

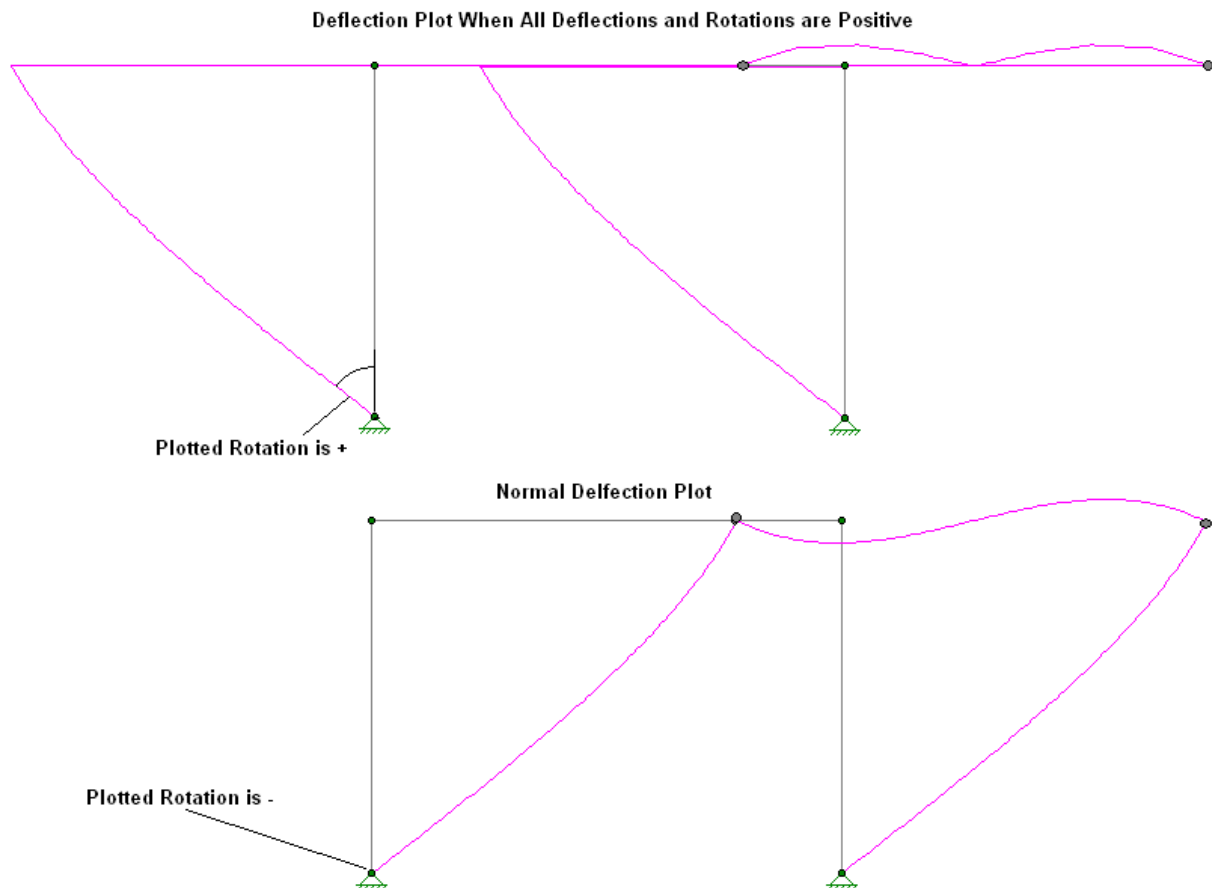
Why Does the Deflection Plot for Response Spectra Solution Look Strange?

The applied loads in a response spectrum analysis (RSA) are the applied masses times the accelerations in the response spectra. Each mode of vibration produces its own set of joint deflections. Response Spectrum Analysis involves the statistical combination of the nodal displacements from multiple modes. A loss of sign results when the individual modal results are combined together to form the total RSA result. Below is an example of the equation used for the Square Root Sum of Squares (SRSS) modal combination method:

$$\Delta_{RSA} = \sqrt{\Delta_1^2 + \Delta_2^2 + \dots + \Delta_n^2}$$

In the above equation, the final RSA deflection at the joint is calculated based on the deflections of that joint for modes 1 through n. This equation makes it clear that the final deflection results will always be a positive number. Since the results are all positive, the deflected plot will be discontinuous at locations where the result would normally have been negative if it had been computed by a regular static analysis. To get a better feel for this, you can compare the deflected shapes of two simple models.

Take a single bay portal frame subjected to a lateral load applied to one of the corners and perform a static analysis. Then subject the same model to dynamic loading via an RSA.



When you plot the deflected shape for this two solutions, you will get differences similar to what is shown above.

Thankfully, it is possible for the RSA deflections to approximately match statics if the option to “Use Dominant Mode for Signage” is chosen.

Dynamics

Eigensolution

Number of Modes: 10

Load Combination for Mass: 1: Seismic Weight

☐ Standard Solver

☒ Accelerated Solver

Response Spectra Analysis

Combination Method: CQC Damping Ratio(%): 5

☒ **X Direction Analysis?**

Spectra to be Used: ASCE 2005, Parametric Design Spectr...

☒ Use Dominant Mode for Signage?

Cutoff Freq (Hz): (For Gupta Combination)

☐ **Y Direction Analysis?**

Spectra to be Used: ASCE 2005, Parametric Design Spectr...

☐ Use Dominant Mode for Signage?

Cutoff Freq (Hz): (For Gupta Combination)

☒ **Z Direction Analysis?**

Spectra to be Used: ASCE 2005, Parametric Design Spectr...

☐ Use Dominant Mode for Signage?

Cutoff Freq (Hz): (For Gupta Combination)

Start Solution Cancel Help

This option merely looks at the deflections for the mode with the highest % mass participation and assigns a positive or negative sign to each joint reaction based on the results for that one individual mode. A model is generally considered to have a dominant model if the mode with the highest mass participation in that direction is 70% or greater.

A similar issue can cause [Why don't my RSA reactions satisfy statics?](#)