Designing Engineered Wood Diaphragm Systems
for Panelized Roofs

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

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Webinar Attendee Survey

Aleeta Dene
Engineered Wood Specialist
Southwest Region

https://www.apawood.org/presentation-survey

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Course Description

Diaphragms play a vital role in a building's lateral load path. Whether that lateral load is from seismic or wind, the diaphragm is responsible for distributing that lateral load to the shear walls. This session provides guidance on the proper design of engineered wood diaphragm and subdiaphragm systems. Participants will learn best practices as they are guided through a simple design example.

Learning Objectives

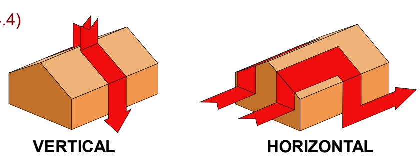
1. **Understand the importance of the diaphragm in the overall load path of a wood building.**
2. **Identify the proper sheathing and nailing patterns for a wood diaphragm.**
3. **Discuss how design choices affect the overall diaphragm deflection.**
4. **Distinguish the benefits and drawbacks of using a subdiaphragm.**

Lateral Load Path

Load Path

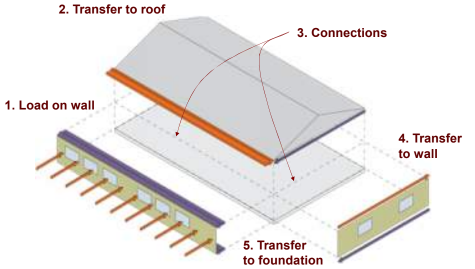
"Any system or method of construction to be used shall be based on a **rational analysis** in accordance with well established principles of mechanics. Such analysis shall result in a system that provides a **complete load path** capable of transferring loads from their point of origin to the load-resisting elements."

(IBC 2021 1604.4)



Lateral Load Path

Load Path Basics



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Lateral Load Path

2021 International Building Code

2021 IBC

- **Chapter 16: Structural Design**
  - ASCE 7-16

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Lateral Load Path

Governing Codes for Engineered Wood Design

2021 IBC

- **Chapter 23: Wood**
- **ANSI/AWC NDS**

(National Design Specification for Wood Construction)

- **ANSI/AWC SDPWS**

(Special Design Provisions for Wind and Seismic)

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Lateral Load Path

2021 IBC

SDPWS-21

(Special Design Provisions for Wind and Seismic)

- https://awc.org/publications/2021-sdpws/ *(Free view-only)*

Lateral Load Path

Wood Shear Wall and Diaphragms Design

Shear Values

- Function of fastener size and spacing, panel thickness and the specific gravity of the framing materials
- Values in tables in ANSI/AWC SDPWS-21
- Alternately, capacities can be calculated by principles of mechanics

Lateral Load Path

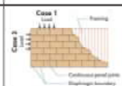
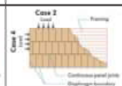
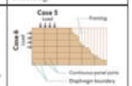
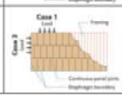
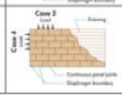
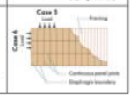
2021 IBC

Shear Wall and Diaphragm Tables

- Tables removed from Ch 23 except for staples
- ANSI/AWC SDPWS-21 lists nominal values – require adjusting for ASD or LRFD

Lateral Load Path

2021 SDPWS

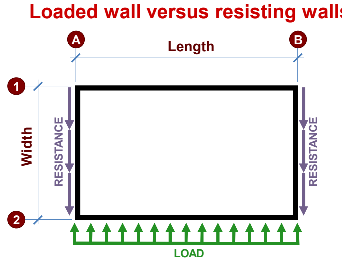
	Cases 1&3:Continuous Panel Joints Perpendicular to Framing	**Cases 2&4**: Continuous Panel Joints Parallel to Framing	**Cases 5&6**: Continuous Panel Joints Perpendicular and Parallel to Framing
Long Panel Direction Perpendicular to Supports			
Long Panel Direction Parallel to Supports[a]			

(a) Panel span rating for out-of-plane loads may be lower than the span rating with the long panel direction perpendicular to supports (See Section 3.2.2 and Section 3.2.3)

