RISA-3D

Structural Analysis Software for Every Material

Wood Wall Panel: Introduction & Tutorial

A NEMETSCHEK COMPANY

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Introduction

This hands-on guide will help introduce you to the RISA-3D Wood Wall Panel functionality, while also walking you through a start to finish example, including helpful tips and tricks along the way. This tutorial is intended for both experienced and first-time RISA-3D users and can be completed in a single sitting.

All the "actionable steps" in this tutorial are indicated with bullets as shown below:

- Actionable Step

This guide is intended to show teach the basics of the wood wall panel functionality. If you have further questions that fall outside of the scope of this guide, please refer to the RISA-3D General Reference Guide and the online Help file.

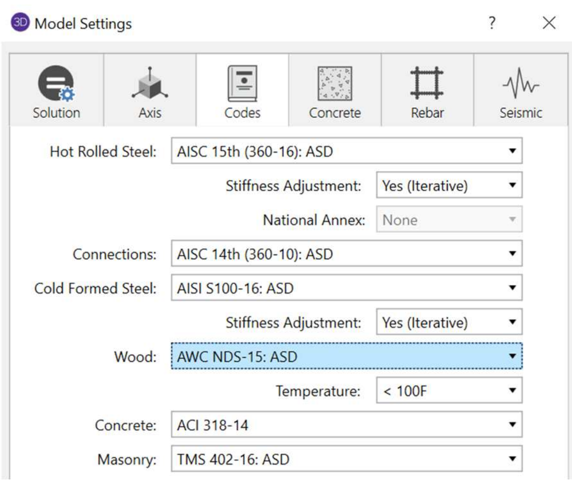
Note: If you are not familiar with RISA-3D, you should also complete the tutorials available on the RISA website at https://risa.com/documentation.

The RISA-3D Wood Wall Panel: Introduction & Tutorial is compatible with RISA-3D v18 or higher.

Wood Codes & Materials

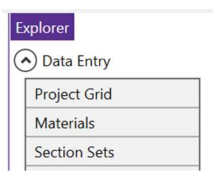
Let's start by setting the design code:

- Click on the **Model Settings** Settings icon.
- Choose the **Codes** tab.
- Select the **Wood** code from the drop-down list: **AWC NDS-15: ASD**.
- Click **OK**.

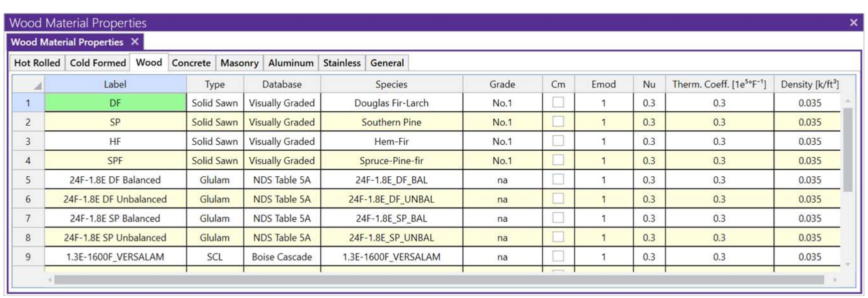


Next, let's create the material for the wood wall:

- Click on the **Materials** button on the **Data Entry** Toolbar:



- Click on the **Wood** tab at the top of the dialog box
- We'll use **DF**.


Wood Material Properties

Hot Rolled | Cold Formed | Wood | Concrete | Masonry | Aluminum | Stainless | General

	Label	Type	Database	Species	Grade	Cm	Emod	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]
1	DF	Solid Sawn	Visually Graded	Douglas Fir-Larch	No.1		1	0.3	0.3	0.035
2	SP	Solid Sawn	Visually Graded	Southern Pine	No.1		1	0.3	0.3	0.035
3	HF	Solid Sawn	Visually Graded	Hem-Fir	No.1		1	0.3	0.3	0.035
4	SPF	Solid Sawn	Visually Graded	Spruce-Pine-fir	No.1		1	0.3	0.3	0.035
5	24F-1.8E DF Balanced	Glulam	NDS Table 5A	24F-1.8E_DF_BAL	na		1	0.3	0.3	0.035
6	24F-1.8E DF Unbalanced	Glulam	NDS Table 5A	24F-1.8E_DF_UNBAL	na		1	0.3	0.3	0.035
7	24F-1.8E SP Balanced	Glulam	NDS Table 5A	24F-1.8E_SP_BAL	na		1	0.3	0.3	0.035
8	24F-1.8E SP Unbalanced	Glulam	NDS Table 5A	24F-1.8E_SP_UNBAL	na		1	0.3	0.3	0.035
9	1.3E-1600F_VERSALAM	SCL	Boise Cascade	1.3E-1600F_VERSALAM	na		1	0.3	0.3	0.035

- Click ✕ to close the spreadsheet.

Wood Design Codes in RISA-3D:

- AWC-NDS-18/15/12:ASD
- AWC-NDS-18/15:LRFD
- AF&PA NDS-08/05/01/97:ASD
- CSA-O86-14/09: Ultimate

The wood species available can be found by clicking in the **Species** column in the **Materials** spreadsheet and clicking on the dropdown arrow. The list is organized with all the species available in the NDS first, and the Glulam types at the bottom. If you add your own Custom Material Species, you will find your new species name located between the NDS wood species and the glulam types.

Custom Wood Species can be created by opening the **Custom Wood** icon found on the **Advanced** tab.

TIP: RISA-3D has a variety of default material properties available; you can save your own default materials by pressing the **Save as Defaults** icon at the top of the screen when the **Materials** spreadsheet is open.

NOTE: If you don't see the **DF** label in your **Wood Materials** spreadsheet, you may use the available species or go to **File > Application Settings > General > Advanced > Reset all Program Defaults** to get all the wood species defaults for v16 or higher.

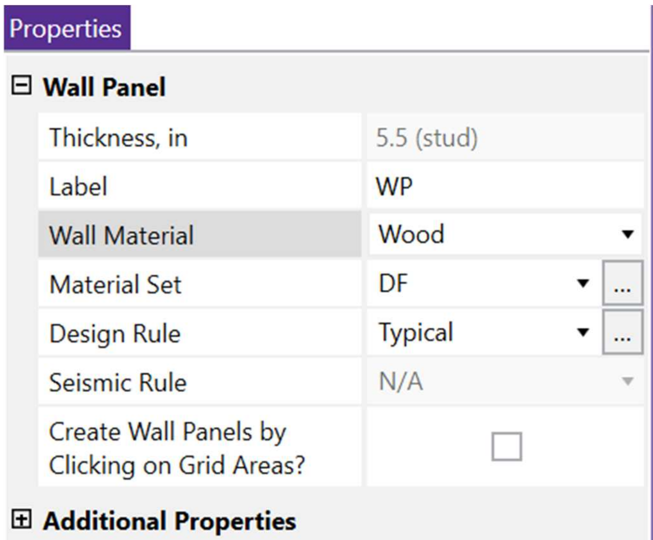
Creating Wall Geometry

Let's start by drawing the wall:

- Click on the 

icon on the **Draw Elements** section of the **Toolbar**.
- You should now see the **Properties Panel** update with design properties specific to Wall Panels:

You must first define the material you want to use. The current options available are Masonry, Wood, Concrete and General. In this exercise, we will be drawing a wood wall.



You can draw a wall by clicking on existing nodes or drawing the wall using a grid. We'll draw a wall using the drawing grid.

Choose which type of wall:

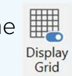
- Select **Wood** from the drop-down menu.
- Select **Material Set: DF**
- The mouse cursor will appear with crosshairs and you are ready to start drawing.

Using the drawing grid to create a 12' high rectangular wall:

- Click on the bottom left corner (0,0,0),
- Move the cursor to the top right corner and left click on (16,10,0),
- Right-click the mouse or press Esc to stop drawing.

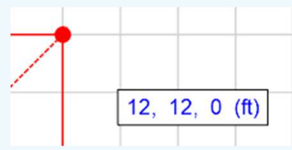
The wall panel will be created after the second click of the mouse and should look like the picture above.

The Drawing Grid will help you draw the wall. As the cursor hovers over the drawing grid intersection lines, a red dot will appear which indicates where the joint will be located.

If the grid is not visible, click the 

icon in the **Drawing Tools** tab.

