diaphragm itself or of the girder web (Refs. 20–23). Whichever attachment is used, it should preferably be connected directly to the top flange or the cap channel of the crane girder rather than its web.

A premium method of lateral bracing for runway girders involves a proprietary tieback linkage, such as that illustrated in Fig. 15.17. The linkage allows for rotation and movement of girder ends while providing the desired resistance to side thrust.

The details described above are intended for light- and medium-capacity cranes commonly found in pre-engineered buildings. For heavy cranes, much more substantial details are needed, some of which are illustrated in *AISC Design Guide* 7. Heavy mill cranes may also require additional bracing not discussed here. For example, AISE 13 calls for the *bottom* flanges of the crane girders longer than 36 ft to be laterally braced.

15.6.6 Specifying Crane Rails and Rail Attachments

Crane rails are normally selected and provided by the crane supplier, but the methods of their attachment, splicing, and layout may be in the specifier's domain. Crane rails, if installed incorrectly, can lead to a host of crane performance problems, such as premature wear-out of various crane components, high levels of noise and vibration, and even failures of runway girders. According to AISE 13,[4] the rails should be centered on the girder; the maximum allowed eccentricity should not exceed three-fourths of the girder web thickness.

The rails should be laid out in such a manner that on both runway girders their splices, as well as splices in the girders and in the cap channels, are staggered by at least 1 ft relative to each other. The crane supplier should verify that the crane's wheelbase does not happen to equal the amount of stagger. All crane rails should be specified as being "for crane service."

Rail splices can be made by bolting or welding. Successful welded splices require special end preparation and very close control of the operation; both could be difficult to achieve at the jobsite. Bolted splices offer a more practical alternative. The best splice detail is a tight joint between the rail sections instead of the commonly used joint with a small ($^1/_{16}$- to $^1/_8$-in) gap.[18] This detail

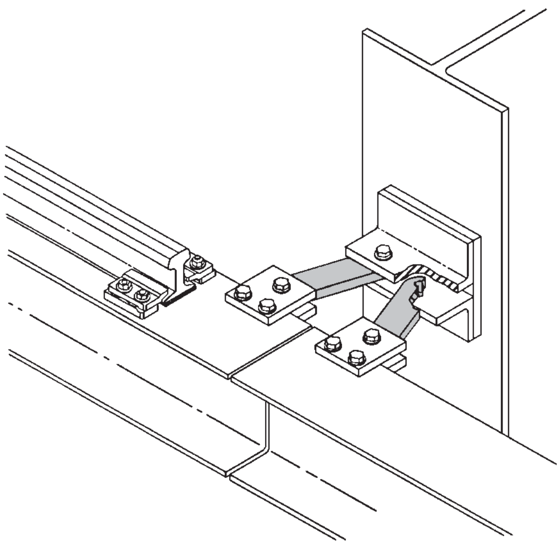


FIGURE 15.17 Proprietary rail clips and tieback linkage. (*Gantrex Corporation.*)

requires mill finish of rail ends and a particular rail drilling pattern. The adjacent rail sections are fastened with high-strength bolts through the rails and two connecting bars that match the rail profile.

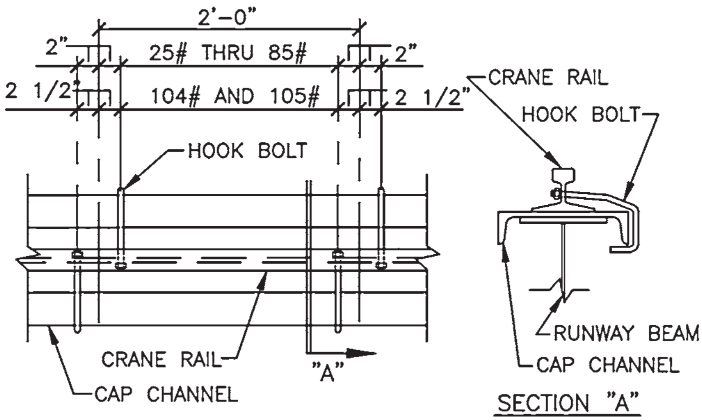
Perhaps the biggest challenge confronting the specifiers of crane rails is how to attach the rails to the girders. The ideal connection should be able to resist the side thrust from the crane wheels without constraining the rail's capacity to expand and contract with temperature changes independent of the girder. (Hence, the rails should never be welded to the runway.)

Rails can be attached to crane girders in three different ways. The first one is by hook bolts which used to be popular but now are not recommended except for the lightest of cranes. Hook bolts are not very good in resisting side-thrust forces, because the bolts tend to stretch and the nuts loosen under load. For this reason, hook bolts require frequent inspection and adjustment to maintain rail alignment.[24] Hook bolts are dimensionally suitable for capless crane girders with narrow flanges that leave no room for any other attachment method. Hook bolts are supplied in pairs and are usually spaced 2 ft on centers (Fig. 15.18).

Rail clamps perform somewhat better than hook bolts and can be used for nearly any crane. The clamp assembly consists of a clamp plate connected by two high-strength bolts through a filler bar to the girder. Rail clamps are spaced not more than 3 ft apart (Fig. 15.19). The clamps can be of tight or floating type. Floating clamps are intended to allow for a thermal expansion of the rail but, unfortunately, may also permit excessive rail movement in the transverse direction, making it difficult to maintain rail alignment. Tight clamps, on the other hand, tend to prevent any rail movement at all and may lead to a buildup of thermal stress in the rail and in the girder.

The third method of rail attachment involves proprietary adjustable rail clips offered by various crane manufacturers. The patented clips claim to allow for a longitudinal expansion of the rails *and* restrict their transverse movement. Some crane manufacturers also advocate the use of synthetic rubber pads under the rail at the clip locations that reportedly provide for a more uniform rail bearing and for reduced impact, noise, and girder wear. An example of proprietary clips and pads is shown in Fig. 15.17. At this time, adjustable clips represent the best available method of rail attachment.

Regardless of the rail attachment method, periodic inspection and maintenance is required to keep the bolts properly tightened and the rail aligned.



RAIL	HOOK BOLT DIA.
25#–30#	5/8"
40#–60#	3/4"
80#–105#	7/8"

FIGURE 15.18 Attachment of crane rail to runway beam by hook bolts. (*Nucor Building Systems.*)