

2.7 Crane gantry girders

The function of the crane girders is to support the rails on which the traveling cranes move. These are subjected to vertical loads from crane, horizontal lateral loads due to surge of the crane, that is, the effect of acceleration and braking of the loaded crab and swinging of the suspended load in the transverse direction, and longitudinal force due to acceleration and braking of the crane as a whole. In addition to the weight of the crane, impact and horizontal surge must be considered. According to IS: 875, the values given in Table 13-9 may be taken for the design of crane gantry girders and columns. Both the horizontal forces, lateral and longitudinal, are assumed not to act together with the vertical loads simultaneously. Only one of them is to be considered acting with the vertical load at a time. Vertical load, of course, includes the additional load due to impact.

Table 2.1

Impact and surge of cranes

| Type of Load | Additional Loads |
|--|--|
| Vertical – electrical operated hand operated | 25% of max. static wheel load 10% of max. static wheel load |
| Horizontal, lateral to rails electrically operated hand operated | 5% of weight of crab plus weight lifted per rail 2 ½% of weight of crab plus weight lifted per rail |
| Horizontal, along rails | 5% of max. static wheel load |

The crane girder spans from column to column, usually having no lateral support at intermediate points excepting when a walkway is formed at the top level of the girder which restrains the girder from lateral bending. Thus under

normal circumstances, the crane girder must be designed as laterally unsupported beam carrying vertical and horizontal load at the level of the top flange. Apparently a girder with heavier and wider compression flange is required. Figure 2.27 shows some typical sections adopted for crane girders

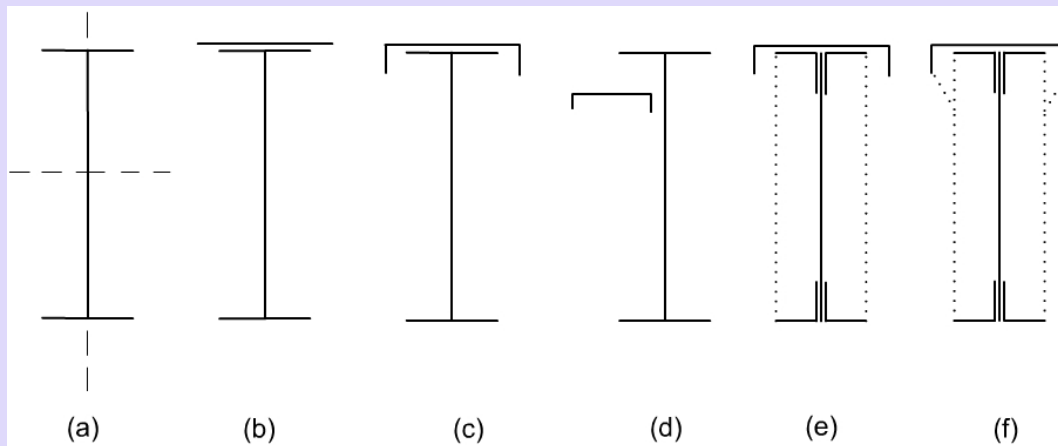


Fig. 2.27 Crane girders (Typical sections)

Fig. 2.27(a) shows a wide flange beam with out any reinforcement and may be used for short spans and very light crane loads. In Fig.2.27 (b), a cover plate is used on the compression face which improves the lateral buckling strength of the beam and provides larger moment of inertia about the vertical axis against the lateral loads. In Fig. 2.27(c), a channel has been used instead of the cover plate to further increase I_{yy} . In Fig. 2.27(d), the channel is used just below the compression flange of the wide flange beam and is supported by brackets to increase the torsional stiffness of the girder. Figure 2.27(e) and (f) show plate girder sections used for longer spans and heavier crane loads.

The fibre stresses in the gantry crane girders should rationally be computed considering bi-axial bending combined with torsion. The torsion is

produced by the lateral force being applied at the top flange. To simplify analysis, it is assumed that the lateral moment is resisted only by the top flange bending horizontally without any assistance from the bottom flange. Of course, it is assumed to be restrained in the vertical plane. The design bending stress therefore will be full value f_y/γ_{m0} . For the moment in the vertical plane produced by vertical crane reaction and self weight of the girder, the full section of the girder is taken effective but with laterally unsupported compression flange. The design stress for vertical bending will be determined according to the rules for unrestrained compression flanges given in Cl.8.2.2. The two stresses should satisfy the relation give in Cl.9.3.1 and Cl.9.3.2.

The crane girders are supported either on brackets connected to columns of uniform section or on stepped columns. Brackets are used for lighter crane loads and the stepped columns for heavy crane loads and taller columns. Some arrangements are shown in Fig 2.27.

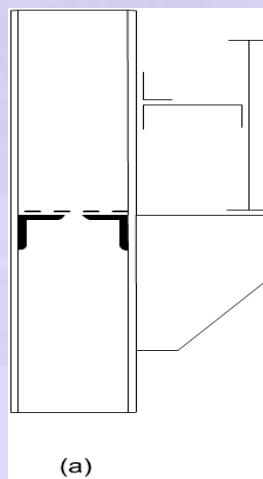


Fig. 2.28 Bracket support for gantry girders

The girder is supported on a suitably formed seat and it is also connected to the column near the top flange in each case in order to restrain it from lateral bending and twisting at the support point. In Fig. 2.28(a), a channel has been used for this purpose. To permit longitudinal movement, due to temperature and deflection, slotted holes are used to connect the channel with the column. In Fig. 2.28 (b) and (c) vertical plates have been employed for providing the restraint. Since such plates are flexible for horizontal bending no slotted holes are necessary. Where roof leg and crane leg are provided separately in a built-up column as shown at (c), the two legs are properly braced together to act as one piece. The bracing is designed to take $2\frac{1}{2}\%$ of column load plus shear due to bending under crane load and wind. The load of roof leg and crane are eccentric to the combined column axis and should be considered as such.

The crane columns must be properly braced in the longitudinal direction of the crane girders to be able to take the longitudinal forces due to crane. Such bracing may be provided every fourth or fifth bay. In other bays, struts must be used to transmit the longitudinal force to the bracing frame.

