Framing Techniques for Builders: Lessons Learned and Best Practices

Gary Schweizer, PE
Weyerhaeuser
April 14, 2020

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

“The Wood Products Council” is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES), Provider #G516.

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Today's session is intended to improve framing techniques; addressing common commercial and multi-family construction issues. We will review several case studies and discuss the lessons learned so that similar issues are avoided on your projects.

You may ask questions through the chat box. We will filter those and attempt to answer these during the presentation

Learning Objectives

1. Highlight framing issues and discuss solutions.
2. Discuss proper load path framing techniques.
3. Review lessons learned from different project case studies.
4. Examine construction strategies that result in high-performing structures.

A bit about me

Academics –

- **BSCE - The Ohio State University**
- **MBA – The University of Dayton**

Experience -

- **Consulting Structural Engineer – Columbus, Ohio**
- **Wood Products/Structural Engineering – Trus Joist/Weyerhaeuser**

Registered Professional Engineer/Structural Engineer

Expertise – Design & Analysis, Forensics, Litigation Support

Agenda

1. **Load Path Resolution**
   - Vertical & Lateral
   - Lateral Stability
   - Differential Deflection
   - Unique Floor Requirements
2. **Moisture Management**

   Keep it Dry

   Preservative Treatments

   Protecting Products in Inventory & Jobsites
3. **Fire, Sound and Vibration Design**
4. **Roof Anchors**

Vertical Load Path Resolution

Simply stated … loads need to be transferred to the foundation.

Load rationalization =
Joist → Beam → Column → Foundation

- **Proper member selection/accessories**
- **Adequate support/bearing**
- **Appropriate load transfer details**
- **Foundation adequacy**

Software – 2d analysis; 3d view; review of software operator design

It sounds simple;
but the devil is in the details

Load Path Resolution – *"What to watch for?"*

Vertical Loads

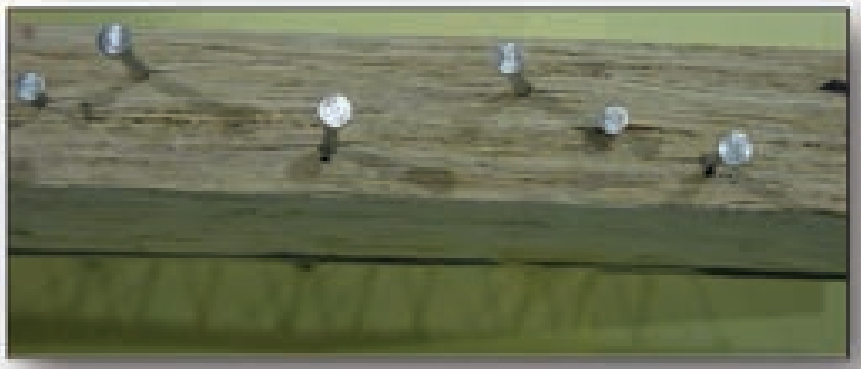
- Increased Dead Loads – lightweight concrete, tile or stone, non-load bearing walls
- Concentrated Loads (Fc perp or Fc parallel)
  - Beams & Headers
  - Girder Truss
- Construction Loading
- Differential loading conditions

Sequence the Framing - Builder's prospective

Lateral Loads

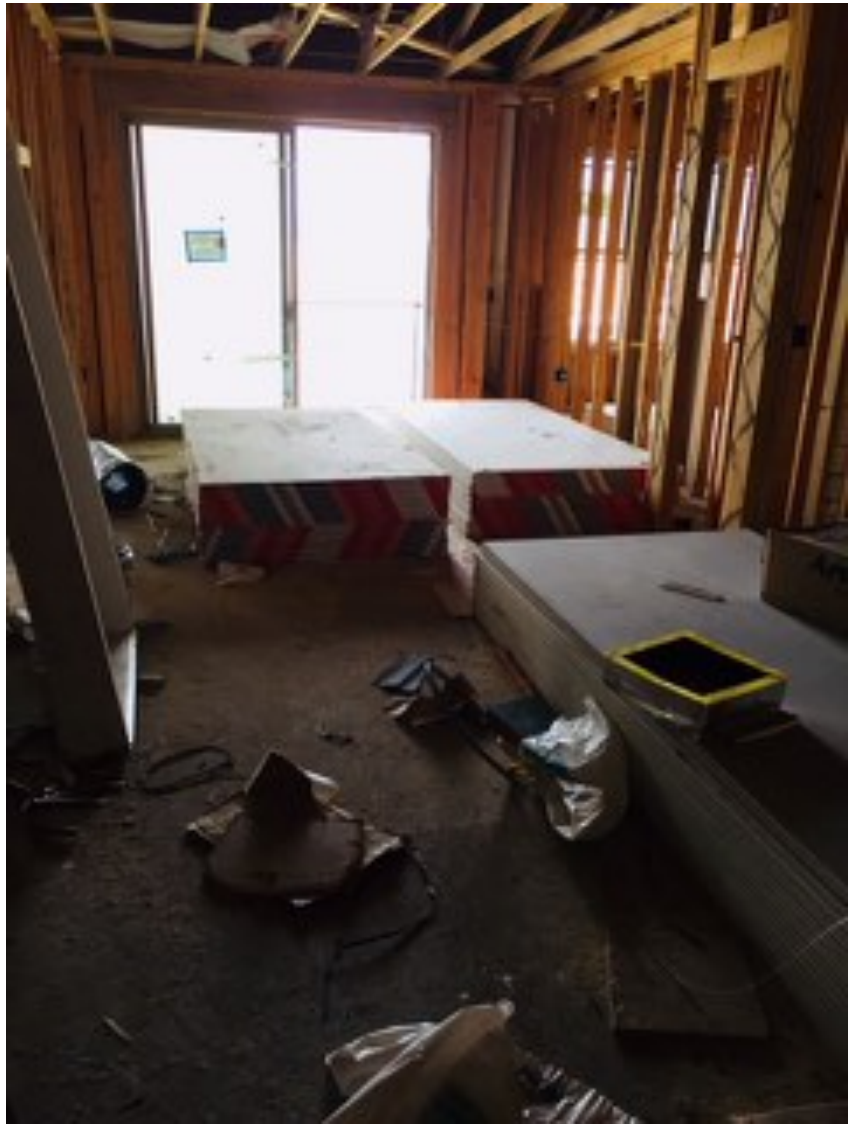
- Location of Shear Walls – connection design; fastener limitations
- Blocking
- Screws vs. Nails

