713: Shaft Enclosures

- Shafts are constructed as fire barriers

  713.2 Construction. Shaft enclosures shall be constructed as *fire barriers* in accordance with Section 707 or horizontal assemblies in accordance with Section 711, or both.

- Shaft fire resistance rating (independent of construction type)
  - 1 hr: < 4 stories
  - 2 hrs: 4 stories or more

Shaft Code Requirements

- 713.5 Shaft continuity requirements per fire barrier requirements

713.5 Continuity. Shaft enclosures shall be constructed as *fire barriers* in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both, and shall have continuity in accordance with Section 707.5 for *fire barriers* or Section 711.2.2 for *horizontal assemblies*, as applicable.

- 707.5 Fire barrier continuity requirements

707.5 Continuity. *Fire barriers* shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above and shall be securely attached thereto. Such *fire barriers* shall be continuous through concealed space, such as the space above a suspended ceiling. Joints and voids at intersections shall comply with Sections 707.8 and 707.9

Shaft Code Requirements

- 707.5.1 Supporting Construction: required to be the same fire resistance rating of the fire barrier being supported

707.5.1 Supporting construction. The supporting construction for a *fire barrier* shall be protected to afford the required *fire-resistance rating* of the *fire barrier* supported. Hollow vertical spaces within a *fire barrier* shall be fireblocked in accordance with Section 718.2 at every floor level.

Shaft Code Requirements

Floor & secondary members FRR requirements per construction type

	Type I		Type II		Type III		Type IV				Type V	
	A	B	A	B	A	B	A	B	C	HT	A	B
FRR	2	2	1	0	1	0	2	2	2	HT	1	0

Shaft FRR (independent of construction type)

	< 4 stories	4 or more stories
FRR	1 hr	2 hr

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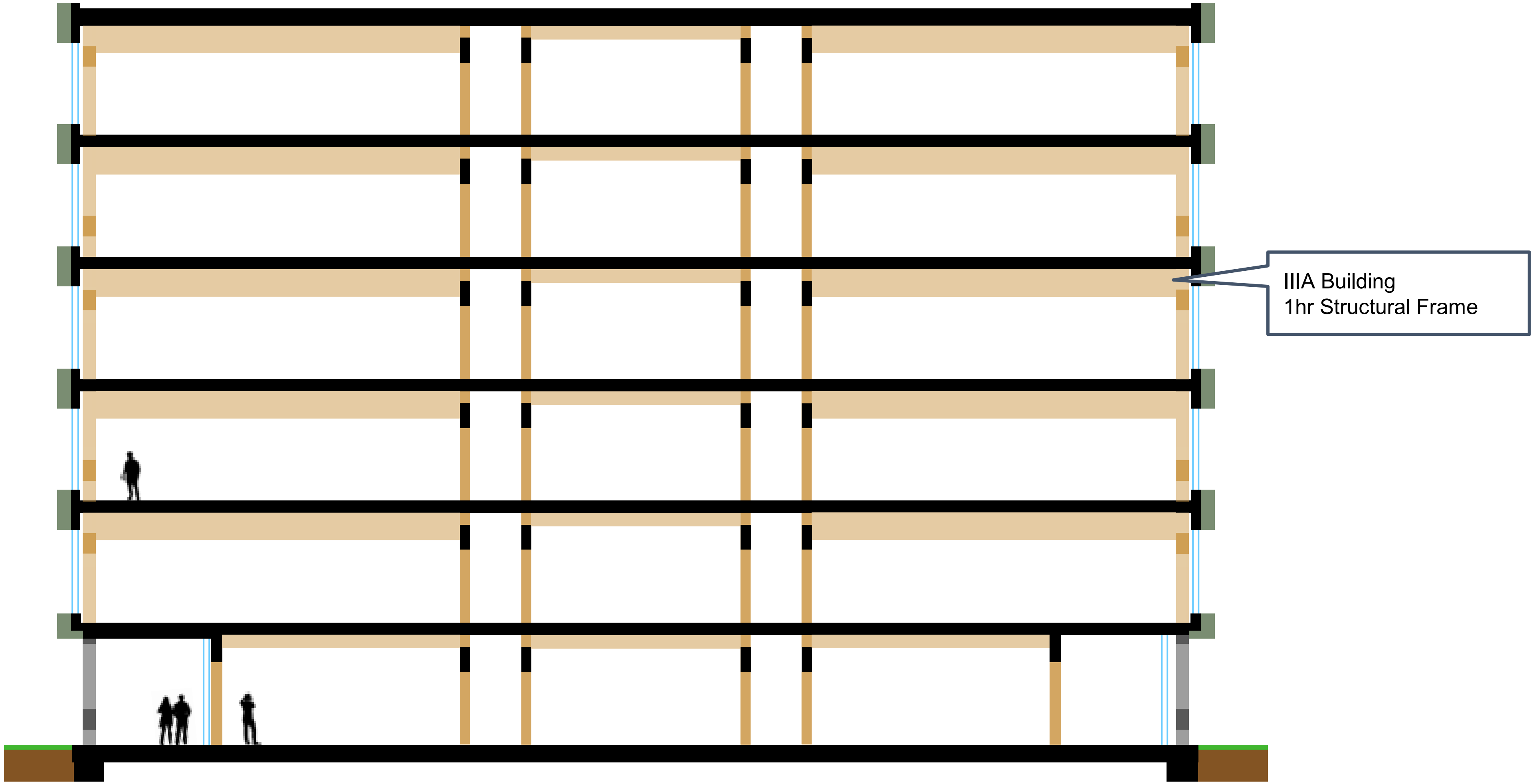
Building Overview

270’x140’ 6 storey all mass timber superstructure

Structural System:

- Number of innovative structural solutions outside of design codes
- Long-span composite (CLT/GLT) floor cassettes (requires testing)
- Perimeter lateral & gravity structure (requires testing)
- Internal CLT shear walls with BRB hold-downs (relies on previous testing)

