Replacement Of Castellated Beam By Tapered Castellation

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Abstract —*Castellated beam is defined as the beam in which increasing width of beam without increasing the self-weight of beam. Now a day castellated beam is a new technique. A castellated beam is fabricated from a standard steel I-shape by cutting the web on a half hexagonal line down the center of the beam. The two halves are moved across by one spacing and then rejoined by welding. This process increases the width of the beam and hence the major axis bending strength and stiffness without adding additional materials. Due to the opening in the web, castellated beams are more susceptible to lateral-torsional buckling. The main benefit of using a castellated beam is to increase its buckling resistance about the major axis. However, because of the openings in the web, castellated beam have complicated sectional properties, which make it extremely difficult to predict their buckling resistance analytically. In the Castellation process the fabrication of a section with improved section properties from virgin rolled section that is improving moment of inertia, improving depth. There by increase in moment of resistance and controlled on deflection.* ***Keywords-*** *Castellated column, fabrication*

INTRODUCTION

Castellated beams had occasional usage in this country for many years, during which time they were produced by simple hand procedures. Though these fabrication methods were not conducive to broad development, castellated beams have long been recognized as advantageous structural members. The pattern of holes in the web presents an attractive appearance for beams exposed to view. The web holes are becoming ever more functional with the increase of piping, conduits and ductwork in modern construction. The greatest advantage, however, is the economy effected by the increased load carrying capacity and stiffness. In developing this structural member, the Mississippi Valley Structural Steel Co. carried on an extensive program of design investigation, production studies and economic comparisons. European production methods and product applications were reviewed, because on that continent castellated beams have been used extensively for many years. This development took place in Europe because of the limited number of sections available from European mills and because of the high ratio of material cost to labour cost. The investigation was primarily directed toward the Litzka process and equipment which was developed by Litzka Stahlbau of Bavaria, Germany. Study and evaluation of this process led to the conclusion that it is particularly adaptable to large volume production and automatic methods; therefore the equipment and the rights for its use were acquired.

FAILURE MODE

1 Flexural Failure Mechanism

Due to the pure bending this failure may occurred. The span subjected to pure bending moment, the tee -sections above and below the holes yielded in a manner similar to that of a plain webbed beam, as the spread of yield towards the central axis was stopped by the presence of the holes by which time the two throat sections had become completely plastic in compression and in tension.

Fig 1. Flexure Buckling of Castellated Beam

2. Shear Bucking of a Web Post

As we know in castellated beam one inclined edge of the opening should be in tension, and the opposite edge in compression and buckling will cause a effect of twisting in the web post along its height. The horizontal shear force in the web-post is associated with double curvature bending over the height of the post.

Fig 2. Shear Bucking of a Web Post

3. Lateral-Torsional Buckling

Due to lack of lateral support to the compression flange Non-composite castellated beams are more susceptible to lateral-torsional buckling than composite beams. The lateral torsional buckling behavior of castellated beams is similar to that of plain webbed beams. The opening had a significant influence on lateral-torsional buckling behavior.

Fig 3 Lateral-Torsional Buckling of Castellated Beam

OBJECTIVES OF INVESTIGATION

1. Analysis and design of water tanks.
2. Study the guidelines for the design of liquid retaining structure according to the IS Code.
3. To know about the design philosophy for the safe & economical design of water tank.
4. The deflected shape is analyzed and also the axial force of respected tank cases.
5. To develop programs for the design of water tank of flexible base and rigid base and the underground tank to avoid the tedious calculations.
6. Comparison between is code method design and various software design result.
7. To understand governing loads and carry out literature review related to underground water tank.
8. To study the base deflection criteria, shell stresses and joint reaction of underground water tank structure by considering dynamic type of loading when the tank is empty and full water level conditions.

SECTION PROPERTIES USED FOR CASTELLATION

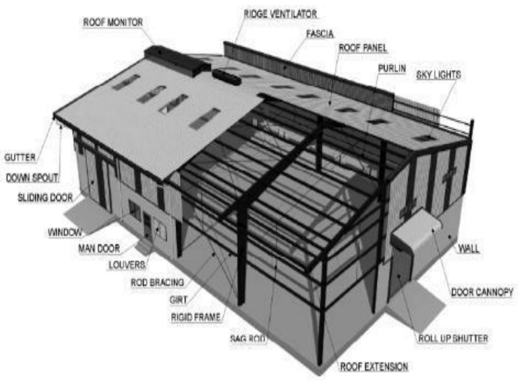
Section Properties of ISMB 150

Designation		ISMB 150
Weight (w) kg/m		14.99
Area (a) cm^2		19.10
Depth of section (D) mm		150
Width of flange (b_f) mm		75
Thickness of flange (t_f) mm		8
Thickness of web (t_f) mm		5
Moment of Inertia	I_{xx} cm^4	717.6
	I_{yy} cm^4	46.8
Radii of Gyration	r_{xx} cm^4	6.13
	r_{yy} cm^4	1.57
Moduli of section	Z_{xx} cm^4	95.7
	Z_{yy} cm^4	12.5
Max Size of Flange Rivet	Φ mm	12

