RISA-3D

Structural Analysis Software for Every Material

Masonry Wall Panel: Introduction & Tutorial

A NEMETSCHEK COMPANY

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Introduction

This hands-on guide will help introduce you to the RISA-3D Masonry 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 masonry 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.

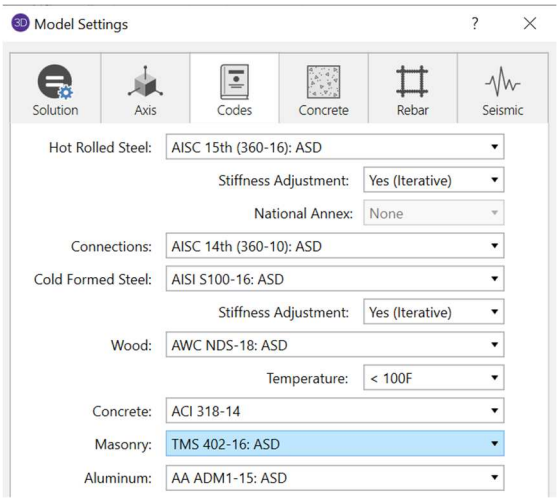
Note: If you are not familiar with RISA-3D, you should also complete the tutorials available on the RISA website at https://risa.com/documentation.

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

Masonry Codes & Materials

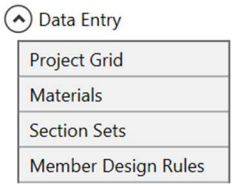
Let's start by setting the design code:

- Click on the **Model Settings** icon.
- Choose the **Codes** tab.
- Select the **Masonry** code from the drop-down list: **TMS 402-16: ASD**.
- Click **OK**.



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

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

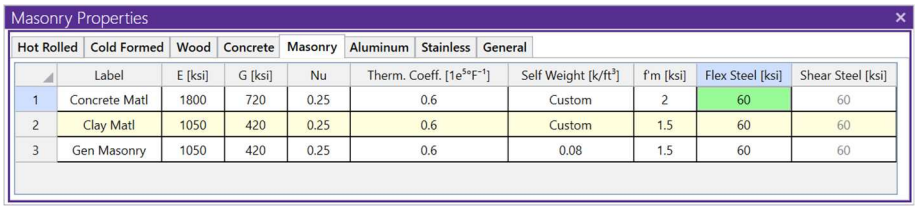


- Click on the **Masonry** tab at the top of the dialog box
- Change the **Concrete Matl** properties by typing directly in the cell:

  E = 1800 ksi

  G = 720 ksi

  f'm = 2 ksi



	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e^{5}F^{-1}]	Self Weight [k/ft^3]	f'm [ksi]	Flex Steel [ksi]	Shear Steel [ksi]
1	Concrete Matl	1800	720	0.25	0.6	Custom	2	60	60
2	Clay Matl	1050	420	0.25	0.6	Custom	1.5	60	60
3	Gen Masonry	1050	420	0.25	0.6	0.08	1.5	60	60

- Click on the in the upper right corner to close the spreadsheet.

Masonry Design Codes in RISA-3D:

- TMS 402-16 ASD & Strength
- ACI 530-13 ASD & Strength
- ACI 530-11 ASD & Strength
- ACI 530-08 ASD & Strength
- ACI 530-05 ASD & Strength
- ACI 530-99 ASD
- UBC 97 ASD & Strength

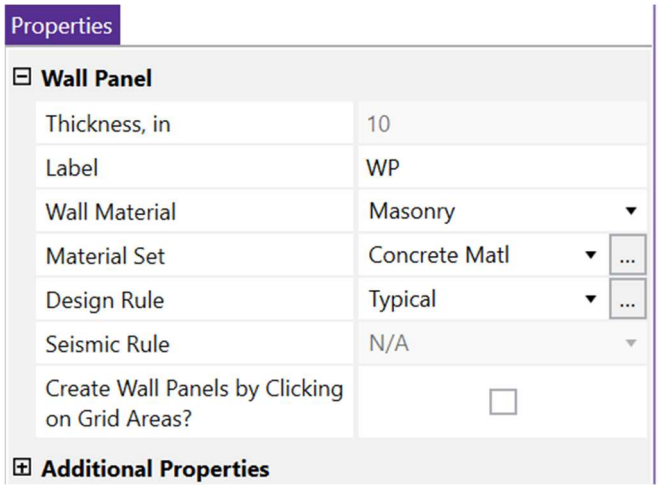
TIP: RISA-3D has a variety of default material properties available; you can save your own default materials available by pressing the default icon at the top of the screen when the **Materials** spreadsheet is open.

Creating Wall Geometry

Let's start by drawing the wall:

- Click on the 

icon on the **Draw Elements** section on the **Home** tab.
- 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 masonry wall.

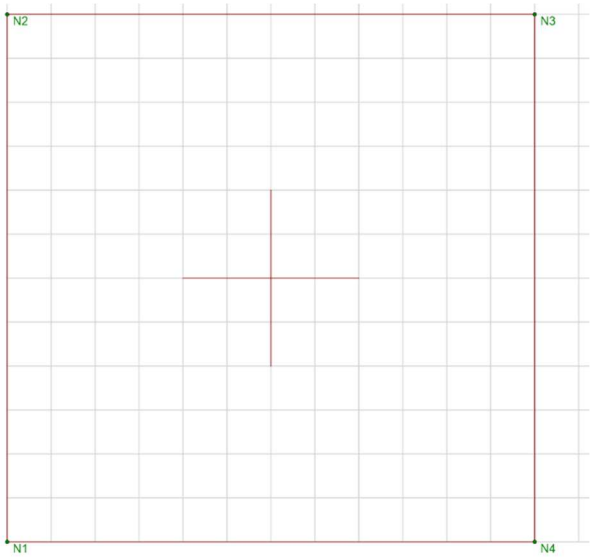
You can draw a wall by clicking on existing nodes or drawing the wall using a grid. We will draw a wall using the drawing grid.

Choose which type of wall:

- Select **Masonry** from drop-down menu.
- Select **Material Set: Concrete Matl**.
- 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:

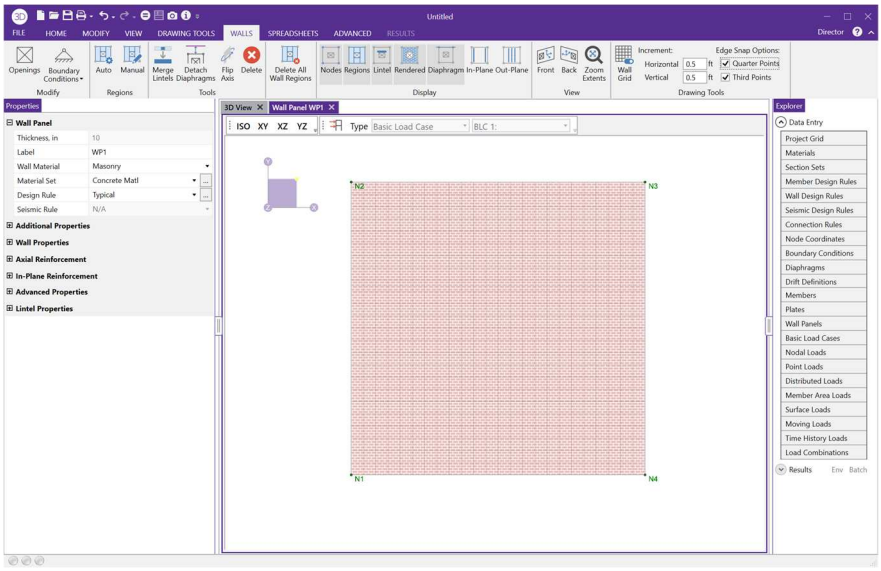
- Click on the bottom left corner (0,0,0),
- Move the cursor to the top right corner and left click on (12,12,0),
- Right-click the mouse or press Esc to stop drawing.