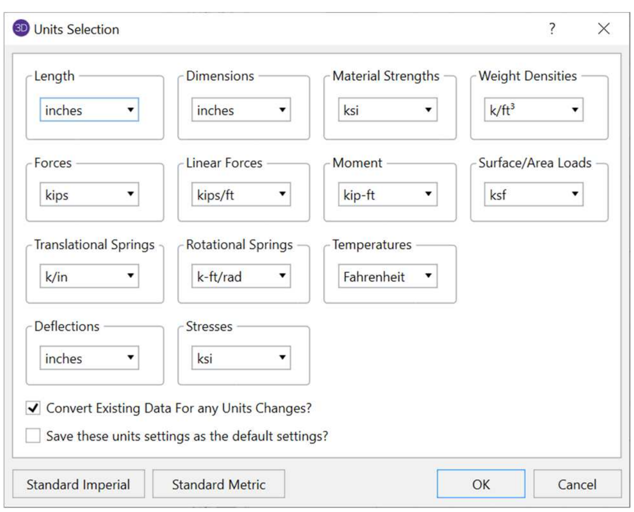
Notice that you can view the cursor coordinate information when you hover over an existing node or drawing grid intersection.



Let's change the Units to inches:

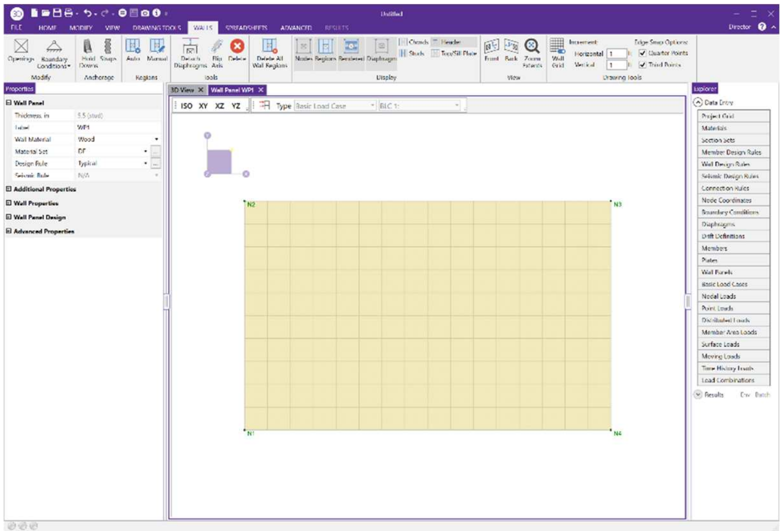
- Click on the **Units** 

icon on the **Home** tab.
- Under **Length**, click on the dropdown menu and select **inches**
- Click **OK.**



Let's open the Wall Panel Editor to add openings:

- Double click on the **Wall Panel** to view the **Wall Panel Editor**. A new **Walls** tab will appear in the **Ribbon Toolbar**.

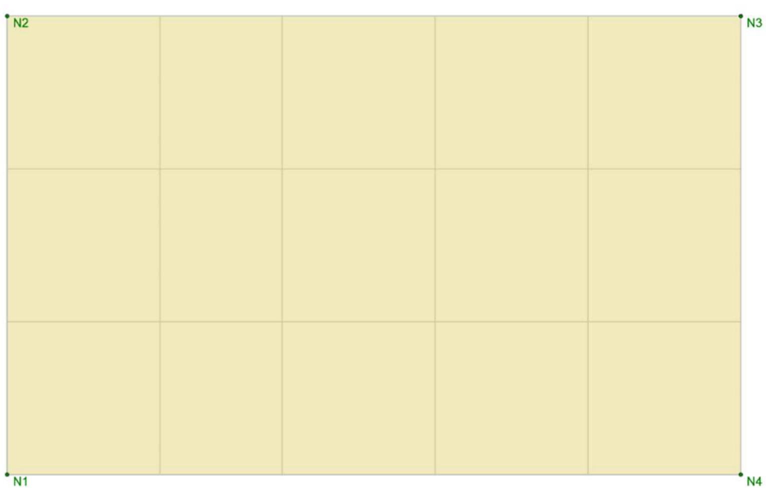


Next, let's change the drawing grid to locate the openings:

- In the **Drawing Tools** section of the **Walls** tab, click in the box next to **Horizontal (in),** clear the current entry and type **40, 32, 3@40**
- In the **Drawing Tools** section of the **Walls** tab, click in the box next to **Vertical (in),** clear the current entry and type **3@40**
- Press the **Tab** key to complete the input.

The grid will automatically resize to adjust to the new scale. You can also toggle the grid display on and off by clicking the 

icon.



The drawing grid within the Wall Panel Editor is a tool that guides your placement of openings, hold-downs, straps, and boundary conditions. The grid is independent of your model, so you may change the grid as you build the wall without changing anything in your model.

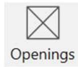
Note: In the Drawing Grid, you may use symbols such as:

"@" (to specify multiple, equally spaced increments).

"/" (to subdivide a larger increment into smaller increments).

"," (to enter multiple increments in the increment field).

With the grid set, create a window and a door opening:

- Click on the **Openings** 

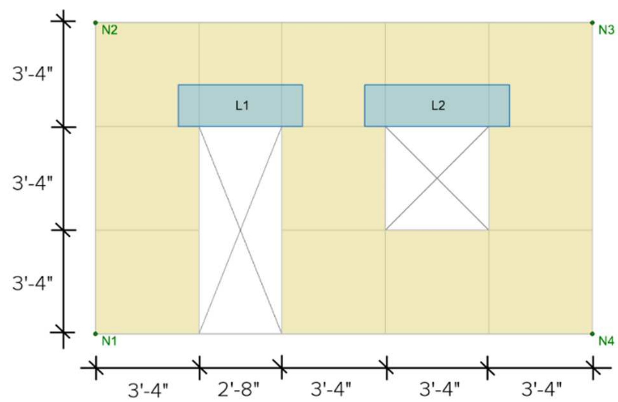
icon at the top left of the **Wall Panel Editor** to create an opening.

Let's create the door opening:

- Using the **Wall Grid** coordinates, left click on the bottom left corner of the opening **(40,0)**
- Move the mouse to the top right corner **(72,80)** and left click on the grid intersection.

Now let's create a window opening:

- Left click on the bottom left corner **(112,40)**
- Move the mouse to the top right corner **(152,80)** and left click on the grid intersection.
- Right click to end the command.



Now we can add boundary conditions (supports):

- Click the **Create New Boundary Conditions** 

icon in the top left of the **Wall Panel Editor**
- For this wall panel, we will choose the **Pinned**  support option. Additionally, since the support is being assigned within the **Wall Panel Editor**, the boundary condition will be assigned as **Continuous** along the edge of the wall panel.
- Select a node along the bottom edge of the wall panel to apply the boundary condition.

- Right click to end the command.

Wall Panels can have rectangular openings. You can click on any location on the grid to create an opening.

Openings can be created anywhere on the wall panel except the upper and side edges.

Note: You can utilize the **Delete** tool to remove the openings if you make a mistake. 

Other **boundary** conditions can be used. It is possible to modify all six degrees of freedom in the model (translation in X, Y and Z and rotation in X, Y and Z). The preset options for boundary conditions include:

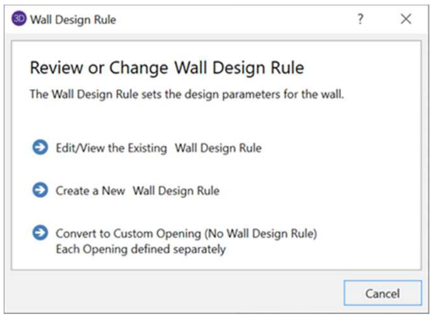
- Free
- Fixed
- Roller

Headers

Headers will automatically be created and placed above the openings in wood walls.

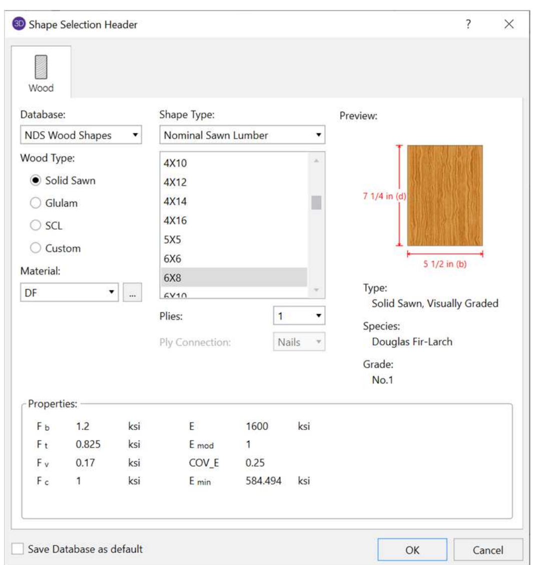
Let's review the header design parameters:

- Double left click directly inside the window opening to view the **header** design parameters, in this example select **Edit/View Existing Wall Design Rule**.



- If the headers do not show, use the toggle Header icon to turn them on.

The header selection is based on the design rule assigned in the **Wall Panel Design Rules** or you can create a **Custom Opening** where each opening within the wall is defined separately.