Shaft Schematic Approaches



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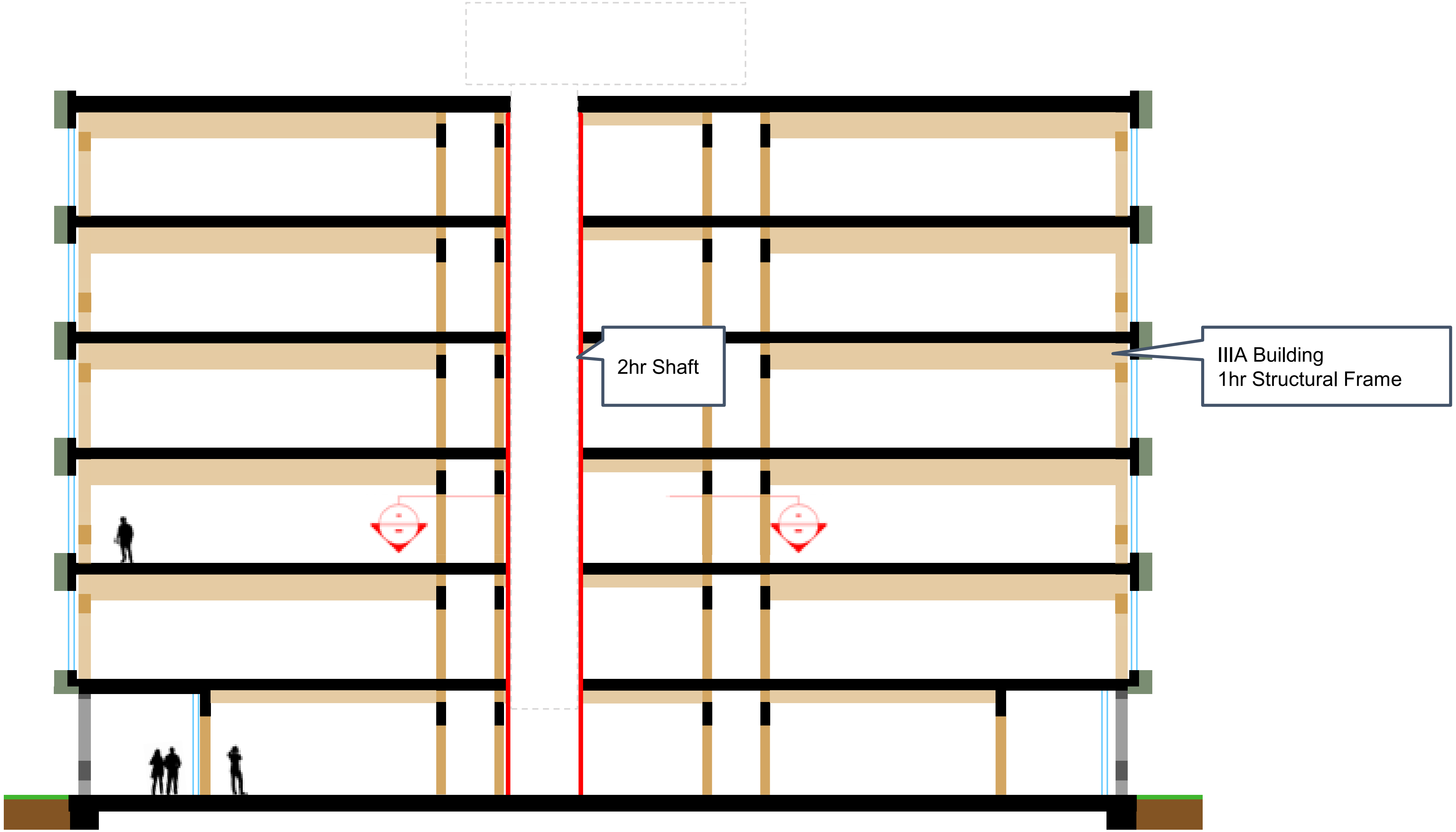
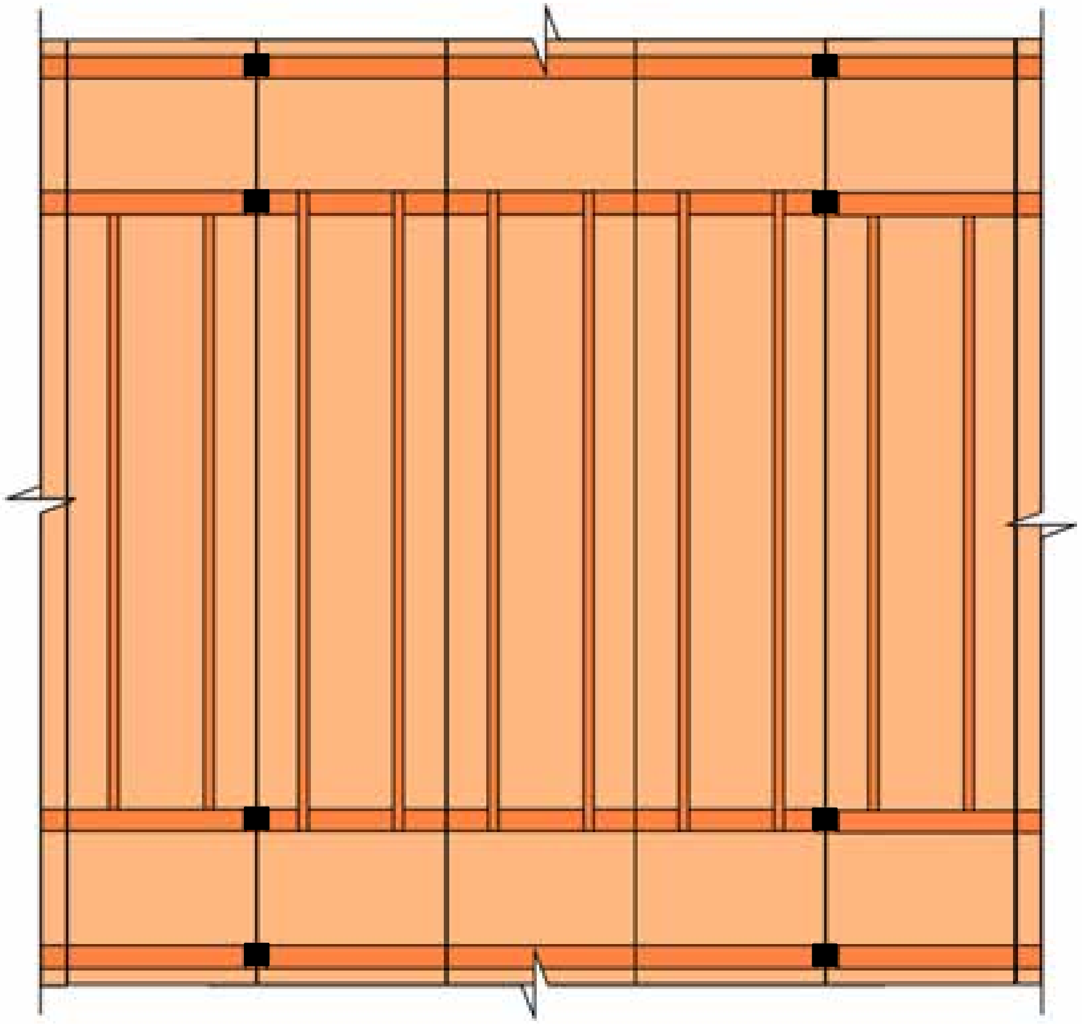


Shaft Schematic Approaches

General Structural Gravity System:

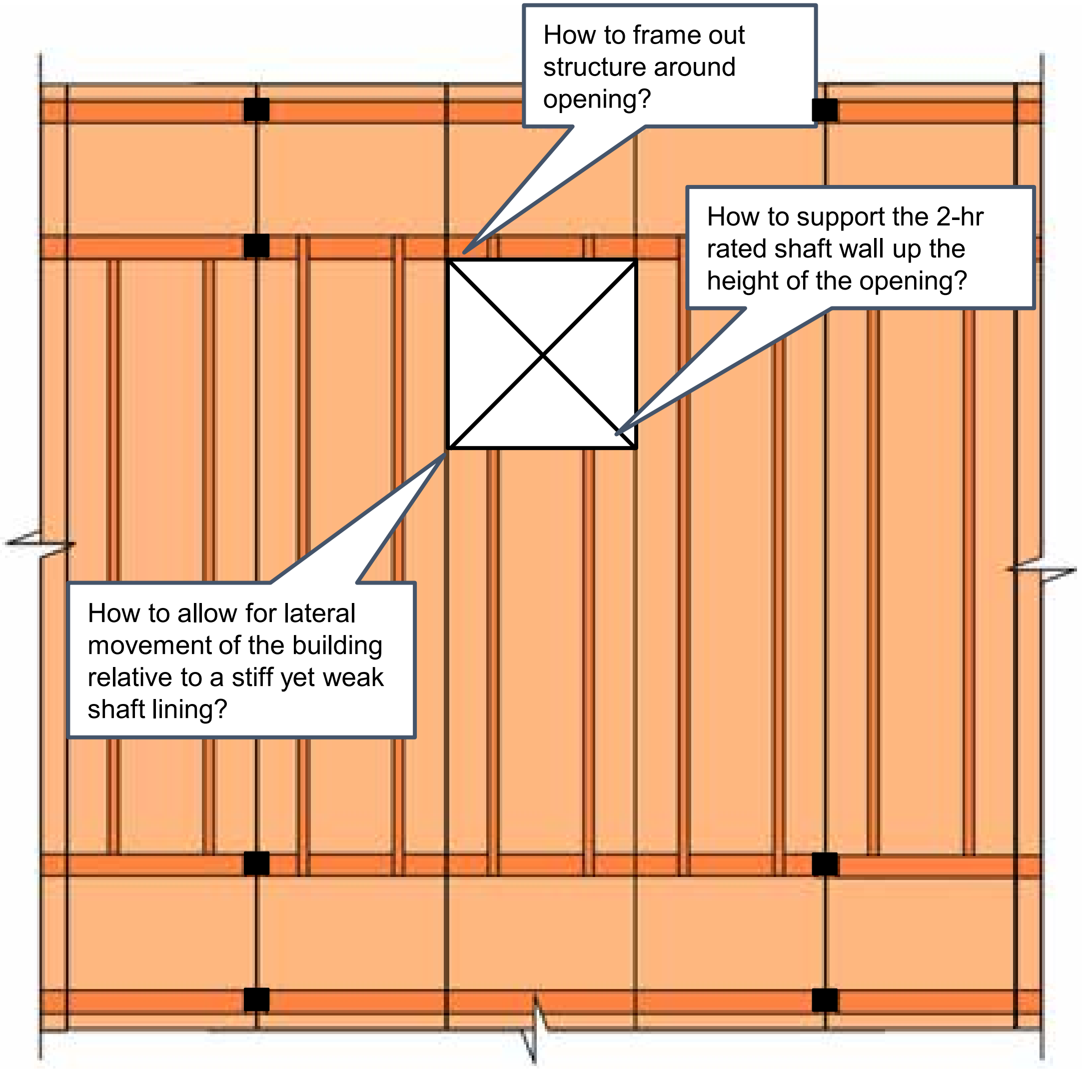
- Columns
- Girders spanning east-west
- Mass Timber Double T Cassettes spanning north-south



Shaft Schematic Approaches

Particular shaft difficulties

- This project uses an exterior distributed lateral system, therefore no internal shear cores to frame out shaft openings
- All shaft openings must accommodate lateral movement without attracting lateral load
- Intent is to avoid cracking of brittle materials during a serviceability level event
- Exposed cassette soffit makes framing out openings difficult



