Study of Beam with Plain Web, Trapezoidal Corrugated Web, and Triangular Corrugated Web

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Abstract – Corrugated beam is a developed beam with thin wall corrugated web. The profile of the web maintains the stability of beam. Mostly there are diverse types of corrugated web shape which we will discuss in this paper. This paper contains study on expert's research paper on behaviour of steel beam with plain web, trapezoidal corrugated web, triangular corrugated web. The aim of this review paper was study of engineering properties such as stress, strain, lateral torsion, flexure of plain web, trapezoidal corrugated, triangular corrugated web. The load sustaining capability and manners of failure of beams were studied from previous research. And also comparison between the series of web is carried out to determine which is suitable and sustainable for construction.

Keywords: corrugated beam, advantages, disadvantages, load carrying capability, failure mode

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1. INTRODUCTION

Corrugated steel beam were freshly used to change the stiffened steel beam of plate/box girders the flexural strength of a steel girder with a corrugated beam plate was providing by the flanges with almost no influence from the beam and with no interface. In many instances, it is necessary to support heavy vertical loads over long spans resulting large bending moments and shear forces. The -section beams are commonly used in structural steel works.

1.1 I-Section

An I-beam, also known as H-beam. I-beams are widely used in the construction industry and are available in a variety of standard sizes.

Fig. No 1:-I-section

I-beams may be used both on their own, or acting compositely with another material, typically concrete. A beam under bending sees high stresses along the axial fibres that are farthest from the neutral axis. To prevent failure, most of the material in the beam must be located in these regions. Comparatively little material is needed in the area close to the neutral axis. This observation is the basis of the I-beam cross-section; the neutral axis runs along the center of the web which can be relatively thin and most of the material can be concentrated in the flanges.

1.2 Trapezoidal Corrugated Web

Today the corrugation process is carried out using the process of roll forming. This modern process is highly automated to achieve high productivity and low costs associated with labour. The corrugations are described in terms of pitch (the distance between two crests) and depth (the height from the top of a crest to the bottom of a trough). It is important for the pitch and depth to be quite uniform, in order for the web to be easily stackable for transport, and to overlap neatly when joining two sheets.

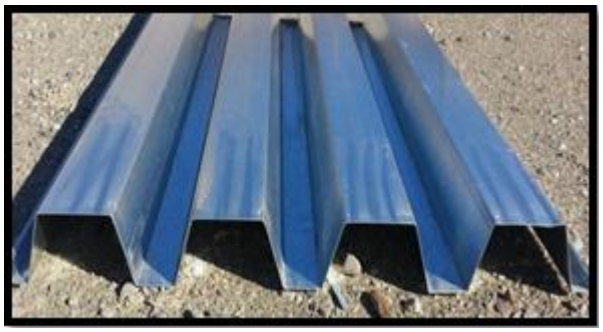

Fig. No 2:-Trapezoidal Corrugated Web

The corrugations increase the bending strength of the sheet in the direction perpendicular to the corrugations, but not parallel to them.

1.3 Triangular Corrugated Web

The term corrugated, describing a series of parallel ridges and furrows.

Fig. No 3:-Triangular Corrugated Web

2. LITERATURE

The task manages review of experimentation and examination of trapezoidal corrugated beam and I-section. So numerous papers are available which depicts the impediments of utilizing I-section, advantages of corrugated beam.

Raiza Ashrawi[1]:- The load sustaining capability of the beam is investigated under different cases by doing a non-linear static analysis using commercial (FES)finite element software.

Amarsingh Jamdar[2]:-The project pacts with the how proficient corrugated beam than that of I-section beam. I-section beams are mostly consumed in automobile & also in construction industry such as slender structure and bridges, etc., these solicitations can proficiently replace by using corrugation of web beam. By using trapezoidal corrugation of web beam, by falling the web thickness. Bending letdown by laterals torsional buckling, Bending failure by local buckling, and Shear letdown of beam is improved and also weight of the beam reduces which is actually very beneficial for number of uses of beam. Stress exploration of Trapezoidal shaped corrugated beam and I-section beam is performed to find out the stress/strain including at serious location. By using FFT analyzer modal exploration of Trapezoidal shaped corrugated beam and I-section beam is performed.

