C-28: Analysis of deep beams with openings

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Deep beams behave differently from shallow beams for which the simple bending theory is adequate. Simply supported beams are considered as deep when their span/depth ratio is less than 2, while this ratio is 2.5 for continuous beams. Often in buildings, deep beams which are designed as load carrying members, also have openings for doors, windows etc. and this further complicates their behaviour.

The objective of this study was to analyse deep beams with openings and prepare plots showing how the total moment at an opening is distributed between the ligaments. Using the finite element method, simply supported beams of 3 different span/depth ratios were analysed with 2 sizes of central openings under 2 load conditions. Normalized results for the moments at the top and bottom ligaments and the moment due to the normal force in the ligaments, were plotted against span/depth ratios for different opening sizes and different opening locations.

The limited results obtained can be used in the design of simply supported beams of span/depth ratios between 1 and 4.