Design of Steel Compression Members per AISC360-16

An Online Continuing Education Course for Engineers

Course Number: S-2018

Credit: 2 Hours / 2 PDH / 2 CPD

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1. Introduction

Steel structures are used very widely for many reasons, such as rapid construction, ease of erection, and controlled quality of fabrication.

The processes of structural design can be summarized in the following steps (Figure 01):

1. Determination of applied loads
2. Selection of economic and proper structural system
3. Structural analysis of the structural system to get internal actions
4. Design of structural members to resist internal actions

By putting the loads on the chosen statical system, we get the straining action in the members of the statical system. Several straining actions can be found with different analysis methods, such as tension, compression, flexure, shear, and torsion.

In this course, we will study the design of steel compression members, which exist in many steel structures, such as trusses, bracing, and columns.

Figure (02) shows examples of members that act as compression members, such as top chords, diagonals, and bracing members.

This course is the second course of a series related to the design of members. All of these courses are independent and do not require any prerequisites. The following is the list of related courses:

1. Design of Steel Tension Members per AISC360-16.
2. Design of Steel Compression Members per AISC360-16.
3. Design of Steel Flexure Members per AISC360-16.
4. Design of Steel Members Subject to Shear per AISC360-16.
5. Design of Steel Members subject to Combined Stresses per AISC360-16.
6. Design of Steel Members subject to Torsion per AISC360-16.

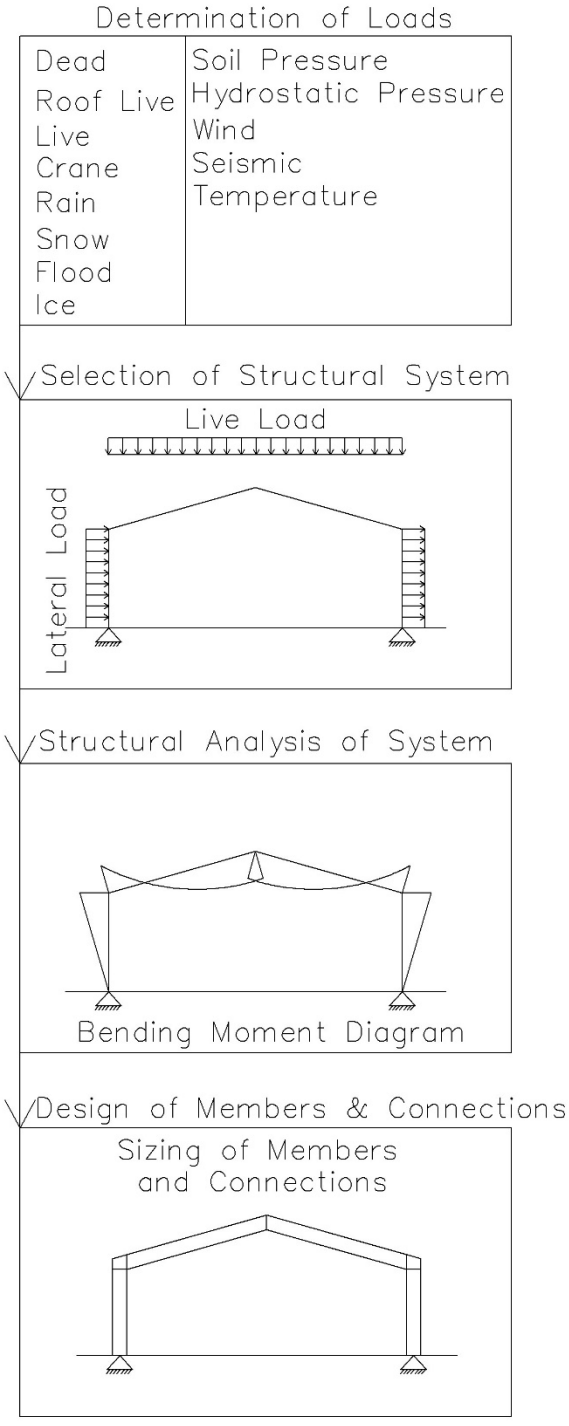

Figure (01). Steps of Structural Design

This course covers the following topics:

1. Modes of failure of compression members.
2. Effective length and slenderness ratio.
3. Classification of sections subject to axial compression.
4. Flexure buckling of members without slender elements
5. Torsional & Flexural-Torsional buckling of members without slender elements.
6. Members with slender elements
7. Design of single angle compression member (Concentrically & Eccentrically loaded)
8. Design for built-up members for buckling.