Installation Review

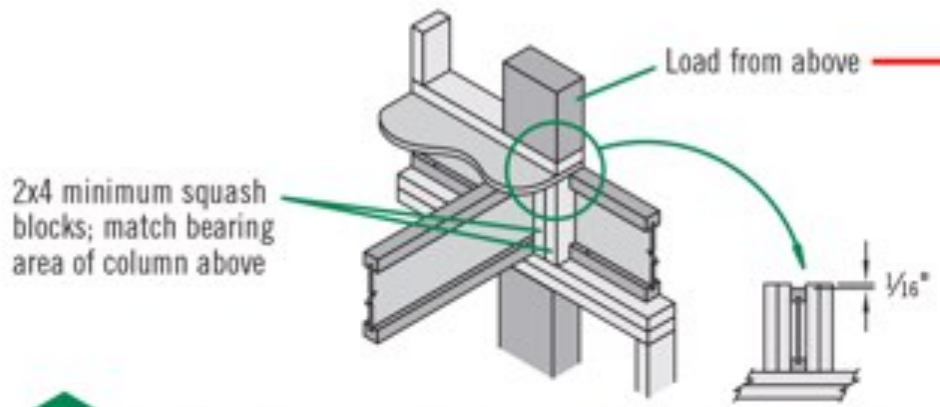


Construction Loads – The Unforeseen

Are we overloaded?



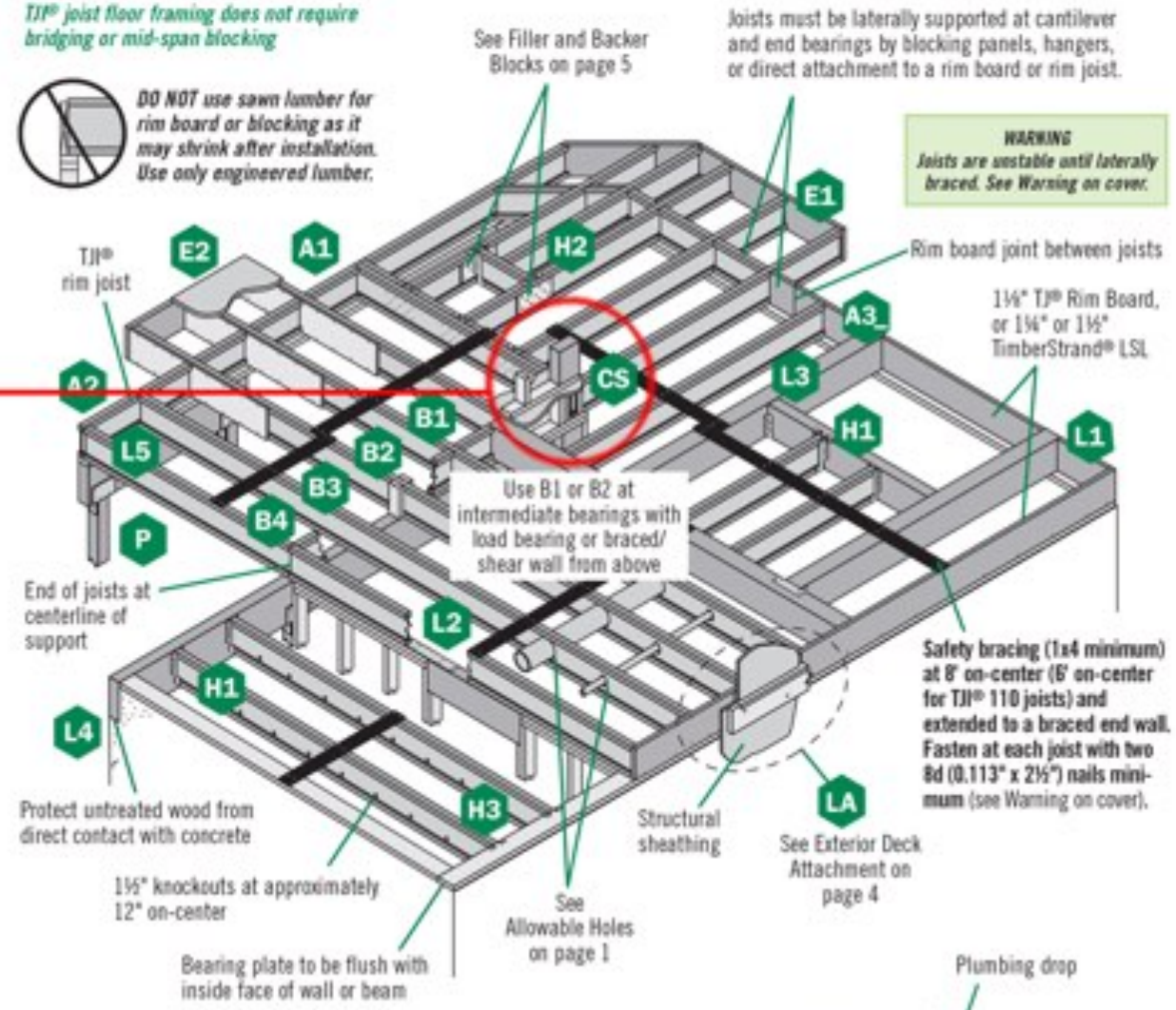
Wall and Post Load Transfer



CS ***Use 2x4 minimum squash blocks to transfer load around TJI® joist***

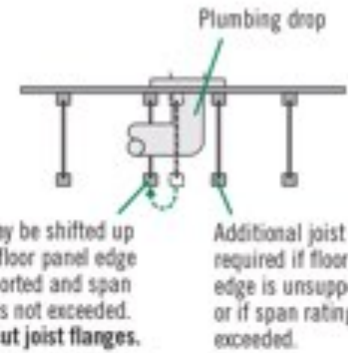
TJI® joist floor framing does not require bridging or mid-span blocking

