CODE

COMMENTARY

Design examples for the strut-and-tie method are given in ACI SP-208 (Reineck 2002) and ACI SP-273 (Reineck and Novak 2010). The process of designing by the strut-and-tie method to support the imposed forces acting on and within a D-region is referred to as the strut-and-tie method, and it includes the following four steps:

(1) Define and isolate each D-region.

(2) Calculate resultant forces on each D-region boundary.

(3) Select the model and calculate the forces in the struts and ties to transfer the resultant forces across the D-region. The axes of the struts and ties are chosen to approximately coincide with the axes of the compression and tension fields, respectively.

(4) Design the struts, ties, and nodal zones so that they have sufficient strength. Widths of struts and nodal zones are determined considering the effective concrete strengths defined in 23.4.3 and 23.9.2. Reinforcement is provided for the ties considering the steel strengths defined in 23.7.2. The reinforcement should be anchored in or beyond the nodal zones.

The components of a strut-and-tie model of a single-span deep beam loaded with two concentrated loads are identified in Fig. R23.2.1. The cross-sectional dimensions of a strut or tie are designated as thickness and width, and both directions are perpendicular to the axis of the strut or tie. Thickness is perpendicular to the plane, and width is in the plane of the strut-and-tie model. A tie consists of nonprestressed or prestressed reinforcement plus a portion of the surrounding concrete that is concentric with the axis of the tie. The surrounding concrete is included to define the zone in which the forces in the ties are to be anchored. The concrete in a tie is not used to resist the axial force in the tie. Although not explicitly considered in design, the surrounding concrete will reduce the elongations of the tie, especially at service loads.

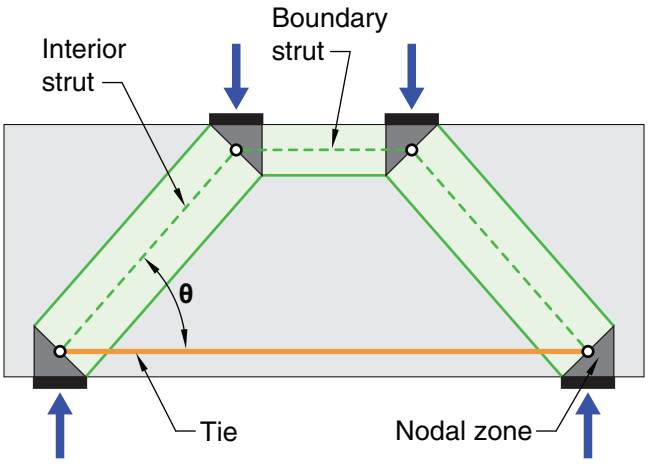

Fig. R23.2.1—Description of strut-and-tie model.