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Analysis and Performance of Ogrid Lateral Bracing System

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Abstract - *In steel structures, inorder to resist lateral forces like earthquake and wind pressure, bracings are provided. There are many conventional types of bracings used. In this paper a new bracing is proposed and studied through FEM (finite element method) numerical analysis. These proposed bracing systems are called OGrid. These are braced frames with circular braces connected to MRF (moment resisting frame) with welded connections. Various section geometries according to IS code for the brace is adopted and analysed in ANSYS workbench 16.1. From the analysis OGrid bracing with I- section showed good ductility and load carrying property compared with other types. So for further analysis OGrid with I-section geometry is selected. Thus this type of bracing can be used for rehabilitation and strengthening of structures, if this proposed system could pass the elementary requirements of structural bearing codes and its behavior shows good response such as better drift controlling and better energy dissipation.*

Key Words: **OGrid bracing, numerical analysis, moment resisting frame, circular braces, welded connection, drift.**

1. INTRODUCTION

1.1 General Background

An earthquake is the sudden movement of the ground that releases elastic energy stored in earth's crust and generates seismic waves. These elastic waves radiate outward from the source and vibrates the ground. The structures are susceptible to collapse or large lateral displacements due to earthquake ground motions and require special attention to limit this displacement. The development of lateral bracing systems and proper details of braces that began in 1960 and research's been continuing on them so far, has made it possible to achieve a system with suitable stiffness and ductility. The OGrid bracing system is braced frame with circular brace connected to moment resisting frame (MRF) with joint connections. The lateral stiffness of this system is provided by circular brace, and the circular brace yield in axial force and bending to dissipate energy during severe seismic excitation. At the lowest story, this brace must be connected to the foundation like the column. OGrid bracing system in tall buildings can be used with one circular brace in each two stories, that its advantage is decreasing the weight.

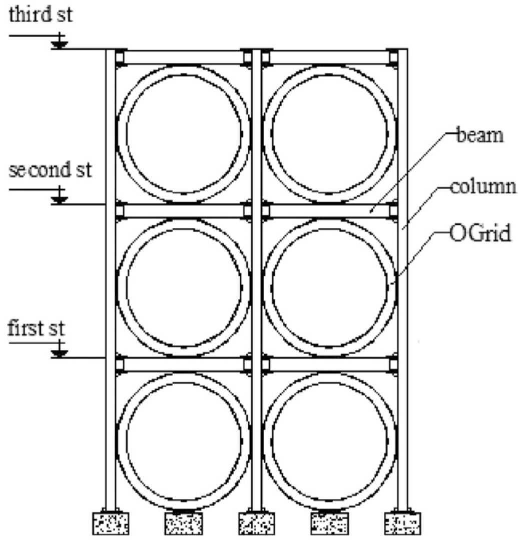

Fig -1: OGrid bracing system

2. NUMERICAL INVESTIGATION USING ANSYS WORKBENCH 16.1

2.1 Modelling

Numerical modelling of OGrid with different sectional geometries were done using ANSYS 16.1 WORKBENCH, a finite element software for mathematical modelling and analysis. The frame of OGrid-I bracing system is having span 2250mm and height 3000mm.The dimensions and properties of all the beams and columns of all the specimens are same. The size of different section geometries are shown in Table 1.

Table -1: Different Brace Section Geometries.

NAME OF MODEL	COLUMN SECTION	BEAM SECTION	BACE SECTION
Ogrid with I-section(O-I)	ISHB 150	ISMB 175	ISMB125
Ogrid with C-section(O-C)	ISHB 150	ISMB 175	ISMC 122
Ogrid with rectangular section(O-R)	ISHB 150	ISMB 175	122×61×4.5

The different section geometries are selected from IS code and the geometries are showed in Table 2.

Table -2: Section Property.