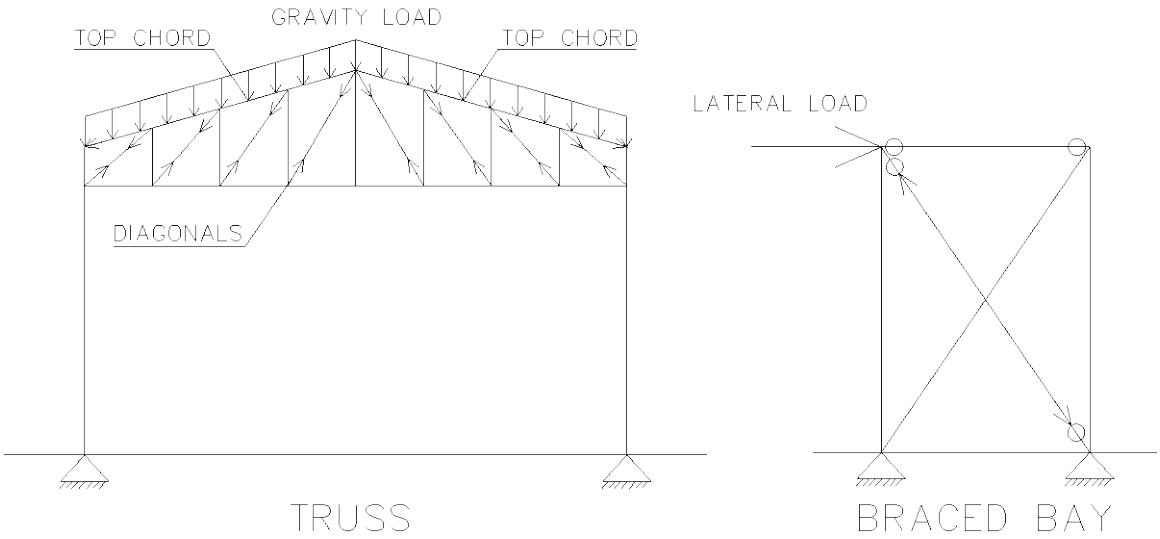

Figure (02). Examples of Compression Members

Compression members shall be designed to satisfy the requirements stated by AISC360-16 as follows:

1. Recommended slenderness ratio
2. Check of compression buckling

2. Modes of Failure for Compression Members

In this section, we discuss modes of failure for members subject to compression from a conceptual point of view without going through equations, such as member compression yielding, member compression buckling, local yielding of section elements, and local buckling of section elements.

a. Member compression yielding:

This mode occurs when the overall slenderness ratio of the member is very low, and the member is stocky, so the local yielding or local buckling of elements will not govern the design, as well as member compression buckling.

This mode, commonly, does not govern the design of members in real-life applications, but it can govern connection elements such as gusset plates and stiffeners.

Figure (03) shows the compression yielding of a gusset plate.

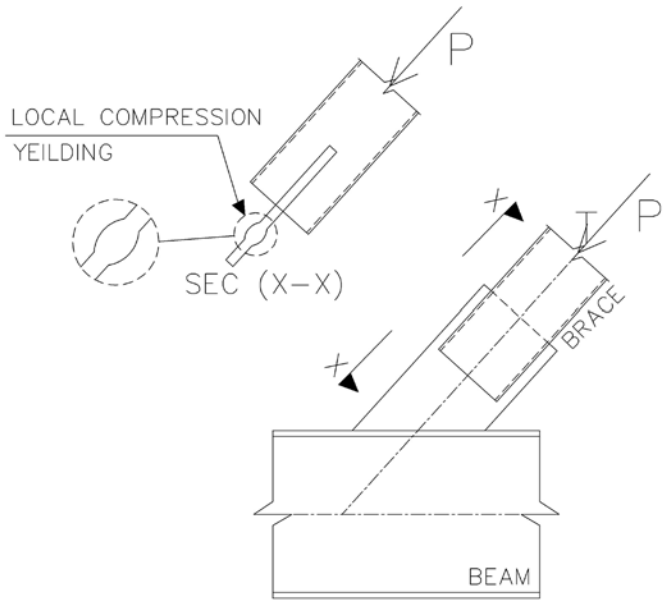

Figure (03).Compression Yielding of Gusset Plate

Figure (04) shows the compression yielding of an "I" shaped steel column.

