Experimental Analysis of Trapezoidal Corrugated Steel Web Beam For Its Stress And Deflection

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Abstract- *The objective of the project is to show efficiency of the corrugated web beam as compare to I-beam. Now a day's weight optimization is very efficient tool for obtain maximum efficiency, some of failure modes of the I-section beam are Bending failure by yielding, Bending failure by lateral torsional buckling, Bending failure by local buckling, Shear failure, Vibration. There are various shapes such as corrugation along horizontal direction and vertical direction, one arc and two arc sinusoidal along vertical direction and horizontal direction, trapezoidal corrugated shape for horizontal direction of web. Strength of the beam can be increased by using different shapes of corrugation for beam which also optimize the material of web and is useful for the application for many construction. There are various methods of fabrication such bending and welding, hot rolling and cold rolling. Experimental analysis will be carry out by using UTM to find the failure modes of corrugated web beam. Verification of testing will be carry out by using various software's such as ANSYS.*

Keywords- Trapezoidal corrugated beam, ANSYS.

I. INTRODUCTION

I - section beams are widely used in construction industry such as bridges, slender structure etc. and is available in variety of standard sizes. An I-beam, also known as H-beam, W- beam (for "wide flange"), Universal Beam (UB), Rolled Steel-Joist (RSJ),or double-T ,is a beam with an I- or H-shaped cross-section. The horizontal elements of the "I" are known as flanges, while the vertical element is termed the "web". I-beams are usually made of structural steel and are used in construction. The method of producing an I-beam, as rolled from a single piece of steel, was patented by Alphonse Halbou of the company forges de la Providence in 1849. There are two standard I- beam forms: Rolled I-beam, formed by hot rolling, cold rolling or Extrusion (depending on material).

A. Aim

To carry out experimental analysis of trapezoidally corrugated web steel beam for its stress and deflection.

B. Objectives

- To carry out stress analysis of I-section beam and trapezoidal corrugated web beam using suitable FEA software such as ANSYS.
- To carry out experimental stress and deflection analysis of trapezoidal corrugated web beam with comparison to I-section beam.
- To validate the results obtained by experimental testing and ANSYS.

II. METHODOLOGY

1) The design of Trapezoidal corrugated web beam and selection of standard I-section beam as per BIS (808:1989).
2) To build up a 3-D solid model of trapezoidal corrugated web beam and I-section beam as per BIS (808:1989) by using suitable modeling software such as CATIA.
3) To perform stress analysis of trapezoidal corrugated web beam and I-section beam as per BIS (808:1989) by using FEA software, such as ANSYS.
4) Redesign and fabrication of trapezoidal corrugated web beam and standard I-section beam to get deformation/stress induced in critical location will be carried out.
5) By using suitable Experimental set up Stress analysis of trapezoidal corrugated web beam and I-section beam as per BIS (808:1989) will be carried out.
6) To compare and validate the result obtained by using software analysis with results obtained by experimental Analysis for strength for trapezoidal corrugated web beam and I-section beam as per BIS (808:1989).

A. ANSYS

The default mesh controls that the ANSYS program uses may produce a mesh that is adequate for the model you are analysing. In this case, you will not need to specify any mesh controls. However, if you do use mesh controls, you must set them before meshing your solid model. Mesh controls allow you to establish such factors as the element

shape, mid side node placement, and element size to be used in meshing the solid model. This step is one of the most important of your entire analysis, for the decisions you make at this stage in your model development will profoundly affect the accuracy and economy of your analysis. The ANSYS Mesh Tool (Main Menu> Pre-processor> Meshing> Mesh Tool) provides a convenient path to many of the most common mesh controls, as well as to the most frequently performed meshing operations.

