RISA Webinar

In-Depth Look at Wood Wall Design in RISA

Presenter: Deborah Brisbin, P.E.

RISA TECHNOLOGIES

RISAFloor

RISA-3D

Version 4.1

Version 8.1

LATEST VERSION

Walls geometry is based on the Design Rules Spreadsheet (Studs, etc.)

Wood Wall Panel Parameters

Size/UC | Concrete Rebar | Masonry Wall | Wood Wall (Studs) | Wood Wall (Fasteners)

	Label	Top Plate	Sill Plate	Studs	Min Stud S...	Max Stud ...	Green Lu...
1	Typical	2-2X6	2X6	2X6	16	16	☐

Design criteria can be set in the Design Rules

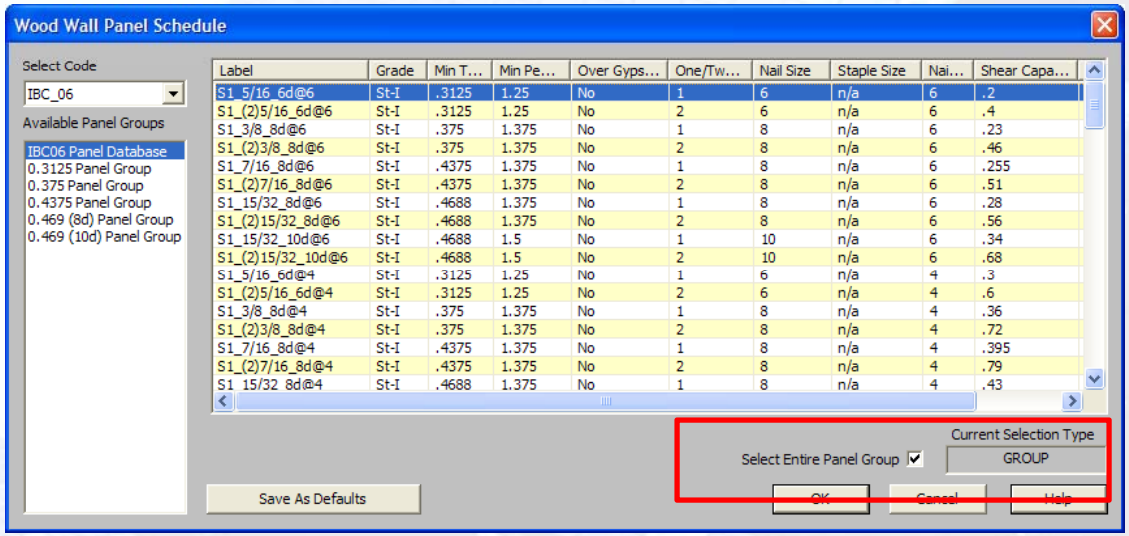
Additional Wood Wall Panel Parameters

Size/UC | Concrete Rebar | Masonry Wall | Wood Wall (Studs) | Wood Wall (Fasteners)

	Label	Schedule	Min. Panel...	Max. Panel...	Double Si...	Max. Nail ...	Min. Nail S...	HD Chords	HD Chord M...	Hold Down
1	Typical	IBC06 Panel Database	.375	.4688	Optimum	6-in.	3-in.	2-2X6	Same as Wall	SIMP HDA Database

Or you can narrow down the criteria in the Wood Schedules

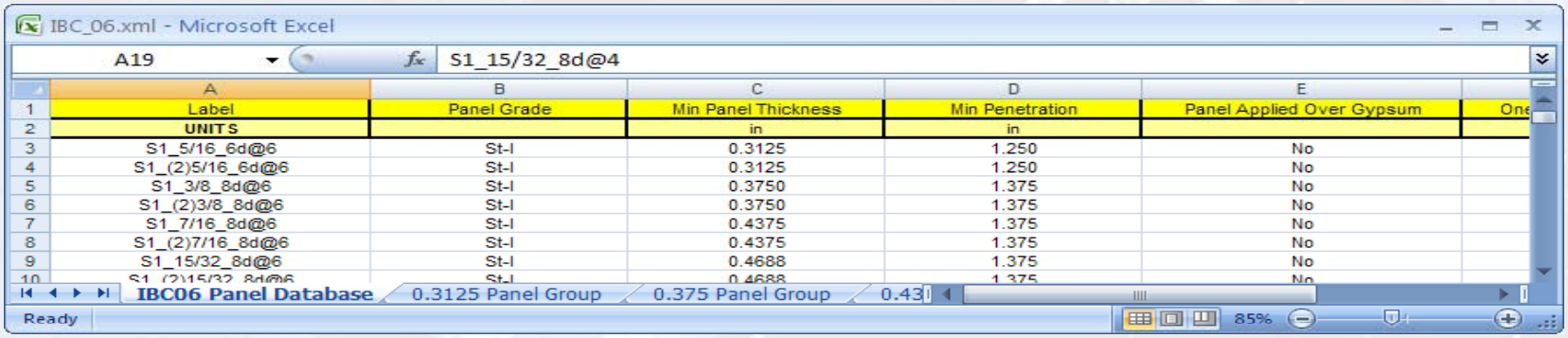
Wood Wall Parameters



Using this Spreadsheet

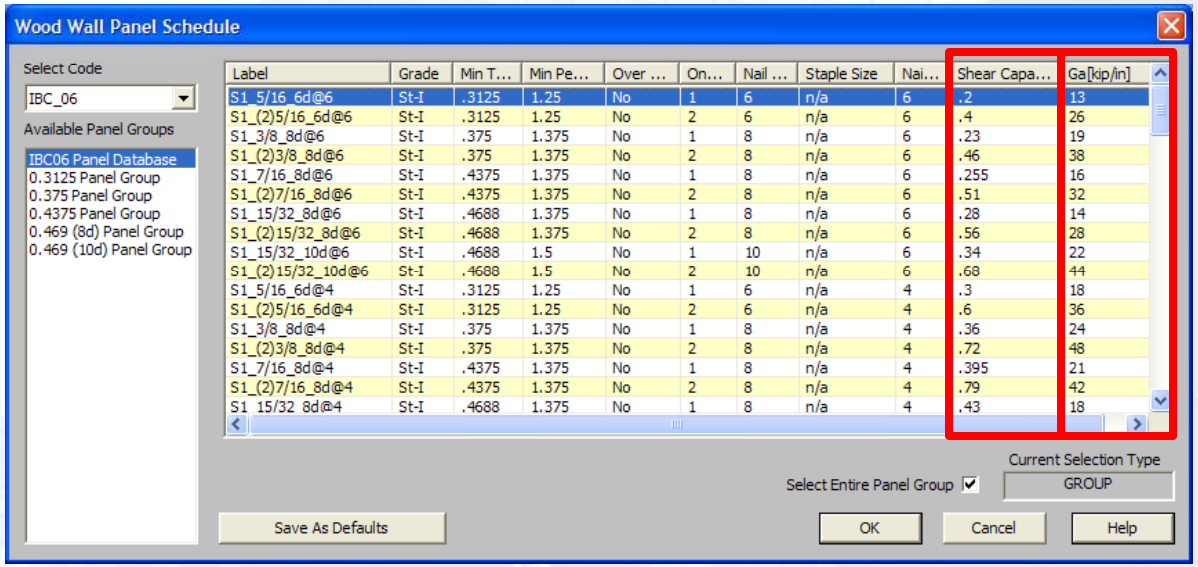
- Select the Code
  Then select the "Group" for design OR Select a Single Panel

- Based on the Excel Spreadsheets outside of the RISA programs
  C:\RISA\RISA_Wood_Schedules\ShearPanels



Wood Wall Parameters

Shear Panel Schedule



Label	Grade	Min T...	Min Pe...	Over ...	On...	Nail ...	Staple Size	Nai...	Shear Capa...	Ga[kip/in]
S1_5/16_6d@6	St-I	.3125	1.25	No	1	6	n/a	6	.2	13
S1_(2)5/16_6d@6	St-I	.3125	1.25	No	2	6	n/a	6	.4	26
S1_3/8_8d@6	St-I	.375	1.375	No	1	8	n/a	6	.23	19
S1_(2)3/8_8d@6	St-I	.375	1.375	No	2	8	n/a	6	.46	38
S1_7/16_8d@6	St-I	.4375	1.375	No	1	8	n/a	6	.255	16
S1_(2)7/16_8d@6	St-I	.4375	1.375	No	2	8	n/a	6	.51	32
S1_15/32_8d@6	St-I	.4688	1.375	No	1	8	n/a	6	.28	14
S1_(2)15/32_8d@6	St-I	.4688	1.375	No	2	8	n/a	6	.56	28
S1_15/32_10d@6	St-I	.4688	1.5	No	1	10	n/a	6	.34	22
S1_(2)15/32_10d@6	St-I	.4688	1.5	No	2	10	n/a	6	.68	44
S1_5/16_6d@4	St-I	.3125	1.25	No	1	6	n/a	4	.3	18
S1_(2)5/16_6d@4	St-I	.3125	1.25	No	2	6	n/a	4	.6	36
S1_3/8_8d@4	St-I	.375	1.375	No	1	8	n/a	4	.36	24
S1_(2)3/8_8d@4	St-I	.375	1.375	No	2	8	n/a	4	.72	48
S1_7/16_8d@4	St-I	.4375	1.375	No	1	8	n/a	4	.395	21
S1_(2)7/16_8d@4	St-I	.4375	1.375	No	2	8	n/a	4	.79	42
S1_15/32_8d@4	St-I	.4688	1.375	No	1	8	n/a	4	.43	18

Required Fields

Label

Min Panel Thickness- Used to set the elastic stiffness of the wall panel used during the FEM solution.

Ga - Apparent Shear Stiffness – from NDS Equation 4.3-1

One/Two Sided – used during optimization

Boundary Nail Spacing – used during optimizaion

Shear Capacity – value for code check capacity

All other fields are Optional

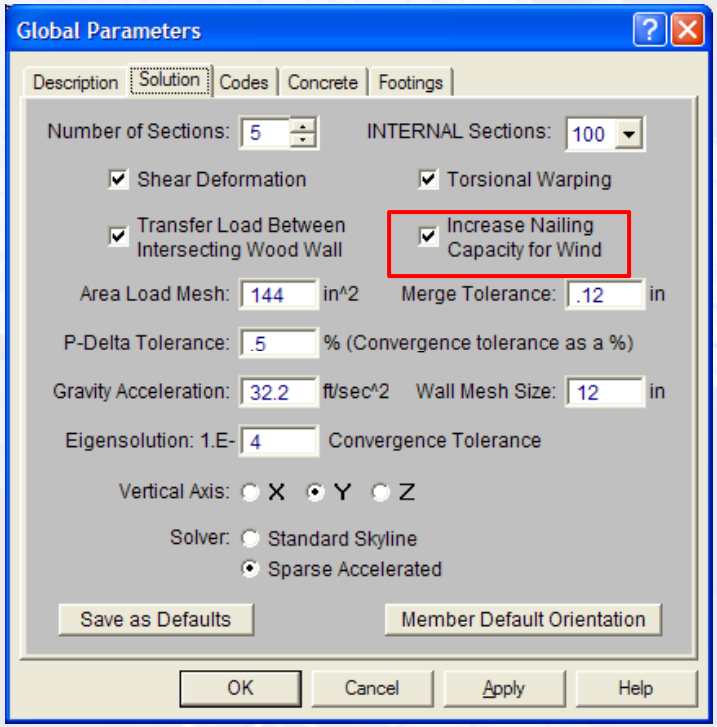
Wood Wall Parameters

RISA TECHNOLOGIES

Shear Capacity

- Based the Seismic Loads or the Wind Loads capacities
  With Global Parameters turned on

- Must use the Load Categories in Basic Load Cases
  & Load Combinations



Basic Load Cases

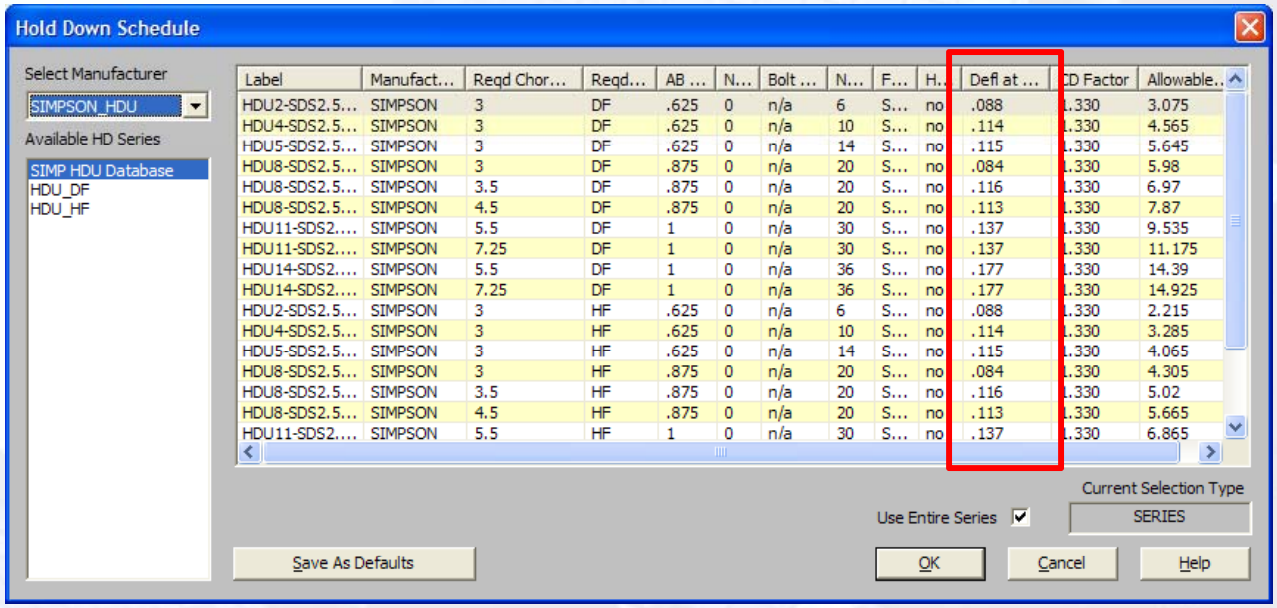
	BLC Description	Category	X
1	Dead Load	DL	
2	Wind Load	WL	
3	Earthquake Loads	EL (Eartl	
4		None	

Load Combinations

Combinations | Design

	Description	Solve	PDelta	SR...	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	IBC 16-8	☑			DL	1						
2	IBC 16-9	☑			DL	1	LL	1	LLS	1		
3	IBC 16-11 (a)	☑			DL	1	LL	.75	LLS	.75	RLL	.75
4	IBC 16-11 (b)	☑			DL	1	LL	.75	LLS	.75	SL	.75
5	IBC 16-11 (c)	☑			DL	1	LL	.75	LLS	.75	RL	.75
6	IBC 16-12 (a)	☑			DL	1	WL	1				
7	IBC 16-12 (b)	☑			DL	1	EL	.7				

Wood Wall Parameters



Label	Manufact...	Reqd Chor...	Reqd...	AB ...	N...	Bolt ...	N...	F...	H...	Defl at ...	CD Factor	Allowable...
HDU2-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	6	S...	no	.088	1.330	3.075
HDU4-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	10	S...	no	.114	1.330	4.565
HDU5-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	14	S...	no	.115	1.330	5.645
HDU8-SDS2.5...	SIMPSON	3	DF	.875	0	n/a	20	S...	no	.084	1.330	5.98
HDU8-SDS2.5...	SIMPSON	3.5	DF	.875	0	n/a	20	S...	no	.116	1.330	6.97
HDU8-SDS2.5...	SIMPSON	4.5	DF	.875	0	n/a	20	S...	no	.113	1.330	7.87
HDU11-SDS2....	SIMPSON	5.5	DF	1	0	n/a	30	S...	no	.137	1.330	9.535
HDU11-SDS2....	SIMPSON	7.25	DF	1	0	n/a	30	S...	no	.137	1.330	11.175
HDU14-SDS2....	SIMPSON	5.5	DF	1	0	n/a	36	S...	no	.177	1.330	14.39
HDU14-SDS2....	SIMPSON	7.25	DF	1	0	n/a	36	S...	no	.177	1.330	14.925
HDU2-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	6	S...	no	.088	1.330	2.215
HDU4-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	10	S...	no	.114	1.330	3.285
HDU5-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	14	S...	no	.115	1.330	4.065
HDU8-SDS2.5...	SIMPSON	3	HF	.875	0	n/a	20	S...	no	.084	1.330	4.305
HDU8-SDS2.5...	SIMPSON	3.5	HF	.875	0	n/a	20	S...	no	.116	1.330	5.02
HDU8-SDS2.5...	SIMPSON	4.5	HF	.875	0	n/a	20	S...	no	.113	1.330	5.665
HDU11-SDS2....	SIMPSON	5.5	HF	1	0	n/a	30	S...	no	.137	1.330	6.865

