



MASONRY INSIGHTS

Masonry - How to Extract Results

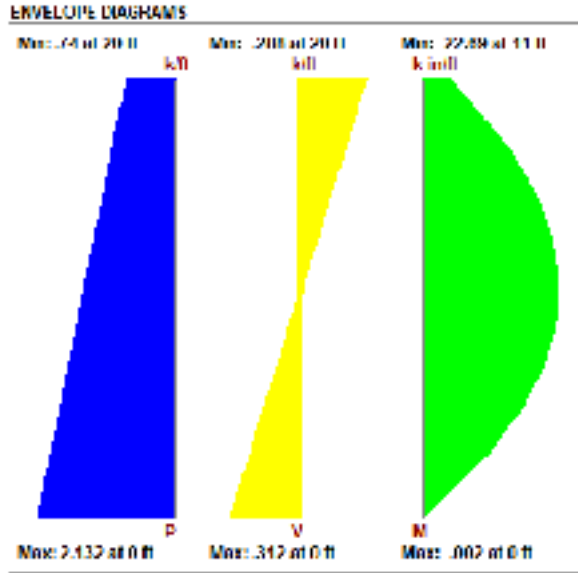
Finite element analysis can be difficult to navigate especially when first getting started. The multitude of programs available can make the process seem even more difficult especially since each one looks and operates completely differently. Once you have chosen a software package to use, managed to build a model, and hit “run calculation”, often times you are then presented with a screen that doesn’t look all that different than before the calculation was performed. So now what? How do you find the results and make sense of it all? Each software package has its own approach to finding how to display the information but each tends to present the information in similar ways which include both numerical and graphical output. The numerical output will tend to give the maximum and minimum values for the various results but this doesn’t tell the whole story about the internal flow of forces with the element. This is where the graphical results will provide much more complete information with a handful of interactive pictures. The visual representation of the force load path through provides the engineer with a much better understanding of how the materials behave beyond the simplified and idealized approximations we are also used to with conventional engineering calculations. When reviewing the output, be sure to verify whether the output given is a total for the entire wall panel versus a per foot basis. Keep in mind that the required information may not be contained all in the same location. The following example will step through the qualitative output for a simple masonry wall panel to start understanding the results.

Post-processing example 1: Typical masonry wall panel

Given: 8” normal weight CMU wall with #5 rebar at 32” oc supporting a single roof bay
Wall supports single bay of roof with eccentricity equal to half of wall thickness
Wall Length = 25’
Wall Height = 20’
Wind Load: $W_u = 30\text{psf}$

1. Find maximum values for axial load, out of plane shear, and vertical span moment by using the envelope diagram for each.

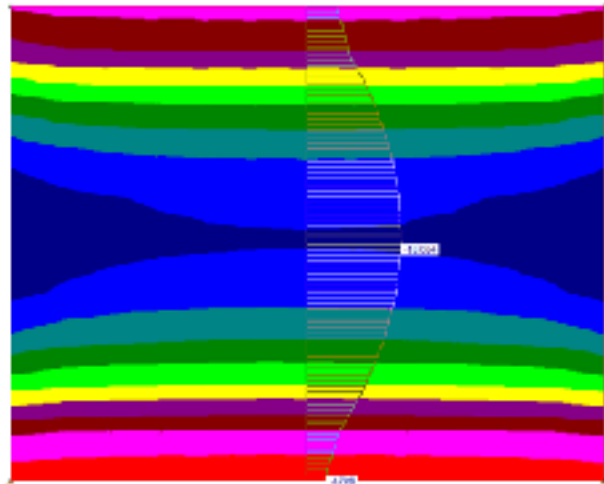
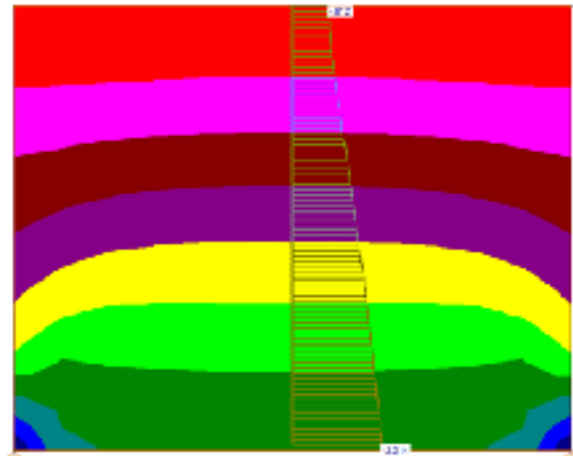
ID	LC	Wall Label	Elevation (ft)	Axial (k)	+Shear (k)	-Shear (k)	Max Moment (ft-k)	Min Moment (ft-k)
1	1	WP1	0	53.3	0	7.794	-0.17	0
2	2	WP1	0	53.3	10	.294	.002	2393.94
3	3	WP1	0	41.5	0	4.633	.028	0
4	0	WP1	0	41.5	0	4.633	-0.20	0



$P_{u,max} = 53.3 \text{ k}$ (numerical)
 $P_{u,max} = 2.1 \text{ k/ft}$ (graphical)
 $V_{u,max} = 7.794 \text{ k}$ (numerical)
 $V_{u,max} = 0.312 \text{ k/ft}$ (graphical)
 $M_{u,max} = \text{Not Given}$ (numerical)
 $M_{u,max} = 22.69 \text{ in-k/ft}$ (graphical)

2. Axial Load:

The image to the right show a representation of the axial load within the wall. Red being less and green being more in this case. This distribution makes sense as there is an axial load from the roof at the top of the wall. The total self weight of masonry increases at each point moving downward. Comparing with the envelope diagram above, this matches what we we would expect to see.



3. Out-of-plane flexural moment:

To the left is the graphical depiction of the moment diagram for the entire masonry wall panel. Depending on how the wall is modeled, the location of the various magnitudes will vary throughout when compared to the idealized moment distribution which can be seen by the envelope moment diagram in part 1 of this example.

In this instance, a vertical cut near the middle shows that the maximum envelope moment occurs near the ends of the panel rather than the middle when comparing the magnitudes of the cut with the envelope diagram.

4. Out-of-plane Shear:

The image to the right shows the out of plane shear load within the wall panel. For the most part, the shear distribution is as expected being highest at the top and bottom. However, there are some anomalies near the corners of the panels where the shear is reduced.