Shaft Schematic Approaches

<table>
<tr><th rowspan="2">Number</th><th rowspan="2">Name</th><th colspan="3">Shaft</th><th colspan="3">Floor</th><th rowspan="2">Example</th><th rowspan="2">Reason to use</th><th rowspan="2">Reason to not use</th><th rowspan="2">Notes</th></tr>
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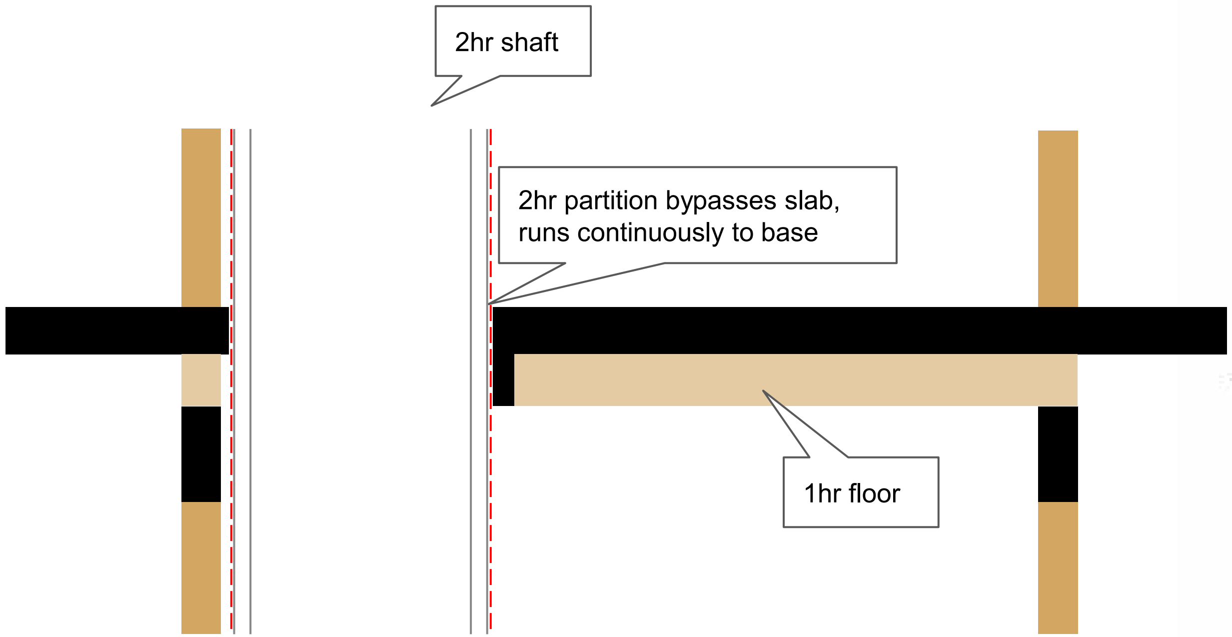

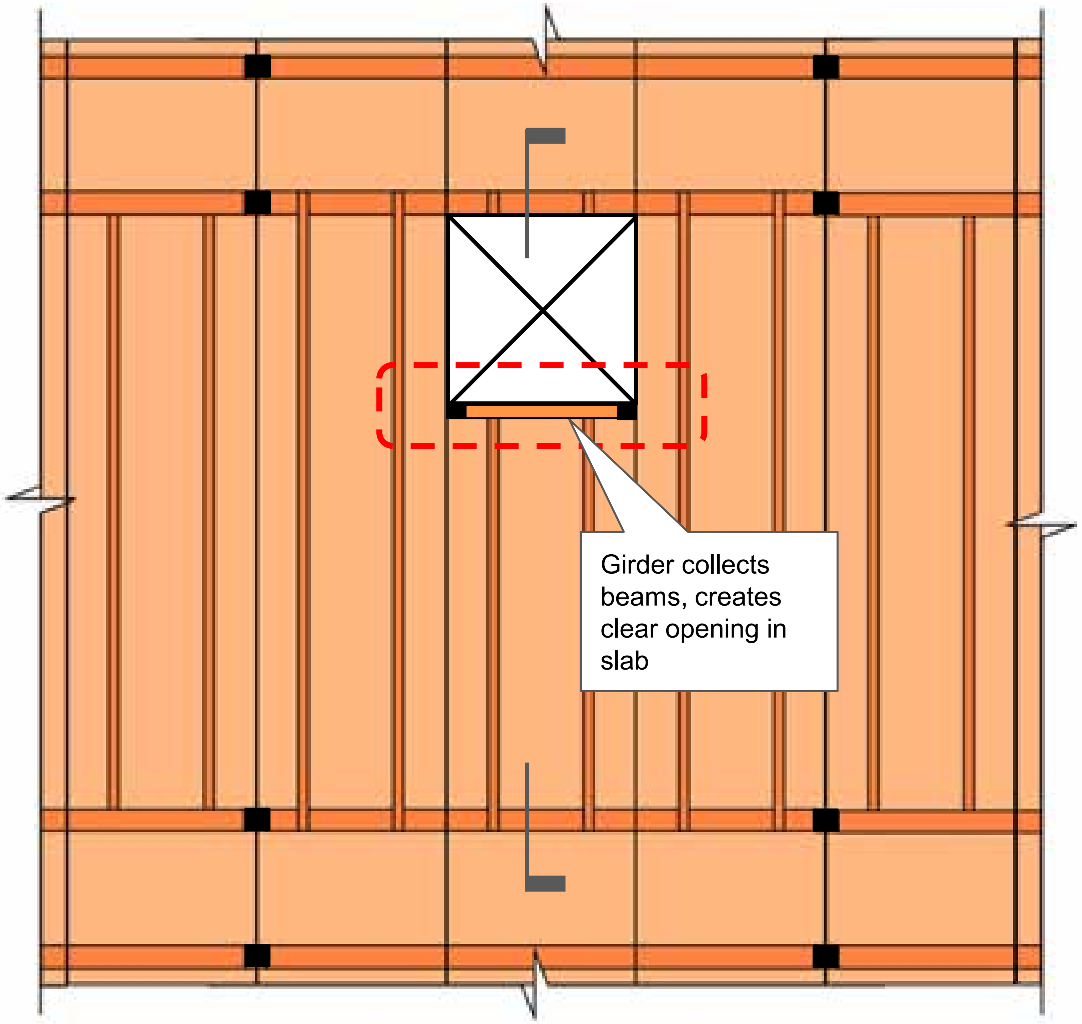

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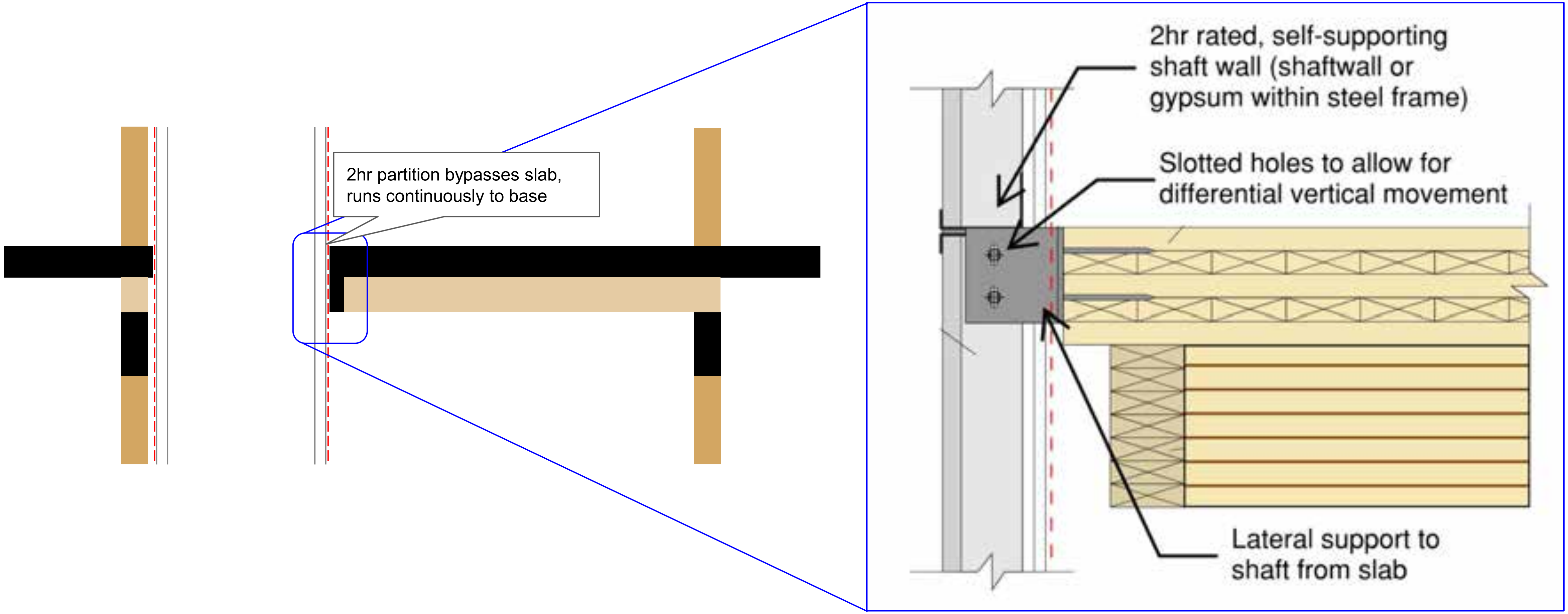

