

CODE

- (a) Member cross sections are nonrectangular
- (b) Discontinuities in or near the general zone cause deviations in the force flow path
- (c) Minimum edge distance is less than 1.5 times the anchorage device lateral dimension in that direction
- (d) Multiple anchorage devices are used in other than one closely spaced group
- (e) Centroid of the tendons is located outside the kern
- (f) Angle of inclination of the tendon in the general zone is less than -5 degrees from the centerline of axis of the member, where the angle is negative if the anchor force points away from the centroid of the section
- (g) Angle of inclination of the tendon in the general zone is greater than $+20$ degrees from the centerline of axis of the member, where the angle is positive if the anchor force points towards the centroid of the section

25.9.4.3.3 Three-dimensional effects shall be considered in design and analyzed by (a) or (b):

- (a) Three-dimensional analysis procedures
- (b) Approximated by considering the summation of effects for two orthogonal planes

25.9.4.4 Reinforcement limits

25.9.4.4.1 Tensile strength of concrete shall be neglected in calculations of reinforcement requirements.

25.9.4.4.2 Reinforcement shall be provided in the general zone to resist bursting, spalling, and longitudinal edge tension forces induced by anchorage devices, as applicable. Effects of abrupt changes in section and stressing sequence shall be considered.

COMMENTARY

flanged sections, or irregular sections, or where the tendons have appreciable curvature within the general zone, more general procedures such as those of **AASHTO LRFDUS** Articles 5.8.2.7 and 5.8.3 are required. Detailed recommendations for design principles that apply to all design methods are given in Article 5.9.5.6.5b of the **AASHTO LRFDUS**.

Groups of monostrand tendons with individual monostrand anchorage devices are often used in beams. If a beam has a single anchorage device or a single group of closely spaced anchorage devices, the use of simplified equations such as those given in R25.9.4.3.1 is permitted, unless 25.9.4.3.2 governs. More complex conditions can be designed using the strut-and-tie method. Detailed recommendations for use of such models are given in **AASHTO LRFDUS** and **Breen et al. (1994)**.

R25.9.4.3.3 The provision for three-dimensional effects is to ensure that the effects perpendicular to the main plane of the member, such as bursting forces in the thin direction of webs or slabs are considered. In many cases, these effects can be determined independently for each direction, but some applications require a full three-dimensional analysis (for example, diaphragms for the anchorage of external tendons).

R25.9.4.4 Reinforcement limits

R25.9.4.4.2 In some cases, reinforcement requirements cannot be determined until specific tendon and anchorage device layouts are selected. Design and approval responsibilities should be clearly assigned in the construction documents.

Abrupt changes in section can cause substantial deviation in force paths. These deviations can greatly increase tensile forces, as shown in Fig. R25.9.4.4.2.