

Effect of size of the opening on reduction in sectional property of castellated steel beams

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Abstract

This research aims to find out the relation between the size of the opening and thereby the standard property of the castellated steel beams. To achieve this, a modeled solid beam without openings and another model with perforation in beam called castellated beams in ANSYS. The deflection and stress values for the applied load are calculated using the formulae and they are compared with the ANSYS results for verification. Those values tend to be matched to a reasonable extent and hence it is concluded that the ANSYS results of stress and deflection are dependable. Since the castellated beam is modeled using finite element and therefore meshing size governs the results. The deflection and stress tend to be more than the solid beam as there is the loss of material from the web of the castellated beam and hence the reduction of sectional properties is obvious. After getting the stress values from back substitution one can calculate the Z_{xx} of the castellated beam and it is found to be lower than the solid beam for the same span and load. The percentage reduction is in the narrow range. The variation mostly depends on the variation in pitch. Initially, the angle is kept at 60 degrees and hence the horizontal portion of the incline part of the opening is kept fixed. The top and bottom horizontal part of the opening is changed by varying the factor from 1.2 to 2.0 in multiples of 0.2 to get a rough idea of the trend. The reduction in sectional property of castellated beams as compared to solid beams is around 10% to 12%.

Keywords: Castellated Steel beam, Horizontal factor, Size of opening, Stress, Deflection, Section property, ANSYS.

Introduction and literature review

The usage of castellated steel beams in the private and industrial zone is increased rapidly. The castellated steel beams are having high aesthetic value when the face of the building is exposed to nature. The usage of castellated steel beams provides an increase in depth of section without any extra weight and high strength to weight ratio. It also increases vertical bending stiffness and simplicity of services provision. One more added advantage of castellated steel beams, it reduces the transportation cost. Castellated Steel Beams (CSBs) is rapidly used as a long span system in steel construction globally. Castellated Beams

(CBs) are generally built from hot rolled steel sections with different cutting patterns from the parent I section; two halves are separated, rearranged, lastly welded together, and grinding is done for the perfect shape and size of the opening to get castellated steel beams. The resulting section depth is 1.5 times more than the virgin section with the same weight as shown in Fig 1. The parent section is having a depth of 150 mm whereas CSBs having a depth of 225 mm. For improvement of the moment of inertia and depth of a section and section properties of virgin rolled steel section is to be improved by castellation. It increases the load-carrying capacity and control on a deflection. Web resists shear force whereas flange resists the bending moment. According to the theory of beam, the rolled steel I section is much effective for


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