International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 08 | Aug 2022 www.irjet.net p-ISSN: 2395-0072

NUMERICAL EVALUATION OF DIFFERENT TYPES OF BRACING SYSTEMS USING ANSYS SOFTWARE BY CHANGING THE MATERIAL PROPERTIES

Anjal Krishna T V[1], Krishna M M [2]

[1]M.Tech Student, Structural Engineering, Universal Engineering College, Thrissur, Kerala
[2]Assistant Professor, Civil Department, Universal Engineering College, Thrissur, Kerala

---***---

Abstract – *The steel industry is growing rapidly in almost all parts of the world. When global warming is a threat, use of steel structures is not only economical but also environmentally friendly. Here, the term "affordable" refers to time and cost. Being the most important aspect of time, steel structures are constructed in a very short time. In the seismic design of industrial buildings, the properties of horizontal ground motion are considered and upright ground movement is neglected. The main aim of the project is to compare the energy absorption as well as the energy transfer mechanism of different types of bracing systems such as K bracing and O grid bracing. Also, several materials are used in the analysis. The structure and shape of O Grid braces, can be used in any part of the structure without removing architectural space and architectural form. O bracing system has good ductility and stiffness. Thus, this O bracing can be effectively used in engineering structures in seismic prone areas which have the ability to withstand lateral loads.*

***Keywords:* Forward, Bracing, energy absorption bracing**

1. INTRODUCTION

1.1 General Background

A modular framework consists of larger interlocking steels. This system has or does not have vertical components, and since the primary load components are members, they also have lateral support. Ties are commonly used to steady building structure against lateral loading. Main function of the struts is to become stable the structure and prevent its collapse. Various fastening systems are currently in use. Dependent on the shape, the braces are diagonal bracings, X-shaped, K-shaped-shaped, elliptical and O-shaped. In this paper different types of bracing systems are numerically analysed.

2. NUMERICAL INVESTIGATION USING ANSYS WORKBENCH 2021 R2

2.1 Numerical Investigation Of K Bracing Using Ansys Workbench 2021 R2

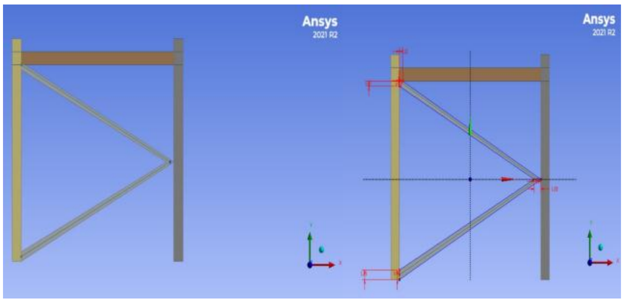

Fig -1: Geometry of K bracing

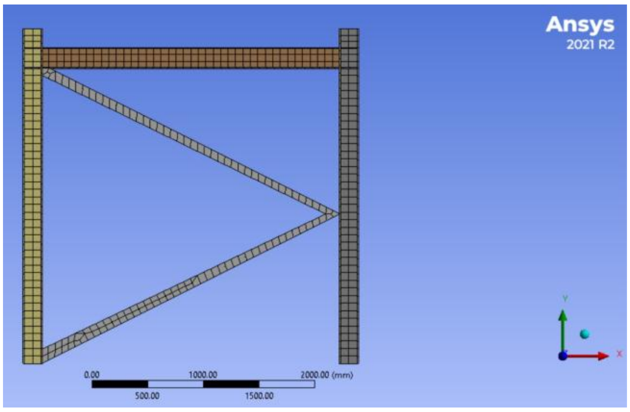

Fig -2: Mesh generated in K bracing

In the present model, the defaulting mesh size is adopted. The size of the element is 100 mm. This mesh structure consists of 1998 numerical nodes, 1151 numerical elements are present.

