

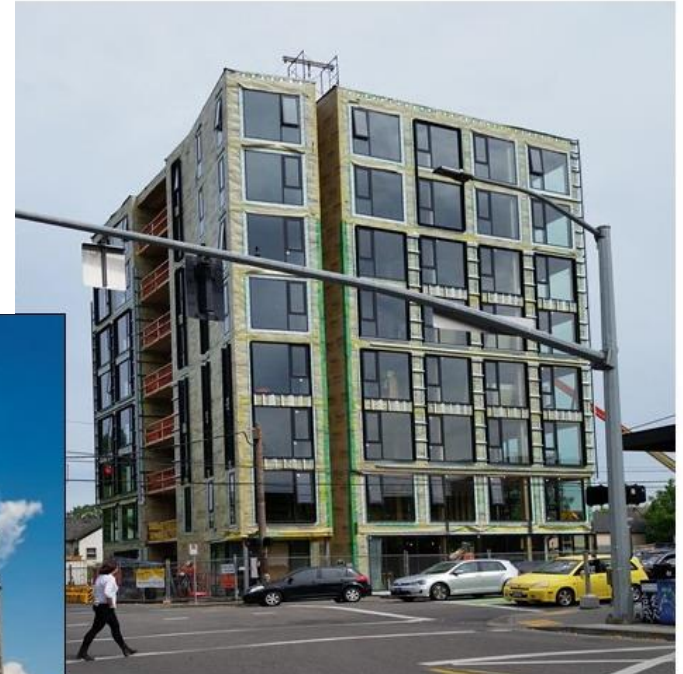
Cantilever Wood Diaphragm Webinar Series

A Design Example of a Wood Cantilever Diaphragm

Part 2-Shear Wall Design in Cantilever Diaphragm Structures



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



Course Description

Part 2 of this series will introduce an open front diaphragm design example that will be worked through in the remaining webinars. Topics addressed will include seismic force calculation and distribution, and preliminary shear wall design taking into account nominal shear wall stiffness. The impact of factors such as horizontal and torsional irregularities on force distribution to shear walls will be examined, and design of elements contributing to shear wall rotation and overturning will be discussed. The effect of gravity loads on shear walls will also be reviewed.

Learning Objectives

- 1. Discuss evolutions in mid-rise building typology that have led to the need for open-front diaphragm analysis.**
- 2. Review diaphragm flexibility provisions in ASCE 7 and the 2015 Special Design Provisions for Wind & Seismic (SDPWS).**
- 3. Explore one option for open-front diaphragm analysis under seismic and wind loading in a wood-frame structure.**
- 4. Highlight how to calculate story drift, diaphragm deflection and torsional irregularities, and discover their effects on load distribution through a cantilever diaphragm structure.**

Fasten Your Seatbelts



5 out of 5 Calculators

WoodWorks Example and Method of Analysis:

- **The solutions paper and this webinar were developed independently from the AWC task group for open-front diaphragms.** The method of analysis used in this example is based on our engineering judgement, experience, and interpretation of codes and standards as to how they might relate to open-front structures.
- **The analysis techniques provided in this presentation are intended to demonstrate one method of analysis, but not the only means of analysis.** The techniques and examples shown here are provided as guidance and information for designers and engineers.

Cantilever Wood Diaphragm Webinar Series-Content

Webinar Part 1- Code Requirements and Relative Stiffness issues:

- Introduction
- Questions needing resolution
- Horizontal distribution of shear and stiffness issues
- 2015 SDPWS open-front requirements
- Review preliminary design assumptions

Webinar Part 2- Shear Wall Design in Cantilever Diaphragm Structures:

- Introduction to open-front example
- Calculation of seismic forces and distribution
- Preliminary shear wall design
- Nominal shear wall stiffness
- Verification of shear wall design

Webinar Part 3- Cantilever Diaphragm Design, Flexibility and Drift Checks :

- Diaphragm design
- Maximum diaphragm chord force
- Diaphragm flexibility
- Story drift

Webinar Part 4-Torsional Irregularity, Other Design Checks, and Final Comments :

- Amplification of accidental torsion
- Redundancy
- Transverse direction design
- Multi-story shear wall effects

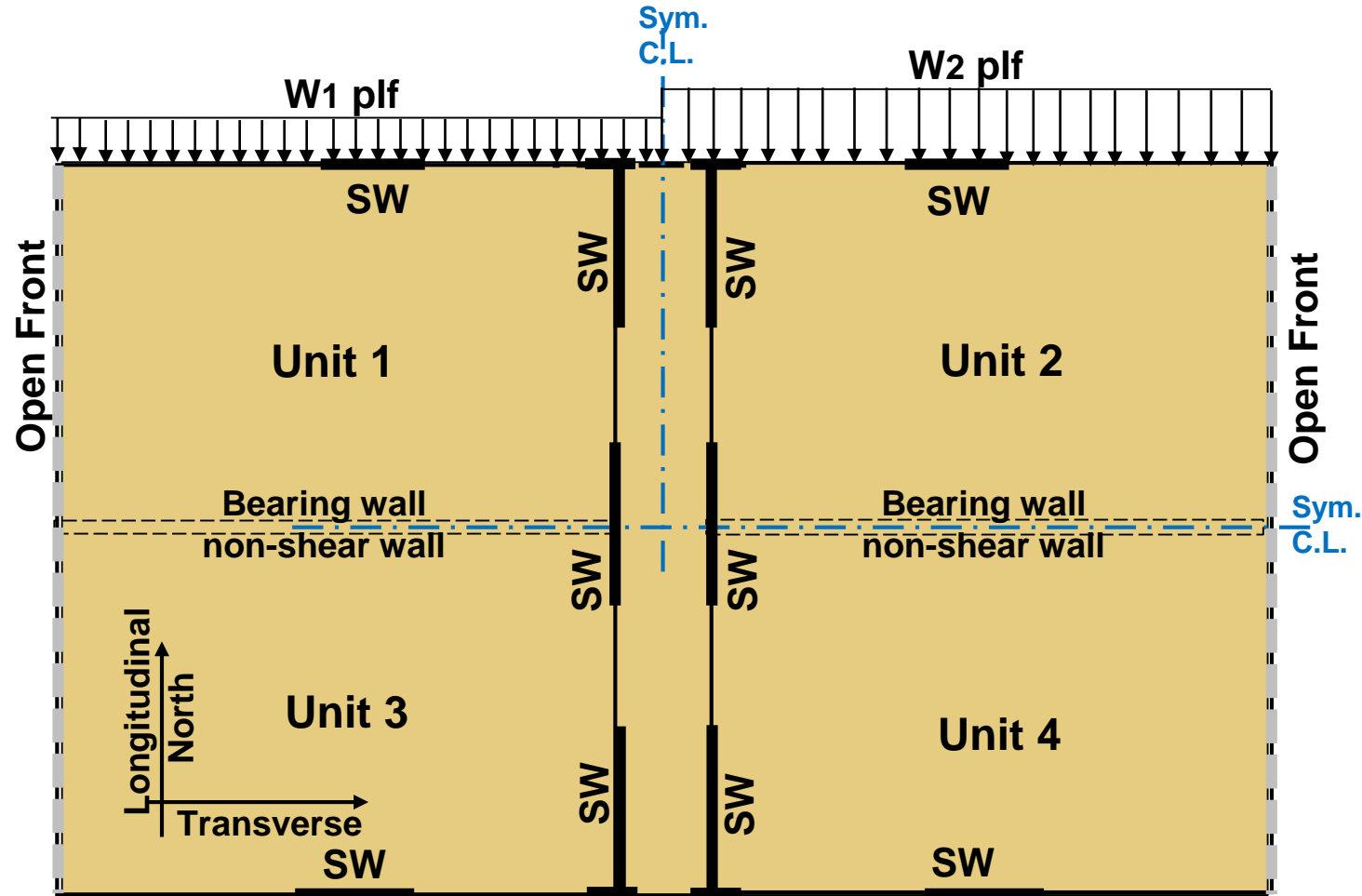
Content and Learning Objectives

Shear Wall Design:

- **Introduction to open-front design example**
The design example plan layout and goal of the example will be explained.
- **Calculation of seismic forces and distribution**
The basic seismic forces and distribution to the shear walls will be covered.
- **Preliminary shear wall design**
The basic shear wall construction will be chosen. Suggestions for improving the preliminary wall design to limit drift and reduce torsion will be discussed.
- **Nominal shear wall stiffness**
A new approach for determining a single shear wall stiffness will be presented.
- **Verification of shear wall design**
Verification of the wall capacity will be examined after the redistribution of forces are calculated using the nominal shear wall stiffness.