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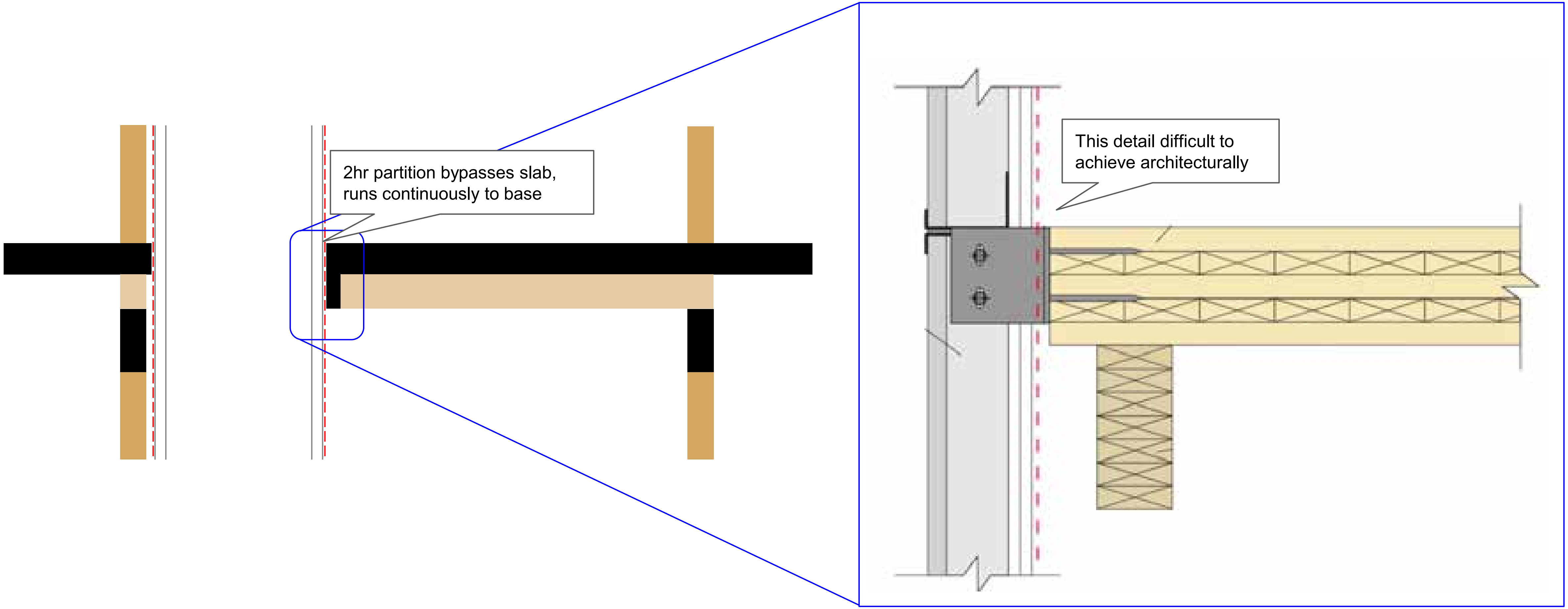

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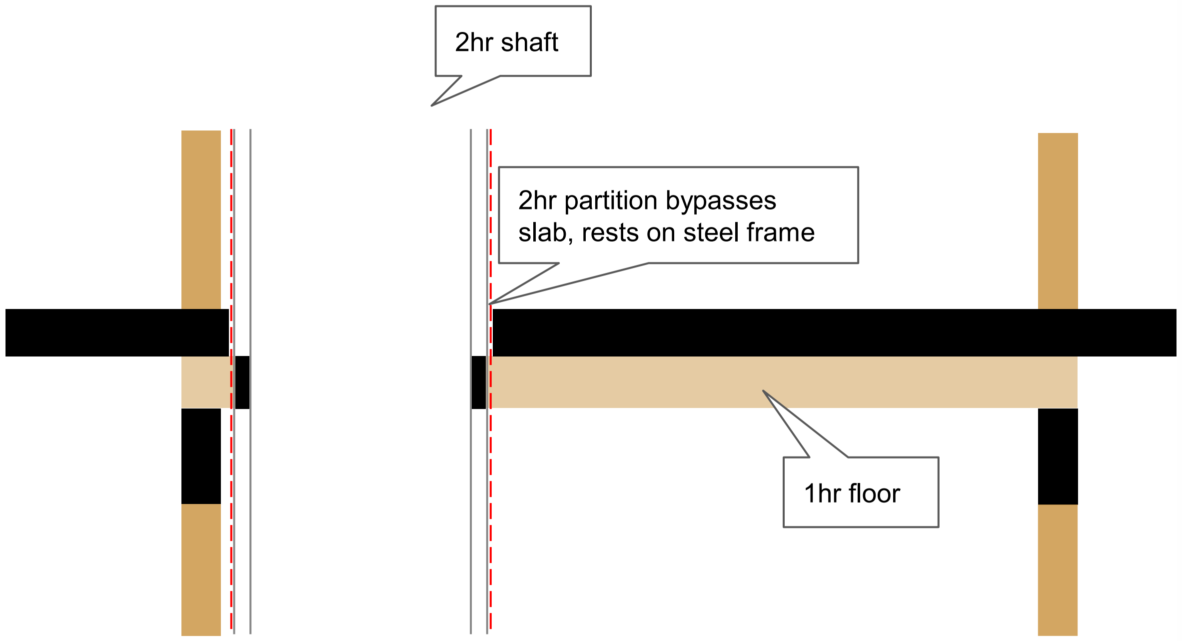