DO NOT use sawn lumber for rim board or blocking as it may shrink after installation. Use only engineered lumber.



INSTALLATION TIPS

- Subfloor adhesive will improve floor performance, but may not be required.
- Squash blocks and blocking panels carry stacked vertical loads (details B1 and B2). Packing out the web of a TJI® joist (with web stiffeners) is not a substitute for squash blocks or blocking panels.
- When joists are doubled at non-load bearing parallel partitions, space joists apart the width of the wall for plumbing or HVAC.
- Additional joist at plumbing drop (see detail at right).



Inadequate Load Transfer – Brick Ledge Cantilever

Learning Opportunity

Student Apartments

Complaint – Floor Levelness, Water Leaks

Construction Issue – Load Transfer (rim not bearing on masonry wall)

Squash Blocks added to Stabilize, floor jacked to level

What could the EOR/AOR have done better? – Load Transfer detailing

What could the suppliers have done better? – 'Protocol' communications

Load Path Resolution
Best Practices

What should you expect?

SUPPLIER/MANUFACTURER

- **Highlight deviations**
- **Load rationalization**
- **Value design – professional protocol**
- **Framing details**

CONTRACTOR

- **OFA Review**
- **Framing for correctness**
- **Notes and deviations**
- **Notes are acceptable unless noted otherwise**

Correspondence

2. Moisture Management

Simple stated … keep it dry or use preservative treated wood

Guiding Principles

- **Dry Usage is classified as < 16%**
- **Reasonable construction rainfall is OK**
- **Service Life - Keep it Dry**
- **When in doubt – Preservative Treated or Naturally Durable Wood**

Dry Use Conditions - *"what to watch for?"*

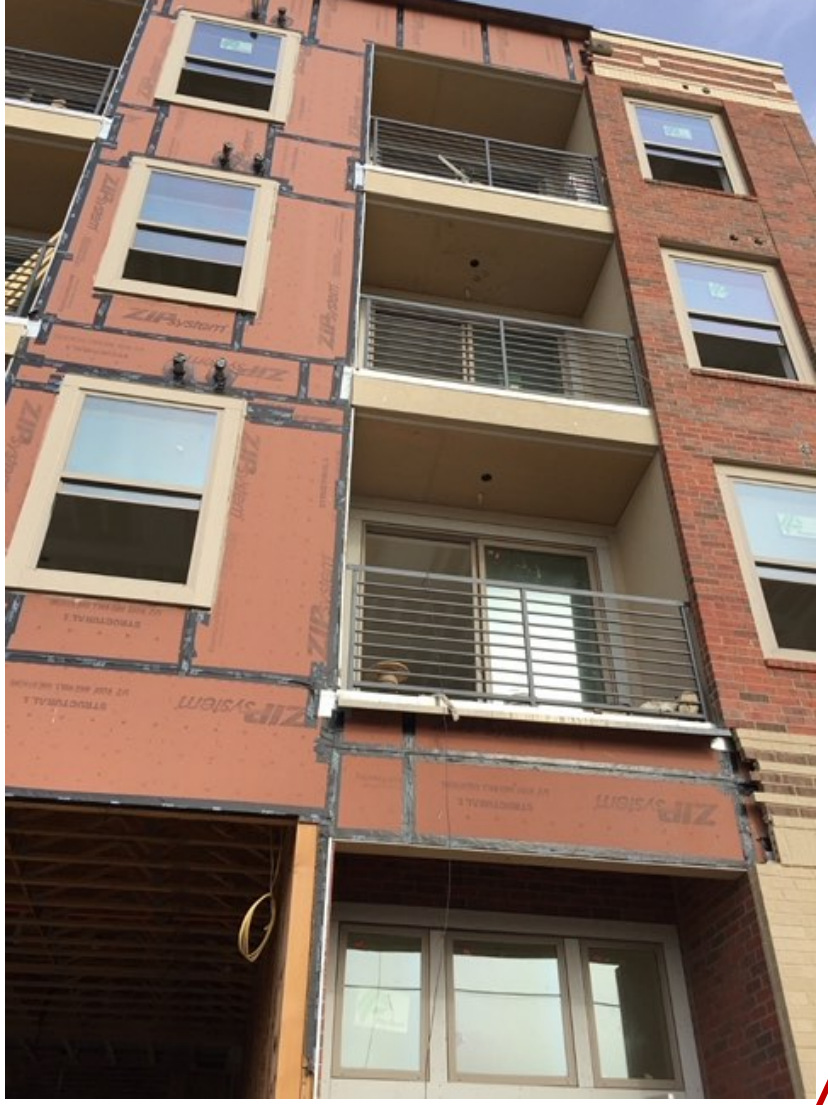
Balcony/Deck Conditions

- **Flashing, connections, detailing, etc. → waterproofing**
- **Allow for wicking – don't encapsulate**
- **Installation Review**
- **Maintenance Program**

Balconies

Suggested Best Practices

- Construction documents should contain moisture barrier details and installation instructions
- Moisture barrier inspection
- Consider a higher design live load (1.5 times)
- Require ventilation
- Require a slope on the framing