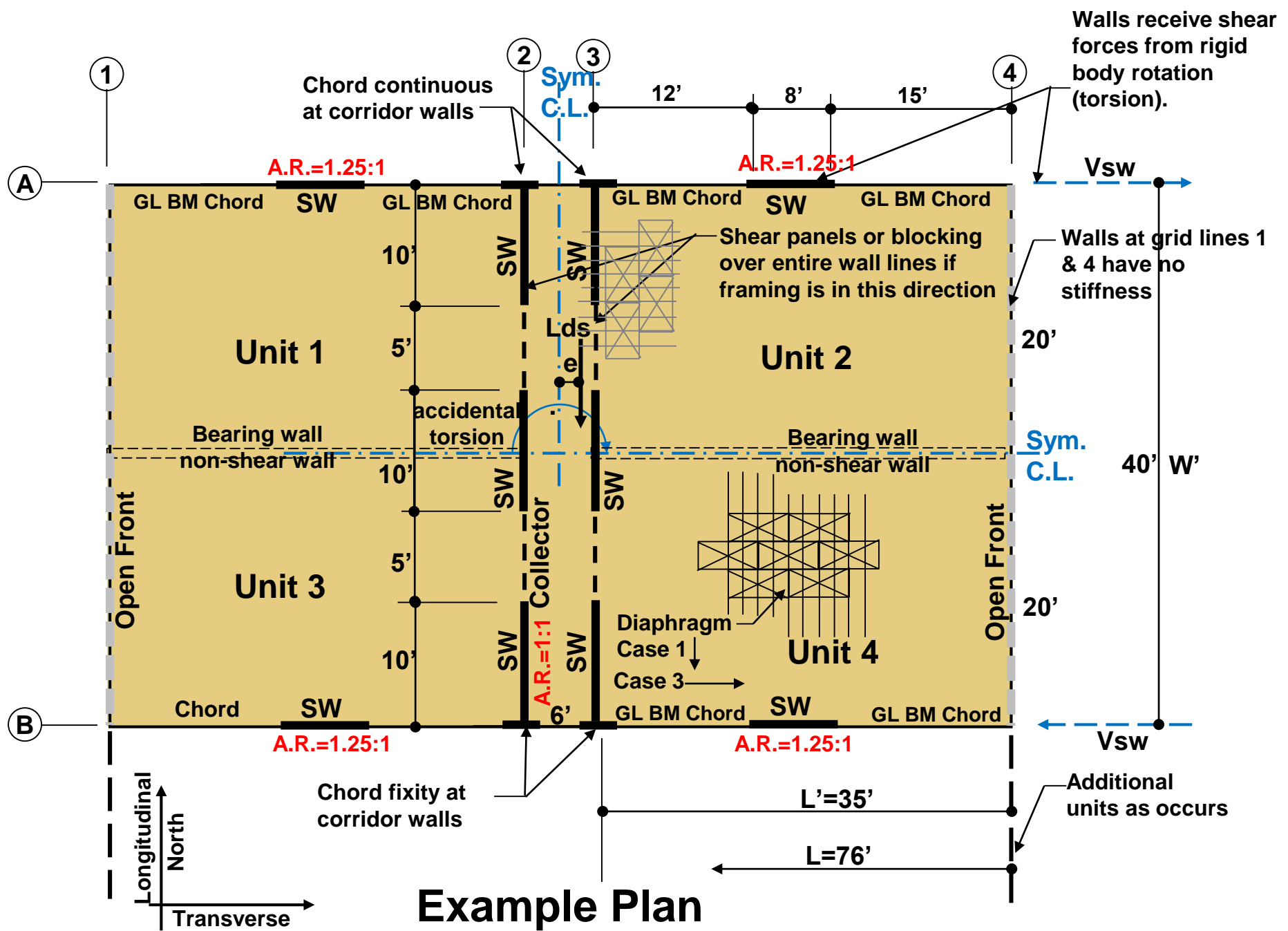
Design Example- Longitudinal Direction

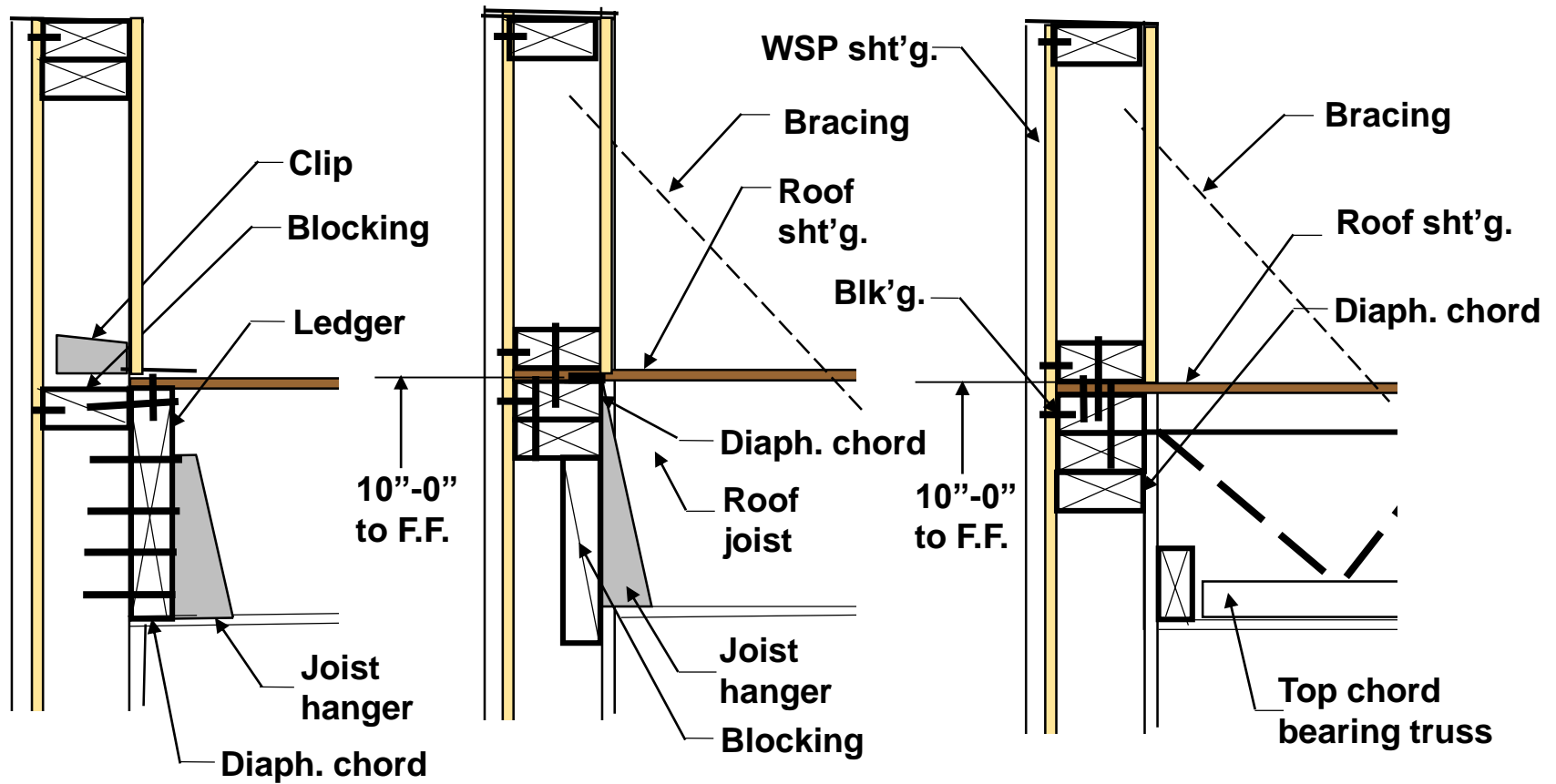
Example plan selected to provide maximum information on design issues



Disclaimer:

The following information is an open-front diaphragm example which is subject to further revisions and validation. The information provided is project specific, and is for informational purposes only. It is not intended to serve as recommendations or as the only method of analysis available.





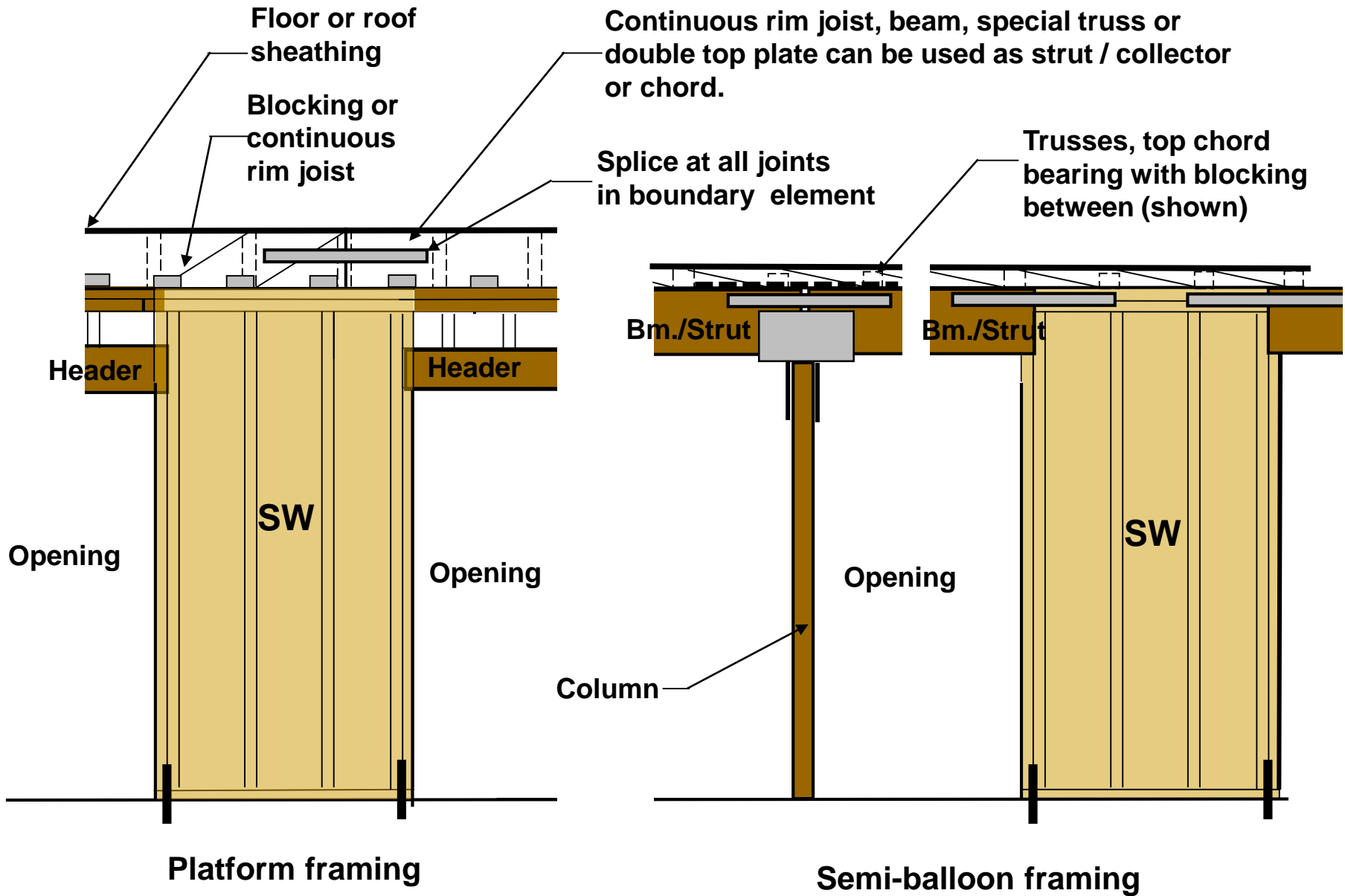
Ledgered Roof Joist

Hangered Roof Joist

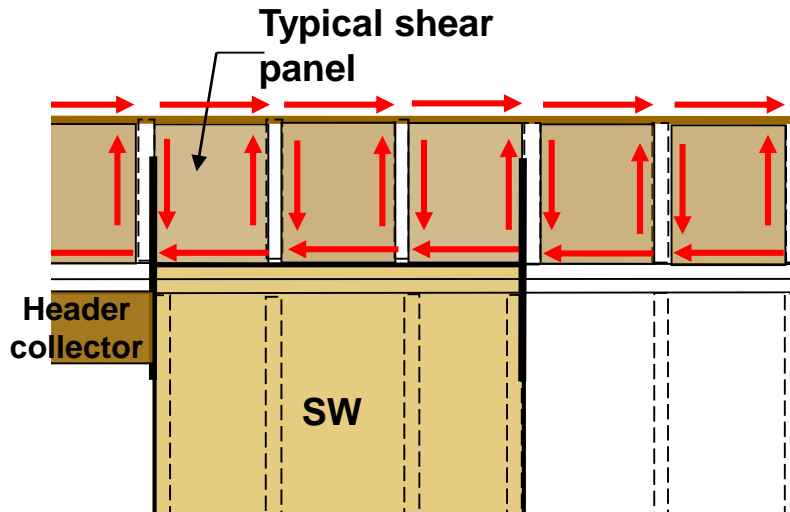
Alt.-Top Chord Bearing Truss

(Platform framing not shown)