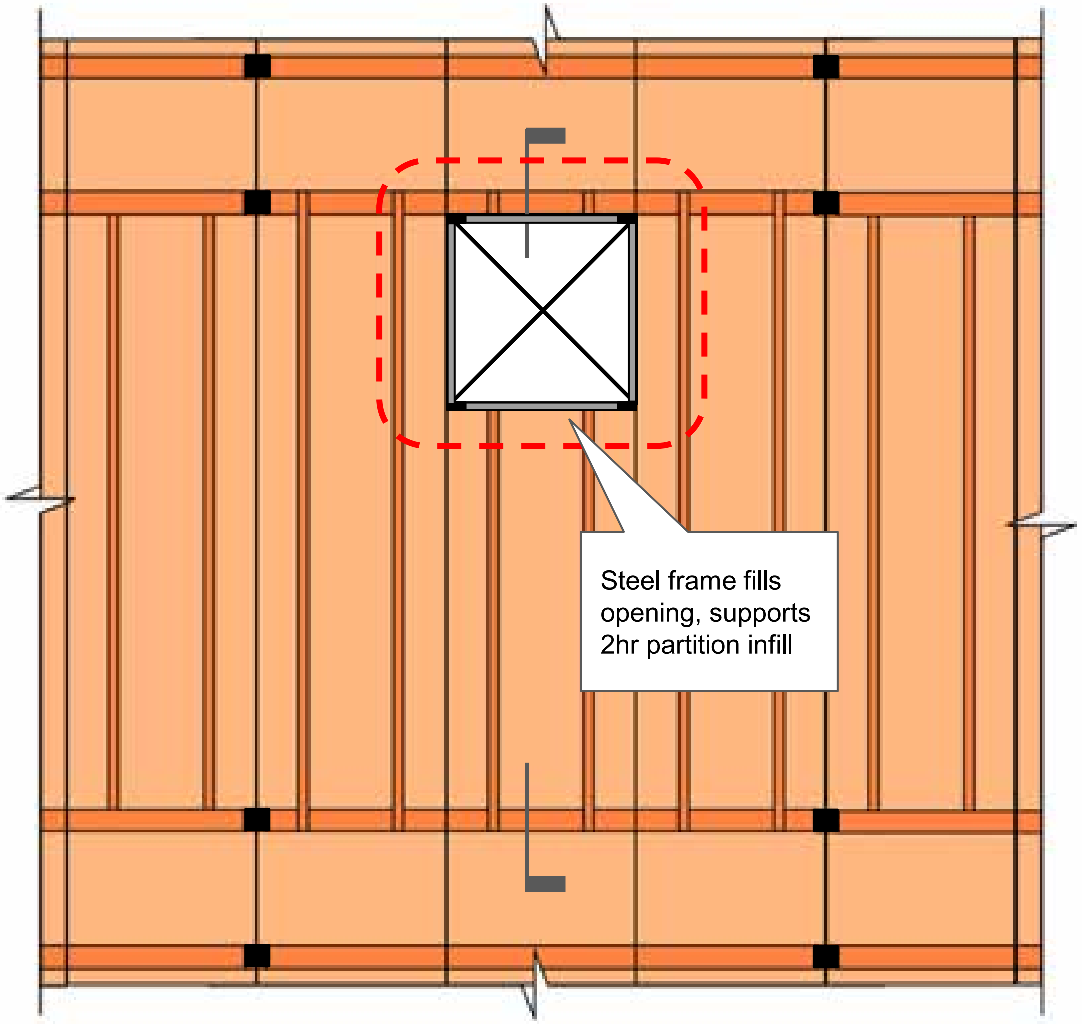

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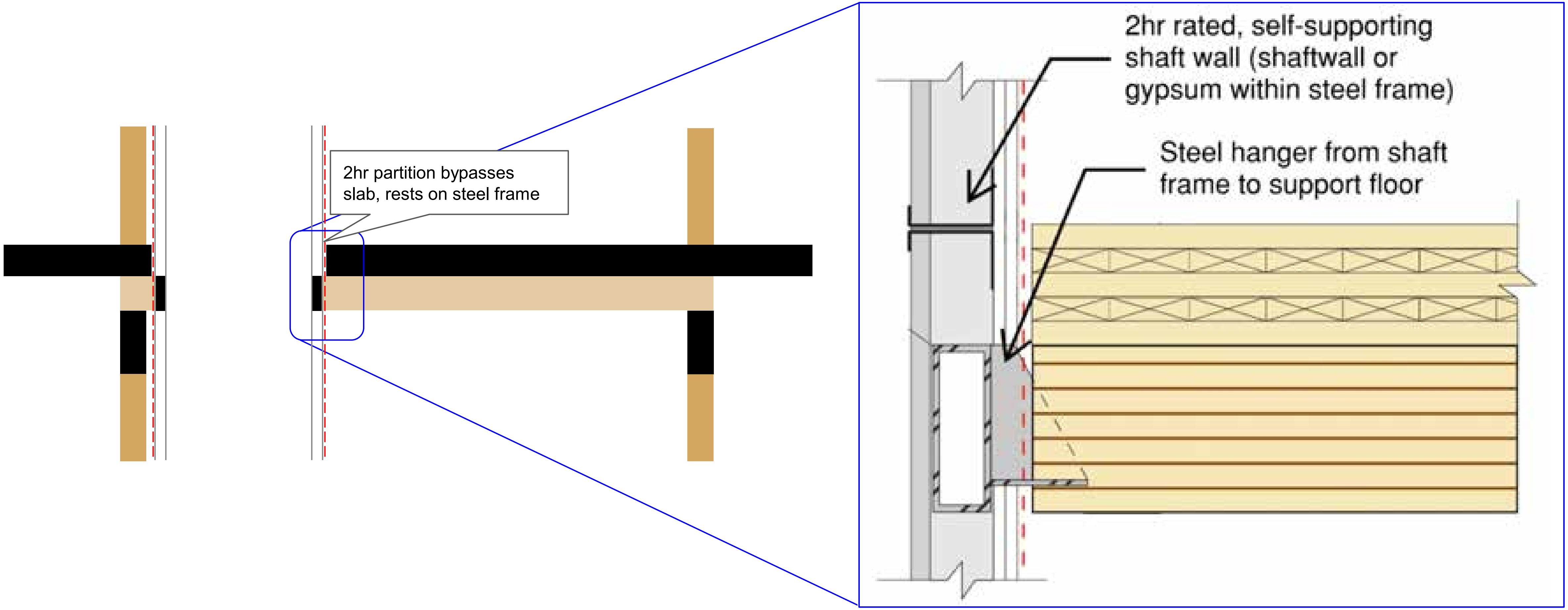

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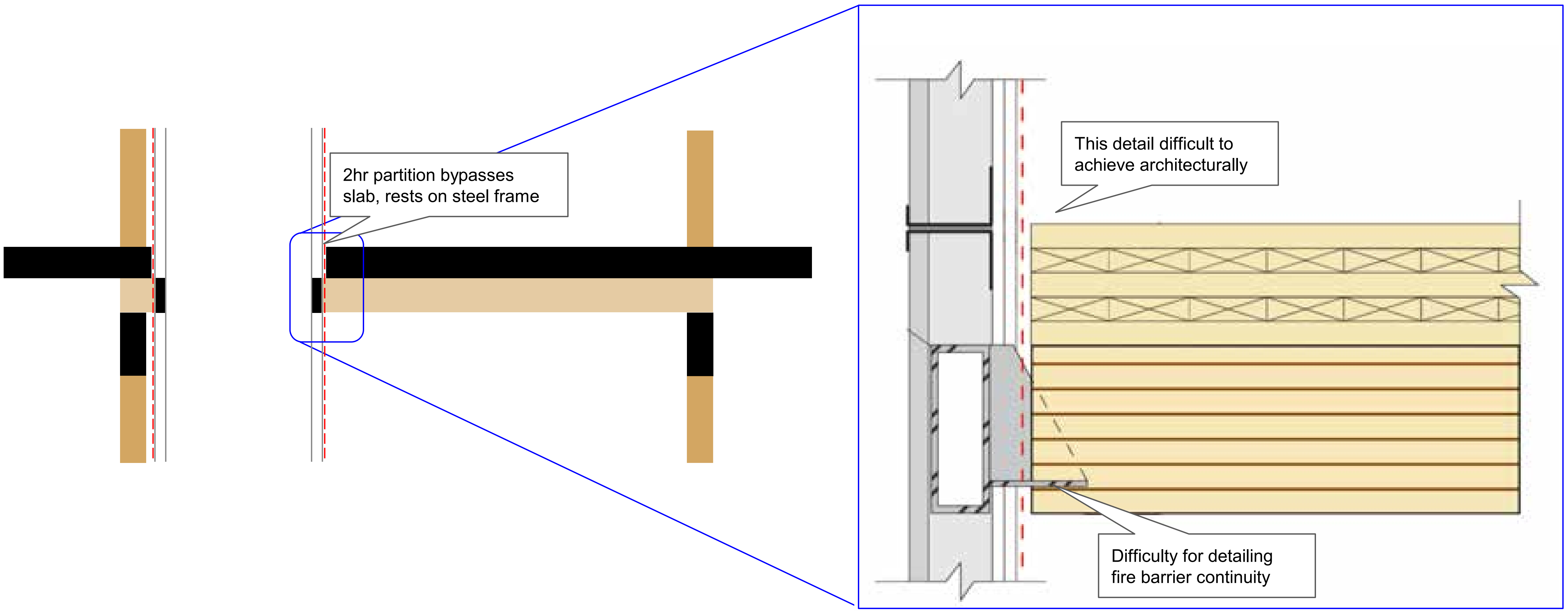

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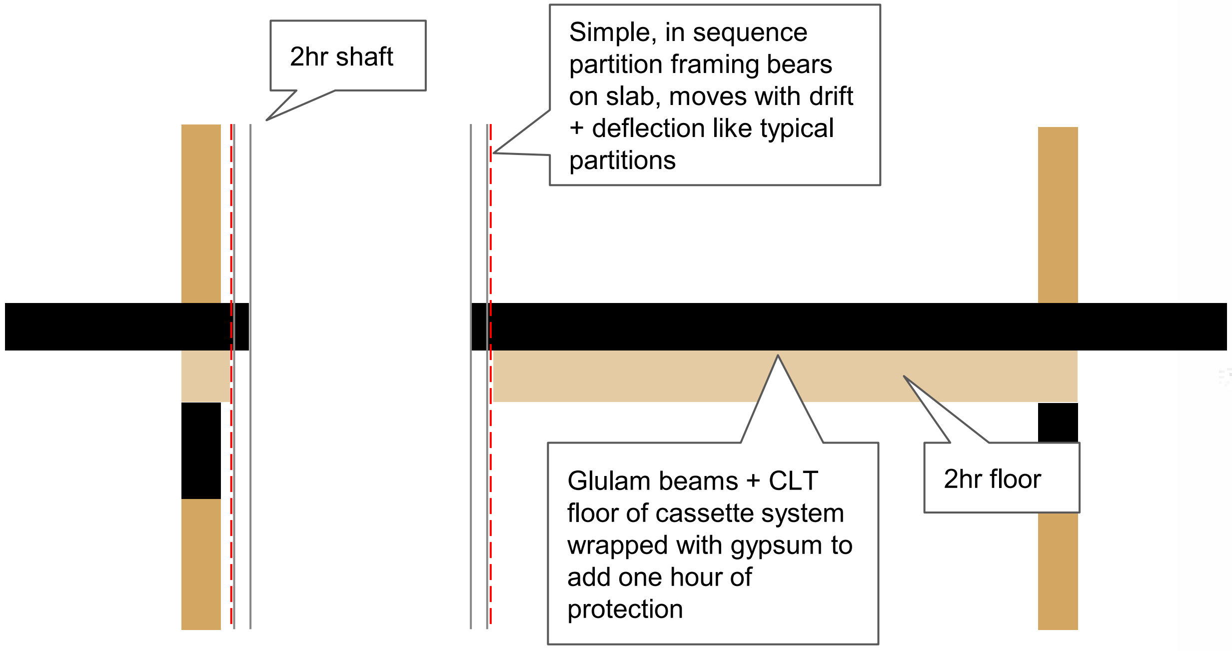

