

PushOver analysis

Pushover is a static-nonlinear analysis method where a structure is subjected to gravity loading and a monotonic displacement-controlled lateral load pattern which continuously increases through elastic and inelastic behavior until an ultimate condition is reached. Lateral load may represent the range of base shear induced by earthquake loading, and its configuration may be proportional to the distribution of mass along building height, mode shapes, or another practical means.

Output generates a static-pushover curve which plots a strength-based parameter against deflection. For example, performance may relate the strength level achieved in certain members to the lateral displacement at the top of the structure, or bending moment may be plotted against plastic rotation. Results provide insight into the ductile capacity of the structural system, and indicate the mechanism, load level, and deflection at which failure occurs.

When analyzing frame objects, material nonlinearity is assigned to discrete hinge locations where plastic rotation occurs according to FEMA-356 or another set of code-based or user-defined criteria. Strength drop, displacement control, and all other nonlinear software features, including link assignment, P-Delta effect, and staged construction, are available during static-pushover analysis.

Cyclic pushover analysis may be performed using either of two approaches, outlined as follows:

Sequence of nonlinear-static load cases

Cyclic pushover analysis may be performed through a sequence of chained pushover analyses. Two key aspects of this approach include:

- Each pushover analysis would be pushing the structure in the direction opposite to that of the preceding pushover load case.
- Each pushover load case, aside from the first, would use stiffness at the end of the previous pushover load case.

Time-history load cases

An alternate approach is to use a single nonlinear time-history load case.

Some special considerations are necessary when using a time-history load case to model applied loading, listed as follows:

- Load should be scaled up or down to achieve the monitored pushover displacement desired for each cycle.
- The time function should consist of linear segments which apply the loads in one direction and then the reverse, possibly with a constant segment to hold loads before their reverse.

- For each cycle in the sequence, the peak positive and negative time-function values must be found, starting with the first cycle of load application.

A sample of a time function is shown in Figure 1:

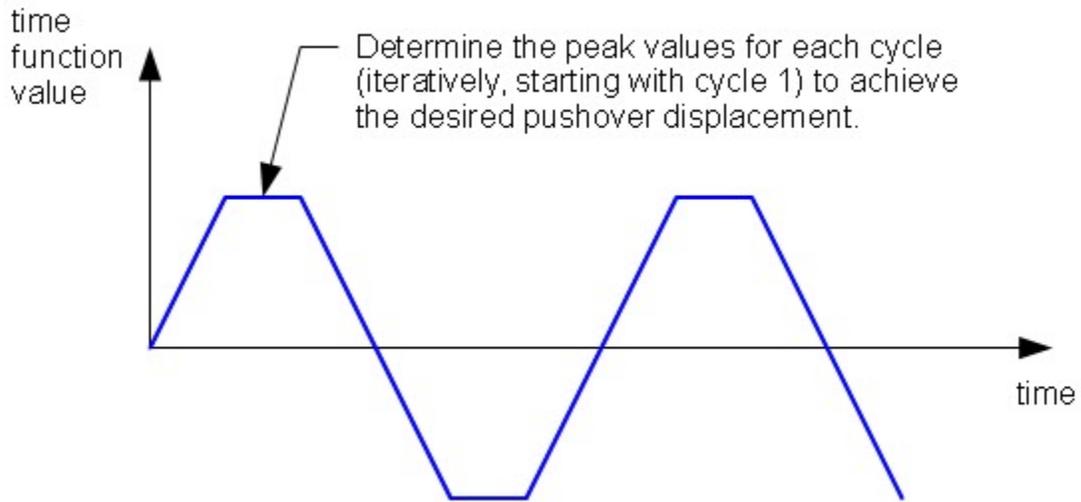


Figure 1 - Cyclic time function