Required Fields

Label

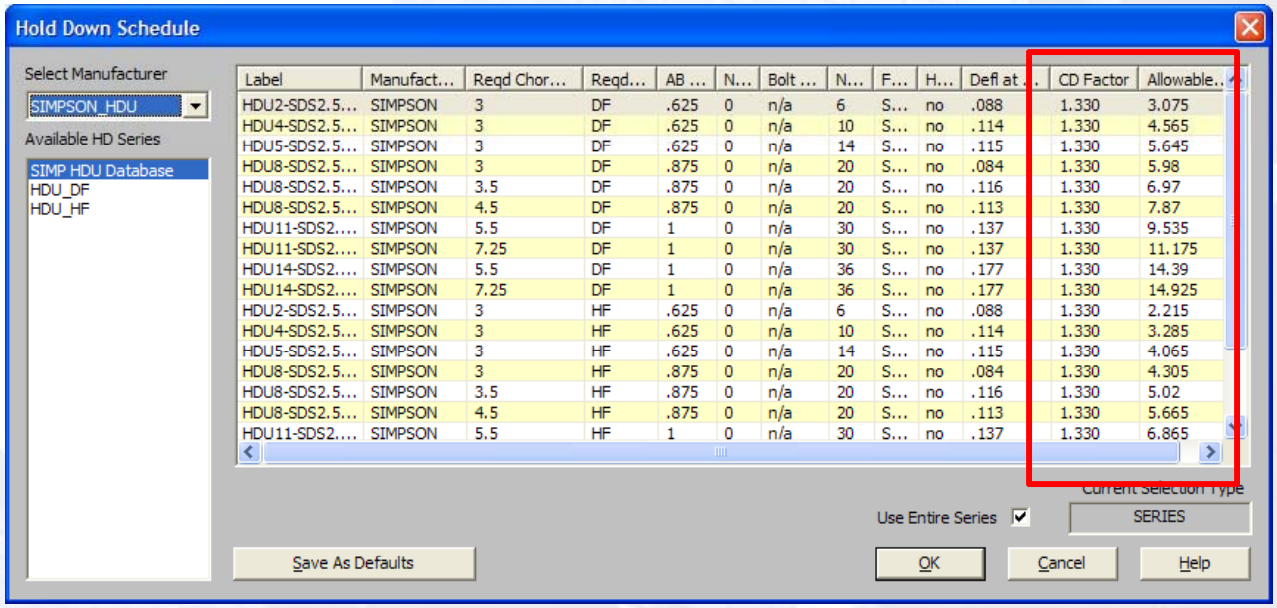
Deflection at Peak Load used to calculate the deflection per APA/NDS formula.

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b}$$

Δ_a = Total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc.) at the induced unit shear in the shear wall, in

Since this is the PEAK Load, to find the actual deflection it is scaled per the actual tension force; by multiplying this value by the holddown ratio given in the output.

Wood Wall Parameters



Label	Manufact...	Reqd Chor...	Reqd...	AB ...	N...	Bolt ...	N...	F...	H...	Defl at ...	CD Factor	Allowable...
HDU2-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	6	S...	no	.088	1.330	3.075
HDU4-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	10	S...	no	.114	1.330	4.565
HDU5-SDS2.5...	SIMPSON	3	DF	.625	0	n/a	14	S...	no	.115	1.330	5.645
HDU8-SDS2.5...	SIMPSON	3	DF	.875	0	n/a	20	S...	no	.084	1.330	5.98
HDU8-SDS2.5...	SIMPSON	3.5	DF	.875	0	n/a	20	S...	no	.116	1.330	6.97
HDU8-SDS2.5...	SIMPSON	4.5	DF	.875	0	n/a	20	S...	no	.113	1.330	7.87
HDU11-SDS2....	SIMPSON	5.5	DF	1	0	n/a	30	S...	no	.137	1.330	9.535
HDU11-SDS2....	SIMPSON	7.25	DF	1	0	n/a	30	S...	no	.137	1.330	11.175
HDU14-SDS2....	SIMPSON	5.5	DF	1	0	n/a	36	S...	no	.177	1.330	14.39
HDU14-SDS2....	SIMPSON	7.25	DF	1	0	n/a	36	S...	no	.177	1.330	14.925
HDU2-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	6	S...	no	.088	1.330	2.215
HDU4-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	10	S...	no	.114	1.330	3.285
HDU5-SDS2.5...	SIMPSON	3	HF	.625	0	n/a	14	S...	no	.115	1.330	4.065
HDU8-SDS2.5...	SIMPSON	3	HF	.875	0	n/a	20	S...	no	.084	1.330	4.305
HDU8-SDS2.5...	SIMPSON	3.5	HF	.875	0	n/a	20	S...	no	.116	1.330	5.02
HDU8-SDS2.5...	SIMPSON	4.5	HF	.875	0	n/a	20	S...	no	.113	1.330	5.665
HDU11-SDS2....	SIMPSON	5.5	HF	1	0	n/a	30	S...	no	.137	1.330	6.865

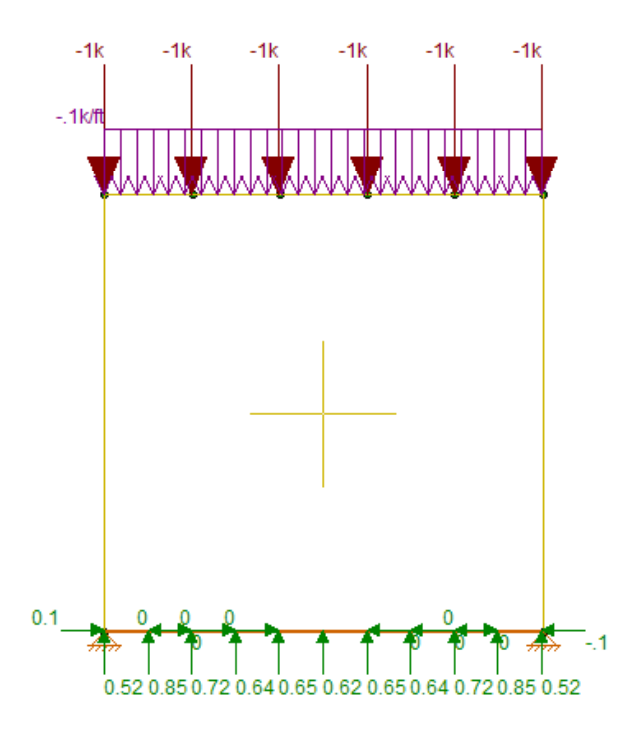
Required Fields

CD Factor- the assumed load duration factor that was used to find the **Allowable Tension** value for that hold down. (1.33 per Simpson Catalog)

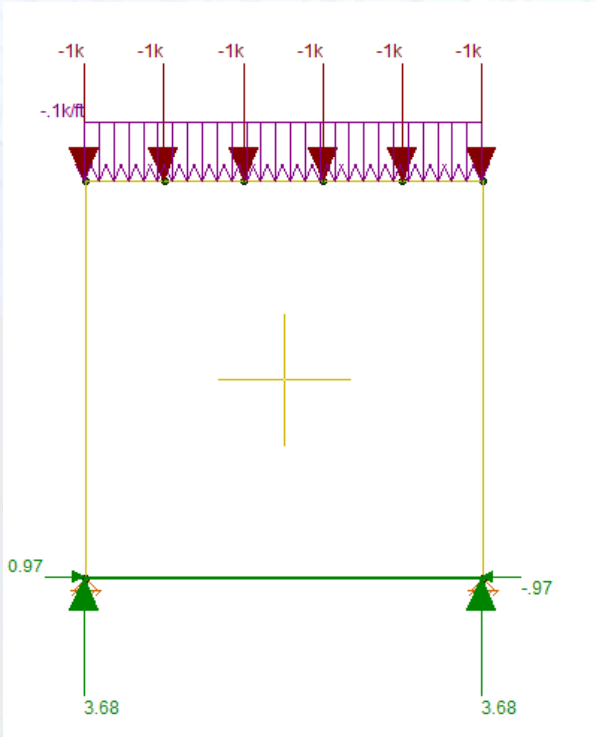
Allowable Tension – from the manufacturer's catalog - adjusted based on the difference between the assumed and actual load duration factors.

All other fields are Optional

Wood Wall Parameters



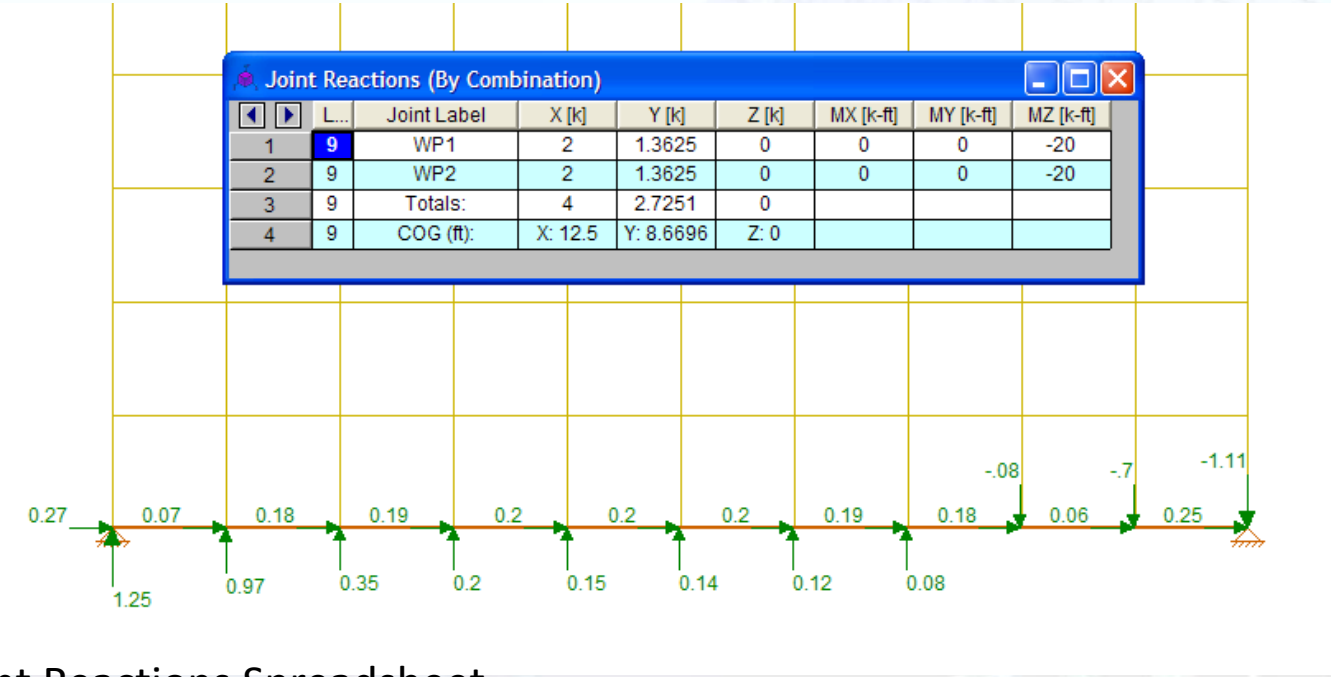
Program Default – Continuous Pinned



Manually set to “FREE” Boundary Condition with HD’s

NOTE: All Wall Boundary Conditions need to be added in the wall panel editor.

Boundary Conditions Assumptions



	L...	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	9	WP1	2	1.3625	0	0	0	-20
2	9	WP2	2	1.3625	0	0	0	-20
3	9	Totals:	4	2.7251	0			
4	9	COG (ft):	X: 12.5	Y: 8.6696	Z: 0			

Joint Reactions Spreadsheet

- Per Wall Reactions- Forces & Moment

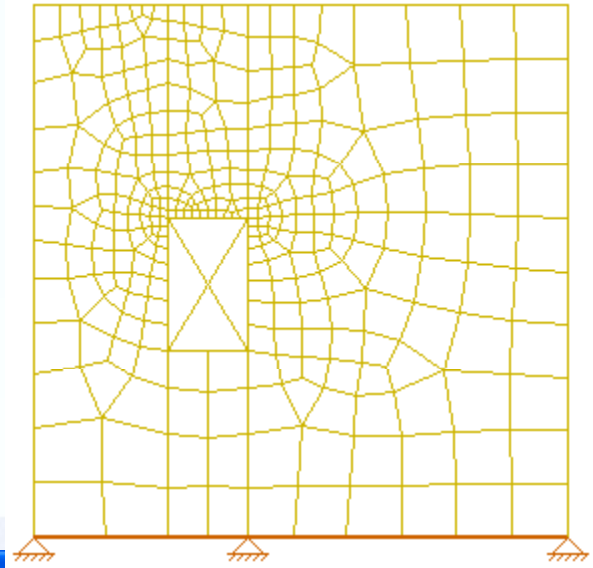
Display Individual Plate forces – Plot Options – Display Joint Reactions

Boundary Conditions Assumptions

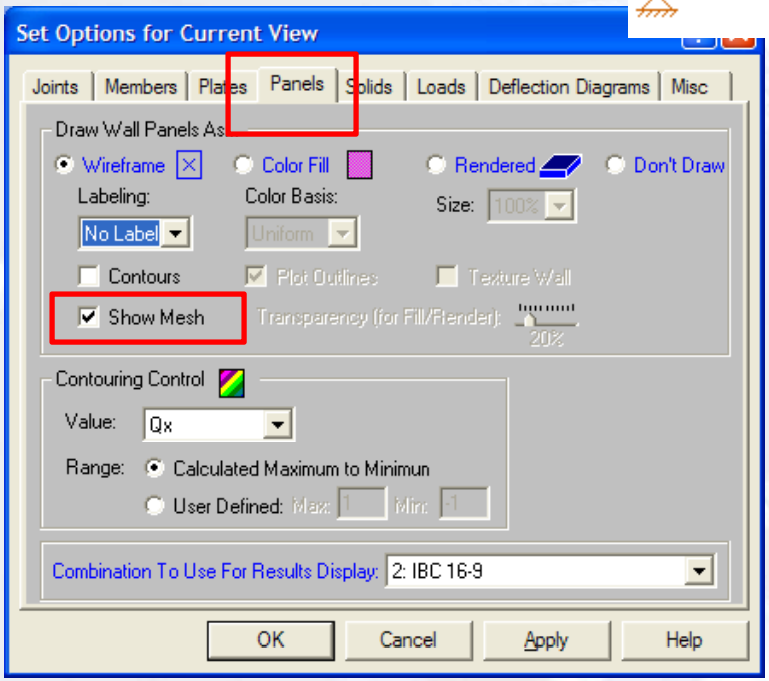
BC Model.r3d

Walls consists of Plate Elements

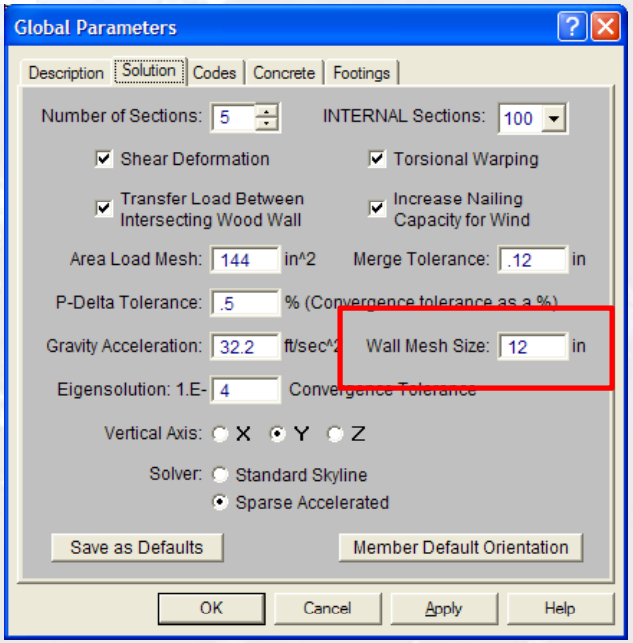
- Automatically meshed



Turn on the Mesh in Plot Options



Mesh Size controlled by Global Parameters



FEA Analysis

Wall Panel Loads

Distributed Loads

- Global Axis (X,Y,Z)
- Local Axis (x,y,z)