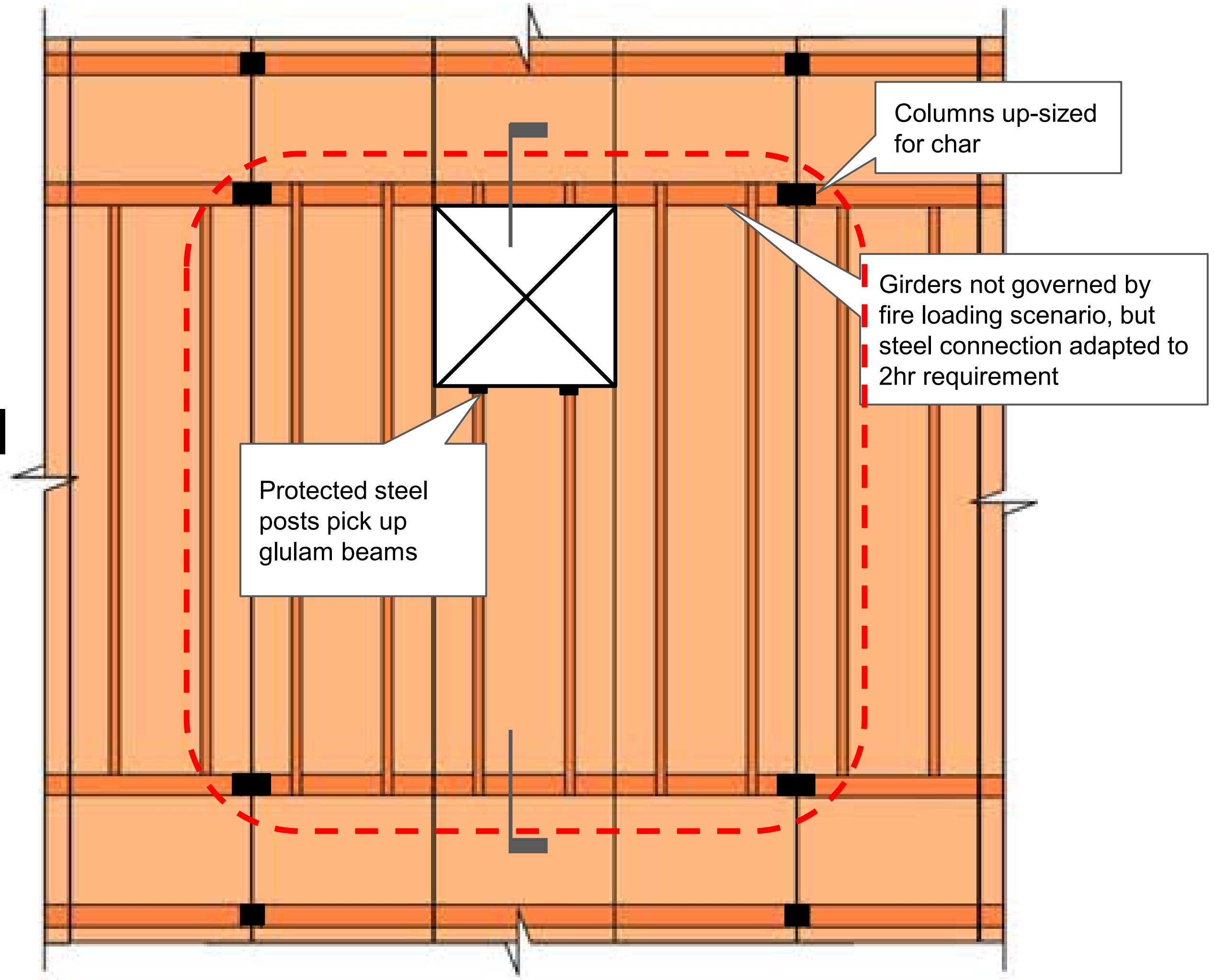

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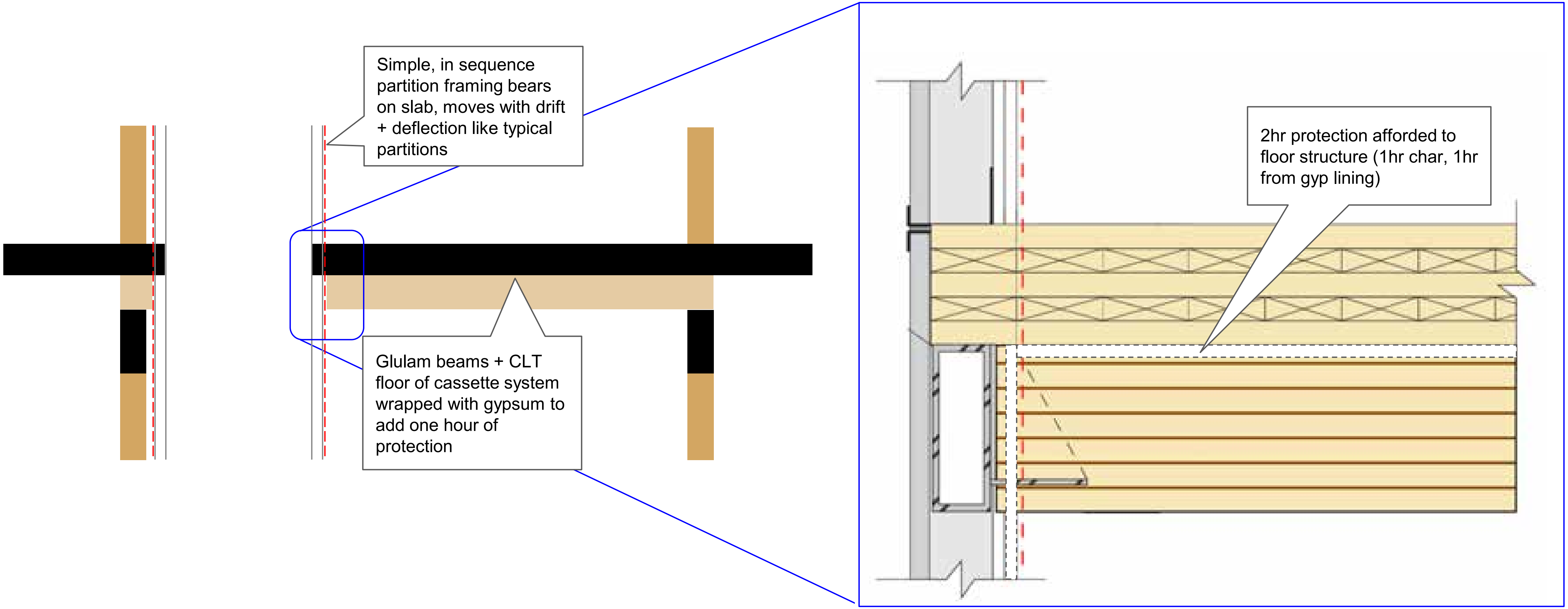

