WoodWorks

Five-story Wood-frame Structure over Concrete Podium Slab

By: Douglas Thompson P.E, S.E, SECB
STB Structural Engineers, Inc.

Copyright Materials

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© The Wood Products Council 2013

"***The Wood Products Council***" is a Registered Provider with *The American Institute of Architects Continuing Education Systems (AIA/CES)*. Credit(s) earned on completion of this program 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 program 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.

Learning Objectives

At the end of this program,

participants will be able to:

- Selection of appropriate building type and related provisions in the building code governing multi-story wood-frame buildings.
- Detailing and design for wood shrinkage. Learn how to calculate wood shrinkage amounts.

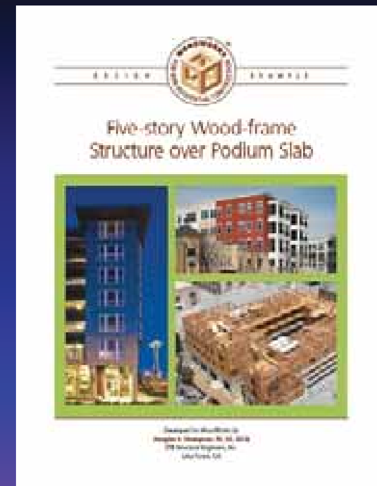
Learning Objectives

At the end of this program,

participants will be able to:

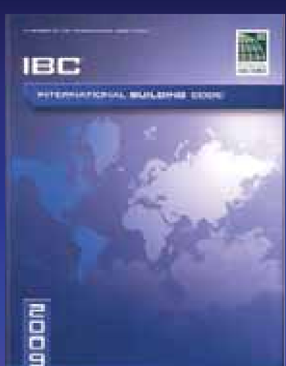
- ✓ Detailing and design for lateral system. A summary of design assumptions and code criteria.
- ✓ Detailing and design for continuous tie-down systems. A summary of important design considerations for this type of system.

WoodWorks Design Examples



http://www.woodworks.org/education-publications/case-studies-design-examples/

2009 International Building Code



- Key code issues related to multi-story wood framed construction:

Increase for Sprinkler System

- 2009 IBC § 504.2 Automatic sprinkler system increase
- For Group R buildings equipped throughout with an approved automatic sprinkler system in accordance with § 903.3.1.2, the value specified in Table 503 for maximum building height is increased by 20 feet and the maximum number of stories is increased by one, but shall not exceed 60 feet or four stories respectfully.

Special Provisions-Podium Construction

- 2009 IBC § 509.2 A building shall be considered as a separate and distinct building for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories and type of construction *where*:

Special Provisions-Podium Construction

- 2009 IBC § 509.2

  Two separate buildings one on top of each other separated by a 3-hour horizontal barrier.

  Mixed occupancies (uses)/ Mixed construction

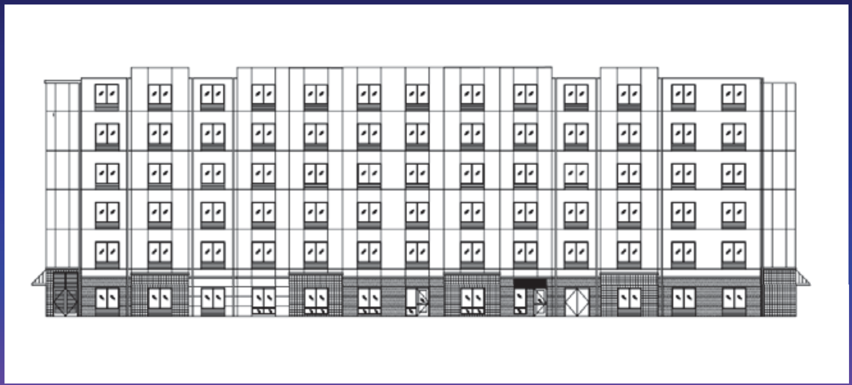
  Total height limited to the smaller Table 503 Allowable Heights of the 2 buildings measured from the grade plane.

Special Provisions-Podium Construction

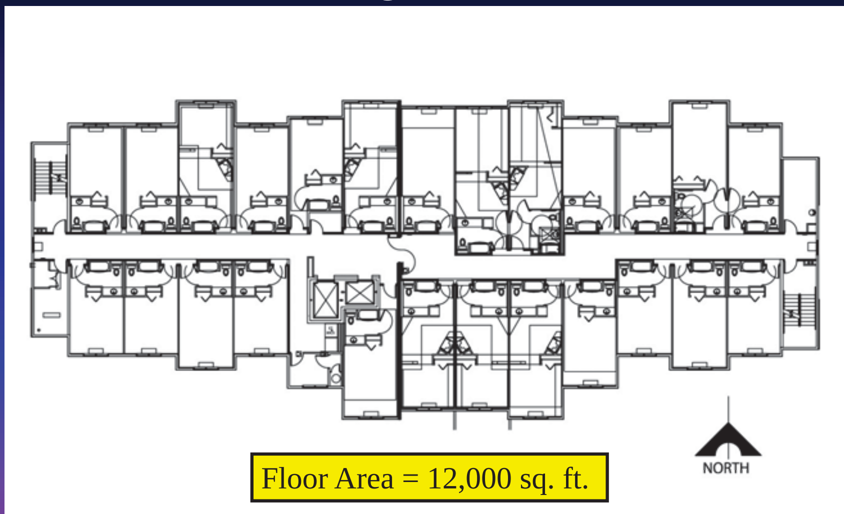
- 2009 IBC § 509.5 Group R-2 Buildings with Type IIIA construction

  The height limitation for buildings of Type IIIA construction in Group R-1 and R-2 shall be increased to six-stories and 75 feet where the first floor construction above the basement has a fire-resistive rating of not less than 3 hours and the floor area is subdivided by 2-hour fire resistance rated walls into areas of not more than 3000 sq. ft.

5 Stories o/ Podium Slab



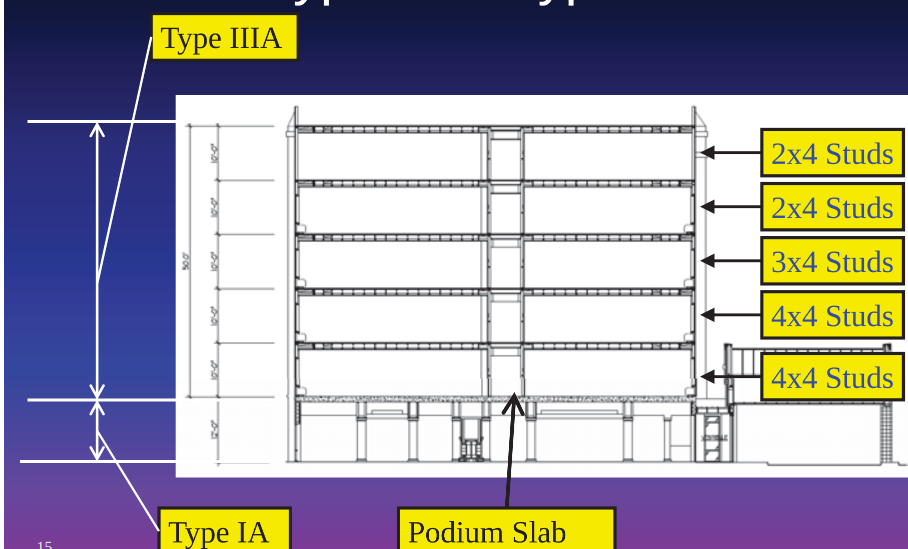
Building Floor Plan



Structural/Seismic Height Limitation

- ☑5 Stories Type IIIA Wood Framing over Type I Concrete
- ☑Max. Height of Structure: ASCD 7-05 Table 12.2.1
  - Seismic Force-Resisting System (SFRS):
    - Light Framed Bearing Wall System
    - Seismic Design Category <u>(SDC) D, E, &</u> F the height limit is <u>65 feet</u>.
    - Seismic Design Category <u>(SDC) B & C</u> the height limit has <u>no limit</u>.

Type IA & Type IIIA



Fire, Life Safety & Area Limitations

Lower Portion (1st Story):

- Type 1A Construction
- Occupancy is S2, B, E and A2
- Per IBC Table 503:
  - ✓Allowable height is unlimited
- Per IBC Table 503:
  - ✓Allowable area is unlimited

Fire, Life Safety & Area Limitations

Upper Portion (2nd – 6th Stories):

Type IIIA Construction

Occupancy is R2

Per IBC 509.5:

- ✓Allowable height is 75 feet
- ✓Allowable number of stories is 6
- ✓Floor area is subdivided into 3,000 sq. ft. areas with two hour ratings.

Type III Construction

☑2009 IBC §602.3

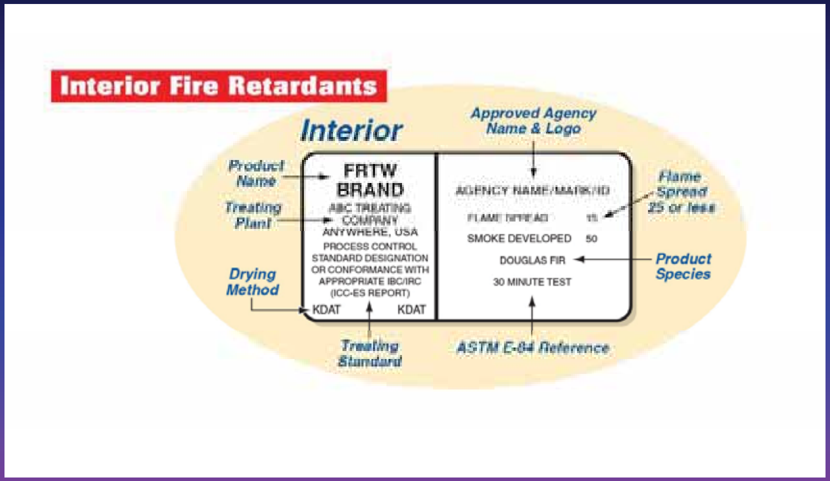
"Type III. Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by the code. **Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior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

Fire-retardant-treated (FRT) wood

☑2009 IBC §2303.2

- Labeling
- Strength Adjustments
- Exposure to weather, damp or wet locations requires **Exterior** rating.
- Typical walls in "dried in" building can have **Interior** rating.

FRT Wood Labeling



Fire-retardant-treated wood

☑Strength Adjustments

Property	Brand A			Brand B		
	DF	SP	Other	DF	SP	Other
F_b	0.97	0.91	0.88	0.90	0.89	0.89
F_t	0.95	0.88	0.83	0.87	0.92	0.87
$F_{c\parallel}$	1.00	0.94	0.94	0.91	0.94	0.91
F_v	0.96	0.95	0.93	0.94	0.95	0.94
E	0.96	0.95	0.94	0.98	0.98	0.98
$F_{c\perp}$	0.95	0.95	0.95			
Nails/Bolts	0.90	0.90	0.90	0.92	0.92	0.92

Obtain actual adjustment factors from the Evaluation Service Report

Fire-retardant-treated wood

☑Fasteners:

- IBC § 2304.9.5.4
  - Fasteners in fire-retardant-treated wood used in interior locations <u>shall be in accordance with the manufacturer's recommendations</u>. In the absence of manufacturer's recommendations, Section 2304.9.5.3 shall apply.

Fire-retardant-treated wood

☑Cutting, trimming ripping, boring:

- Treated lumber must not be ripped or milled as this will invalidate the flame spread.
- End cuts, holes are usually excepted (check *ESR* report).

Fire-retardant-treated wood

☑Some suppliers of the treated wood require the wood to be treated to be first shipped to their plant.

☑Some suppliers stock most "saw lumber" (2x, 3x and 4x) for immediate shipping.

