Buckling FAQ

This page is devoted to **frequently asked questions** (FAQ) related to buckling.

On this page:

Analysis

Why do my hand calculations not match linear-buckling results?

ANSWER: Structural objects should be meshed before running linear-buckling analysis such that the software may accurately capture the instability modes under the specified set of loading conditions.

What happens analytically when a member reaches buckling capacity during nonlinear buckling analysis?

ANSWER: The analysis process typically experiences convergence problems at the buckling limit.

What is the process for buckling analysis of a structure with cables?

ANSWER: To analyze buckling in a structure with cables, nonlinear analysis should be run to determine the structural stiffness at the end of a nonlinear case. Buckling analysis may then be run, starting at the end of this nonlinear case.

Does buckling analysis include the effect of shear deformation?

ANSWER: Yes, buckling analysis includes the effect of shear deformation. For models in which shear deformation governs, this may keep the calculated buckling factors from matching the theoretical critical load. The influence of shear deformation on buckling behavior may be eliminated by setting large property modifiers to shear areas in directions 2 and 3.

Buckling factors

Why does lateral-force application not reduce the buckling factors of a cantilevered column?

Expanded question: I modeled a simple cantilever column and determined its buckling load. Then, in a different analysis, I applied lateral load to the column and determined the buckling load at the end of lateral-load analysis. Regardless of lateral-load magnitude, the same buckling load is generated though a smaller buckling load is expected. Am I making a mistake?

ANSWER: For a cantilevered-column model, linear buckling analysis would produce buckling factors independent from applied lateral load. This is because, in this particular case, lateral load does not affect the geometric stiffness of the structure.

The structural softening which occurs under lateral-load application may still be captured. However, nonlinear analysis must be run with P-Delta and Large Displacement effect. Lateral load may then be plotted against lateral displacement. Initially, this relationship will be linear, but then the structure will begin softening at a certain load. Response of a column with slight initial perturbation is shown in Figure 1:

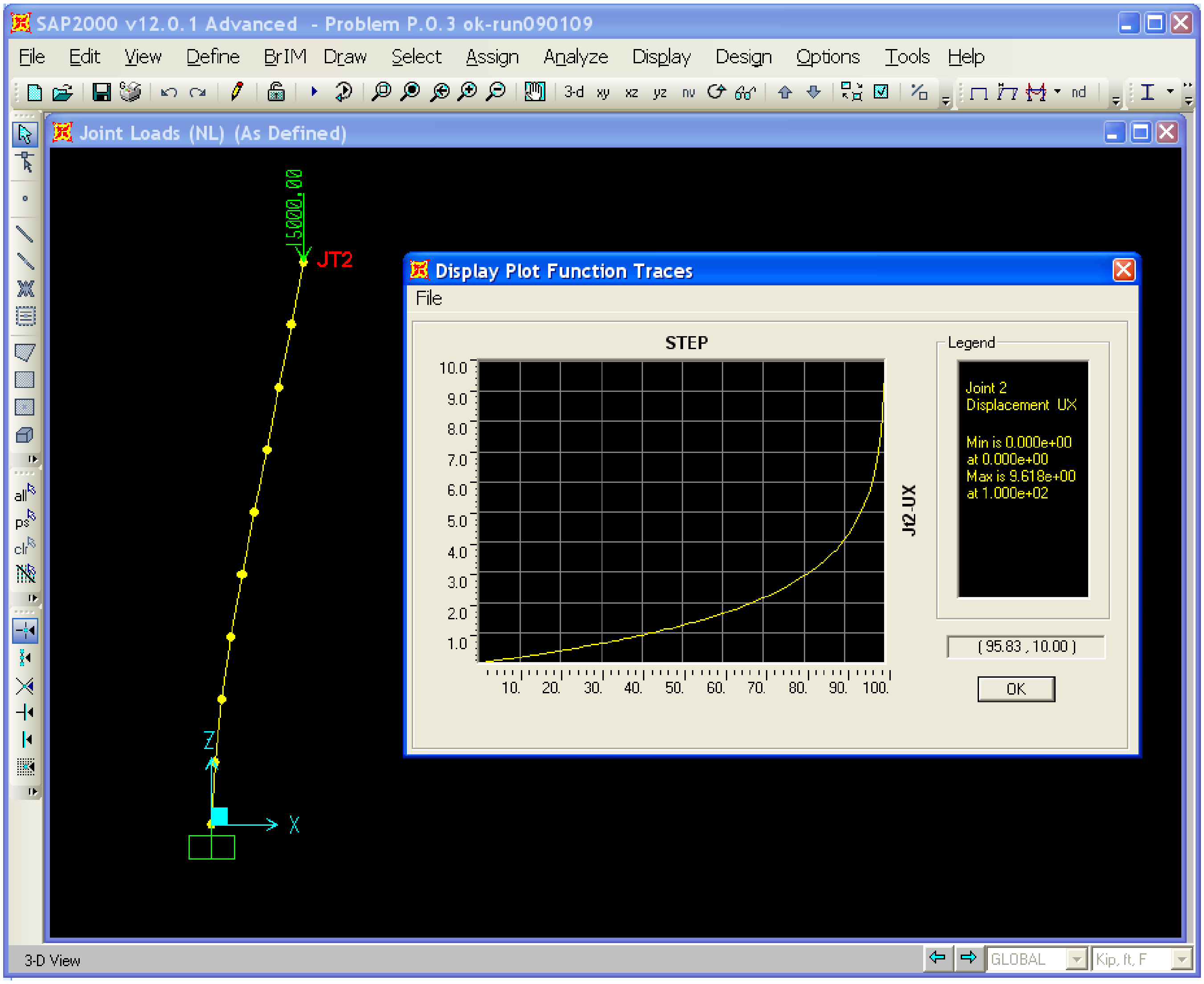

Figure 1 - Nonlinear buckling evaluation

Reporting

How should internal forces and reactions be interpreted for buckling analysis?

Extended Question: When performing buckling analysis for a cantilevered column, buckling mode shapes result in proportion to applied loading. When an axial load is applied to the column, the resultant axial force is zero for every mode shape, though moment and shear reactions are present. Could you please explain?

ANSWER: The internal forces and reactions reported for buckling load cases correspond to the buckled configuration of the structure. For a vertical cantilever model, the structure buckles laterally, generating internal moments and shears without axial force.

Why am I getting a negative-stiffness error during P-Delta analysis?

ANSWER: Negative stiffness occurs during P-Delta analysis when structural objects buckle under second-order P-Delta effects. To avoid negative stiffness and buckling, object size should be increased, especially at columns and diagonals.