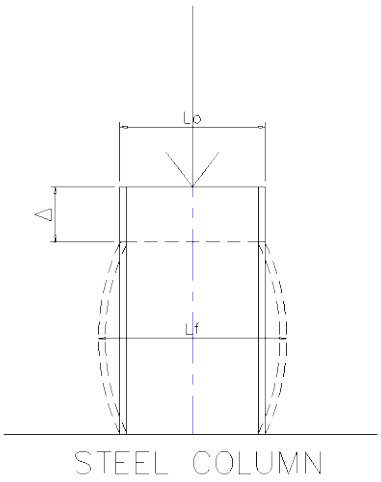

Figure (04). Compression Yielding of Steel Column

b. Member compression buckling (elastic buckling):

This mode occurs when the overall slenderness ratio of the member is high, so the local yielding or local buckling of elements will not govern the design, as well as member compression yielding.

There are several shapes of member compression buckling, which are summarized as follows:

- Flexural buckling.
- Flexural torsional buckling.
- Torsional buckling.

Figure (05) shows modes of failure of member compression buckling.

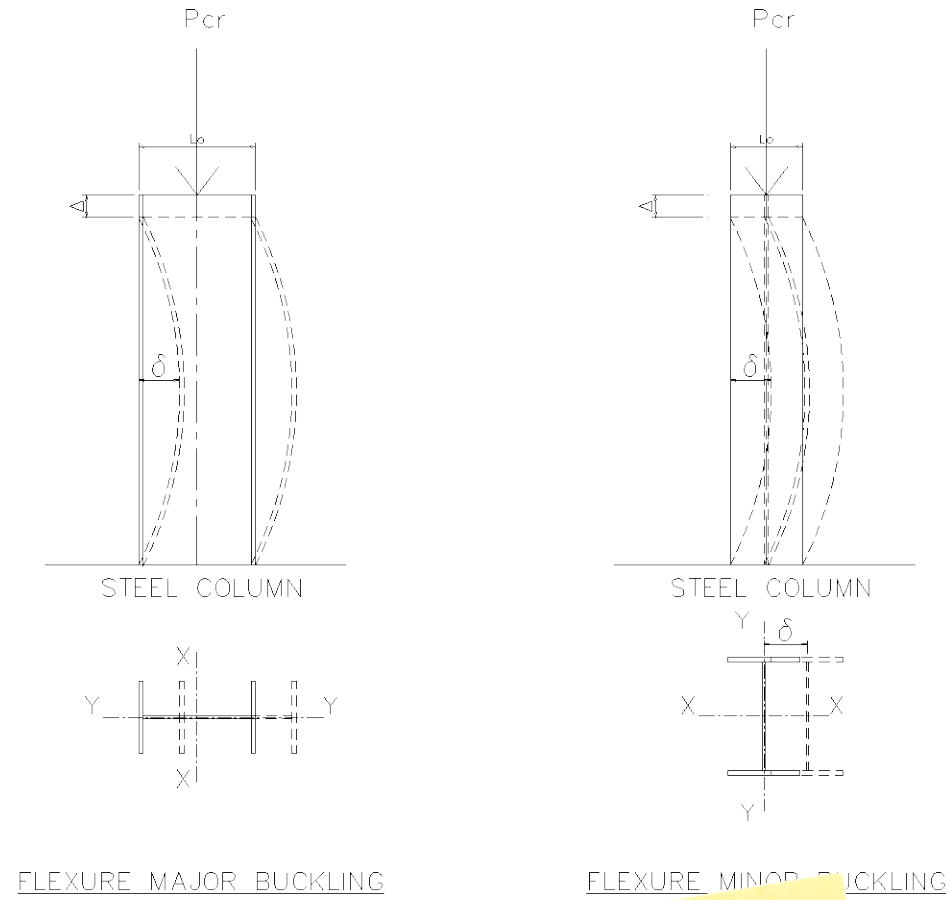

Figure (05). Mode

Figure (06) shows the elationship between the slenderne re is a limiting slenderness ra buckling and inelastic buckling. This ength of the column.