HDH Complex – Frisco, TX

Best Practices

Perforated Vinyl

Waterproof Membrane

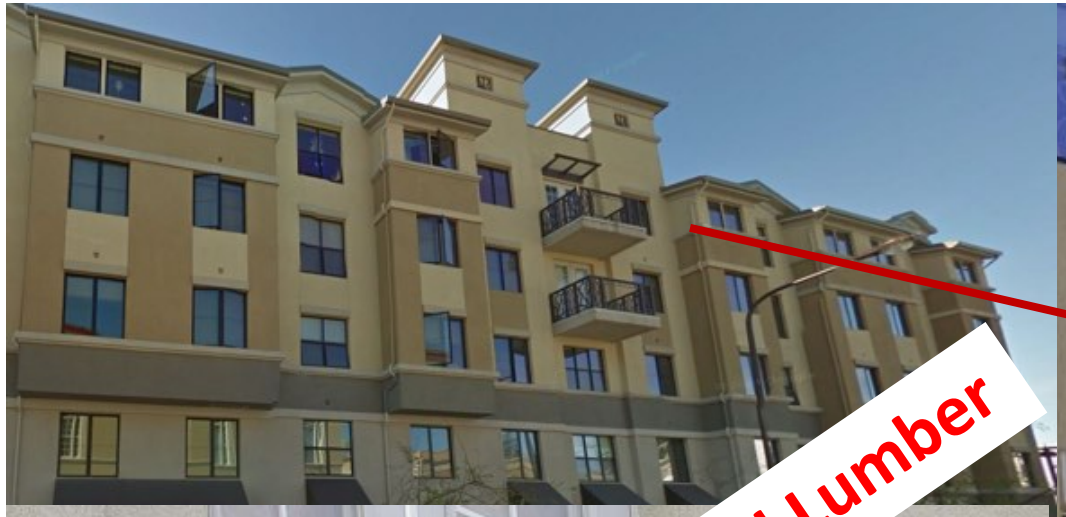
Moisture Management – What can Happen?