☑Treatment process adds about 50% to the cost of the material for Interior and 80% to the cost of the material for Exterior

Condition of Seasoning

S-GRN = >19% moisture content (unseasoned)
S-DRY, KD, KD-HT = 19% maximum moisture content (seasoned)
MC 15 or KD 15 = 15% maximum moisture content

Availability of Dry Lumber

- ☑ Varies on region and market conditions
- ☑ In Southwest region "green" (S-GRN) is common.
- ☑ Other parts of country "dry" (S-DRY) is common.
- ☑ Engineer should consider the availability of kiln dried lumber.
- ☑ WoodWorks website provides access to technical support looking for this type of information

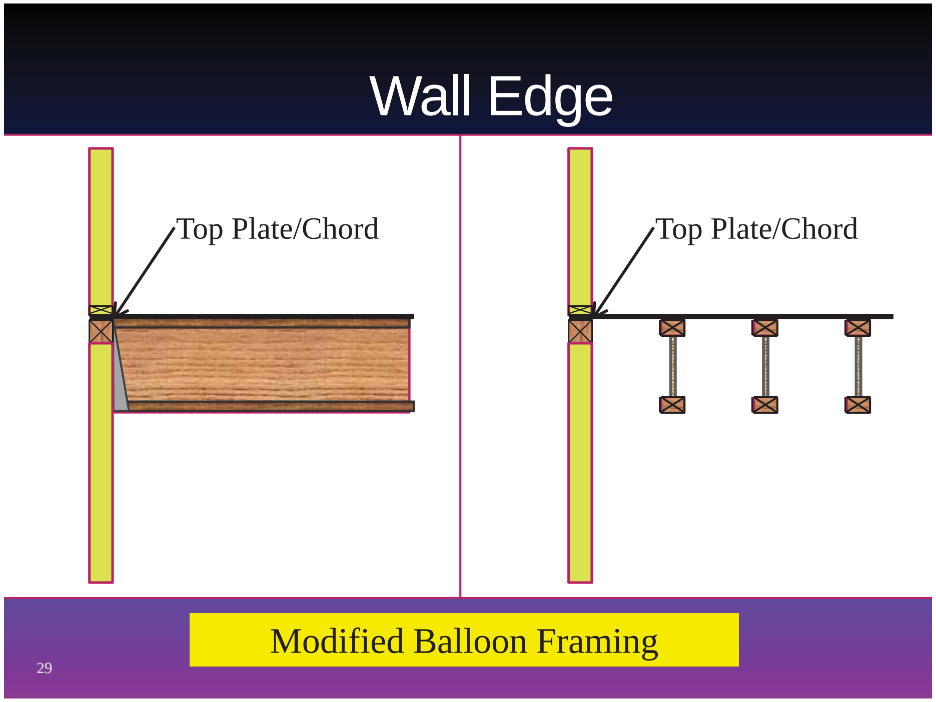
Availability of Dry Lumber

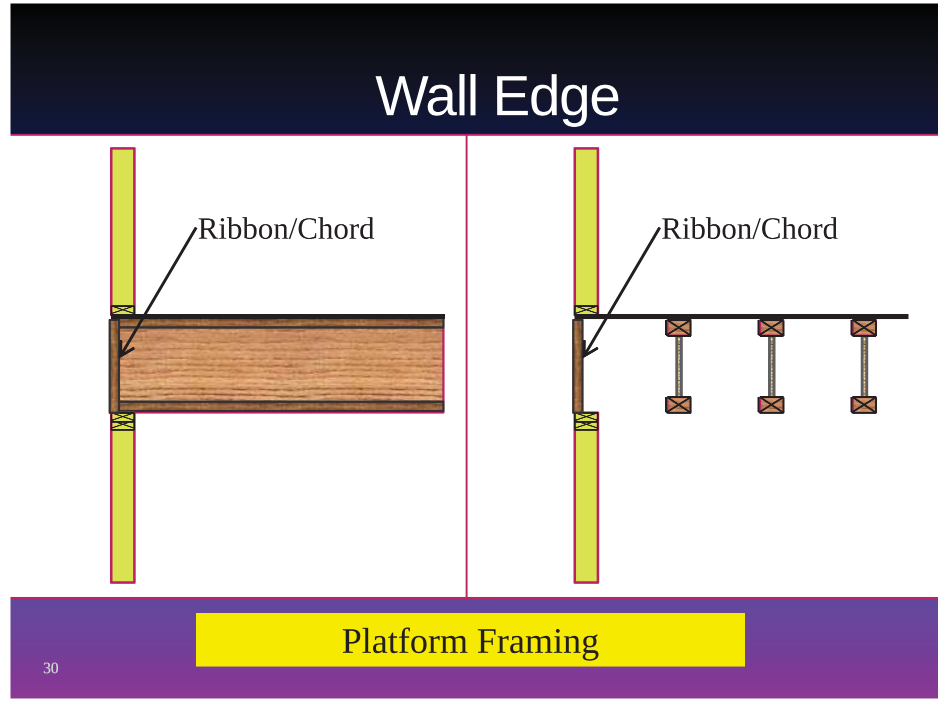
- ☑ WoodWorks website provides access to technical support, either one-on-one or via wood associations nationwide.
- ☑ Visit Website:
  - www.Woodworks.org/aboutWoodworks/technical-support.aspx

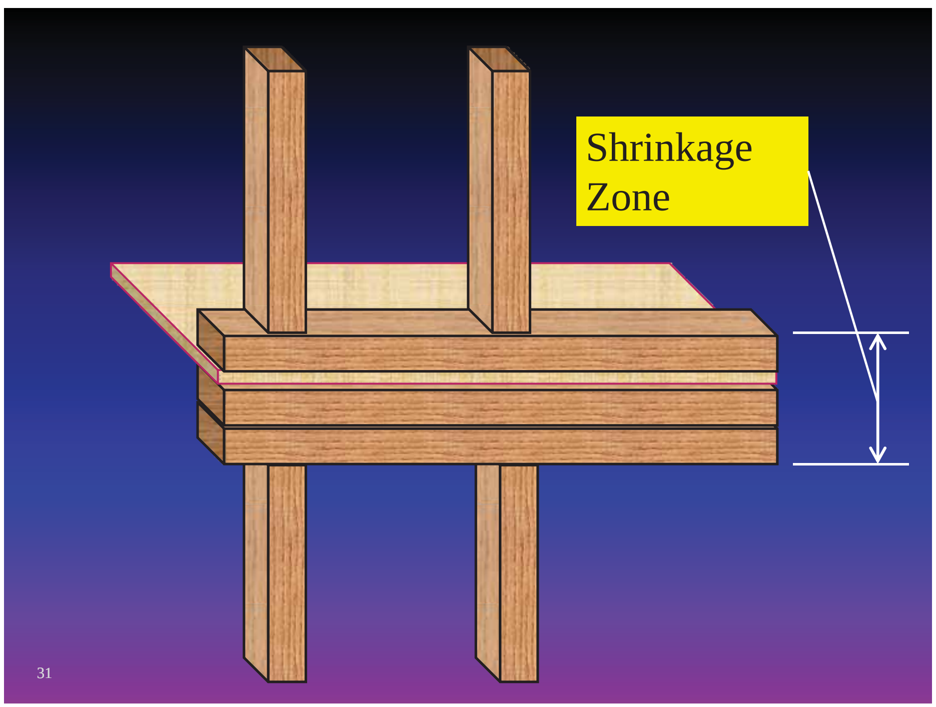
Wood Shrinkage

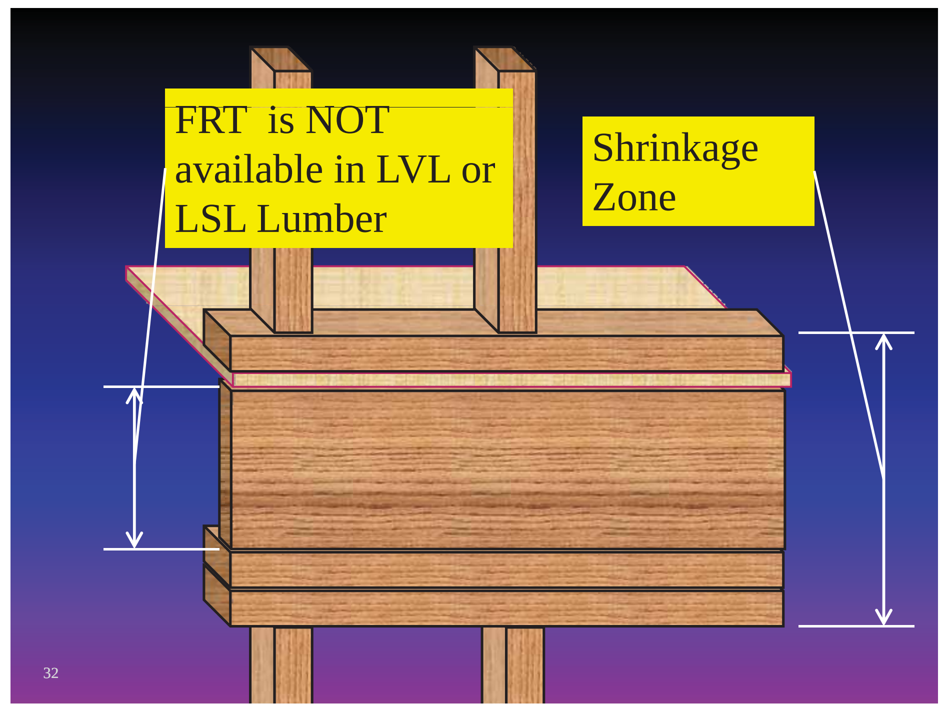
- ☑ Wood only shrinks *perpendicular* to grain.

  (Shrinkage parallel to grain is approximately 1/40 of the shrinkage perpendicular to grain and can be neglected.)
- ☑ The amount of shrinkage (or expansion) in wood is directly proportional to the *change* in moisture content.
- ☑ The higher the moisture content at time of construction, the more shrinkage that can occur in the structure.


Wall Edge
Top Plate/Chord
Top Plate/Chord
Modified Balloon Framing
29


Wall Edge
Ribbon/Chord
Ribbon/Chord
Platform Framing
30


Shrinkage Zone
31


FRT is NOT available in LVL or LSL Lumber
Shrinkage Zone
32

Comprehensive Shrinkage Estimation

- For a dimensional change with the moisture content limits of 6 to 14 percent the formula is:

$$S = D_i\left[C_T\left(M_F - M_i\right)\right]$$

Comprehensive Shrinkage Estimation

☑ For a dimension change with the moisture content limits greater than 6 to 14 percent <u>where one of the values is outside of those limits the formula is:</u>

$$S = \frac{D_i\left(M_F - M_i\right)}{\frac{30(100)}{S_T} - 30 + M_i}$$

Comprehensive Shrinkage Estimation

$$S = \frac{D_i\left(M_F - M_i\right)}{\frac{30(100)}{S_T} - 30 + M_i}$$

☑ Where:

S = shrinkage (in inches)

D_i = initial dimension (in inches)

S_T = tangential shrinkage (percent) from green to oven dry

S_T = 7.775 for Douglas Fir-Larch

M_F = final moisture content (percent)

M_i = initial moisture content (percent)

Equilibrium Moisture Contents (*EMC*)

☑ The final moisture content (M_F) for a building is referred to as the Equilibrium Moisture Content (*EMC*).

☑ The final equilibrium moisture content can be higher in coastal areas and lower in inland or desert areas. These ranges are normally between 6 to 15 percent (low to high).