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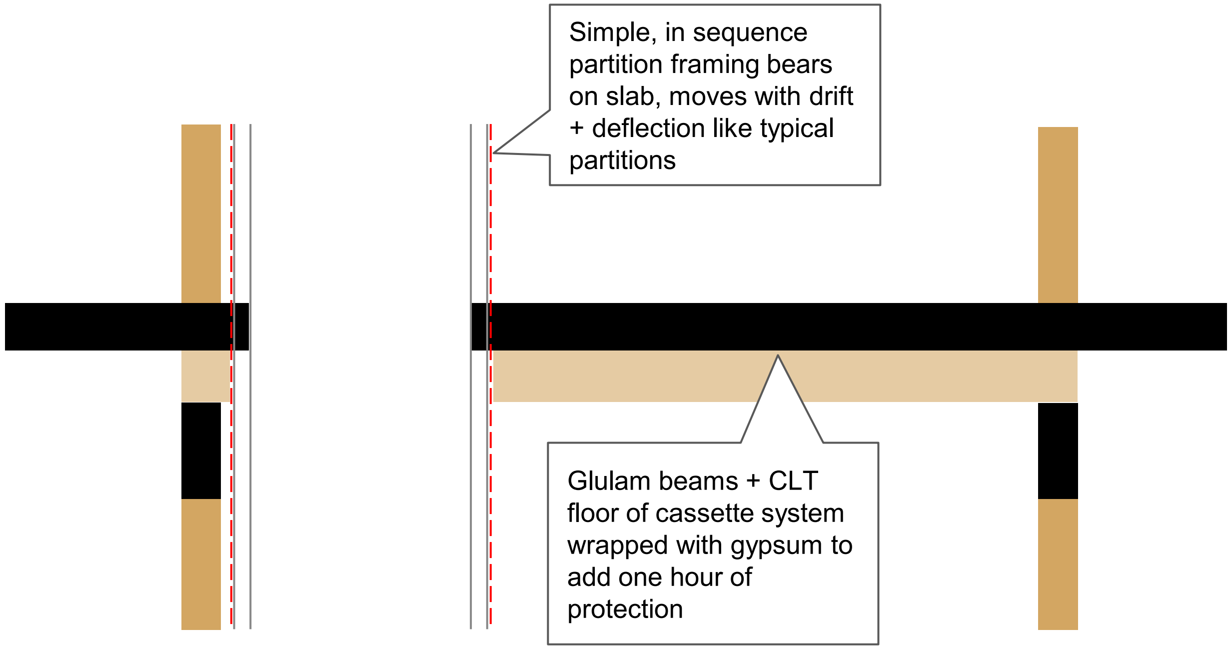
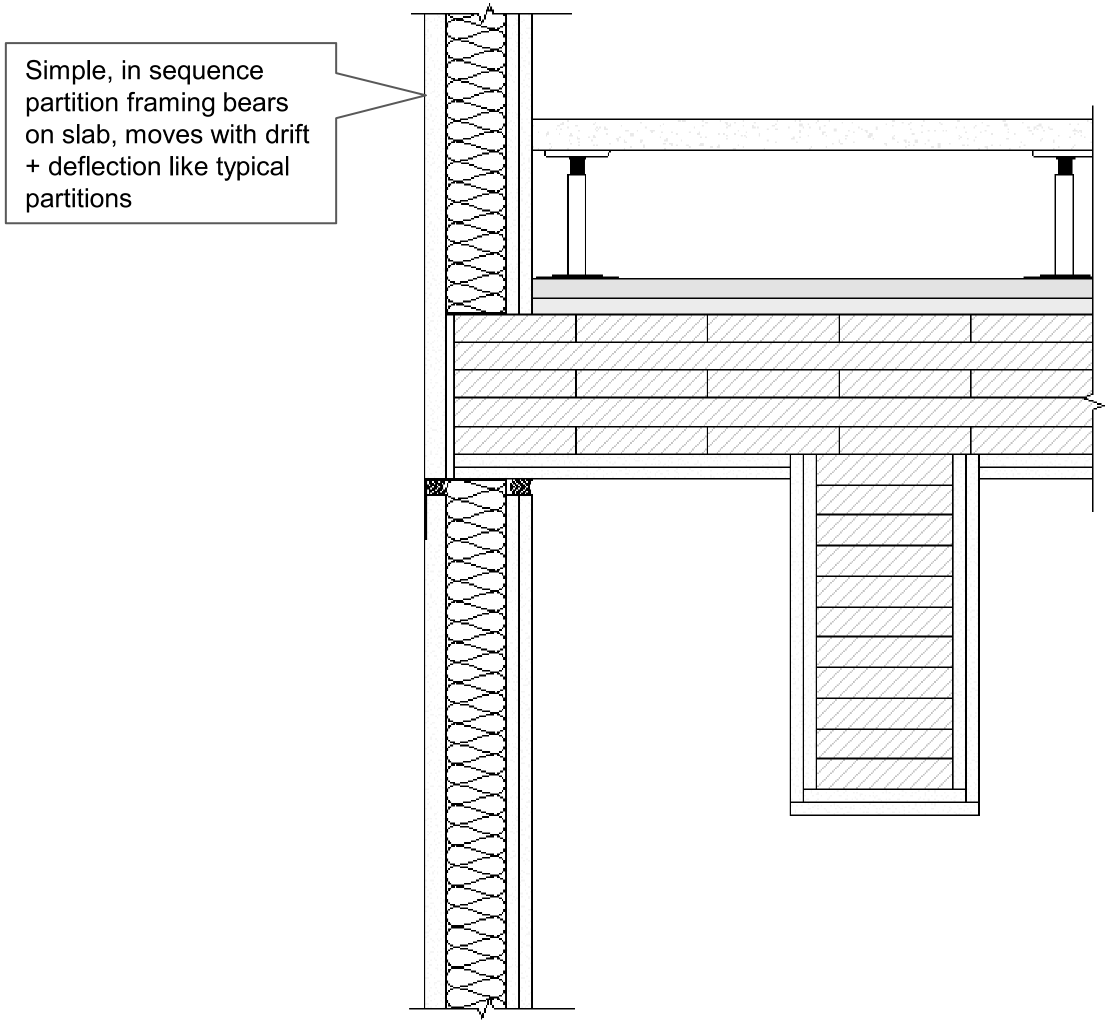
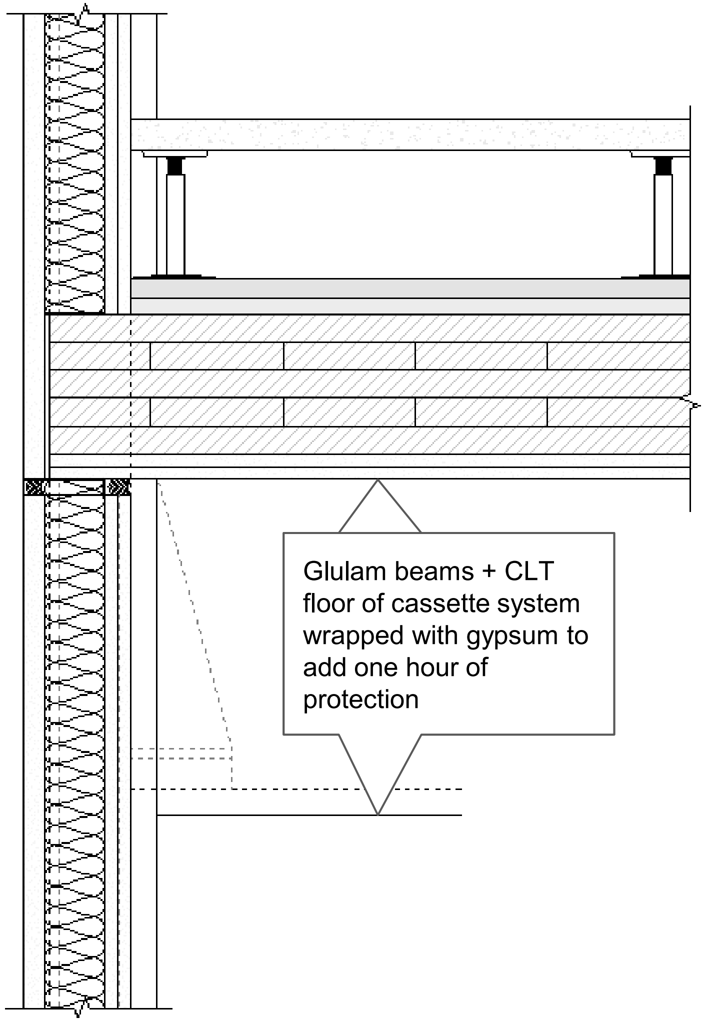


