# Eigenvalue vs. Nonlinear buckling analysis

## Eigenvalue analysis

Please note that Buckling is the load case used for **Eigenvalue analysis**.

Eigenvalue analysis predicts the theoretical buckling strength of a structure which is idealized as elastic. For a basic structural configuration, structural eigenvalues are computed from constraints and loading conditions. Buckling loads are then derived, each associated with a buckled mode shape which represents the shape a structure assumes under buckling. In a real structure, imperfections and nonlinear behavior keep the system from achieving this theoretical buckling strength, leading Eigenvalue analysis to over-predict buckling load. Therefore, we recommend Nonlinear buckling analysis.

## Nonlinear buckling analysis

Please note that Static, Nonlinear with P-Delta and Large Displacements is the load case for **Nonlinear buckling analysis**.

Nonlinear buckling analysis provides greater accuracy than elastic formulation. Applied loading incrementally increases until a small change in load level causes a large change in displacement. This condition indicates that a structure has become unstable. Nonlinear buckling analysis is a static method which accounts for material and geometric nonlinearities (P- and P-), load perturbations, geometric imperfections, and gaps. Either a small destabilizing load or an initial imperfection is necessary to initiate the solution of a desired buckling mode.

## Important considerations

- The primary output of linear buckling analysis is a set of buckling factors. The applied loading condition is multiplied by these factors such that loading is scaled to a point which induces buckling. Please refer to the CSI *Analysis Reference Manual* (Linear Buckling Analysis, page 315) for additional information.
- Since the deflections, forces, and reactions of linear buckling analysis correspond to the normalized buckled shape of a structure, users must run Nonlinear buckling analysis to obtain the actual displacements, forces, and reactions. Figure 1 illustrates the Nonlinear-buckling-analysis output of a column subjected to an initial imperfection where lateral load induces displacement equal to 0.6% of column height. Softening behavior indicates the onset of buckling.

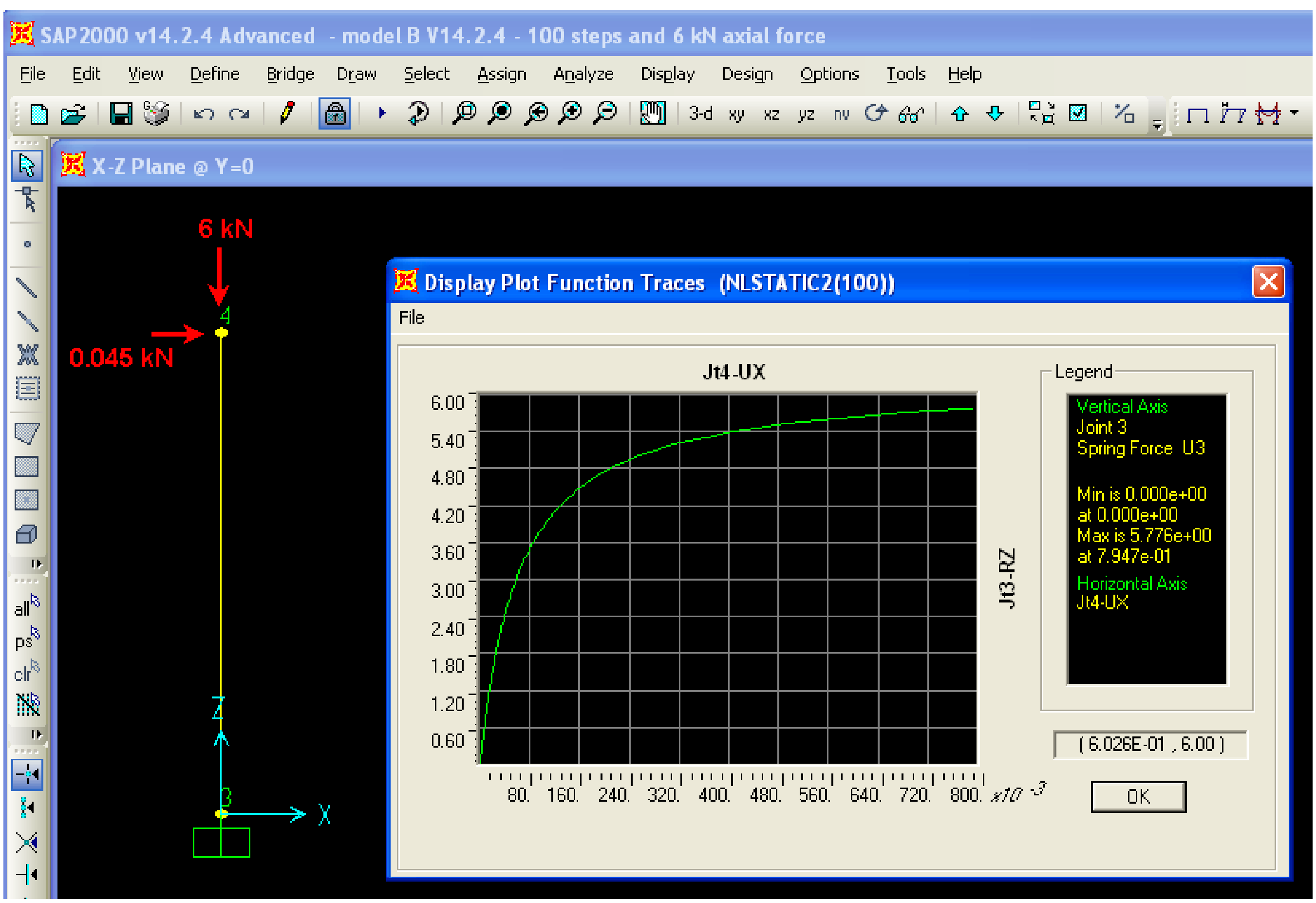

Figure 1 - Nonlinear buckling analysis of a column

Users may download the analytical model for this system through the P-Delta effect for fixed cantilever column test problem.

# See Also

- Nonlinear buckling article