Section property	ISMB 125	ISHB 150	ISMB 175	ISMC 125
Depth	125	150	175	125
Width of flange	75	150	90	65
Thickness of flange	7.6	9	8.6	9.5
Thickness of web	4.4	8.4	5.5	5

The material property of OGrid bracing system is shown in table 3.Figure 2 shows modelled view of Ogrid with I-section geometry, Figure 3 shows modelled view of Ogrid wih C-section geometry and Figure 4 shows modelled view of Ogrid wih rectangular-section geometry.

Table -3: Material Properties of Steel.

Young's modulus of Steel (Gpa)	200
Poisson's ratio of Steel (v)	0.3
Density of Steel, (kg/m^3)	7850
Yield Stress (Mpa)	235

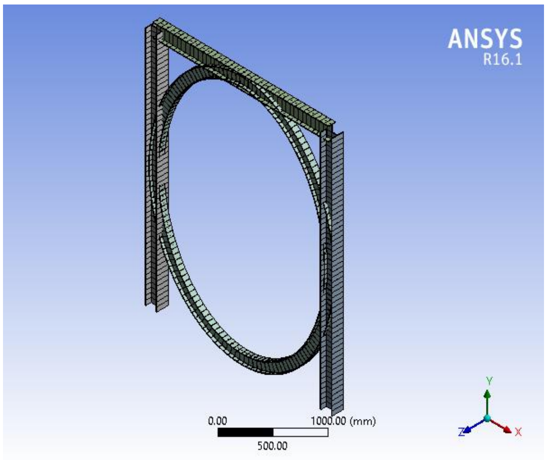

Fig -2: Modelled view of Ogrid with I-section geometry.

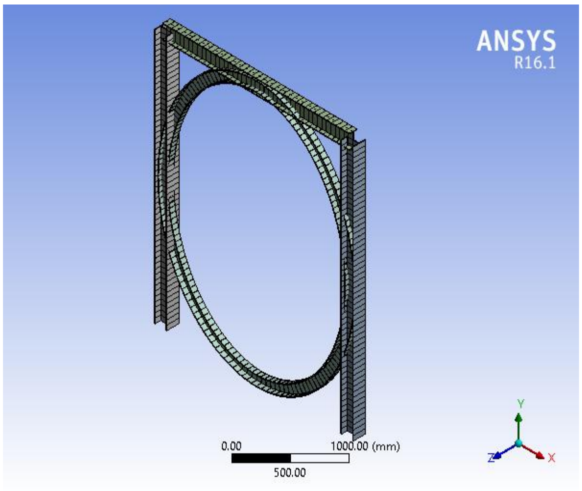

Fig -3: Modelled view of Steel with Ogrid wih C-section geometry.

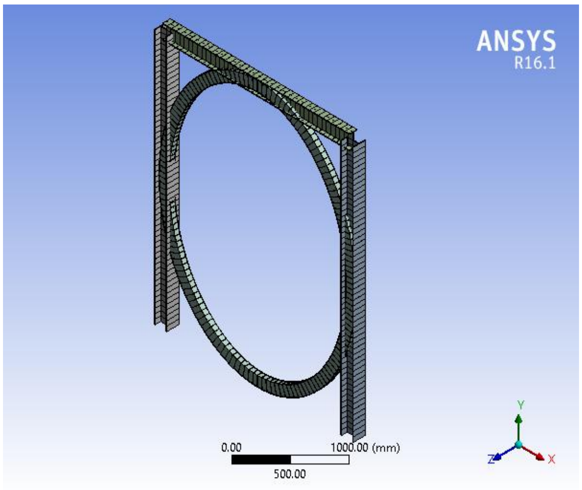

Fig -4: Modelled view of Ogrid wih rectangular-section geometry.

2.2 Loading and boundary conditions

Figure 5 shows the boundary conditions of OGrid with different bracing geometries. To stimulate the real conditions, OGrid bracing system is analysed with fixed support at two columns to restrain axial deformation whereas load is applied in one direction.

The bilinear isotropic hardening rule was used for the finite element analysis. Deformation of 100mm is applied in x-direction in each model for the analysis. For the three models sae boundary condition and same loading is applied for the easy comparison.

