

Post-Fire Restoration of Cross-Laminated Timber (CLT)

Example Solutions for the ATF/FPL Test Structure

Ad Hoc Committee – Tall Wood Buildings
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Presented By: Smartlam - Jim Henjum, PE
Contribution by AWC – Jason Smart, PE

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Presentation Objectives

- Goals of developing rehabilitation guidance for CLT post-fire
- Examine Options to restore structural capacity of CLT post-fire
- Discuss Next Steps

(Using ATF/FPL Test Structure as the Example)

Goals

- Provide Architects, Engineers, Contractors and Building Officials guidance on how to approach post-fire rehabilitation of CLT.
 - Concepts to think about during the design and detailing phase, which may or may-not define design approach.
 - Concepts to understand for post-fire rehabilitation
- Flexibility to make design choices
- Restore Fire Resistance Rating while Maintaining Design Intent
- Confidence

ATF / FPL Test Structure



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Exposed Portion on Ceiling: Before the Fire



Figure 1: Exposed Ceiling for Test 2

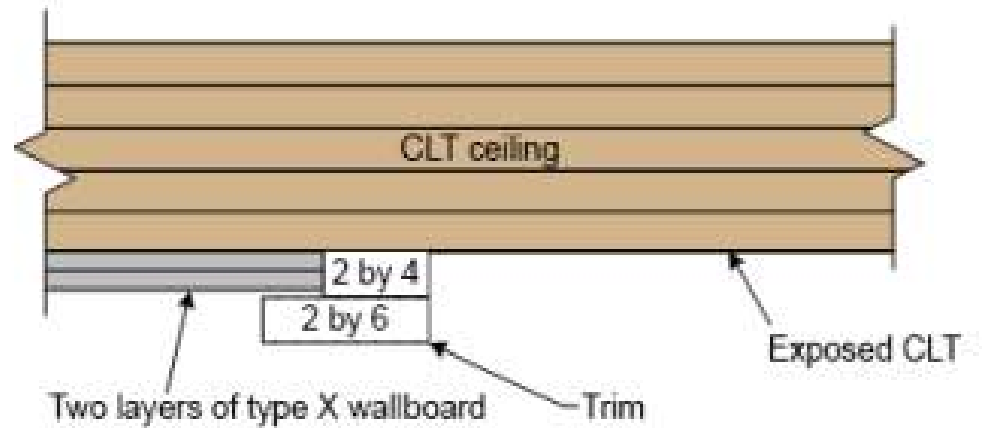


Figure 2: Edge Details of Exposed CLT Ceiling for Test 2

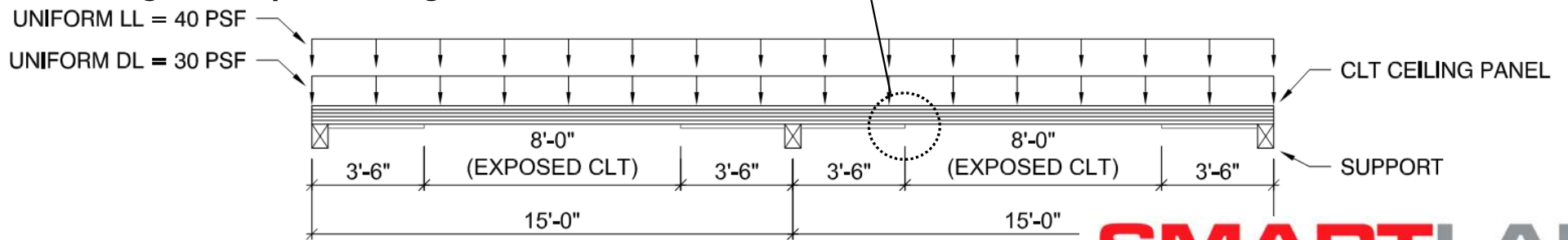


Figure 3: CLT Span and Loading Conditions

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Test Structure: During and After the Fire