Equilibrium Moisture Contents (*EMC*)

- The Western Wood Products Association has downloadable documents listing Equilibrium Moisture Contents (*EMC*) for all the major US cities for each month of the year.
- At the web address after login, go to "Shrinkage", then "EMC Charts"(free user login with password is required):

http://www2.wwpa.org/Shrinkage/EMCUSLocations1997/tabid/888/Default.aspx

Calculation of *EMC*

$$EMC = \frac{1800}{W}\left[\frac{KH}{1-KH} + \frac{\left(K_1KH + 2K_1K_2K^2H^2\right)}{\left(1+K_1KH + K_1K_2K^2H^2\right)}\right]$$

- Where:

$$W = 330 + (0.452)T + (0.00415)T^2$$

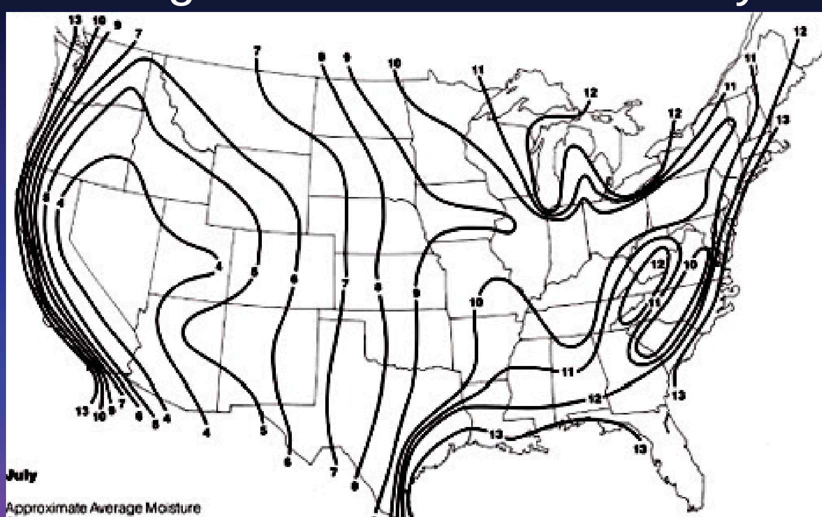
$$K = 0.791 + (0.000463)T - (0.000000844)T^2$$

$$K_1 = 6.34 + (0.000775)T - (0.0000935)T^2$$

$$K_2 = 1.09 + (0.0284)T - (0.0000904)T^2$$

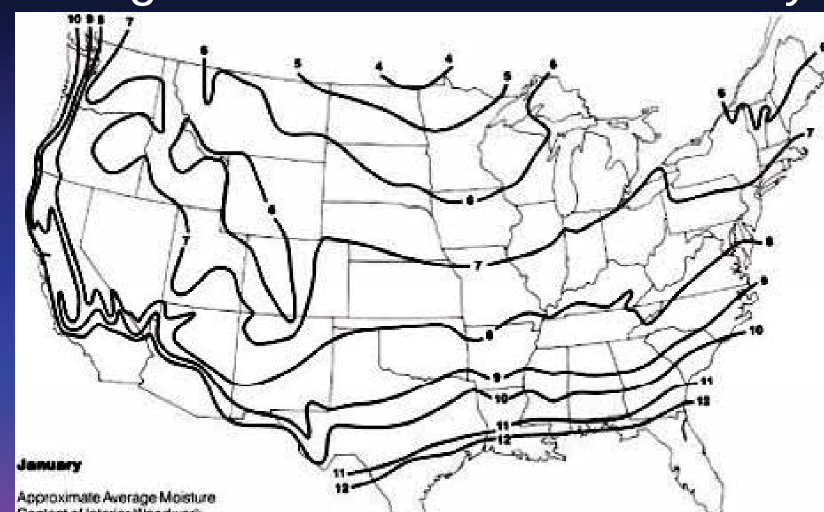
$$H = relative\ humity\ (\%)$$

Average Moisture Contents - July



Map courtesy of US Forest Products Laboratory

Average Moisture Contents - January



Map courtesy of US Forest Products Laboratory

Average Moisture Contents

City	High M/C	Low M/C	Difference	Avg. M/C
Portland	17.4	11.7	5.7	14.6
Eugene	20.2	11.7	8.5	15.9
Seattle-Tacoma	16.5	12.2	4.3	14.4
Boise	15.2	7.3	7.9	11.3
Astoria	17.8	16.0	1.8	16.9
Yakama	16.5	8.8	7.7	12.7
Las Vegas	8.5	4.0	4.5	6.2

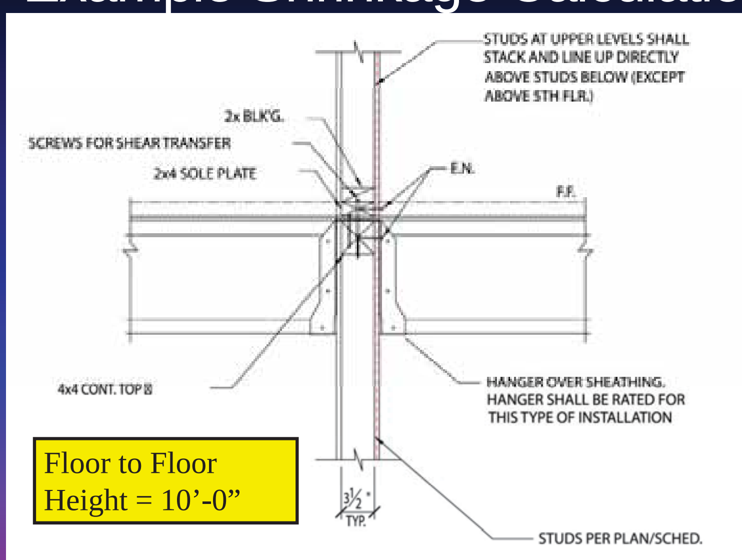
Source: U.S. Forest Products Laboratory

Average Moisture Contents

City	High M/C	Low M/C	Difference	Avg. M/C
Baltimore	13.0	11.3	1.7	12.2
Atlanta	14.2	11.8	2.4	10.0
Raleigh	14.5	11.7	2.8	13.1
Charleston	14.6	12.5	2.1	13.6
Daytona Beach	15.4	13.0	2.4	14.2
Savannah	14.4	11.8	2.6	13.1
Las Vegas	8.5	4.0	4.5	6.2

Source: U.S. Forest Products Laboratory

Example Shrinkage Calculation



Shrinkage Calculations

- ☑ Shrinkage amounts are approximate
- ☑ Shrinkage values not only differ between species of wood, but also between trees of the same species.
- ☑ Shrinkage also may vary slightly depending on drying conditions: low or high temperatures, rapid or slow drying.

Example Shrinkage Calculation

- Since our initial MC (M_i) is 19 percent and the final MC (M_F) is 12 percent, the equation is:

$$S = \frac{D_i(M_F - M_i)}{\frac{30(100)}{S_T} - 30 + M_i} = \frac{3.5(12-19)}{\frac{30(100)}{7.775} - 30 + 19} = -0.065 \quad inch$$

- Our final size of our 4x4 is:

$$3.5 - 0.065 = 3.435 \quad inch$$

Quick Shrinkage Estimation:

- A close approximation that is much easier to determine amount of shrinkage is:

$$S = CD_i(M_F - M_i)$$

- Where:

  S = shrinkage (inches)

  C = average shrinkage constant

  C = 0.002

  M_F = final moisture content (percent)

  M_i = initial moisture content (percent)

Quick Shrinkage Estimation:

- Since our initial MC (M_i) is 19 percent and the final MC (M_F) is 12 percent, the equation is:

$$S = CD_i(M_F - M_i) = 0.002 \times 3.5(12-19) = -0.049 \quad inch$$

- Our final size of our 4x4 is

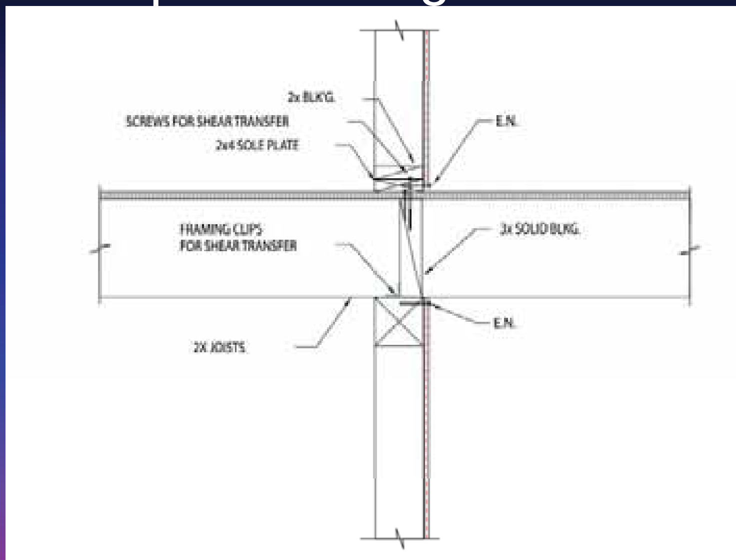
$$3.5 - 0.049 = 3.451 \quad inch$$

Quick Shrinkage Estimation:

- Note that this is quick estimation is within ½ percent of the actual calculated dimension of 3.435 inch using the comprehensive formulas.
- Total shrinkage per floor level with the 4x4 top plate and 2x4 sole plate:

$$S = 0.049 + 0.021 = 0.07 \quad inch$$

Example Shrinkage Calculation



Quick Shrinkage Estimation:

☑Determine shrinkage of sawn joists with platform framing

$$S = CD_i(M_F - M_i) = 0.002 \times 9.25(12-19) = -0.129 \;\; inch$$

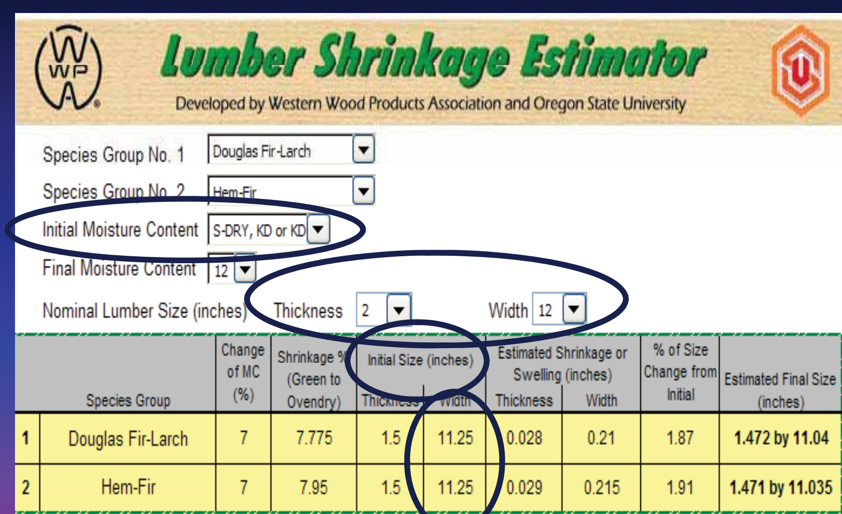
☑Total shrinkage per floor level with the 4x4 top plate, 2x12 sawn joists and 2x4 sole plate:

$$S = 0.049 + 0.021 + 0.129 = 0.199 \;\; inch$$

Wood Shrinkage

☑A free "shrinkage calculator" can be down loaded from the Western Wood Products Association web site link: www2.wwpa.org

WWPA Shrinkage Calculator

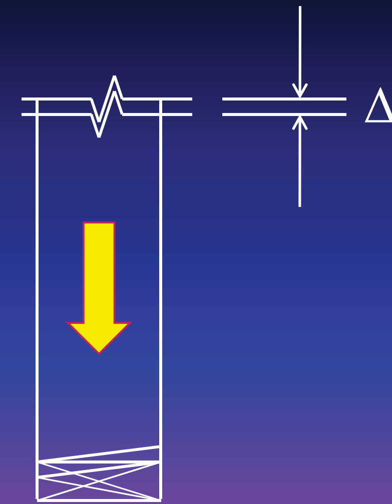


	Species Group	Change of MC (%)	Shrinkage % (Green to Ovendry)	Initial Size (inches) Thickness	Initial Size (inches) Width	Estimated Shrinkage or Swelling (inches) Thickness	Estimated Shrinkage or Swelling (inches) Width	% of Size Change from Initial	Estimated Final Size (inches)
1	Douglas Fir-Larch	7	7.775	1.5	11.25	0.028	0.21	1.87	**1.472 by 11.04**
2	Hem-Fir	7	7.95	1.5	11.25	0.029	0.215	1.91	**1.471 by 11.035**