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

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

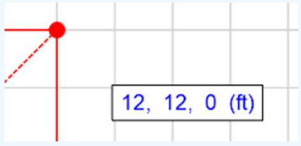
- Double click on the **Wall Panel** to view the **Wall Panel Editor**. A new **Walls** tab will appear in the **Ribbon Toolbar**.



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.

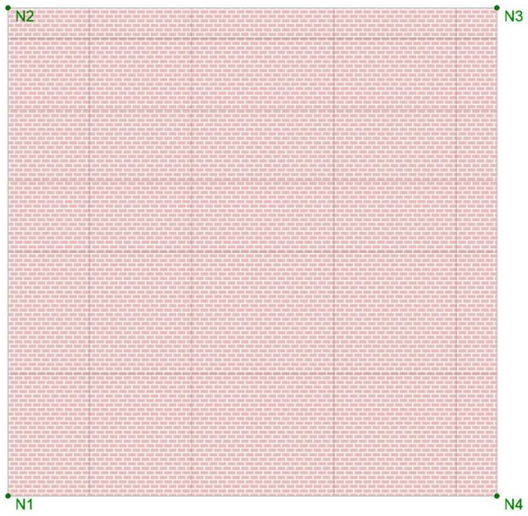


Next, change the drawing grid in order to locate the openings:

- In the **Drawing Tools** section, click in the box next to **Horizontal (ft),** clear the current entry and type **2,2.5,3.5,3**
- In the **Drawing Tools** section, click in the box next to the **Vertical (ft),** clear the current entry and type **2@3, 1.75**
- 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.



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 window opening:

- Using the **Wall Grid** coordinates, left click on the bottom left corner of the opening **(2,3,0)**.
- Move the mouse to the top right corner **(4.5,6,0)** and left click on the grid intersection.

Now let's create a door opening:

- Left click on the bottom left corner **(8,0,0)**
- Move the mouse to the top right corner **(11,7.75,0)** and left click on the grid intersection.
- Right click to end the command.

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

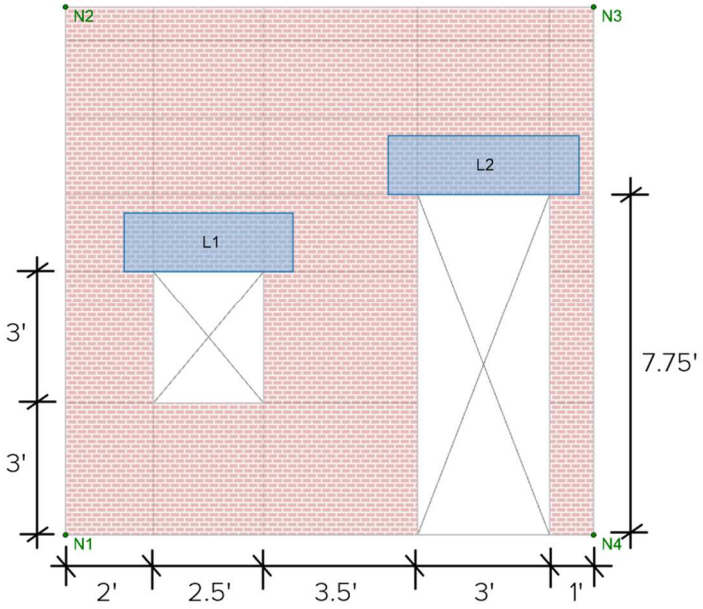
"@" (to specify multiple, equally spaced increments).

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

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

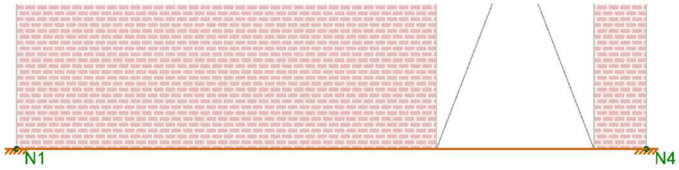
The Wall Grid within the Wall Panel Editor is a tool that guides your placement of openings. The grid is independent of your model, so you may change the grid as you build the wall without changing anything in your model.

The wall should now look like the picture shown below.



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 **Fixed** 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:

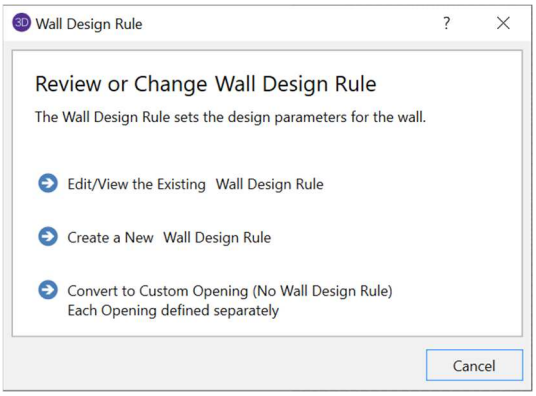
- Free
- Fixed
- Roller

Lintels

Lintels will automatically be created and placed above the openings in masonry walls.

Let's review the lintel design parameters:

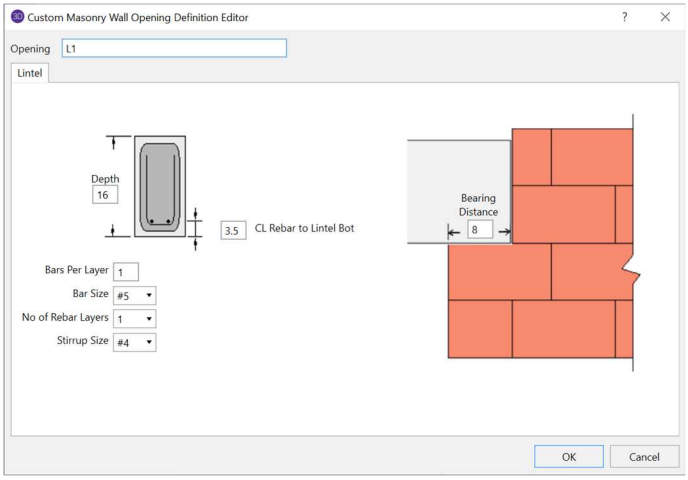
- Double left click directly inside the window opening to view the **Lintel** design parameters, in this example select **Edit/View Existing Wall Design Rule**



- If the lintels do not show, use the toggle 

icon to turn them on.

The lintel 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**.