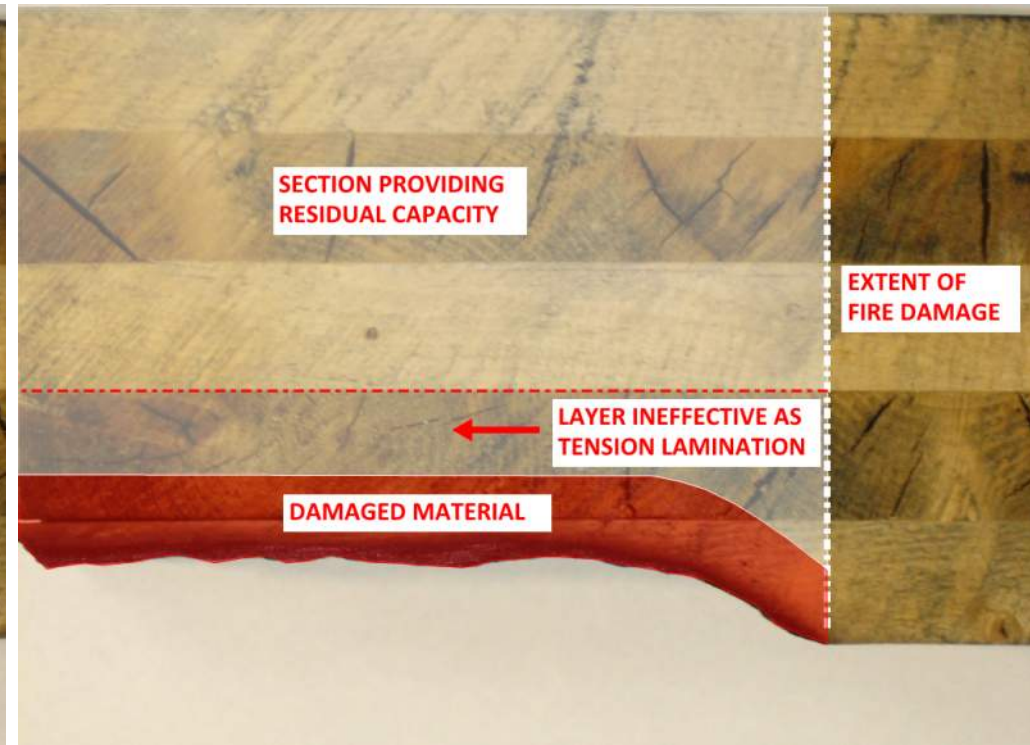
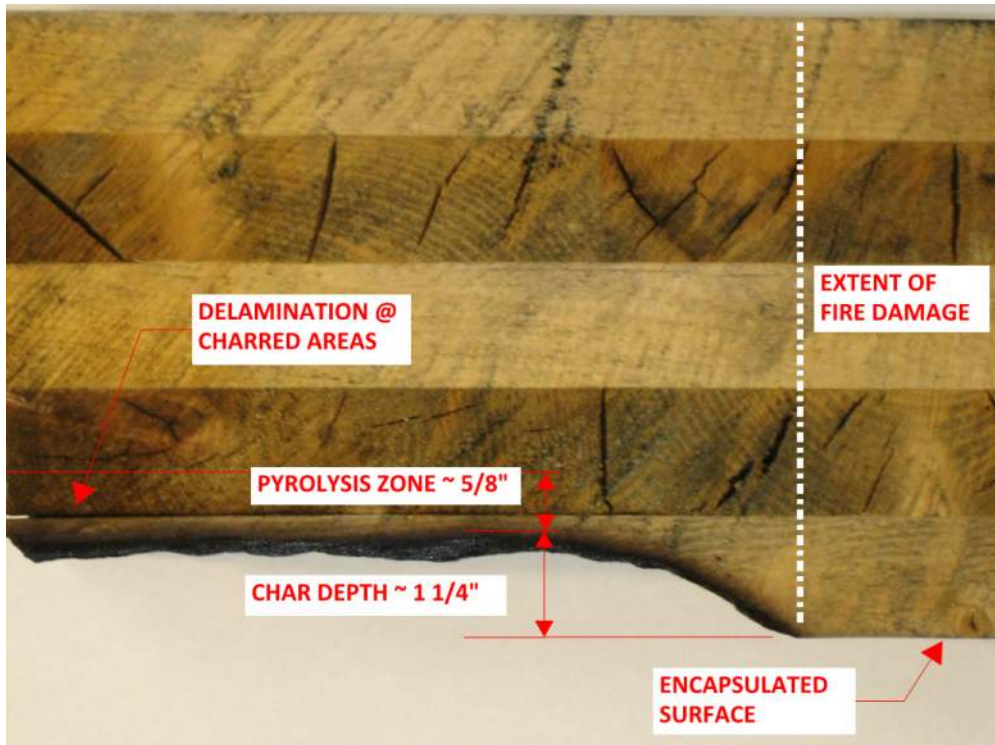
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Exposed Portion on Ceiling: After the Fire