Joint Loads

- Joint Loads can be anywhere on the wall
- Need to create a Joint first

Surface Loads

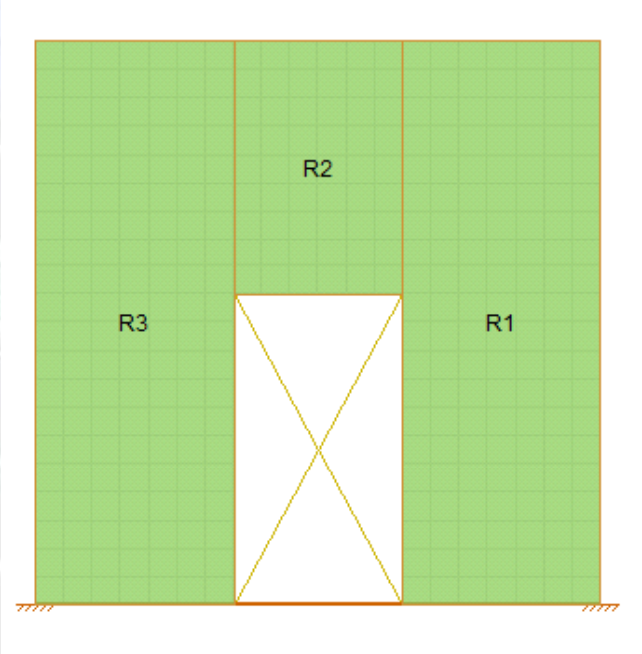
- Not advisable for Wood Walls with Flexible Diaphragms
  Very little Out of Plane Stiffness

Segmented Design based on “Regions” defined within a wall

- A Region must be Rectangular
- Regions can be defined by the user 

  Auto-Defined 

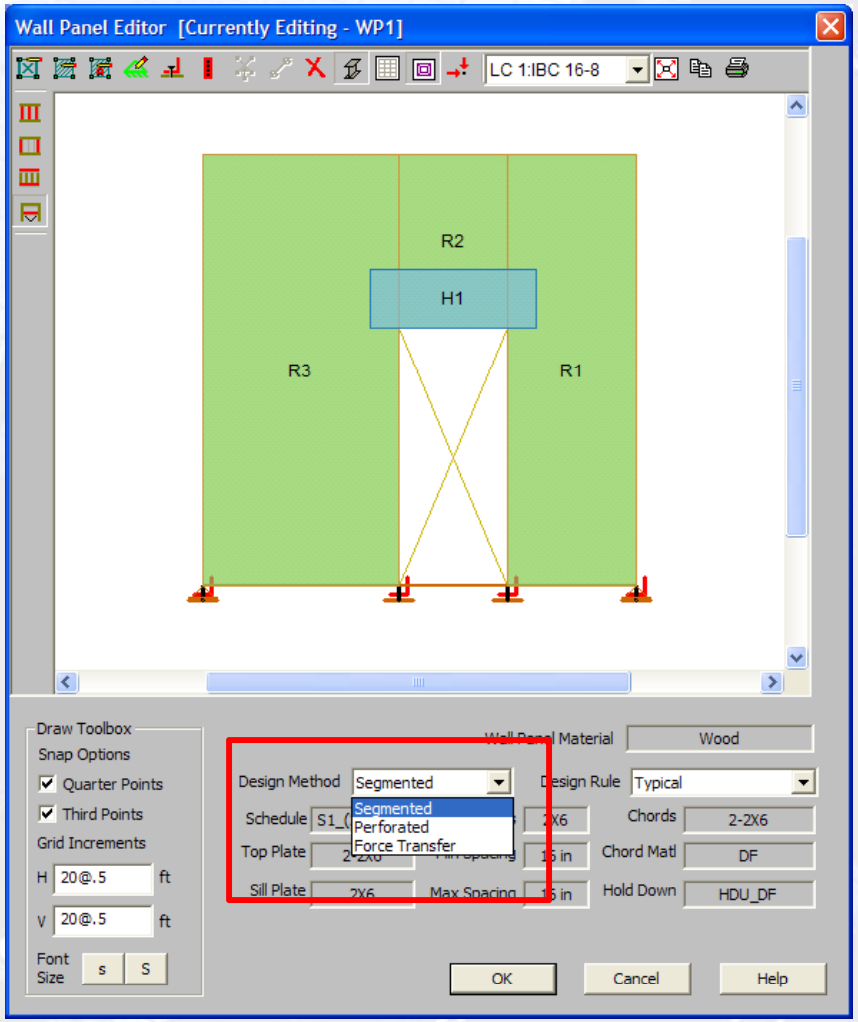
  OR Not defined and Auto-Defined at run-time
- Only the Full-height Regions are designed
- Hold Downs are automatically placed at each side of the region



Segmented Design

Select Design Method in Wall Panel Editor:

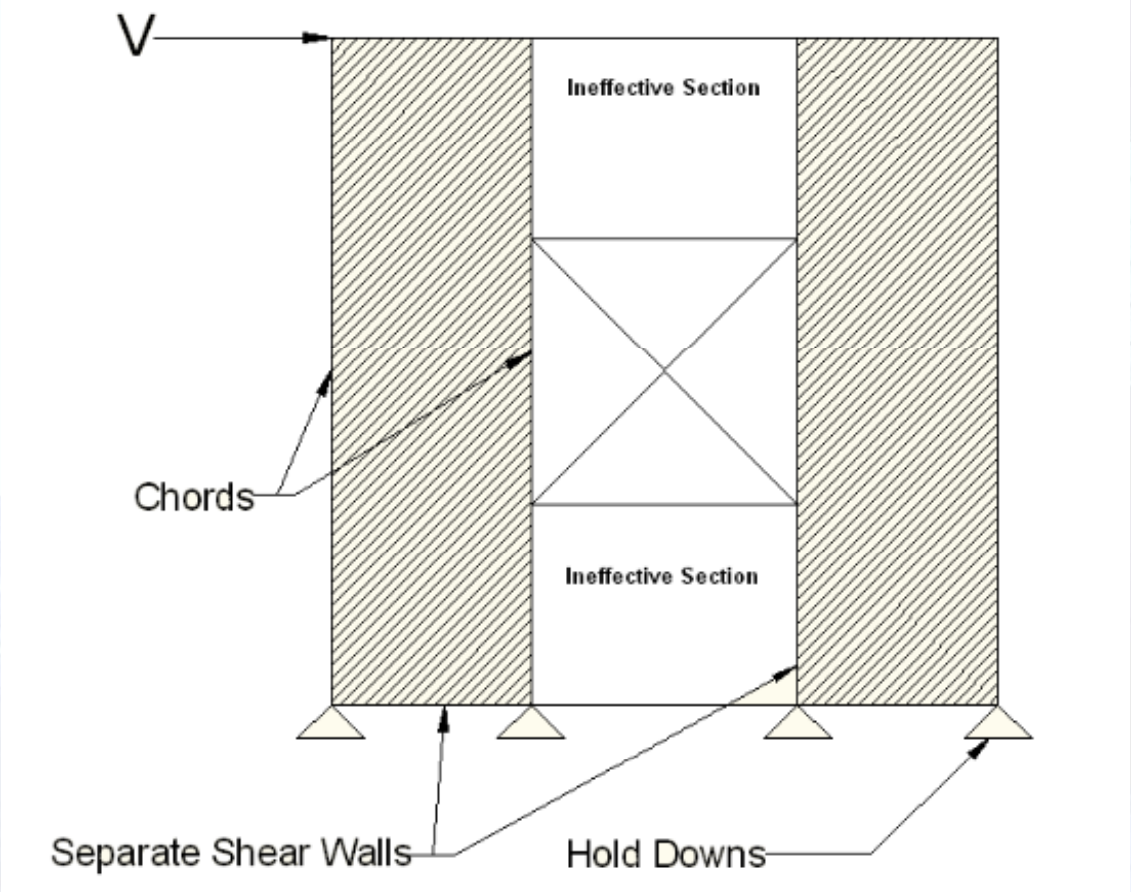
- Segmented
- Perforated
- FTAO



Or in the Wall Panel Spreadsheet

Wall Panel Data

	Label	A Joint	B Joint	C Joint	D Joint	Material Type	Material Set	Thickness...	Design Rule	Design Method
1	WP1	N1	N2	N3	N4	Wood	DF	5.5	Typical	Segmented
2	WP2	N9A	N10A	N11A	N12A	Wood	DF	5.5	Typical	Segmented



- Each Region has Detail Report
  Designing the Chords & Hold-downs per region
- No Header Design in Segmented Design → Ineffective Section
- h/w ratio is required for design (NDS Table 4.3.4)

Segmented Design

Segmented wall design.r3d

Echo Input

Geometry of the Entire wall

Max H/W Ratio- per Region

Enveloped Results

Controlling Region

Region Information

Deflection Information

Detail Report for - WP1

<< >> Print Page Setup Help

Wall

Company :
Designer :
Job Number :

WP1 (In-Plane)

June 16, 2010
10:41 AM
Checked By:_____

GENERAL

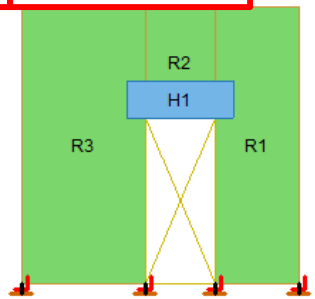
Code : NDS 2005:ASD
Design Method : Segmented
Wall Material : DF
Panel Schedule : User Selected
Sel. Shear Panel: S1_(2)15/32_10d@3

GEOMETRY

Total Height : 10 ft
Total Length : 10 ft
Max H/W Ratio : 3.33

MATERIALS

Description	Material	Size
Top Pl	DF	2-2X6
Sill	DF	2X6
Wall Stud	DF	2X6
Chord	DF	2-2X6



DESIGN DETAILS

ENVELOPED RESULTS

Controlling Shear Region	Shear Panel	Shear UC	Shear LC	Controlling Hold-down	Hold-down UC	Hold-down LC	Chord UC	Chord LC	Stud UC	Stud LC
R3	S1_(2)15/32...	0.890	10 (W)	HDU14-S...	0.902	17 (W)	0.922	10 (W)	0.119	2

REGION INFORMATION

Full-Height Region Label	H/W Ratio	Shear UC	Shear LC	Hold-down	Hold-down UC	Hold-down LC	Chord UC	Chord LC	Stud UC	Stud LC
R1	3.33	0.644	9 (W)	HDU14-SDS2.5...	0.550	18 (W)	0.564	9 (W)	0.119	2
R3	2.22	0.890	10 (W)	HDU14-SDS2.5...	0.902	17 (W)	0.922	10 (W)	0.117	2

OPENING INFORMATION

Headers of openings are not designed for Segmented walls.
Please choose Perforated or FTAO design method to get header design.

DEFLECTION RESULTS

Maximum Region Deflection (in)	Deflection LC	Finite Element Deflection (in)	Shear Stiffness Adjustment Factor (SSAF)
.6814 (R3)	10	.6321	1

Wall Detail Report

NDS Special Design Provisions for Wind And Seismic
Eq 4.3-1

$$\delta_{sw} = \boxed{\frac{8vh^3}{EAb}} + \boxed{\frac{vh}{1000G_a}} + \boxed{\frac{h\Delta_a}{b}}$$

RISA Detail Report

DEFLECTIONS		
Flexure Comp	: .0057	in
Shear Comp	: .1818	in
HD Elong	: .0543	in
Tot Deflection	: .2418	in
Governing LC	: 9	

E = Modulus of elasticity of end posts (chords), psi
A = Area of end post (chord) cross-section, in^2

Ga = Apparent Shear Stiffness from nail slip and panel deformation.
This value (in combination with the Min Panel Thickness) is used to set the elastic stiffness of the wall panel that will be used during the FEM solution.

Δ_a = Total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc.) at the induced unit shear in the shear wall, in

Deflection & FEA Analysis

DEFLECTION RESULTS

Maximum Region Deflection (in)	Deflection LC	Finite Element Deflection (in)	Shear Stiffness Adjustment Factor (SSAF)
.2418 (R1)	9	.2112	1

FEM Deflection → NDS Imperial Equation

Wall Panel Data

	Label	A Joint	B Joint	C Joint	D Joint	Material Type	Material Set	Thickness...	Design Rule	Design Method	SSAF
1	WP1	N1	N3	N4	N5	Wood	DF Larch	5.5	Typical	Segmented	1
2	WP2	N6	N7	N8	N9	Wood	DF Larch	5.5	Typical	Segmented	1

SSAF (Shear Stiffness Adjustment Factor)

This column allows the user to manually adjust the shear stiffness of a particular wall panel.

With this adjustment factor the user can match up the deflections from their hand calculations with the FEM joint deflections at the top nodes in the wall.

Deflection & FEA Analysis

Enveloped Results

Controlling Region

Detail Report for - WP1

<< >> Print Page Setup Help

Wall

Company :
Designer :
Job Number :

WP1 (In-Plane)

June 16, 2010
10:41 AM
Checked By:_____

GENERAL

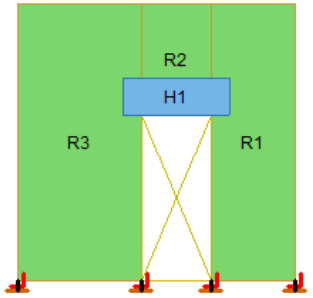
Code : NDS 2005:ASD
Design Method : Segmented
Wall Material : DF
Panel Schedule : User Selected
Sel. Shear Panel: S1_(2)15/32_10d@3

GEOMETRY

Total Height : 10 ft
Total Length : 10 ft
Max H/W Ratio : 3.33

MATERIALS

Description	Material	Size
Top Pl	DF	2-2X6
Sill	DF	2X6
Wall Stud	DF	2X6
Chord	DF	2-2X6



DESIGN DETAILS

ENVELOPED RESULTS

Controlling Shear Region	Shear Panel	Shear UC	Shear LC	Controlling Hold-down	Hold-down UC	Hold-down LC	Chord UC	Chord LC	Stud UC	Stud LC
R3	S1_(2)15/32...	0.890	10 (W)	HDU14-S...	0.902	17 (W)	0.922	10 (W)	0.119	2

REGION INFORMATION

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Please choose Perforated or FTAO design method to get header design.

DEFLECTION RESULTS

Maximum Region Deflection (in)	Deflection LC	Finite Element Deflection (in)	Shear Stiffness Adjustment Factor (SSAF)
.6814 (R3)	10	.6321	1

Wall Detail Report

- **Echo Input**
- **Region Geometry**
  Region H/W
  Capacity Adjustment Factor per 4.3.4.1
  Wind ASIF- NDS give 40% increase in the lateral tabular values
  Stud Spacing- Per Design Rules

Design Summary

- **Shear capacity** from Wall Panel database (based on IBC 06 Table 2306.4.1)

- **Chords Forces**

Region R3

CRITERIA

Code	NDS 2005:ASD
Wall Material	DF
Panel Schedule	User Selected
Optimize HD	No
HD Manufacturer	SIMPSON

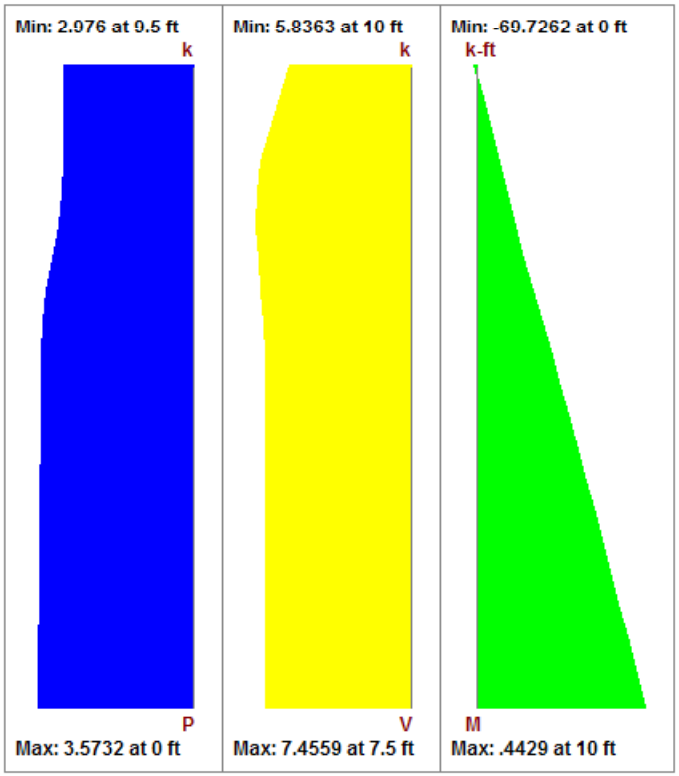
MATERIALS

Wall Studs	DF
Stud Size	2X6
Chord Material	DF
Chord Size	2-2X6
Top Pl & Sill	DF
Top Pl Size	2-2X6
Sill Pl Size	2X6

GEOMETRY

Total Height	10	ft
Total Length	4.5	ft
Region H/W	2.22	
Cap. Adj. (2w/h)	1.00	
Wind ASIF	1.4	
Stud Spacing	16	in

ENVELOPE DIAGRAMS



DESIGN SUMMARY

SHEAR PANEL

Required Cap	1.6569	k/ft
Provided Cap	1.862	k/ft
Ratio	.8898	
Governing LC	10 (Wind)	

CHORDS

Max Comp Force	15.6212	k
Comp Capacity	16.9428	k
Comp Ratio	.922	
Gov Comp LC	10	
Max Tens Force	15.6118	k
Tens Capacity	23.166	k
Tens Ratio	.6739	
Gov Tens LC	17	