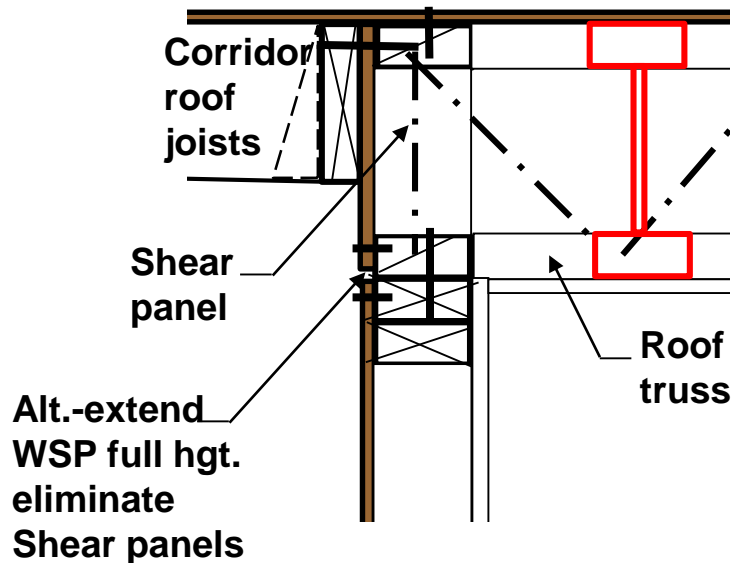
Typical Exterior Wall Sections



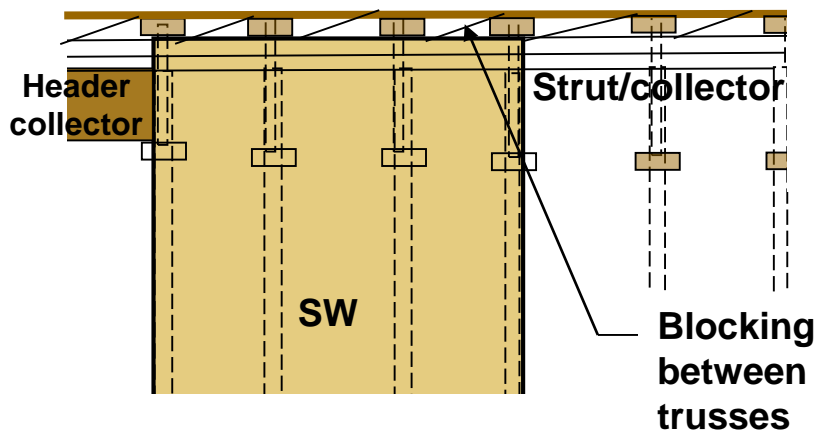
Typical Exterior Wall Elevations at Grid Lines A and B



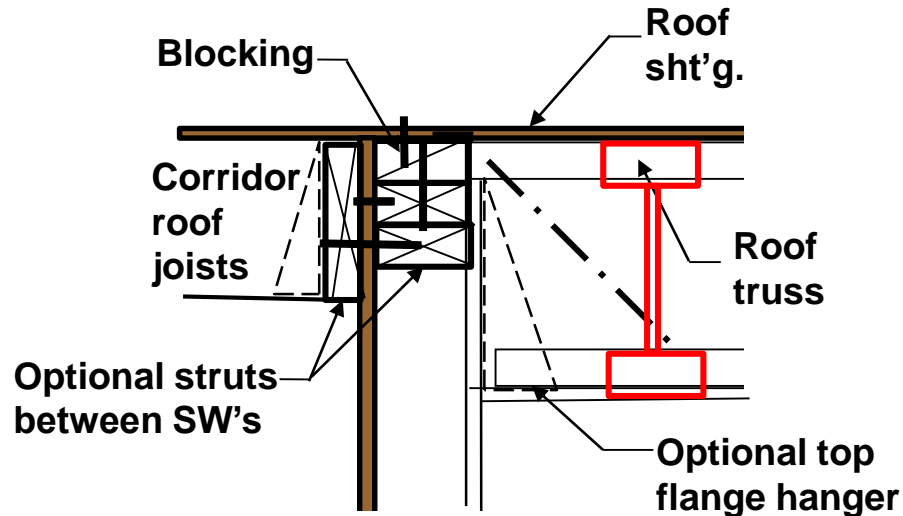
Platform Framing at Corridor



Section at Corridor



Semi-balloon Framing at Corridor

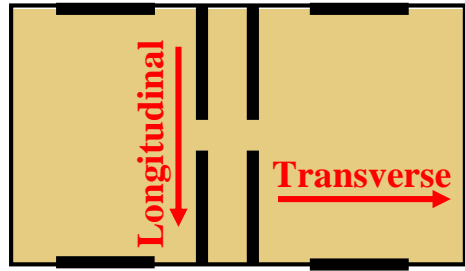


**Section at Corridor
(Similar to example)**

Typical Wall Sections at Corridor Walls

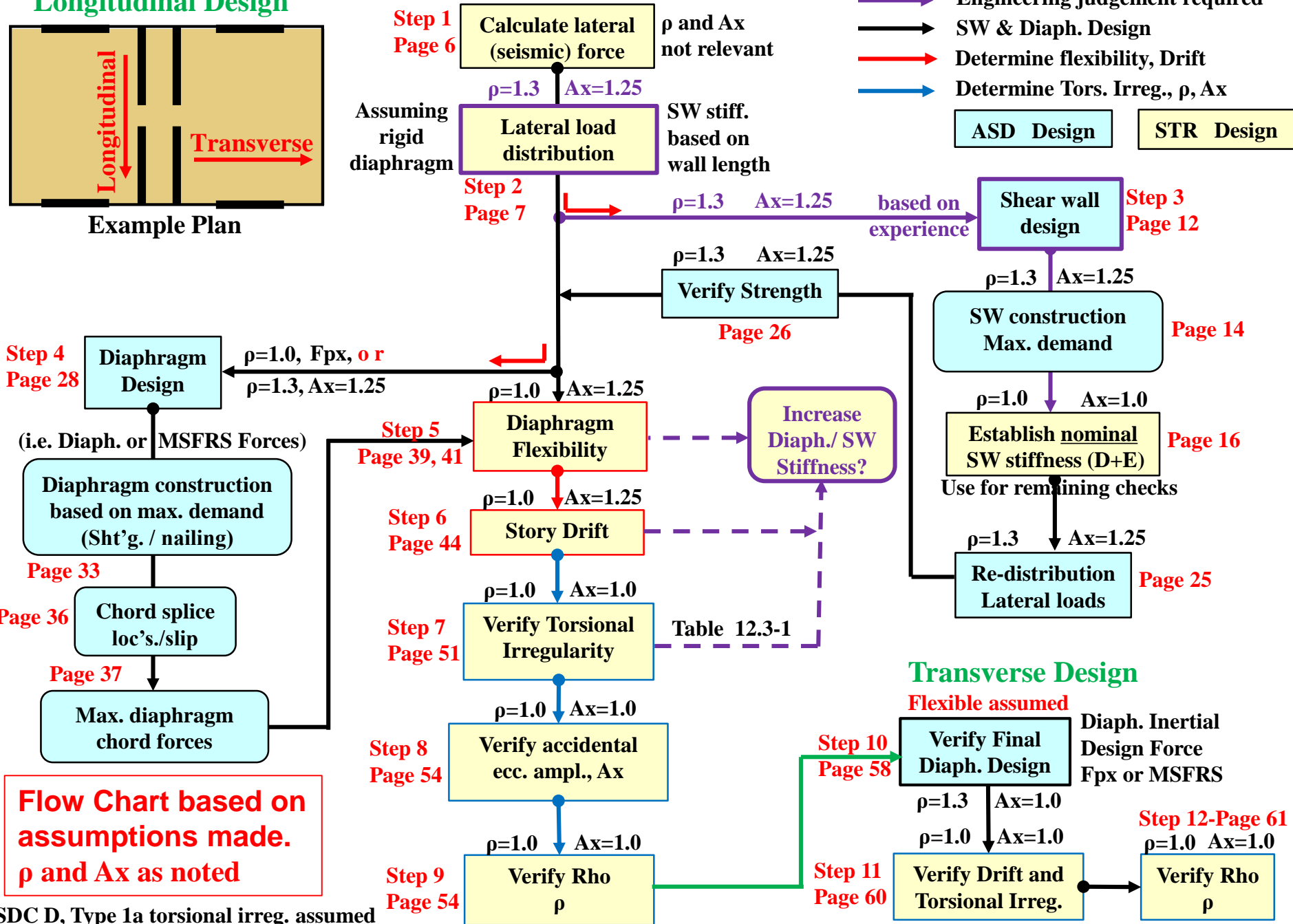
Analysis Flow- **Not in paper**

Longitudinal Design



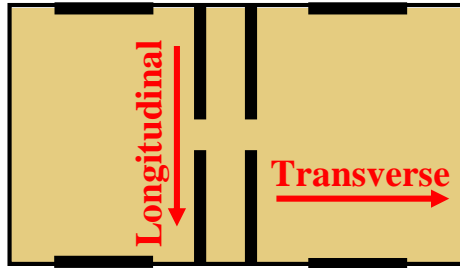
Legend

- Engineering judgement required
- SW & Diaph. Design
- Determine flexibility, Drift
- Determine Tors. Irreg., ρ , A_x