Lateral Load Path

Load Path Basics

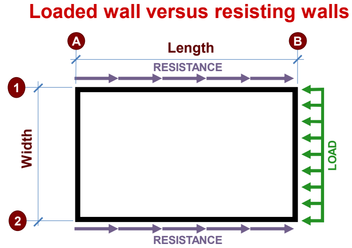
Loaded wall versus resisting walls



Lateral Load Path

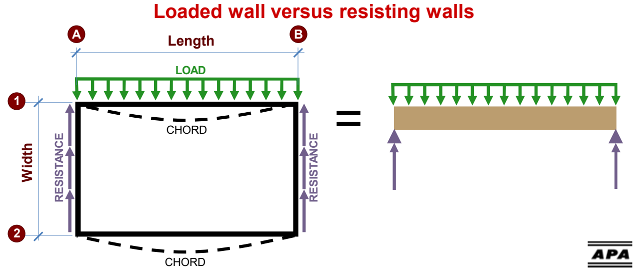
Load Path Basics

Loaded wall versus resisting walls

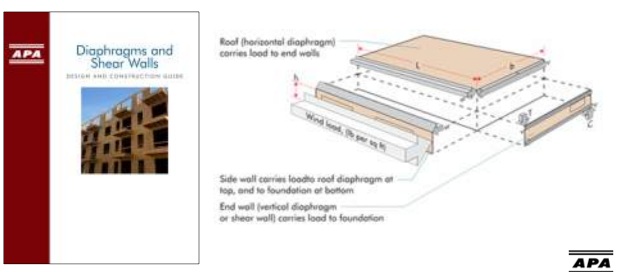


Load Path Basics

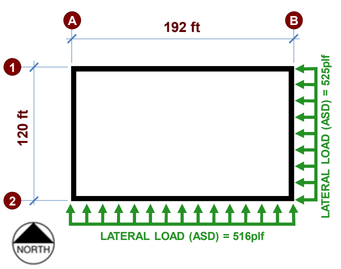
Loaded wall versus resisting walls



Simple Diaphragm Example



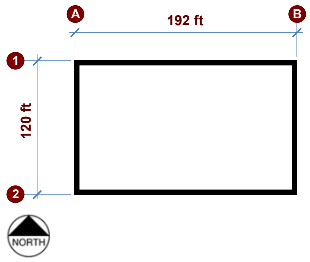
Simple Diaphragm Example



Diaphragm Design

1. Check aspect ratio
2. Calculate diaphragm shear
3. Determine sheathing and nailing required
4. Calculate chord force
5. Check chord capacity

Simple Diaphragm Example



Check Aspect Ratio

SDPWS 2021

Table 4.2.2 Maximum Diaphragm Aspect Ratios

(Flat or Sloped Diaphragms)

Sheathed Wood-Frame Diaphragm Assemblies	Maximum L/W Ratio
Wood structural panel, unblocked	3:1
Wood structural panel, blocked	4:1
Single-layer horizontally-sheathed lumber	2:1
Single-layer diagonally-sheathed lumber	3:1
Double-layer diagonally-sheathed lumber	4:1

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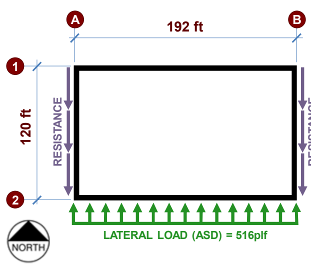
Simple Diaphragm Example



Calculate Diaphragm Shear

$V = \frac{wl}{2B} = \frac{516 \text{ plf} \times 192 \text{ ft}}{2 \times 120 \text{ ft}}$

$= 413 \text{ plf}$

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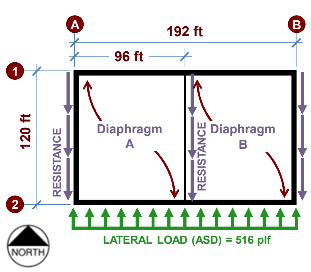
Multi-span Diaphragm Example



Calculate Diaphragm Shear

$V = \frac{wl}{2B} = \frac{516 \text{ plf} \times 96 \text{ ft}}{2 \times 120 \text{ ft}}$

$= 206 \text{ plf}$

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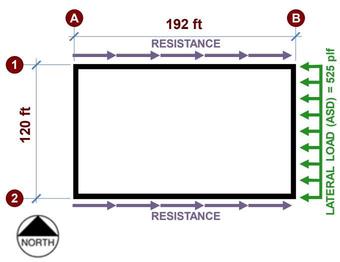
Simple Diaphragm Example

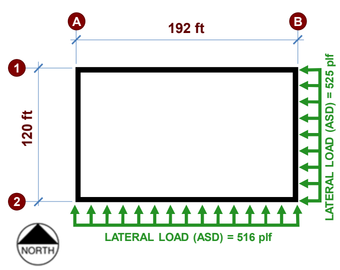


Calculate Diaphragm Shear

$$V = \frac{wl}{2B} = \frac{525 \text{ plf} \times 120 \text{ ft}}{2 \times 192 \text{ ft}} = 164 \text{ plf}$$

164 plf < 413 plf

Simple Diaphragm Example



Determine Sheathing and Nailing Required

V(ASD) = 413 plf

Diaphragm Capacities

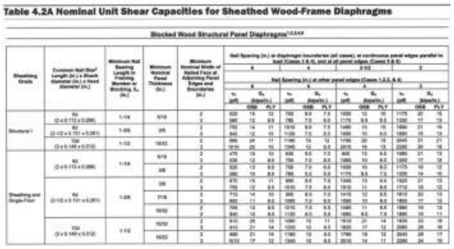


Table 4.2A Nominal Unit Shear Capacities for Sheathed Wood-Frame Diaphragms

Blocked Wood Structural Panel Diaphragms

Wind Factors

ASD: $v_s/2.0$

LRFD: $0.8v_s$

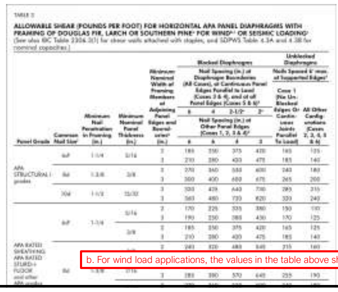
Seismic Factors

ASD: $v_s/2.8$

LRFD: $0.5v_s$

Simple Diaphragm Example

Diaphragm Capacities



b. For wind load applications, the values in the table above shall be permitted to be multiplied by 1.4.