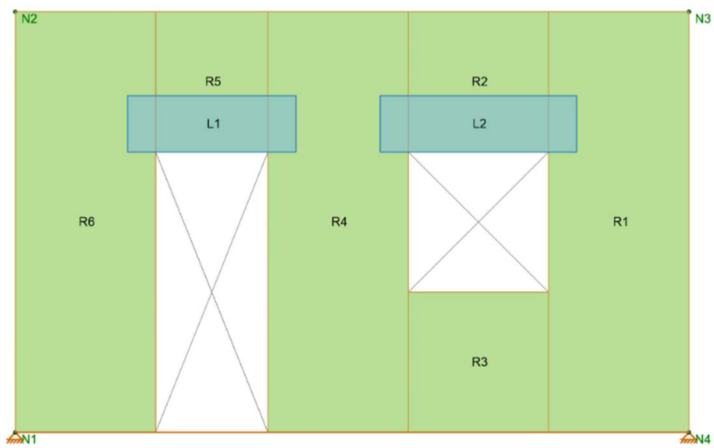
- Click **Cancel**.

We will review the header Design Rule in the next section.

Assigning Design Parameter Regions

Let's define regions inside the wall for design/analysis of the wood shear wall:

- Select the **Generate Wall Regions Automatically** Auto icon.



The wall drawing should now look like the picture above.

You can use the **Wood View Controls** to Toggle the display of the following:

- Wall Studs Studs
- Chords Chords
- Sill Plates Top/Sill Plate

- Click ✕ to exit the **Wall Panel Editor**

What is a Region?
In RISA, we define a wall strip for design as a Region. In reference codes this is referred to as a full height wall segment or pier.

Regions must be rectangular. To create them, use the cursor to select two nodes or grid intersections which define the lower left corner and upper right corner of the region.

Note: Regions cannot overlap openings.

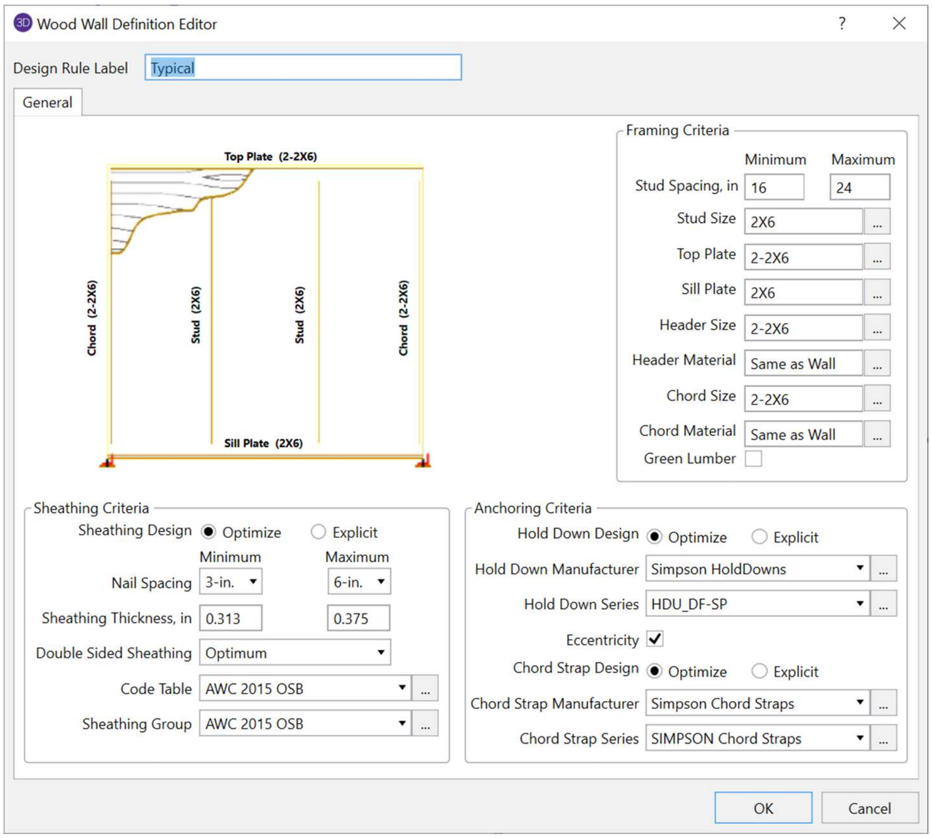
RISA automatically creates regions for walls. However, it is also possible to manually create Regions by selecting **Design Wall Regions Manually** icon. Manual

To design a **Segmented Wall**, a region must be defined for every piece of the wall.

Wall Design Rules

Let's review the Design Rule from the Properties Panel of the wood wall.

- Select the wood wall and click on the ellipsis ... button next to the design rule.
- Click **Edit/View the Existing Wall Design Rule** and set the wall panel design parameters as shown in the dialog below.



The dialog allows for all of the wall design parameters to be assigned and modified in one location.

- Click **OK** when you have assigned the parameters correctly.

Stud design is accomplished by taking the entire axial load in the wall and dividing it by the number of studs. The spacing is optimized based on the range in the **Design Rules (Studs)** spreadsheet.

Optimizing the Wall Panels

RISA will design and optimize the wall panels based on the criteria in the **Wall Panel Design Rules.**

Additionally, there is an option in the **Model Settings** Settings that will enable optimization of walls upon solution. If you want to check an existing wall, you can explicitly select the wall panel size and make sure to turn off the wall optimization.

The **Wood Wall Panel Schedule** and **Hold Down Schedule** are based on an XML file database.

The **Wood Wall Panel Schedule** database is specified by an XML file in the Shear Panels folder, a sub-directory of the RISA_Wood_Schedules folder located in the C:\RISA folder. (This defaults into the C:\RISA folder, but you can also find the directory location by going to File > Application Settings > File Locations)

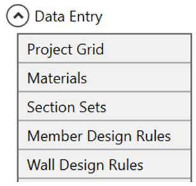
The **Hold Down Schedule** database is specified by an XML file in the HoldDowns folder, a sub-directory of the RISA_Wood_Schedules folder.

The wall panel design is optimized based on the shear capacity. The shear demand is determined for the wall, and the panel is chosen with the closest shear capacity.

You can select an entire series or list of panels or select one panel by clicking on the **Label**.

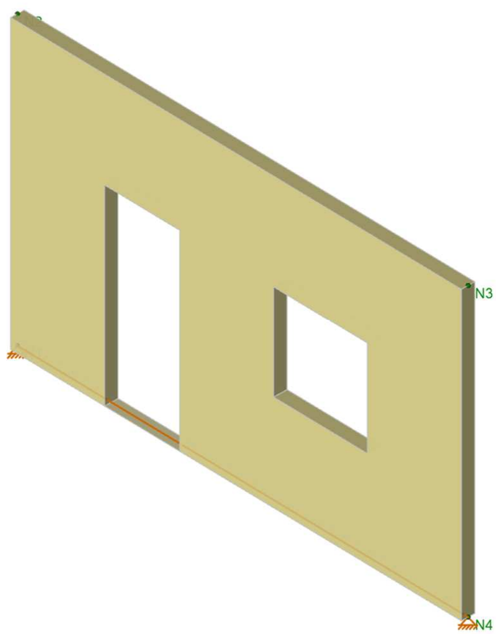
Wall Panel parameters can also be assigned directly in the Wall Panel Design Rules spreadsheet.

- Select **Wall Design Rules** from the **Data Entry** panel.



- Click on the **Wood Wall (Studs)** and **Wood Wall (Fasteners)** tabs
- Click ✕ to exist the **Wall Design Rules**

To better view the wall, in the 3D view, click on the **Rendered Icon** found in the **Quick View** section of the **Home** tab twice and the **Snap to Isometric** view option **ISO**.



It is possible to modify the existing databases or create new databases at any time. For more information on the formatting requirements, refer to the **Appendix F Wood Shear Wall Files** in the Help Menu of RISA-3D.

Note: If you want to view the wall panel rendered at 100%, click on the **Model View Settings** button and click the **Wall Panels** tab and select **100%** using the sliding scale.

Model

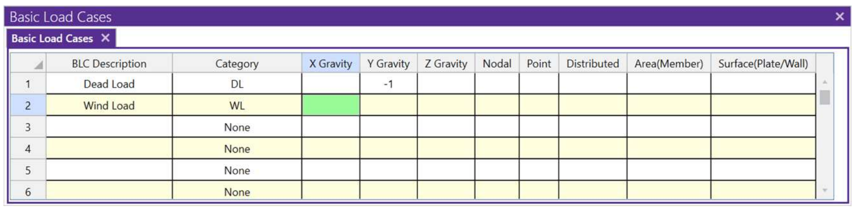
Loading

We first need to create the Basic Load Cases:

- Open the **Basic Load Case** spreadsheet on the **Data Entry** toolbar or press the Basic Load Cases icon.
- Type **Dead Load** on the first line under the **BLC Description** column.
- Select **DL (Dead Load)** from the **Category** drop-down menu.
- Type **-1** into the **Y Gravity** column.