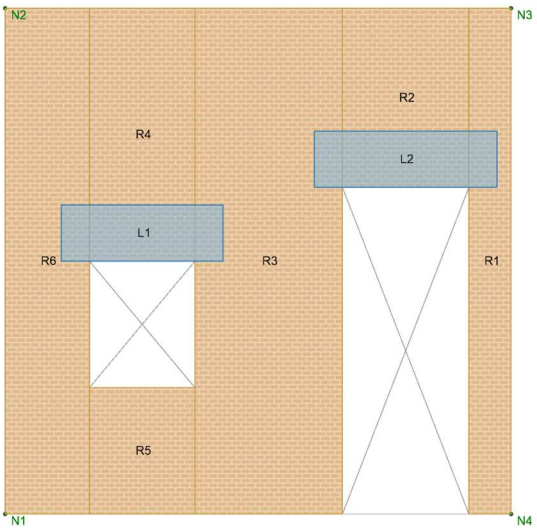
We will review the header Design Rule in the next section.

Assigning Design Parameter Regions

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

- Select the **Generate Wall Regions Automatically** 

icon.



- The wall drawing should now look like the picture above.

Let's now review the Region Design Parameters:

The masonry design parameters and reinforcement are specified as part of the **Wall Design Rules**. The **Wall Design Rule** will automatically update the design parameters for the entire wall. In the next section, we will review the **Wall Design Rules**. You can review the design parameter named "**Typical**" that is being applied to this wall:

- Double left click directly inside the **Region R6** and click **Edit/View the Existing**

Wall Design Rule to view the **Region Design Parameters**.

The information can be edited directly in this dialogue or can be edited in the **Wall Design Rules** spreadsheet. Additionally, if you need a special reinforced region, you can click **Convert to Custom** to edit only this region.

- Click **OK** to close the region details.
- Click on the  in the upper right corner to close 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.

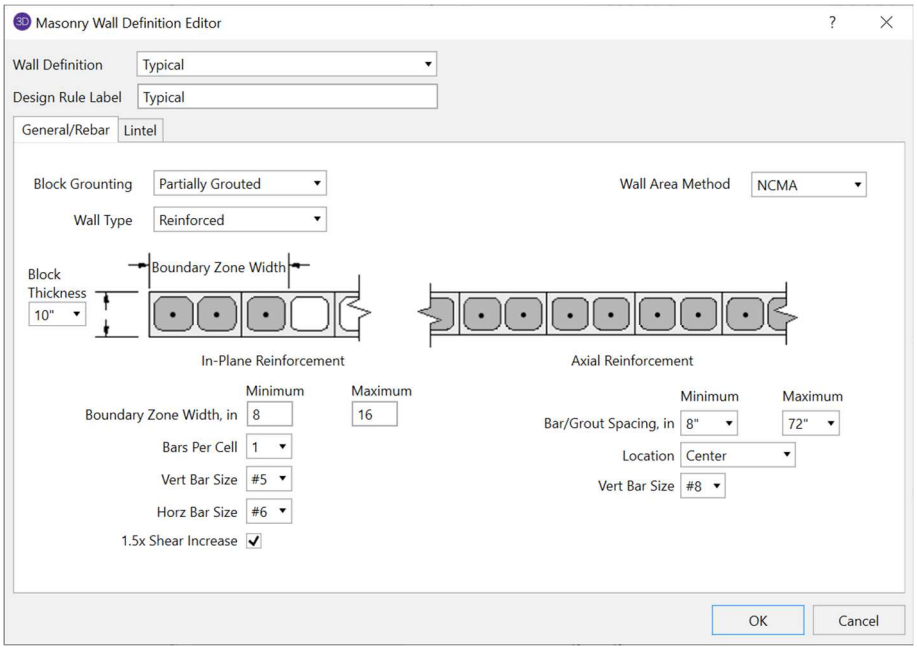
RISA automatically creates regions for walls. However, it is also possible to manually create Regions by selecting **Design Wall Regions Manually** 

icon.

Wall Design Rules

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

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

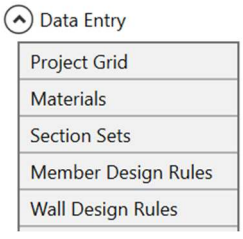


The dialogue allows for all of the wall design parameters to be assigned and modified in one location.

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

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

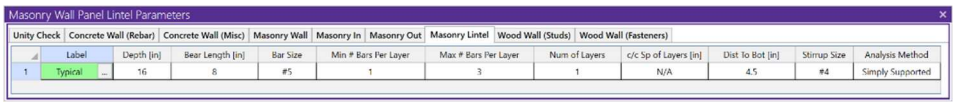
- Select **Wall Design Rules** from the **Data Entry** panel



- Click on the **Masonry Lintel** tab and set the properties for lintel design as shown on the next page.

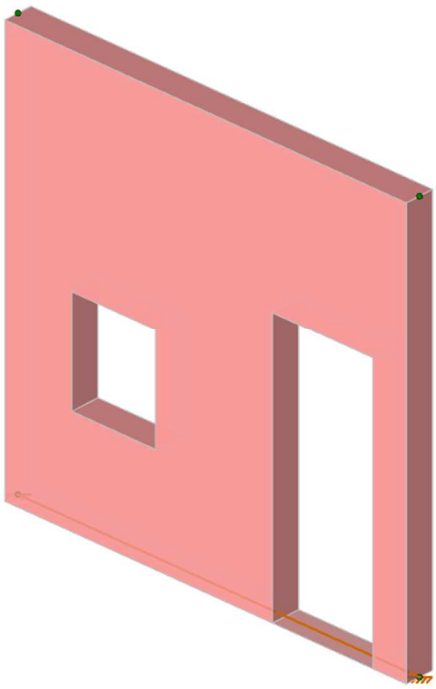
Block Nominal Width: This is used to calculate thickness of masonry walls. This value is used along with the value of grout/bar spacing to determine the effective thickness of the wall. The effective thickness is based on tables B-3a and B-3b of the **Reinforced Masonry Engineering Handbook, by Amrhein, Copyright 1998.**

Block Nominal Length: This value is used to optimize the boundary zone length of the masonry walls. It is assumed that there are 2 cells per block (typical for concrete masonry) and based on the value of **Bars Per Cell** we can increment the value of the boundary zone while incrementing the number of bars in the boundary zone.

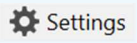


- **Depth:** 16”
- **Bearing Length:** 8”
- **Bar Size:** #5
- **Min # Bars Per Layer:** 1
- **Max # Bars Per Layer:** 3
- **Num of Layers:** 1
- **c/c Sp of Layers:** N/A
- **Dist to Bot:** 4.5
- **Stirrup Size:** #4
- **Analysis Method:** Simply Support
- Click  to exit the **Wall Design Rules.**

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**.



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** 

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.

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.

Loading

We first need to create the Basic Load Cases:

- Open the **Basic Load Case** spreadsheet on the **Data Entry** toolbar or press the 

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.

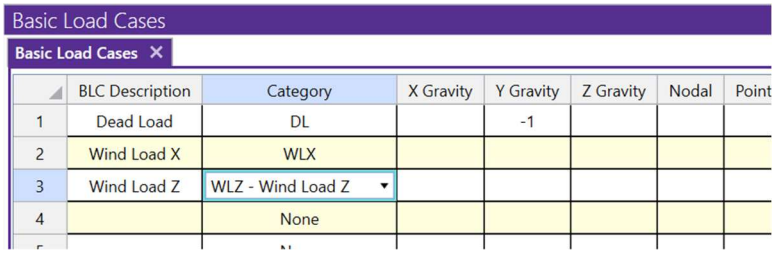
Walls can be loaded with joint, surface loads, or distributed loads.