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Exposed Portion on Ceiling: After the Fire



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Rehabilitation Option 1:

Removal and replacement of damaged CLT slabs

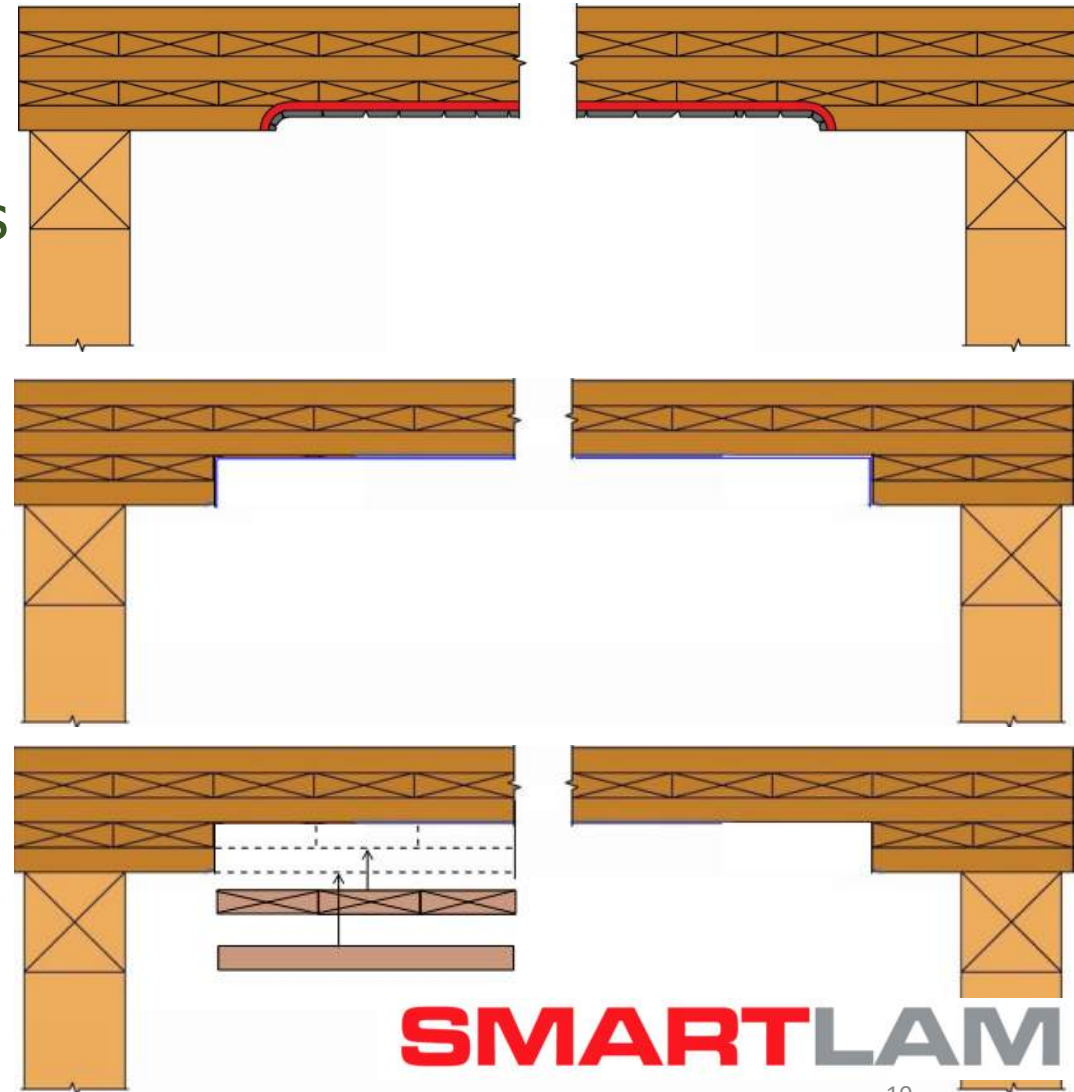
- Restores Full Capacity of Panel



Rehabilitation Option 2:

Analysis to Prove Fire Damaged CLT has Capacity to meet demands of service loads.

- Fire Damage CLT
- Remove and Clean Damage Portion
- Replace with new laminations attached with adhesive. Mechanical Fasten or Clamp. (Reference Option 3)



Rehabilitation Option 2 Cont'd:

- Simple
 - Based on Engineering Mechanics
 - Defined Properties in PRG-320 or Manufacturers Product Report.