STUDS

Required Cap	.8933	k
Provided Cap	7.62	k
Ratio	.1173	
Governing LC	2	

HOLD-DOWNS

Required Cap	15.6118	k
Provided Cap	17.3113	k
Ratio	.9018	
Governing LC	17	

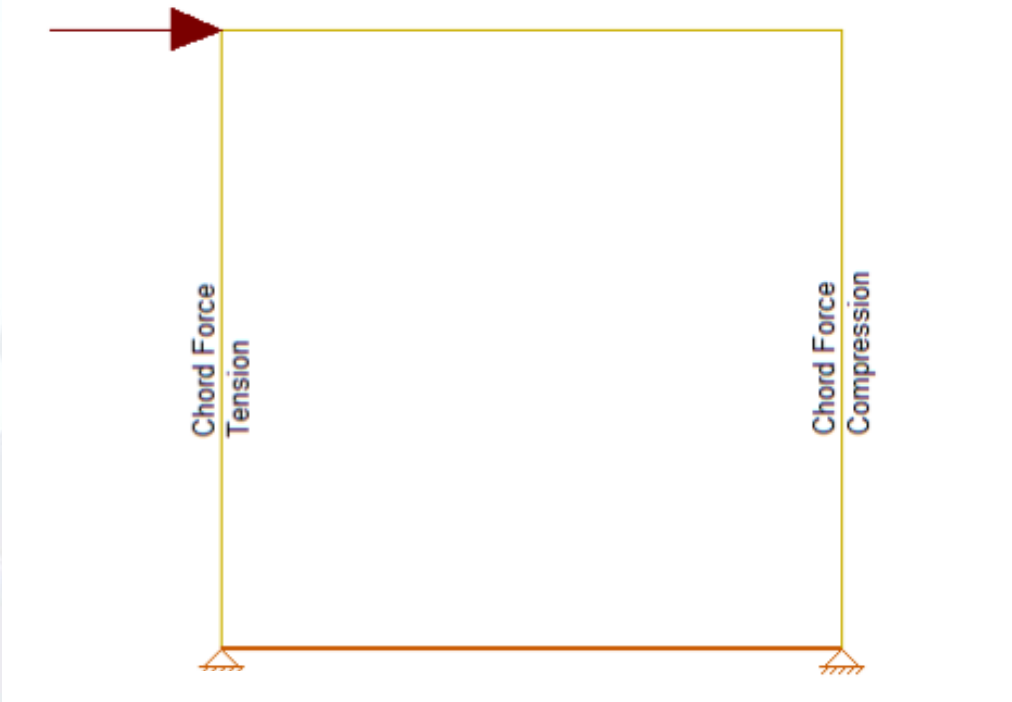
DEFLECTIONS

Flexure Comp	.105	in
Shear Comp	.2301	in
HD Elong	.3463	in
Tot Deflection	.6814	in
Governing LC	10	

Region Detail Report

Chord Forces

- Calculated differently Tension vs. Compression
- Tension: NDS 2005 4.3.6.4.2 includes Dead Load stabilizing moment
- Compression: Include only the tributary area of one stud spacing



Segmented Design: Chord forces based on only one Region

FTAO & Perforated: Chord Forces based on the entire wall

$$\text{Chord Force Tension} = \frac{M}{L} - \frac{P}{2}$$

$$\text{Chord Force Compression} = \frac{M}{L} + \frac{P}{\#\ \text{Studs}}$$

M = Max Moment in the wall
L = Length of the wall
P = Axial Force in the wall

Chord Design

Stud Design

- Stud design is based on the Enveloping the maximum section forces from each region over the entire wall.
- Stud Spacing based on Required Capacity (unless spacing explicit in Design Rules)
- Code Check: Required Cap / Provided Cap
- Optimizing spacing starts at max and work its way down at 2" increments

NOTE: All the load combos considered
Run a batch solution with only Gravity only loads

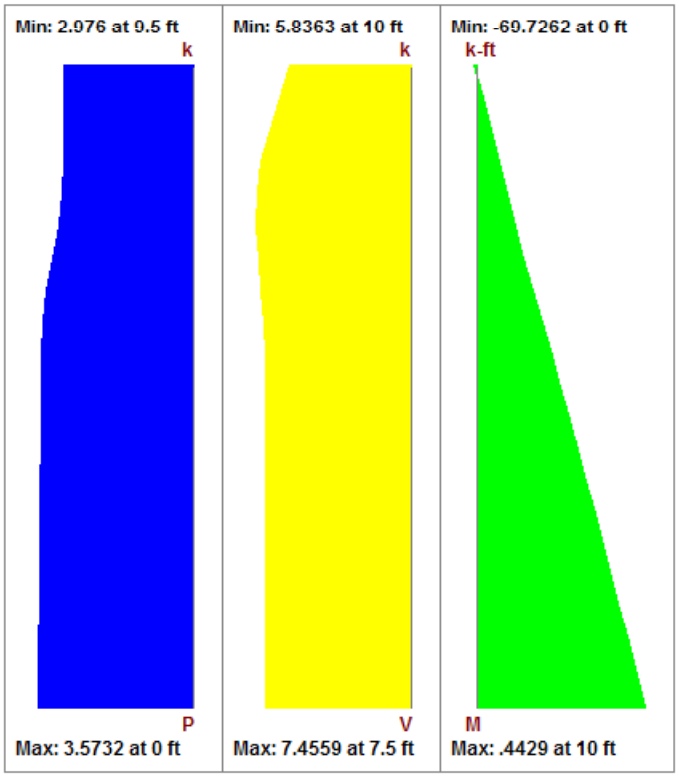
Region R3

CRITERIA
Code : NDS 2005:ASD
Wall Material : DF
Panel Schedule : User Selected
Optimize HD : No
HD Manufacturer: SIMPSON

MATERIALS
Wall Studs : DF
Stud Size : 2X6
Chord Material : DF
Chord Size : 2-2X6
Top Pl & Sill : DF
Top Pl Size : 2-2X6
Sill Pl Size : 2X6

GEOMETRY
Total Height : 10 ft
Total Length : 4.5 ft
Region H/W : 2.22
Cap. Adj. (2w/h) : 1.00
Wind ASIF : 1.4
Stud Spacing : 16 in

ENVELOPE DIAGRAMS



DESIGN SUMMARY

SHEAR PANEL
Required Cap : 1.6569 k/ft
Provided Cap : 1.862 k/ft
Ratio : .8898
Governing LC : 10 (Wind)

CHORDS
Max Comp Force: 15.6212 k
Comp Capacity : 16.9428 k
Comp Ratio : .922
Gov Comp LC : 10
Max Tens Force : 15.6118 k
Tens Capacity : 23.166 k
Tens Ratio : .6739
Gov Tens LC : 17

STUDS
Required Cap : .8933k
Provided Cap : 7.62 k
Ratio : .1173
Governing LC : 2

HOLD-DOWNS
Required Cap : 15.6118k
Provided Cap : 17.3113k
Ratio : .9018
Governing LC : 17

DEFLECTIONS
Flexure Comp : .105 in
Shear Comp : .2301 in
HD Elong : .3463 in
Tot Deflection : .6814 in
Governing LC : 10

Region Detail Report

Hold Down Forces

- Tension only forces
- Provided Cap is the **Allowable Tension** column of the hold-down database.
- The hold-down LC Governing is the largest tension force.

NOTE: The HD Deflection is reported for the maximum shear LC, which may not result in the largest hold-down component, but typically results in the highest total deflection.

Region R3

CRITERIA
Code : NDS 2005:ASD

Wall Material : DF
Panel Schedule : User Selected

Optimize HD : No
HD Manufacturer: SIMPSON

MATERIALS
Wall Studs : DF
Stud Size : 2X6

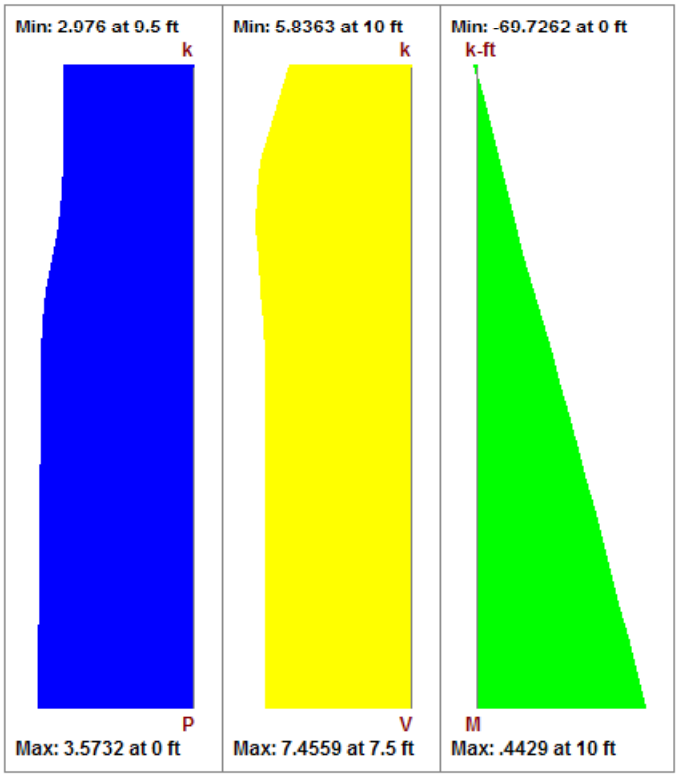
Chord Material : DF
Chord Size : 2-2X6

Top Pl & Sill : DF
Top Pl Size : 2-2X6
Sill Pl Size : 2X6

GEOMETRY
Total Height : 10 ft
Total Length : 4.5 ft

Region H/W : 2.22
Cap. Adj. (2w/h) : 1.00
Wind ASIF : 1.4
Stud Spacing : 16 in

ENVELOPE DIAGRAMS



DESIGN SUMMARY

SHEAR PANEL
Required Cap : 1.6569 k/ft
Provided Cap : 1.862 k/ft
Ratio : .8898
Governing LC : 10 (Wind)

CHORDS
Max Comp Force: 15.6212 k
Comp Capacity : 16.9428 k
Comp Ratio : .922
Gov Comp LC : 10
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Tens Ratio : .6739
Gov Tens LC : 17

STUDS
Required Cap : .8933k
Provided Cap : 7.62 k
Ratio : .1173
Governing LC : 2

HOLD-DOWNS
Required Cap : 15.6118k
Provided Cap : 17.3113k
Ratio : .9018
Governing LC : 17

DEFLECTIONS
Flexure Comp : .105 in
Shear Comp : .2301 in
HD Elong : .3463 in
Tot Deflection : .6814 in
Governing LC : 10

Region Detail Report

DESIGN DETAILS

SELECTED SHEAR PANEL : S1_(2)15/32_10d@3

Panel Grade	: St-I		Nail Size	: 10d		Num Sides	: Two	
Panel Thick	: 0.469	in	Reqd Pen	: 1.250	in	Over Gyp Brd	: No	
			Reqd. Spacing	: 3	in	Shear Capacity	: 1.330	k/ft
						Adjusted Cap	: 1.862	k/ft

NOTE: NDS 2005 defines a 10d nail as being 3.0" x 0.1480" common or 3.0" x 0.122" galvanized box

SELECTED HOLD-DOWN : HDU14-SDS2.5_5.5_DF

Raised	: No		Fastener Size	: SDS25212		Reqd Chord Thk	: 5.50	in
AB Diameter	: 1.000	in	Num Fasteners	: 36		Reqd Chord Mat	: Douglas Fir	
						Base Capacity	: 10.820	k
						CD factor	: 1.6	

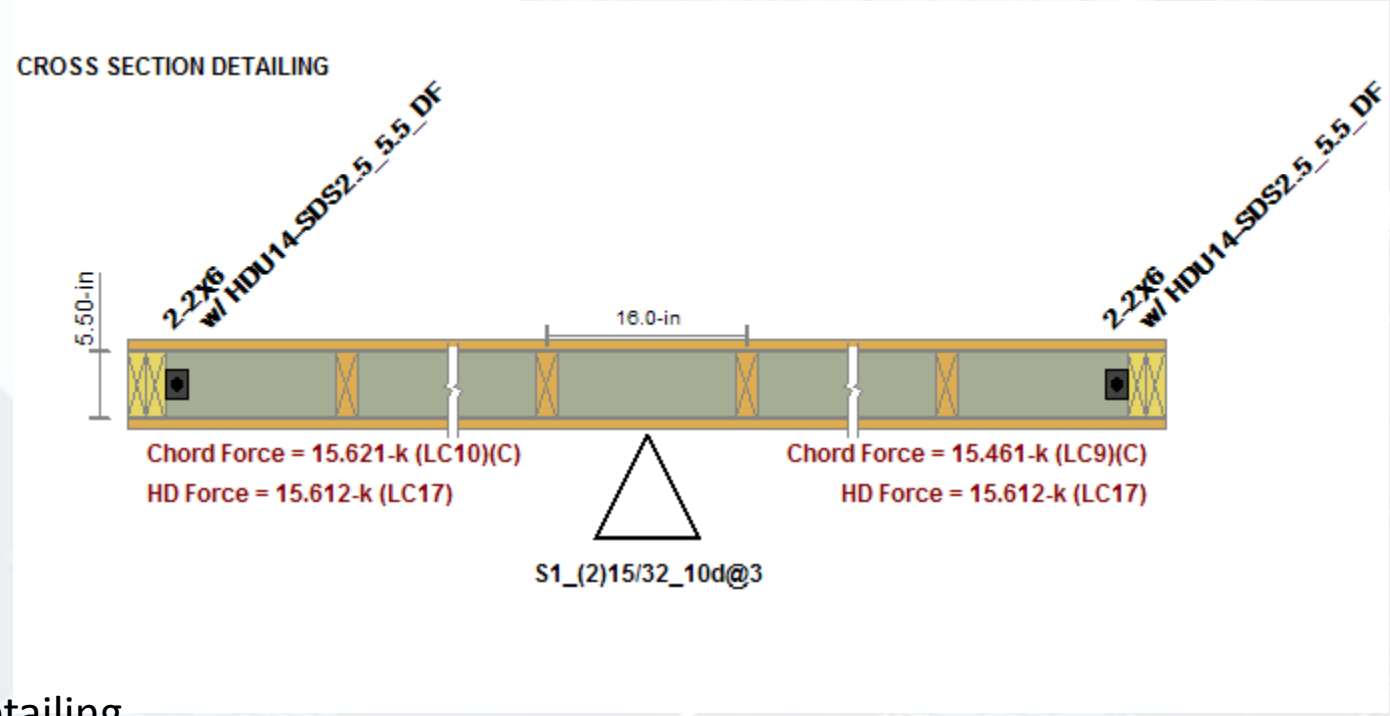
Selected Shear Panel

- Echo all information from Shear Panel Database
- Adjusted Capacity:
  - Seismic force controls: 2bs/h from IBC06 2305.3.8.2.2.3
  - Wind force controls: 1.4 Increase

Selected Hold-Down

- Echo all information from Hold-Down Database
- The "Base Capacity" is the capacity from the manufacturer divided by the assumed Cd value from the database. The actual capacity of the hold-down is the Base Capacity*CD factor.

Region Detail Report



Cross Section Detailing

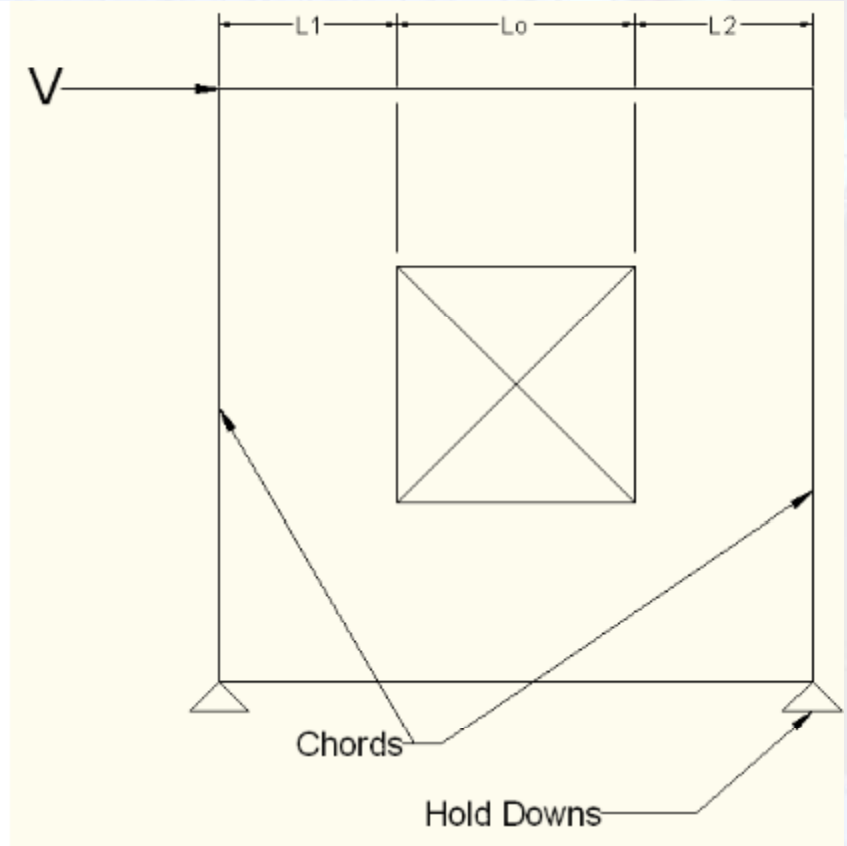
- Wall thickness, and stud spacing
- Sheathing panel designation.
- Chord sizes/forces with T= Tension, or C=Compression forces
- Hold down designations/forces

Note: If either chord is only experiencing a compression ONLY force, the hold down will not be drawn.