Let's add wind load case:

- Type **Wind Load** on the second line under the **BLC Description** column.
- Select **WL (Wind Load)** from the **Category** drop-down menu.

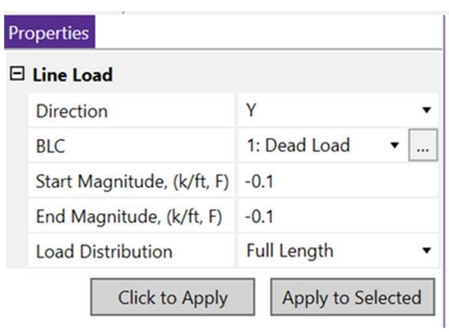

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Nodal	Point	Distributed	Area(Member)	Surface(Plate/Wall)
1	Dead Load	DL		-1						
2	Wind Load	WL								
3		None								
4		None								
5		None								
6		None								

- Exit **BLC Spreadsheet** by clicking the ✕ on the top right corner.

Add a distributed load to the wood wall:

- Click on **Distributed Load** Line icon.
- Select **Y** for **Direction** in the drop-down menu.
- Select **Basic Load Case 1: Dead Load**.
- Type **-0.1** as the **Start Magnitude** and the **End Magnitude** will automatically populate.



- Press **Click to Apply** and then click on the top of the wall.

Walls can be loaded with joint, surface loads, or distributed loads.

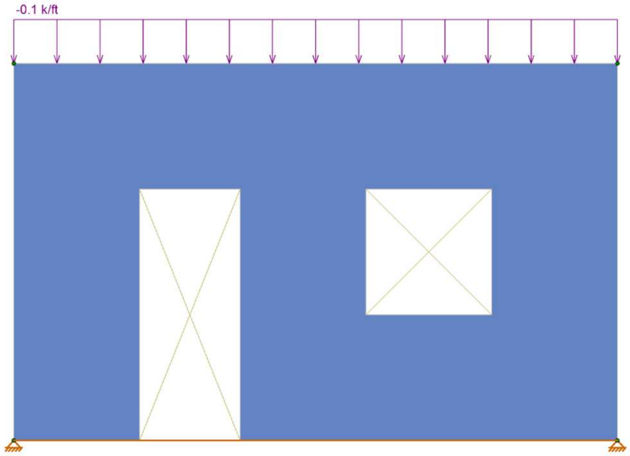
You must define the **Category** to use the **Load Combination Generator.**

Typing a **-1** in the **Y Gravity** column creates a Basic Load Case which includes self-weight.

You can end any command by **right clicking** the mouse.

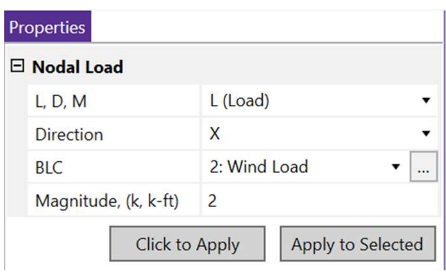
Nodal loads can only be applied in the global directions. We can tell that this is the global axis because the **X** is capitalized.

The wall should now look like the image below with the distributed load applied.



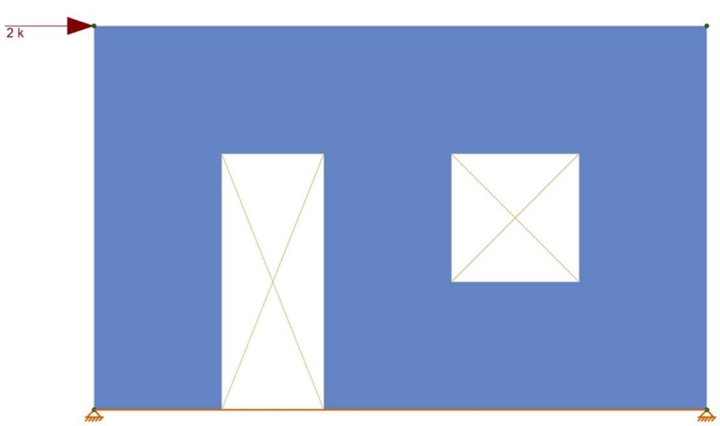
Let's add a point load of wind load to this wall:

- Click on **Nodal Load**  icon.
- Select **LOAD (L).**
- Select **Basic Load Case 2: Wind Load.**
- Select **Direction X** from the dropdown list.
- **Magnitude:** 2 kips
- Select **Click to Apply.**



- Click on or draw a box around **Node N2.**

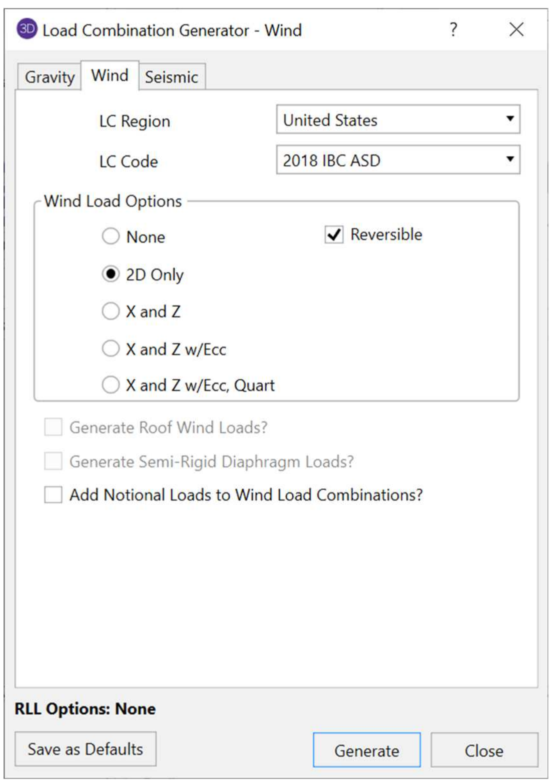
The wall should now look like the image below with the point load applied.



Load Combinations

Let's create the load combinations using the LC Generator:

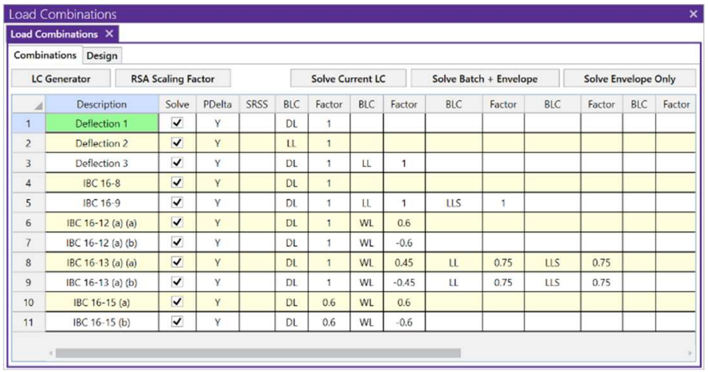
- Open the **Load Combination** spreadsheet by selecting the LC Load Combinations icon at the top of the screen.
- Select **LC Generator** LC Generator
- Select **United States** for the **LC Region.**
- Select **2018 IBC ASD** for the **LC Code.**
- Uncheck **RLL, SL** and **RL**
- Click **Generate** to create gravity load combinations
- Click on **Wind** tab
- Click the **2D Only** button under **Wind Load Options**
- Check the **Reversible** option.
- Click **Generate**



- Click **Close**

The LC Generator allows you to create load combinations quickly based on the code you select.

The Load Combination spreadsheet will automatically generate all the load combinations from the IBC 2018 and should look like the picture below:



Load Combinations

Load Combinations

Combinations | Design

LC Generator | RSA Scaling Factor | Solve Current LC | Solve Batch + Envelope | Solve Envelope Only

	Description	Solve	PDelta	SRSS	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	Deflection 1	✓	Y		DL	1								
2	Deflection 2	✓	Y		LL	1								
3	Deflection 3	✓	Y		DL	1	LL	1						
4	IBC 16-8	✓	Y		DL	1								
5	IBC 16-9	✓	Y		DL	1	LL	1	LLS	1				
6	IBC 16-12 (a) (a)	✓	Y		DL	1	WL	0.6						
7	IBC 16-12 (a) (b)	✓	Y		DL	1	WL	-0.6						
8	IBC 16-13 (a) (a)	✓	Y		DL	1	WL	0.45	LL	0.75	LLS	0.75		
9	IBC 16-13 (a) (b)	✓	Y		DL	1	WL	-0.45	LL	0.75	LLS	0.75		
10	IBC 16-15 (a)	✓	Y		DL	0.6	WL	0.6						
11	IBC 16-15 (b)	✓	Y		DL	0.6	WL	-0.6						

- Close the **LC** spreadsheet.

