Determination of Crane Loads As Per ASCE7-16, MBMA2018, and AISE13

An Online Continuing Education Course for Engineers

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Credit: 4 Hours / 4 PDH / 4 CPD

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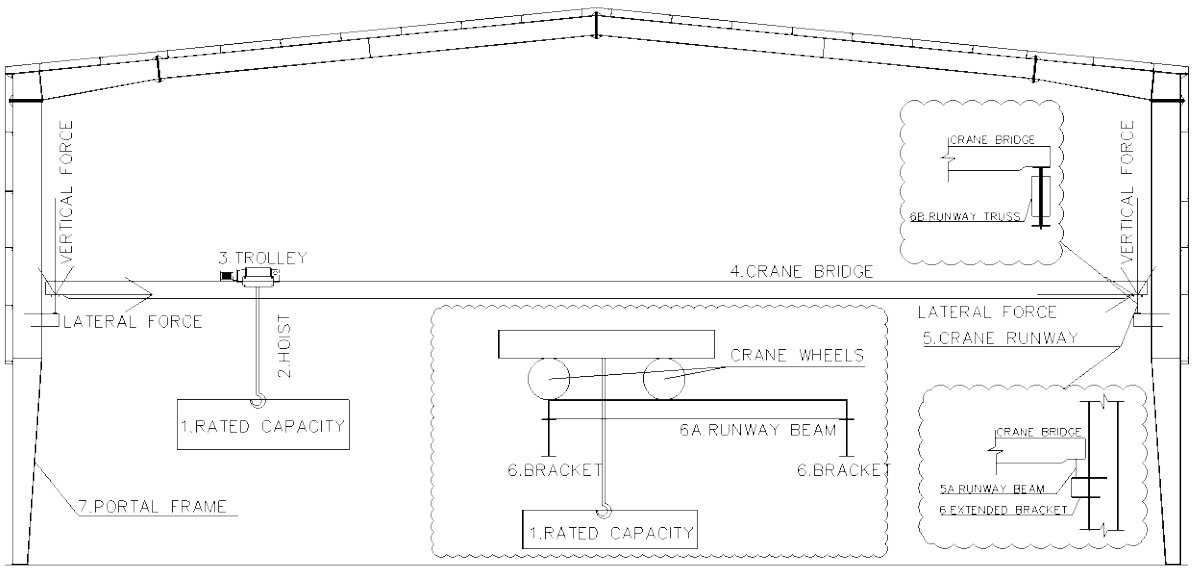
Introduction

Cranes are essential elements in many industrial buildings, as they are used to lift and handle heavy equipment, tools, and materials within the coverage area.

This course involves a deep study of the crane loads on structural elements of industrial buildings, according to the latest US standards: ASCE7-16, Design Guide No.7 (Industrial Building Design-Third Edition), CMMA-Technical Report.No.74, 2015, and IBC2018. All course equations are presented using ASD and LRFD methods.

As shown in figure (01), crane loads are respectively transferred through the following path:

1. Lifted load (rated capacity) to hoist
2. Hoist to trolley
3. Trolley to crane bridge
4. Crane bridge to crane runway beams or trusses
5. Crane runway beam or truss to column bracket or column cap plate
6. Column bracket or column cap plate to the portal frame for vertical and lateral loads
7. Column bracket or column cap plate to wall bracing for longitudinal loads



