BEHAVIOUR OF TRIANGULAR HOLLOW FLANGE COLD-FORMED STEEL BEAM

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Abstract - *The cold-formed steels are usually used in day by day in residential, commercial and industrial buildings in this world. This paper explains a testing and numerical analysis on the behavior of triangular hollow flange cold formed steel beam. The dimension of beam is 100x150x1.6mm and length is 1m. The numerical analysis is using finite element method software by ABAQUS software. The loading method is two points loading is apply to the specimens simply supported condition. This unique section testing two triangular flanges and a slender web is susceptible to a lateral distortional buckling mode of failure involving lateral deflection, twist, and cross-section change due to web distortion.*

Key Words: ABAQUS, *cold-formed steel, two point load, Triangular hollow flanges.*

1. INTRODUCTION

There are divided into two primary structural steel member types are used: hot-rolled steel members and cold-formed steel members. The hot-rolled steel members are formed at elevated temperatures and the cold-formed steel members are formed at room temperatures in the factories. The structural behavior of these light gauge high strength steel members is characterized by various buckling modes. Nowadays steel markets used the open steel sections are C, Z, hat sections. That section is simple forming procedure and easy connections. This study is aimed at developing an innovative cold-formed beam with Triangular hollow flanges and a slim web formed using fitful weld Connection to improve the flexural capacity at lowest manufacturing cost. The new cold-formed steel beam introduced in this paper is referred to as triangular Hollow Flange Beam (THFB) to differentiate from the conventional hollow flange beams (HFB) containing triangular flanges. This study is involves investigations of the flexural behavior of triangular hollow flange beams (THFB).

2. MATERIAL TEST

Tensile tests are performs for several reasons. The results of tensile tests are normally used in selecting materials for engineering applications. Tensile properties frequently are included in material specifications to ensure quality of the steel. Tensile properties are measured during development of new materials and processes used to predict the behavior of a material. These measures of strength are used, with appropriate caution in engineering design Low ductility in a tensile test often is accompanied by low resistance to fracture under other forms of loading.

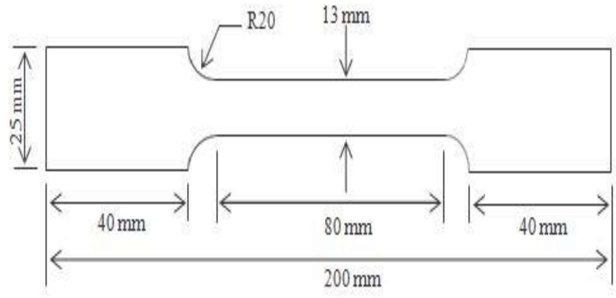

Fig -1: Tensile test dimension of specimen

- ✓ Stress-strain curves, including discussions of elastic versus plastic deformation, yield points, and ductility.
- ✓ True stress and strain.
- ✓ Test methodology and data analysis.

It has enlarged ends or shoulders for gripping shown in fig. The gage section is the important part of the specimen. The cross-sectional area of the gage section is reduced while testing is deformed in remaining portion and the failure is occur that region. Then measure the final elongation of the specimen by vernier caliper. Finally, the test was conducted by universal testing machine (UTM).

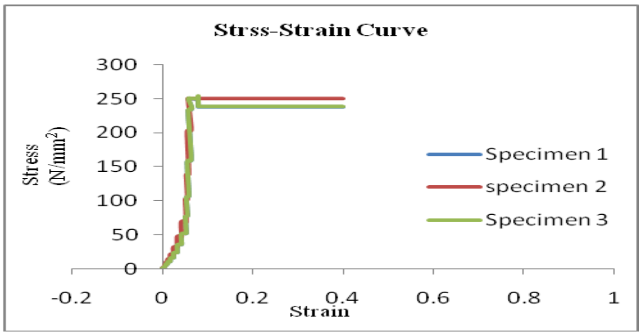

Chart -1: Stress strain curve

3. ABAQUS ANALYSE

Finite element method is a numerical procedure for analyzing a wide range of steel elements. It is too complicated to be solved satisfactorily by classical analytical methods. Finite element method models create a structure as an assemblage of small parts (elements). Each element is creating a simple geometry and therefore is much easier to analyze than the actual structure. In the present work, finite element analysis of super-plastic process was carried-out using ABAQUS6.11 software package. The ABAQUS is general purposes of which provides quality engineering tools to help all of the design and analysis needs. ABAQUS/CAE is provide a simple, consistent interface for creating, submitting, monitoring, and evaluating results from ABAQUS. ABAQUS/CAE is divided into modules, where each module defines a logical aspect of the modeling process; for example, defining the geometry, defining material properties, and generating a mesh. Then submit the model and get result from the ABAQUS software. The solver performs the analysis, sends information to ABAQUS/CAE to allow you to monitor the progress of the job, and generates an output database. Finally, you use the Visualization module of ABAQUS/CAE to read the output data base and view the results of your analysis and generating the graphs in this module. The following figures are describing the ABAQUS analyzing and results.