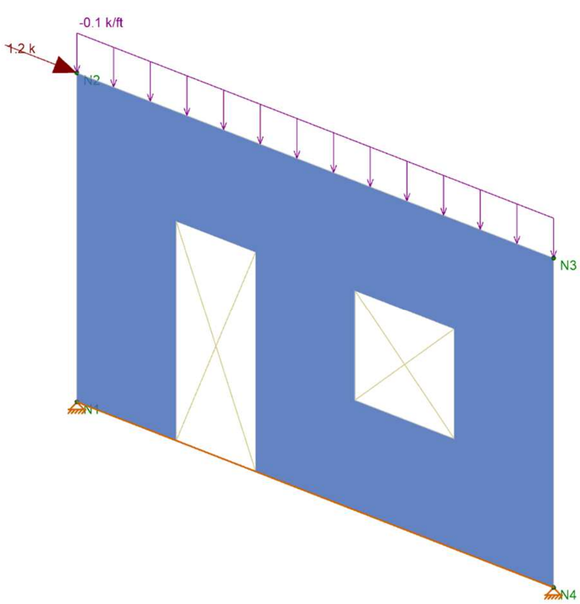
To display loads, we will work with the loading display toolbar at the top of the screen.

Let's review the loads as they are applied to the wall:

- Toggle on the loads display by clicking the icon if they're not already turned on.
- The load display control panel is on the top of the screen.

- Click on the drop-down menu to switch Type to **Load Combination.**
- Select the **LC6** in the drop-down dialog.

You should now see the **Load Combination 6: IBC 16-12 (a) (a) = DL + 0.6WL** displayed on your screen as below.

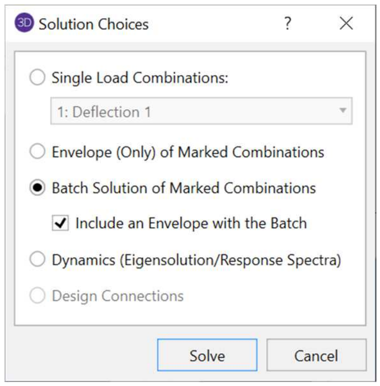


- Enable **2D mode** by selecting the **2D Lock** icon at the top of the 3D view. This will provide out-of-plane stability.

With all the loads applied, let's run the analysis:

- Click the **Analysis and Design** 

 icon.
- Select the **Batch Solution of Marked Combinations** radio button.
- Click **Solve.**



A **Single** solution will only solve the selected load combination. An **Envelope** solution will solve multiple load combinations and the results will show only the maximum and minimum. The **Batch** solution will solve multiple combinations and the results will be retained for every solution.

The Detail Report is only available for Single Combination solutions or Batch solutions.

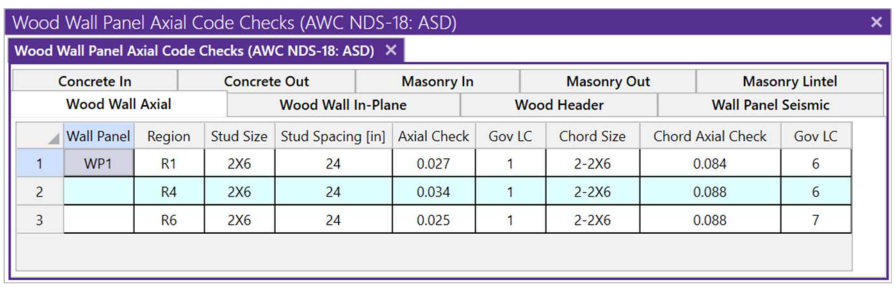
Designing the Wall: Segmented Method

Reviewing results:

- Select the **Wall Panel Design** spreadsheet from the **Results** toolbar.

- To view the different results for wall panels, click on the tabs at the top: **Wood Wall Axial**, **Wood Wall In-Plane, Wood Header**

The **Wood Wall Axial** results provide the code checks relevant to **axial loads** of the wall.


Wood Wall Panel Axial Code Checks (AWC NDS-18: ASD)

Concrete In | Concrete Out | Masonry In | Masonry Out | Masonry Lintel
Wood Wall Axial | Wood Wall In-Plane | Wood Header | Wall Panel Seismic

	Wall Panel	Region	Stud Size	Stud Spacing [in]	Axial Check	Gov LC	Chord Size	Chord Axial Check	Gov LC
1	WP1	R1	2X6	24	0.027	1	2-2X6	0.084	6
2		R4	2X6	24	0.034	1	2-2X6	0.088	6
3		R6	2X6	24	0.025	1	2-2X6	0.088	7

– The **Wall Panel Label** and **Region** correspond to the wall panel labels and regions defined in the Wall Panel Editor.

– The **Stud Size** and **Stud Spacing** correspond to the studs selected and spacing range in the Design Rules.

– The **Axial Check** is a code check ratio between the member load and the member capacity. A value greater 1.0 for either of these values indicates failure. The **Gov LC** shows the load combination that governed for the code check.

– The **Chord Size** corresponds to the chord selected and spacing range in the Design Rules. Note that the chords are the vertical hold down members/posts at both ends of every Region.

– The **Chord Axial Check** is a code check ratio between the member load and the member capacity. A value greater 1.0 for either of these values indicates failure. The **Gov LC** shows the load combination that governed for the ratio mentioned above.

Design Methods

Segmented: A wall is broken up into separate full-height regions or segments and designed separately. If the shear wall has openings, the area above and below the openings are disregarded.

Perforated: The total shear is applied to the wall and is divided by the width of the full height sections of your wall. There are many limitations as to when the Perforated Method can be applied, refer to the NDS 2005, Special Design Provisions for Wind and Seismic 4.3.5.3.

Force Transfer, FTAO: This method allows you to use the entire area of the wall minus the openings to resist the shear in the wall. The framing around the openings is reinforced for this method.

Note: The chords are the vertical hold down members/posts at both ends of every Region.

The **In-Plane** results provide the code checks for the shear wall behavior of the wall.

Wood Wall Panel In Plane Code Checks (AWC NDS-18: ASD)

Wood Wall Panel In Plane Code Checks (AWC NDS-18: ASD)

Concrete In | Concrete Out | Masonry In | Masonry Out | Masonry Lintel | Wood Wall Axial | Wood Wall In-Plane | Wood Header | Wall Panel Seismic

	Wall Panel	Shear Panel Label	Region	Shear Check	Shear Force [k/ft]	Gov LC	Hold-Down Label	Chord Strap Label	Tension Check	Tie-Down Force [k]	Gov LC
1	WP1	S1_5/16_6d@6	R1	0.532	0.13	6	HDU2-SDS2.5_DF-SP	NC	0.37	1.138	11
2		S1_5/16_6d@6	R4	0.548	0.134	7	HDU2-SDS2.5_DF-SP	NC	0.358	1.1	10
3		S1_5/16_6d@6	R6	0.945	0.232	7	HDU2-SDS2.5_DF-SP	NC	0.396	1.219	10

– The **Shear Panel Label** describes the shear panels selected for the wall. The designation **NC** indicates **no calculation** done on regions above and below openings.

– The **Shear Check** is a code check ratio between the panel shear load and the panel shear capacity. A value greater 1.0 for either of these values indicates failure. The **Gov LC** shows the load combination that governed for the code check.

– The **Hold-Down Label** describes the hold downsize selected for the wall.

– The **Chord Strap Label** describes the chord strap size selected for the wall.

– The **Tension Check** is a code check ratio between the tension load and the hold down provided capacity. A value greater 1.0 for either of these values indicates failure. The **Gov LC** shows the load combination that governed for the ratio mentioned above.

- Close the **Wall Panel Design** spreadsheet.

Let's take a closer look at the wall by viewing the Detail Report:

- Click the **Detail** button  on the left-hand side of the screen.
- Click anywhere on the wall panel. The **Detail Report** Summary Report will open.