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.

Let's add wind load case:

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

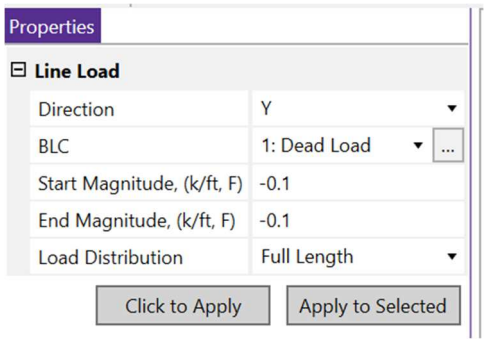


- Type **Wind Load Z** on the third line under the **BLC Description** column.
- Select **WLZ (Wind Load Z)** from the **Category** drop-down menu.
- Exit **BLC Spreadsheet** by clicking the  on the top right corner.

Add a distributed load to the wood wall:

- Click on **Distributed Load** 

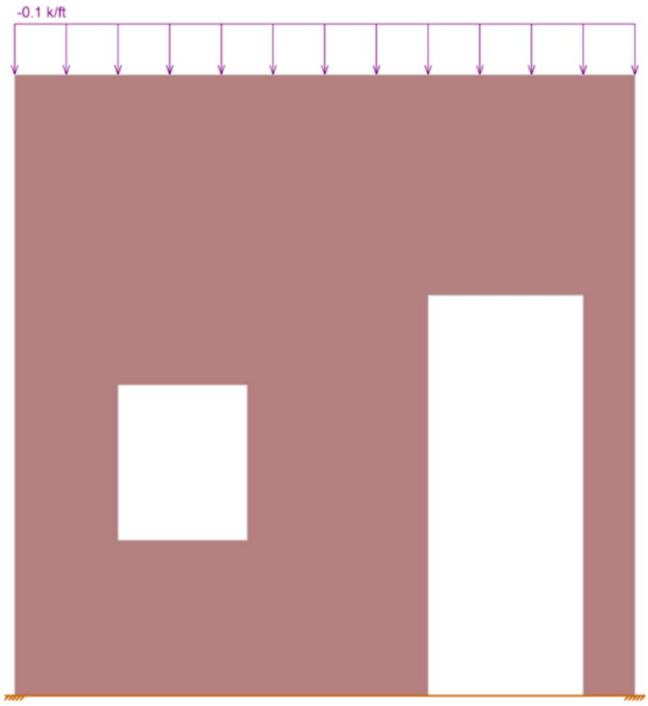
icon.
- Select **Y** for **Direction** in the drop-down menu.
- Select **Basic Load Case 1: Dead Load**.
- Type **-0.1** as the **Start Magnitude** and the **End Magnitude** will automatically populate.



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

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

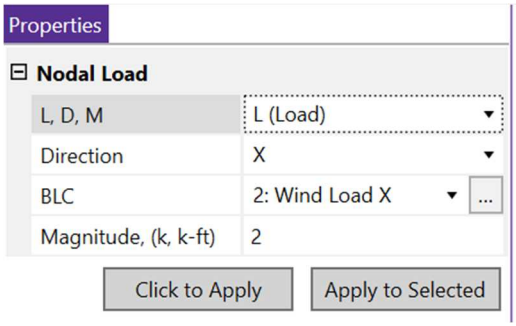
The wall should now look like the image below with the distributed load applied.



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 X.**
- Select **Direction X** from the dropdown list.
- **Magnitude:** 2 kips
- Select **Click to Apply.**



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

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

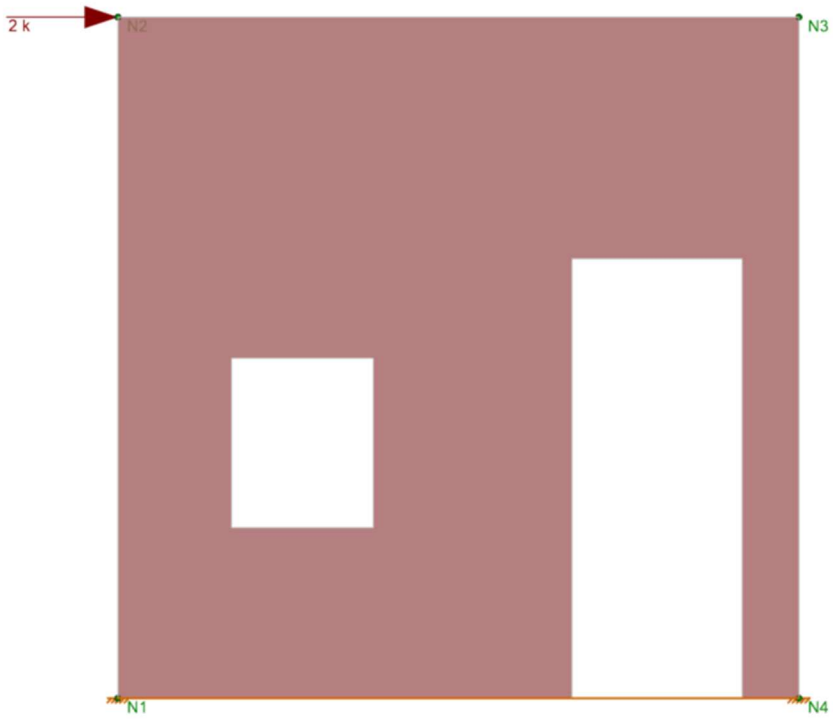
Wall Panels can have uniform or tapered surface loads.

The direction of the load is applied to the Global Z direction.

The global axis is always indicated with capital letters and the local axis is indicated by lower case letters.

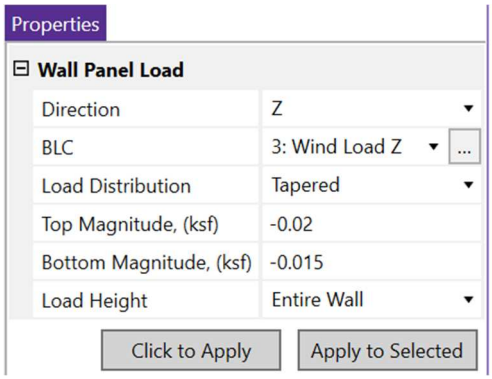
When you have openings in your wall panel, the load that is attributed to the opening(s) in the wall panel is applied as a transient load distributed around the openings. You can view these by going to **View > Model View Settings > Loads > Check Include Transient (Wall)** after solution.

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



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

- Click on **Wall Surface Load**  icon.
- Select **Direction Z** from the dropdown list.
- Select **Basic Load Case 3: Wind Load Z.**
- Select **Tapered Load Distribution.**
- **Top Magnitude:** -0.02 ksf
- **Bottom Magnitude:** -0.015 ksf
- **Load Height:** Entire Wall
- Select **Click to Apply** and click on the wall.