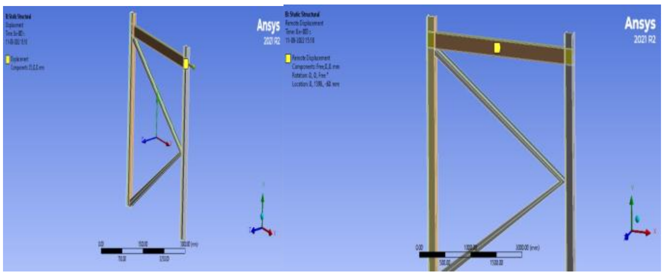

Fig -3: Boundary conditions provided in K bracing

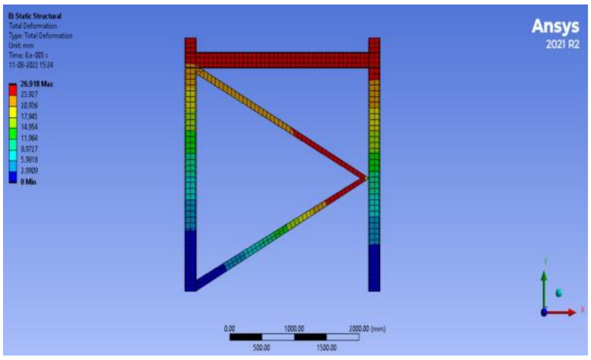

Fig -4: Total deformation obtained in K bracing

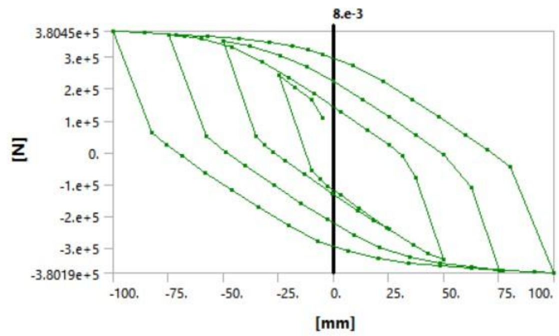

Chart-1: Load–displacement hysteresis curves of K Bracing

2.2 Numerical Investigation O Bracing Using Ansys Workbench 2021 R2

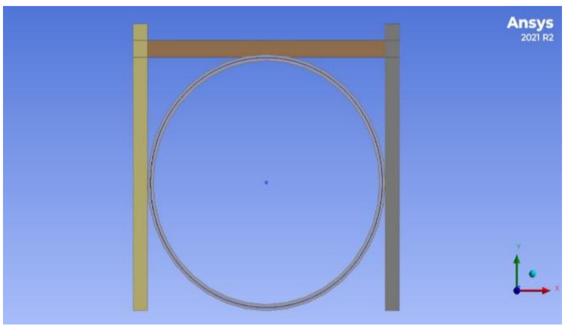

Fig -5: Geometry of O bracing

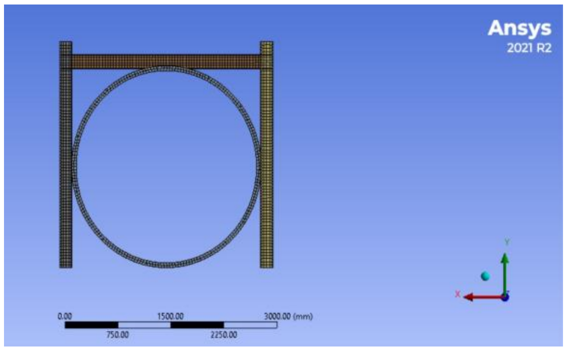

Fig -6: Mesh generated in O bracing

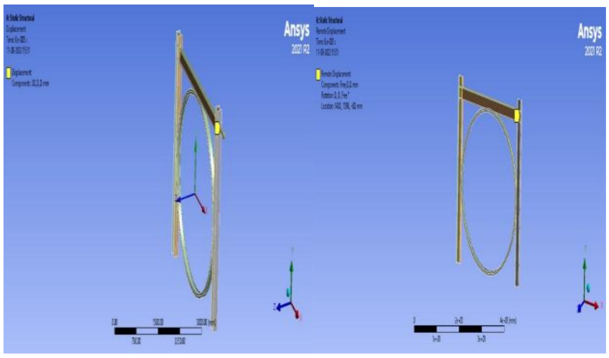