Region Detail Report

Perforated Design

- Use only the portions of wall that have full height sheathing
- Treat the wall instead as a significantly shorter wall.
- Amplifies the chord and hold down design forces significantly while at the same time increasing the design unit shear
- There are a number of Code constraints- which are enforced in RISA (NDS05 4.3.5.3)
- Hold Downs only at the ends of the walls



Perforated Design

Perforated wall design.r3d

Perforated Design- Header Design

- All Load combinations enveloped
- Header suggestion: Run Gravity Loads for design

CRITERIA

Code : NDS 2005: ASD
Wall Type : Perforated

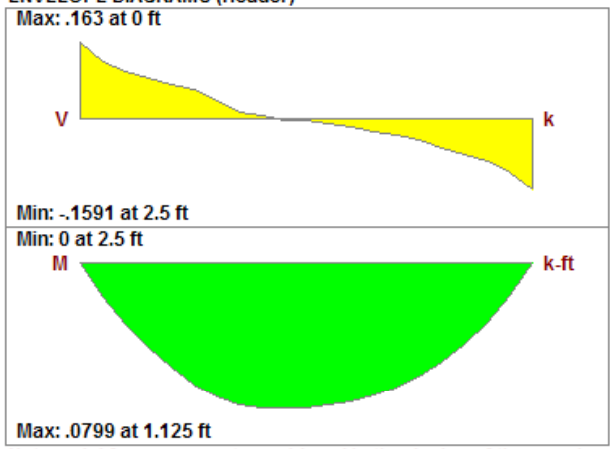
GEOMETRY

Opening Height: 6 ft
Opening Width : 2.5 ft
h/w ratio : 2.4

MATERIALS

Description	Material	Size
Header	DF	6x8
Sill	DF	2X6
Trimmer	DF	6x6

ENVELOPE DIAGRAMS (Header)



Note: axial forces are not considered in the design of the member.

DESIGN DETAILS

HEADER

Max Bending Check	0.015	Max Shear Check	0.035 (y)
Location	1.125 ft	Location	0 ft
Equation	3.9-3	Gov LC	2

CD 1.000 RB 2.727 CL 1.000
Cr 1.000

	(ksi)	Cm	Ct	CF
Fb1'	1.2	1	1	1
Fv'	.17	1	1	

Le-Bending 2.5 ft

- Code check based on Shear and Moment only
  Not Axial Loads

Perforated Design

Perforated wall design.r3d

The length of the wall is calculated:

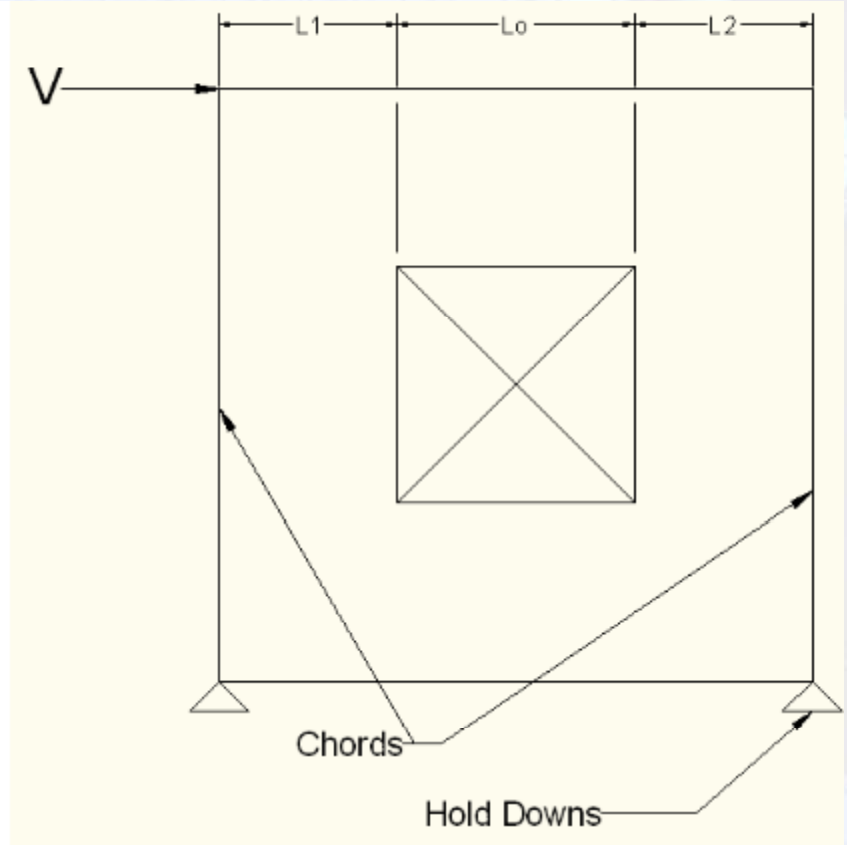
$$\Sigma L_i := L1 + L2$$

Max induced unit shear force (NDS05 4.3-6):

$$v_{max} := \frac{V}{C_o \cdot \Sigma L_i}$$

Tension and Compression Chord forces (NDS05 4.3-5)

$$T := \frac{V \cdot h}{C_o \cdot \Sigma L_i}$$



Co = Shear Capacity Adjustment Factor (NDS05 Table 4.3.3.4)

or

Calc using equ. available in NDS08

$$Co = \left(\frac{r}{3-(2*r)}\right) * \frac{Ltot}{\Sigma Li} \qquad r = \frac{1}{1+\left(\frac{Ao}{h*\Sigma Li}\right)}$$

Perforated Design

$$Co = \left(\frac{r}{3-(2*r)}\right) * \frac{Ltot}{\Sigma Li}$$

$$r = \frac{1}{1+\left(\frac{Ao}{h*\Sigma Li}\right)}$$

Ao defined by NDS05 Table 4.3.3.4

"maximum opening height shall be taken as the Maximum opening clear height in a perforated shear wall."

Ao= 2.5' * 5' = 15 ft2

$$r = \frac{1}{1+(15/10*7.5)} = .83$$

$$Co = \frac{.83}{3-(2x0.83)} * \frac{10'}{7.5'} = .83$$

GENERAL

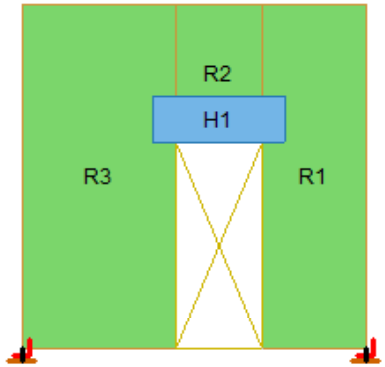
Code	: NDS 2005:ASD
Design Method	: Perforated
Wall Material	: DF
Panel Schedule	: User Selected
Optimize HD	: No
HD Manufacturer:	SIMPSON

GEOMETRY

Total Height	: 10	ft
Total Length	: 10	ft
Wall H/W Ratio	: 1.00	
Max Opening Ht	: 6.00	ft
Open/Wall Ht Ratio	: 0.60	
Full Ht Sheathed	: 7.50	ft
% Full Ht Sheathed	: 75.00	

MATERIALS

Description	Material	Size
Top Pl	DF	2-2X6
Sill	DF	2X6
Wall Stud	DF	2X6
Chord	DF	2-2X6



DESIGN DETAILS

Shear Stiffness Adjustment Factor	: 1.00
Wall Capacity Adjustment Factor (2w/h):	1.00
Nailing Capacity Increase for Wind	: 1.4

Shear Capacity Adjustment Factor (Co):	0.83	
Total Area of Openings (Ao)	: 15.00	ft^2
Sheathing Area Ratio (r)	: 0.83	

Perforated Design

$$Co = \left(\frac{r}{3-(2*r)}\right) * \frac{Ltot}{\Sigma Li}$$

$$r = \frac{1}{1+\left(\frac{Ao}{h*\Sigma Li}\right)}$$

Ao defined by NDS05 Table 4.3.3.4

"maximum opening height shall be taken as the Maximum opening clear height in a perforated shear wall."

Ao= 2.5' *3.5' = 8.75 ft2

$$r = \frac{1}{1+(8.75/10*7.5)} = .90$$

$$Co = \frac{.90}{3-(2x0.90)} * \frac{10'}{7.5'} = .99$$

GENERAL

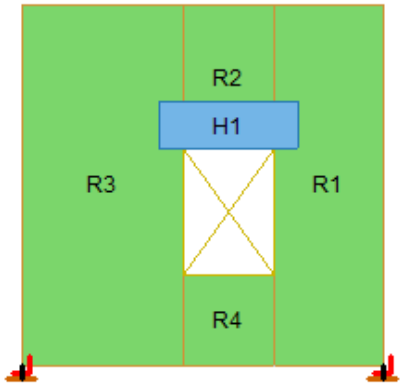
Code	: NDS 2005:ASD
Design Method	: Perforated
Wall Material	: DF
Panel Schedule	: User Selected
Optimize HD	: No
HD Manufacturer:	SIMPSON

GEOMETRY

Total Height	: 10	ft
Total Length	: 10	ft
Wall H/W Ratio	: 1.00	
Max Opening Ht	: 3.50	ft
Open/Wall Ht Ratio	: 0.35	
Full Ht Sheathed	: 7.50	ft
% Full Ht Sheathed	: 75.00	

MATERIALS

Description	Material	Size
Top Pl	DF	2-2X6
Sill	DF	2X6
Wall Stud	DF	2X6
Chord	DF	2-2X6



DESIGN DETAILS

Shear Stiffness Adjustment Factor	: 1.00	
Wall Capacity Adjustment Factor (2w/h):	1.00	
Nailing Capacity Increase for Wind	: 1.4	
Shear Capacity Adjustment Factor (Co):	0.99	
Total Area of Openings (Ao)	: 8.75	ft^2
Sheathing Area Ratio (r)	: 0.90	

Perforated Design

Chord Forces

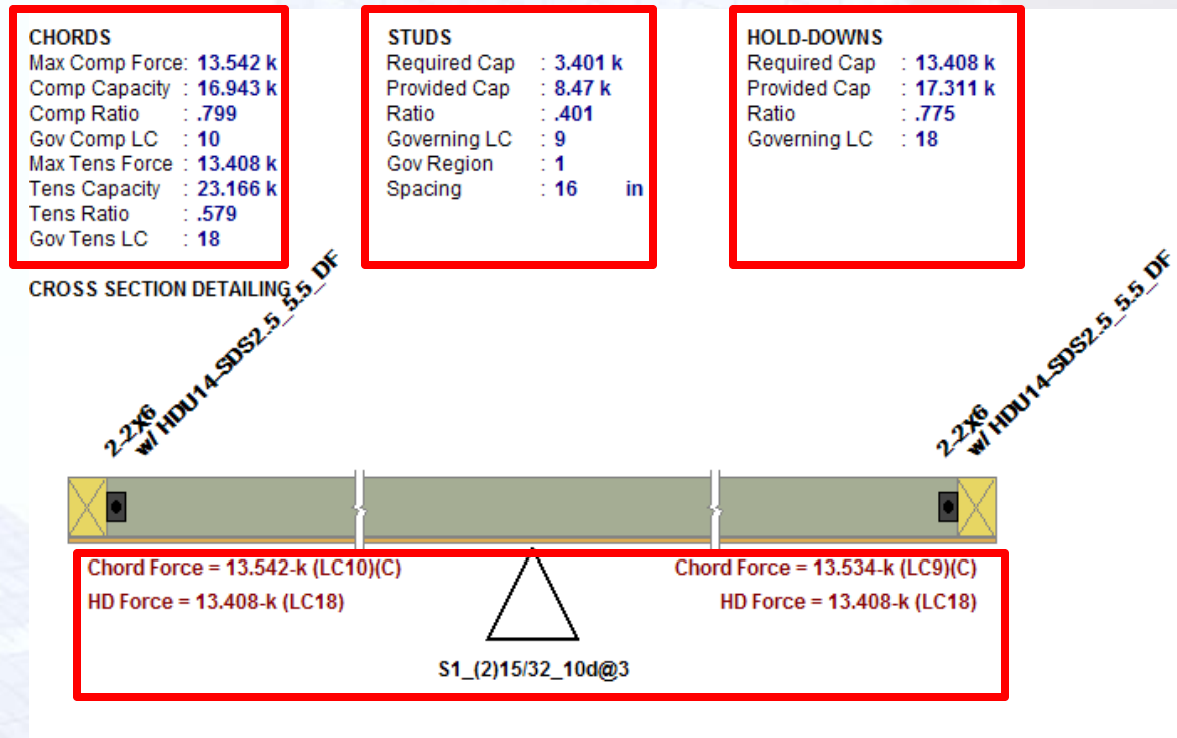
- Each side of the wall is governed by different Load Combinations (T or C)

Stud Design

- Design Spacing

Hold Downs

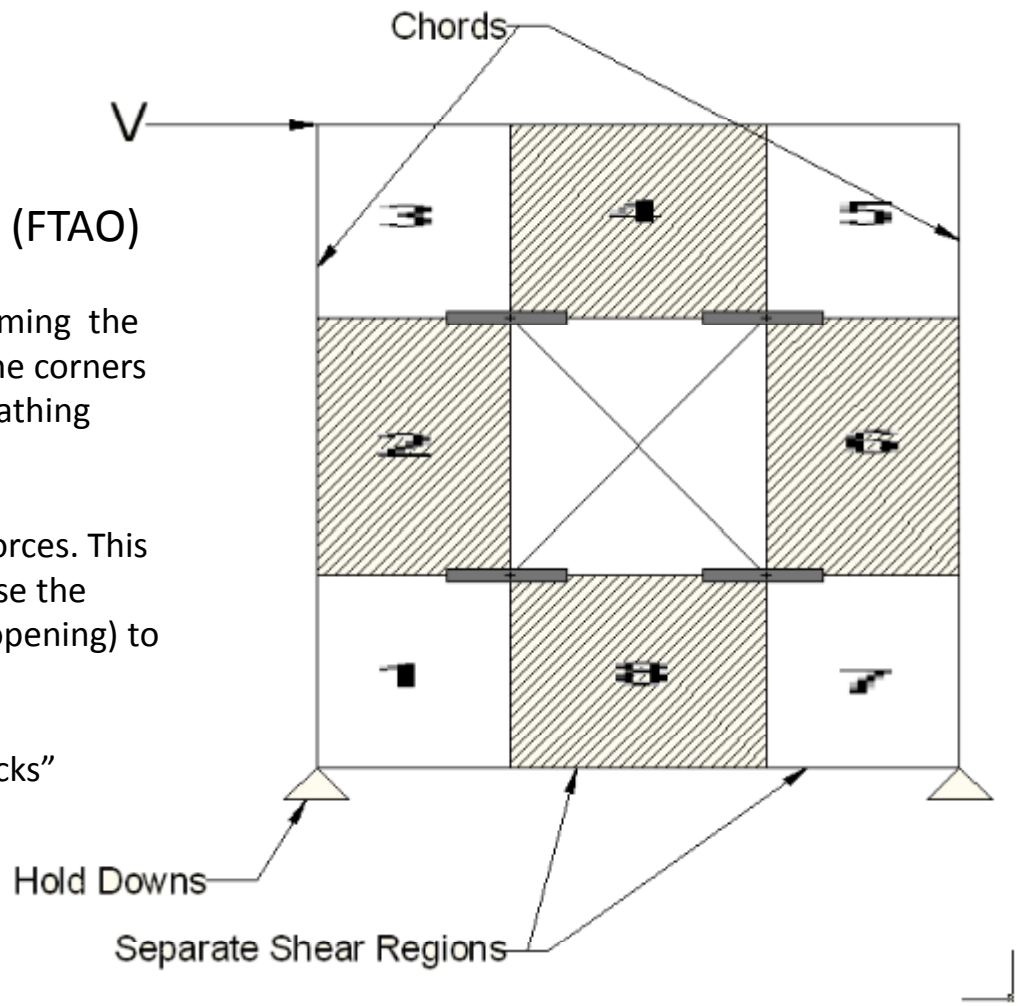
- Only Tension forces displayed



Perforated & FTAO Design

Force Transfer Around Openings (FTAO)

