

Stability Analysis & Design of Steel Frame Structures by the 2005 AISC Specification Direct Analysis Method

by

Leroy Z. Emkin, PhD, PE, FASCE

Founder and Co-Director
Georgia Tech - CASE Center

Abstract

In an attempt to impose a more rational analytical procedure to account for structural stability of steel frame structures, the AISC code committees have incorporated three analysis options into the 2005 AISC LRFD & ASD Specification which are referred to as the:

- (1) Direct Analysis Method (i.e., Nonlinear Geometric Elastic Analysis),
- (2) Effective Length Method, and
- (3) First-Order Analysis Method.

Even though the Direct Analysis Method is the most rational and rigorous of the methods, the use of the other two approximate methods are permitted. However, the formulations of the approximate methods are based upon assumptions associated with excessively simplified structural models and thus severely limit their applicability to modern steel frame structures. Since such limitations are contrary to the goal of requiring more rigorous methods of stability analysis of general steel frame structures, and since future editions of the AISC code are expected to de-emphasize, if not eliminate, references to the use of the approximate methods, this presentation will only discuss the use of the Direct Analysis Method.

Although steel member design that is based on the Direct Analysis Method as described in the 2005 AISC Specification contains innumerable and, some would argue, highly convoluted details, it is not the intent of this presentation to cover such details in depth. Rather, it is the intent of this presentation to

- (1) Describe a strategy for performing the controlling step-by-step procedure that is required for the correct computer analysis/design/decision-making iterative process in order to obtain safe and cost-effective designs of steel frame structures based upon nonlinear geometric elastic analysis and pursuant to the 2005 AISC LRFD & ASD Specification,
- (2) Identify serious pitfalls that can lead to grossly incorrect solutions, and
- (3) Help structural engineers reduce the potentially high increase in cost of performing such analysis and design.

The example used in the presentation will be a typical, albeit relatively small, industrial steel frame structure.