~~**Wind Factors**~~
~~ASD: $v_s/2.0$~~
~~LRFD: $0.8v_s$~~

Seismic Factors
ASD: $v_s/2.8$
~~LRFD: $0.5v_s$~~

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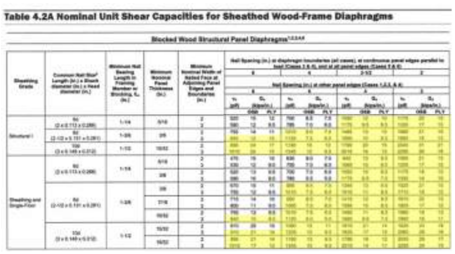
Simple Diaphragm Example

Diaphragm Capacities



Determine Sheathing and Nailing Required
V (ASD) = 413 plf

For wind:
v_s(req.) = 2.0 x 413 plf = 826 plf

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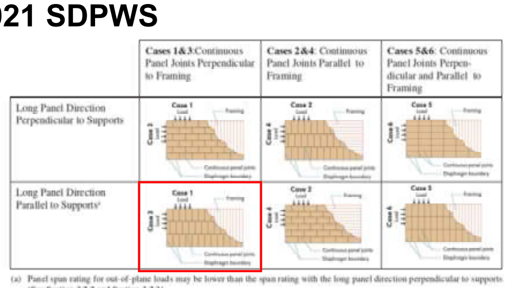
Simple Diaphragm Example

2021 SDPWS



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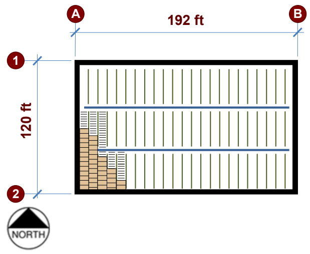
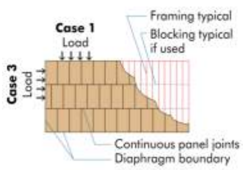
Simple Diaphragm Example

Simple Diaphragm





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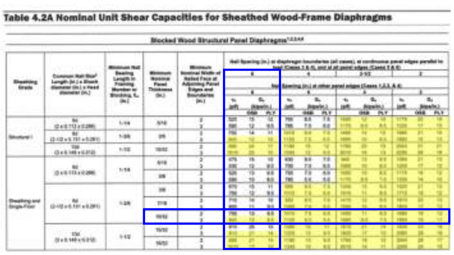
Simple Diaphragm Example

Diaphragm Capacities



Determine Sheathing and Nailing Required

V (ASD) = 413 plf

For wind:

v_s(req.) = 2.0 x 413 plf = 826 plf

15/32 Cat. Panel with 8d @ 6"oc

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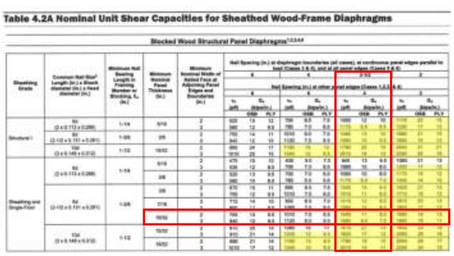
Simple Diaphragm Example

Diaphragm Capacities



Determine Sheathing and Nailing Required

V (ASD) = 413 plf

For seismic:

v_s(req.) = 2.8 x 413 plf = 1,156 plf

15/32 Cat. Panel with 8d @ 2-1/2"oc

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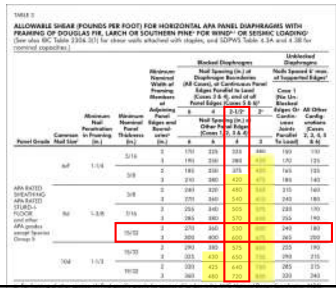
Simple Diaphragm Example

Diaphragm Capacities



Determine Sheathing and Nailing Required

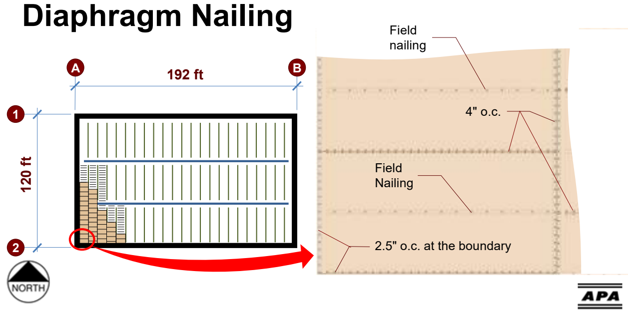
V (ASD) = 413 plf

For seismic:
v_s(req.) = 413 plf

15/32 Cat. Panel with 8d @ 2-1/2"oc

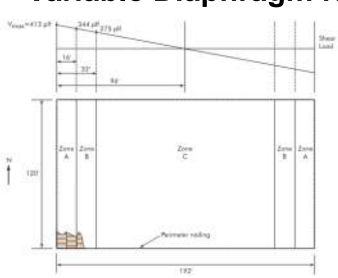
Simple Diaphragm Example

Diaphragm Nailing



Simple Diaphragm Example

Variable Diaphragm Nailing



Determine Sheathing and Nailing Required

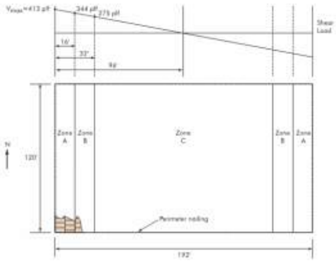
For Zone A (seismic):
v_s(req.) = 413 plf

