



# Design of Structural Welds

An Online Continuing Education Course for Engineers

**Course Number: MA-3007**  
**Credit: 3 Hours / 3 PDH / 3 CPD**

# Design of Structural Welds

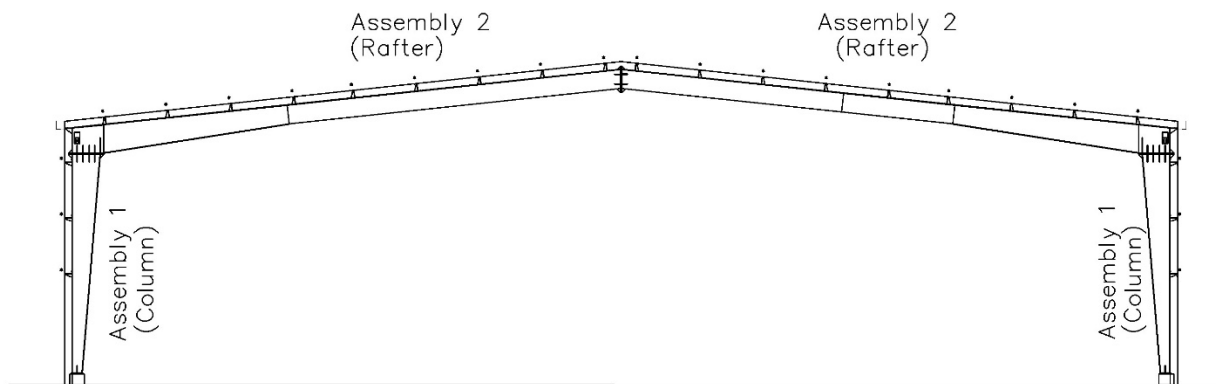
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## 1. Introduction

It is well known to structural engineers that a major advantage of steel structures over concrete structures is that they are fabricated in a workshop rather than erected on the site, giving the schedule of the project an accelerated rate.

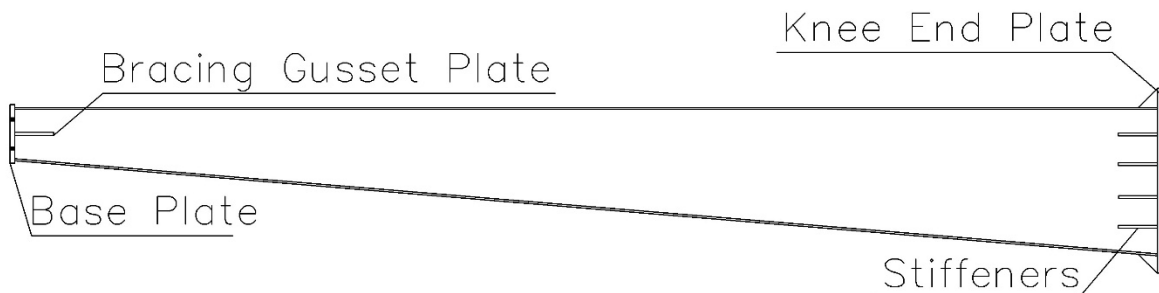
To understand that process, let's look at the components of steel buildings and how they are assembled.

The steel portal frame shown in figure (01) is the main system of a building. The erected steel frame is composed of four steel assemblies, two-column assemblies, and two rafter assemblies, as shown in figure (02), which demonstrates a column assembly.



**Figure (01) Typical Portal Frame**

Each assembly is composed of a hot rolled section/plate girder welded to some stiffeners at knee connections, gusset plates at bracing connections, and clips at purlins/girts connections, as shown in figure (02), which illustrates a bracing gusset plate welded to a column.



**Figure (02) Frame Column Assembly**

Stiffeners, gusset plates, end plates, and clips are called “parts” in the steel structures industry, but according to AISC360, they are called connecting elements, as they connect the structural elements (assemblies) together through bolts or welds.