Analysis Flow

Longitudinal Design



Example Plan

Legend

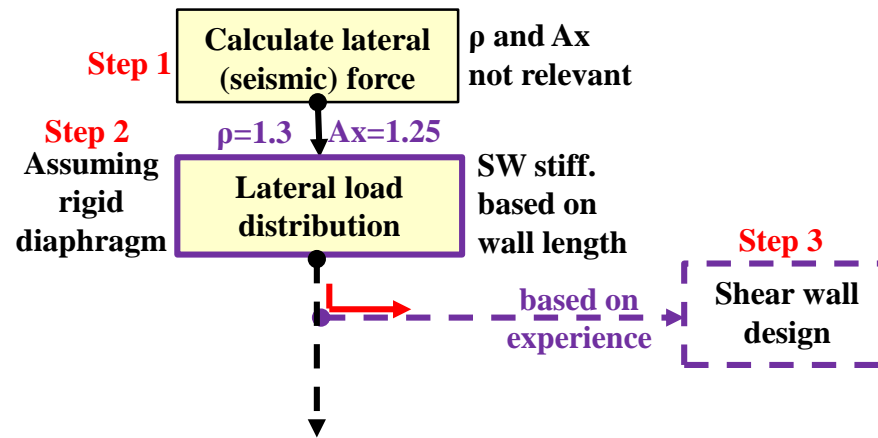
- Engineering judgement required
- SW & Diaph. Design
- Determine flexibility, Drift
- Determine Tors. Irreg., ρ , A_x

ASD Design

STR Design

Assumptions Made: Page 8

- Diaphragm is rigid or semi-rigid in both directions
- Torsional irregularity Type 1a occurs in longitudinal direction, but not transverse, $A_x=1.25$.
- Horizontal irregularity Type 1b does not occur in either direction.
- No redundancy in both directions, $\rho=1.3$



Force Distribution to Shear Walls

Seismic- $\rho=1.3$, $A_x=1.25$

Basic Project Information

- **Structure-Occupancy B, Office, Construction Type VB-Light framing:**
 - **Wall height=10'-Single story**
 - **L=76', total length**
 - **W'=40', width/depth**
 - **L'=35', cantilever length (max.)**
 - **6' corridor width**
- **Roof DL (seismic)= 35.0 psf including wall/ partitions**
- **Wall DL = 13.0 psf (in-plane)**
- **Roof snow load = 25 psf > required roof LL=20 psf**
- **Roof (lateral)= roof + wall H/2 plus parapet**

Lateral Load Calculations- seismic

Calculate Seismic Forces -ASCE 7-16 Section 12.8 Equivalent Lateral Force Procedure, F_x

- Risk category II
- Importance factor, $I_e = 1.0$

Using USGS Seismic Design Map-Tool, 2015 NEHRP, 2016 ASCE 7-16:

- Location-Tacoma, Washington
- Site class D-stiff soil
- $S_s = 1.355 \text{ g}$, $S_1 = 0.468 \text{ g}$
- $S_{DS} = 1.084 \text{ g}$, $S_{D1} = 0.571 \text{ g}$
- Seismic Design Category (SDC) = D

ASCE 7-16 Table 12.2-1, Bearing Wall System, A(15) light framed wood walls w/ WSP sheathing. $R = 6.5$, $\Omega_0=3$, $C_d=4$, Maximum height for shear wall system=65'.

Seismic Force Calculation results:

$$C_s = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)} = 0.167 \text{ short period controls}$$

12.8-2

Basic lateral force MSFRS

$$V = C_s W = 0.167(35)(76)(40) = 17769 \text{ lbs. STR}$$
$$17769(0.7) = 12438 \text{ lbs. ASD}$$

Rigid Diaphragm Analysis- $\rho=1.3$, $A_x=1.25$

Initial wall stiffness will be based on wall length.

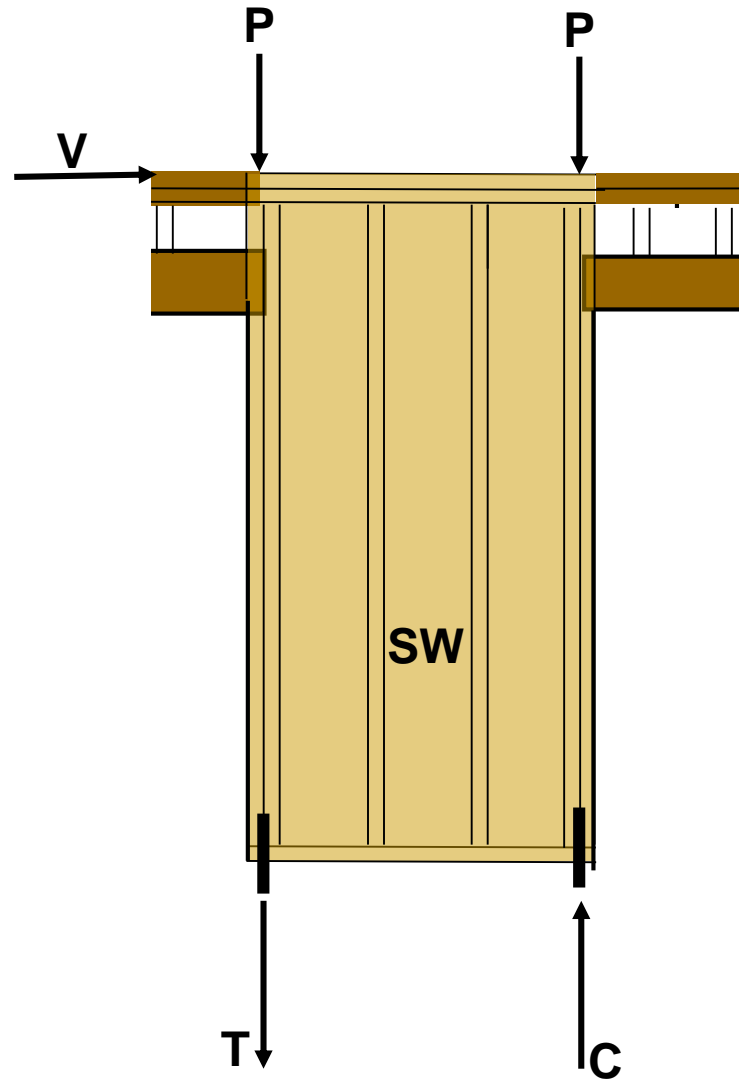
The final wall Nominal stiffness's are used for all final analysis checks.

RDA Equations

$$T = V(e)(A_x)(\rho) \text{ ft. lbs.} \quad F_T = T \frac{kd}{\sum kd_x^2 + kd_y^2} \quad F_{sw} = F_V + F_T$$

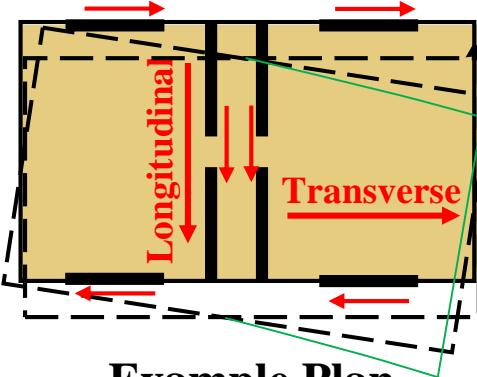
$$J = \sum kd_x^2 + kd_y^2 \quad F_V = F_x \frac{k}{\sum k}$$

Preliminary Shear Wall Design



Analysis Flow

Longitudinal Design



Example Plan

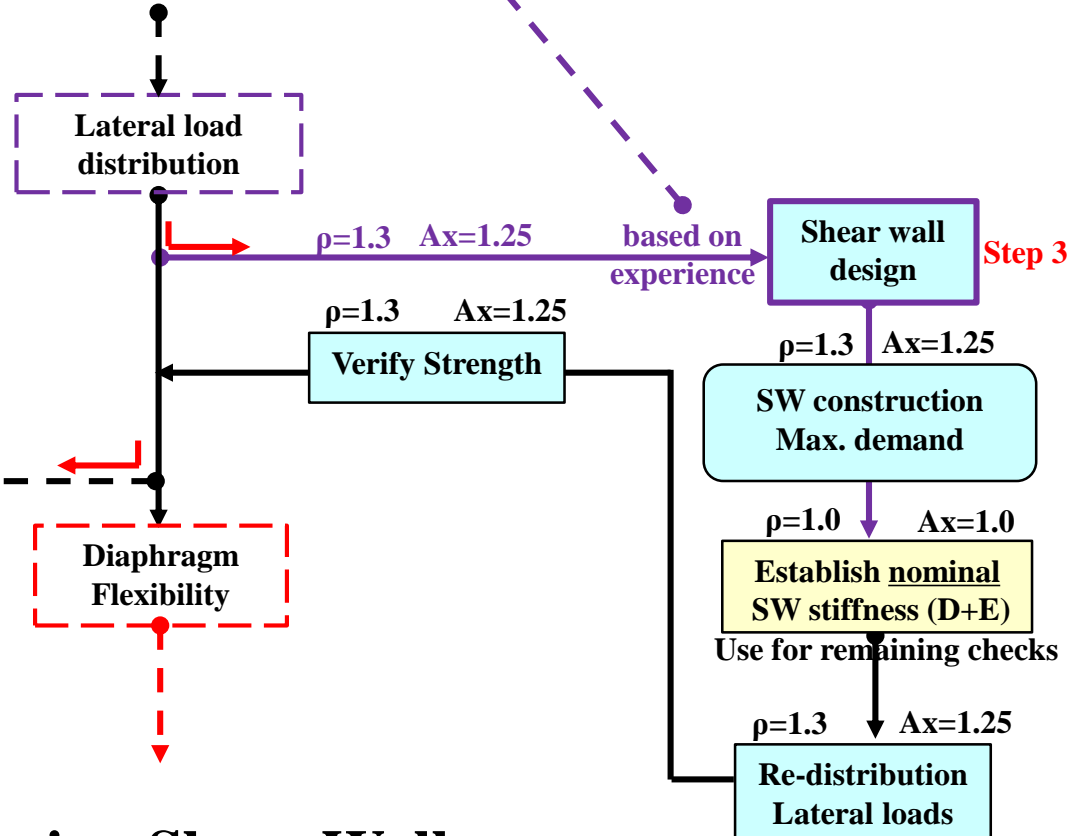
- Drift
- Torsional Irreg.

Legend

- Engineering judgement required
- SW & Diaph. Design
- Determine flexibility, Drift
- Determine Tors. Irreg., ρ , A_x

ASD Design

STR Design



Design Shear Walls

Seismic- $\rho=1.3$, $A_x=1.25$

Preliminary Shear wall Design (ASD): ASCE 7-16 Section 2.3.6-Seismic

SW Design Checks

- Check aspect ratio, If A.R.>2:1, reduction is required per SDPWS Section 4.3.4. A.R. = 1.25:1 < 3.5:1. Since the A.R. does not exceed 2:1, no reduction is required.

- Wall shear: $V_{sw A, B} = \frac{V_{wall\ line}}{2}$ Lbs. each wall segment, $v_s = \frac{V_{wall}}{L_{wall}}$ plf

- Select over-turning anchor-capacity > demand.