ELEVATION

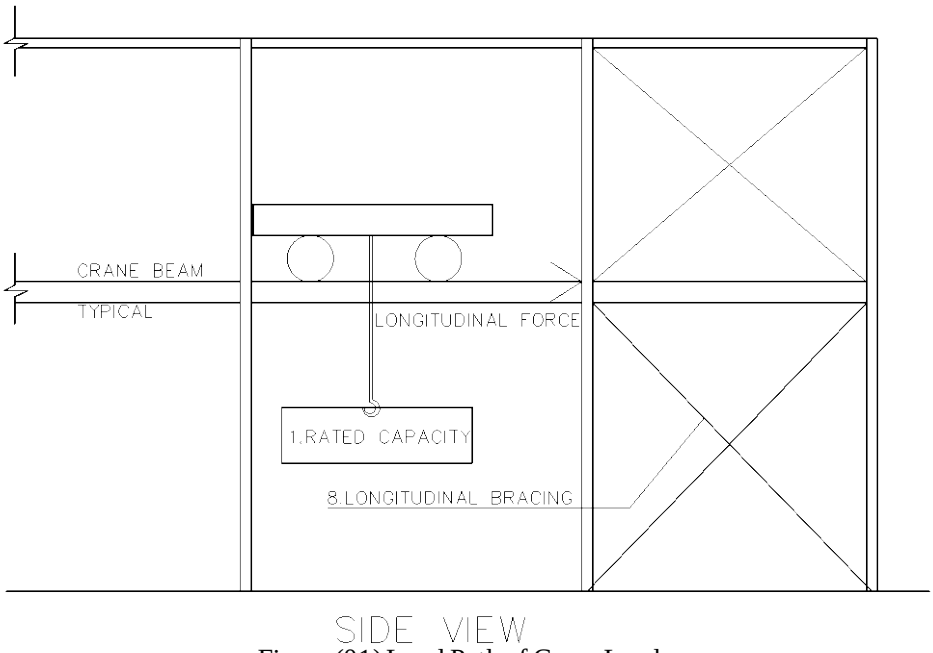


Figure (01) Load Path of Crane Loads

In this course, we will study how to apply crane loads to crane runway systems, such as runway beams or trusses, and on crane supporting structures, such as portal frames and wall bracing.

This course covers the following topics:

Types of cranes and runways
Crane vertical and impact forces
Crane lateral and longitudinal forces
Crane stop force and collision force
Crane skewing force and eccentric crane forces
Other loads acting on crane supporting elements, such as wind, seismic, ice, snow, and test loads
Load combinations of cranes
Application of crane loads to runway systems and supporting structures
Multiple crane loading conditions

Types of Cranes and Runways

Before discussing the types of crane runway beams, we have to know the common types of cranes used in industrial buildings. In the following section, we will discuss some crane types and the advantages of each type.

a. Overhead Cranes

The most common typical type of cranes used in industrial buildings, overhead cranes, have the advantage of covering the entire area of the building aisle, laterally and longitudinally, as shown in figure (02).

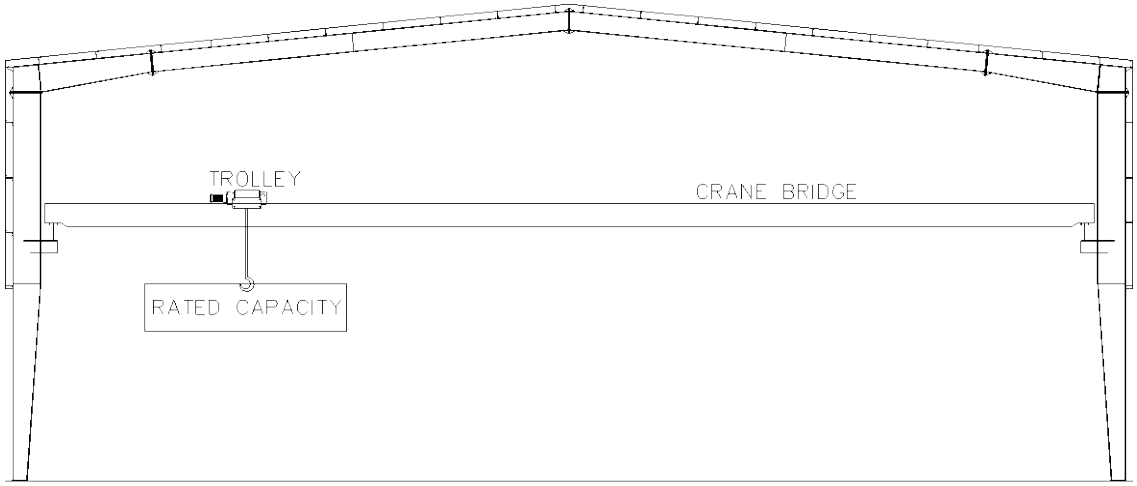


Figure (02) Overhead Crane

b. Underhung Cranes

Underhung cranes are used when it is not required to cover the entire area of the building aisle. They also provide greater hook cover, clearance beneath the runway beam, and clearance for overhead obstructions, and it also provides lateral and longitudinal load transfer, as shown in figure (03).