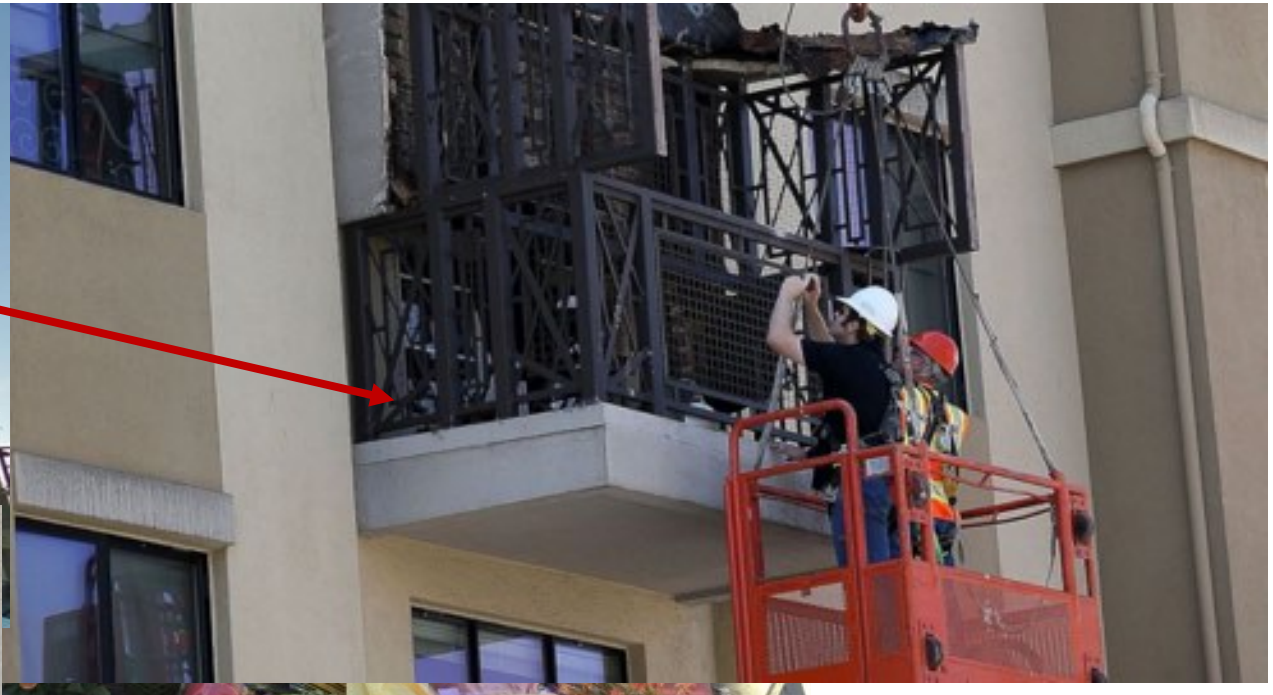
Learning Opportunity

Waterproof Deck Membrane
Alberta, Canada
150^{o} F differential

Waterproof Roof Membrane
Santa Rosa, California
Closed Roof/Floor Cavity

Moisture Management





Preservative Treated Wood Lumber

Berkley, CA
Balcony Deck Collapse
2015

More than a Learning Opportunity

Moisture Management

Selecting the Correct Preservative Treatment

Exposure 4A

Phillip Merrill Center, MD
Exposed Heavy Timber
CuAz Treated

An Expensive Learning Opportunity

Moisture Management Summary

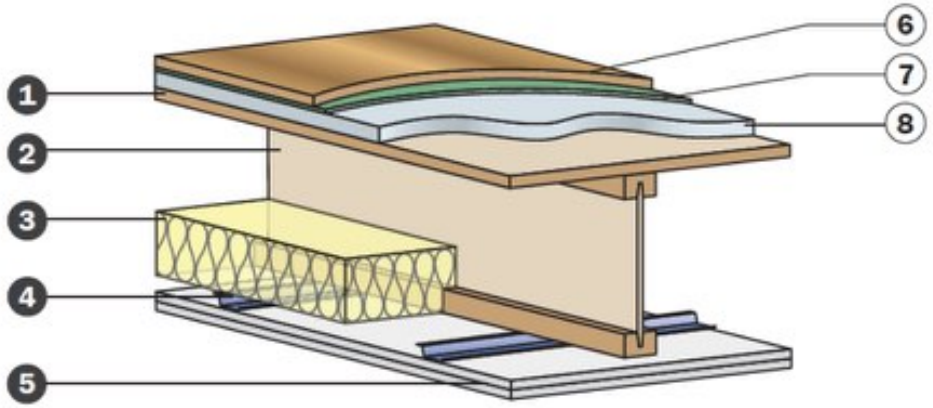
Untreated wood products are intended for dry-use applications only. When used for exterior applications, the construction must maintain dry-use over the entire service life of the structure.

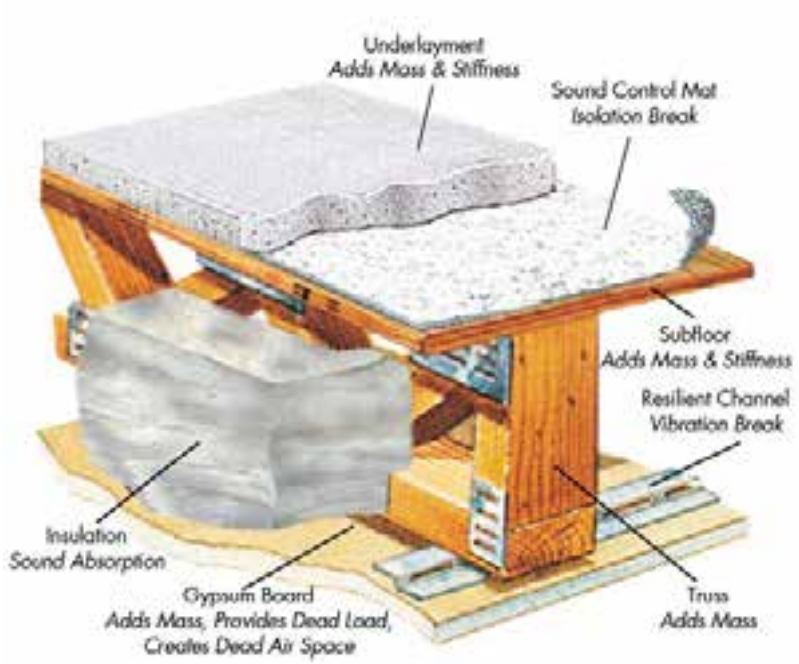
- **Belt & Suspenders**
- **Positive drainage**
- **Adequate separation for ventilation/condensation control**
- **Wrap dry products only**

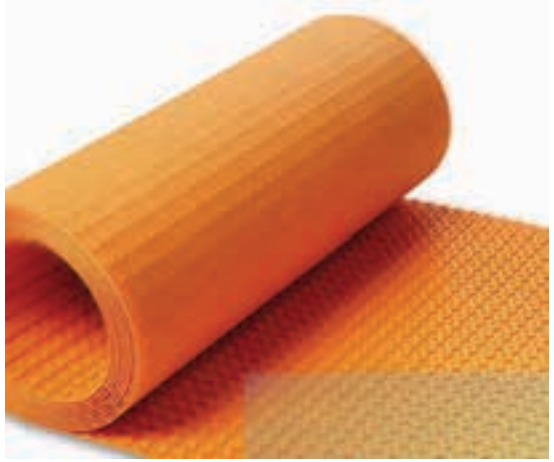
3. Fire, Sound and Vibration Design

Specification

- **Prescribed Code vs 'Preferred' Standards (apartments to condos)**
- **'Full' Floor Specification (including varied finished floor coverings)**
- **Sound Control – coverings, isolation**







Park Place; Fountain Hills, AZ

Matching specification; manufacturer's recommendation Isolation/De-Couple

Vibration – Holistic Design

- **Basic Stiffness** is a combination of joist depths and span.
- **Composite Action**—Careful nailing in conjunction with construction adhesives increases basic stiffness.
- **Continuity**—Continuous joists over several supports generally perform better than simple spans. Care must be taken if the joists continue into another occupancy.
- **Joist Spacing and Deck Stiffness**—Reduced spacing or increased deck thickness generally improves floor performance.
- **Ceilings** directly applied to the bottom edge of the floor members, or equivalent 1x or 2x strapping, is a performance enhancement.
- **Beams**—Floor systems supported by steel or wood beams tend to feel less stiff than those supported by solid bearing walls.
- **Bridging or Blocking** can be a contributor to improved floor performance.
- **Non-bearing Partition Walls** dampen vibration and improve floor performance when installed transverse to the floor joists.
- **Mass** reduces damping in a floor system, causing a decrease in floor performance. This impact is more noticeable as span lengths increase.

Vibration Design

$$f = 1.57\sqrt{\frac{386EI}{WL^3}}$$

Fundamental Frequency – f (Hz)

E – MOE (psi)

I - moment of inertia (in^4)

W – true dead load (lbs.)

L - joist span (in)

Virginia Tech Guidelines

Floor Joist

Shorten the span

Increase the joist depth

L/480 +

Floor System

Floor decking – hybrid, thickness

Glued/Nailed

Bridging/Ceiling – tied to a support wall?