- Calculate actual anchor slip, $slip = \frac{\text{Max slip at capacity}(T)}{\text{Strength capacity}}$

- Determine shear wall chord properties:

2x6 DF-L no. 1 framing used throughout.

E = 1,700,000 psi, wall studs @ 16" o.c.

EA= 42,075,000 lbs. at grid line A,B = (3)2x6 D.F., KD, studs @16" o.c. boundary elem.

EA= 28,050,000 lbs. at grid line 2,3 = (2)2x6 D.F., KD, studs @16" o.c. boundary elem.

- Calculate wall deflection

- Shear Wall Deflection-calculated using:

Traditional 4 term deflection equation

$$\delta_{SW} = \frac{8vh^3}{EAb} + \frac{vh}{G_v t_v} + \overbrace{0.75he_n}^{\text{SDPWS combines}} + \frac{h\Delta_a}{b_{eff}} \quad \text{C4.3.2-1}$$

Bending
Shear
Nail slip
Rod elongation (Wall rotation)

SDPWS 3 term deflection equation

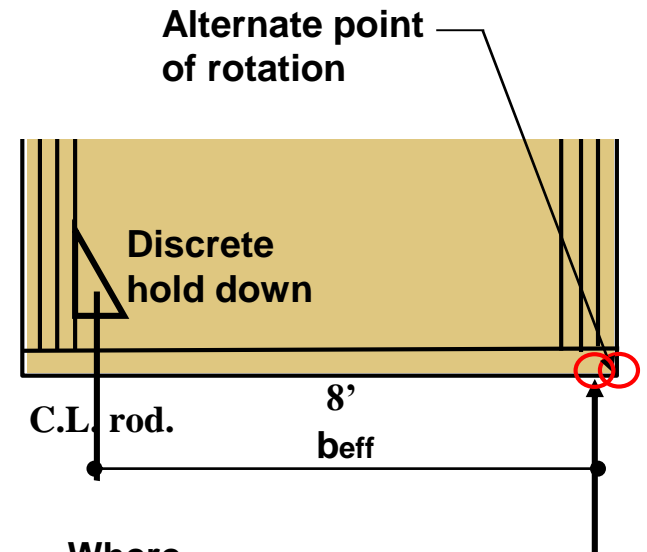
$$\delta_{SW} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b_{eff}} \quad \text{4.3-1 Alt.}$$

Bending
Vertical elongation

Apparent shear stiffness

- Device elongation
- Rod elongation

- Nail slip
- Panel shear deformation



Where

v=wall unit shear (plf)

h=wall height (ft.)

b_{eff}=Wall rotation width (ft.)

b=Wall width (ft.)

G_a=apparent shear stiffness (k/in.)

Δ_a=Sum of vertical displacements at anchorage and boundary members (in.)

Note:

Calculate wall deflection as: $\delta_{sw A,B} = \frac{F}{k}$

after Nominal stiffness has been established

Causes of Wall Rotation

- Hold downs = pre-manufactured bucket style with screw attachments **Same H.D used at all SW locations**
 - Manuf. table gives Allowable ASD hold down capacity and displacement at capacity (ESR Reports)
 - Displacement at hold down = $\frac{T(Allow.Displ)}{ASD Capacity}$
 - Min. wood attachment thickness = 3" per table
- Sill plate shrinkage:

Dimensional change = 0.0025 inches per inch of cross-sectional dimension for every 1 percent change in MC.

Shrinkage = (0.0025)(D)(Starting MC - End MC)

Where: D is the dimension of the member in the direction under consideration, in this case the thickness of a wall plate.

- Sill plate crushing:**

$F'_{c\perp}$ values in AWC 2018 NDS section 4.2.6 are based on 0.04" deformation/crushing limit for a steel plate bearing on wood.

Adjustment factor = 1.75 for parallel to perpendicular grain wood to wood contact.

Boundary values for bearing perpendicular to grain stresses and crushing-D.F.

$$F_{c\perp 0.02} = 0.73F'_{c\perp} = 0.73(625) = 456.3 \text{ psi}$$

$$F_{c\perp 0.04} = F'_{c\perp} = 625 \text{ psi}$$

When $f_{c\perp} \leq F_{c\perp 0.02}$ "

$$\Delta_{crush} = 0.02 \left(\frac{f_{c\perp}}{F_{c\perp 0.02}} \right)$$

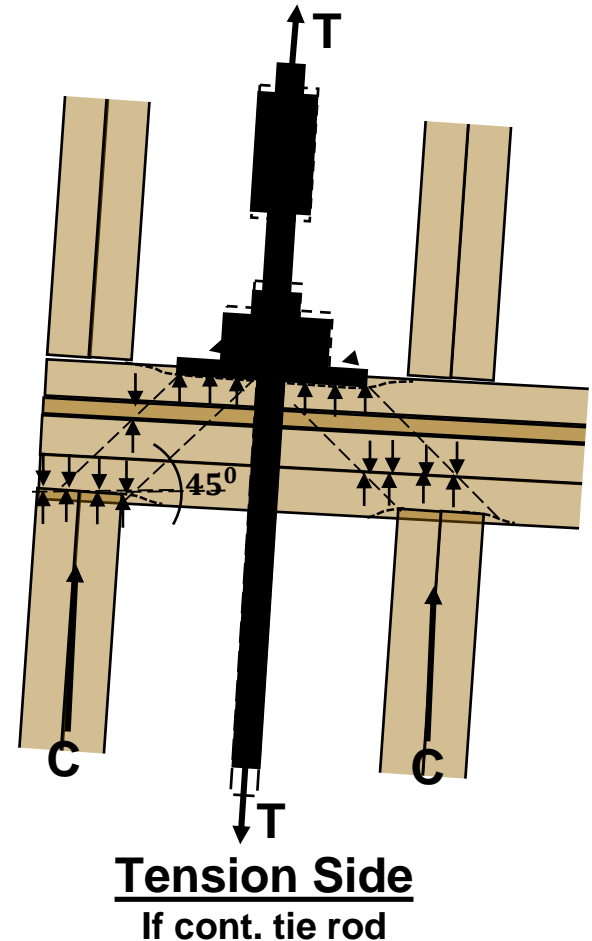
When $F_{c\perp 0.02} \leq f_{c\perp} \leq F_{c\perp 0.04}$ "

$$\Delta_{crush} = 0.04 - 0.02 \left(\frac{1 - \frac{f_{c\perp}}{F_{c\perp 0.04}}}{0.27} \right)$$

When $f_{c\perp} > F_{c\perp 0.04}$ "

$$\Delta_{crush} = 0.04 \left(\frac{f_{c\perp}}{F_{c\perp 0.04}} \right)^3$$

If $f_{c\perp} = \left(\frac{C}{A_{chord}} \right) < 456.3 \text{ psi}$, $Crushing = 0.02 \left(\frac{f_{c\perp}}{456.3} \right) (1.75)$

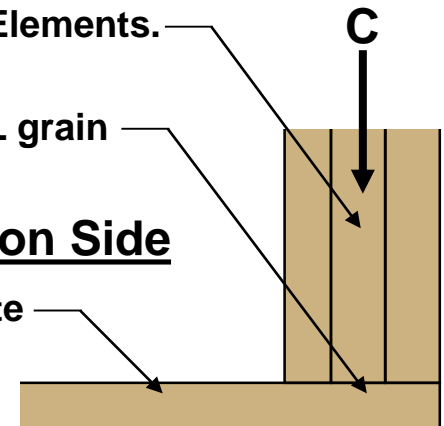


SW boundary Elements.
 $A=24.75 \text{ in}^2$

Crushing // to \perp grain
Factor = 1.75

Compression Side

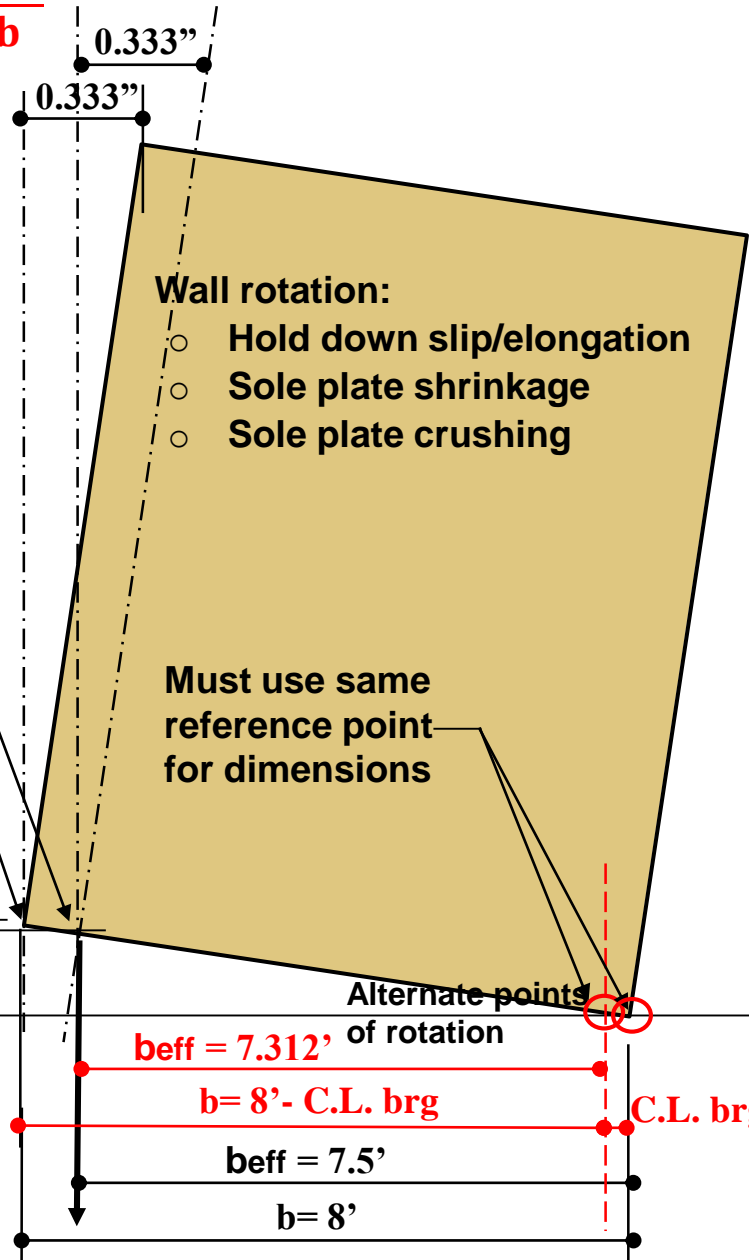
Sill plate



Shear Wall Rotation

Proposed nomenclature of next edition of SDPWS

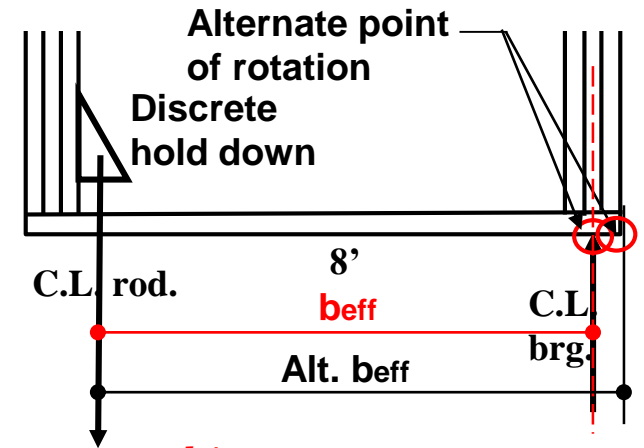
Current term = $\frac{h\Delta_a}{b}$



- Wall rotation:
- Hold down slip/elongation
 - Sole plate shrinkage
 - Sole plate crushing

Must use same reference point for dimensions

Slip calculated at anchor
Slip translated to end of wall



$SW_{rot} = \frac{h\Delta_a}{beff}$ or $SW_{rot} = \frac{h\Delta_a eff}{b}$

Where

h=wall height (ft.)

beff =Wall rotation arm (ft.)

b=Wall width (ft.)