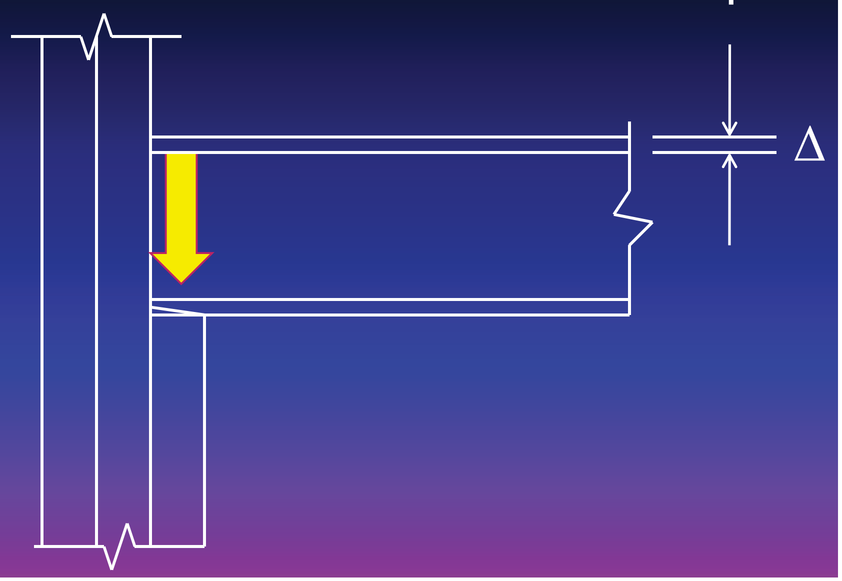
Settlement Under Construction Gaps

- ☑ Small gaps can occur between plates and studs; this can include mis-cuts (short studs) and the lack of square-cut ends. And can account for up to a 1/8 inch per story. Where “perfect” workmanship would be 0 inches and a more “sloppy” workmanship would be 1/8 inch.
- ☑ This case study will use 1/10 inch.

Settlement Under Construction Gaps



Settlement Under Construction Gaps



Cumulative Displacement

Level	Vertical Displacement		Design Displacement (in)
	Per Floor	Cumulative	
5th Floor	0.170	0.68	3/4
4th Floor	0.170	0.51	5/8
3rd Floor	0.170	0.34	3/8
2nd Floor	0.170	0.17	1/4

Notes on Plumbing & Electrical Drawings to accommodate these displacements

Methods to Reduce Displacement

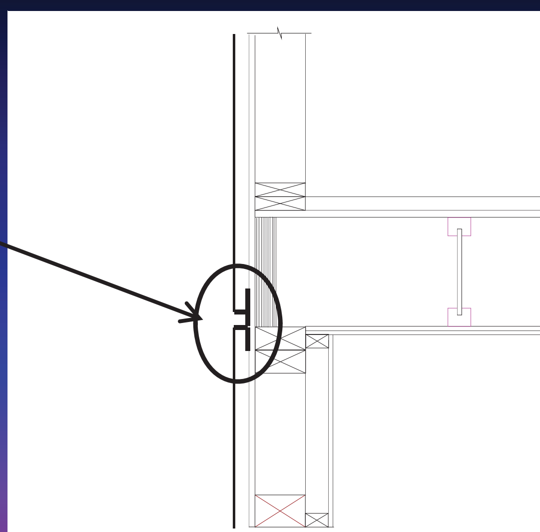
- ☑ Use kiln-dried plates (MC < 19 percent) or even MC15 (MC<15 percent) lumber or engineered lumber for plates.
- ☑ Consider single top plate instead of double top plate.
- ☑ Consider balloon framing or a modified balloon framing.

Methods to Reduce Displacement

- ☑ Place floor joists in metal hangers bearing on beams or top plates instead of bearing on the top plates.
- ☑ The site storage of the material stock can negate all design and planning when the material is not properly stored on the site. Lumber should be kept away from moisture sources and rain.

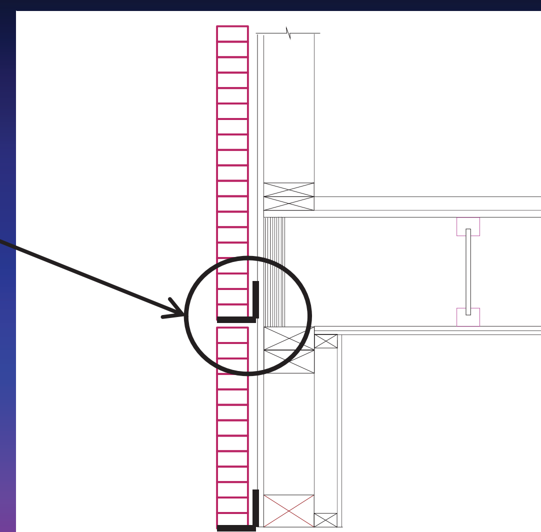
Wall Edge

Expansion Joint in Finish Material



Wall Edge

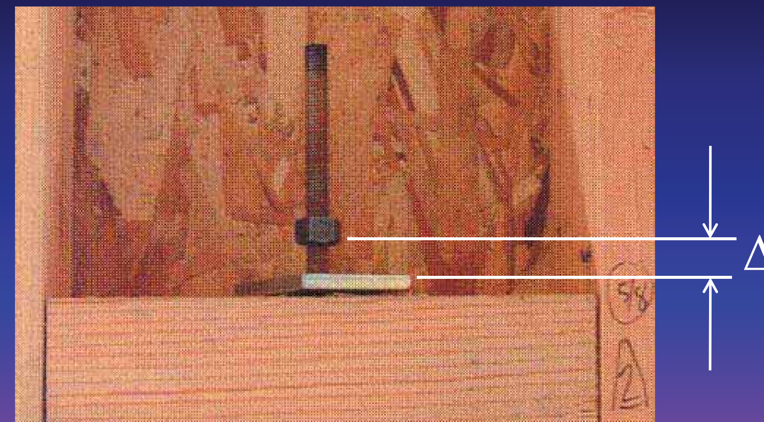
Expansion Joint in Finish Material



Tiedowns & Shrinkage Compensation

Level	Vertical Displacement		Design Displacement (in)
	Per Floor	Cumulative	
5th Floor	0.170	0.68	3/4
4th Floor	0.170	0.51	5/8
3rd Floor	0.170	0.34	3/8
2nd Floor	0.170	0.17	1/4

Without Shrinkage Compensation



Take-up Devices

- ☑Devices are proprietary
- ☑Purpose is to compensate for building shrinkage and settlement.
- ☑Keep rotating the nut down or use a compression spring.

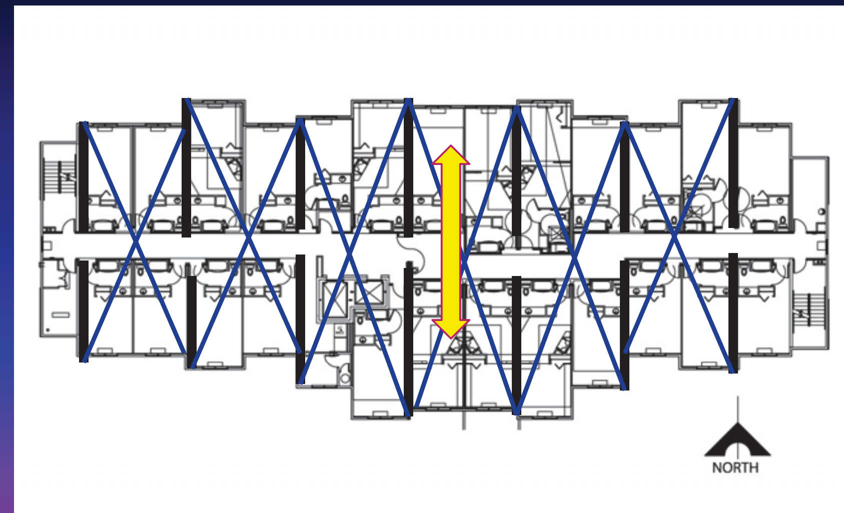
Take-up Devices

- ☑ICC Evaluation Service has Acceptance Criteria (AC 316) for take-up devices.

Take-up Devices

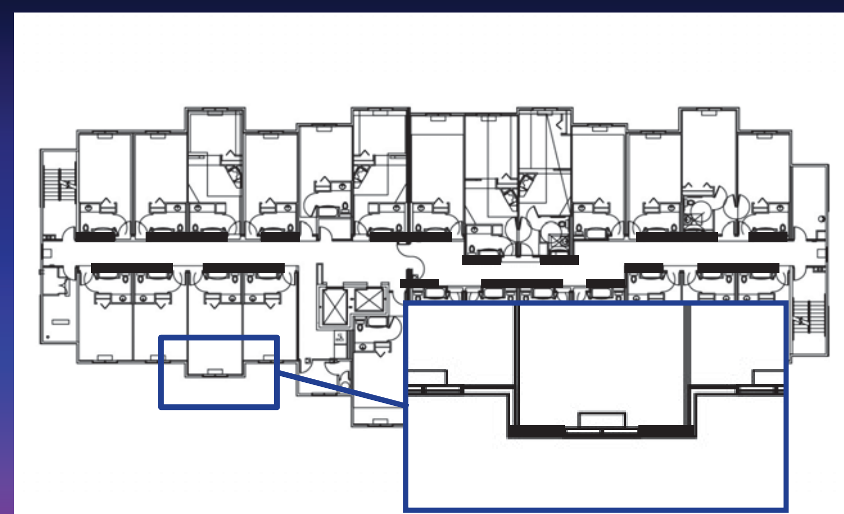
☑Design Engineer should check to see that the proprietary devices conform to these criteria.

Location of Shear Walls

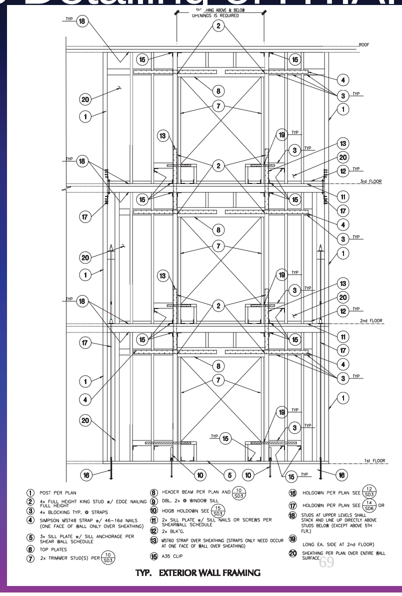


Location of Shear Walls

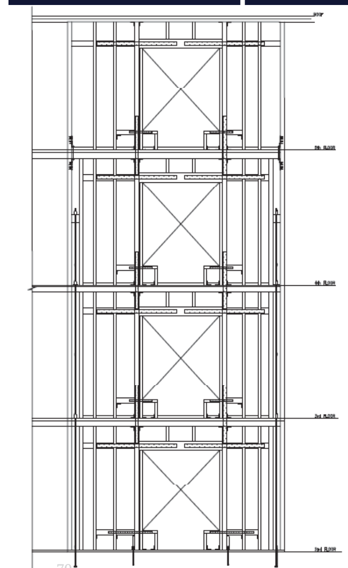
Location of Shear Walls

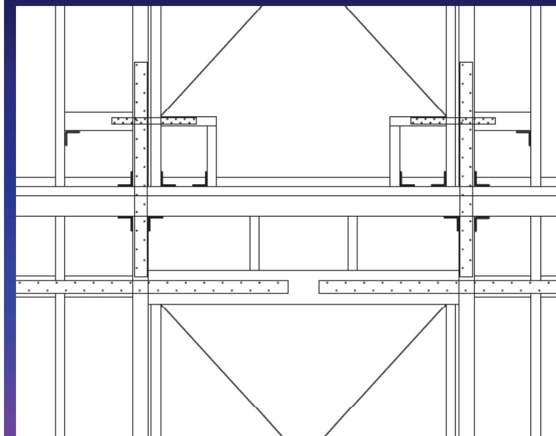


Example Detailing of F.T.A.O.