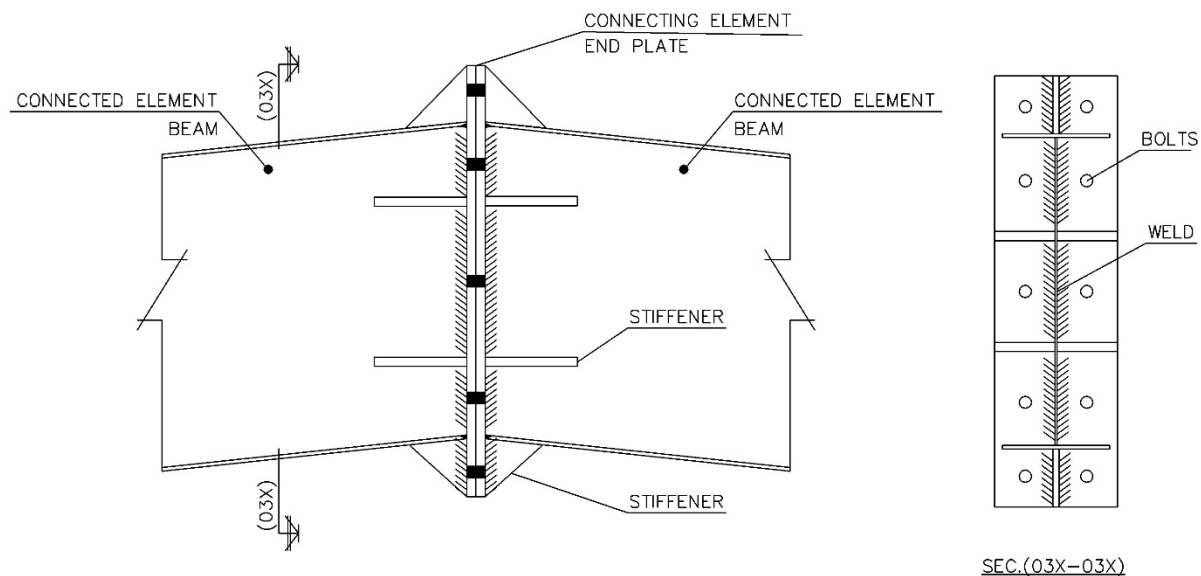
From the previous paragraphs, we can notice that connections are commonly composed of four elements:

- Welds
- Bolts/Threaded Parts (anchors)
- Connecting Elements (stiffeners, gusset plates, end plates, and clips)
- Connected Elements (supporting elements and supported elements)

Commonly, connecting elements (parts) are welded to structural elements (assemblies) at a workshop, and structural elements (assemblies) are bolted together at the site.

Sometimes, connections are completely bolted, and other times they are completely welded.

Figure (03) illustrates a typical moment connection with welds, bolts & connecting elements.



**Figure (03) Typical Moment Connection**

Proper understating of the design of each component is a great entry to the design of any connection in steel structures, such as shear connections, moment connections, bracing connections, base plate connections, HSS connections, which will be studied, separately, through subsequent courses.

In the following sections, we will study the bolts types, welding positions, weld symbols, fillet welds, PJP welds, CJP welds, plug and slot welds, effective area of welds, the strength of welded joints, and maximum and minimum weld thickness and length.

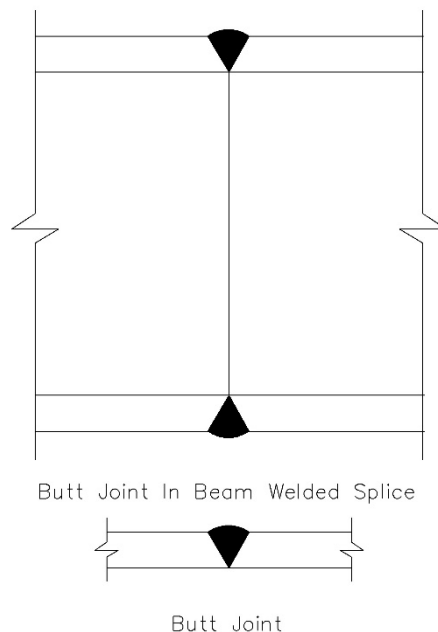
## 2. Welded Joints Types

It is well known that welds are a type of fasteners that use to join steel pieces together.

