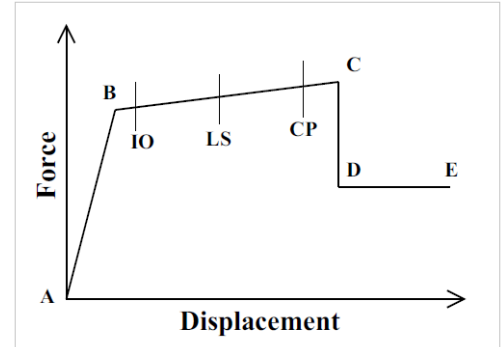


Hinge

For [nonlinear static](#), and nonlinear [direct-integration time-history](#) analyses, users may simulate [post-yield](#) behavior by assigning concentrated plastic [hinges](#) to [frame](#) and [tendon](#) objects. Elastic behavior occurs over member length, then deformation beyond the elastic limit occurs entirely within hinges, which are modeled in discrete locations. Inelastic behavior is obtained through integration of the plastic strain and plastic curvature which occurs within a user-defined hinge length, typically on the order of member depth (FEMA-356). To capture plasticity distributed along member length, a series of hinges may be modeled. Multiple hinges may also coincide at the same location.

Plasticity may be associated with force-displacement behaviors (axial and shear) or moment-rotation (torsion and bending). Hinges may be assigned (uncoupled) to any of the six DOF. Post-yield behavior is described by the general backbone relationship shown to the right. The modeling of strength loss is discouraged, to mitigate load redistribution (which may lead to progressive collapse) and to ensure numerical convergence.

CSI Software automatically limits negative slope to 10% of elastic stiffness, though overwrite options are available. For informational purposes, additional limit states (IO, LS, CP) may be specified which are reported in analysis, but do not affect results. Unloading from the point of plastic deformation follows the slope of initial stiffness.



Both [P-M2-M3 hinges](#) and [fiber hinges](#) are available to capture coupled axial and biaxial-bending behavior. The P-M2-M3 hinge is best suited for nonlinear static pushover, whereas the fiber hinge is best for hysteretic dynamics. Additional information on hinges can be found in the [CSI Analysis Reference Manual](#) (Frame Hinge Properties, page 131).

Articles

Tutorials

Title	Description	Program
Hinge first steps (CSiBridge)	Basic introduction to hinge application in CSiBridge.	CSiBridge
Hinge first steps (SAP2000)	Basic introduction to hinge application in SAP2000.	SAP2000
Pushover analysis first steps	Guidelines for performing pushover analysis.	SAP2000

Test Problems

Title	Description	Program
Hinge response when yield point changes	Behavior of a concentrated plastic hinge when the loading applied to a nonlinear frame object causes the yield point of the interaction surface to change position.	SAP2000