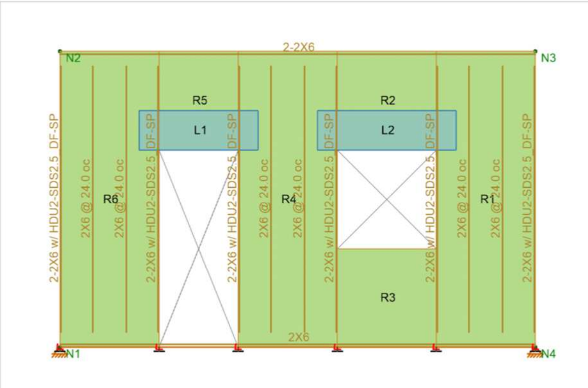
Wall Summary Detail Report

Detail Report - WP1

Detail Report - WP1 ×

<< Wall Panel Label: WP1 >> Add to Full Report Options Print

Detail Report: WP1 Enveloped Results



Input Data:

Code:	AWC NDS-18: ASD
Design Method:	Segmented
Height (in):	120
Length (in):	192
Wall Material:	Douglas Fir-Larch No.1
Panel Schedule:	AWC 2015 OSB
Sel. Shear Panel:	S1_5/16_6d@6

Wall Properties:

Top Plate:	2-2X6
Sill:	2X6
Wall Stud:	2X6
Chord:	2-2X6
Max H/W Ratio:	3.00
K:	1

Material Properties:

Top Plate:	Douglas Fir-Larch No.1	Fb (ksi):	1	Ft (ksi):	0.675
Sill:	Douglas Fir-Larch No.1	Fv (ksi):	0.18	* All values per 2015 NDS Supplement Table 4A (Reference Design Values for Visually Graded Dimension Lumber)	
Wall Stud:	Douglas Fir-Larch No.1	Fc (ksi):	1.5		
Chord:	Douglas Fir-Larch No.1				
E:	1700	Density (k/ft³):	0.035		

Design Summary: Enveloped Results

Limit State	Gov. LC	Required	Available	Unity Check	Result
Controlling region					PASS

Deflection Results

Maximum Region Deflection (in)	Gov. LC	Finite element Deflection (in)	Shear Stiffness Adjustment Factor (SSAF)
0.289(R6)	7 (W)	0.167	1

Region Design

	Shear UC	Strap / Hold-Down UC	Chord UC	Stud UC	Result
R1 (In-Plane)	0.532	0.37	0.084	0.027	PASS
R2 (In-Plane)	No design for regions above or below the openings in segmented walls.				
R3 (In-Plane)	No design for regions above or below the openings in segmented walls.				
R4 (In-Plane)	0.548	0.358	0.088	0.034	PASS
R5 (In-Plane)	No design for regions above or below the openings in segmented walls.				
R6 (In-Plane)	0.945	0.396	0.088	0.025	PASS
Opening Design H1					
Opening Design H2					

General/Geometry/Materials

The top section of the detail report echoes the entire user defined input also summarizing the selections. The shear panel selected is shown as well as the Maximum H/W ratio for all the regions.

Wall Region Drawing

This drawing shows the regions and openings with hold-down locations for your reference.

Design Details

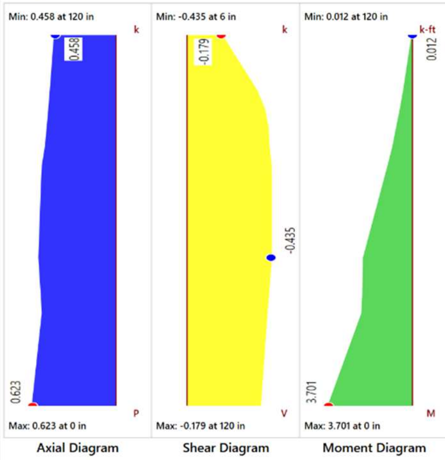
The Enveloped Results will display the controlling region, with the maximum Unity checks for Shear, Hold-down, and Studs. The Region Information will show the unity checks for all the regions. The openings are not design for Segmented walls. The deflection results are shown for the FEA solution as well as the NDS calculation method.

Regions In-Plane Detail Report

Region Design

	Shear UC	Strap / Hold-Down UC	Chord UC	Stud UC	Result
R1 (In-Plane)	0.532	0.37	0.084	0.027	PASS

Envelope Diagrams



Region Criteria

Code:	AWC NDS-18:ASD
Design Method:	Segmented
Wall Material:	DF
Panel Schedule:	AWC 2015 OSB
Optimize Strap:	Yes
Strap Manuf:	SIMPSON

Region Materials

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

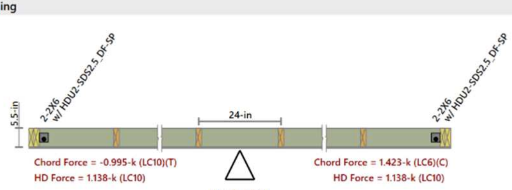
Region Geometry

Total Heigth (in):	120
Total Length (in):	40
Region H/W:	3.00
Capacity Adj. (2w/h):	1.00
Aspect Ratio:	0.88
Gov. H/W Capacity:	1.00
Stud Spacing (in):	24
K:	1.0

Code Check:

Limit State	Required	Available	Unity Check	Result
Shear Panel Design	0.011 k/in	0.017 k/in	0.532	PASS
Shear Panel: S1_5/16_6d@6				
Panel Grade				St-I
Panel Thickness				0.313 in
Number Sides				One
Over Gyp. Board				No
Nail Size				6d
Required Penetration				1.25 in
Required Spacing				6 in
Shear Capacity				0.017 k/in
Adjusted Capacity				0.017 k/in
NOTE: AWC NDS-18 defines a 6d nail as being 2.5" x 0.131" common, or 2.5" x 0.113" galvanized box				
Chord Design	1.423 k	16.943 k	0.084	PASS
Gov Compression LC = 6				
Compression Analysis	1.423 k	16.943 k	0.084	PASS
Gov Tension LC = 11				
Tension Analysis	1.052 k	23.166 k	0.045	PASS
Stud Design	0.208 k	7.616 k	0.027	PASS
Gov. LC = 1				
Gov. Region = R6				
Spacing = 24				
Hold Down Design	1.138 k	3.075 k	0.37	PASS
Selected Chord Strap / Hold Down:	HDU2-SDS2.5_DF-SP			
Governing Load Combination = 11				
Clear Span				3
Fastener Size				0
Required chord Mat				Douglas Fir
Base Cap (C_D=1)				1.922 k
CD Factor				1.6
Adjusted Capacity				3.075 k
Deflection				
Governing LC = 6				
Flexure Compression				0.011 in
Shear Compression				0.1 in
HD Elongation				0.08 in
Total Deflection				0.192 in

Cross Section Detailing



Criteria/Materials/Geometry
The top section of the detail report echoes the entire user defined input.

Envelope Diagrams
The next section will display the envelope axial, shear and moment diagrams.

Design Summary
This section provides the capacity and strength values at the section in the wall where the combined check is maximum, as well as governing load combinations.

The shear capacity is taken from the allowable shear value from the Table 2306.4.1 of the IBC 2018. The shear provided is adjusted by the 2w/h if the H/W ratio exceeds 2:1 per NDS-18 Special Provisions for Wind and Seismic 4.3.4.1.

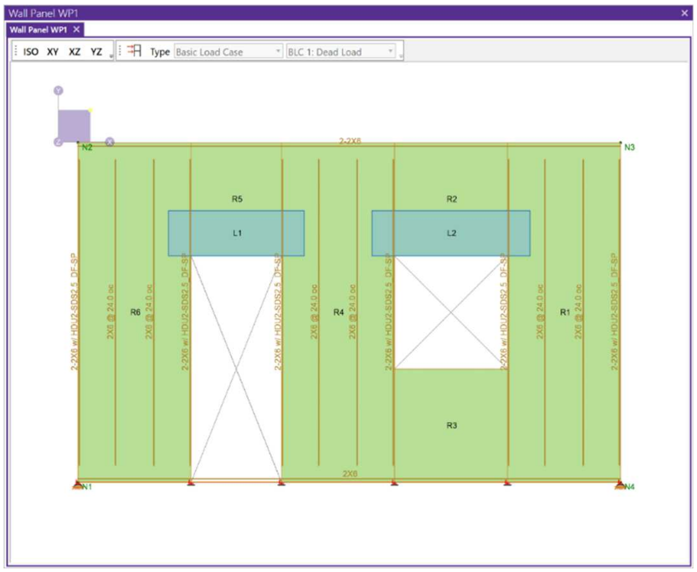
The Deflection listed is based on the NDS-18 Special Provisions for Wind and Seismic Eq. 4.3-1.

Note: This is the theoretical deflection of the wall and may differ from the deflection found from the FEA within RISA.

Let's review the results graphically:

- Double click on the wall to open the **Wall Panel Editor** and you'll see the designed wall detailed with the chords, studs and shear panel information.

Let's take a minute to review all the different components that make up the wall element:

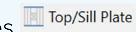


Wall Panel View

You can use the Wood View Controls to toggle the display of the:

- Wall Studs 

- Chords 

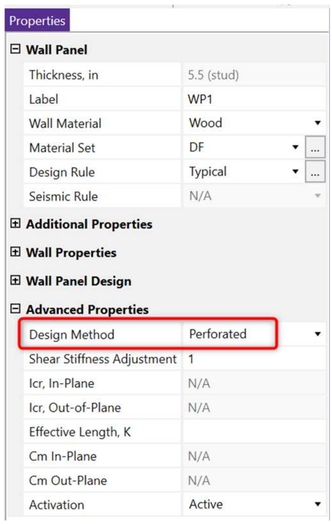
- Sill Plates 

Note: You'll notice the boundary conditions are only at the ends of the walls once you switch to **Perforated** method. This is because the entire wall is considered at once in the Perforated Design Method without regions.