In this section, a brief of welded joints will be demonstrated.

*a. Butt Joint:*

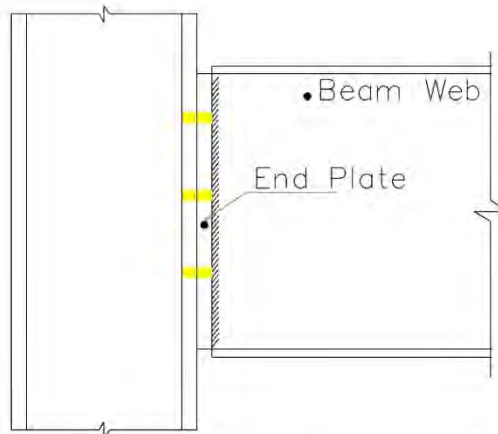
These are commonly used to join flange splices or web splices.



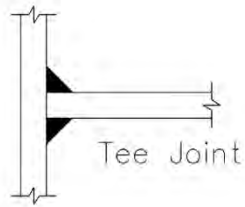
**Figure (04) Butt Joint Detail**

*b. Tee Joint:*

These are commonly used to join beam webs to end plates, columns to base plates, gusset to beam/column flanges or webs, and brackets to columns.



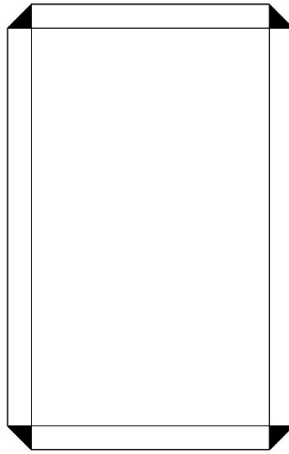
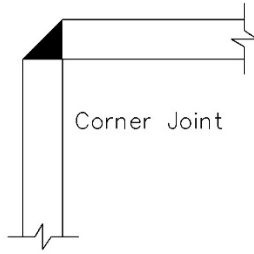
Tee Joint Between Beam Web and End Plate



**Figure (05) Tee Joint Detail**

*c. Corner Joint:*

Examples of corner joints are welded, built-up squares or rectangular sections.

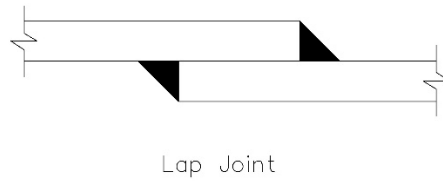
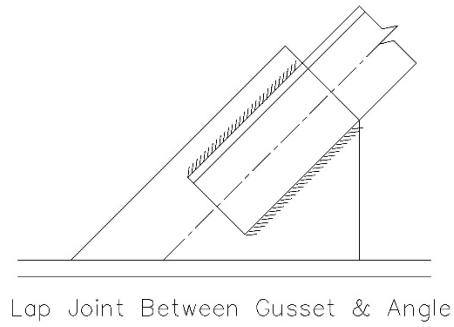


RHS Built Up Section Welded By Corner Joints

### **Figure (07) Corner Joint Detail**

#### *d. Lap Joint:*

These are commonly used to join clip angles to beam webs, angles to beam webs, and doublers to beam/column webs or flanges.



**Figure (08) Lap Joint Detail**

*e. Edge Joint:*

These are used in built-up sections of two members, such as a built-up section composed of two RHS sections.

