

# Tendon

**Tendons** are line objects which may be embedded within other objects ([frames](#), [shells](#), [solids](#), etc.) to simulate the effects of [prestressing](#) and post-tensioning. Tendons may be modeled either as independent structural objects or simply as equivalent loads which act upon the structure. When modeled as objects, [nonlinear](#) behavior may be assigned through axial [hinges](#), and losses may be calculated, including those from elastic shortening and time-dependent effects ([creep](#), [shrinkage](#), and aging). Tendons extend between two [joint](#) locations, may follow a curvilinear or segmented path within 3D space, and do not need to be entirely contained within other objects. Tendons have axial, shear, bending, and torsional stiffness properties, though axial is of primary concern. A maximum tension (positive) and compression (negative) may be assigned to tendons. No-compression behavior is specified by setting the compression limit to zero. These limits only apply during nonlinear analysis. [Target forces](#) may also be applied to tendons. Additional information on tendons and their application is available in the [CSI Analysis Reference Manual](#) (The Tendon Object, page 279).

## Articles

## Test Problems

Title	Description	Program
<a href="#">Align solid and hollow sections</a>	Model relative positive position for frame sections which have identical outlines, but different center-of-gravity locations due to one section being hollow.	SAP2000
<a href="#">Hyperstatic forces for bridge-object superstructures</a>	The hyperstatic forces within a superstructure which is modeled using bridge objects may be obtained using any of three methods described in this test problem.	CSiBridge
<a href="#">Modeling segmental-bridge joint openings</a>	The modeling and response of joint openings, simulated using gap link elements, between shell segments of a post-tensioned bridge deck.	CSiBridge
<a href="#">Tendon force vs. frame response</a>	Tendon application is validated by comparing tendon forces to those in an equivalent frame system.	SAP2000

## References

- [LAPBOX: Linear-Elastic Analysis of Box-Girder Bridges](#), NISEE Online Archive, University of California, Berkeley – the LAPBOX Manual explains calculation of tendon forces