- Rational analysis of the wall assuming the straps and blocking can added at the corners of the openings to transfer the sheathing forces across these joints.
- The sheathing resists the shear forces. This method essentially allows you to use the entire area of the wall (minus the opening) to resist the shear in the wall.
- RISA breaks up the wall into “Blocks”
- Only valid for Windows not Doors



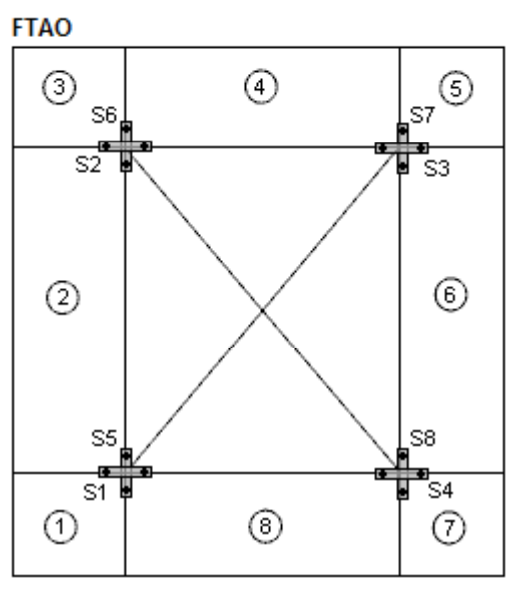
FTAO Wall

FTAO wall .r3d

Header Detail Report

ANALYSIS SUMMARY

Block #	Unit Shear (lb/ft)	h/w Ratio
1	217.068	0.625
2	435.604	1.000
3	152.254	0.375
4	326.066	0.214
5	151.505	0.375
6	438.770	1.000
7	219.314	0.625
8	250.281	0.357

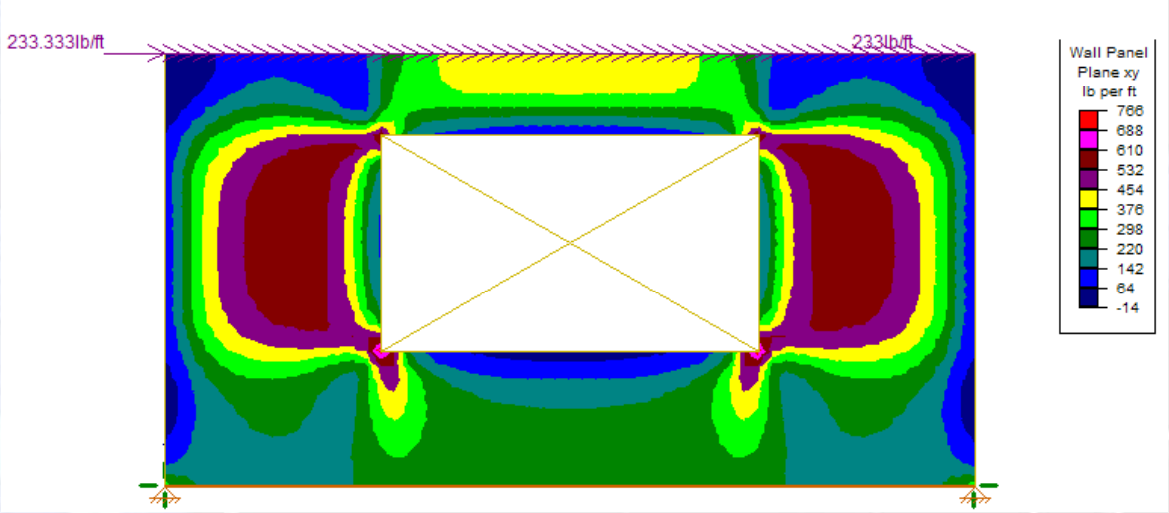


- The **average** shear force in each block of the wall is displayed that location.

- The **maximum** shear in each of these locations will control the design of the wall.

Display Panel Contours: Fxy

- Area weighted average of the Fxy plate forces to determine the average shear for each block.



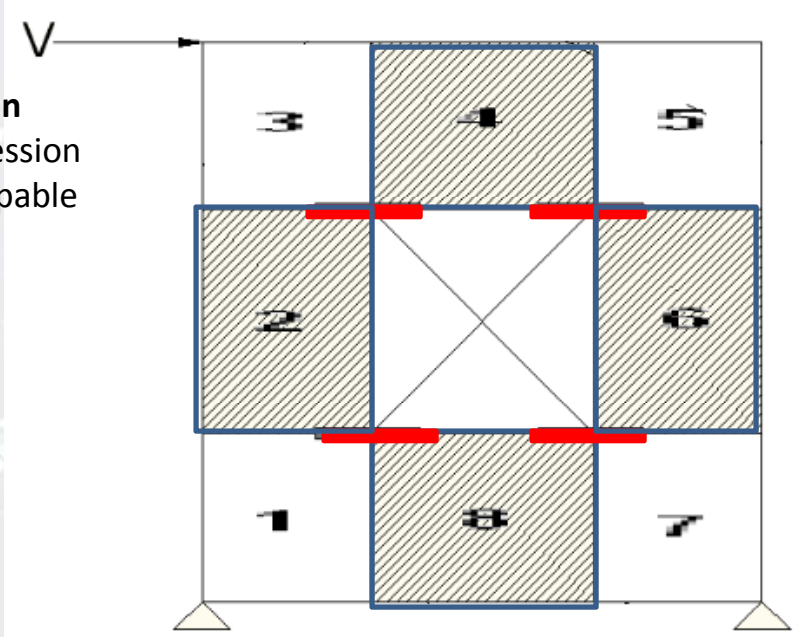
FTAO Wall

Header Detail Report

DESIGN DETAILS
OPENING STRAPS

Name	Location	Direction	Req'd Cap (lb)	Gov LC
S1	Bottom, Left	Horizontal	388.5	1
S2	Upper, Left	Horizontal	-476.5	1
S3	Upper, Right	Horizontal	485.4	1
S4	Bottom, Right	Horizontal	-393.1	1
S5	Bottom, Left	Vertical	1687.1	1
S6	Upper, Left	Vertical	-54.8	1
S7	Upper, Right	Vertical	84.0	1
S8	Bottom, Right	Vertical	-1670.7	1

- The Strap Forces are shown based on the Blocks
- The moment at the edge of each block **above or below an opening** is transmitted across the opening interface by horizontal tension straps or compression blocks
- The moment at the edge of each block that is to the **right or left of an opening** is transmitted across the opening by tension straps or compression blocks. However it is likely that the sheathing and king studs will be capable of transmitting these forces.



FTAO Wall

FTAO Wall Results ⟷ Perforated Wall Results

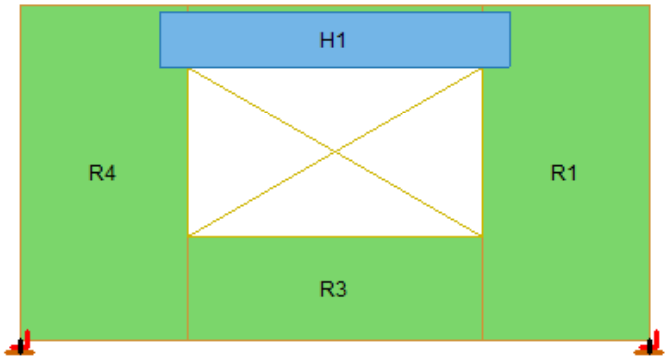
- **Echo Input**
- **Design Details**
  SSAF
  Capacity Adjustment Factor per 4.3.4.1
- **Wall Deflections** NDS Eq 4.3-1
- **Wall Results:**
  Max Unit Shear: Max Block Shear from Header Detail Report
  Total Shear

GENERAL
Code : NDS 2005:ASD
Design Method : FTAO
Wall Material : DF Larch
Panel Schedule : User Selected
Optimize HD : No
HD Manufacturer: SIMPSON

GEOMETRY
Total Height : 8 ft
Total Length : 15 ft
Wall H/W Ratio : 0.53

MATERIALS

Description	Material	Size
Top Pl	DF Larch	2-2X6
Sill	DF Larch	2X6
Wall Stud	DF Larch	2X6
Chord	DF Larch	2-2X6



DESIGN DETAILS
Shear Stiffness Adjustment Factor : 1.00
Wall Capacity Adjustment Factor (2w/h): 1.00

WALL DEFLECTIONS
Elastic: : .004 in
HD: : .015 in
Shear: : .092 in
Total: : .111 in

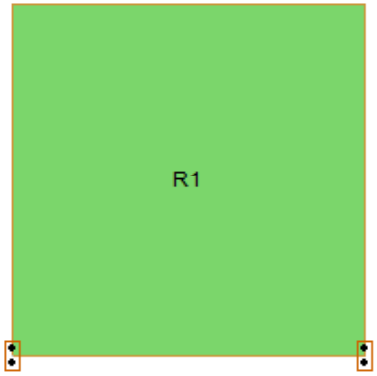
WALL RESULTS:
Governing LC : 1 (Seismic)
Total Shear : 3497.49 lb
Max Unit Shear : 438.77 lb/ft
Shear Ratio : .954

SELECTED SHEAR PANEL : S1_(2)3/8_8d@6
Panel Grade : St-I
Panel Thick : 0.375in
Nail Size : 8d
Reqd Pen : 1.375in
Reqd. Spacing : 6 in
Num Sides : Two
Over Gyp Brd. : No
Shear Capacity : 459.996 lb/ft
Adjusted Cap : 459.996 lb/ft

NOTE: NDS 2005 defines a 8d nail as being: 2.5" x 0.1310" common, or
2.5" x 0.113" galvanized box

Walls can be stacked on top of each other using Straps

- Straps are used for anchorage to the wall panel below
- You can only add straps after Regions are added
- Strap forces are only Tension forces



DESIGN DETAILS

ENVELOPED RESULTS

Controlling Shear Region	Shear Panel	Shear UC	Shear LC	Strap Force (k)	Strap LC	Chord UC	Chord LC	Stud UC	Stud LC
R1	RS_3/8_8d@3	0.976	1 (S)	4.000	2 (S)	0.333	2 (S)	0.000	1 (S)

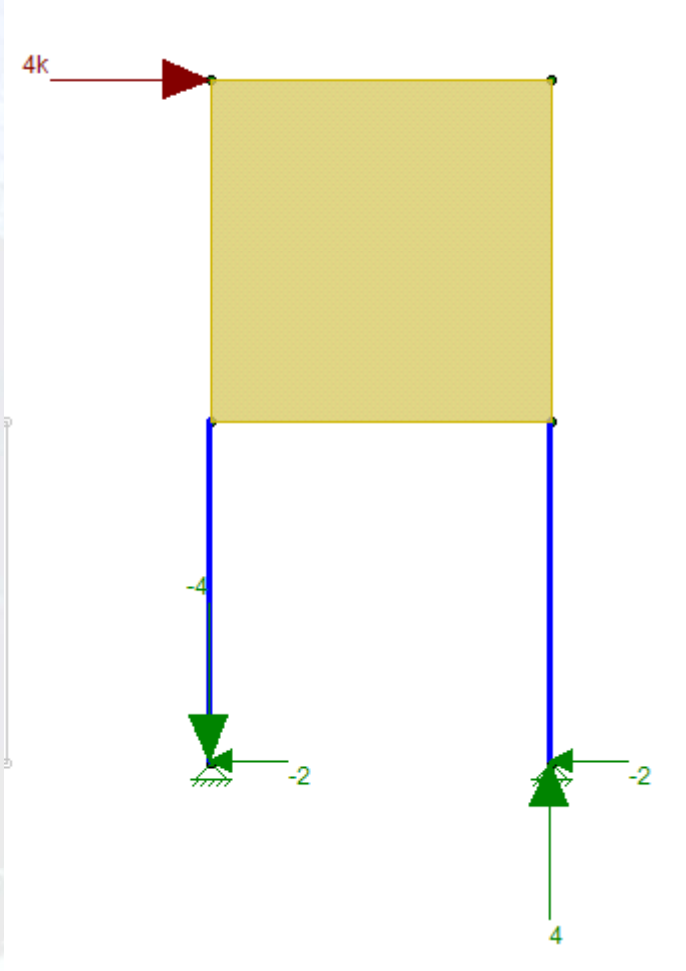
REGION INFORMATION

Full-Height Region Label	H/W Ratio	Shear UC	Shear LC	Strap Force (k)	Strap LC	Chord UC	Chord LC	Stud UC	Stud LC
R1	1.00	0.976	1 (S)	4.000	2 (S)	0.333	2 (S)	0.000	1 (S)

Strap Forces

Straps can be used to tie walls to Columns below

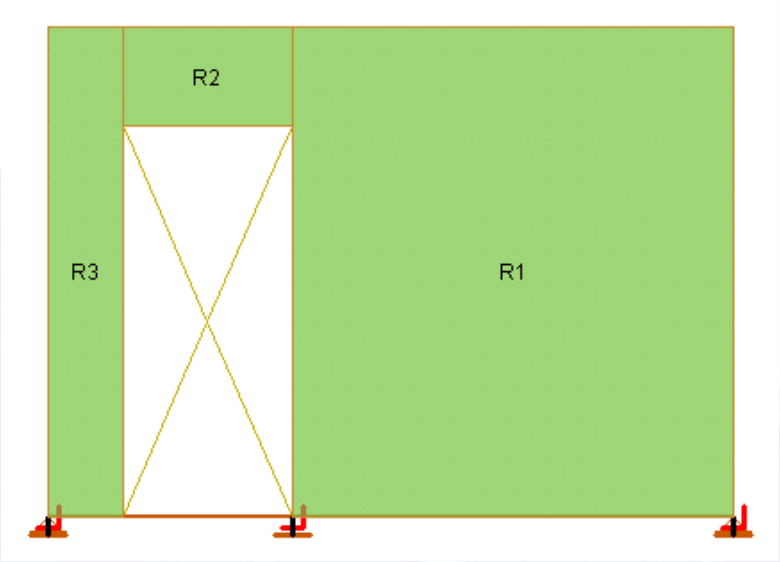
- You will need to manually add these straps in the Wall Panel Editor