Floor covering/floor membranes

Fire Design

Type 3 Construction Requires FRT Wood Framing

(Type A Flamespread ≠ FRTW)

- **Fire-Retardant-Treated Wood Must be Impregnated with Chemicals**

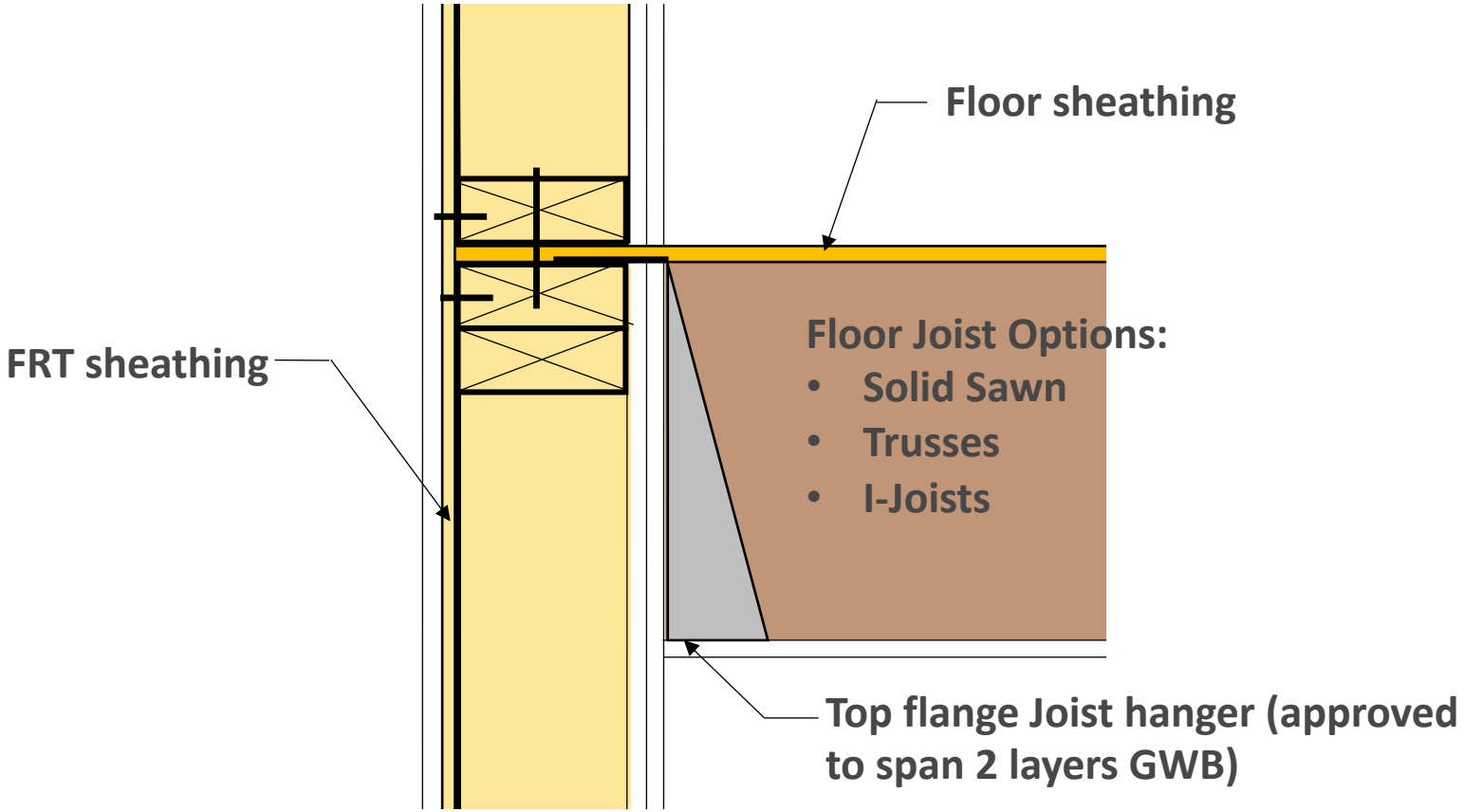
  (2018 International Building Code)
- **FRTW in accordance with ASTM E84 or UL723.**
- **Field Applied Coatings ≠ Manufactured FRT Products**

  Quality Control, plant vs. field environments, etc.)

Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

Exterior Walls – Intersecting Floors

Type III Construction – 2 HR Wall, 1 HR Floor
Semi-Balloon Framing with Additional Fire Protection