$\Delta_a eff$ =Sum of vertical displacements at anchorage (in.)

Δ_a =Sum of vertical displacements at tension edge of wall

$\Delta_a = 0.25''$

$\Delta_a eff = \frac{0.25(8)}{7.5} = 0.267''$

$SW_{rot} = \frac{10(0.25)}{7.5} = 0.333''$

$SW_{rot} = \frac{10(0.267)}{8} = 0.333''$

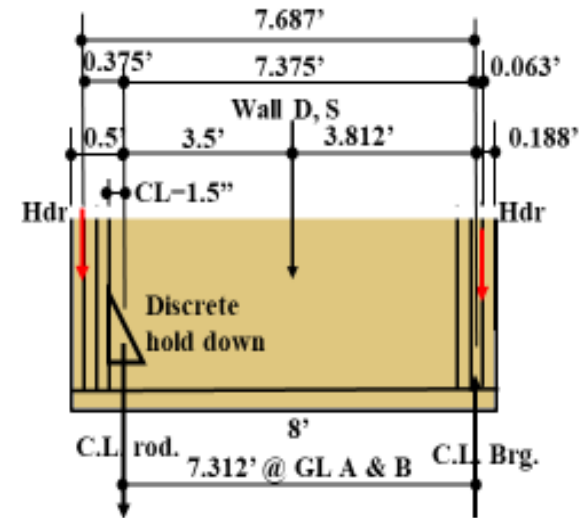
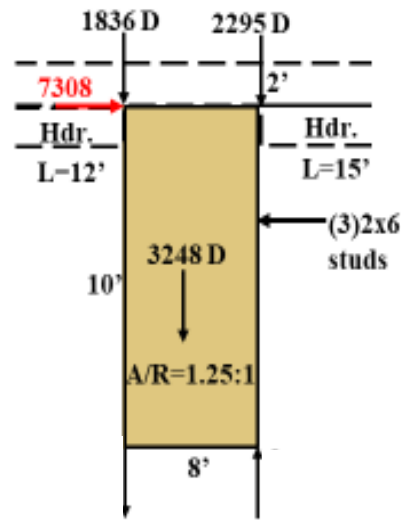
Load Combinations (ASD):

$$LC8 = 1.152D + 0.7\rho Q_E$$

$$LC9 = 1.114D + 0.525\rho Q_E + 0.75S$$

$$LC10 = 0.448D + 0.7\rho Q_E$$

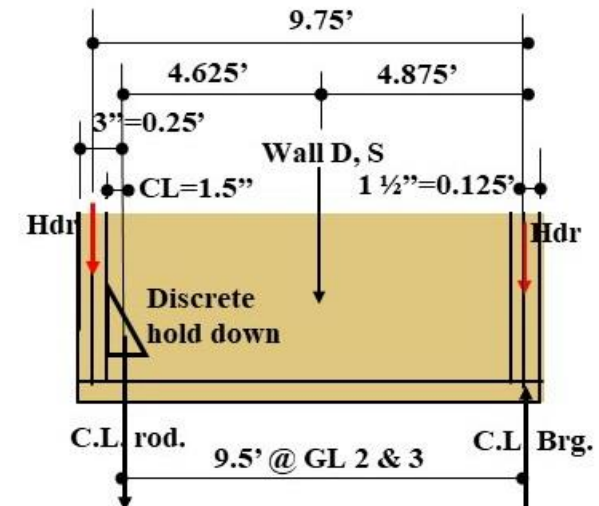
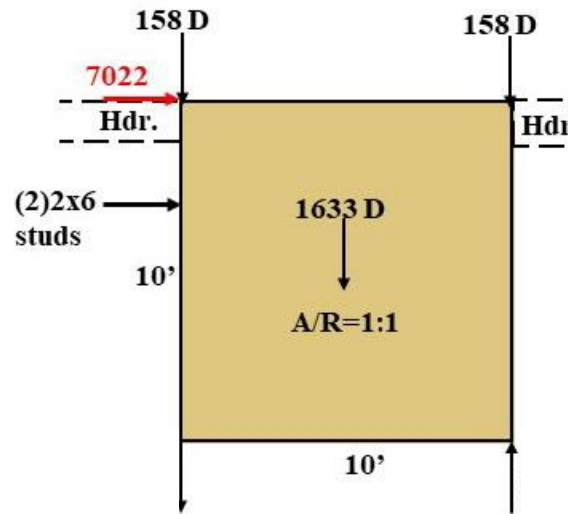
Full dead loads shown, 1.0D



Adding Gravity Loads to SW's

- Can have a significant impact on horizontal shear wall deflections and stiffness.
- Results in wall stiffness ($K = F/\delta$) relationships which are non-linear with the horizontal loading applied.

Shear Walls Along Grid Lines A and B Design Dimensions



Shear Walls Along Grid Lines 2 and 3 Design Dimensions

Based on initial Relative Wall Stiffness's, ASD, $\rho=1.3$, $A_x=1.25$ –by wall lengths

Longitudinal Direction, $e=4.75'$, $T = 76806.5$ ft. lbs.

SW Line	Ky k/in	Kx k/in	Dx Ft.	Dy Ft.	Kd	Kd ²	Fv Lbs.	F _T Lbs.	Total Lbs.
A	-----	16	-----	20	320	6400	0	1842.4	1842.4
B	-----	16	-----	20	320	6400	0	-1842.4	-1842.4
2	30	-----	3	-----	90	270	8084.9	-518.2	7566.7
3	30	-----	3	-----	90	270	8084.9	518.2	8603.1

$\Sigma K_y=60$ $\Sigma K_x=32$

J=16169.8

Corridor Walls at Grid
Walls lines A & B

Transverse Direction, $e=2.5'$, $T = 40424.5$ ft. lbs.

SW Line	Ky k/in	Kx k/in	Dx Ft.	Dy Ft.	Kd	Kd ²	Fv Lbs.	F _T Lbs.	Total Lbs.
A	-----	16	-----	20	320	6400	8084.9	969.7	9054.6
B	-----	16	-----	20	320	6400	8084.9	-969.7	7115.2
2	30	-----	3	-----	90	270	0	-272.7	-272.7
3	30	-----	3	-----	90	270	0	272.7	272.7

$\Sigma K_y=60$ $\Sigma K_x=32$

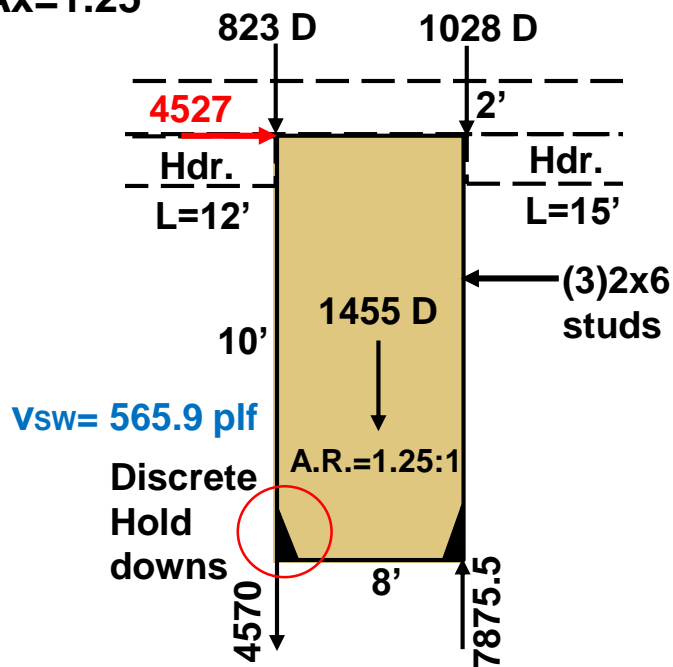
J=16169.8

Corridor Walls at Grid
Walls lines A & B

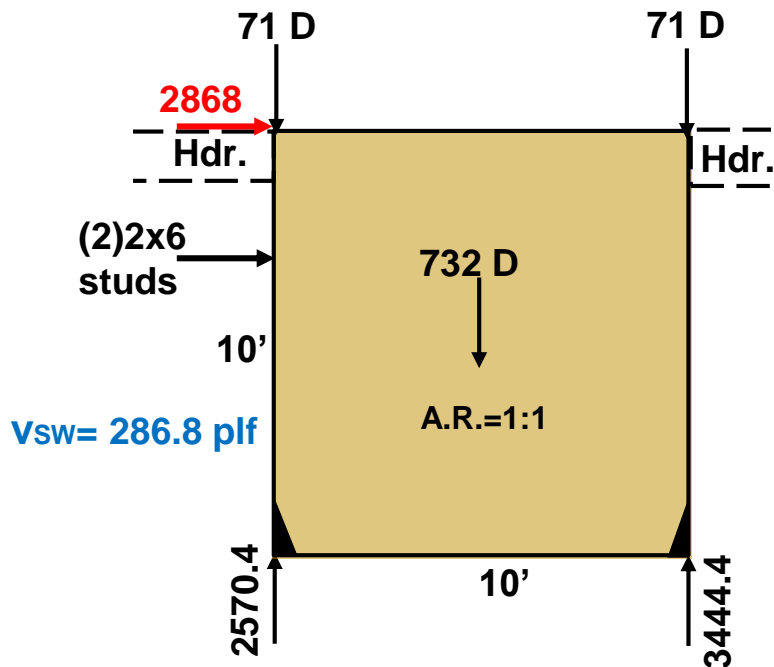
Preliminary Shear Wall Design-Distribution based on wall lengths