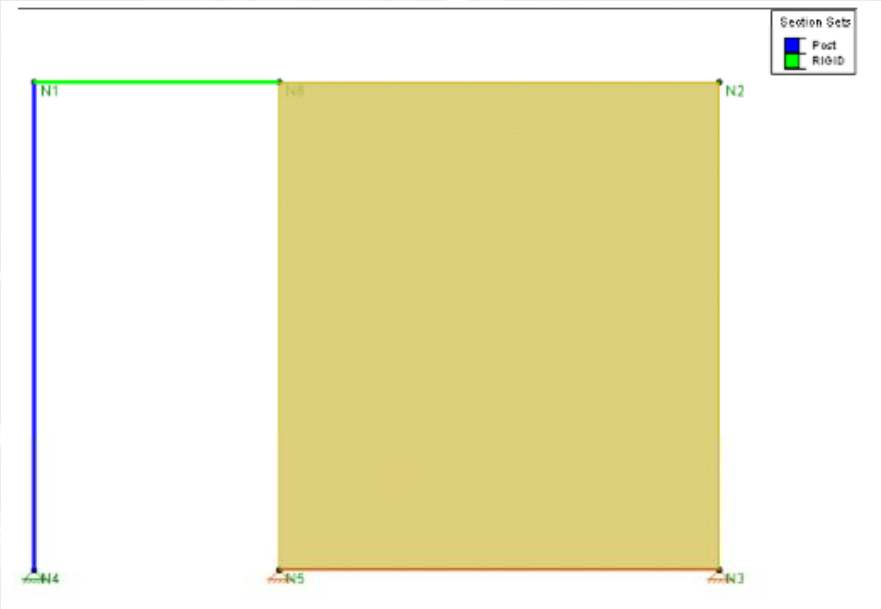
Strap Forces

Soft Story.r3d

Problem: R3 Does not meet the Aspect Ratio. Design Not Done

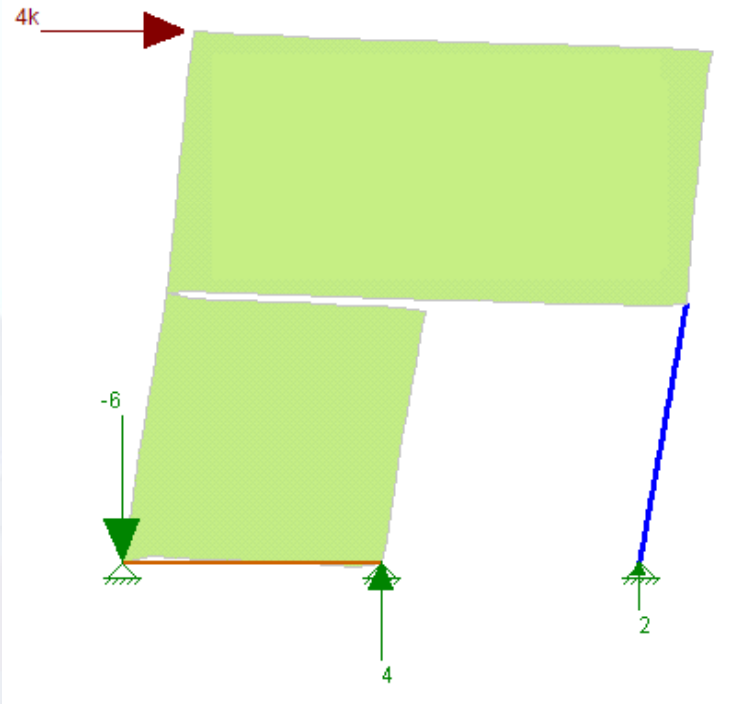


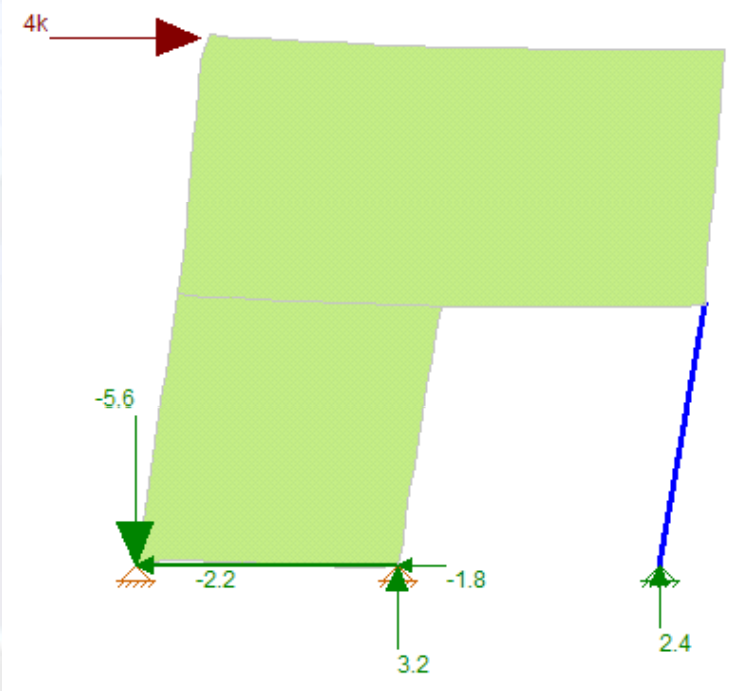
Fix: Draw Post and Beam next to the wall



Common Problems

Problem: Soft Story Hand Calculations ≠ FEM Model



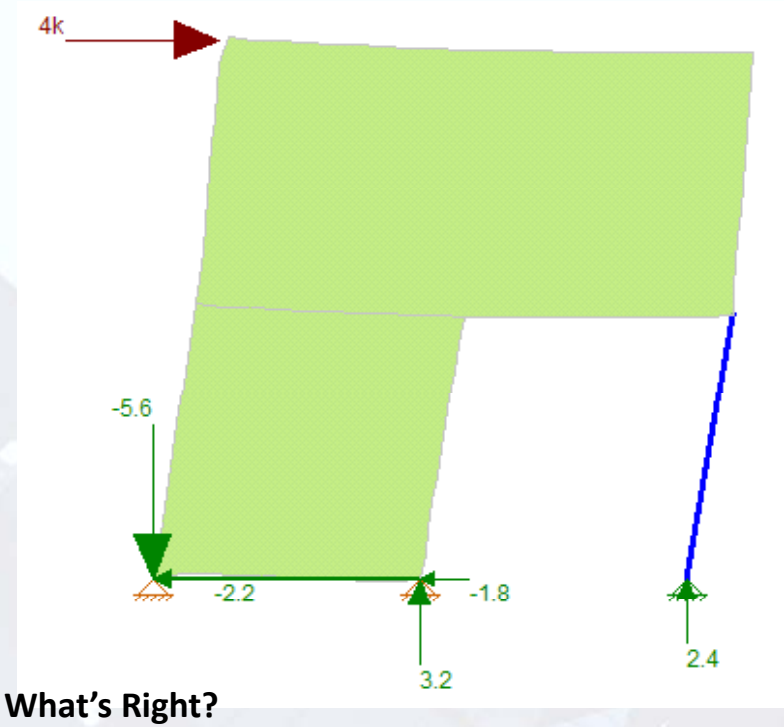


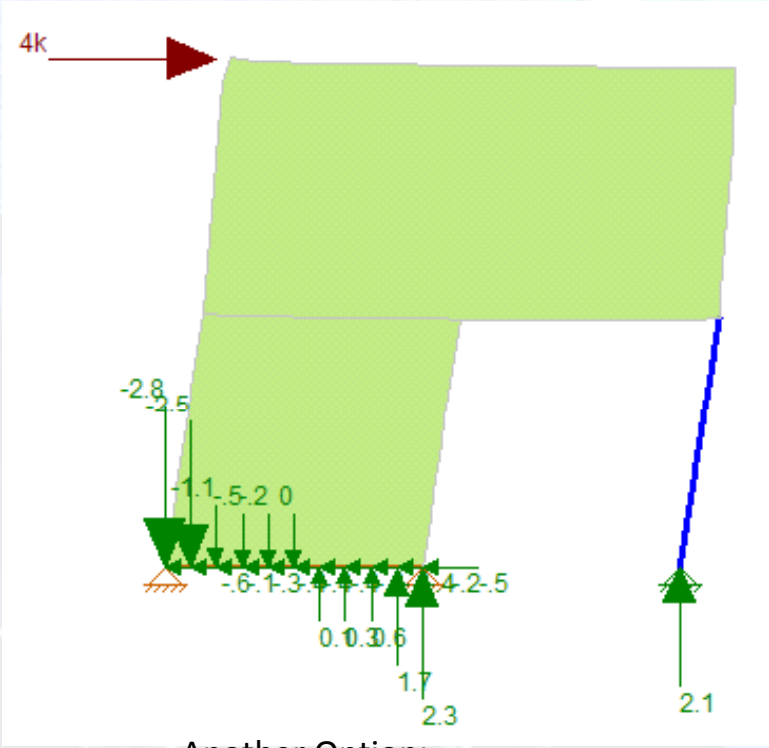
Strap Forces for both situations: 2k both sides of the upper wall

Deflection is different for these two assumptions (SSAF)

Common Problems

Problem: Soft Story Hand Calculations ≠ FEM Model





What's Right?

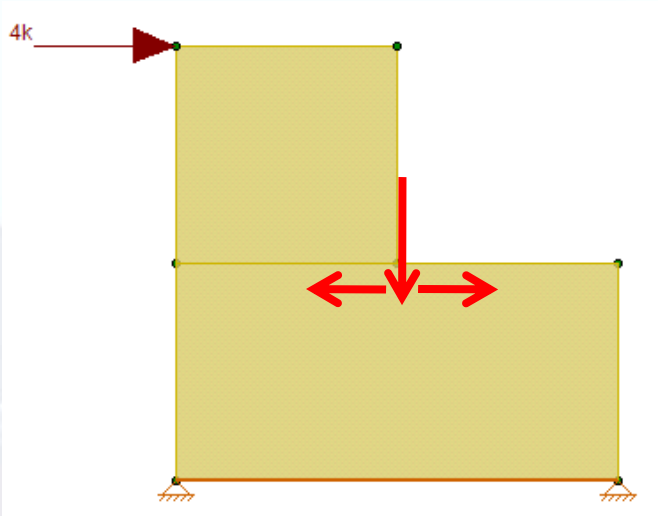
Engineering Judgment !!

Another Option:
Assume Fully Pinned under wall

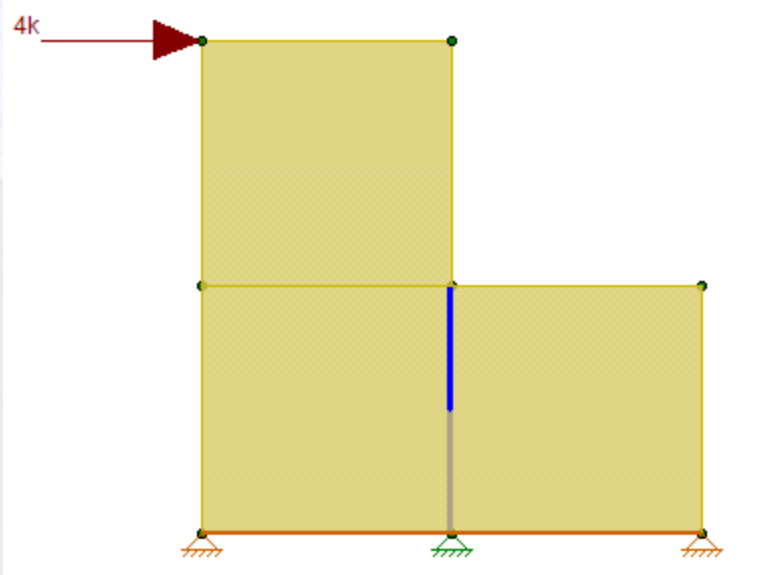
- How is it being built?
  Continuous sheathing or a strap only at the end post?

Common Problems

Problem: Discontinuous Walls



- Loads are transferred into the wall below.



- Add Post to center of wall
  Post can be “Compression Only”
- Add Boundary Condition at the base of the wall

Common Problems

Problem: Discontinuous Walls

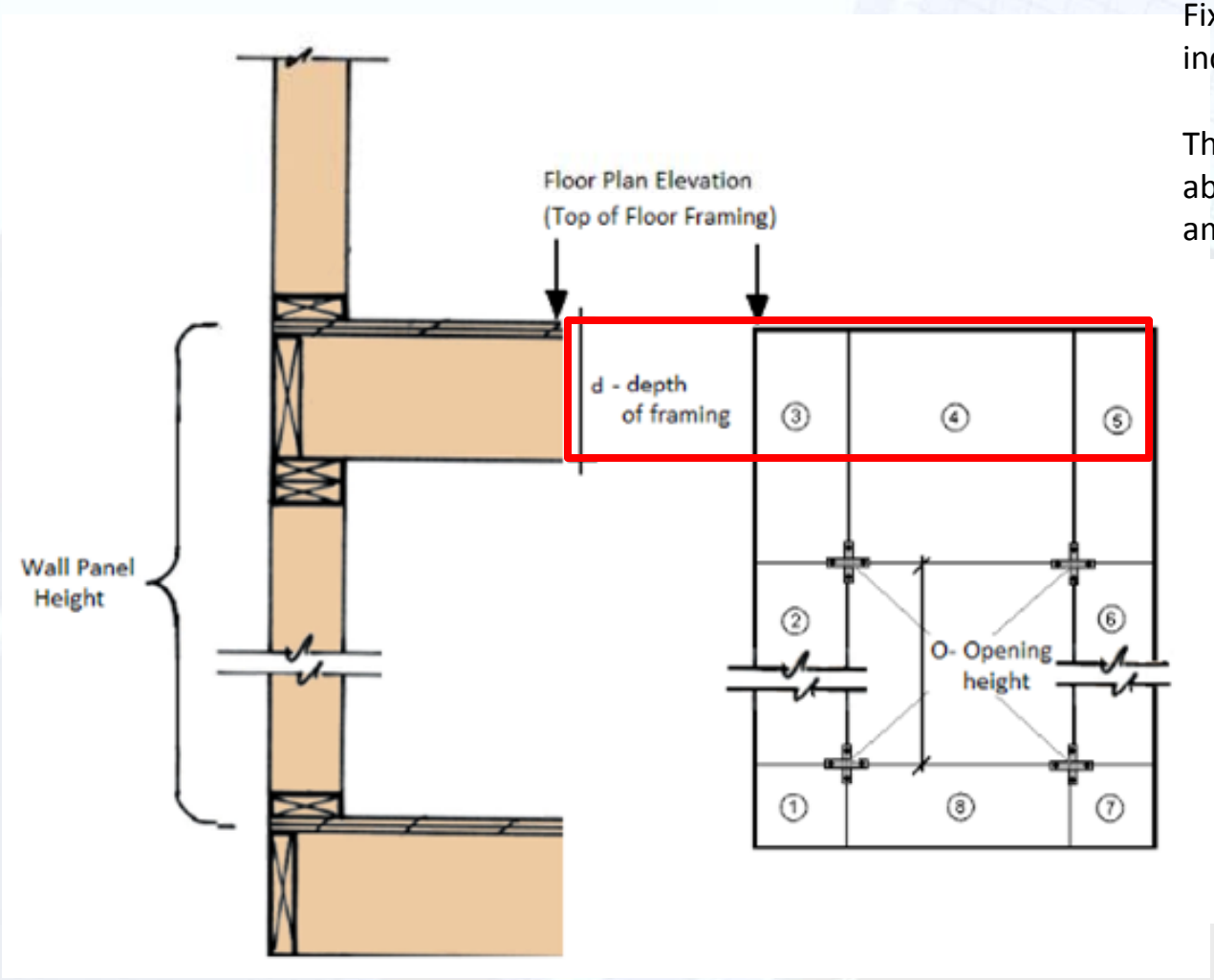
- Different Reactions due to the Post
- Different Chord Forces
- Different Deflections

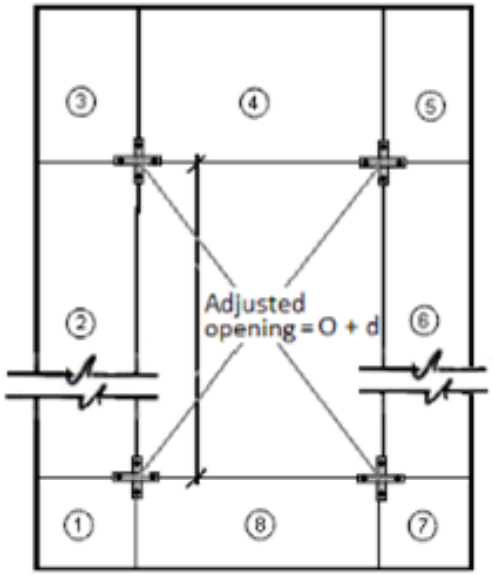
Common Problems

Problem: Platform Framing (FTAO only)

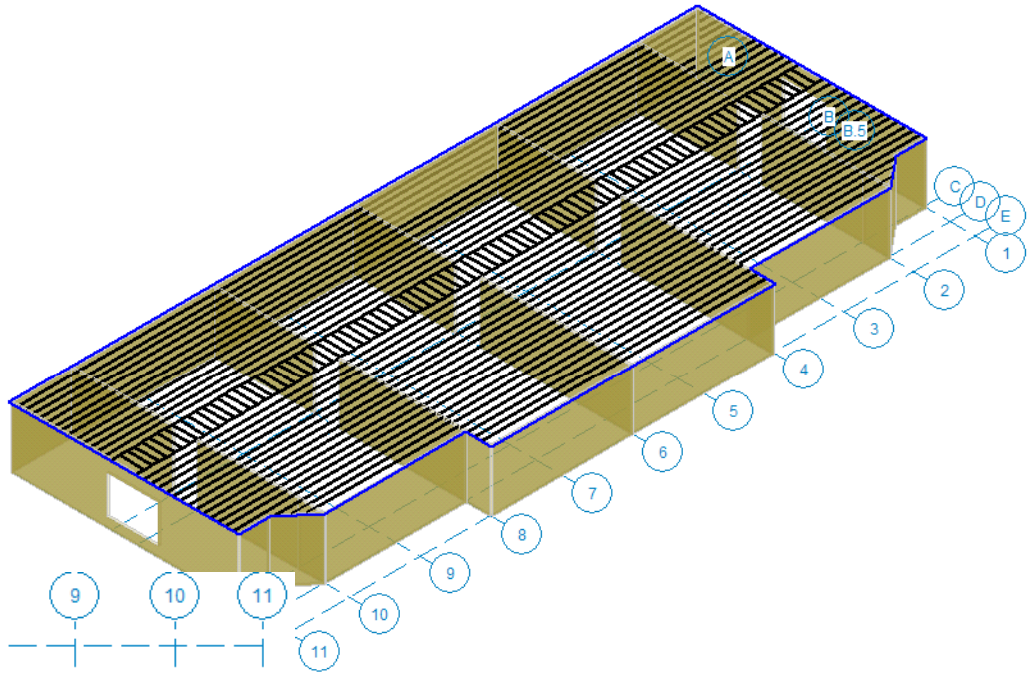
Fix: Adjust your opening height to include the depth of the floor framing.