De'nan F.[3]:-The new steel segment known as triangular web (Triangular web plate)was contemplated by past specialist to steel I-section for better resistance on bending performance. Keeping in mind the end goal to decrease the weight of Triangular web plate steel section for monetary moto of getting on the steel web section is presented. This paper depicted the examination on the bending behaviour in major axis and mostly concentrate on the result of shape on the Triangular web serving dish consequence of the web width on triangular web profile with opening steel section and consequence of various type of opening shape on Triangular web plate with opening. From (FES) it can be observed that the deflection on the Triangular web plate steel section is a smaller amount than the Triangular web plate.

Sumathi & M. Chandra Babu [4]:- This paper study behaviour of (CSF) cold formed steel beam with plain web, triangular corrugated web and trapezoidal corrugated web. This study involves in examination of hypothetical and experimental investigations of sample in series. Overall three samples were verified with length of 1.2m. All cases are tested under two point loading with upheld condition (simply supported condition). The hypothetical data are calculated using IS 801-1975. The load sustaining (carrying) capability and manners of miscarriage of beams were studied. On the basis of test beam with trapezoidal corrugated web results maximum load carrying capability compared with the I-section.

R. Divahar[5]:-The corrugated steel plate is a usually used structural element in many arenas of claim because of its number of complimentary properties. To rise the shear ability of web of large steel plate, the web having different designs such as tapered web, haunches, and corrugations of various outlines are used. This paper shows the outcomes of the investigational study on load sustaining (carrying) capability of cold-formed steel section with trapezoid web. The load sustaining (carrying) capability of the cold form steel beam with plain web is observed with the load carrying ability of beam with trapezoidal corrugated web having 30^0 and 45^0angle of corrugations. From the study, it is detected that the (CFS) beam having trapezoidal corrugated web with 30^0 corrugation has advanced load sustaining (carrying) capability as compared with the beams having plain web and 45^0 corrugated web.

Fatimah Denan[6]:- Experimental and mathematical deep study on torsional buckling (lateral)performance of steel section with trapezoid web is shown in the paper. Evaluation is made with conservative beams with flat web. It is concluded

that steel beam with trapezoidal corrugated web section have greater opposition to lateral torsional buckling as compared to the section having flat web. The observation leads to conclude that corrugation thickness effect the resistance to lateral torsional buckling.

T. Manju[7] :- A cold-formed steel (CFS) section is more delicate to local buckling than conventional hot rolled sections. It is characterized by light weight, high strength, inexpensive, wide diversity, smooth surface and precise size. The web plates are utilised as stiffened plates that are able to sustain both high shear strength and high moment in different sections or in the same section. One of the approaches of decreasing the web thickness is the implementation of corrugated webs. The fore most goal of this paper is to discover the maximum load sustaining (carrying) capability of the sample and possible manners of failure under two(2) point load condition at the corrugated web in (CFS) with varying thickness of the web.

3. STUDY OF TEST

3.1 Load carrying capacity and failure modes [1]

Three beams were fabricated; dimensions (mm) are as shown in the table.

Sr. No	Ft	Fw	Wt.	Wd	Angle
Beam1	2	120	2	150	0^0
Beam 2	2	120	2	150	45^0
Beam 3	2	120	2	150	45^0

Table No.1:- Dimension of sample

Ft:-Thickness of flange Ft

Fw:-Width of flange Fw

Wt:-Thickness of web Wt

Wd:-Depth of web Wd

Fig. No 4 beam 1

Fig. No 5 beam2

Fig. No 6 beam3

The specimens are tested in loading frames under two point loading at l/3 distances. The specimens are simply supported hinged-hinged over the loading frame. The load is transferred through the load cells which measure the deflection and load

Fig. No.7 Experimental setup

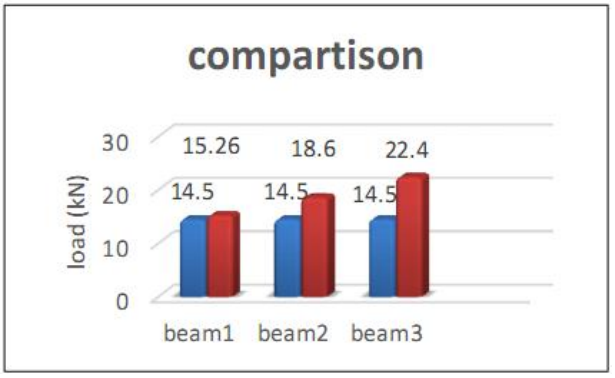

Fig No.8 theoretical

And experimental results.