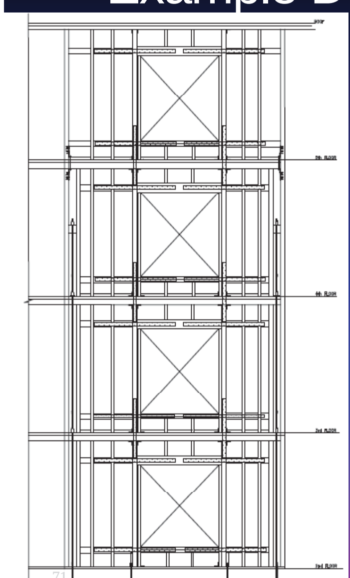


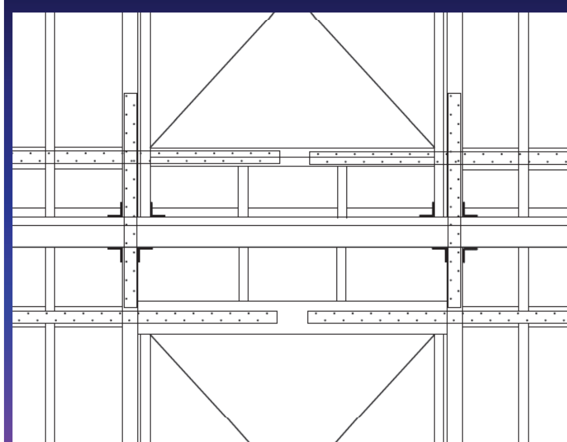
Example Detailing of F.T.A.O.



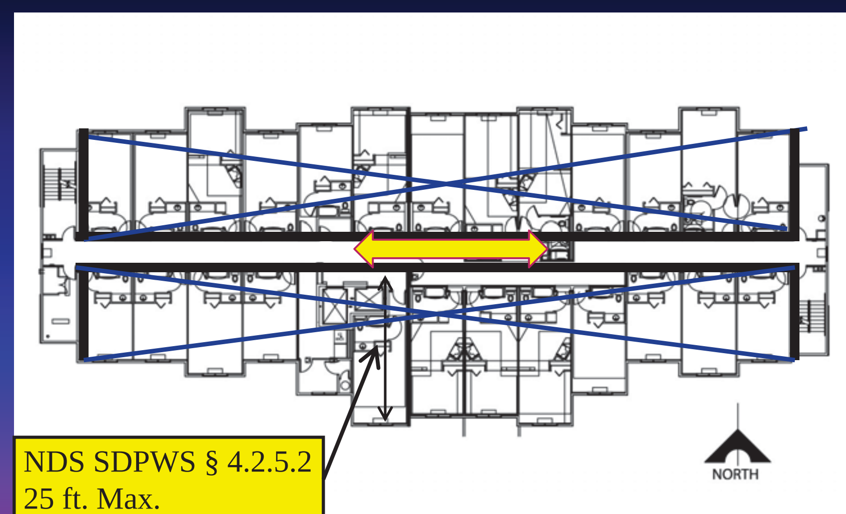


Example Detailing of F.T.A.O.

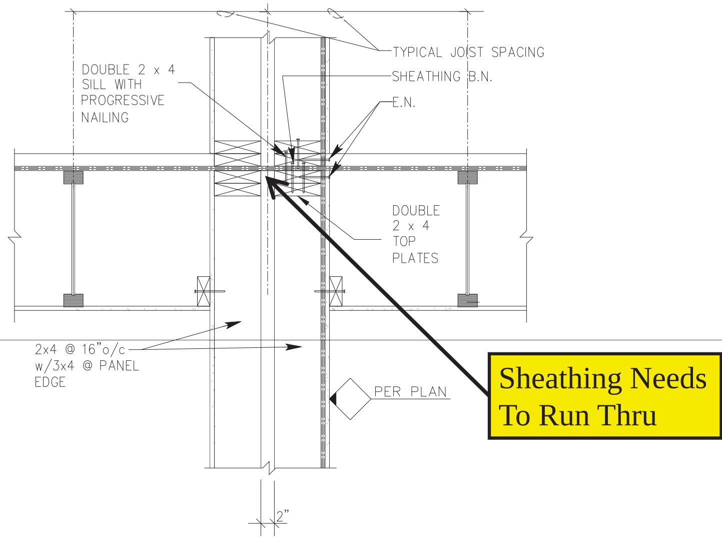




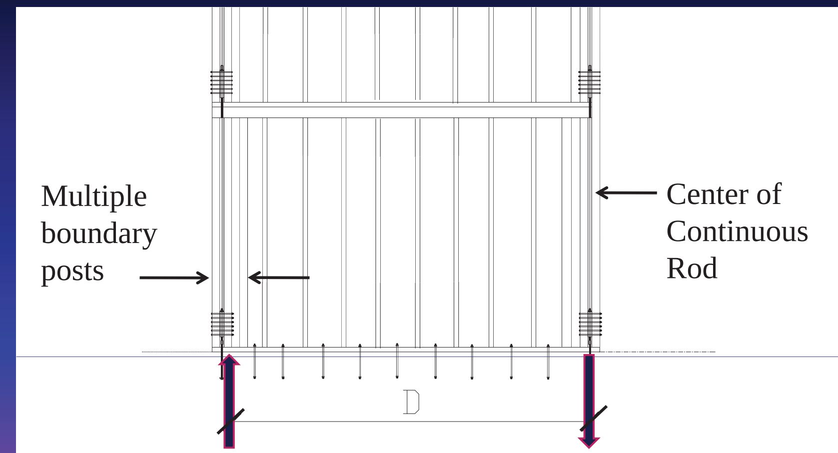
Location of Shear Walls



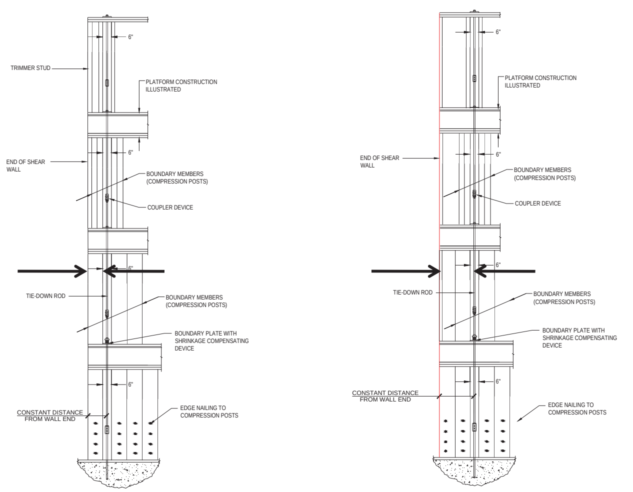
Shear Transfer at Floor



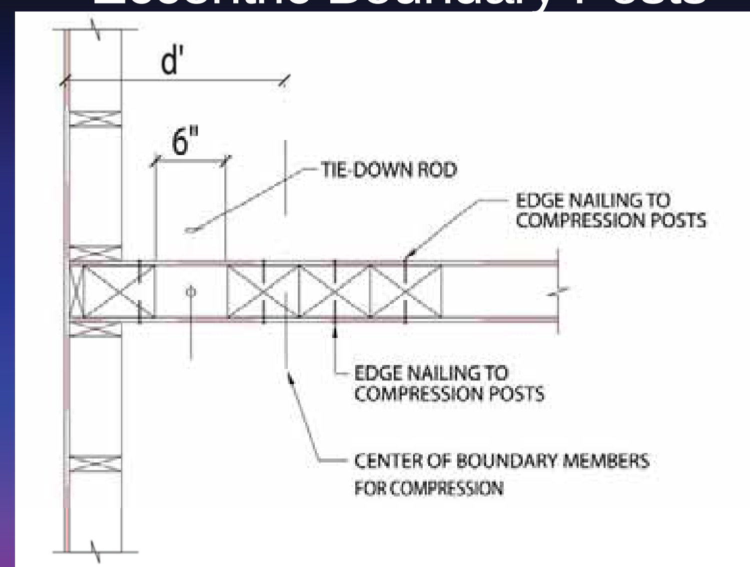
Wall Overturning



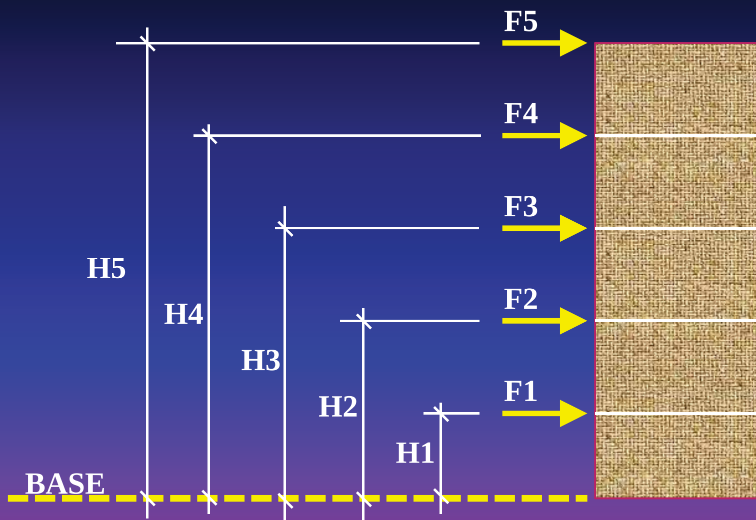
Eccentric vs. Concentric



Eccentric Boundary Posts



Cumulative Overturning

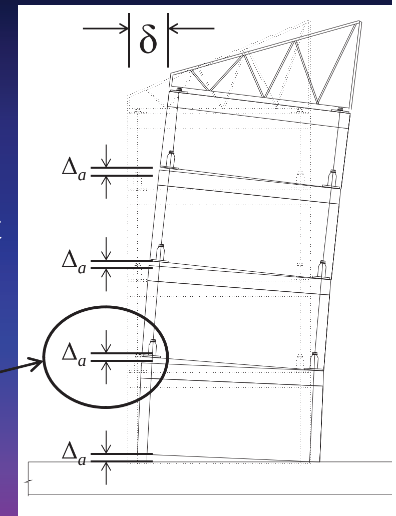


System Stretch

Design for following system elements for stretches (Δ_a):

- Rod elongation
- Take-up device displacement
- Bearing Plate crushing
- Sill Plate crushing

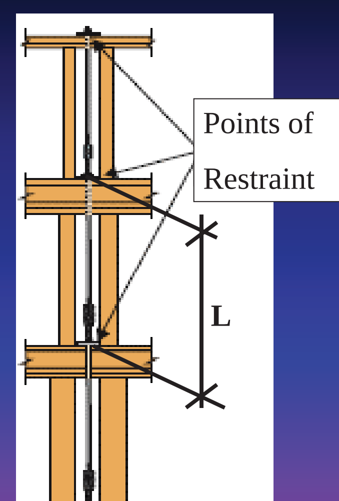
Formally known as d_a



Rod Elongation

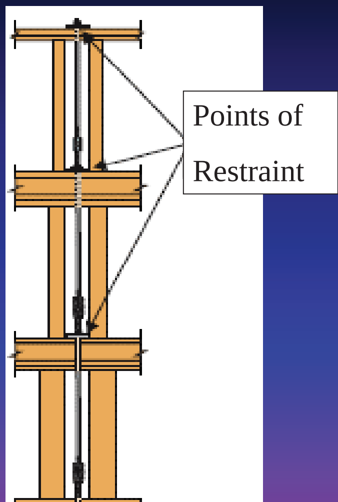
- ☑Measured between restraint connectors.
- ☑Rod elongation limit by itself does not eliminate the need to include the rod elongation in the shear wall deflection calculation.
- ☑Rod elongation is the same for different yield strengths.
- ☑If threaded rods used for entire length then net tensile area should be used (A_t vs. A_g)

Rod Elongation



- ☑Rod length is between points of restraint.
- ☑Some jurisdictions have limits on the amount of rod elongation and some require that the “allowable stress area” (Ae vs. Ag) be used in elongation calculations.
- ☑Local building departments requirements should be checked.