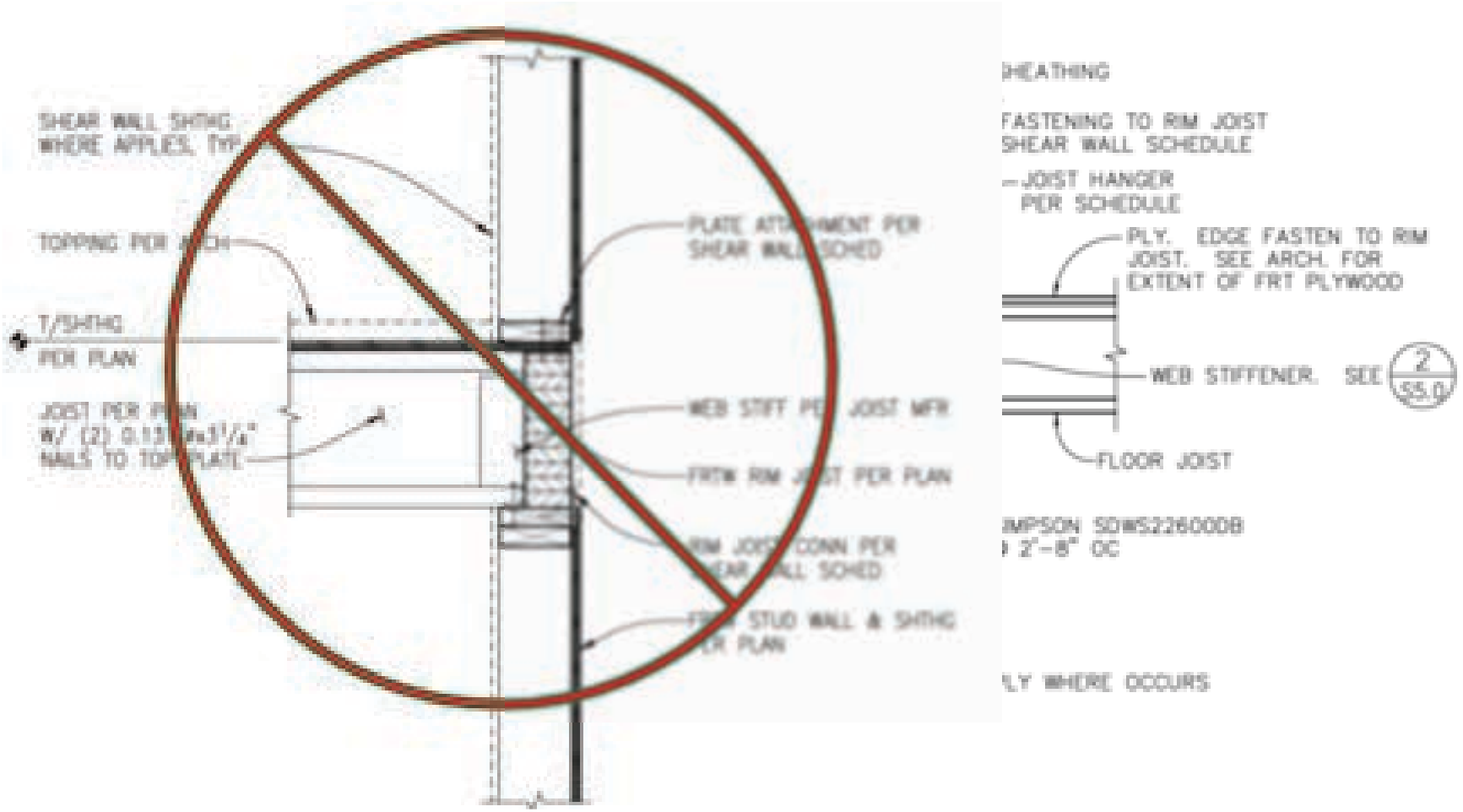
Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:

Membranes on both side of wall provide fire resistance via their approved assembly

Type 3 Construction – Rim Board



Code Approved FRTW – Field Issue

Apartment projects in Minneapolis — non-code approved FRT requires replacement (2x6 and 2x8 perimeter framing)

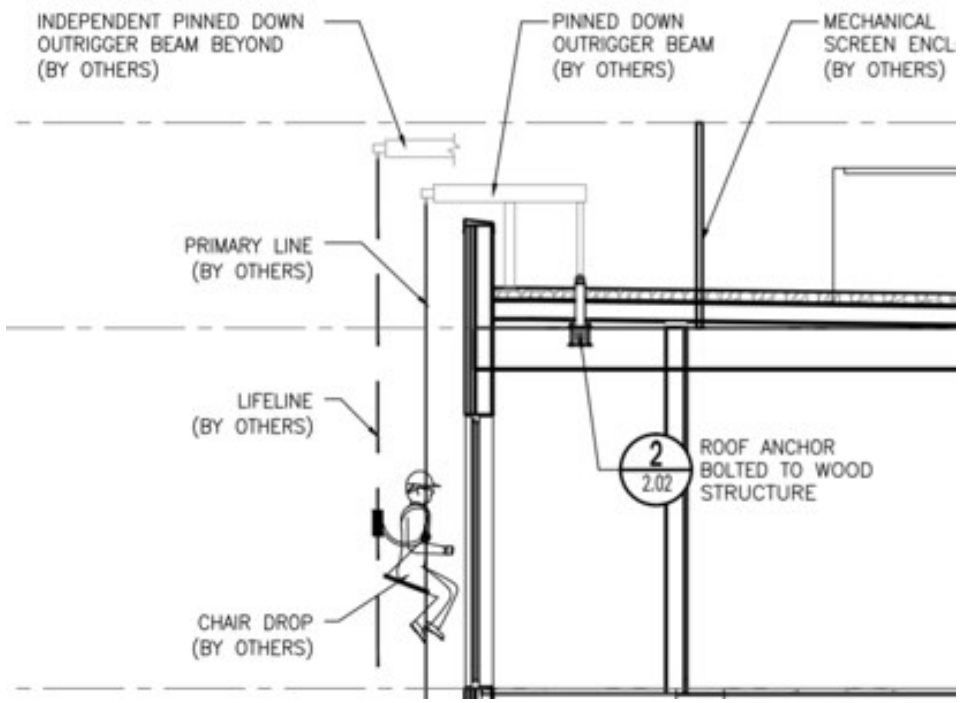
"On Big-D's watch, lumber that was not approved or code-compliant was used on the Hello Apartments project and Golden Villas will not tolerate actions that create any risk for future tenants," **Golden Villas Chief Manager Traci Tomas said in a news release.**

Professional Protocol Approval Process

Another Learning Opportunity

4. Roof Anchors
(window wash/maintenance)

- Design by EOR or specialty engineer
- Load can act in any direction
- Requires beams
- Coordination with suppliers/contractors