For Zone B (seismic):
v_s(req.) = 344 plf

For Zone C (seismic):
v_s(req.) = 275 plf

Simple Diaphragm Example

Diaphragm Sheathing



Determine Sheathing and Nailing Required

For Zone A (seismic):

v_s(req.) = 413 plf

15/32 Cat. Panel with 8d at 2-1/2"oc

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Simple Diaphragm Example

Diaphragm Capacities

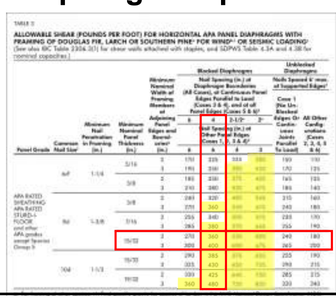
TABLE 3

ALLOWABLE SHEAR (POUNDS PER FOOT) FOR HORIZONTAL APA PANEL DIAPHRAGMS WITH FRAMING OF DOUGLAS FIR, LARCH OR SOUTHERN PINE FOR WIND OR SEISMIC LOADING

Panel Grade	Common Nail Size	Minimum Nail Penetration in Framing (in.)	Minimum Nominal Panel Thickness (in.)	Minimum Nominal Width of Framing Members at Adjoining Panel Edges and Boundaries (in.)	Blocked 6 / 6	Blocked 4 / 6	Blocked 2-1/2 / 4	Blocked 2 / 3	Unblocked Case 1	Unblocked All Other Configurations
APA RATED SHEATHING, APA RATED STURD-I-FLOOR and other APA grades except Species Group 5	6d	1-1/4	5/16	2	170	225	[illegible]	[illegible]	150	110
				3	190	250	[illegible]	[illegible]	170	125
			3/8	2	185	250	[illegible]	[illegible]	165	125
				3	210	280	[illegible]	[illegible]	185	140
	8d	1-3/8	3/8	2	240	320	[illegible]	[illegible]	215	160
				3	270	360	[illegible]	[illegible]	240	180
			7/16	2	255	340	[illegible]	[illegible]	230	170
				3	285	380	[illegible]	[illegible]	255	190
			15/32	2	270	360	[illegible]	[illegible]	240	180
				3	300	400	[illegible]	[illegible]	265	200
	10d	1-1/2	15/32	2	290	385	[illegible]	[illegible]	255	190
				3	325	430	[illegible]	[illegible]	290	215
			19/32	2	320	425	[illegible]	[illegible]	285	215
				3	360	480	[illegible]	[illegible]	320	240

Determine Sheathing and Nailing Required

For Zone A (seismic):

v_s(req.) = 413 plf

For Zone B (seismic):

v_s(req.) = 344 plf

15/32 Cat. Panel with 8d @ 4"oc

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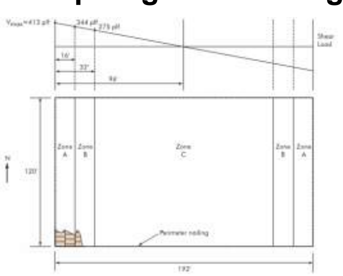
Simple Diaphragm Example

Diaphragm Sheathing



Determine Sheathing and Nailing Required

For Zone A (seismic):

v_s(req.) = 413 plf

15/32 Cat. Panel with 8d at 2.5"oc

For Zone B (seismic):

v_s(req.) = 344 plf

15/32 Cat. Panel with 8d at 4"oc

For Zone C (seismic):

v_s(req.) = 275 plf

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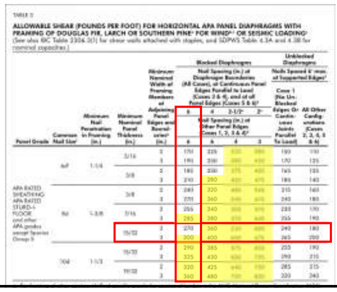
Simple Diaphragm Example

Diaphragm Capacities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APA RATED SHEATHING APA RATED STURD-I-FLOOR and other APA grades except Species Group 5	6d	1-1/4	5/16	2	170	225	[illegible]	[illegible]	150	110
				3	190	250	[illegible]	[illegible]	170	125
			3/8	2	185	250	[illegible]	[illegible]	165	125
				3	210	280	[illegible]	[illegible]	185	140
	8d	1-3/8	3/8	2	240	320	[illegible]	[illegible]	215	160
				3	270	360	[illegible]	[illegible]	240	180
			7/16	2	255	340	[illegible]	[illegible]	230	170
				3	285	380	[illegible]	[illegible]	255	190
			15/32	2	270	360	[illegible]	[illegible]	240	180
				3	300	400	[illegible]	[illegible]	265	200
	10d	1-1/2	15/32	2	290	385	[illegible]	[illegible]	255	190
				3	325	430	[illegible]	[illegible]	290	215
			19/32	2	320	425	[illegible]	[illegible]	285	215
				3	360	480	[illegible]	[illegible]	320	240

Determine Sheathing and Nailing Required

For Zone A (seismic):
v_s(req.) = 413 plf

For Zone B (seismic):
v_s(req.) = 344 plf

For Zone C (seismic):
v_s(req.) = 275 plf

15/32 Cat. Panel with 8d @ 6"oc

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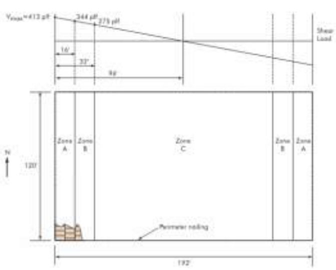
Simple Diaphragm Example