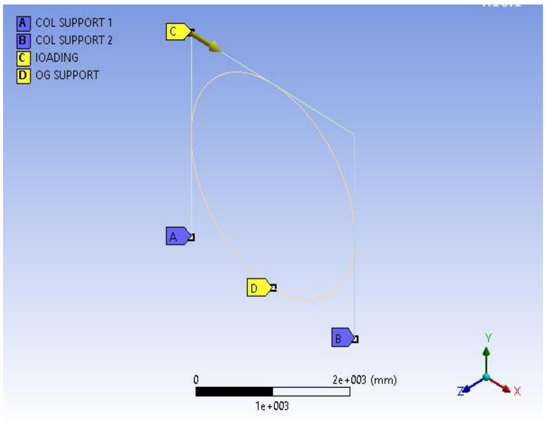

Fig -5: Loading and boundary condition of OGrid with different bracing geometries

3. RESULTS AND DISCUSSIONS

After the analysis of the structures, the results are noted. The load and corresponding displacements of OGrid with different bracing geometries is shown in table 4. The load vs deflection graph is given in chart 1.

Table -4: Maximum load and deflection.

SPECIFICATION	DEFLECTION (mm)	LOAD(kN)
O-I	62.926	86.106
O-C	59.422	74.09
O-R	60.579	84.527

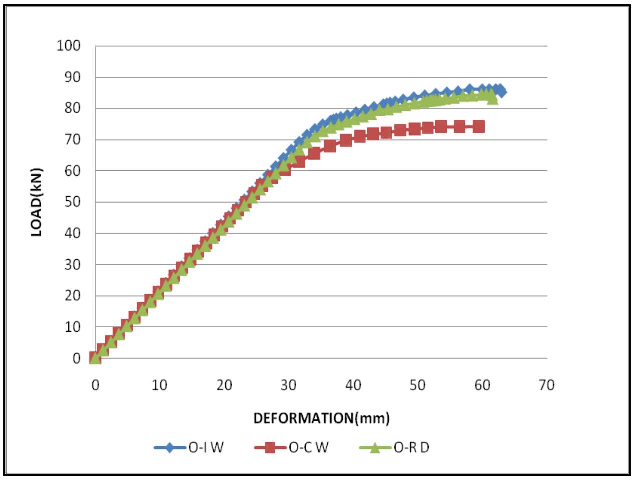

Chart -1: Load-Deflection graph.

From figure 6 to figure 8 shows the total deformation that has occured in three models during the analysis. Figure 9 to figure 11 shows the equivalent principle stress and figure 12 to fugure 14 shows the maximum principle strain.

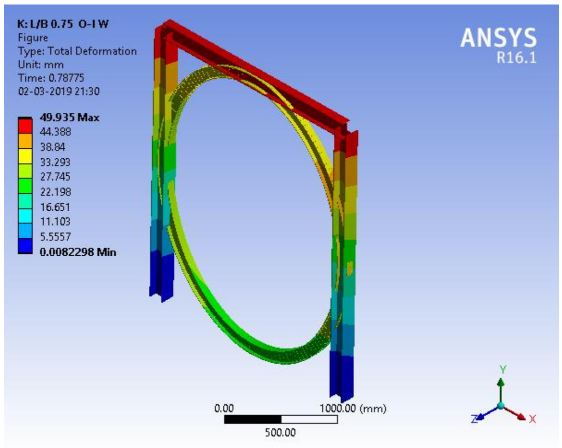

Fig -6: Total deformation for Ogrid with I-section geometry.