Fig -7: Boundary conditions provided in O bracing

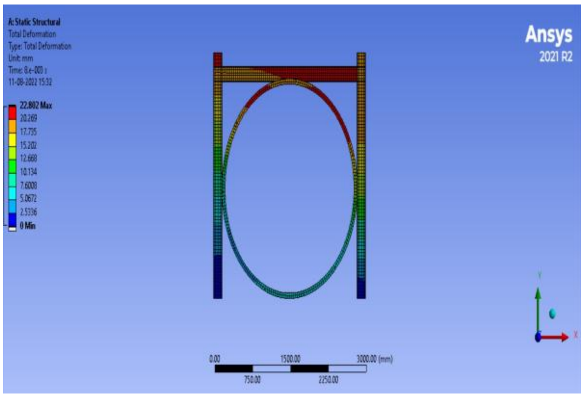

Fig -8: Total deformation in O bracing

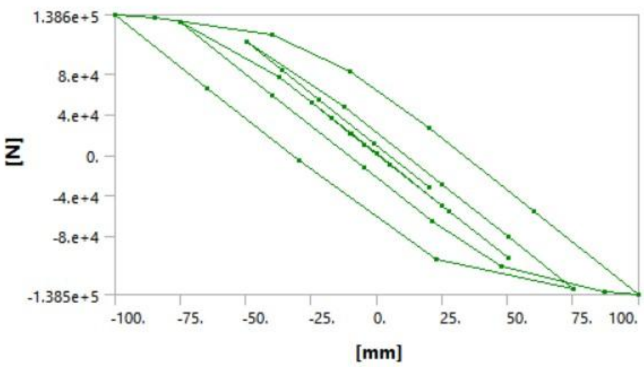

Chart-2: Load–displacement hysteresis curves of O Bracing

3. BRACING WITH DIFFERENT MATERIALS

By using different materials, the yield strength of bracings are changed to 199 MPa.

3.1 Performance Of K Bracing With Different Material Properties

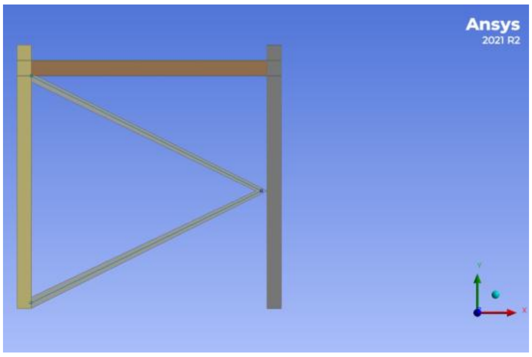

Fig -9: Geometry of K bracing using different materials

There are 1927 nodes and 1236 number of elements.