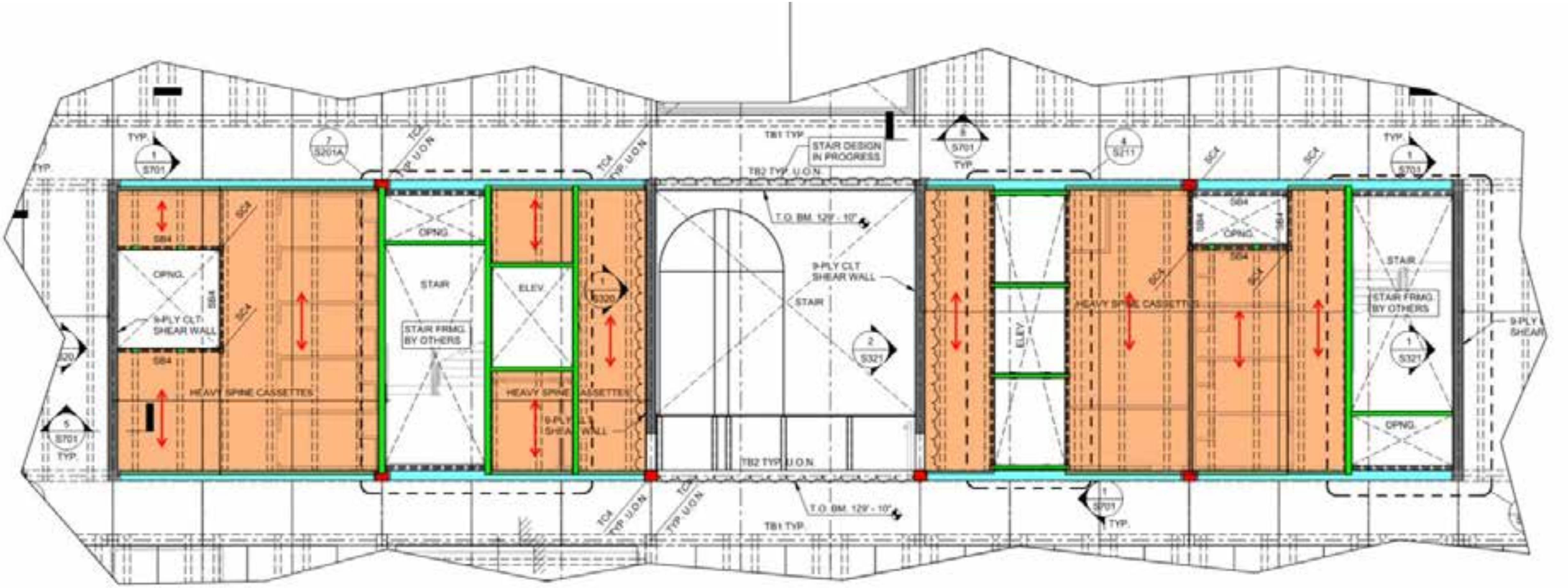
2hr Structure Impacts		
Element	1hr	2hr
CLT Deck & GLT Ribs	Unwrapped	(2) layers ⅝” gyp added
GLT Girders	Unwrapped	Unwrapped
GLT Girder - Column Connection	Embedded bearing pl w/ 1.8” blocking for char protection	Embedded bearing pl w/ 1.8” gyp for insulation protection
GLT Column Size (at base)	14.25x18”	14.25x25.5”

Detailing


Simple, in sequence partition framing bears on slab, moves with drift + deflection like typical partitions


Glulam beams + CLT floor of cassette system wrapped with gypsum to add one hour of protection

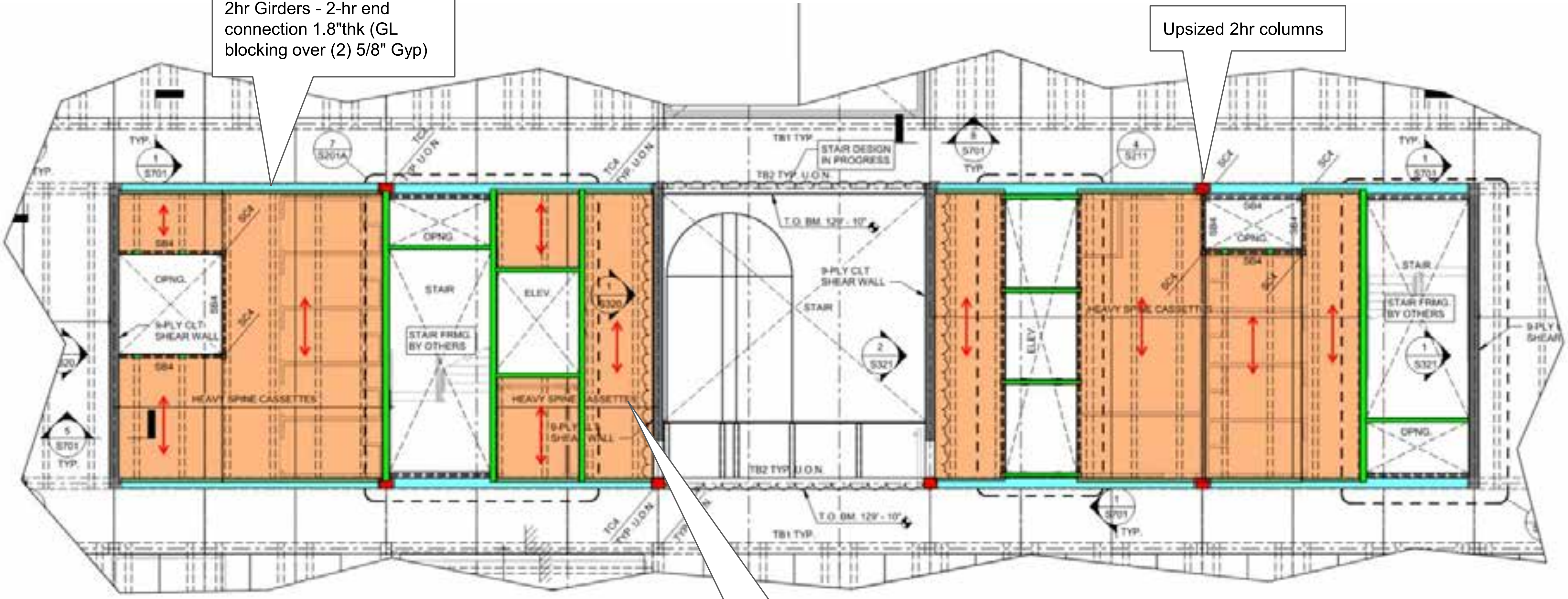
Framing Variations



Framing Variations

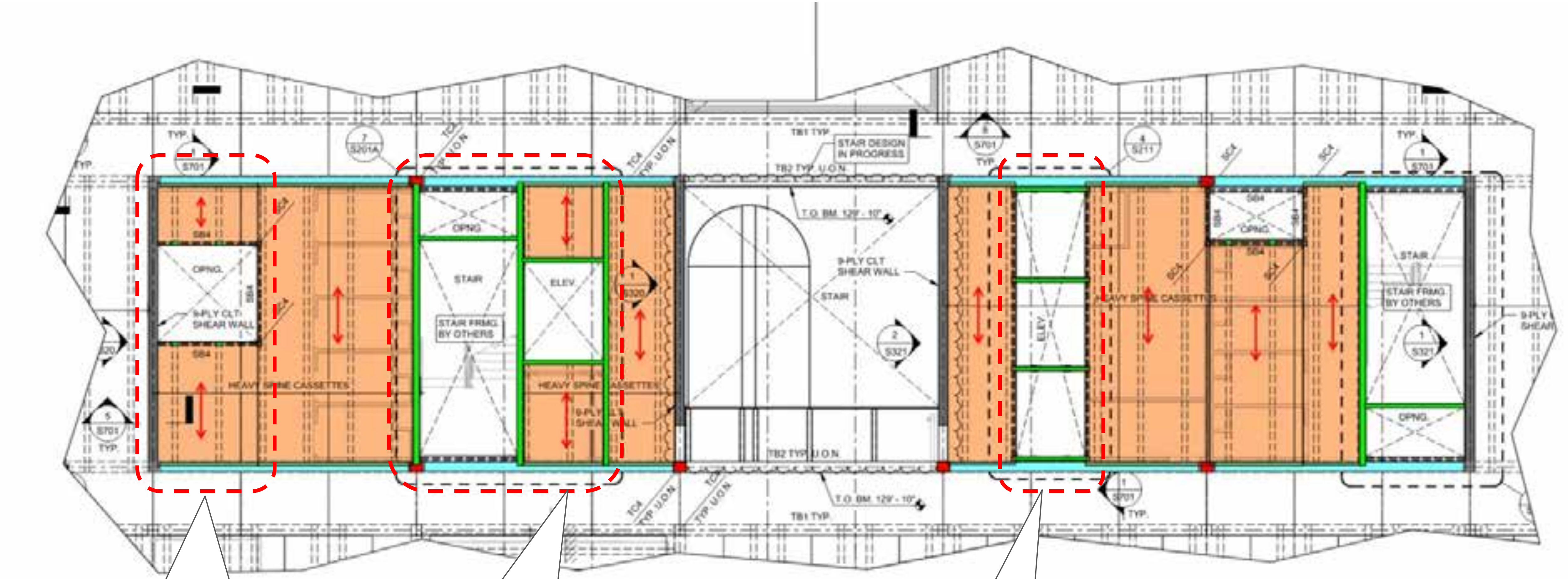
2hr Girders - 2-hr end connection 1.8"thk (GL blocking over (2) 5/8" Gyp)

Upsized 2hr columns



1hr gyp lining added to deck structure

Framing Variations



Floor supported on steel posts, posts track down to ground floor concrete transfer slab

Floor supported on steel beams which frame out opening. Transfer slab inefficient due to openings

Elevator shaft walls supported by 2hr rated floor

❯ QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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