Damping

NOTE: We recommend using at least a small amount of damping for modal and direct-integration cases, even when dampers are present in the model.

Damping, a property of the material and the structure, influences dynamic response. A certain type of damping is available for each type of load case. Within all load cases of a certain type, damping is applied consistently, though additional damping may be added to individual load cases.

- **Modal damping** is used for response-spectrum and modal time-history analyses. Material modal damping, also known as composite modal damping, is weighted according to element and modal stiffness. For each material, users specify a material modal damping ratio $r$, in which $0 < r < 1$, which relates to the damping ratio of each mode.
- **Viscous proportional damping** is used for direct-integration time-history analysis. This property is proportional to mass and stiffness.
- **Hysteretic proportional damping**, also mass- and stiffness-proportional, is used for steady-state and power-spectral-density analyses.
- **Damping devices** may also be modeled as a structural subsystem, as described in the Tuned-mass damper tutorial.

### Articles

### Tutorials

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuned-mass damper</td>
<td>An overview of the tuned-mass damper and guidelines for modeling the device.</td>
<td>SAP2000</td>
</tr>
</tbody>
</table>

### See Also

- **SAP2000** verification examples 6-005, 6-006, and 6-007 – examples which incorporate dampers and associated behaviors
- Additional information on each of these damping types may be found in the CSI Analysis Reference Manual (Chapter VI: Material Properties, Material Damping)