- Restores Fire Resistance Rating.

- Does not restore full structural capacity of CLT panel

- Maintains exposed CLT

- ATS/FPL Span Example – 5ply CLT

Example Calculation:

Effective Span Length = 14'-3"

Service Load Demand

- Moment = 1,776 lbf-ft/ft
- Shear = 625 lbf/ft

Post Fire Capacity of Remaining Section (ASD)

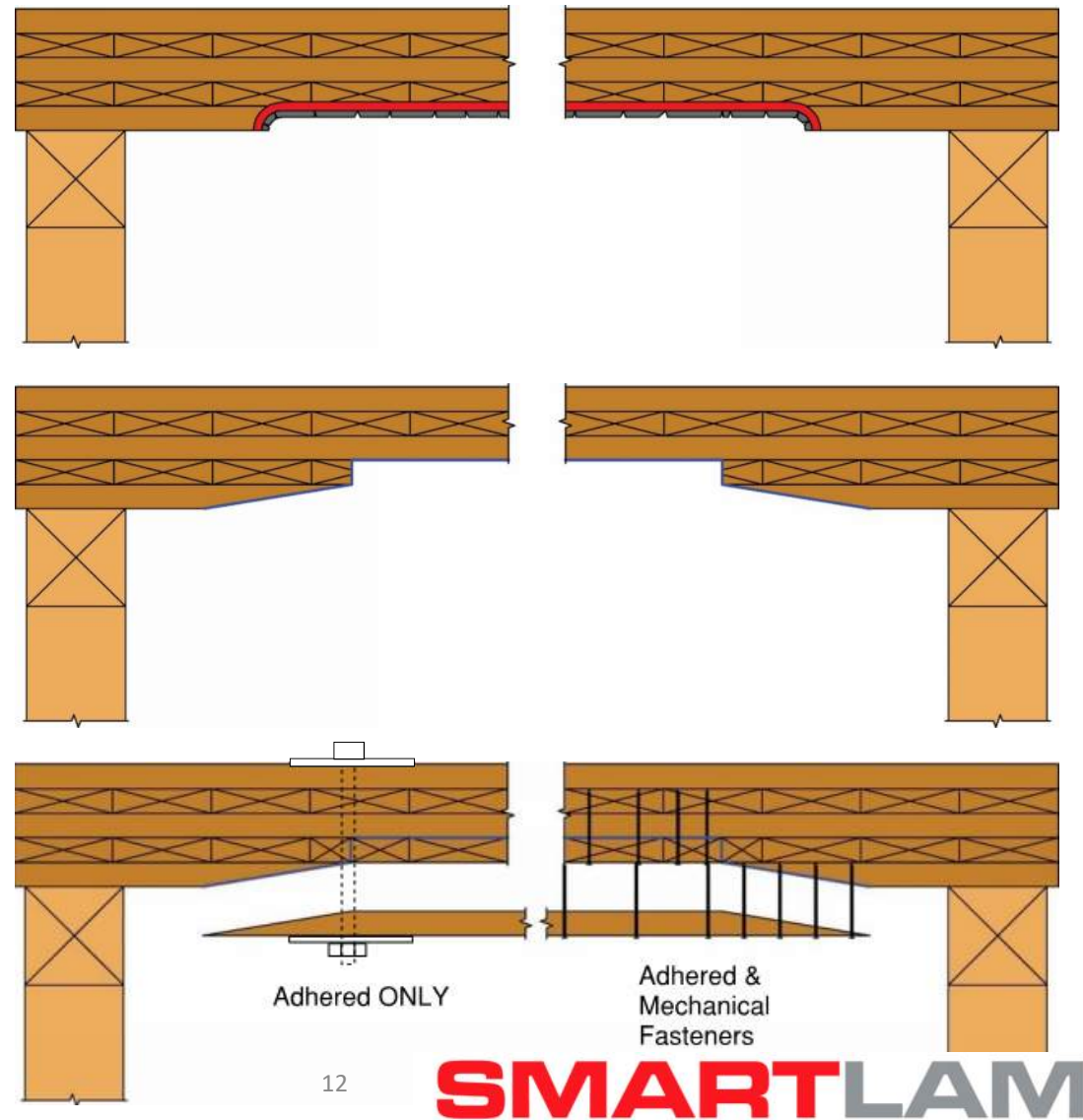
- Moment = 1,800 lbf-ft/ft
- Shear = 1,490 lbf/ft
- SL-V4 Grade CLT

For the example 5ply CLT floor has residual capacity to meet the service load demands post fire

Rehabilitation Option 3:

Restores Full Capacity of Panel

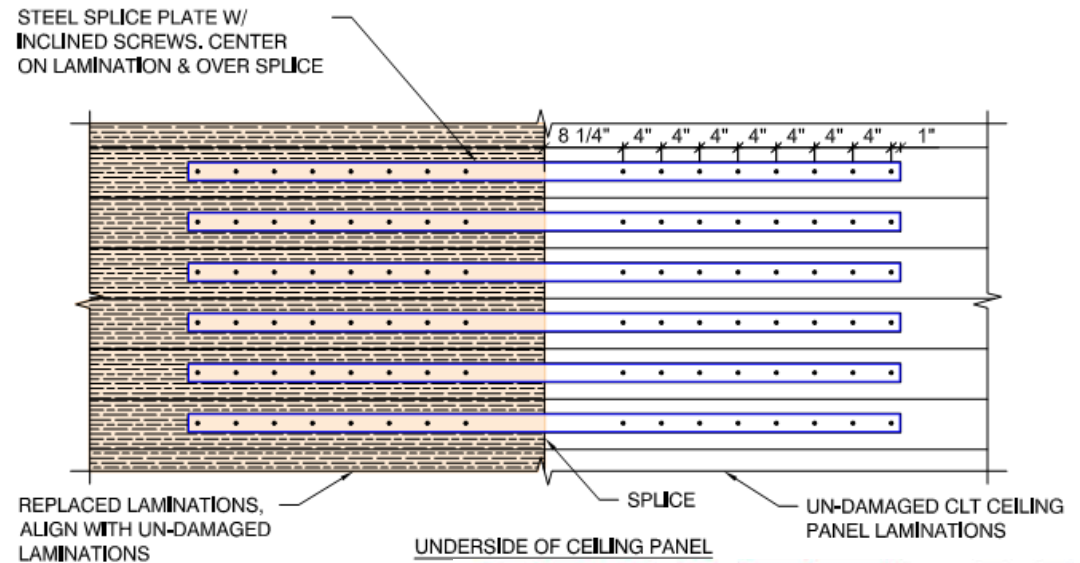
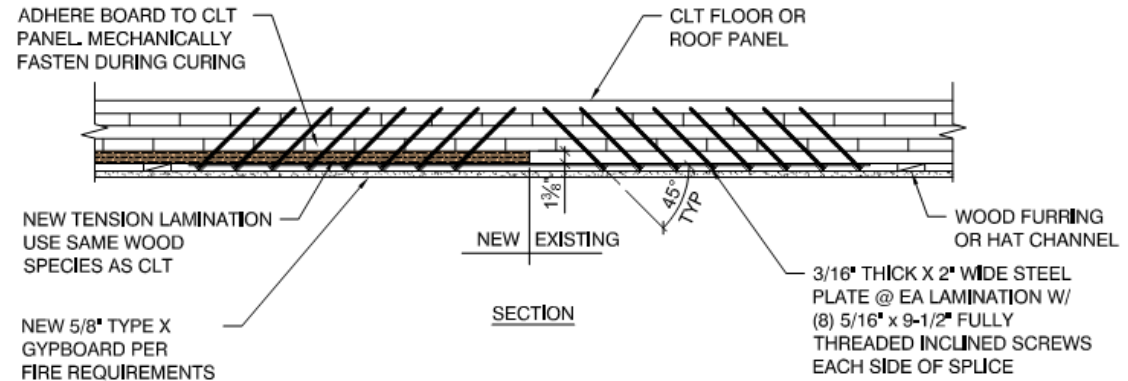
- Shoring to remove load
- Removal of damaged portions
- Replacement with new laminations attached with adhered and screwed scarf joints -OR- Adhered ONLY.
- Re-establishes pre-fire structural capacity, maintains exposed CLT and Restores Fire Resistance Rating



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Rehabilitation Option 4: Mechanical splice to restore flexural capacity of CLT panel

- Similar concept to Option 2 but use mechanical splice to restore flexural capacity.
- Must protect mechanical splice with gypboard.
- No exposed CLT post fire.