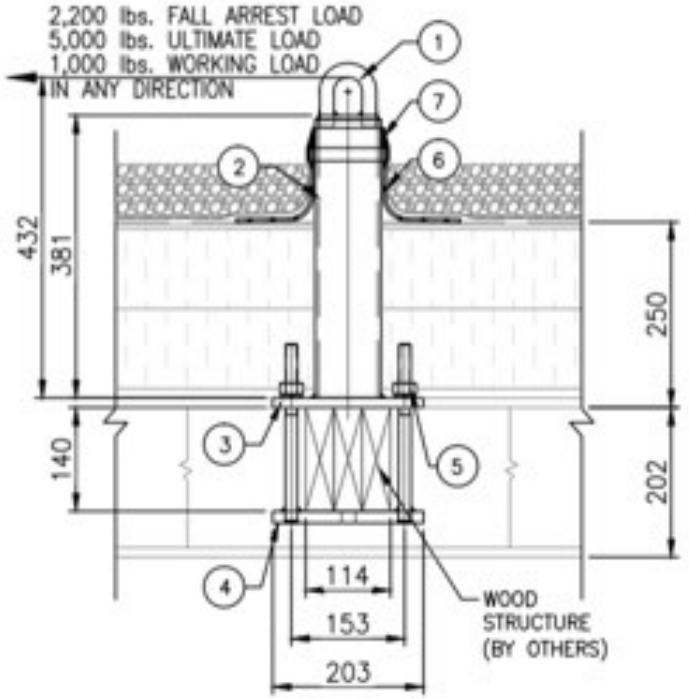
PRO-BEL FULL ASSEMBLY MODEL #206382

1. 3/4"ø STAINLESS STEEL U-BAR.
2. 3 1/2" O.D. GALVANIZED STEEL PIER.
3. TOP PLATE 8" X 8".
4. BOTTOM PLATE 8" X 8".
5. 4- 5/8"ø STAINLESS STEEL THREADED STUDS (15" Lg) c/w HEX NUTS, FLAT AND LOCK WASHERS.

ADDITIONAL PARTS

PART MODEL #CUSTOM
6. 5" TALL CONVENTIONAL FLASHING.

PART MODEL #P-HSM-1
7. HEAT SHRINK c/w MASTIC TAPE.



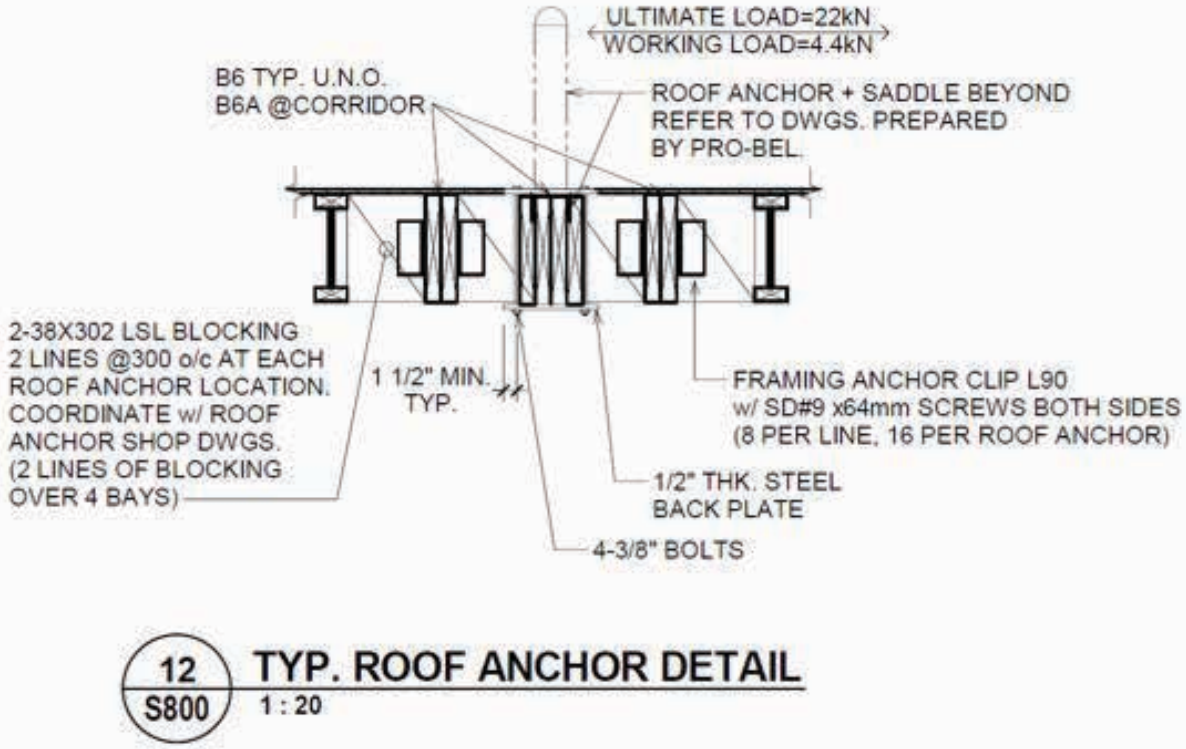
IMPORTANT NOTE:
STRUCTURE BY OTHERS TO ACCOMMODATE STEEL PIER BASE PLATE. SUPPORTING STRUCTURE MUST FULLY DEVELOP THE ANCHORAGE CONNECTION FOR THE MOMENT, SHEAR AND AXIAL FORCES, WHICH WILL BE PLACED ON THE ANCHOR.

Roof Anchors

Clearly state loads

Solid blocking

Uplift restraint



Summarizing - My Personal List
“to allow for caution”

- **Tight Construction Timeline (design/modify as you ‘go’)**
- **Construction ‘Tolerances’**
- **Adverse Weather**
- **Manufacturing v. Installation Issues**
- **Deflection v. Vibration (gaging customer expectations)**
- **Load Tracking**

Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

Thank you for the privilege of your time!

Jose Diaz-Balart - NBC News

Gary Schweizer, PE
Weyerhaeuser
Gary.Schweizer@weyerhaeuser.com