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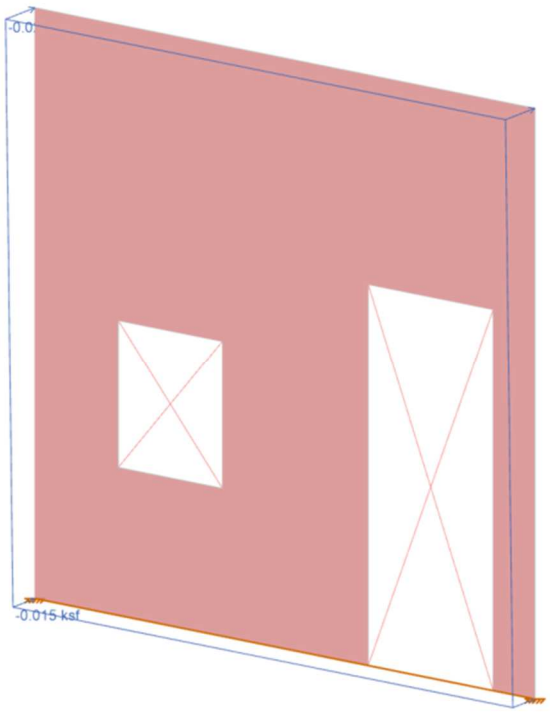
The wall should now look like the image below with the surface load applied.



With the loads applied to the masonry wall, we can now create load combinations prior to analysis and design.

Load Combinations

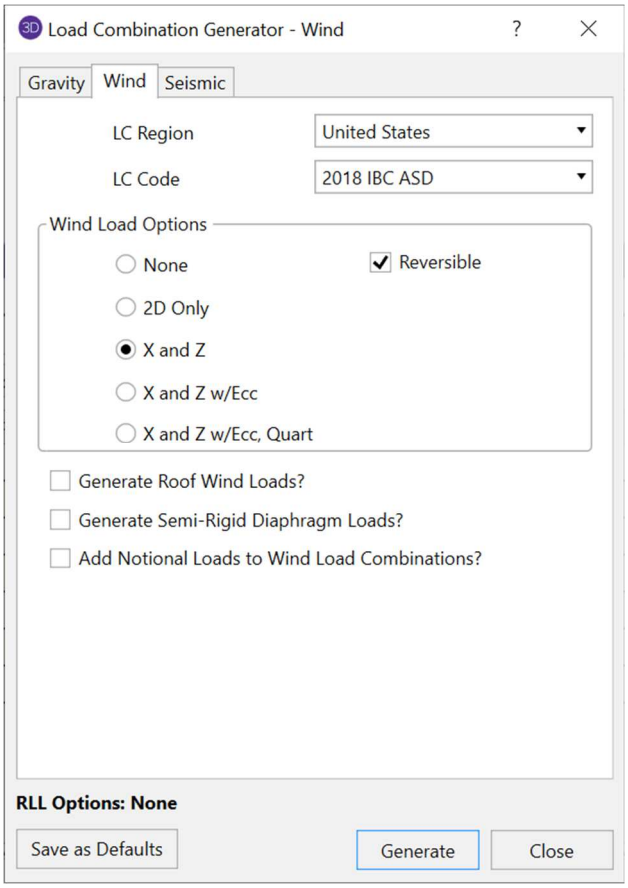
The LC Generator allows you to create load combinations quickly based on the code you select.

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

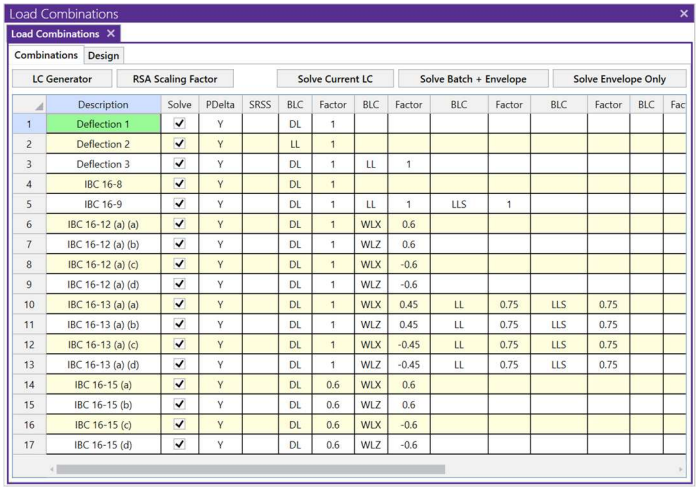
- Open the **Load Combination** spreadsheet by selecting the 

Icon at the top of the screen.
- Select **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.
- Select the **Wind** tab.
- Click the **X and Z** button under the **Wind Load Options**
- Select the **Reversible** checkbox.
- Click **Generate**.
- Click **Close**.



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



	Description	Solve	PDelta	SRSS	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Fac
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	WLX	0.6						
7	IBC 16-12 (a) (b)	☑	Y		DL	1	WLZ	0.6						
8	IBC 16-12 (a) (c)	☑	Y		DL	1	WLX	-0.6						
9	IBC 16-12 (a) (d)	☑	Y		DL	1	WLZ	-0.6						
10	IBC 16-13 (a) (a)	☑	Y		DL	1	WLX	0.45	LL	0.75	LLS	0.75		
11	IBC 16-13 (a) (b)	☑	Y		DL	1	WLZ	0.45	LL	0.75	LLS	0.75		
12	IBC 16-13 (a) (c)	☑	Y		DL	1	WLX	-0.45	LL	0.75	LLS	0.75		
13	IBC 16-13 (a) (d)	☑	Y		DL	1	WLZ	-0.45	LL	0.75	LLS	0.75		
14	IBC 16-15 (a)	☑	Y		DL	0.6	WLX	0.6						
15	IBC 16-15 (b)	☑	Y		DL	0.6	WLZ	0.6						
16	IBC 16-15 (c)	☑	Y		DL	0.6	WLX	-0.6						
17	IBC 16-15 (d)	☑	Y		DL	0.6	WLZ	-0.6						

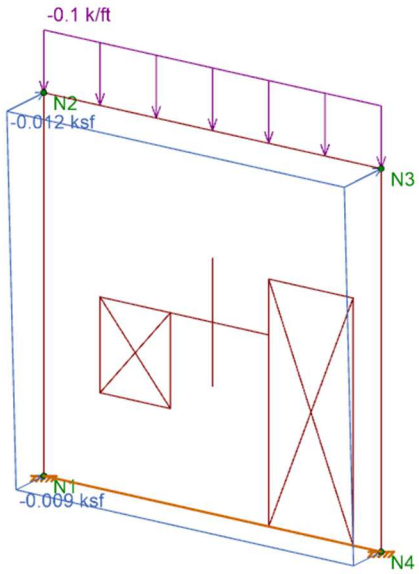
- Close the **LC Spreadsheet**.

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 **LC7** in the drop-down dialog.

You should now see the **Load Combination 7: IBC 16-12 (a) (b) = DL + 0.6 WLZ** displayed on your screen as below.