Rod Elongation



- ☑Design Example in publication uses $\mathbf{A_e}$ for rod elongation and $\mathbf{A_g}$ or $\mathbf{A_n}$ for rod capacity.
- ☑Many manufacturers will vary the yield strength in rods.
- ☑With higher strength rod can actually increase the drift of the shear wall.

$$Rod\ \ Elongation: \Delta = \frac{PL}{A_e E}$$

Δ	The elongation of the rod in inches.
P	The accumulated uplift tension force on the rod in kips (tension demand).
L	Length of rod in inches from bearing restraint to bearing restraint, with the bearing restraint being where the load is transferred to the rod.
E	29,000 ksi
A_e	The effective area of the rod in square inches. When smooth rods are used, the area is equal to the gross area (*Ag*). When threaded (all-thread) rods are used, the area is equal to the tension area (*Ae*) of the threaded rod. Since many of the proprietary systems that have smooth rods have long portions threaded at the ends, it is recommended that *Ae* be used when calculating rod elongation.

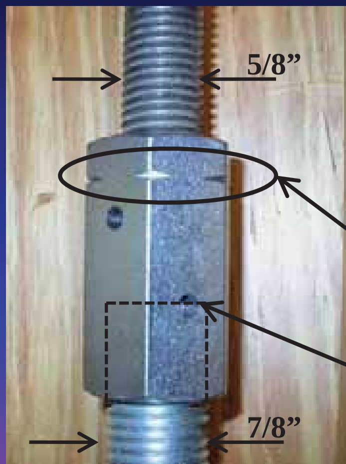
Tie-Down Rods

- ☑ Rods usually A36/A307 steel
- ☑ High-strength rods are A449 or A193-B7. Usually marked with embossed stamp at end (sometimes on side).
- ☑ High-strength rods should have special inspection to confirm rod type (stamp may be hidden inside couple nut).
- ☑ High-strength rods are not weldable.

Rod Couplers

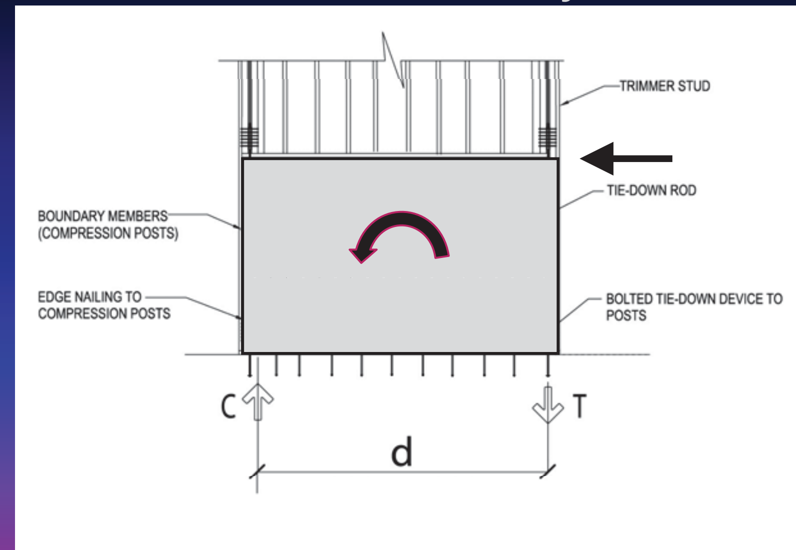
- ☑Straight or Reducing
- ☑Need "pilot" or "witness" holes for verification of proper embedment.

Rod Couplers

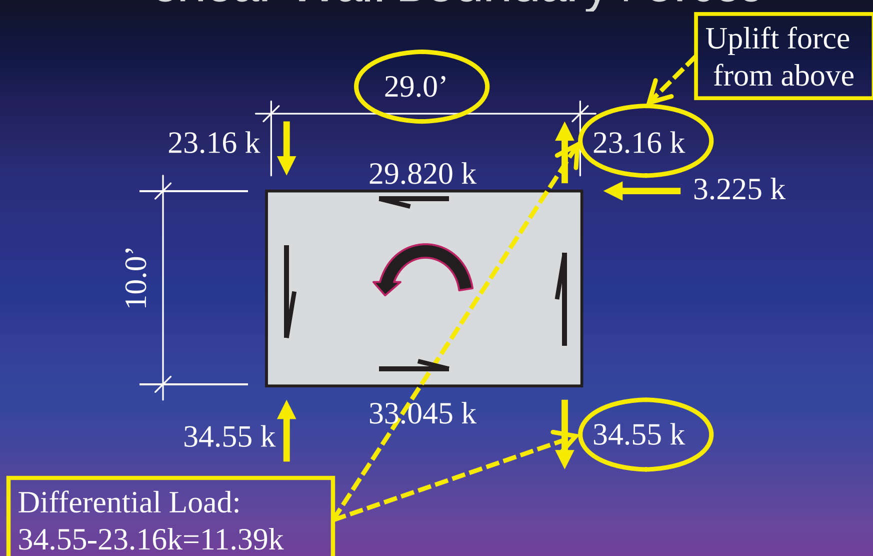


- ☑Reducing Coupler
- ☑High-strength Coupler

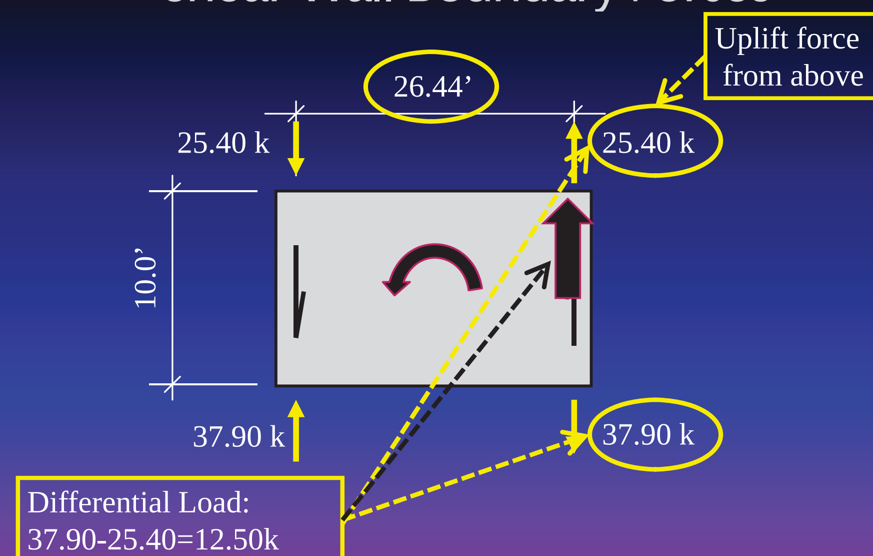
Shear Wall Boundary Forces



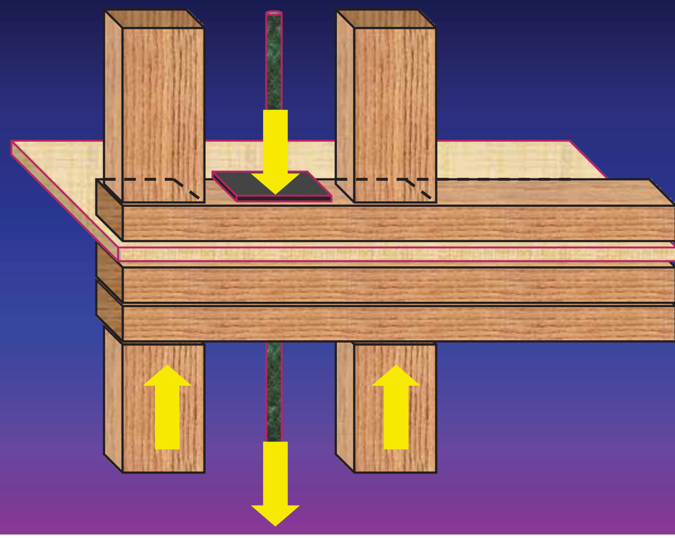
Shear Wall Boundary Forces



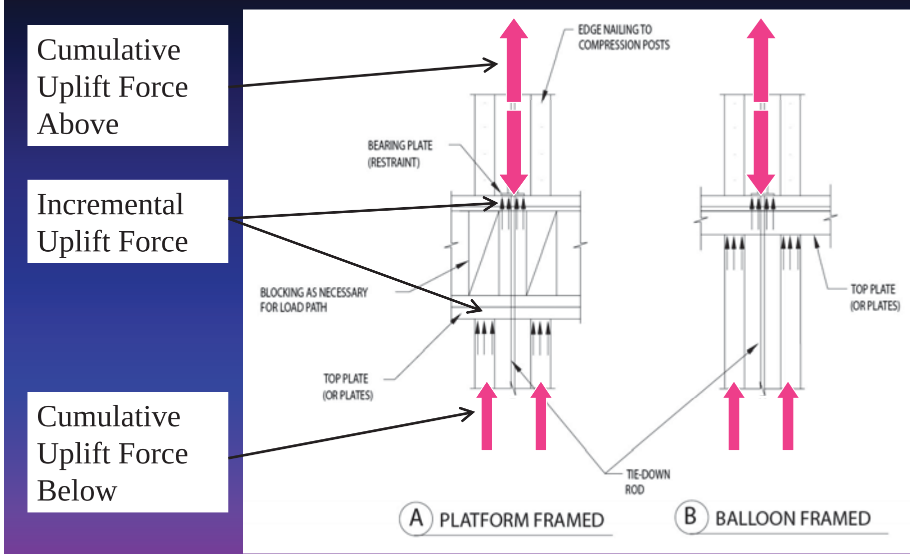
Shear Wall Boundary Forces



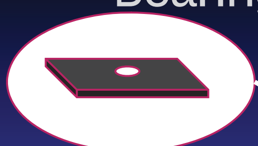
Bearing Plate Crushing



Load Transfer-Uplift Posts to Bearing Plates

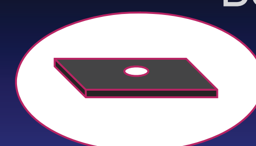


Bearing Plate Sizes & Capacities



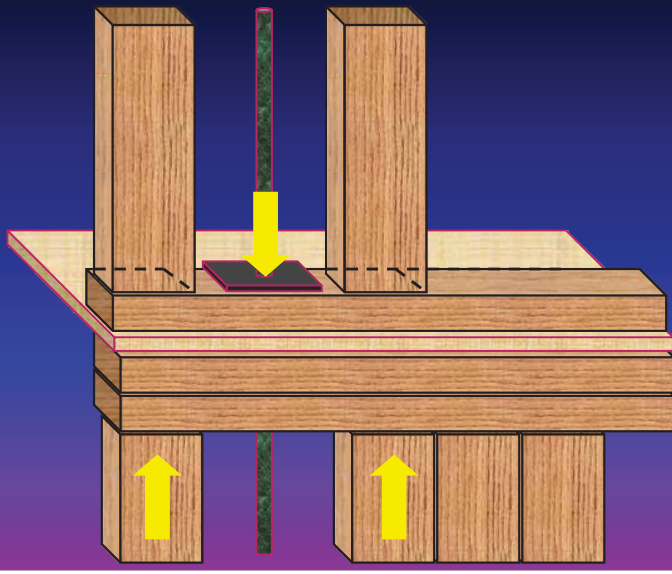
Level	Bearing Plate					Bearing Factor C_b	Bearing Load (kips)	Allowable Capacity (kips)
	Width (in)	Length (in)	Thickness (in)	Hole dia. (in)	A_{Brg} (in^2)			
Roof	3.0	5.5	0.6	0.8125	15.898	1.07	2.565	10.631
5th Floor	3.0	3.5	0.4	0.8125	9.982	1.11	2.785	6.925
4th Floor	3.0	3.5	0.4	0.8125	9.982	1.11	4.665	6.925
3rd Floor	3.0	5.5	0.6	1.0625	15.613	1.07	5.395	10.441

