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Numerical Simulation of Punching Shear of Flat Plates with Low Reinforcement

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Abstract : Punching shear failure is usually the governing failure mode of flat plate structures. Punching failure is brittle in nature which induces more vulnerability to this type of structure. In the present study, a 3D finite element model of a flat plate with low reinforcement ratio and without any transverse reinforcement has been developed. Punching shear stress and the deflection data were obtained on the surface of the flat plate as well as through the thickness of the model from numerical simulations. The obtained data were compared with the experimental results. Variation of punching stress with respect to deflection as obtained from numerical results is found to be in good agreement with the experimental results; the range of variation of punching stress is within 5%. The numerical simulation shows an early and gradual onset of nonlinearity, whereas the same is late and abrupt as observed in the experimental results. The range of variation of punching stress for different slab thicknesses between experimental and numerical results is less than 15%. The developed numerical model is useful to complement available punching test series performed in the past. The results obtained from the numerical model will be helpful for designing retrofitting schemes of flat plates.

Keywords : flat plate, finite element model, punching shear, reinforcement ratio
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