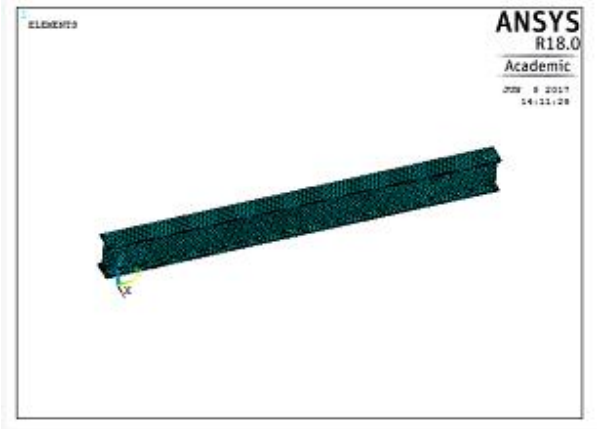


Fig. 1 Mesh Model of I-section beam

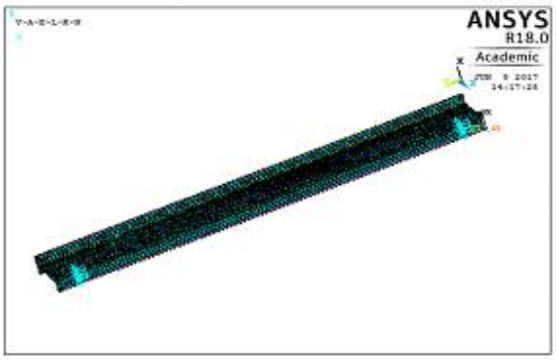


Fig. 2 Boundary condition Model

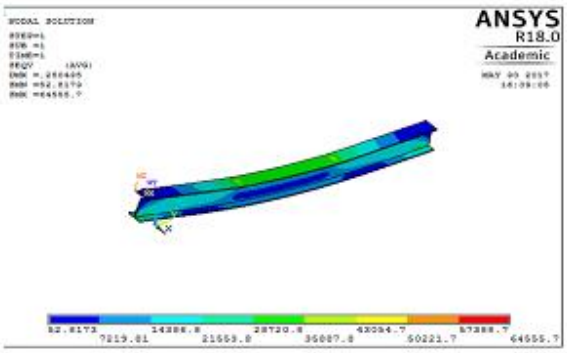


Fig 3 Von-misses stress at 10KN

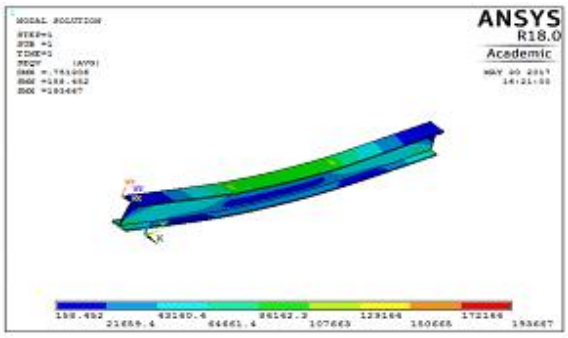
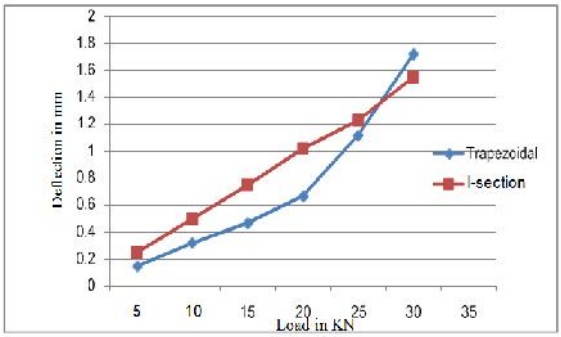


