Behaviour of T Shaped R.C Deep Beam with Opening under Different Loading Condition

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Abstract

In this study, the FE package ANSYS-19 has been used to predict the behaviour of T-shaped R.C. deep beams with opening subjected to different loading types. Verification specimens tested by others have been modelled and analysed by the ANSYS program. Generally, a good agreement is achieved between the experimental and numerical results for the load-deflection curves and crack patterns. The main studied parameters include: flange dimension, shear span-to-depth ratio (a/d), concrete strength (fcu), size and location of opening and finally the loading type. Analysis results showed that: (1) increasing flange depth and width increases the shear capacity and the stiffness but the effect of the flange depth is more than the effect of the flange width. (2) An enhancement in the initial and ultimate shear capacity of the deep beams is noticed by decreasing the shear span-to-depth ratio (a/d) and the stiffness increases with the decrease in (a/d). (3) Increasing the concrete compressive strength (fcu) improves the shear capacity and the stiffness increases with the increase in (fcu) for most load stages. (4) The opening size is more effective for controlling the appearance of diagonal cracks at initial loads and by decreasing the opening size, the initial and ultimate shear capacity increases. The effect of opening size is small for deflection at most load stages. (5) For the bottom loading type, As the position of opening far away from the bottom chord, the initial shear and flexure capacity increase and the effect of opening position is small for changing the deflection. (6) From the results of the loading type effect, the first cracking is shear for all specimens except the bottom-loaded specimen is flexure. The rigidity of the specimens has more loading points is greater

than having fewer loading points but for the bottom loading, the rigidity is low when compared to other specimens. Strut-and-Tie model (STM) was carried out to predict the shear behaviour of studied beams. It was found the results obtained using STM showed a good agreement with those obtained using FEM in most cases.

Keywords: T shaped deep beam; different loading; nonlinear finite element; shear capacity; strut and tie.