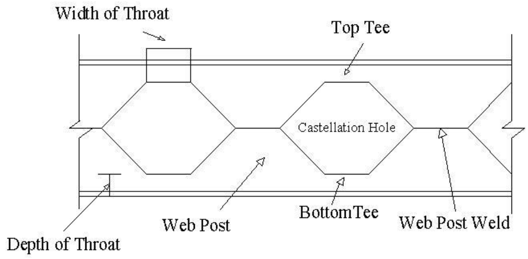
COMPONENT OF PEB

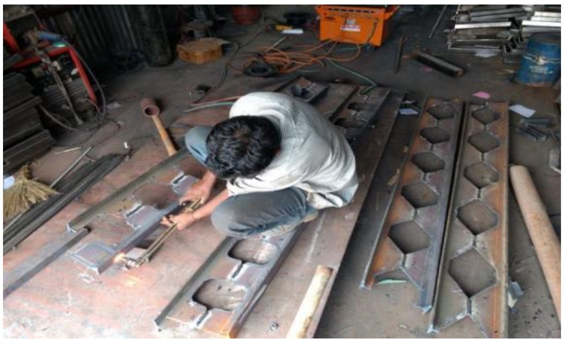
A typical assembly of a simple metal building system is shown below to illustrate the Synergy between the various building components as described below:

- Primary components
- Secondary components
- Sheeting (or) cladding
- Accessories



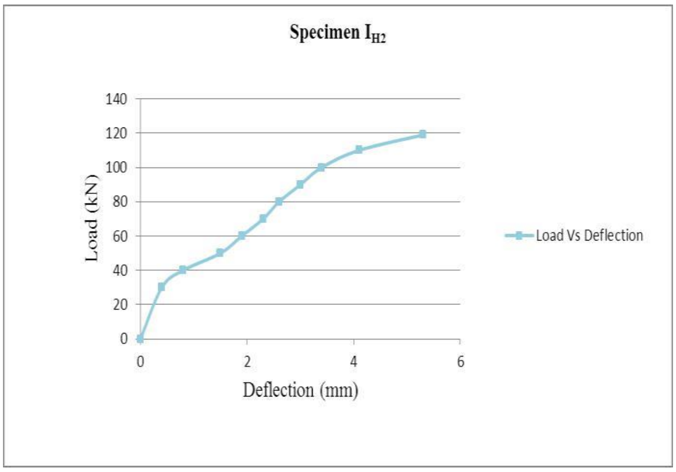
EXPERIMENTAL INVESTIGATION



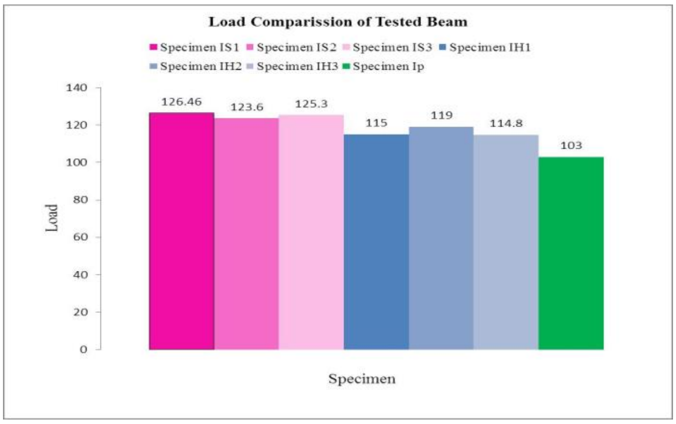


Welding of Sinusoidal Tapered Section

Testing of Hexagonal Prepared Tapered Section (45°)



Load Vs. Deflection for Sinusoidal Section I_{H2}



Comparison of Deflection of Tested Beam Specimens

CONCLUSION

1) Load carrying capacity of castellated beam with sinusoidal web opening is more as compare to castellated beam hexagonal opening.

2) Load carrying capacity of I_{S1} compare to I_P is 18.55% more, that of I_{S2} compare to I_P is 16.66% more and of I_{S3} compare to I_P is 17.79% more.

3) The Castellated beam with sinusoidal web opening has as good structural performances as that with hexagonal openings in forms of the stresses distribution, the shear capacity and failure mode, etc.

4) Also the Castellated beam with Sinusoidal web opening has a higher shear capacity than that with hexagonal web opening.

5) Sinusoidal web opening castellated beam has less deflection as compare hexagonal web opening castellated beam.

6) Deflection of I_{S1} compare to I_P is 14.59 % less that of I_{S2} compare to I_P is 12.5 % less and of I_{S3} compare to I_P is 5.66 % less.

7) Experimental analysis shows that shear stress get easily redistributed at the fillet corner of Sinusoidal Web Opening Castellated Beams.

8) The load to deflection ratio for beam I_{S1} = 1.27, I_{S2} = 1.33 and I_{S3} = 3.14.

9) Comparing the results of all Sinusoidal Web Opening Castellated Beams it is found that a castellated beam with Sinusoidal Web Opening with fillet radius equal to $1/4^{th}$ of opening shows better performance compare to castellated beam with Sinusoidal Web Opening with fillet radius equal to $1/6^{th}$ and $1/8^{th}$ of opening on the basis of load to deflection ratio.

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