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# REGULAR CASTELLATED BEAM REPLACEDAS PEB TAPERED CASTELLATED BEAM

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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.*

***Key Words***: **Castellated column, fabrication**

## 1. 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.

## 2. OBJECTIVES OF INVESTIGATION

**1.** The basic aim of this work is, by using IS code we can develop new methodology for designing of castellated beam.
**2.** To reduce the cost of structure.
**3.** To do the work efficiently by using castellation in PEB.
**4.** To develop new design by which without compromising with strength we achieve the economy for project.
**5.** To compare the structural behavior of the castellated beam with that of the conventional steel beam of similar grade.

### 2.1 Components 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

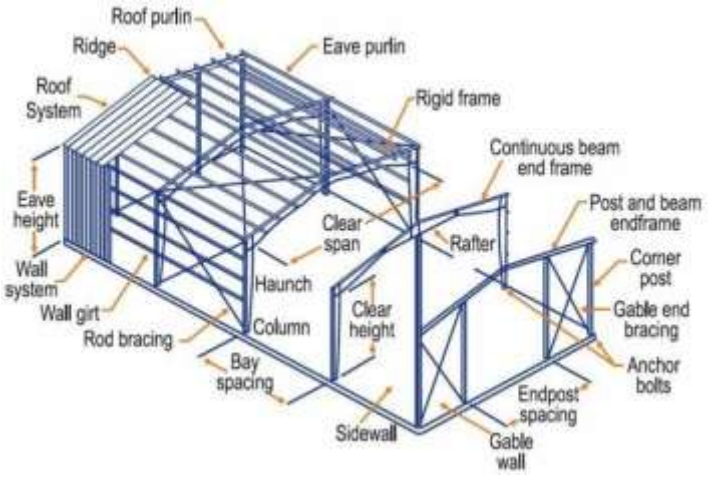


**Fig -1**: Components of PEB

### 3.1 Experimental Analysis of Castellated Beam with Hexagonal Openings

**Comparison of Load vs. Deflection for Hexagonal Section**

| SR. NO. | LOAD | | | DEFLECTION | | |
|---|---|---|---|---|---|---|
| | H1 | H2 | H3 | H1 | H2 | H3 |
| 1 | 30 | 30 | 30 | 0.2 | 0.4 | 0.2 |
| 2 | 40 | 40 | 40 | 1.2 | 0.8 | 0.5 |
| 3 | 50 | 50 | 50 | 1.7 | 1.5 | 0.9 |
| 4 | 60 | 60 | 60 | 2.1 | 1.9 | 1.4 |
| 5 | 70 | 70 | 70 | 2.6 | 2.3 | 2 |
| 6 | 80 | 80 | 80 | 3 | 2.6 | 2.7 |
| 7 | 90 | 90 | 90 | 3.7 | 3 | 3.5 |

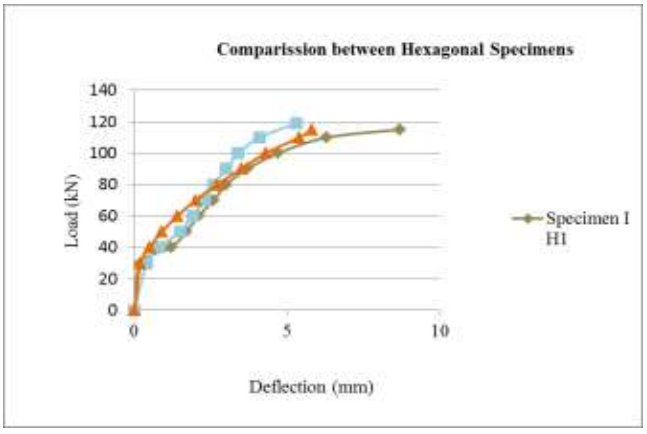


**Fig-2 Comparison between hexagonal openings**

**Comparison of Load vs. Deflection for Sinusoidal section**

| SR. NO. | LOAD | | | DEFLECTION | | |
|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S1 | S2 | S3 |
| 1 | 30 | 30 | 30 | 0.5 | 0.5 | 0.47 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 40 | 40 | 40 | 0.9 | 0.8 | 0.62 |
| 3 | 50 | 50 | 50 | 1.3 | 1.2 | 0.98 |
| 4 | 60 | 60 | 60 | 1.7 | 1.6 | 1.37 |
| 5 | 70 | 70 | 70 | 2.3 | 1.8 | 1.86 |
| 6 | 80 | 80 | 80 | 2.6 | 2.2 | 2.4 |
| 7 | 90 | 90 | 90 | 3 | 2.8 | 2.95 |
| 8 | 100 | 100 | 100 | 3.6 | 3.4 | 3.47 |
| 9 | 110 | 110 | 110 | 4.4 | 4.6 | 4.98 |

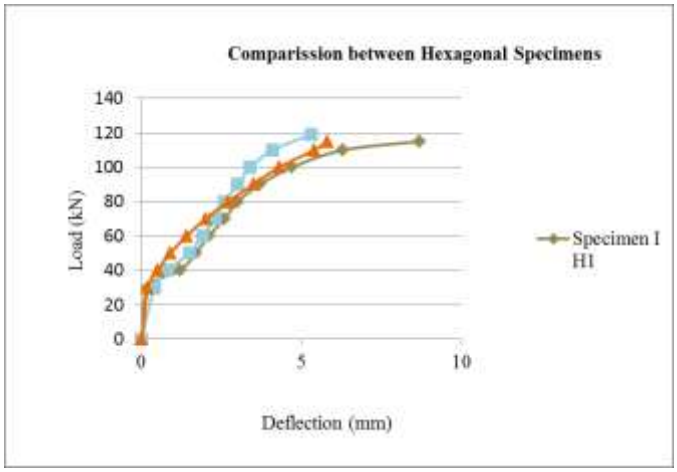


**Fig-2 Comparison between sinusoidall openings**

## 4. CONCLUSIONS

From the above discussed results it can be concluded that:

- Load carrying capacity of castellated beam with sinusoidal web opening is more as compare to castellated beam hexagonal opening.
- 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..
- Sinusoidal web opening castellated beam has less deflection as compare hexagonal web opening castellated beam.
- 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.
- Also the Castellated beam with Sinusoidal web opening has a higher shear capacity than that with hexagonal web opening
- 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.
- Experimental analysis shows that shear stress get easily redistributed at the fillet corner of Sinusoidal Web Opening Castellated Beams.
- The load to deflection ratio for beam $I_{S1}$ = 1.27, $I_{S2}$ = 1.33 and $I_{S3}$ = 3.14.
- 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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