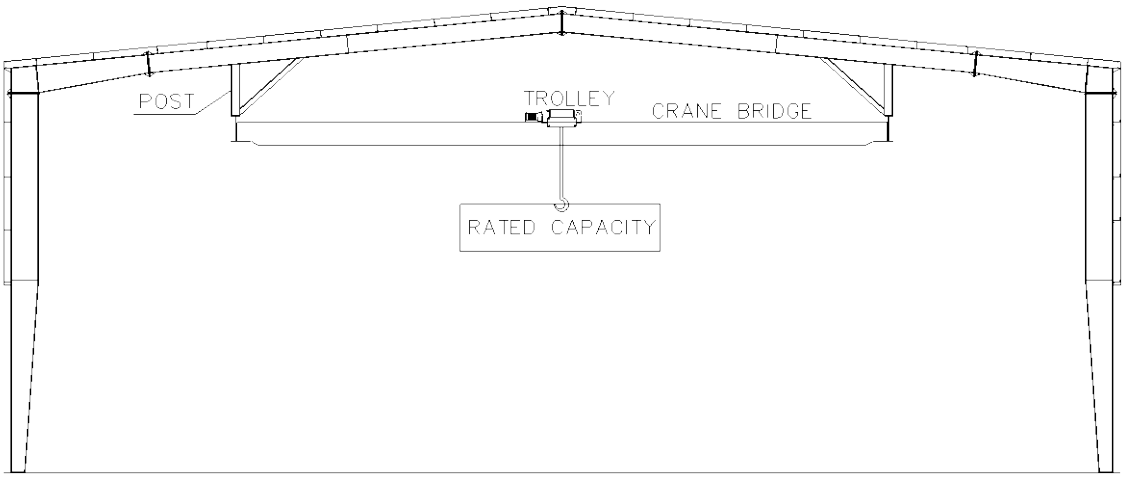


Figure (03) Underhung Crane

c. Monorail Cranes:

Monorail cranes are used for small rated capacities when it is necessary to transfer the load in a longitudinal way only, as shown in figure (04).

d. Jib Cranes:

Jib cranes are only used to cover the area around the columns because the overhead cranes do not cover these areas or may be used for staged operations, as shown in figure (04).

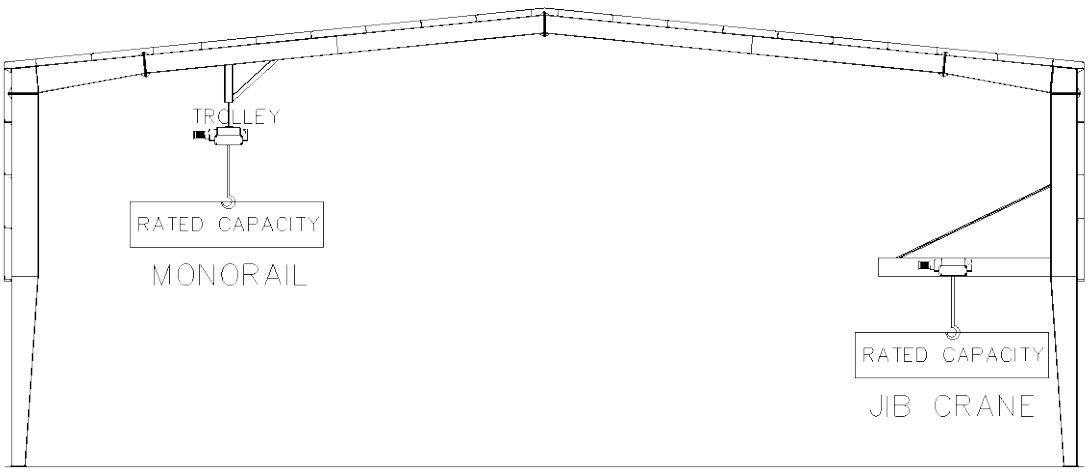


Figure (04) Monorail and Jib Crane

e. Gantry Cranes:

This type is used when it is necessary to add a crane to an existing building that cannot receive the newly added loads of the crane. They may also be used when it is necessary to eliminate the vibration and impact effects of the heavy cranes on the structural system of the building, as shown in figure (05).

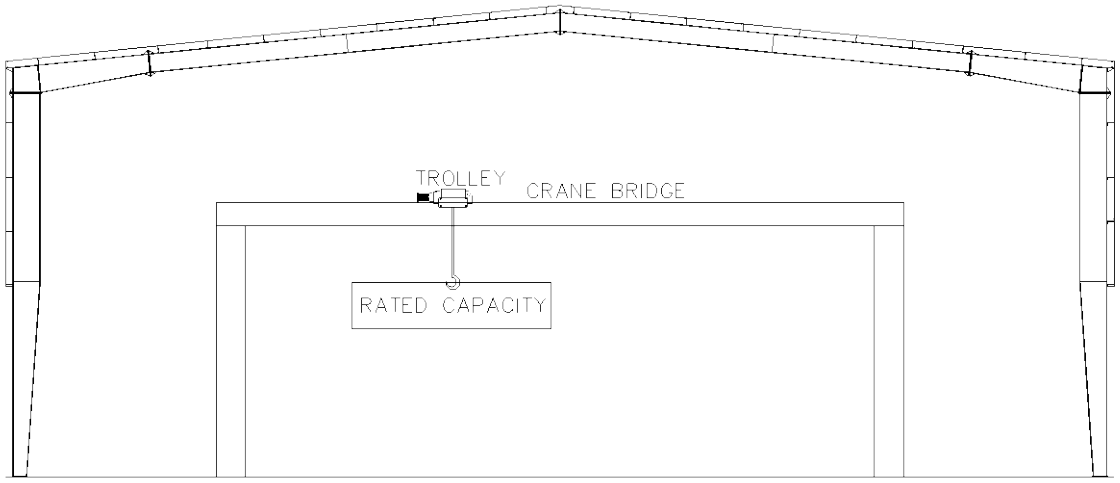


Figure (05) Gantry Crane

Gantry cranes also have a disadvantage in that they do not cover the entire area of the building aisle because the offset of the gantry columns reduces the area served by the crane.

f. Semi-Gantry Cranes:

Similar to gantry cranes, except that this type only has one separate column, as they are supported by the structural system of the building on the other side, as shown in figure (06).