Diaphragm Sheathing



Determine Sheathing and Nailing Required

For Zone A (seismic):
v_s(req.) = 413 plf
15/32 Cat. Panel with 8d at 2.5"oc

For Zone B (seismic):
v_s(req.) = 344 plf
15/32 Cat. Panel with 8d at 4"oc

For Zone C (seismic):
v_s(req.) = 275 plf
15/32 Cat. Panel with 8d at 6"oc

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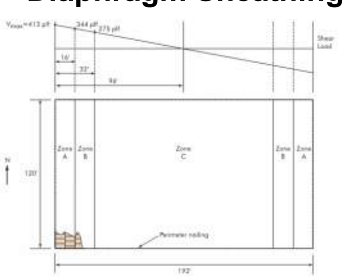
Simple Diaphragm Example

Diaphragm Sheathing



Sheathing Specification

15/32 Performance Category Rated Sheathing, Exposure 1, 32/16 span rating

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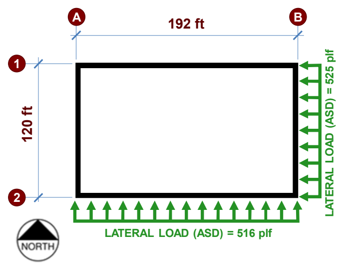
Diaphragm Sheathing

PERFORMANCE CATEGORY AND NOMINAL THICKNESS (in.) BY SPAN RATING
(The predominant Performance Category for each span rating is highlighted in **bold** type.)

Span Rating	Performance Category 3/8	7/16	15/32	1/2	19/32	5/8	23/32	3/4	7/8	1	1-1/8
Sheathing											
W24	**0.375**	0.437	0.469								
24/0	**0.375**	0.437	0.469	0.500							
24/16		**0.437**	0.469	0.500							
32/16			**0.469**	0.500	0.594	0.625					
40/20					**0.594**	0.625	0.719	0.750			
48/24							**0.719**	0.750	0.875		

Diaphragm Chords



Calculate Chord Force

N-S Direction:

T(ASD) $= \frac{wl^2}{8B} = \frac{516 \text{ plf } (192 \text{ ft})^2}{8(120 \text{ ft})}$

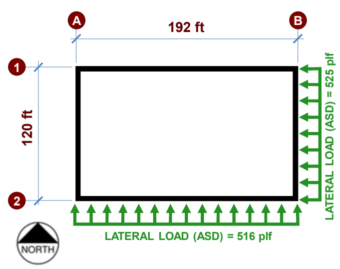
= 19,814 lbs.

E-W Direction:

T(ASD) $= \frac{wl^2}{8B} = \frac{525 \text{ plf } (120 \text{ ft})^2}{8(192 \text{ ft})}$

= 4,922 lbs.

Diaphragm Chords



Check Chord Capacity

2x12 DF-L No. 1 Ledger

Tension:

$F'_t = F_t C_D C_M C_t C_F C_i$
= 675 psi(1.6)(1)(1)(1)(0.8)
= 864 psi

$F'_t A$ = 864 psi(16.88 in^2) = 14,586 lbs. N.G.

Use a 3x12 DF-L No. 1 ledger (Grid 1 and 2)

$F'_t A$ = 864 psi x 28.13 in^2 = 24,304 lbs.

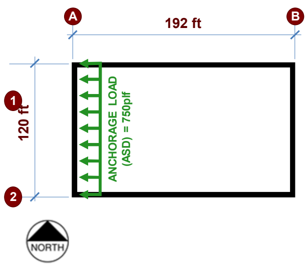
Compression:

$F'_c = F_t C_D C_M C_t C_F C_i C_P$
= 1,500 psi(1.6)(1)(1)(1)(0.8)(1)
= 1,920 psi

$F'_c A$ okay by inspection

Subdiaphragm Example

Subdiaphragm Example



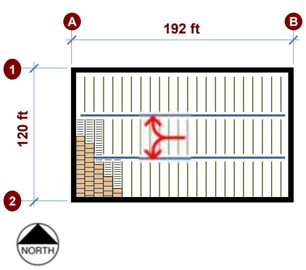
Subdiaphragm Design

"A portion of a diaphragm used to transfer wall anchorage forces to diaphragm cross-ties"
SDPWS 2021

APA

Subdiaphragm Example

Subdiaphragm Example



Subdiaphragm Design

"A portion of a diaphragm used to transfer wall anchorage forces to diaphragm cross-ties"
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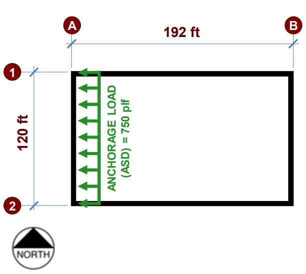
APA

Subdiaphragm Example

Subdiaphragm Example



Subdiaphragm Design

1. Choose subdiaphragm depth
2. Calculate subdiaphragm shear
3. Determine sheathing and nailing required
4. Check chord
5. Calculate connection forces

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Subdiaphragm Example

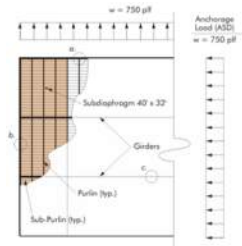
Subdiaphragm Example

Choosing a 16ft depth:

V(ASD) $= \frac{750 \text{ plf}(40 \text{ ft}/2)}{16 \text{ ft}} = 938$ plf

v_s(req.) = 2.8(938 plf) = 2,625 plf

2,625 plf > max shear 2,295 plf



Simple Diaphragm Example

Diaphragm Nailing

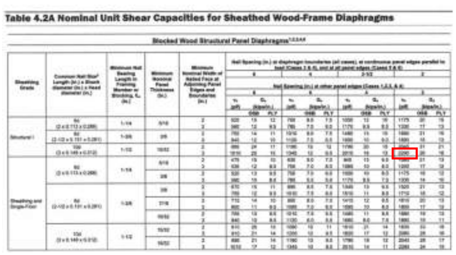


Table 4.2A Nominal Unit Shear Capacities for Sheathed Wood-Frame Diaphragms

Blocked Wood Structural Panel Diaphragms

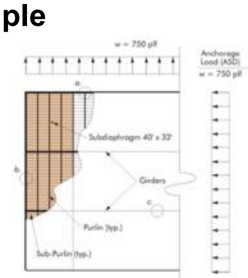
Subdiaphragm Example

Subdiaphragm Example

Choosing a 24ft depth:

V(ASD) $= \frac{750 \text{ plf}(40 \text{ ft}/2)}{24 \text{ ft}} = 625$ plf

v_s(req.) = 2.8(625 plf) = 1,750 plf



Subdiaphragm Example

Subdiaphragm Example

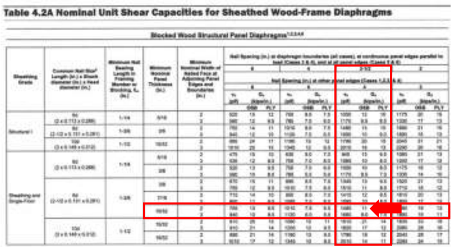


Table 4.2A Nominal Unit Shear Capacities for Sheathed Wood-Frame Diaphragms

Blocked Wood Structural Panel Diaphragms

Determine Sheathing and Nailing Required

For Zone A (seismic):
v_s = 1,485 plf

For Zone B (seismic):
v_s = 1,010 plf

For Zone C (seismic):
v_s = 755 plf

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Subdiaphragm Example

Subdiaphragm Example

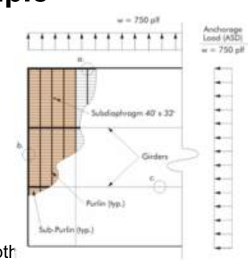
Assuming 24ft depth:

V(ASD) = 750 plf(40 ft/2) / 24 ft = 625 plf

v_s(req.) = 2.8(625 plf) = 1,750 plf

1,750 plf > 1,485 plf (Zone A)

Options:
- Increase nailing to 2" o.c.
- Use 10d nails
- Increase subdiaphragm depth



NORTH

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Subdiaphragm Example

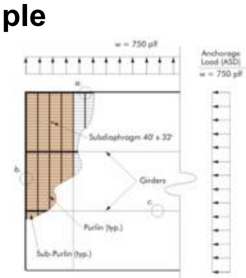
Subdiaphragm Example

Choosing 32ft depth:

V(ASD) = 750 plf(40 ft/2) / 32 ft = 469 plf

v_s(req.) = 2.8(469 plf) = 1,313 plf

1,313 plf < 1,485 plf (Zone A)



NORTH

APA

Subdiaphragm Example

Subdiaphragm Example

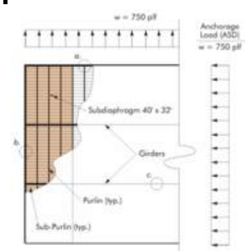
Choosing 32ft depth:

$$V(ASD) = \frac{750 \text{ plf}(40 \text{ ft}/2)}{32 \text{ ft}} = 469 \text{ plf}$$

$$v_s(\text{req.}) = 2.8(469 \text{ plf}) = 1{,}313 \text{ plf}$$

1,313 plf < 1,485 plf (Zone A)

$$T(ASD) = \frac{wl^2}{8B} = \frac{750 \text{ plf } (40 \text{ ft})^2}{8(32 \text{ ft})} = 4{,}688 \text{ lbs.}$$



NORTH

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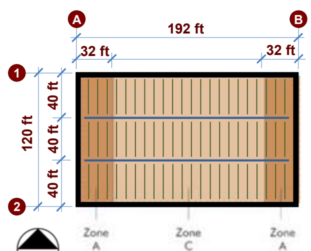
Subdiaphragm Example

Subdiaphragm Example



NORTH

15/32 Performance Category, Rated Sheathing, Exposure 1
8d nails

- 2.5"/4"/12" pattern at Zone A
- 6"/6"/12" pattern at Zone C

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Subdiaphragm Example

Subdiaphragm Example

Purlin Anchorage Force:

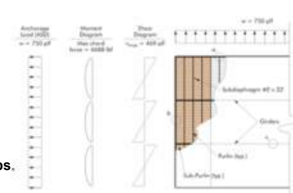
F(for 8 ft spacing) = 750 plf(8 ft) = 6,000 lbs.

Subpurlin Anchorage Force:

F(for 2 ft spacing) = 750 plf(2 ft) = 1,500 lbs.

Girder Force:

F(40 ft spacing) = 750 plf(40 ft) = 30,000 lbs.