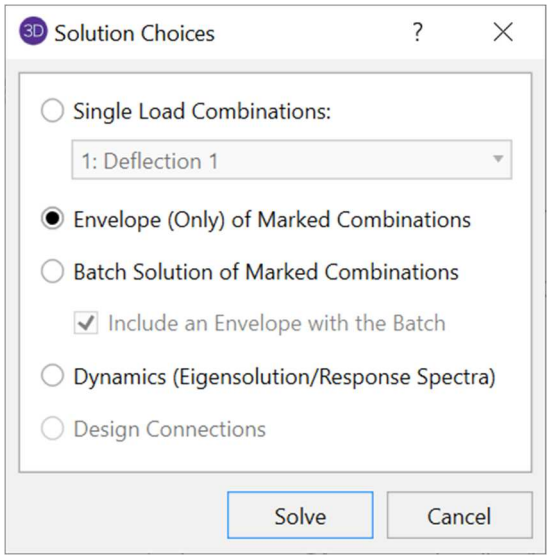


To display loads, we will work with the loading display toolbar at the top of the screen.

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

- Click the **Analysis and Design** 

icon.
- Select the **Envelope (Only) 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.

Designing the Wall

Reviewing results:

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

- To view the different results for wall panels, click on the tabs at the top: **Masonry In**, **Masonry Out, Masonry Lintel.**

Each spreadsheet consists of design results for the wall panel broken down into each individual design region and includes the following information:

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

– The **Combined UC** entry gives the code check due to axial force plus bending. The **Shear UC** shows the code check for shear effects. A value greater than 1.0 for either of these values indicates failure.

– The **Fa** or **Pn*Phi** reports the allowable axial stress or axial capacity.

– The **Fb** or **Mn*Phi** reports the calculated allowable bending stress or moment capacity for the region.

– The **Fv** or **Vn*Phi** reports the calculated allowable shear stress or shear capacity for the region.

Wall Panel TMS 402-16: ASD Masonry Code Checks for Wall Regions (In Plane)

Wall Panel TMS 402-16: ASD Masonry Code Checks for Wall Regions (In Plane)

	Wood Wall Axial		Wood Wall In-Plane			Wood Header			Wall Panel Seismic	
	Concrete In		Concrete Out		Masonry In		Masonry Out		Masonry Lintel	
	Wall Panel	Region	Design Rule	Combined UC	LC	Shear UC	LC	Fa [ksi]	Fb [ksi]	Fv [ksi]
1	WP1	R1	Typical	0.086	6	0.092	6	0.375	0.675	0.05
2		R2	Typical	0.012	16	0.093	8	0.375	0.675	0.055
3		R3	Typical	0.069	6	0.161	16	0.375	0.675	0.043
4		R4	Typical	0.018	6	0.145	6	0.375	0.675	0.051
5		R5	Typical	0.04	8	0.182	8	0.375	0.675	0.047
6		R6	Typical	0.071	8	0.172	8	0.375	0.675	0.056

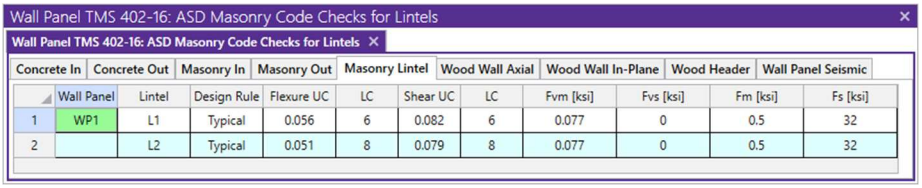
Wall Panel TMS 402-16: ASD Masonry Code Checks for Wall Regions (Out of Plane)

Wall Panel TMS 402-16: ASD Masonry Code Checks for Wall Regions (Out of Plane)

	Wood Wall Axial		Wood Wall In-Plane			Wood Header			Wall Panel Seismic	
	Concrete In		Concrete Out		Masonry In		Masonry Out		Masonry Lintel	
	Wall Panel	Region	Design Rule	Combined UC	LC	Shear UC	LC	Fa [ksi]	Fb [ksi]	Fv [ksi]
1	WP1	R1	Typical	0.801	7	0.124	7	0.375	0.675	0.033
2		R2	Typical	0.015	9	0.007	7	0.375	0.675	0.033
3		R3	Typical	0.667	9	0.104	7	0.375	0.675	0.033
4		R4	Typical	0.078	9	0.031	7	0.375	0.675	0.033
5		R5	Typical	0.579	9	0.151	7	0.375	0.675	0.033
6		R6	Typical	0.476	9	0.078	7	0.375	0.675	0.033

The **Masonry Lintel** tab gives the results for the masonry lintels that span over user defined openings in the wall. They can also be viewed by looking at the detail report associated with each opening.

- The **Flexural UC** entry gives the code check due to pure flexure of the **Lintel**. Axial force is not considered in this code check. The **Shear UC** gives the code check for shear. A value greater than 1.0 for either of these values would indicate failure.
- The **Fa** or **Pn*Phi** reports the allowable axial stress or axial capacity.
- The **Fb** or **Mn*Phi** reports the calculated allowable bending stress or moment capacity for the region.
- The **Fv** or **Vn*Phi** reports the calculated allowable shear stress or shear capacity for the region.



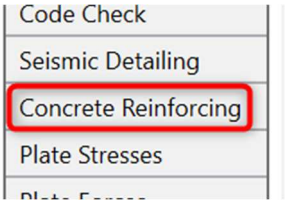
	Wall Panel	Lintel	Design Rule	Flexure UC	LC	Shear UC	LC	Fvm [ksi]	Fvs [ksi]	Fm [ksi]	Fs [ksi]
1	WP1	L1	Typical	0.056	6	0.082	6	0.077	0	0.5	32
2		L2	Typical	0.051	8	0.079	8	0.077	0	0.5	32

For slender wall design, additional checks and analysis are required. These are reported in the regions detail report.

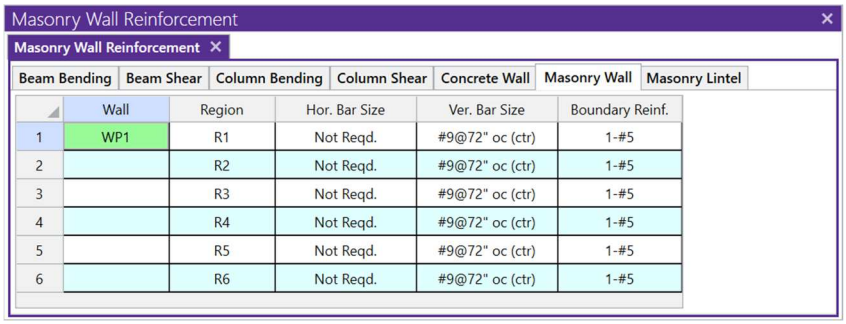
- Close the **Wall Panel Design** spreadsheet.

Let's take a closer look at the wall reinforcement:

- Select the **Concrete Reinforcing** spreadsheet from the **Results** panel.



- To view the different results for wall panels, click on the tabs at the top: **Masonry Wall**, **Masonry Lintel**.



	Wall	Region	Hor. Bar Size	Ver. Bar Size	Boundary Reinf.
1	WP1	R1	Not Reqd.	#9@72" oc (ctr)	1-#5
2		R2	Not Reqd.	#9@72" oc (ctr)	1-#5
3		R3	Not Reqd.	#9@72" oc (ctr)	1-#5
4		R4	Not Reqd.	#9@72" oc (ctr)	1-#5
5		R5	Not Reqd.	#9@72" oc (ctr)	1-#5
6		R6	Not Reqd.	#9@72" oc (ctr)	1-#5

- Close the **Concrete Reinforcing** spreadsheet.