They also has the disadvantage of not covering the entire area of the building aisle, like the gantry crane.

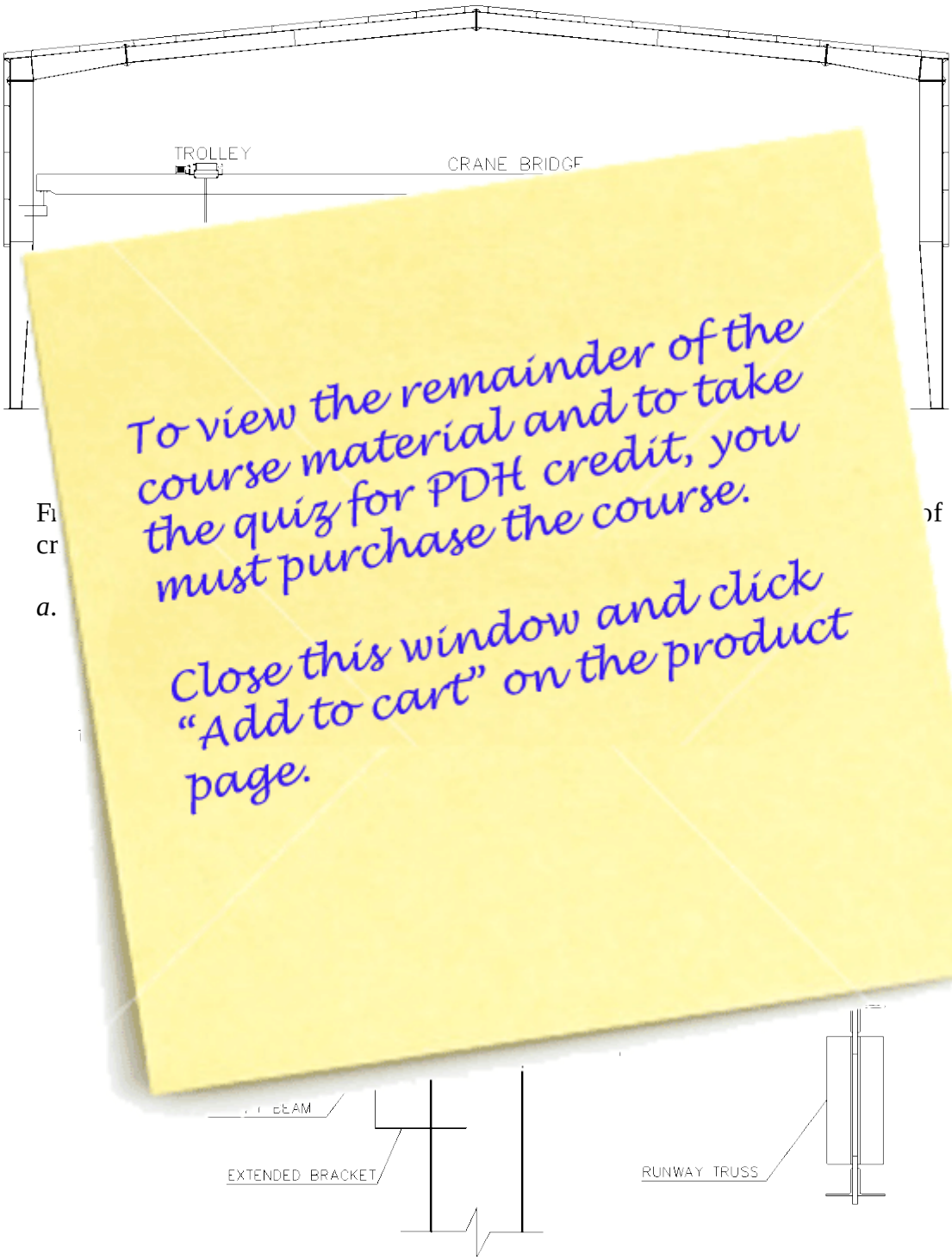


Figure (07) Semi-Gantry Crane

Crane girders may be one girder or two girders, based on the crane capacity.