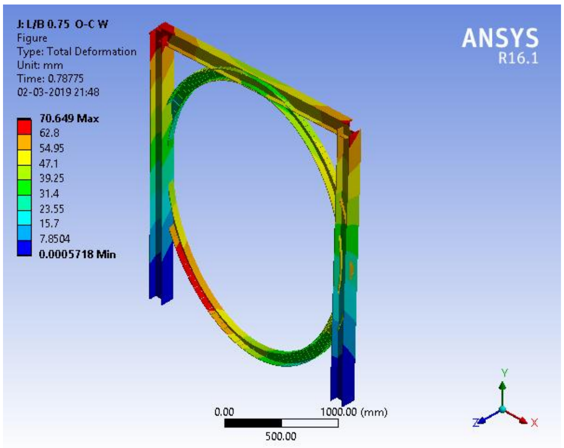

Fig -7: Total deformation for Ogrid with C-section geometry.

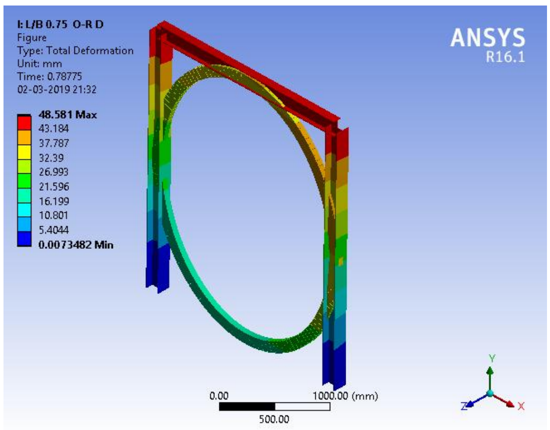

Fig -8: Total deformation for Ogrid with rectangular section geometry.