Detailed Reports

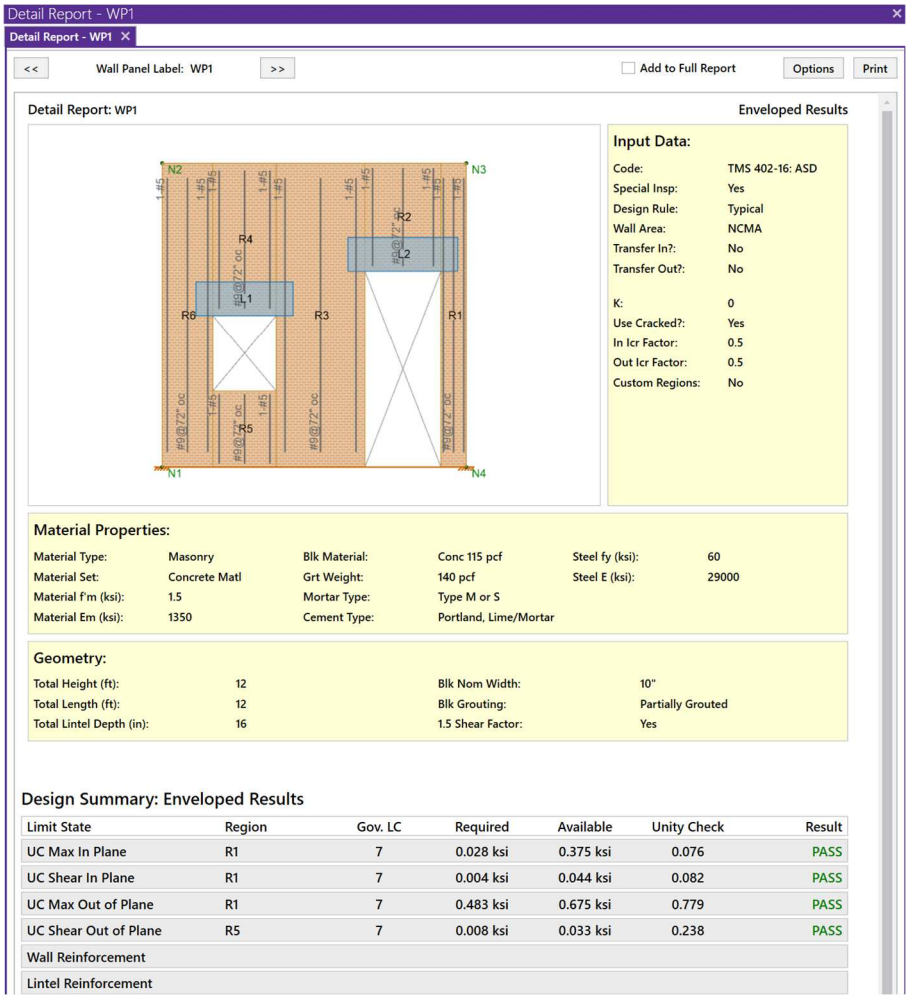
Let's take a closer look at the wall by viewing the Detail Report:

- Click the **Analysis and Design** 

Icon.
- Select the **Single Combination** radio button.
- Select **LC7: IBC 16-12 (a) (b)**.
- Click **Solve.**
- Click the **Detail** button  on the left-hand side of the screen.
- Click anywhere on the wall panel. The **Detail Report Summary** will open.

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

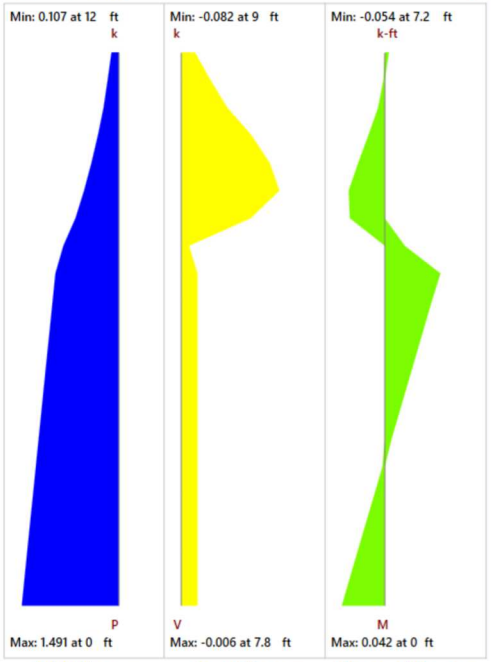
Wall Summary Detailed Report



The top section of the **Detail Report** echoes the entire user defined input.

Regions In-Plane Detail Report

Region R1 (In-Plane)	7	0.003 ksi	0.043 ksi	0.068	PASS



Axial Diagram | Shear Diagram | Moment Diagram

Region Criteria

Code:	TMS 402-16: ASD
Special Insp:	Yes
Wall Area:	NCMA
Hor Bar Size:	#6
Vert Bar Size:	#5
No of Ten Bars:	1
Effective Depth (in):	8

Materials

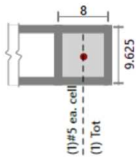
Masonry f'm (ksi):	1.5
Masonry Em (ksi):	1350
Steel fy G (ksi):	60
Steel E (ksi):	29000
Blk Material:	Conc 115 pcf
Grt Weight:	140 pcf
Wall Dead Wt (ksf):	0.072

Geometry

Total Height (ft):	12
Total Length (ft):	1
Blk Grouting:	Partially Grouted
Grt/Bar Spacing (in):	24
Block Nom Width (in):	10
1.5 Shear Factor:	Yes

Code Check:

Limit State	Gov. LC	Required	Available	Unity Check	Result
Axial Design	7	0.024 ksi	0.375 ksi	0.064	PASS
P = 1.491 k			Max axial force		
Location = 0 ft			Governing axial location		
r = 3.1 in			Radius of gyration		
h'/r = 0			Height to width ratio		
R = 1			Reduction factor		
fa = 0.024 ksi			Max axial stress		
Fa = 0.375 ksi			Allowable axial stress		
Bending Design	7	0 ksi	32 ksi	0	PASS
Combined Checks					PASS
Shear Design	7	0.003 ksi	0.043 ksi	0.068	PASS
Cross Section Detailing					



No horizontal reinforcement required

NOTE: All units are in "in"

Effective Depth: This gives you the distance from the compression face of the region to the centroid of tension reinforcement within that region.

The next section will display the envelope axial, shear and moment diagrams as well as a summary of the code checks.

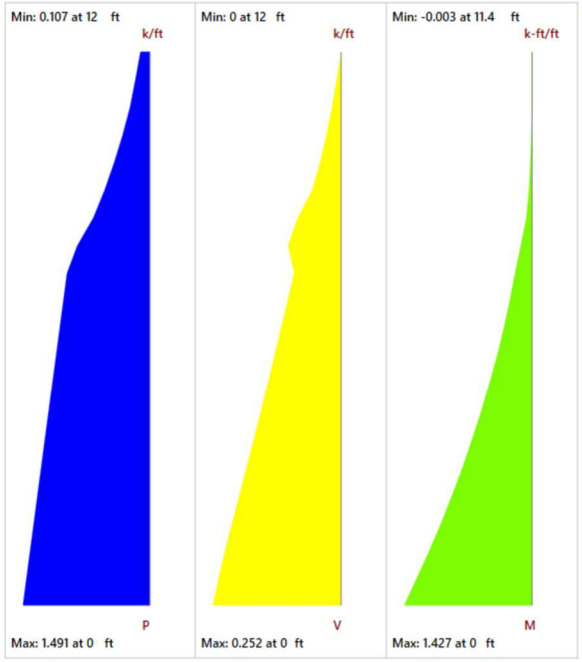
The next section will provide the design details for axial, bending and shear.

