Torsional Irregularities check for Response Spectrum Analysis (RSA)

How can torsional irregularities be calculated for response-spectrum analysis?

**Answer:** For a given direction of acceleration, the maximum displacements, forces, and stresses are computed throughout the structure for each vibration mode. Modal values for a given response quantity are combined to produce a single, positive result for the given direction of acceleration using one of the modal combination methods (CQC, SRSS, or ABS). In a response-spectrum case, the results computed represent a statistical measure of the likely maximum magnitude for a given response quantity. The actual response is expected to vary within a range from this positive value to its negative. No correspondence is made between two different response quantities. Further, no information is available as to when extreme values occur.

To compute **Torsional Irregularity** and **Extreme Torsional Irregularity**, as specified in ASCE 7-05 Table 12.3-1, item 1a and 1b must be performed according to modes, and not the response-spectrum case. These irregularities in turn can trigger requirements for Torsional amplification of seismic loads. Steps are given as follows:

1. Obtain the scaling for each mode as the response-spectrum modal amplitude through Display > Show Tables > Analysis > Results > Modal Results > Response Spectrum Modal Information:

![Figure 1 - Table: Response Spectrum Modal Information](image-url)
2. Select Define > Load Combinations > Add New Combo. Select Modal in drop down list under Load Name and enter Mode number and Scale factor for the specific mode from Response Spectrum Modal information Table as given in item 1. Add each mode in a separate load combination, as shown in Figure 2:

![Load combination data](image)

Figure 2 - Load combination data

3. Obtain joint displacements for each mode per item 2 by selecting Display > Show Tables > Tables > Analysis > Results > Displacements > Joint Displacements.

4. Compute the average story drift at two ends of the building, then compare with the maximum story drift for that specific mode i.e. $D_{max}/D_{avg} < 1.2$ or 1.4 for each mode.

5. Combine all modes using the SRSS or ABS method to determine whether Torsional Irregularity or Extreme Torsional Irregularity is applicable to the model. For example: $\sqrt{\sum(D_{max}/D_{avg})^2} < (1.2\ or\ 1.4) \times \sqrt{\text{number of modes}}$.

Refer also to related watch and learn video below: