

Parametric Study of Castellated Beams

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Abstract: In this study, a detailed parametric study of the castellated beam is carried out by analytical and experimental methods. The use of castellated beams or perforated web beams has become very popular nowadays due to its advantageous structural applications. A lot of research work has been carried out in optimizing sizes of castellated beams and hence there is a need to optimize the beams with varying depths of hexagonal opening. The objective of this report is to do a comparative study of parent beam that is I- beam and castellated beam with varying depth. The study of performance based on bending strength, lateral-torsional buckling moment, bending compressive stress, shear capacity and deflection of I- beam and moment of resistance, deflection of castellated beams with standard hexagonal shape of the opening. These are done on an analytical and experimental basis.

Keywords: Castellated Beam, I- Beam, Parametric Study, Analytical Study, Experimental Analysis.

1. Introduction

A beam with a perforated web is called a castellated beam [1]. It is an open web beam which is made up of a single rolled wide flange beam section and is formed by flame cutting the beam section in a specific pattern and rejoining the segments by welding to produce a regular pattern of holes in the web [2].

The first known use of castellated beams in the US was by H. E. Horton of the Chicago Bridge. G. M. Boyed developed the concept of castellated beams in 1935, worked for a steel fabricator in Argentina. His first idea was to stack two beams of minimum depth on top of one another to increase depth. Boyed then decide to cut a hot rolled section along with the web in a saw tooth pattern, separate the two halves, and weld the web posts back together at the high points. These processes increase the depth of the beam by approximately 50%, therefore increasing the strength and stiffness by about 20 to 30% without increasing the weight of the beam [3],[4].

2. Advantages of Castellated Beam

1. As increase the depth of a beam to increase its strength, without increasing its weight.

2. The castellated beam is highly steel efficient it has a maximum load carrying capacity for the same cross-section area of the I-beam.

3. The physical properties of the beam can be varied to attain good strength against web buckling, web crippling and local failure.

4. It is mostly lighter in weight. Longer spans with fewer support columns are typical of a castellated beam project.

5. It can also utilize the placement of installation. Mechanical, electrical and plumbing runs are integrated, which is not possible using a solid wide flange beam.

2.1 Disadvantages of Castellated Beam

1. Stress concentration- It has high stress concentration in and around the opening.

2. Shear failure- It has a chance to fail in shear.

3. Potential mode of failure- It has six modes of failure [6],[8],[11].

4. The cost of steel is high and also requires highly skilled workers.

5. It has more fabrication cost due to cutting and welding.

3. Methodology

The present study aims to compare the result of analytical [7] and experimental outcomes of plain webbed beams (I-beam) and castellated steel beams [12],[13]. Three types of I beams and