Note: You may click on any of the **Limit States** to view an expanded detailed calculation.

The last section will provide a cross sectional drawing of the boundary zone width and reinforcement.

Regions Out-of-Plane Detail Report

Region R1 (Out-of-Plane)	7	25.644 ksi	32 ksi	0.801	PASS



Axial Diagram | Shear Diagram | Moment Diagram

Region Criteria

Code:	TMS 402-16: ASD
Special Insp:	Yes
Wall Area:	NCMA
Type of Design:	ASD
Reinforced:	Yes
Vert Bar Size:	#5

Materials

Masonry f'm (ksi):	1.5
Masonry Em (ksi):	1350
Steel fy G (ksi):	60
Steel E (ksi):	29000
Blk Material:	Conc 115 pcf
Grt Weight:	140 pcf
Wall Dead Wt (ksf):	0.072
Mortar Type:	Type M or S
Cement Type:	Portland, Lime/Mortar

Geometry

Total Height (ft):	12
Eq Sld Thickness (in):	5.15
Blk Grouting:	Partially Grouted
Grt/Bar Spacing (in):	48
Loc of r/f:	Center

Code Check:

Limit State	Gov. LC	Required	Available	Unity Check	Result
Axial Design	7	0.024 ksi	0.375 ksi	0.064	PASS
Bending Design	7	25.644 ksi	32 ksi	0.801	PASS
M = 1.427 k-ft/ft			Max moment		
Location = 0 ft			Governing location		
k = 0.286			Effective length factor		
d = 4.813 in			Depth of flexural reinforcement		
j = 0.905			Ratio of distance between centroid of compressive and tensile forces		
fb = 0.477 ksi			Max bending stress		
Fb = 0.675 ksi			Allowable bending stress		
fs = 25.644 ksi			Max steel bending stress		
Fs = 32 ksi			Allowable steel bending stress		
Combined Checks					PASS
Shear Design	7	0.004 ksi	0.033 ksi	0.124	PASS
Cross Section Detailing					

NOTE: All units are in "in"

The **Equivalent Solid Thickness** is obtained by dividing the volume of the solid material in the wall by the face area of the wall. This is used in calculating the axial stress in the wall. A good reference for this value is the Reinforced Masonry Engineering Handbook, 5th ed. by James Amrhein, specifically, Tables B-3a and B-3b.

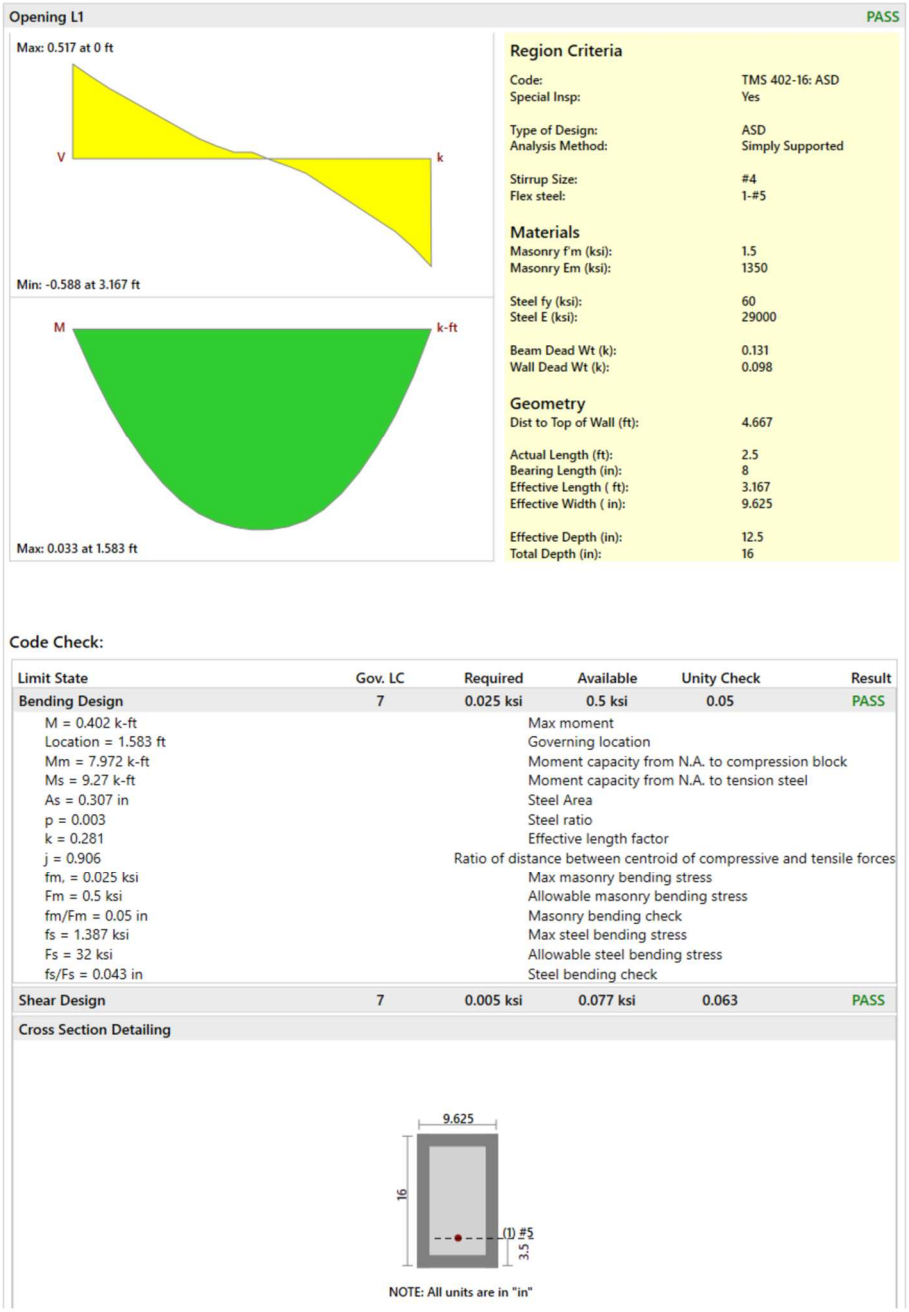
The next section will display the envelope axial, shear and moment diagrams as well as a summary of the code checks.

The next section will provide the design details for axial, bending and shear.

Note: You may click on any of the **Limit States** to view an expanded detailed calculation.

The last section will provide a cross sectional drawing of the Out-of-Plane reinforcement.

Lintel Detail Report



This section will provide the design details for bending and shear.

Note: You may click on any of the **Limit States** to view an expanded detailed calculation.

The last section will provide a cross sectional drawing of the lintel

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

Conclusion

If you have completed the tutorial you should now be familiar with modeling, analyzing and designing masonry wall panels in RISA-3D. In addition to masonry wall panels, RISA-3D has wall panels in Wood 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!