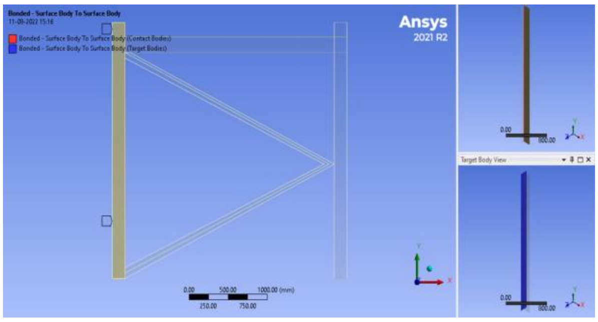

Fig -10: Connections provided in K bracing using different materials

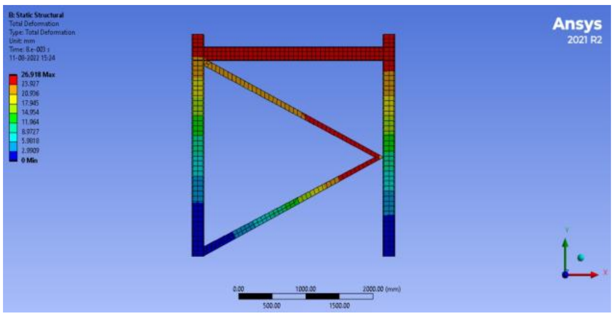

Fig -11: Total deformations K bracing using different materials

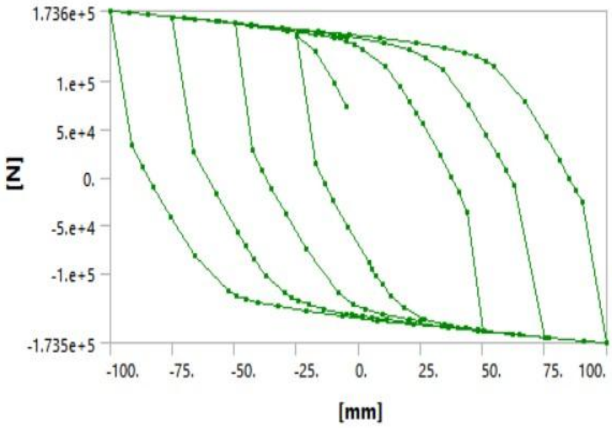

Chart-3: Load–displacement hysteresis curves of K Bracing using different materials

3.2 Performance Of O Bracing With Different Material Properties

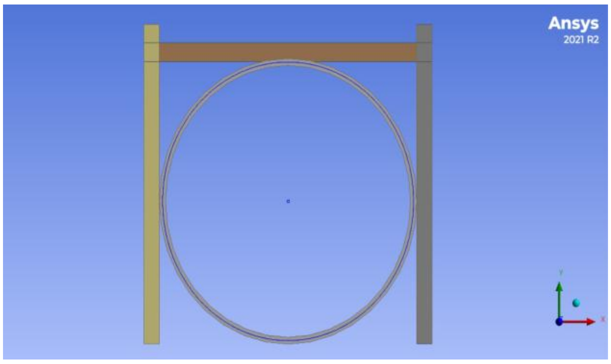

Fig -12: Geometry of O bracing using different materials

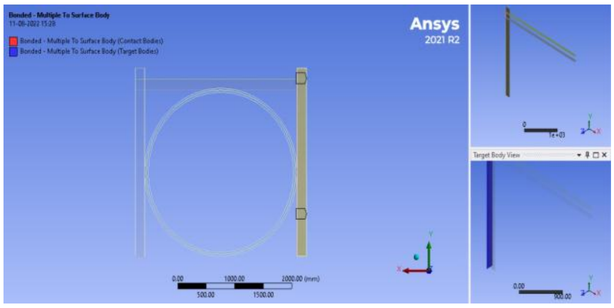

Fig -13: Connections provided in O bracing using different materials

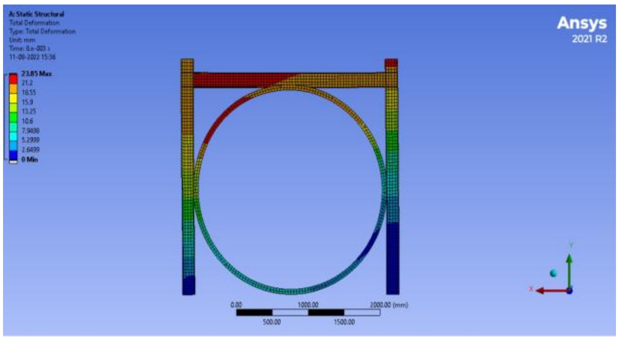

Fig -14: Total deformations O bracing using different materials

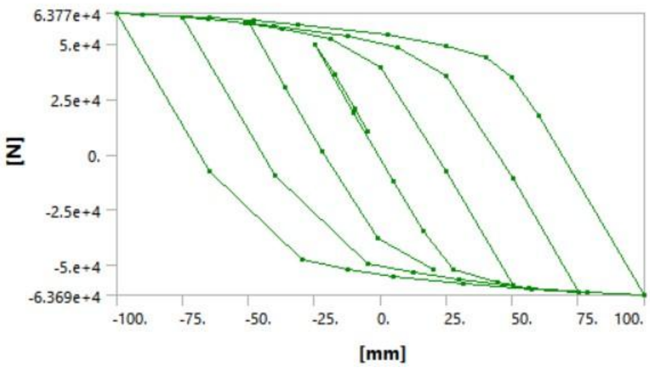

Chart-4: Load–displacement hysteresis curves of O Bracing using different materials

4. CONCLUSIONS

This study was mainly used to compare different types of bracing with different cross section geometries. The forward and O systems, and they have adequate load bearings and can absorb great energy with their axial and flexural behavior. Unlike other braces, the structure and shape of O Grid braces, can be used in any part of the structure without removing architectural space and architectural form. O bracing system has good ductility and stiffness. Thus this O bracing can be effectively used in engineering structures in seismic prone areas which have the ability to withstand lateral loads.

