members are square. When chord shear controls, the connection capacity can be increased by reinforcing with a pair of side plates as shown in Fig. 3.27(b). This failure mode will usually govern when $\beta = 1.0$ and $h_0 < b_0$.

Design guidance for K connections *stiffened with a flange plate*, as shown in Fig. 3.27(a), was first given by Shinouda (1967). However, this method was based on an elastic deformation requirement of the connection plate under specified (service) loads. A more logical limit states approach recommended for calculating the necessary stiffening plate thickness for gap K connections is to use the connection resistance expressions in Table 3.2 (for square or circular web members to square chord members), and Table 3.3 (for rectangular members) by considering t_p as the chord face thickness and neglecting t_0 (Wardenier 1982). The plate yield stress should be used.

It is suggested that proportioning of the stiffening plate be based on the principle of developing the capacity of the web members ($A_i F_{yi}$). Dutta and Würker (1988) consider that this will be achieved providing $t_p \geq 2t_1$ and $2t_2$. Careful attention should be paid to the stiffening plate-to-chord welds which should have a weld throat size at least equal to the wall thickness of the adjacent web member (Dutta and Würker 1988). The stiffening plate should have a minimum length L_p, (see Fig. 3.27(a)), such that

$$L_p \geq 1.5\left(\frac{h_1}{\sin\theta_1} + g + \frac{h_2}{\sin\theta_2}\right) \qquad [3.9]$$

A minimum gap between the web members, just sufficient to permit welding of the web members independently to the plate is suggested (Stelco 1981). All-round welding is generally required to connect the stiffening plate to the chord member, and to prevent corrosion on the two inner surfaces. It may also be advisable to drill a small hole in the stiffening plate under a web member to allow entrapped air to escape prior to closing the weld. This will prevent the expanding heated air from causing voids in the closing weld (Stelco 1981).

If the capacity of a gap K connection is inadequate and chord shear is the governing failure mode, then as mentioned before one should stiffen *with side plate reinforcement*, as shown in Fig. 3.27(b). A recommended procedure for calculating the necessary stiffening plate thickness is to use the chord shear resistance expression in Table 3.3, by calculating A_V as $2h_0 (t_0 + t_p)$. The stiffening plates should again have a minimum length L_p (see Fig. 3.27(b)), given by [3.9] and have the same depth as the chord member.

In order to avoid partial overlapping of one web member onto another in a K connection, fabricators may elect to weld each web member to a vertical stiffener as shown in Fig. 3.28(a). Another variation of this concept is to use the reinforcement shown in Fig. 3.28(b). For both of these connections, $t_p \geq 2t_1$ and $2t_2$ is recommended (Dutta and Würker 1988). The K connection shown in Fig. 3.28(c) is <u>not</u> acceptable, as it does not develop

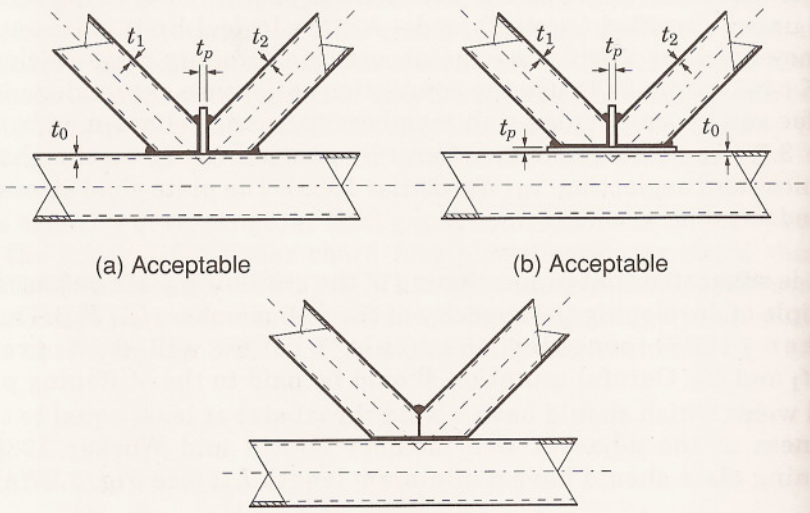

FIGURE 3.28
Some acceptable and unacceptable non-standard K connections

the strength of an overlapped K connection where one web member is welded only to the chord face. Also, it is difficult to create and ensure an effective saddle weld between the two web members.

3.9.1.2 K and KK Connections with Circular HSS Chords

For circular-to-circular HSS K connections, stiffening plates shaped to saddle the chord member have been used, particularly where cross-chord external loads are applied (Fig. 3.29), but no design guidelines exist. The authors tentatively suggest that the connection resistance expression for a K connection in Table 3.1 be used, by again considering t_p as the chord wall thickness and neglecting t_0. As before, a reasonable check would be to ensure that $t_p \geq 2t_1$ and $2t_2$.

There are benefits to using circular HSS members with relatively large diameter-to-thickness ratios in three dimensional truss systems, but this may produce relatively weak multiplanar (or KK) gap connections. It is