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Diaphragm Deflection Example

Calculate Deflection

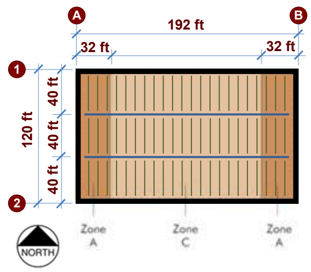

Table 4.2.3 Diaphragm Deflection Equations

Loading case	Equation
1. Mid-span deflection of a single span simply supported diaphragm with uniformly distributed load	$\delta_{dia} = \frac{5vL^3}{8EAW} + \frac{0.25vL}{1000G_a} + \frac{\sum x\Delta_c}{2W}$ (4.2-1)
2. End deflection of a cantilever diaphragm with uniformly distributed load	$\delta_{dia} = \frac{3vL'^3}{EAW'} + \frac{0.5vL'}{1000G_a} + \frac{\sum x'\Delta_c}{W'}$ (4.2-2)
3. End deflection of a cantilever diaphragm with concentrated load at the end	$\delta_{dia} = \frac{8vL'^3}{EAW'} + \frac{vL'}{1000G_a} + \frac{\sum x'\Delta_c}{W'}$ (4.2-3)

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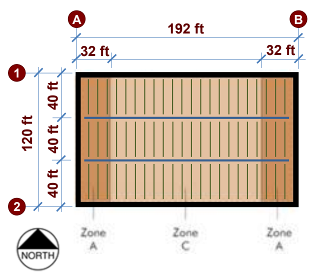
Diaphragm Deflection Example

Calculate Deflection



SDPWS (Eq. 4.2-1):

$$\delta_{dia} = \frac{5vL^3}{8EAW} + \frac{0.25vL}{1000G_a} + \frac{\sum x\Delta_c}{2W}$$

Bending Shear Chord Slip

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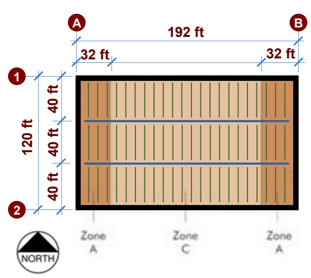
Diaphragm Deflection Example

Calculate Deflection



1st Term:

$$\frac{5vL^3}{8EAW} = \frac{5(413\ \text{plf})(192\ \text{ft})^3}{8(1{,}600{,}000\ \text{psi})(28.13\ \text{in}^2)(120\ \text{ft})} = 0.34\ \text{in}$$

2nd Term:

$$\frac{0.25vL}{1000G_a} = \frac{0.25(413\ \text{plf})(192\ \text{ft})}{1000(11)} = 1.80\ \text{in}$$

Last Term:

$$\frac{\sum x\Delta_c}{2W} = \frac{2(1/32)[2(12\ \text{ft} + 24\ \text{ft} + 36\ \text{ft} + 48\ \text{ft} + 60\ \text{ft} + 72\ \text{ft} + 84\ \text{ft}) + 96\ \text{ft}]}{2(120\ \text{ft})} = 0.2\ \text{in}$$

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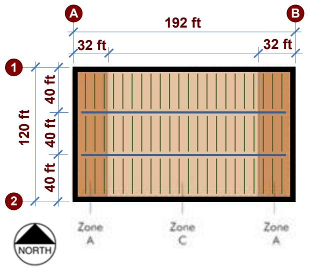
Diaphragm Deflection Example

Calculate Deflection



SDPWS (Eq. 4.2-1):

$$\delta_{dia} = 0.34\text{ in} + 1.80\text{ in} + 0.2\text{ in}$$

14.5% 77% 8.5%

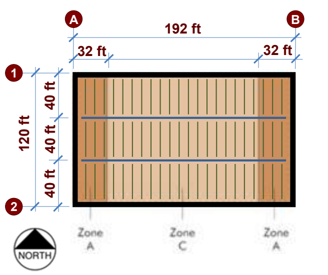
$$= 2.34\text{ in}$$

IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.188Le_n + 0.2\text{ in}$$

Diaphragm Deflection Example

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.188Le_n + 0.2\text{ in}$$

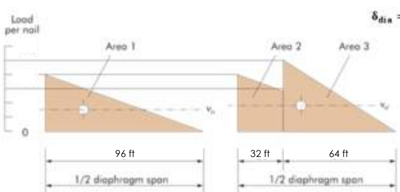
ADJUST THIS IF YOU HAVE MULTIPLE NAILING PATTERNS!

Diaphragm Deflection Example

Calculate Deflection

IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + \cancel{0.188L}e_n + 0.2\text{ in}$$



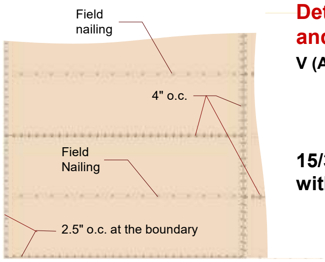
Adjust nail slip coefficient

$$= 0.188\left(\frac{v_n'}{v_n}\right)$$

OR

$$= 0.188\left(\frac{\text{Area 2} + \text{Area 3}}{\text{Area 1}}\right)$$

Diaphragm Nailing

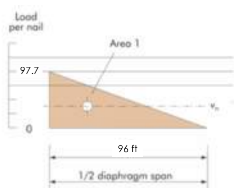


Determine Sheathing and Nailing Required

V (ASD) = 413 plf

15/32 Cat. Panel with 8d at 2.5"oc

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + \sout{0.188Le_n} + 0.2\text{ in}$$

Adjust nail slip coefficient

$$= 0.188\left(\frac{\text{Area 2} + \text{Area 3}}{\text{Area 1}}\right)$$

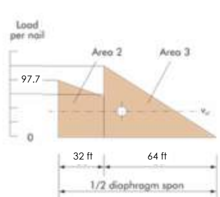
Load per nail

$$413\text{ plf}\left(\frac{2.5}{12}\text{ ft/nail}\right) = 97.7\text{ lb}$$

Which means...