ACKNOWLEDGEMENT

I wish to thank the Management, Principal and Head of Civil Engineering Department of Universal Engineering College, Thrissur, affiliated by APJ Abdul Kalam Technological University for their support. This paper is based on the work carried out by me (Anjal Krishna T V), as part of my PG course, under the guidance of Krishna M M (Assistant professor, Civil Department, Universal Engineering College, Thrissur, Kerala). I express my gratitude towards her for valuable guidance.

REFERENCES

[1] Newmark NM, Hall WJ. 1973. "Seismic design criteria for nuclear reactor facilities", Building Practices for Disaster Mitigation, National Bureau of Standard, U.S. Report No. 46.

[2] Lai SSP, Biggs JM. Inelastic response spectra for aseismic building design. J Struct Div 1980;106:1295–310.

[3] Miranda E, Bertero VV. Evaluation of strength reduction factors for earthquakeresistant design. Earthquake Spectra 1994;10:357–79.

[4] Schafer BW, Ayhan D, Jeng J, Liu P, Padilla-Llano D, Peterman KD, et al. Seismic response and engineering of cold-formed steel framed buildings. Structures 2016;8:197–212.

[5] FEMA P695, 2009. "Quantification of building seismic performance factors", Rep. FEMA P695, Federal Emergency Management Agency, Washington, D.C.

[6] Xian L, He Z, Ou X. Incorporation of collapse safety margin into direct earthquake loss estimate. Earthquakes Struct 2016;10:429–50.

[7] AlHamaydeh M, Abdullah S, Hamid A, Mustapha A. Seismic design factors for RC special moment-resisting frames in Dubai, UAE. Earthquake Eng Eng Vibr 2011;10:495–506.

[8] Zareian F, Krawinkler H. Structural system parameter selection based on collapse potential of buildings in earthquakes. J Struct Eng 2010;136:933–43.

[9] Haselton C, Liel A, Deierlein G, Dean B, Chou J. Seismic collapse safety of reinforced concrete buildings. I: Assessment of ductile moment frames. J Struct Eng 2011;137:481–91.

[10] Hsiao PC, Lehman DE, Roeder CW. Evaluation of the response modification coefficient and collapse potential of special concentrically braced frames. Earthquake Eng Struct Dyn 2013;42:1547–64.

[11] Farahi M, Mofid M. On the quantification of seismic performance factors of Chevron Knee Bracings, in steel structures. Eng Struct 2013;46:155–64.

[12] Comeau G, Velchev K, Rogers C. Development of seismic force modification factors for cold-formed steel strap braced walls. Can J Civ Eng 2010;37:236–49.

[13] Leng J, Schafer B, Buonopane S. 2013. "Modeling the seismic response of coldformed steel framed buildings: Model development for the CFS-NEES building", Annual Stability Conference, St. Louis, Missouri.

[14] Leng J, Schafer B, Buonopane S. Seismic computational analysis of CFS-NEES building. Proceedings of 21th International Specialty Conference on Cold-Formed Steel Structures-Recent Research and Developments in Cold-Formed Steel Design and Construction. 2012. p. 801–20.

[15] Gusella F, Orlando M, Spinelli P. Pinching in steel rack joints: Numerical modelling. Int J Steel Struct 2019;19:131–46.

[16] AS/NZS4600, 2005. "Cold-formed steel structures", Australian Building Codes Board.

[17] AISI. Standard for cold-formed steel framing - Lateral design. Washington, D.C.: American Iron and Steel Institute; 2007.

[18] Zeynalian M, Ronagh H, Hatami S. Seismic characteristics of K-braced cold-formed steel shear walls. J Constr Steel Res 2012;77:23–31.

[19] Building and Housing Research Center, 2005. "Iranian code of practice for the seismic-resistant design of buildings, standard no. 2800", 3rd ed., Tehran, Iran.

[20] Canadian Institute of Steel Construction. Handbook of Steel Construction. 9th ed. Toronto: Canada; 2006.