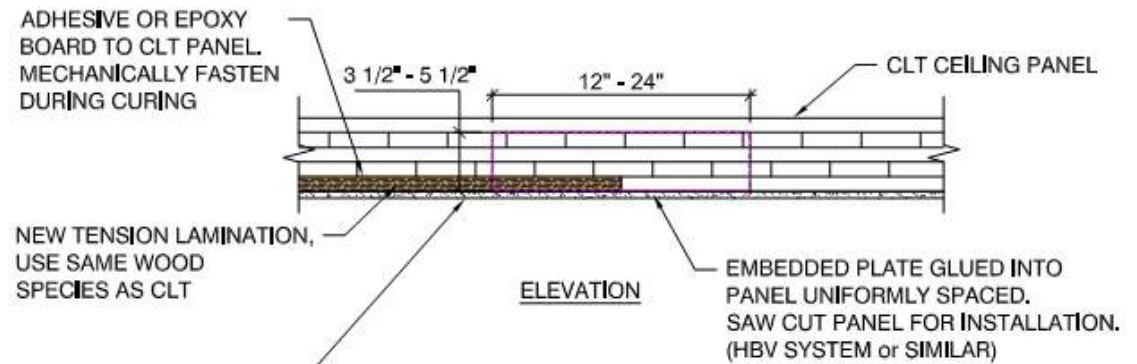
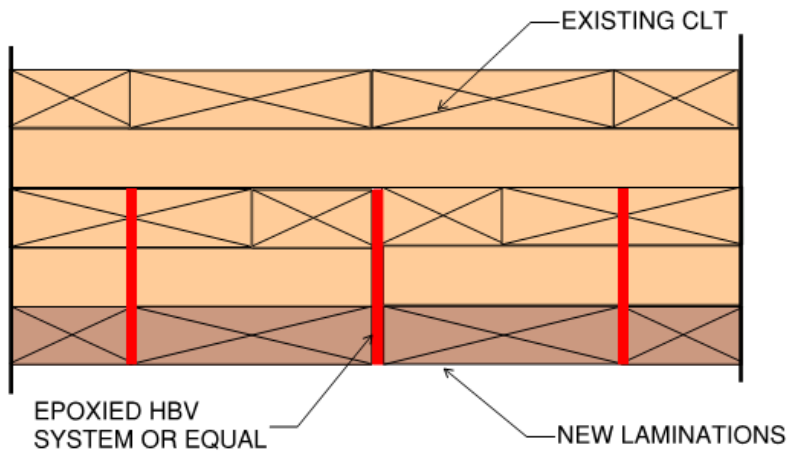


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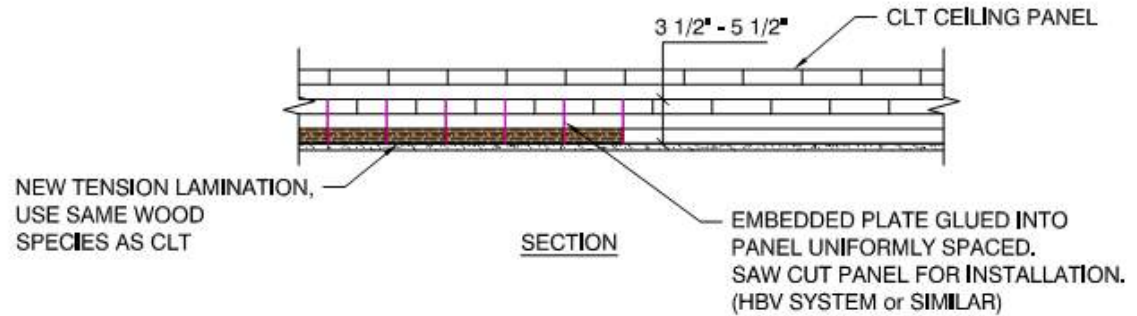
Rehabilitation Option 5: Embedded plate to restore flexural capacity

Similar to Option 4

Timber to Timber Composite



NEW 5/8" TYPE X GYPBOARD PER FIRE RESISTING RATING REQUIREMENTS



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Next Steps

- Develop technical white-paper to provide comprehensive guidance for each rehabilitation option including design methodologies and details.
- Develop installation guides for rehabilitation options.
- Develop field verification inspection/testing standards.
- Lab testing of connection joints for proof of concept
 - Scarf Joint Tension and Block Shear testing of field adhered laminations
 - Tension testing for mechanical connection option
- Education

Questions



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