Design of Crane Supporting Structures

An Online Continuing Education Course for Engineers

Course Number: S-4019

Credit: 4 Hours / 4 PDH / 4 CPD

Design of Crane Supporting Structures

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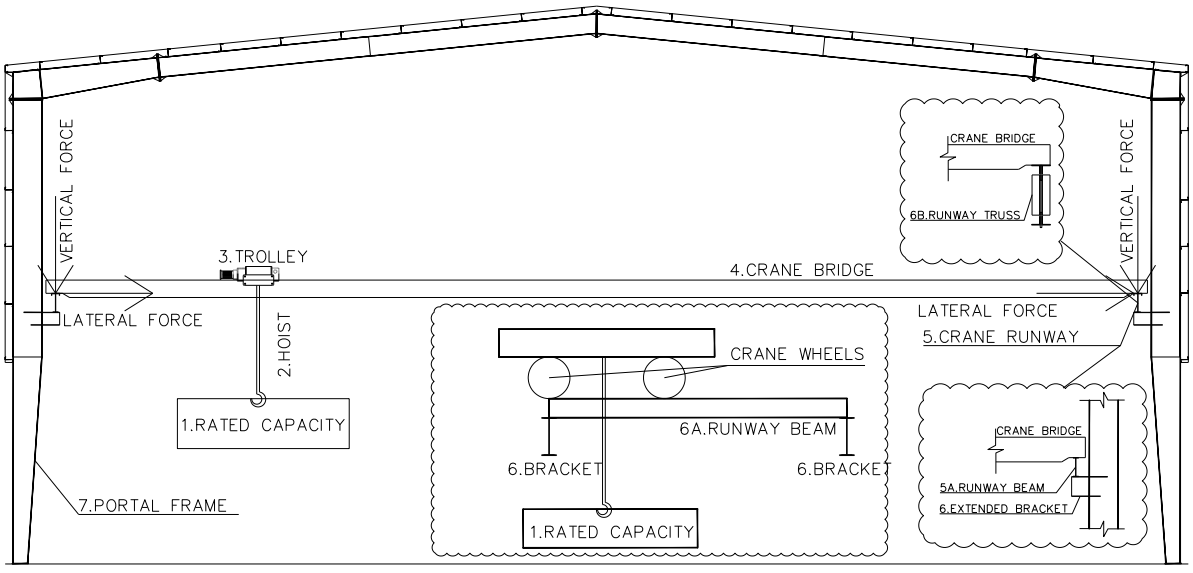
Introduction

Most industrial buildings include interior or exterior cranes for handling materials or moving equipment for maintenance purposes. These cranes are supported on specific structures called "crane supporting structures," which are designed to transfer different cranes loads to the ground.

This course involves a deep study on the design of crane supporting structures, according to the latest US standards: AISC Construction Manual 15th edition, AIST Technical Report No.13, Design Guide No.7 (Industrial Building Design-Third Edition), CMMA-Technical Report.No.74, 2015, ASCE7-16, 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 beam or truss
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

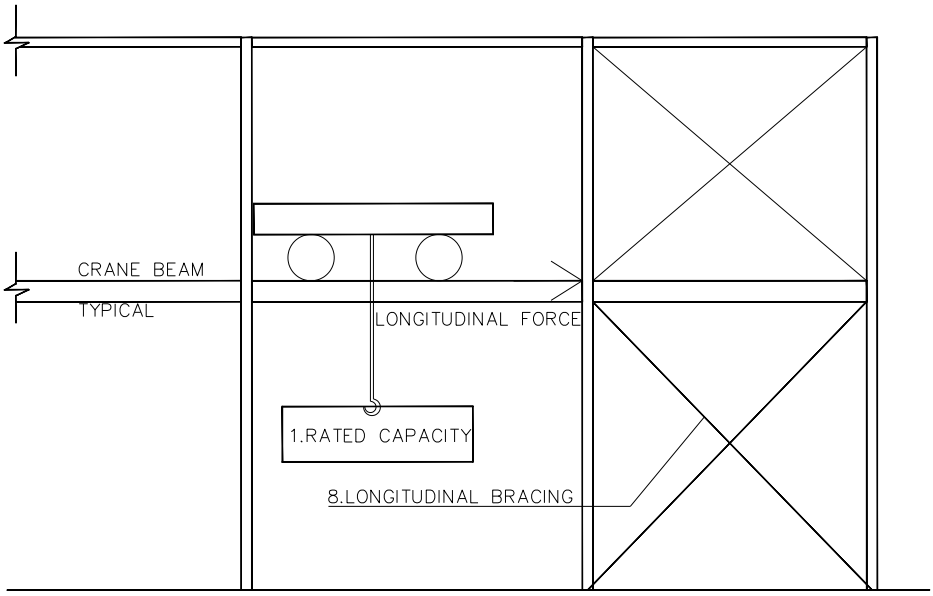


Figure (01) Load Path of Crane Loads

In this course, we will study how to apply crane loads on 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:

1. Types of cranes and runways
2. Components of crane supporting structures
3. Crane loads acting on crane supporting structures
4. Load combinations of cranes
5. Application of crane loads to runway systems and supporting structures
6. Multiple crane loading conditions
7. Vertical systems of crane supporting structures

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 advantages of each type of them as follows.

a. Overhead Cranes

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

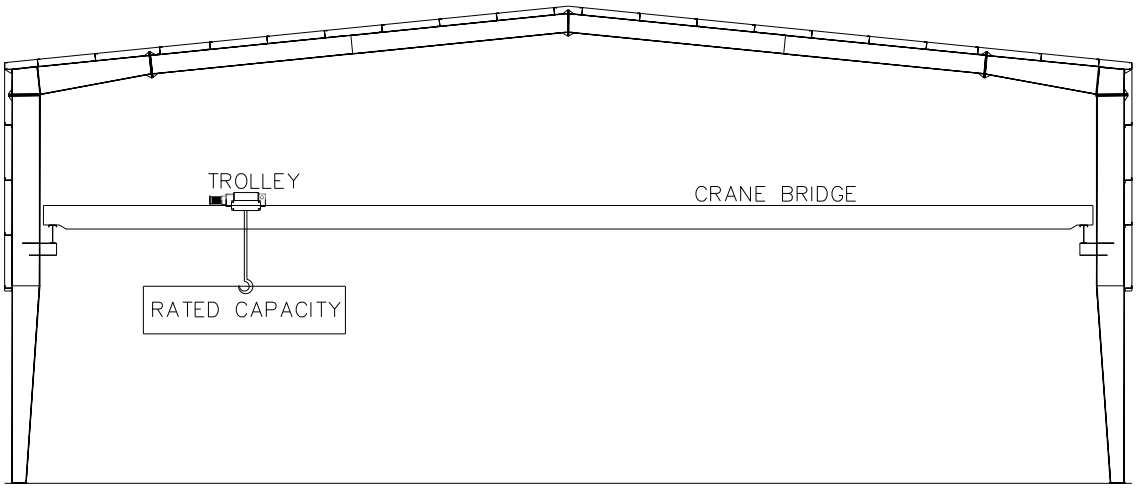


Figure (02) Overhead Crane

b. Underhung Cranes

This type is 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 lateral and longitudinal load transfer, as shown in figure (03).

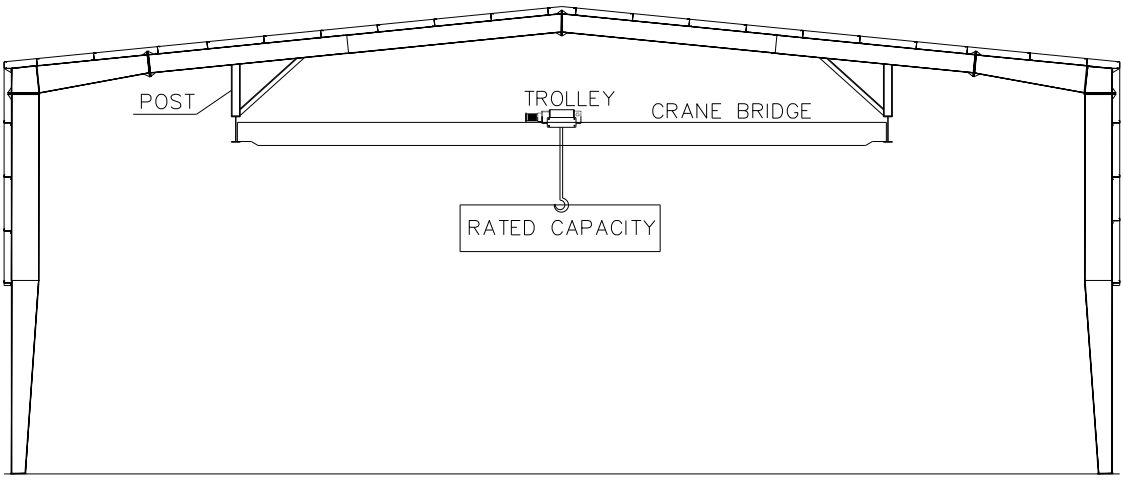


Figure (03). Underhung Crane

c. Monorail Cranes

This type is used for small rated capacities when the load is required to transfer in a longitudinal way only, as shown in figure (04).

d. Jib Cranes

This type is used to cover the area around the columns because the overhead cranes do not cover these areas. They may also be used for staged operations, as shown in figure (04).

