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Castellated Steel Beams-A Torsional Analysis

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Abstract: Practice of castellated beams (CBs) or perforated beams for several structures speedily gaining petition. This is because of the increased depth in the segment, high strength to weight ratio, light in weight, easy to erect, economical, and stronger. The principal advantages of the castellated beam are an attractive provision, an increase in vertical bending stiffness, & ease of service provision. The CBs is prepared from its virgin sections i.e. I beam by cutting it in a zigzag or any suitable cutting pattern and again rejoined it by welding therefore depth of the resulting section increases. The load-carrying capacity of the parent I section is increased with the same quantity of material and weight, due to an increase in depth of beams. Web post-buckling and lateral-torsional buckling failure occur when these beams are subjected to loading, this is the effect of an increase in depth of the castellated beams. There are five basic failure modes associated with castellated steel beams that need to be taken care of 1) Development of flexure mechanism. 2) Lateral-torsional buckling 3) Vierendeel mechanism 4) rupture of the welded joint in a web post 5) shear buckling of a web post. Therefore, in this research paper, an effort has been made to estimate the torsional moment capacity castellated beam for hexagonal or honeycomb opening with 30°, 45°, 60° & sinusoidal opening with different fillet radii.

Keywords: Castellated beam, Hexagonal opening, Sinusoidal opening, Torsion.

I. INTRODUCTION

I-shaped hot rolled steel beams are extensively used as structural components because of their flexural efficiency about the strong axis. However, in various applications beams are eccentrically loaded and as a result experience torsional loads in combination with bending. Like all solid sections, I-shaped steel beams are very inefficient interaction effects due to torsion, and resisting torsion acting in combination with bending can considerably reduce the capability of the solid beams, and hence CBs are the best solution under this situation.

In most of the steel-framed structure, the beam is subjected only bending and not torsion but the situation does arise where torsion effect is significant the designer will also know the value of torsional effect and to consider the resistance of member under the combined bending and torsion Steel beams with an opening in the web part are called castellated steel beams (CSBs).

I-shaped section is a very efficient form for carrying both bending and shears loads in the plane of the web. On the other hand, the cross-section has a reduced capacity in the transverse direction and is also inefficient in carrying torsion, for which hollow structural sections are often preferred.

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CBs offer a designer all types of prospects for "cutting to size". For example, in simple straight castellated beams, by changing the cutting pattern the depth can be determined therefore in this technique, the strength of the beam for the occurring loads should be precisely matched. That's what you call optimum construction! In addition to this, a tapered shaped castellated beam easily built, at a slight angle by setting the cutting design not exactly parallel to the length of the castellated beam. After cutting, among two halves, one is reversed and the two halves are then welded together lengthwise. At one end both low sides come together, at the other end both high sides. CBs are such structural supporters, which are prepared by flame cutting a hot rolled steel beam lengthwise its centerline and then rejoining the two halves by welding, and hence the overall depth of the beam is increased by 50% for better structural presentation against bending, flexure, and shear. Commonly, for CSBs hexagonal, rectangular, oval, elongated circular and circular shaped opening are provided, which are distributed at consistent intervals in the web of the CBs. These are finished from I-section (hot-rolled) which is being cut lengthwise with definite configuration and then both halves are moved and re-welded such that results increases in depth. The castellated steel beam achieved is 50% deeper than virgin I-Section i.e. 1.5 times the depth than the original section. Fig. 1 shows CBs with the hexagonal shaped opening, a castellated beam with the sinusoidal opening as shown in Fig. 2.

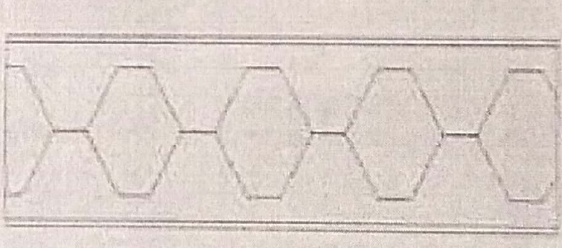

Fig.1. Hexagonal opening CBs.

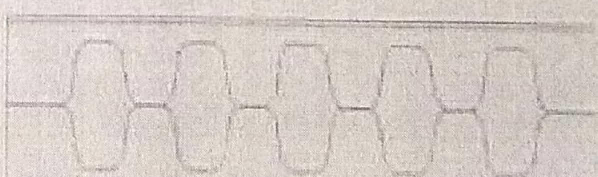

Fig.2. Sinusoidal opening CBs.

II. LITERATURE SURVEY

1. L.M. Gupta [1] carried out experimental investigation & ANSYS analysis on a hexagonal opening castellated beam under constant loading & support condition.

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