Fig 4 Von-misses stress at 15 KN

III. RESULTS AND DISCUSSION

A. Load and deflection in ANSYS

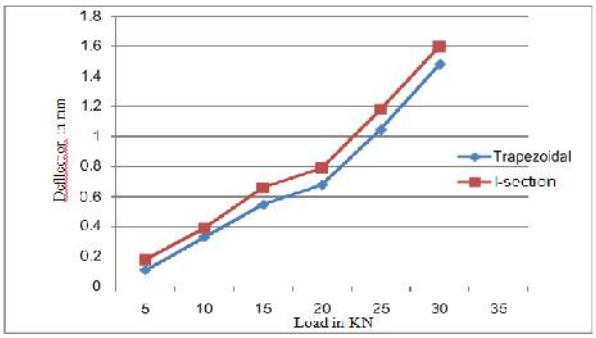
Sr. No.	Load	I-section beam deflection in mm	Trapezoidal beam deflection in mm for 37^{U} corrugation	Difference in mm
1	5	0.25	0.15	0.1
2	10	0.5	0.32	0.18
3	15	0.75	0.47	0.28
4	20	1.02	0.67	0.35
5	25	1.23	1.12	0.11
6	30	1.55	1.72	0.17



The deflection observed in the I-section beam is 15% more than the Trapezoidal corrugated web in given loading condition in experimental results

B. Comparison of Deflection by using Experimental results

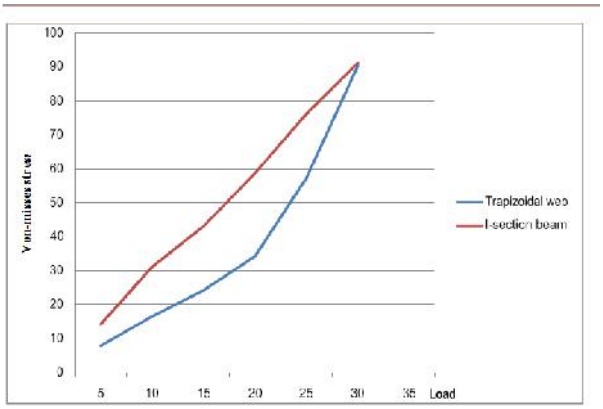
Sr. No.	Load	I-section beam deflection in mm	Trapezoidal beam deflection in mm for 37° corrugation	Difference in mm
1	5	0.18	0.11	0.07
2	10	0.39	0.33	0.06
3	15	0.66	0.55	0.11
4	20	0.79	0.68	0.09
5	25	1.18	1.05	0.13
6	30	1.6	1.48	0.12



By using theory of deflection of beam the deflection is directly proportional to square of length beam and inversely proportional to moment of Inertia. The length of Trapezoidal web increases which bears most of compressive stress which resists the deflection of beam.

C. Comparison of load v/s von-misses stress

Sr. No.	Load	I-section beamVon-misses stress in Web in Mpa	Trapezoidal beam Von-misses stress in Web in Mpa for 37° corrugation	Difference in Von-misses stress in Web in Mpa
1	5	14.38	8.11	6.27
2	10	31.23	16.7	14.53
3	15	43.16	24.33	18.83
4	20	58.74	34.35	24.39
5	25	76.2	57.26	18.94
6	30	91.11	90.31	0.8



IV. CONCLUSION

- Experimental results of loading and deflection are with some variation matching with the FEM hence we can replace I-section beam with Trapezoidal corrugated web beam.
- Stress induced in the I-section beam are 15% to 20% more than the Trapezoidal corrugated web beam at the same loading condition with references to the ANSYS software. The shear stress depends upon the area of contact between the flange and web, for trapezoidal beam more area of contact is present as compare to I-section beam.
- Experimental maximum deflection for I-section beam and Trapezoidal corrugated web beam matches with the ANSYS results with 5% variation for trapezoidal beam, 2% variation for I-section beam, difference which is in, acceptable range. Difference in reading is present may be due to sliding in the lead screw of UTM or environmental condition which may be negligible.
- By using theory of deflection of beam the deflection is directly proportional to square of length beam and inversely proportional to moment of Inertia. The length of Trapezoidal web increases which bears most of compressive stress which resists the deflection of beam.
- The deflection observed in the I-section beam is 18% more than the Trapezoidal corrugated web in given loading condition by using ANSYS results and 15% more in experimental results.
- Therefore we can replace the conventional I-section beam to Trapezoidally corrugated web beam

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