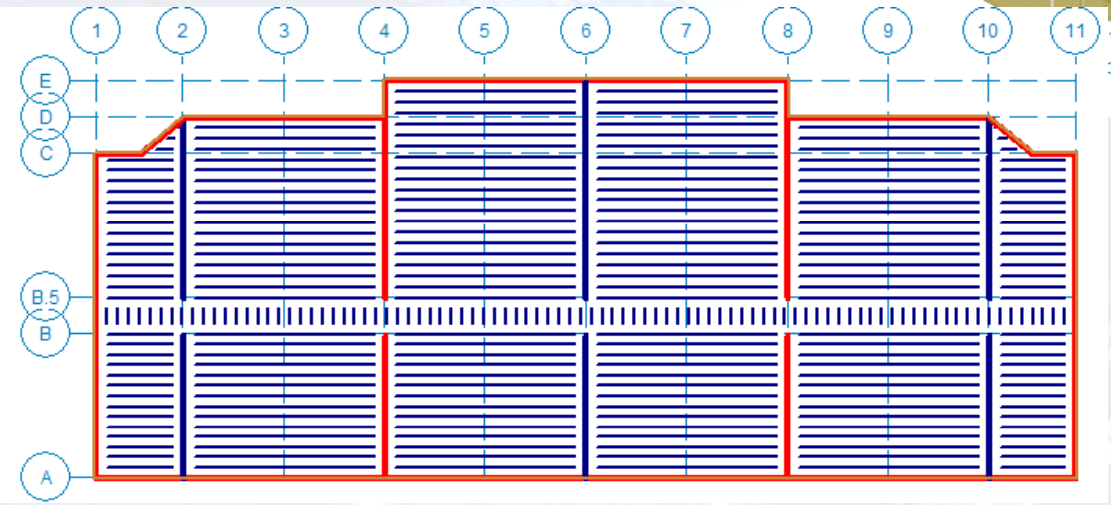
This will reduce the portion of the wall above the opening thus reducing the amount of area to transfer shear forces.





Common Problems



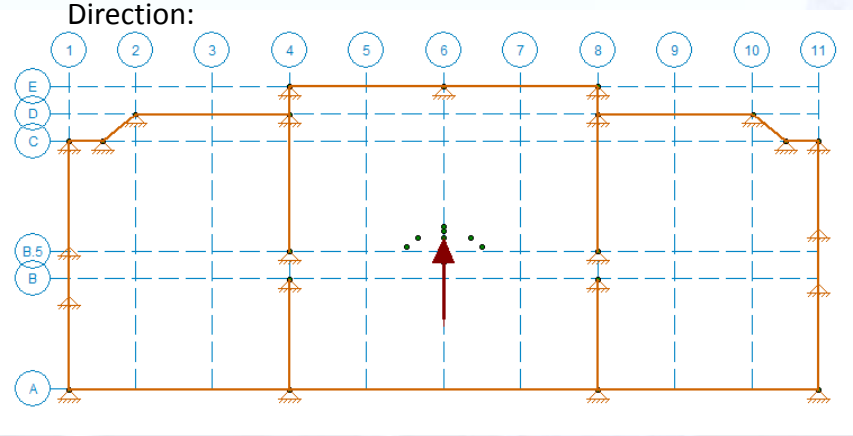


- Diaphragm defined by “Slab Edge”
- **Lateral** walls resisting Lateral loads

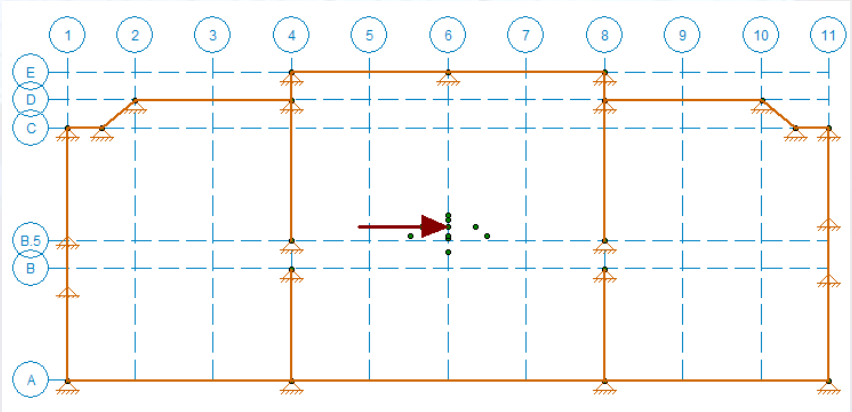
Diaphragms Loads

Wood building Flexible .r3d

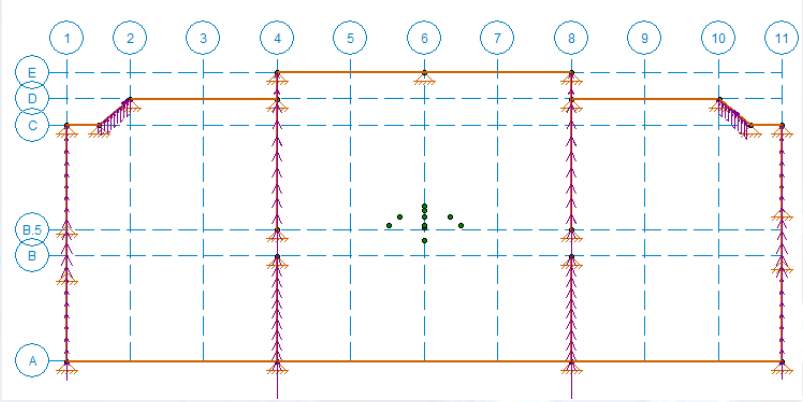
Rigid Diaphragm: Lateral Loads applied in X Direction:



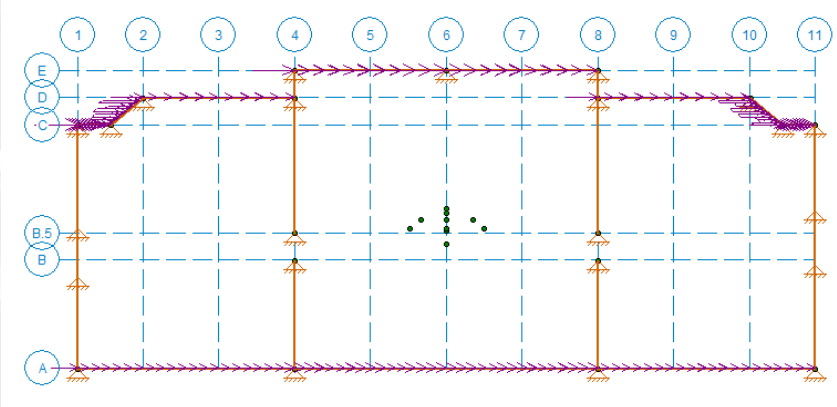
Rigid Diaphragm: Lateral Loads applied in Z Direction:



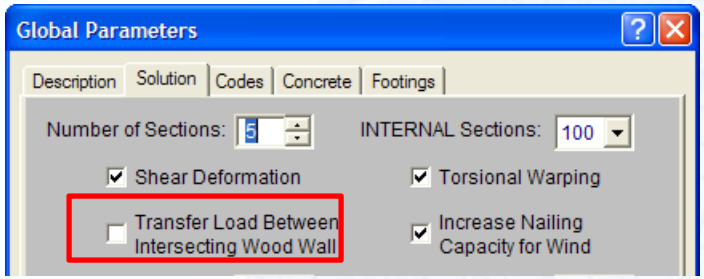
Flexible Diaphragm: Loads are distributed to the **Lateral** walls resisting X direction loads:



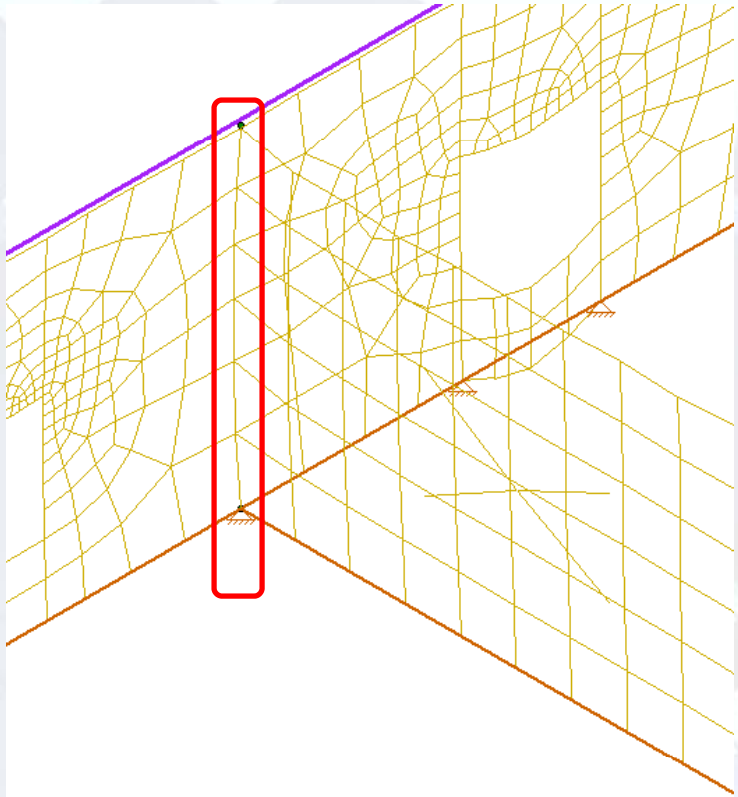
Flexible Diaphragm: Loads are distributed to the **Lateral** walls resisting Z direction loads:



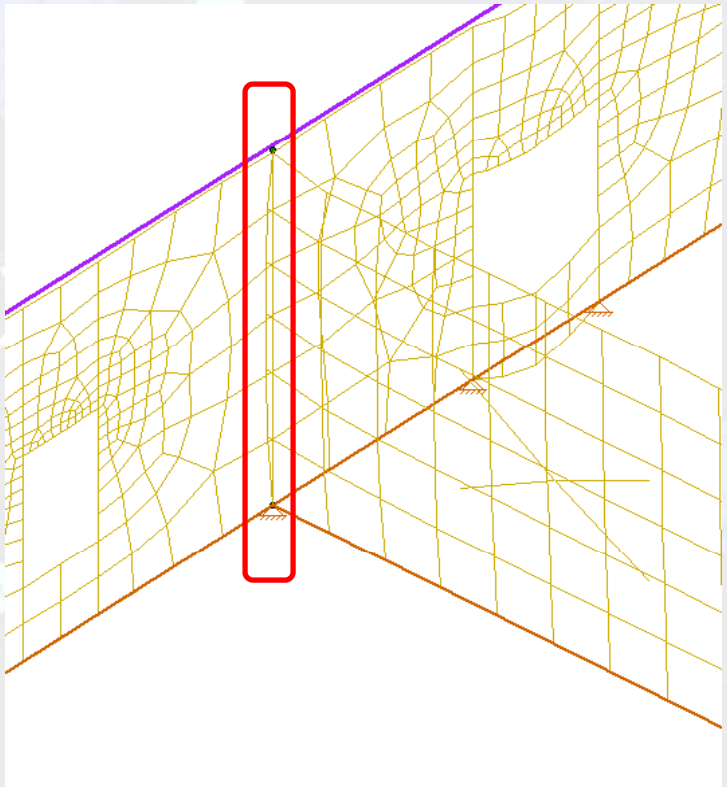
Diaphragm Loads



Transfer Loads: Turned On
Plates Connected



Transfer Loads: Turned Off
Plates Not Connected



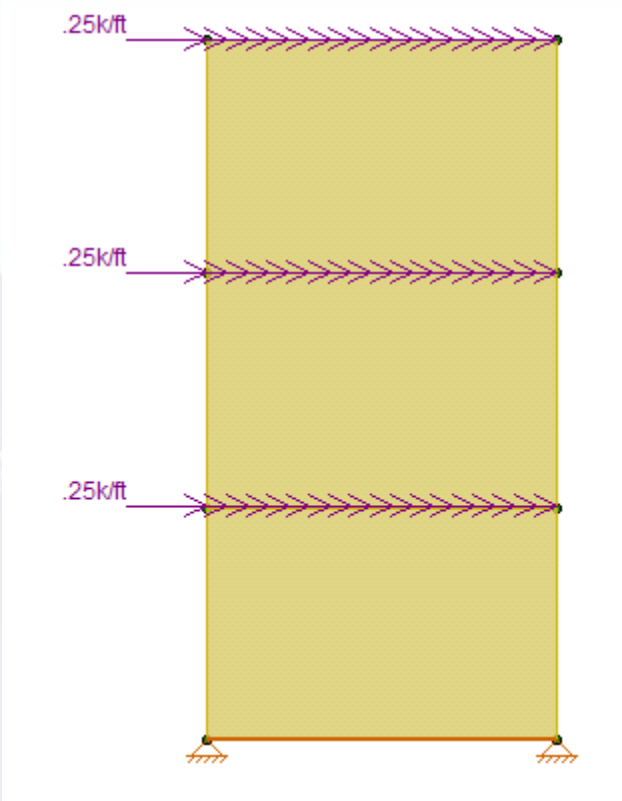
The Lateral loads on the walls are created in the Transient Area Load Cases

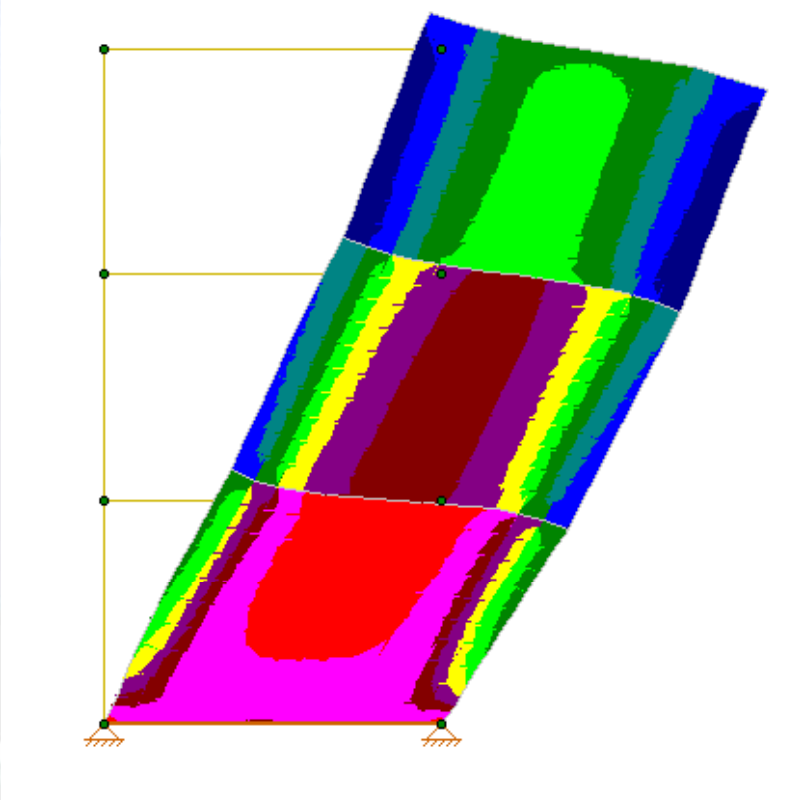
- Automatically Generated
- Automatically applied
- For Viewing purposes only
- You can "Copy" these loads if needed

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distrib...	Area (...	Surfac...
1	Dead Load	DL		-1			192	134		
2	Live Load	LL					192	134		
3	Live Load Special (public assemb	LLS								
4	Roof Live Load	RLL								
5	Snow Load	SL								
6	Snow Load Nonshedding	SLN								
7	Rain Load	RL								
8	Wind Load X	WLX				1				
9	Partial X Wind Load 1	WLXP1				1				
10	Partial X Wind Load 2	WLXP2				1				
11	Wind Load Z	WLZ				1				
12	Partial Z Wind Load 1	WLZP1				1				
13	Partial Z Wind Load 2	WLZP2				1				
14	Earthquake Load X	ELX				1				
15	Earthquake Load X Plus Z Eccentr	ELX+Z				1				
16	Earthquake Load X Minus Z Eccent	ELX-Z				1				
17	Earthquake Load Z	ELZ				1				
18	Earthquake Load Z Plus X Eccentr	ELZ+X				1				
19	Earthquake Load Z Minus X Eccent	ELZ-X				1				
20	Other Load 1	OL1								
21	Other Load 2	OL2								
22	Other Load 3	OL3								
23	Other Load 4	OL4								
24	BLC 8 Transient Area Loads	None						79		
25	BLC 11 Transient Area Loads	None						107		
26	BLC 14 Transient Area Loads	None						79		
27	BLC 17 Transient Area Loads	None						107		
28		None								

Flexible Diaphragms





What's causing the differences between the FEM results and NDS Results?

Rotation

What's really happening?

Multiple Story Building

Multiple Story.r3d

Questions?

Please let us know if you have questions. We will answer as many questions as time permits during the webinar.

Once the webinar is closed, we will post all Q&A's, at the models used and the Power Point presentation, to our website: www.risatech.com

We will be also be sending you a PDH certificate after the presentation.

For further information, contact us at: info@risatech.com

Thank you for Attending!