

P-Delta analysis parameters

Initial [P-Delta](#) analysis may be specified in [ETABS](#) via Define>P-Delta Options and using either of the following two methods:

1. **Non-iterative Based on Mass**, in which load is automatically computed from the [mass](#) at each level. This is an approximate method which does not require an iterative solution, providing for faster computation. [P-Delta](#) is considered by treating the structure as a simplified stick model, a process which is most effective with a single rigid diaphragm at each level. Local buckling is not captured as effectively.

The benefit of this non-iterative method is that P-Delta may be considered in [load cases](#) which do not specify gravity load. When gravity load is specified, we generally recommend the Iterative Based on Load Cases method.

2. **Iterative Based on Load Cases**, in which load is computed from a specified [combination](#) of static load cases, then known as the P-Delta load combination. This is an iterative method which considers P-Delta on an element-by-element basis. Local buckling is captured more effectively. An example application may be when load includes the dead load case and a fraction of a live load case.

When the iterative method is selected, two additional options become available :

- **Convergence Tolerance (Relative)**, Iteration is used to make sure that equilibrium is achieved at each step of the analysis. Use this parameter to set the relative convergence tolerance that is used to compare the magnitude of force error with the magnitude of the force acting on the structure. Using a smaller value ensures better equilibrium, although the default value is usually adequate.
- **P-Delta Load Combination**, in which users may specify the single load combination for the initial P-Delta analysis.

For example, suppose that a building code requires the following load combinations:

- - (1) 1.4 dead load
 - (2) 1.2 dead load + 1.6 live load
 - (3) 1.2 dead load + 0.5 live load + 1.3 wind load
 - (4) 1.2 dead load + 0.5 live load - 1.3 wind load
 - (5) 0.9 dead load + 1.3 wind load
 - (6) 0.9 dead load - 1.3 wind load

A P-Delta load combination of 1.2 DL + 0.5 LL is typically conservative when considering P-Delta effect due to the overall sway of a structure. Combinations (3) and (4) will accurately capture this effect, while (5) and (6) should be conservative. Combinations (1) and (2) have no lateral load, therefore P-Delta effect should not be of concern. Please notice this is a non-linear static case and should be performed only after the model runs without any numerical issues for simple linear cases and results of basic variables such as deformations are within realistic or expected values.

P- effect

[ETABS](#) accounts for [P-](#) effect, which is associated with local deformation relative to the chord between member ends. In most practical cases, this effect can be captured using design factors. There is usually no need to divide columns. More specific information about [P-](#) can be found here: [P-Delta effect](#)

Notes

- ETABS uses the same stiffness for all static load cases, [response-spectrum](#) analysis, and [time-history](#) analysis.

See Also

- [AISC stability benchmark problems\(P- and P- effect\)](#)