ASD Load Combination: $LC10 = 0.448D + 0.7\rho Q_E$

$\rho = 1.3, A_x = 1.25$



Shear Walls Along Grid Lines A and B
Transverse Loading



Shear Walls Along Grid Lines 2 and 3
Longitudinal Loading

Calculated results by wall length

$V_{SW A,B} = 565.9 \text{ plf}$

$V_{SW 2,3} = 286.8 \text{ plf}$

Shear Wall Capacity-Wood Based Panels

Blocked

Table 4.3A Nominal Unit Shear Capacities for Wood-Framed Shear Walls

Wood Based Panels ⁴																			
Sheathing Material	Minimum Nominal Panel Thickness (in.)	Minimum Fastener Penetration In Framing Member or Blocking (in.)	Fastener Type & Size Nail (common or Galvanized box)	A Seismic				B Wind											
				Panel Edge Fastener Spacing (in.)								Panel Edge Fastener Spacing (in.)							
				6		4		3		2		6		4		3		2	
				(plf) (kips/in.)		(plf) (kips/in.)		(plf) (kips/in.)		(plf) (kips/in.)		(plf)		(plf)		(plf)		(plf)	
Wood ^{4,5} Structural Panels- Sheathing	15/32	1-3/8	8d	Vs Ga OSB PLY 520 13 10	Vs Ga OSB PLY 760 19 13	Vs Ga OSB PLY 980 25 15	Vs Ga OSB PLY 1280 39 20	Vw Vw Vw Vw 730 1065 1370 1790	Vw Vw Vw Vw 870 1290 1680 2155	Vw Vw Vw Vw 950 1430 1860 2435	Vw Vw Vw Vw 1790 2155 2435	Vw Vw Vw Vw 1790 2155 2435	Vw Vw Vw Vw 1790 2155 2435	Vw Vw Vw Vw 1790 2155 2435	Vw Vw Vw Vw 1790 2155 2435	Vw Vw Vw Vw 1790 2155 2435			
	15/32			620 22 14	920 30 17	1200 37 19	1540 52 23	870 1290 1680 2155	870 1290 1680 2155	950 1430 1860 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435			
	19/32	1-1/2	10d	680 19 13	1020 26 16	1330 33 18	1740 48 28	950 1430 1860 2435	950 1430 1860 2435	950 1430 1860 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435	1790 2155 2435			

Increasing stiffness to account for drift, torsion, etc. requires engineering judgement.

SW_{A,B}: Use 15/32" OSB w/ 10d@3" o.c., $v_s = (1200)/2 = 600 \text{ plf}$, $G_a = 37$

SW_{2,3}: Use 15/32" OSB w/ 10d@4" o.c., $v_s = (920)/2 = 460 \text{ plf}$, $G_a = 30$

Maximum tension force, $T = 4570 \text{ lbs.}$ - Use HD=4565 lbs. (0.1% under-check later)

ASD, $\Delta a = 0.114''$ @ capacity

STR, $\Delta a = 0.154''$ @ capacity

Determination of **Nominal** Wall Stiffness

Combining Rigid Diaphragm Analysis & shear wall deflection calculations is problematic due to non-linearities, which can effect the distribution of loads to the shear walls and will effect the shear wall deflections. This can lead to a different set of stiffness values that may not be consistent.

Whenever changing:

- Load combinations
- Vertical or lateral loads,
- Direction of loading
- Redundancy, or
- Accidental torsion

Requires an Iterative search for the point of convergence, which is not practical for multi-story structures.

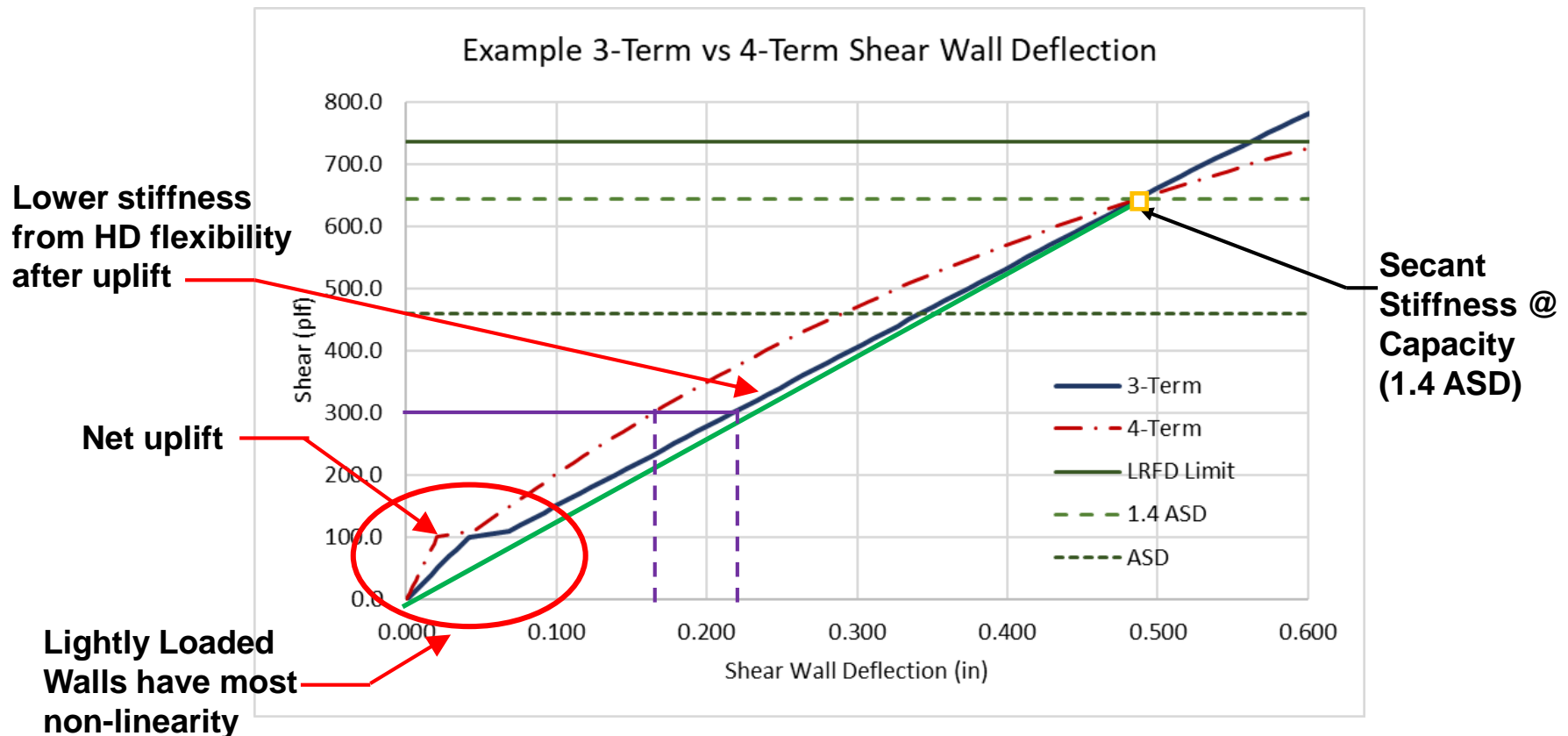
Sources of non-linearities:

- Hold-down slip at uplift (e.g. shrinkage gap)
- Hold-down system tension and elongation
- Compression crushing. Non-linear in NDS
- Shrinkage
- 4-term deflection equation

Since deflection is “non-linear”.... the stiffness can vary with the loading, even when using 3-term deflection equation.

LATERAL Load for Shear Wall Deflection & Stiffness Calculations

- 3-term equation is a linear simplification of the 4-term equation, calibrated to match the applied load at 1.4 ASD.
- This simplification removes the non-linear behavior of e_n .
- Similar approach can be used to remove non-linear effects of Δ_a by calculating the wall stiffness at **strength level capacity of the wall**, not the applied load.



Method allows having only one set of nominal stiffness values.

Objective:

Use a single rational vertical and lateral load combination to calculate deflections and **Nominal** shear wall stiffness.

Gravity Loads:

A simplification of gravity loads are applied similar to nonlinear procedures in ASCE 41-13 in ASCE 41-13 Eq. 7-3.

For this *Single-Story* Example we used **1.0D**, using $\rho = 1.0$ and $A_x = 1.0$. Vertical seismic loading not included. ($E_v = 0.2S_{DS}D$)

For multi-story buildings, suggest **1.0D + αL** as in ASCE 7-16 Section 16.3.2- Nonlinear analysis

Results in single vertical loading condition to use when calculating shear wall deflections and nominal shear wall stiffnesses.

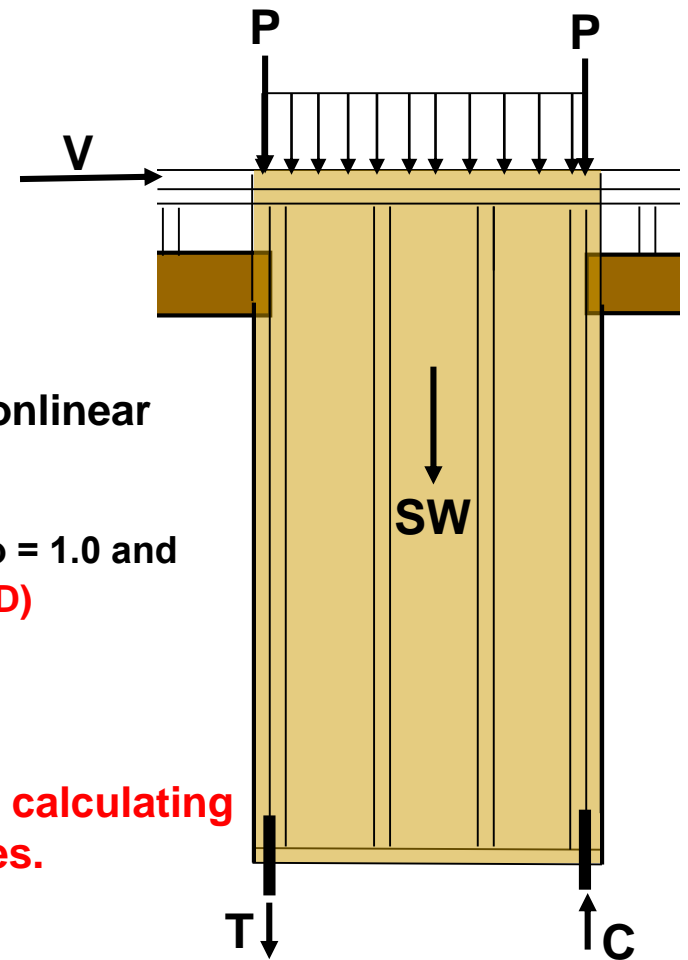
Proposing:

1. Stiffness calculated using 3-term eq. and LC **1.0D+Qe**, with $\rho=1.0$ and $A_x=1.0$.
2. Use stiffness calculated at 100% Maximum Seismic Design Capacity of the Wall for all Load Combinations and Drift Checks from RDA using 3 term equation.