Designing the Wall: Perforated Design Method

Let’s change the Design Method to Perforated:

- We’ll now switch the **Design Method** to **Perforated** in the **Advanced Properties** in the **Properties Panel**.



Note: Select **Yes** when asked to clear the current results.

With the loads still applied, run the analysis:

- Click the **Analysis and Design** 

Icon.
- Select **Batch Solution of Marked Combinations** and leave the **Include an Envelope with the Batch** checkbox enabled.
- Click **Solve.**

Reviewing Results:

- Select the **Wall Panel Design** spreadsheet from the **Results** toolbar

- To view the different results for wall panels, click on the tabs at the top: **Wood Wall Axial**, **Wood Wall In-Plane, Wood Header**

The **Wood Wall Axial** results provide the code checks relevant to Axial Loads of the wall. Here we see similar information that was provided for the Segmented design described above.

Wood Wall Panel Axial Code Checks (AWC NDS-18: ASD)

	Wall Panel	Region	Stud Size	Stud Spacing [in]	Axial Check	Gov LC	Chord Size	Chord Axial Check	Gov LC
1	WP1	N/A	2X6	24	0.032	1	2-2X6	0.124	6

The **In-Plane** results provide the code checks for the shear wall behavior of the wall.

Wood Wall Panel In Plane Code Checks (AWC NDS-18: ASD)

	Wall Panel	Shear Panel Label	Region	Shear Check	Shear Force [k/ft]	Gov LC	Hold-Down Label	Chord Strap Label	Tension Check	Tie-Down Force [k]	Gov LC
1	WP1	RS_5/16_6d@6	N/A	0.714	0.18	6	HDU2-SDS2.5_DF-SP	NC	0.434	1.334	10

The **Shear Panel Label** describes the shear panels selected for the wall. The designation **N/A** is shown for the regions because Perforated design is based on the entire wall rather than regions.

- Close the **Wall Panel Design** spreadsheet

Let's take a closer look at the wall by viewing the Detail Report:

- Click the **Detail** button on the left-hand side of the screen.
- Click anywhere on the wall panel. The **Detail Report** Summary Report will open.

The Perforated Design Method uses the entire wall panel, rather than the regions. As a result, the output will be per wall panel. Therefore, **N/A** is displayed in the **Region** column of the **Code Check** spreadsheets.

Note: The chords are the vertical hold down members/posts at both ends of every wall for the Perforated Design Method.

Wall Summary Detail Report

General/Geometry/Materials
The top section of the detail report echoes the entire user defined input. The Wall H/W Ratio is checked against the aspect ratio limits given in Table 4.3.4 of the NDS 2018 Special Design Provisions for Wind & Seismic (SDPWS). The opening height information is given in order to calculate the C_o.

Design Details
The shear stiffness adjustment factor for wall panels is intended to allow the user to adjust the stiffness of the walls so that they match the APA deflection calculations. This adjustment affects the stiffness of the entire wall.
You can modify this adjustment factor in the **Wall Panel** spreadsheet.

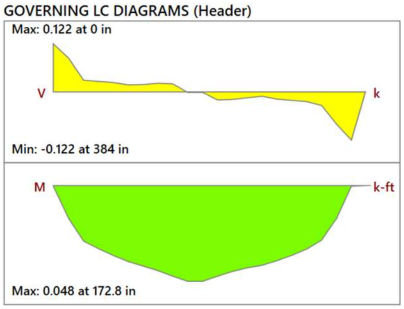
Cross Section Detailing
The last section will provide a cross sectional drawing of the entire wall with all the wall elements shown graphically. The Chord forces and Hold Down Forces are the maximum values from the LC that governed.

Header Detail Report

To navigate the Opening Detail Report, you will need to select the Opening Design H1 to expand the calculation.

Opening Design H1

GOVERNING LC DIAGRAMS (Header)



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

Criteria:

Code:	AWC NDS-18:ASD
Design Method:	Perforated

Geometry:

Opening Ht:	80 in
Opening Width:	32 in
h/w Ratio:	2.5

Material Properties:

Header Material:	DF	Sill Material:	DF
Header Size:	6x8	Sill Size:	2X6

Note: No header design for load combinations containing seismic or wind categories.

Code Check:

Limit State	Location	Required	Available	Unity Check	Result
Header Bending Design	14.4 in	-	1.2 ksi	0.009	PASS

Sawn Lumber Adjustment Factors

C_D = 1
C_M = 1
C_t = 1
C_L = 1
C_F = 1
C_{fu} = 1
C_i = 1
C_r = 1
R_b (Bending Slenderness Ratio) = 2.817

Bending Capacity Determination

Table = 4.3.1
L_e Bending = 32 in
F_b = 1.2 ksi
$F_{b'}$ = $F_b \times C_D \times C_M \times C_t \times C_L \times C_F \times C_{fu} \times C_i \times C_r$ = 1.2 ksi
Gov. LC = 1

Limit State	Location	Required	Available	Unity Check	Result
Header Shear Design	0 in	-	0.17 ksi	0.026	PASS

Sawn Lumber Adjustment Factors

C_D = 1
C_M = 1
C_t = 1
C_i = 1

Shear Capacity Determination

Table = 4.3.1
F_v = 0.17 ksi
$F_{v'}$ = $F_v \times C_D \times C_M \times C_t \times C_i$ = 0.17 ksi
Gov. LC = 1

- Click to close the **Detail Report** or right-click outside of the report to close.

Criteria/Materials/Geometry
The top section of the detail report echoes the entire user defined input from the **Wall Panel Editor.**

Envelope Diagrams (Header)
The next section will display the envelope axial, shear and moment diagrams.

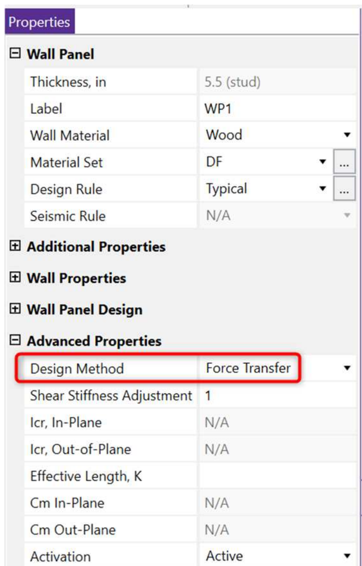
Design Summary
This section provides the Bending and Shear code checks as well as governing location and code equation combinations. The code design factors are also displayed.

Note: The Help file within RISA-3D and the RISA-3D General Reference Guide both provide explicit descriptions of nearly all of the values in the report.

Designing the Wall: Force Transfer Design Method

Let's modify the wall and change the Design Method to Force Transfer Around Openings:

- We'll now switch the **Design Method** to **Force Transfer** in the **Advanced Properties** in the **Properties Panel**.



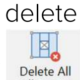
Note: Select **Yes** when asked to clear the current results.

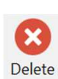
Let's change the drawing grid to locate the openings:

- Double click on the wall panel to activate the **Wall Panel Editor**.
- In the **Drawing Tools**, click in the box next to the **Horizontal (in),** clear the current entry and type **36,40,36,80**
- In the **Drawing Tools**, click in the box next to the **Vertical (in)**, clear the current entry and type **3@40**.
- Press the **Tab** key.
- Toggle the grid display on and off by clicking the 

icon.

We'll need to delete the door opening and delete all the regions.

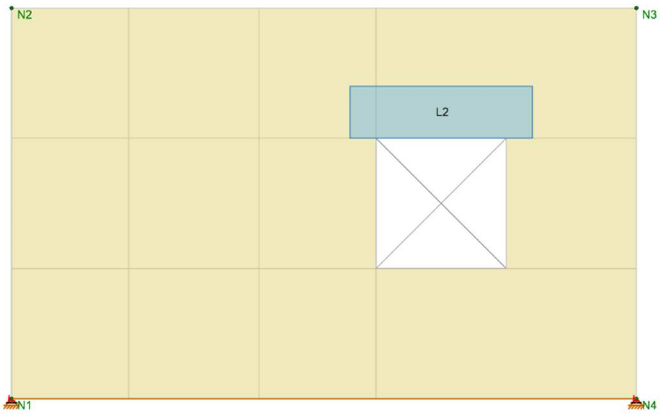
- Click on the **Delete All Wall Regions** 

button.
- Click on the **Delete** 

button and click on the door opening to delete it.
- Right click to end the command.

Note: The Force Transfer Around Openings method relies on reinforcement or straps, which are a functionality which is limited to windows only.

Thus, to use this method you cannot include door openings in your wall panel.