Bearing Plate Crushing

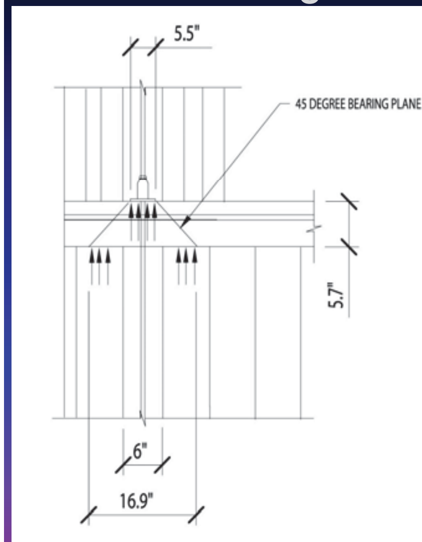


Level	ASD Bearing Load (kips)	Strength Bearing Load (kips)	Bearing Plate A_{Brg} (in^2)	$f_{c\perp}$ (ksi)	$0.73F'_{c\perp}$ (ksi)	Crush (in)
Roof	2.565	3.664	15.788	0.232	0.456	0.010
5th Floor	2.785	3.979	9.788	0.406	0.456	0.018
4th Floor	4.665	6.664	9.788	0.681	0.456	0.047
3rd Floor	5.395	7.707	15.396	0.501	0.456	0.025

Bearing Zone Through Framing

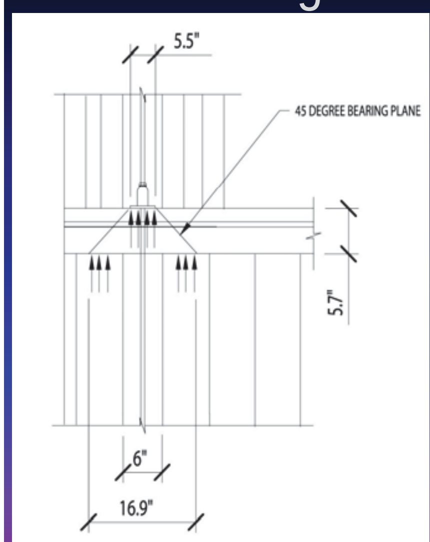


Bearing Zone Through Framing



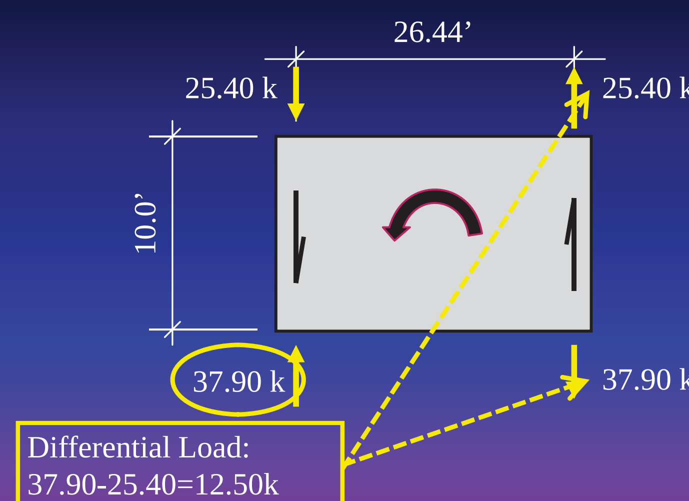
- ☑ Example Bearing Check:
- ☑ Differential Load at 3rd Floor = 5,395 lb
- ☑ Bearing Plate Width = 5.5 inches
- ☑ Bearing Plate width at bottom of 4x4 top plate = (5.5+5.7+5.7) = 16.9 in

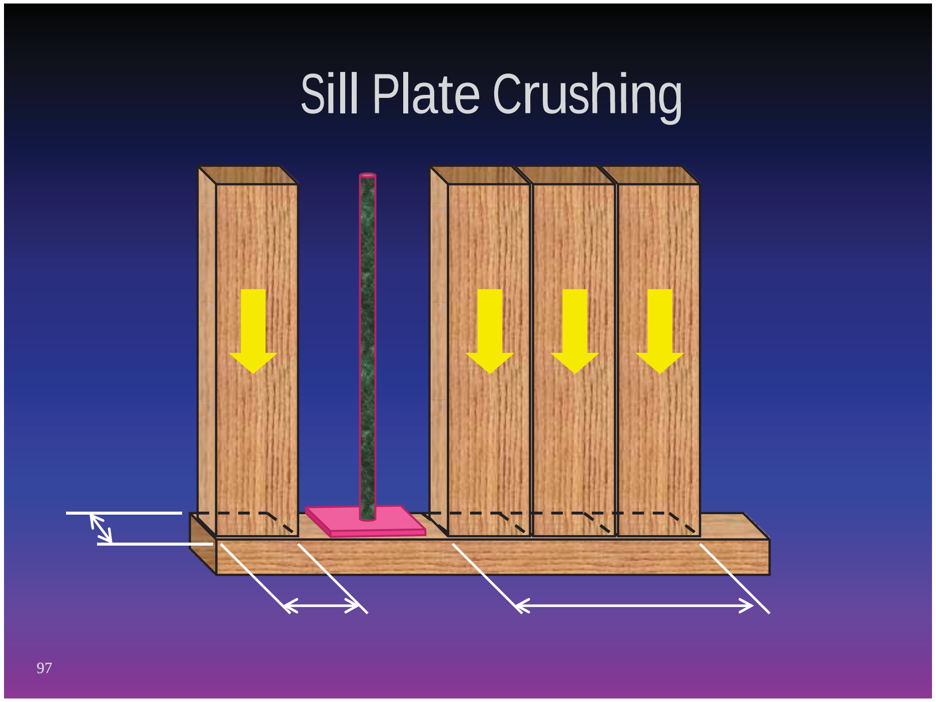
Bearing Zone Through Framing

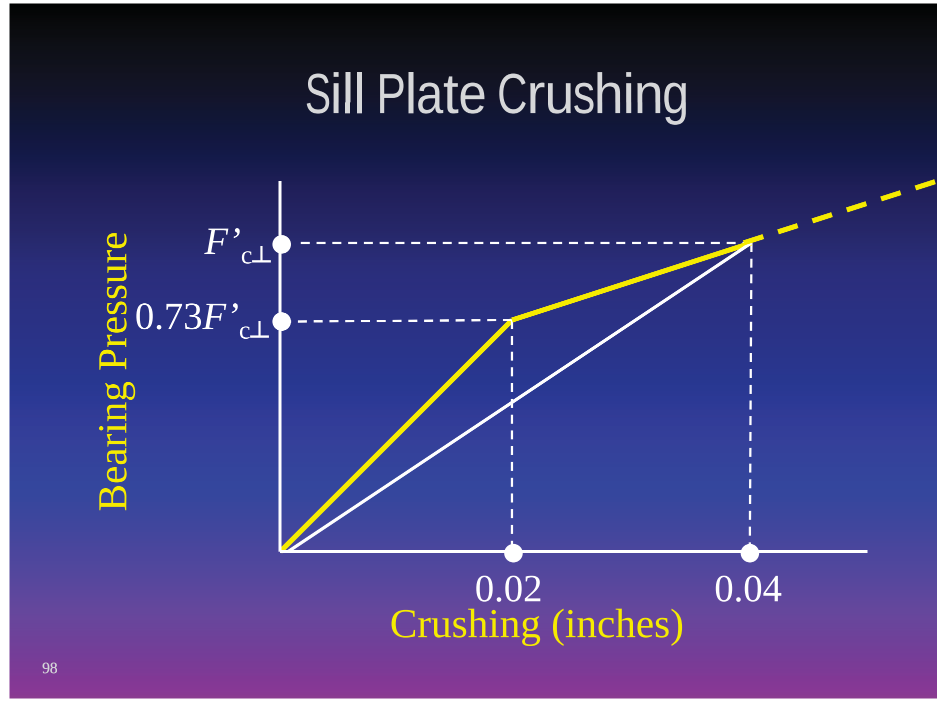


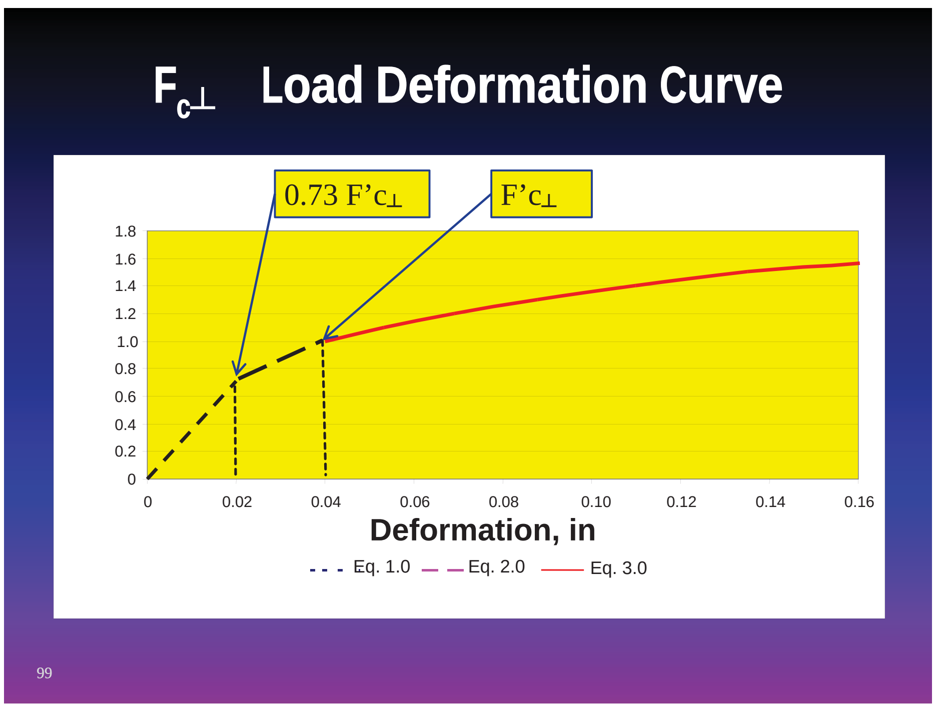
- ☑ Net bearing area:
  (16.9-6.0)x3.5 = 38.1 sq in
- ☑ Bearing stress:
  $f_{c\perp}$=(5,395/38.1)=142 psi
  $F'_{c\perp}$= 625 psi
- ☑ Posts at plate:
  5,395/(2x3.5x3.5) = 220 psi
  $F'_{c\perp}$= 625 psi