The modes of failure of the beam is as follows

Table no.2:-Failure of the beam

Sr. No	Type of beam	Failure mode beam
1	Beam with normal web	Torsional buckling
2	Beam with trapezoidal corrugated web	Torsional buckling + flexural buckling
3	Beam with triangular web	Local buckling +flexural buckling

3.2 Lateral torsional buckling test [5]

A linear buckling analysis is a useful technique that can be applied to relatively stiff structures to estimate the maximum load that can be supported prior to structural instability or collapse. The assumptions used in linear buckling analysis are that the linear stiffness matrix does not change prior to buckling and that the stress stiffness matrix is simply a multiple of its initial value. Lateral torsional buckling tests were conducted on beams, two specimens i.e.

Sections with trapezoid and flat web. The tests were stopped when buckling occurred, as determined in the graph of moment versus lateral displacement. In the test, all beam specimens were found to be still in elastic state after the tests. Relationship between bending moment and lateral deflection were plotted. In general, the lateral deflection increases linearly with the vertical bending moment. Then, the increase becomes non-linear, followed by a stage when the deflection increase monotonically. Sample were tested undertow type of support condition.

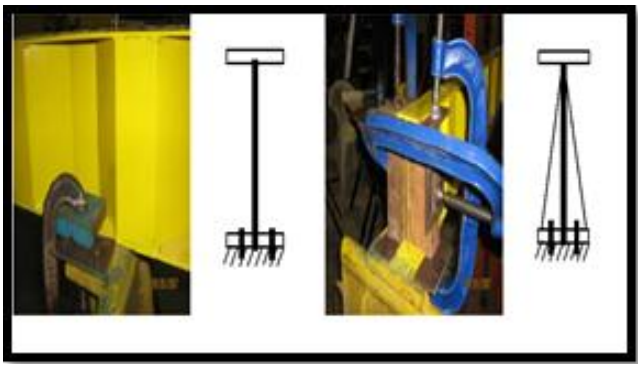

Fig no:-9 Fixed at flange only and Fixed at flange and web

Span of beam (mm	Beam type	Fixed at flange only (Mb)	Fixed at flange and web (Mb)
5000	Trapezoidal	9.00	10.3
	Flat web	7.05	8.55
4000	Trapezoidal	9.65	11.20
	Flat web	8.30	8.65

Table No:-3 Test results of Mb for beams with normal flat web and beams with trapezoid web profile.

4. CONCLUSION

After studying the literature review, it is observed that

1. The triangular corrugated beam has more load carrying capability as compared with plane web beam as and also greater than the trapezoidal web beam.

2. The corrugation reduces the torsional buckling failure to local buckling

3. Specimen with corrugated web, local buckling is predominate, failure occurs under the load.

4. Due the corrugation there is no failure in shear zone.

5. Steel beam with trapezoidal corrugated web section have higher resistance to lateral torsional buckling. Compared to that of section with flat web 6.Higher value of moment of inertia about minor axis for the section with thicker corrugation contributes to the higher resistance to lateral torsional buckling.

5. REFFERENCE

A. Sumathi and M. Chandra Babu (2017). "Flexural Behavior Of Cold Formed Steel I-Section Beam With Corrugated Web".

Amarsingh Jamdar (2016) "Experimental Analysis of Trapezoidal Corrugated Web Beam for Its Strength and Mode"

De'nan F. Finite Element (2015). "Analysis of the Bending Behaviour for Triangular Web Profile with Opening Steel Section"

Fatimah Denan (2010). "The Study of Lateral Torsional Buckling Behaviour Of Beam With Trapezoid Web Steel Section By Experimental And Finite Element Analysis"

Raiza Ashrawi (2016). "International Research Journal of Engineering and Technology"

T. Manju (2016). "Study on Behaviour of Corrugated Webs in Cold Formed Steel Sections with Varying Thickness"

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