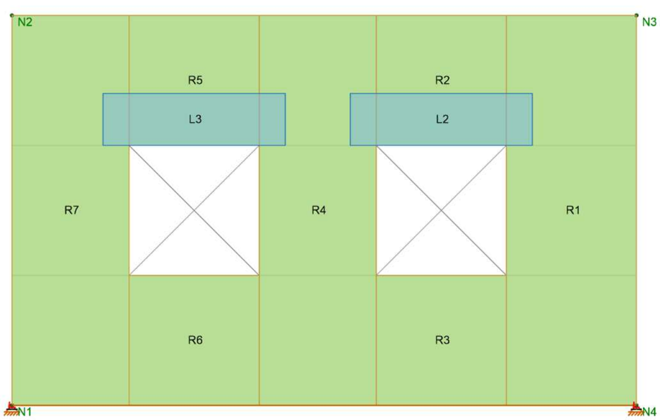


Now let's create a window opening:

- Click on the **Openings**  icon at the top left of the **Wall Panel Editor** to create an opening.
- Left click on the bottom left corner (36,40,0),
- Move the mouse to the top right corner (76,80,0) and left click on the grid intersection.
- Right click to end the command.

Let's define the regions for the wall:

- To define **Regions** inside the wall for design/analysis of the wood shear wall: Select the **Generate Wall Regions Automatically**  icon.

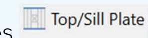


- Click on  to exit the **Wall Panel Editor**.

With the loads still applied, run the analysis:

- Click the **Analysis and Design**  Icon.
- Select **Batch Solution of Marked Combinations** and leave the **Include an Envelope with the Batch** checkbox enabled.
- Click **Solve.**

To display the wall panel as shown, be sure to use the Wood View Controls to toggle the display of the:

- Wall Studs 
- Chords 
- Sill Plates 

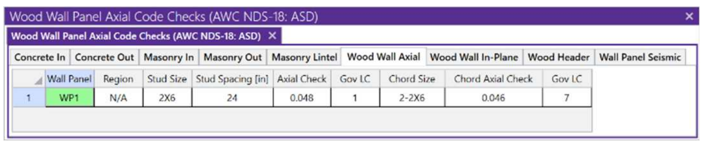
Designing for the **Batch** solution allows us to review the Detail Report as well as design for every load combination.

Reviewing Results:

- Select the **Wall Panel Design** spreadsheet from the **Results** toolbar.

- To view the different results for wall panels, click on the tabs at the top: **Wood Wall Axial**, **Wood Wall In-Plane, Wood Header.**

The **Wood Wall Axial** results provide the code checks relevant to axial Loads of the wall. Here we see similar information that was provided for the Segmented design described above.



	Wall Panel	Region	Stud Size	Stud Spacing [in]	Axial Check	Gov LC	Chord Size	Chord Axial Check	Gov LC
1	WP1	N/A	2X6	24	0.048	1	2-2X6	0.046	7

The **In-Plane** results provide the code checks for the shear wall behavior of the wall.

	Wall Panel	Shear Panel Label	Region	Shear Check	Shear Force [k/ft]	Gov LC	Hold-Down Label	Chord Strap Label	Tension Check	Tie-Down Force [k]	Gov LC
1	WP1	RS_5/16_6d@6	N/A	0.666	0.14	6	HDU2-SDS2.5_DF-SP	NC	0.052	0.161	11

Force Transfer Design uses the entire wall panel, rather than the regions so that results will be per wall panel. Therefore, **N/A** is displayed in the **Region** column.

The **Shear Panel Label** describes the Shear Panels selected for the wall. The designation **N/A** is shown for the regions because Force Transfer Around Openings design is based on the entire wall rather than regions.

- Close the **Wall Panel Design** spreadsheet.

Let's take a closer look at the wall by viewing the Detail Report:

- Click the **Detail** button  on the left-hand side of the screen.

- Click anywhere on the wall panel. The **Detail Report** Summary Report will open.

Wall Summary Detail Report

General/Geometry/Materials
The top section of the detail report echoes the entire user defined input.

Design Details
The shear stiffness adjustment factor for wall panels is intended to allow the user to adjust the stiffness of the walls so that they match the APA deflection calculations. This adjustment affects the stiffness of the entire wall. You can modify this adjustment factor in the **Wall Panel** spreadsheet.

This section displays the selected shear panel and hold downs. The maximum unit shear is also shown is comes from the maximum block unit shear in the **Opening** report.

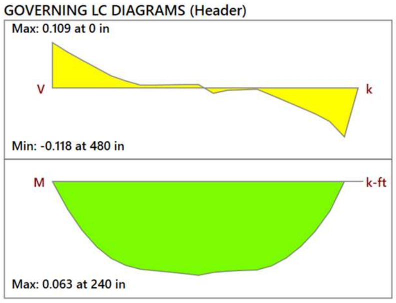
Cross Section Detailing
The last section will provide a cross sectional drawing of the entire wall with all the wall elements shown graphically. The Chord forces and Hold Down Forces are the maximum values from the LC that governed.

Header Detail Report

To navigate the Opening Detail Report, you will need to select the Opening Design H1 to expand the calculation.

Opening Design H1

GOVERNING LC DIAGRAMS (Header)



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

Criteria:

Code:	AWC NDS-18:ASD
Design Method:	FTAO

Geometry:

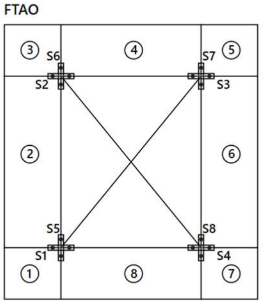
Opening Ht:	40 in
Opening Width:	40 in
h/w Ratio:	1

Material Properties:

Header Material:	DF	Sill Material:	DF
Header Size:	2-2X6	Sill Size:	2X6

Note: No header design for load combinations containing seismic or wind categories.

FTAO



Opening Straps:

Strap Label:	Req'd Cap.(k):	Gov LC:
S1	-0.061	7
S2	-0.193	6
S3	-0.123	7
S4	-0.183	6
S5	0.005	6
S6	-0.157	6
S7	0.054	7
S8	0.169	7

Analysis Summary:

Block #:	Unit Shear(k/ft):	h/w Ratio:
1	-0.079	1.111
2	-0.14	1.111
3	-0.067	1.111
4	-0.09	1
5	-0.044	1
6	-0.111	1
7	-0.076	1
8	-0.091	1

Code Check:

Limit State	Location	Required	Available	Unity Check	Result
Header Bending Design	20 in	-	1.3 ksi	0.038	PASS

Sawn Lumber Adjustment Factors

C_D = 1
C_M = 1
C_t = 1
C_L = 1
C_F = 1
C_{fu} = 1.15
C_i = 1
C_r = 1
R_b (Bending Slenderness Ratio) = 4.944

Bending Capacity Determination

Table = 4.3.1
L_e Bending = 40 in
F_b = 1 ksi
$F_{b1'}$ = $F_b \times C_D \times C_M \times C_t \times C_L \times C_F \times C_{fu} \times C_i \times C_r$ = 1.3 ksi
Gov. LC = 1

Limit State	Location	Required	Available	Unity Check	Result
Header Shear Design	40 in	-	0.18 ksi	0.059	PASS

Sawn Lumber Adjustment Factors

C_D = 1
C_M = 1
C_t = 1
C_i = 1

Shear Capacity Determination

Table = 4.3.1
F_v = 0.18 ksi
$F_{v1'}$ = $F_v \times C_D \times C_M \times C_t \times C_i$ = 0.18 ksi
Gov. LC = 1

Criteria/Materials/Geometry
The top section of the detail report echoes the entire user defined input.

Envelope Diagrams (Header)
The next section will display the envelope shear and moment diagrams.

FTAO & Opening Straps
These sections map out the openings, and the strap forces Required Capacity. The sheathing resists the shear forces. The average shear force in each block of the wall (numbered 1 thru 8 as shown in the image above) is used as the controlling shear force in that location. The maximum shear in each of these locations will control the design of the wall and will be displayed in the Wall Summary Detail Report. The program uses an area weighted average of the Fxy plate forces to determine the average shear for each block.

Design Details
This section provides the Bending and Shear code checks as well as governing location and code equation combinations. The code design factors are also displayed.

Note: In the Help file within RISA-3D and the RISA-3D General Reference both provide explicit descriptions of nearly all the values in the report.

Conclusion

If you have completed the tutorial you should now be familiar with modeling, analyzing and designing wood wall panels in RISA-3D. In addition to wood wall panels, RISA-3D has wall panels in masonry and general materials. To learn more about the other materials or if you wish to know more about specific features, you can refer to the RISA-3D General Reference Guide or the Help from within RISA-3D.

If you have any questions, comments or suggestions feel free to email us at support@risa.com or call us at 949-951-5815.

Thank you for choosing RISA!