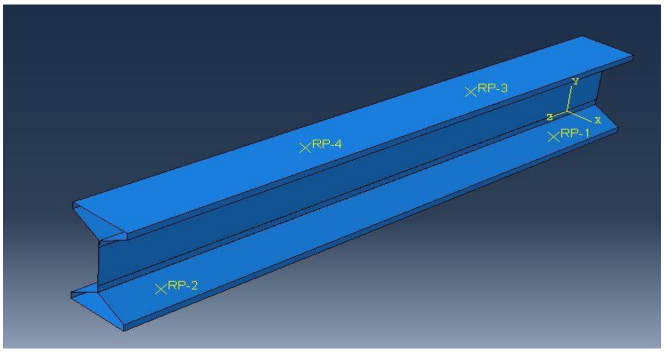

Fig -2: Geometry of the specimen

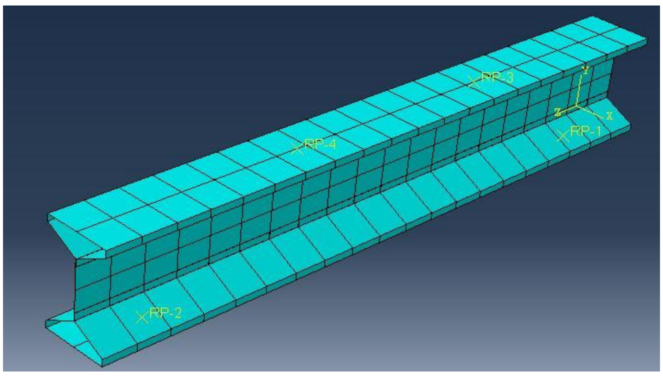

Fig -3: Creating mess of the specimen

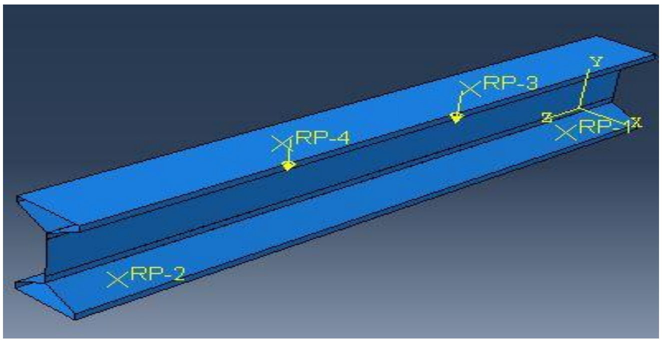

Fig -4: Loading and BC process in ABAQUS

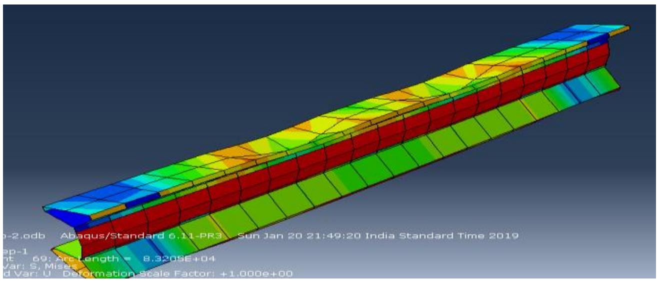

Fig -5: Deformation of the specimen

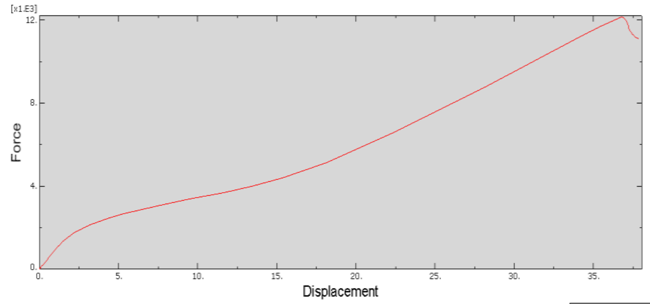

Chart -2: Force vs. displacement graph of ABAQUS

4. RESULTS AND DISCUSSION

This mechanical testing method measures the behavior of materials subjected to simple bending loads and simple boundary conditions. The values calculated from the slope of the bending load vs. deflection curve like tensile modulus, fineness modulus. Flexural testing involves the bending of a material, then applying the force, to determine the relationship between bending stress and deflection. The two point load is given and the results are provides the values for the modulus of elasticity in bending, flexural stress in bending, flexural strain in bending and the flexural stress-strain response of the material. The following figures are describing the laboratory testing and results.