3. Use nominal stiffness for all other analysis checks, calculating wall deflection,

$$\delta_{SW} = \frac{F}{K}$$

4. Maximum wall capacity = max. allow. Shear (nailing) or HD capacity whichever is less.

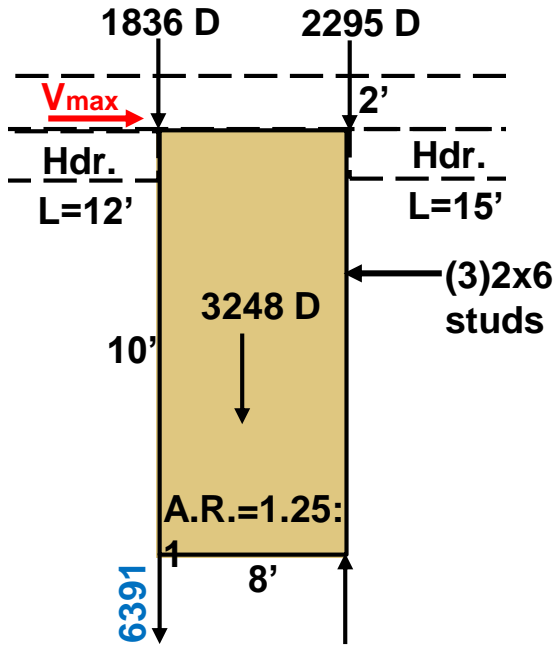


Nominal Shear Wall Stiffness's (STR) $\rho=1.0, A_x=1.0$

Load Combination: 1.0D + Q_E

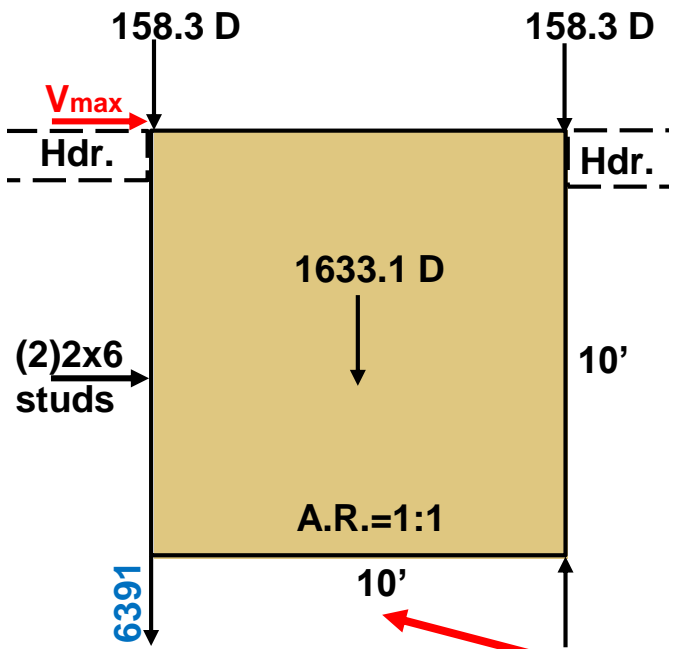
Grid Line	G _a	V on wall	v	T	C	Δ_a	$F_{c\perp}$	Crush.	Shrink	δ_B	δ_S	δ_{Rot}	δ_{SW}
Calculate Stiffness of Walls on A & B using LRED Capacity													
A	37	7308.0	913.5	6391	13770	0.154	556.36	0.056	0.019	0.022	0.247	0.313	0.581
B	37	7308.0	913.5	6391	13770	0.154	556.36	0.056	0.019	0.022	0.247	0.313	0.581
Calculate Stiffness of Walls on 2 & 3 using LRFD Coading													
2	30	7022.0	702.2	6391	8341	0.154	505.50	0.045	0.019	0.020	0.234	0.230	0.484
3	30	7022.0	702.2	6391	8341	0.154	505.50	0.045	0.019	0.020	0.234	0.230	0.484

Wall Capacity based on hold down



Shear wall Grid A and B
Trib. = 10'

Transverse Loading
Nominal Strength



Shear wall Grid 2 and 3
Trib. = 2'

Longitudinal Loading
Nominal Strength

	K (k/in)
A	25.14
B	25.14
Aver.=	25.14
2	43.54
3	43.54
Aver.=	43.54

Max. capacity check (STR):

Shear_{A,B} = 0.8(1200)(8) = 7680 lbs.
 Shear_{2,3} = 0.8(920)(10) = 7360 lbs.

H.D._{A,B,2,3} = 6391 lbs. (STR),
 $\Delta_a = 0.154''$

Set tension force = H.D. cap. and solve for allowable V at top of wall.

V_{max}. A,B = 7308 lbs. controls
 V_{max}. 2,3 = 7022 lbs. controls

Verification of Wall Strength (ASD)

Based on selected wall construction and Nominal Wall Stiffness

Longitudinal Direction, $e=4.75'$, $T = 76806.5$ ft. lbs. $\rho=1.3$, $A_x=1.25$

SW Line	Ky k/in	Kx k/in	Dx Ft.	Dy Ft.	Kd	Kd ²	Fv Lbs.	F _T Lbs.	Total Lbs.	Corridor Walls at Grid lines A & B
A	-----	25.14	-----	20	502.8	10056	0	1848.1	1848.1	
B	-----	25.14	-----	20	502.8	10056	0	-1848.1	-1848.1	
2	43.54	-----	3	-----	130.62	391.86	8084.9	-480.1	7604.8	
3	43.54	-----	3	-----	130.62	391.86	8084.9	480.1	8565.0	
$\Sigma K_y=87.08$ $\Sigma K_x=50.28$					$J=20895.72$					

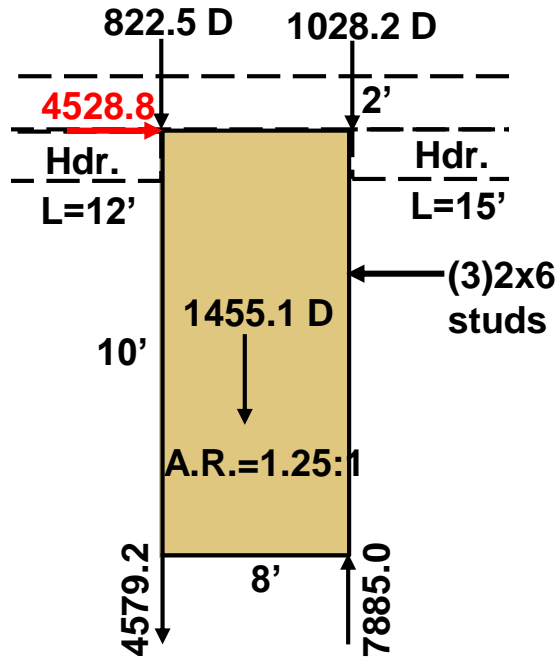
Transverse Direction – $e=2.5'$, $T = 40424.5$ ft. lbs. $\rho=1.3$, $A_x=1.25$

SW	Ky k/in	Kx k/in	Dx Ft.	Dy Ft.	Kd	Kd ²	Fv Lbs.	F _T Lbs.	Total Lbs.	Corridor Walls at Grid lines A & B
A	-----	25.14	-----	20	502.8	10056	8084.9	972.7	9057.6	
B	-----	25.14	-----	20	502.8	10056	8084.9	-972.7	7112.2	
2	43.54	-----	3	-----	130.62	391.86	0	252.7	252.7	
3	43.54	-----	3	-----	130.62	391.86	0	-252.7	-252.7	
$\Sigma K_y=87.08$ $\Sigma K_x=50.28$					$J=20895.72$					

Nominal stiffness values used

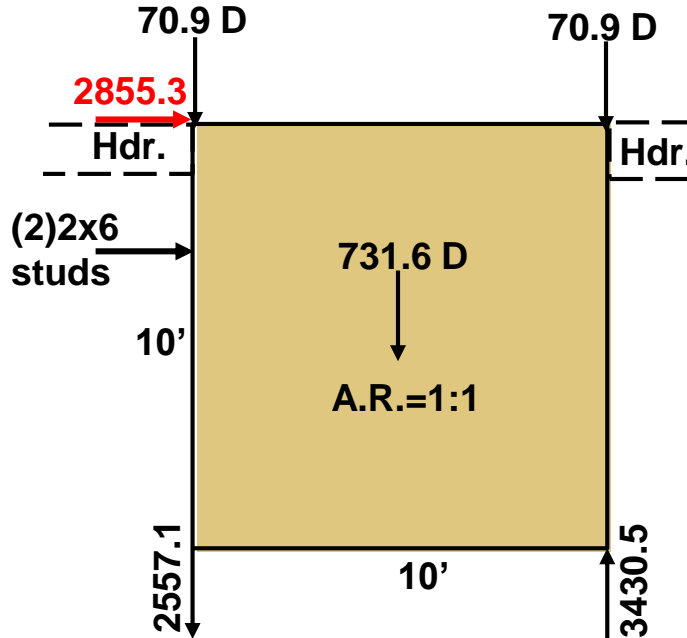
ASD Load Combination: LC10 0.448D + 0.7ρQE

ρ=1.3, Ax=1.25



Shear wall Grid A and B

Shear Walls Along Grid Lines A and B
Transverse Loading- Nominal Strength



Shear wall Grid 3

Shear Walls Along Grid Lines 2 and 3
Longitudinal Loading- Nominal Strength

$$vs = \frac{4528.8}{8} = 566.1 \text{ plf} < 600 \text{ plf allowed} \therefore \text{o.k.}$$

T = 4579.2 lbs. ≈ 4565 lbs. allowed, 0.3% over
 ∴ hold down o.k. –check later

$$vs = \frac{2855}{10} = 285.5 \text{ plf.} < 460 \text{ plf allowed} \therefore \text{o.k.}$$

T = 2557.1 lbs. < 4565 lbs. allowed
 ∴ hold down o.k.

Questions?

This concludes Woodworks Presentation on:

Part 2-Shear Wall Design in Cantilever Diaphragm Structures

Your comments and suggestions are valued. They will make a difference.

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Thank You

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