$$\text{Area 1} = \frac{97.7\text{ lb}(96\text{ ft})}{2} = 4,690$$

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.188Le_n + 0.2\text{ in}$$

Adjust nail slip coefficient

$$= 0.188\left(\frac{v_n'}{v_n}\right)$$

Load per nail

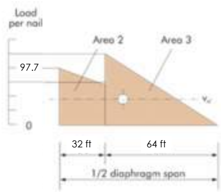
Zone A @ 32 ft: $275\text{ plf}\left(\frac{2.5}{12}\text{ ft/nail}\right) = 57.3\text{ lb}$

Which means...

$$\text{Area 2} = \frac{(97.7\text{ lb} + 57.3\text{ lb})32\text{ ft}}{2} = 2,480$$

Diaphragm Deflection Example

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.188Le_n + 0.2\text{ in}$$

Adjust nail slip coefficient

$$= 0.188\left(\frac{v_n'}{v_n}\right)$$

Load per nail Zone C:

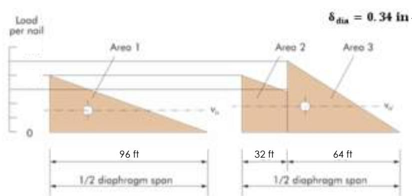
$$275\text{ plf}\left(\frac{6}{12}\text{ft/nail}\right) = 137.5\text{ lb}$$

Which means...

$$\text{Area 3} = \frac{137.5\text{ lb} \times 64\text{ ft}}{2} = 4,400$$

Diaphragm Deflection Example

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + \cancel{0.188L}e_n + 0.2\text{ in}$$

Adjust nail slip coefficient

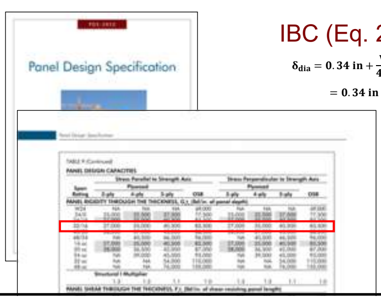
$$= 0.188\left(\frac{\text{Area 2} + \text{Area 3}}{\text{Area 1}}\right)$$

$$= 0.188\left(\frac{2,480 + 4,400}{4,690}\right)$$

$$= 0.276$$

Diaphragm Deflection Example

Calculate Deflection



IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.267Le_n + 0.2\text{ in}$$

$$= 0.34\text{ in} + \frac{(413\text{ plf})(192\text{ ft})}{4Gt} + 0.267(192\text{ ft})e_n + 0.2\text{ in}$$

Where:

$$Gt = 83{,}500\text{ lbs/in}$$

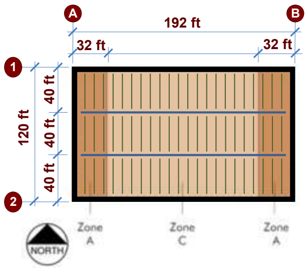
$$e_n = 1.2\left(\frac{v_{nail}}{616}\right)^{3.018}$$

$$= 1.2\left[\frac{137.5\text{lb/nail}}{616}\right]^{3.018}$$

$$= 0.013\text{ in}$$

Diaphragm Deflection Example

Calculate Deflection



SDPWS (Eq. 4.2-1):

$$\delta_{dia} = 0.34\text{ in} + 1.80\text{ in} + 0.2\text{ in} = 2.34\text{ in}$$

14.5% 77% 8.5%

IBC (Eq. 23-1):

$$\delta_{dia} = 0.34\text{ in} + \frac{vL}{4Gt} + 0.188Le_n + 0.2\text{ in}$$
$$= 0.34\text{ in} + \frac{(413\text{ plf})(192\text{ ft})}{4Gt} + 0.267(192\text{ ft})e_n + 0.2\text{ in}$$
$$= 0.34\text{ in} + 0.24\text{ in} + 2.12\text{ in} + 0.2\text{ in} = 2.90\text{ in}$$

11.7% 8.2% 73.2% 6.9%

81.4%

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Questions?

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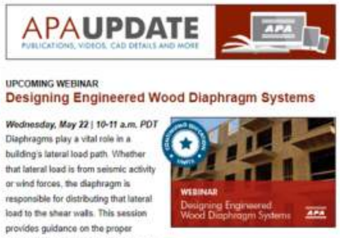
APA Update Newsletter

(www.apawood.org)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PUBLICATIONS, VIDEOS, CAD DETAILS AND MORE

UPCOMING WEBINAR
Designing Engineered Wood Diaphragm Systems

Wednesday, May 22 | 10-11 a.m. PDT
Diaphragms play a vital role in a building's lateral load path. Whether that lateral load is from seismic activity or wind forces, the diaphragm is responsible for distributing that lateral load to the shear walls. This session provides guidance on the proper

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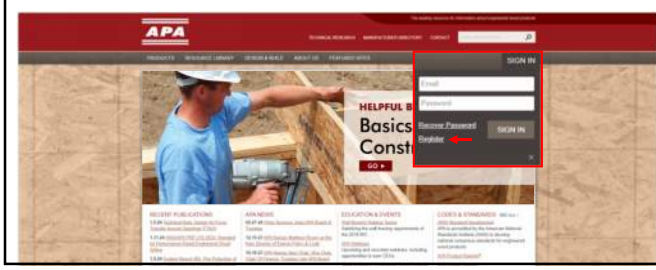

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