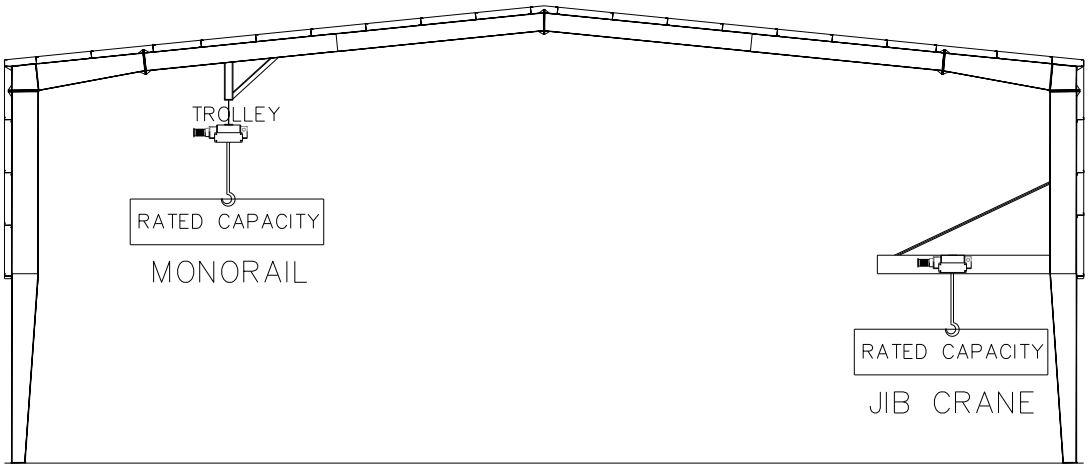


Figure (04). Monorail and Jib Crane

e. Gantry Cranes

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

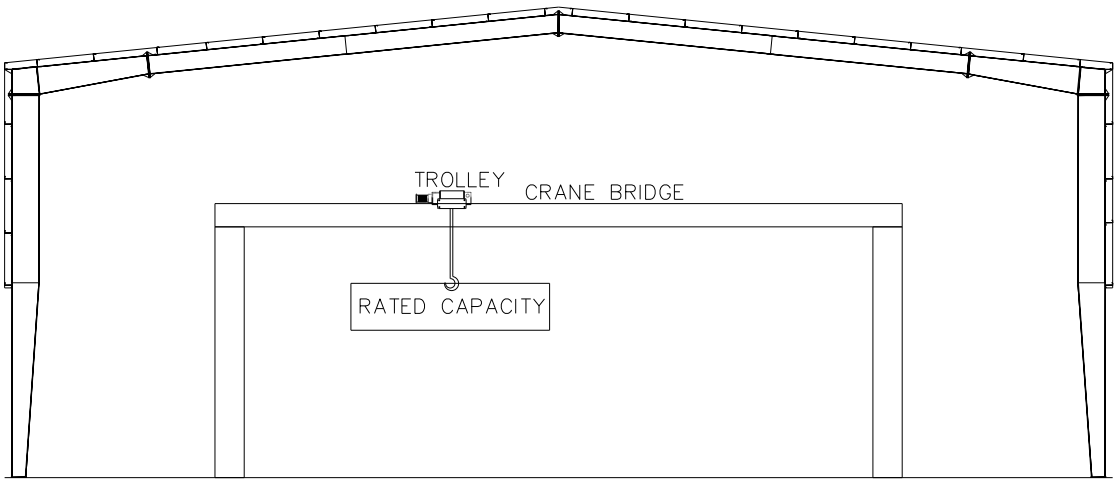


Figure (05). Gantry Crane

It also has a disadvantage in that it does not cover the entire area of the building aisle, as the offset of the gantry columns reduces the area served by the crane.

f. Semi-Gantry Cranes

They are similar to gantry cranes, except that they have only 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 have the disadvantage of not covering the entire area of the building aisle, like the gantry crane.