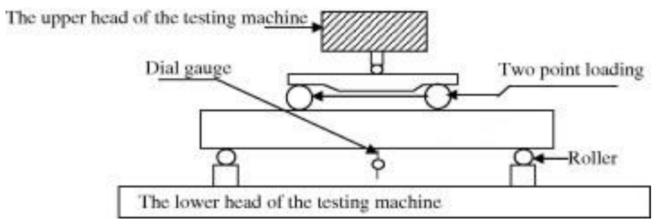

Fig -6: Loading pattern of the specimen

Fig -7: Experimental setup of the specimen

Fig -8: Bending during testing

Fig -9: Spcimen after testing

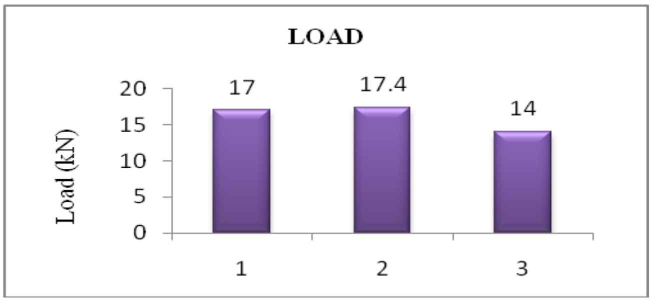

Chart -3: loading capacity of the specimens

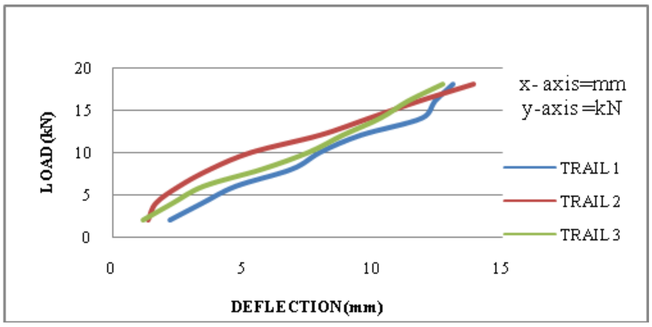

Chart -4: Deflection graph of specimen

5. CONCLUSION

This research involved a numerical and experimental investigation aimed at widening the scope of finite element analysis to investigate the buckling and ultimate failure behaviors of THFBs subjected to flexural actions. Accurate finite element models simulating the physical conditions of both lateral buckling and section moment capacity tests were developed and validated by comparing the failure loads, the load-deflection curves and the failure modes with corresponding results from the full scale tests. Apart from these experimental finite element models, ideal finite element models simulating ideal simply supported boundary conditions and a uniform moment loading were also developed for use in a detailed parametric study. Both finite element models included all significant effects that may influence the ultimate moment capacity of THFBs, including material local buckling, lateral distortional buckling. Finally we can use this section to roof beams, purlins.

REFERENCES

[1] Anh Tuan Tran, "Lateral-torsional buckling resistance of cold-formed high strength steel rectangular hollow beams," 2016, ISBN 978-1-138-02927-9.

[2] M. Narayana Rao, Ph.D., "Investigation on cold formed steel rectangular hollow flanged 'z' beam section," 2014, Volume 2, Issue 10.

[3] P. Mangala Gowri, S.S. Manu, "Analytical study on flexural behavior of cold formed hollow flanged z – sections," 2018, Volume 7, Special Issue 5.

[4] Poologanathan Keerthan, Mahen Mahendran and Edward Steau, "Experimental studies on web crippling behavior of hollow flange channel beams under two flange load cases," Thin-Walled Structures.

[5] Tim Wilkinson & Gregory J. Hancock, "Compact or Class 1 Limit for Rectangular Hollow Sections in Bending," 1998, pp 409-416.

[6] V. Sweetlin Rose ,D.Annlin Jebitha , D. Ramalingam, "Shear behavior of delta hollow flange beam with and without web stiffener".

[7] P. Vijayaragunath, S. Vimal, T. Vinitha, T. V. Prathib, S. Sureshbabu, "Experimental study on buckling behavior of cold-formed steel sections," 2018, Volume: 05 Issue: 04.

[8] L. Gardner, N. Saari and F. Wang, "comparative experimental study of hot-rolled and cold-formed rectangular hollow sections," 2010, 48(7), 495-507.

[9] D. S. Yerudkar, G. R. Vesmawala, "Strength and behavior of cold formed steel stiffened sections under interaction of local, distortional and lateral torsional buckling a review," 2015, Vol. 3, Issue 1, pp: (234-250).

[10] M. Karunakaran, Helen Santhi, "FE analysis of hollow flanged cold-formed steel 'z' beams," 2013.