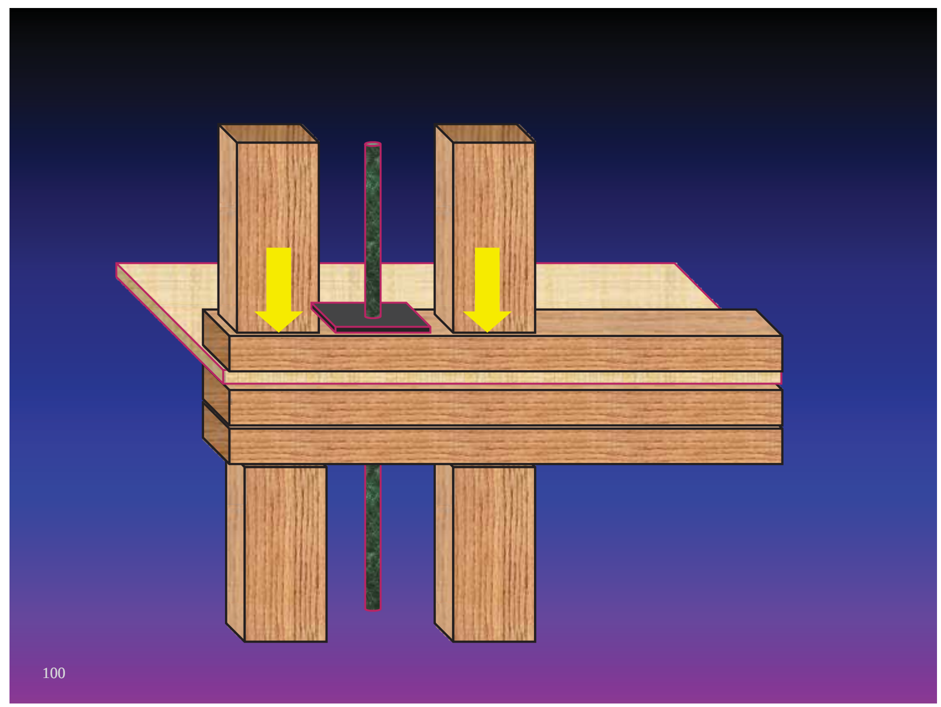
Sill Plate Crushing

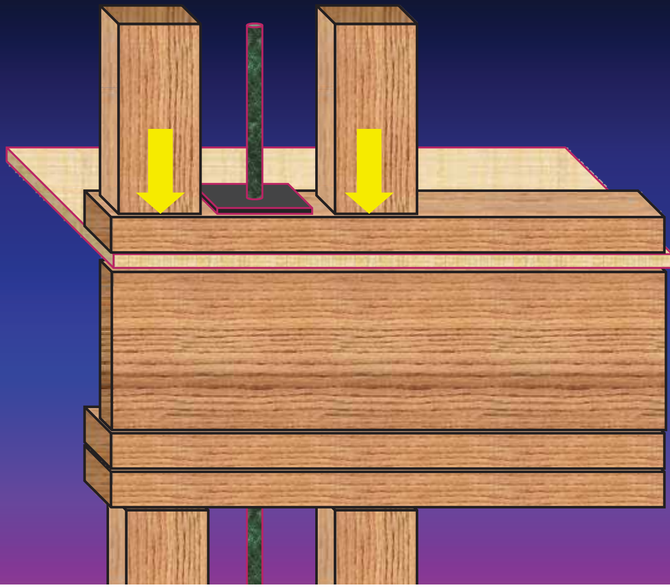



Sill Plate Crushing
97

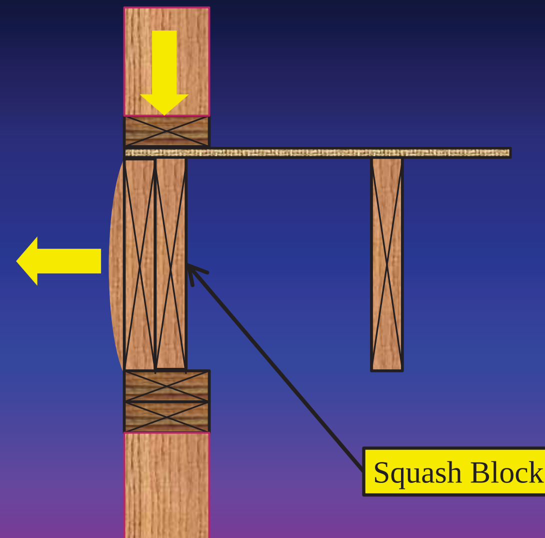

Sill Plate Crushing
F'c⊥
0.73F'c⊥
Bearing Pressure
0.02
0.04
Crushing (inches)
98


Fc⊥ Load Deformation Curve
0.73 F'c⊥
F'c⊥
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
Deformation, in
Eq. 1.0
Eq. 2.0
Eq. 3.0
99

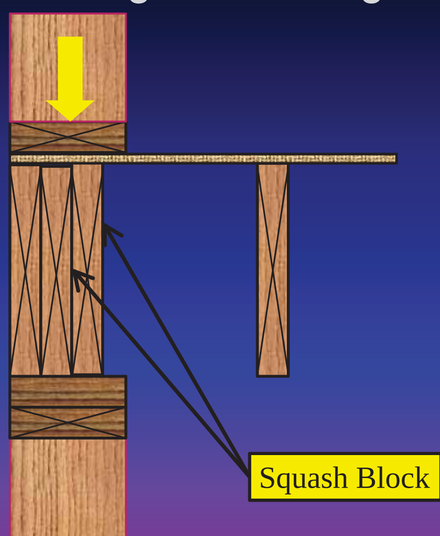

100



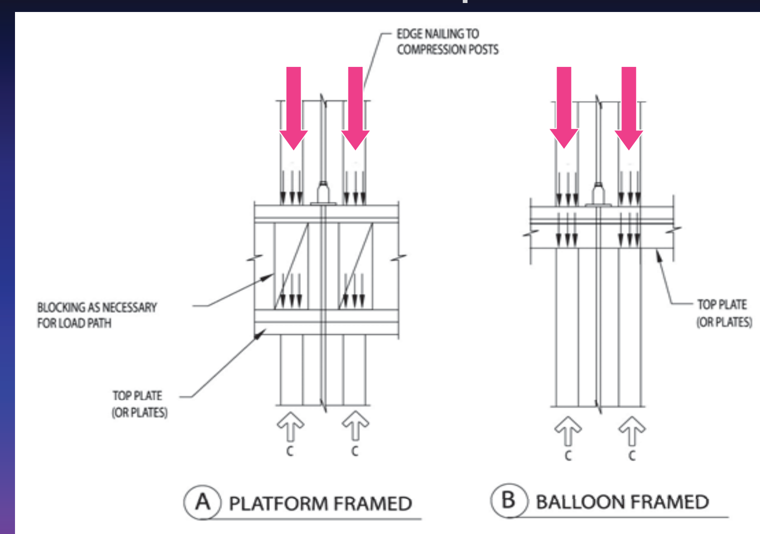
Crushing + Buckling



Crushing + Buckling



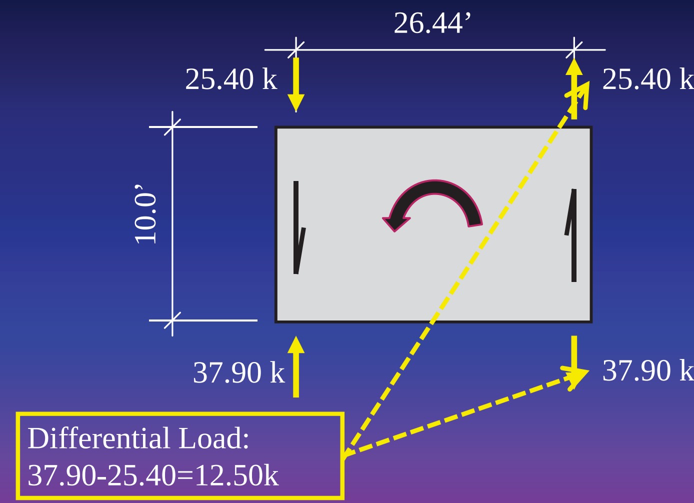
Load Transfer-Compression Posts



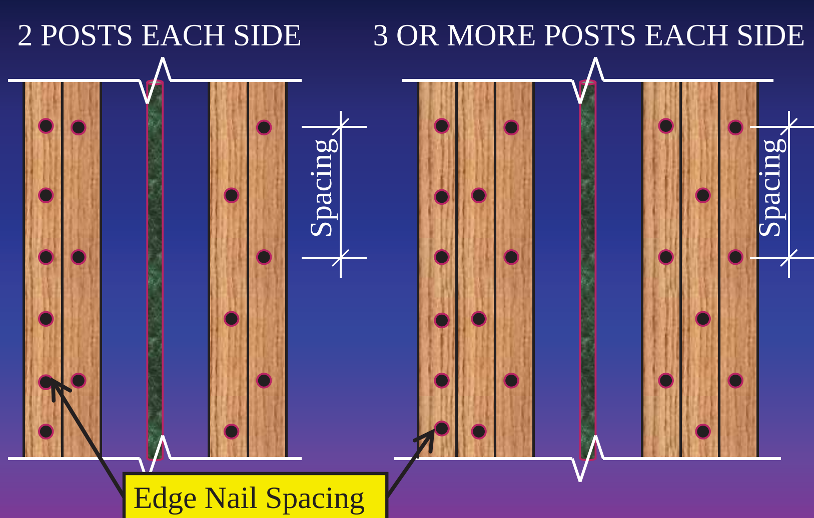
Sill Plate Crushing

Level	Chord Posts	ASD Demand (kips)	Strength Demand (kips)	Total Area (in^2)	$f_{c\perp}$ (ksi)	$0.73F'_{c\perp}$ (ksi)	Crush (in)
Roof	4-3x4	4.06	5.62	35.0	0.160	0.456	0.007
5^{th} Floor	4-3x4	11.53	16.13	35.0	0.461	0.456	0.023
4^{th} Floor	4-4x8	22.88	32.13	101.5	0.317	0.456	0.015
3^{rd} Floor	4-4x8	33.85	47.62	101.5	0.469	0.456	0.025

Boundary Member Nailing



Boundary Member Nailing



Boundary Member Nailing

E.N. SPACING PER PLAN	EDGE NAIL SPACING TO EACH POST	
	4 POSTS	6+ POSTS
2	4”	6”
3	6”	9”
4	8”	12”
6	12”	12”

Tie-Down Assembly Displacement **With** Shrinkage Compensators

Level	Rod Elong. (in)	Shrinkage (Vertical Displacement) (in)	Chord Crushing (in)	Bearing Plate Crushing (in)	Take-up Deflection Elongation (in)	Total Displacement d_a (in)
Roof	0.047	0.03	0.007	0.010	0.03	0.124
5th Floor	0.098	0.03	0.023	0.018	0.03	0.199
4th Floor	0.183	0.03	0.015	0.047	0.03	0.305
3rd Floor	0.138	0.03	0.025	0.025	0.03	0.248

Tie-Down Assembly Displacement

Total Displacement d_a (in)
0.124
0.199
0.305
0.248

- ☑AC 316 is the Acceptance Criteria for Shrinkage Compensating Devices
- ☑ ICC-ES has place a limit of 0.20" displacement for d_a
- ☑This limit is for ASD forces
- ☑For strength forces this would be 0.28"
- ☑AC 316 allows the 0.20" displacement to be exceeded if the total shear wall drift is in compliance with code allowable drifts.

Sample Drawing Specification:

- ☑Specify a particular manufacturer.
- ☑Specify cumulative uplift forces and compression forces at each level.
- ☑Specify displacement limits (if any) for tie-down system at the specified uplift forces.
- ☑Specify whether or not restraint connections must be at every floor.
- ☑Specify estimated wood shrinkage per floor

Sample Drawing Specification:

- ☑Specify whether of not shrinkage compensating devices are required.
- ☑Specify maximum bored hole size for utilities.
- ☑Specify minimum boundary post sizes.
- ☑Substitutions from specified system shall include shop drawings and design calculations for review/approval.
  - Design calculations must be stamped and signed by a licensed Civil or Structural Engineer.

Summary

- ☑Wood Construction can be an more economical than steel, masonry and concrete.
- ☑When *Type III* construction is necessary, consider *Fire-Retardant Treated* wood.
- ☑Consider shrinkage in design and detailing of structure.

Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

Douglas Thompson

dougt@stbse.com

Wood Products Council 866.966.3448 info@woodworks.org