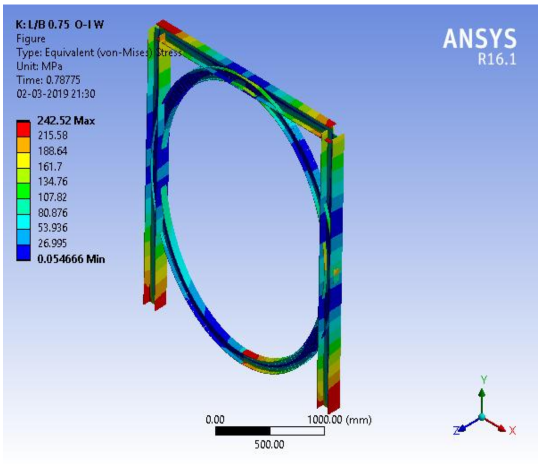

Fig -9: Equivalent stress for Ogrid with I-section geometry

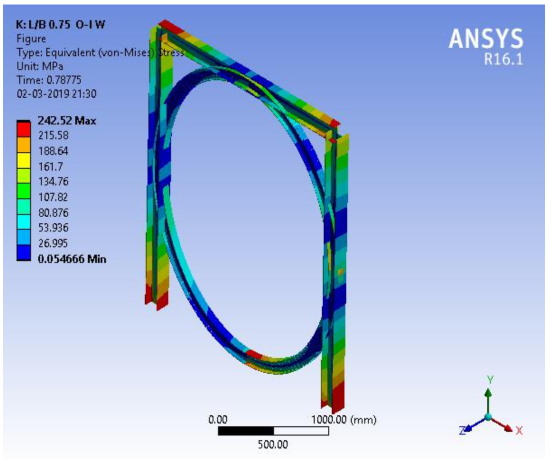

Fig -10: Equivalent stress for Ogrid with C-section geometry

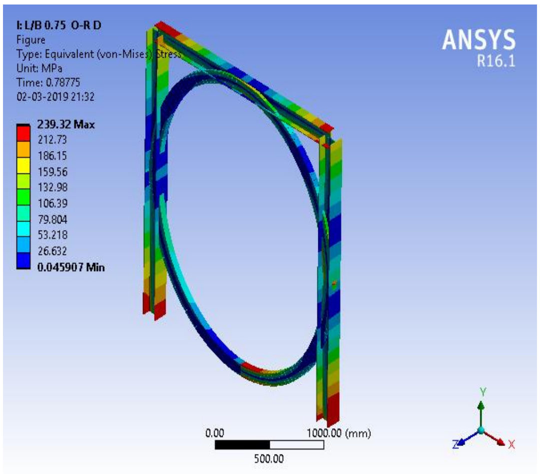

Fig -11: Equivalent stress for Ogrid with rectangular section geometry

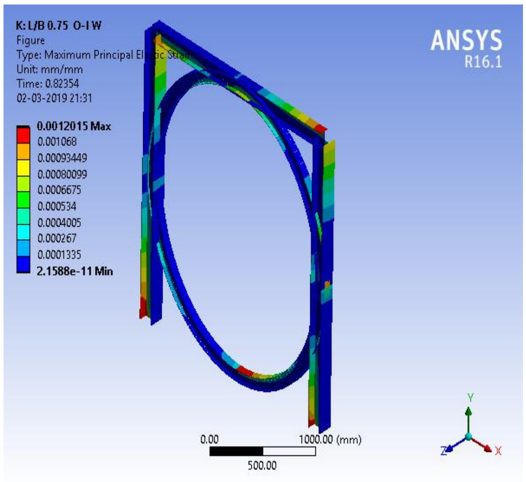

Fig -12: Maximum principle strain for Ogrid with I-section geometry

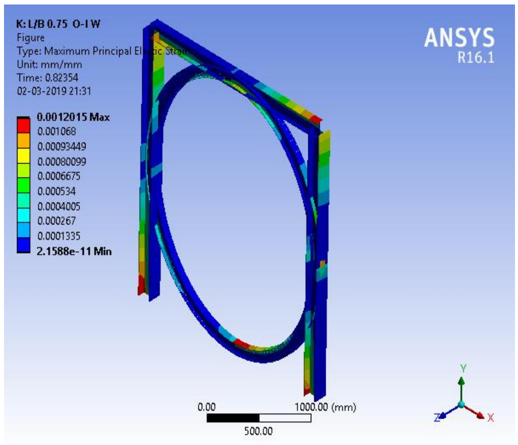

Fig -13: Maximum principle strain for Ogrid with C-section geometry

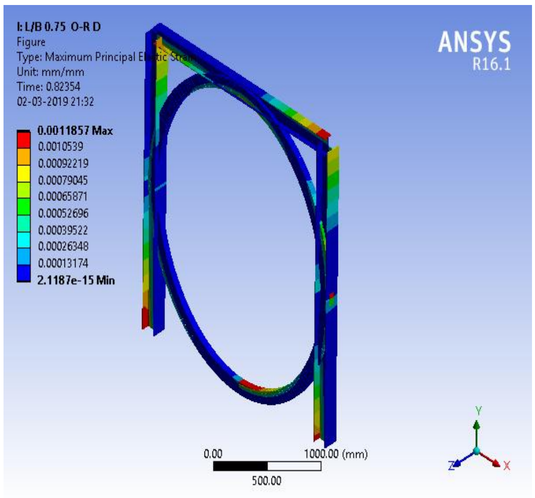

Fig -14: Equivalent stress for Ogrid with rectangular section geometry

4. CONCLUSIONS

This study proposed a new bracing system to resist lateral forces called Ogrid bracing system, OGrid bracing system is braced frame with circular brace connected to moment resisting frame(MRF) with joint connection. Unlike other braces, the structure and form of OGrid braces, it can be used in any part of the structure without removing architectural space and architectural form due to the beauty of this braces. Ogrid bracing system has good ductility and stiffness.
The result of analytical study on the Ogrid with different bracing section geometry is shown in following conclusions:

- The load-deflection curve of three models, OGrid with I-section bracing, Ogrid with C-section bracing and Ogrid with rectangular section bracing.
- The result showed that Ogrid with I-section bracing has more ductility and load carrying capacity, also the one with rectangular section bracing shows comparable result.
- Thus this type of bacing can be effectively used in engineering structures in seismic prone areas which have the ability to withstand lateral loads.

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