ISSN No:-2456-2165

Analysis and Comparing Result of Lamella Dome and Schwedler Dome under Application of External Loads

Manhor K[1], Anuradha.P.Annigeri[2]

[1]Assistant Professor, Civil Engineering Shayaderi College of Engineering and Management, Mangalore, India

[2]Mtech Student, Structural Engineering Shayaderi College of Engineering and Management, Mangalore, India

Abstract:- In this present study the analysis of steel dome will be carried by the use of computer software STAAD. Pro. The lamella domes and Schwedler domes will be modeled and analysis to be done by using software STAAD. Pro for different rise to span ratios for different load cases and results are compared. The domes have span of 50m, 30m and their height-to-span ratio is 1/2. Here, four domes have been analyzed statically under self-weight. Also, for earthquake loads and lwindiloads, equivalent Seismic Coefficient methods have been employed according to IS1893:2002.Various steel section were considered for different models as per IS 800-2007.

Keywords:- *Steel Sections, STAAD. Pro, Braced Dome.*

I. INTRODUCTION OF DOME STRUCTURES

Domes are one of the commemorated structural arrangements, which acquire strength and stiffness by their shape and form. The maximum domes in the past were of stone masonry and now days RCC Steel domes are constructed more over India as the re-usability of the material is another advantage. These structures encircle the maximum amount of space with minimum surface and steel truss Lattice system has secured recognition amongst engineers due to its skillful structural shape. Compared to regular form structure dome structures are lighter. During classical age stone was only the material used to build domes, later replaced with brickwork, later timber was used in the middle ages for same execution. But from the beginning of 19th century there was momentous enhancement in dome structure with development of steel industry. By assigning the rigid joint makes the dome structurally stable and the strength of the dome is depends on the inelastic buckling and restrained connection between the members.

- *Types of Domes*

1. Beehive/Corbel Dome
2. Crossed Arch Dome
3. Cloister Dome
4. Geodesic Dome
5. Oval dome
6. Onion Dome
7. Braced Dome

a. Ribbed dome
b. Lamella Dome
c. Schwedler Dome
d. Diametric Dome

II. METHODOLOGY OF PROJECT

For analysis and comparison of the project considering two different types of dome with varying diameter. The two different types of domes are Schwedler domes and Lamella domes, hence for overall analysis we are considering 4 models in this present project. The loads are Dead loads, Live load, Wind load and Seismic load and these loads are generated using software STAAD PRO. Wind load are calculated using IS 875 (Part-III) and seismic loads using IS 1893-2002. Various steel properties are assigned to the models using Software. The load combinations are given as per IS 800-2007.

Types of dome	Lamella dome and Schwedler dome
Base Diameter	30m and 50m
Plate thickness for 30m	0.125m
Plate thickness for 50m	0.1m

Table 1:- Details of Domes

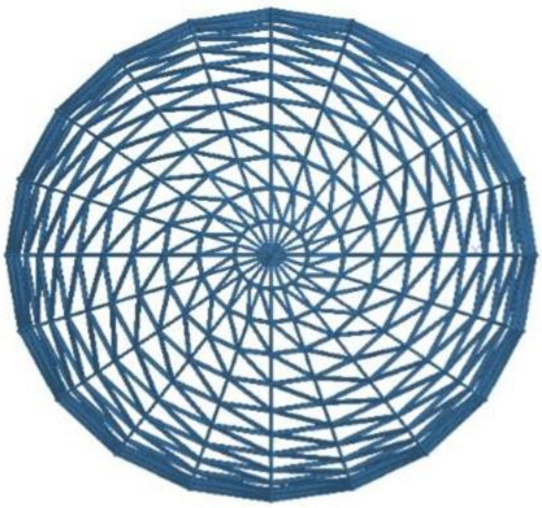


Fig 1:- Model of Dome of Schwedler dome

ISSN No:-2456-2165

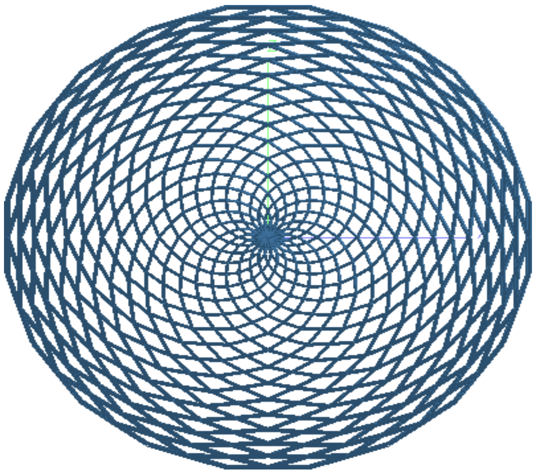


Fig 2:- Model of Dome of lamella dome

III. MATERIAL PROPERTIES

Type of Dome	Properties
Lamella Dome and Schwedler Dome 30m	ISMB 250 ISMB 300 ISMB 350
Lamella Dome and Schwedler Dome 50m	ISMB 400 ISMB 450 ISMB 500

Table 2

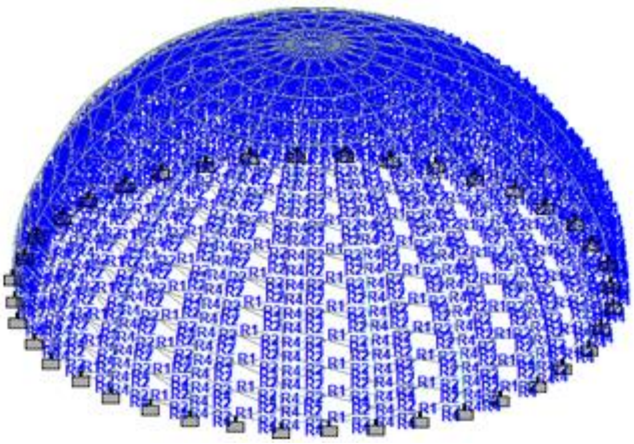


Fig 3:- Properties of dome

IV. TYPES OF LOADS

➢ *Self-Weight-*

The self-weight of the structure can beige generated using STAAD Pro.

➢ *Dead Load*

Plate Load - This load is generated by STAAD Pro. by specifying load on the members and the load on the plate is calculated by considering plate thickness, height and density of steel

Plate load calculation for 30m domes: Plate thickness x height (radius) of dome x density
= 0.125 x 15 x 7.85
= 14.71 KN/m

Plate load calculation for 50m domes Plate thickness x height (radius) of dome x density
= 0.1 x 25 x 7.85
= 19.62 KN/m

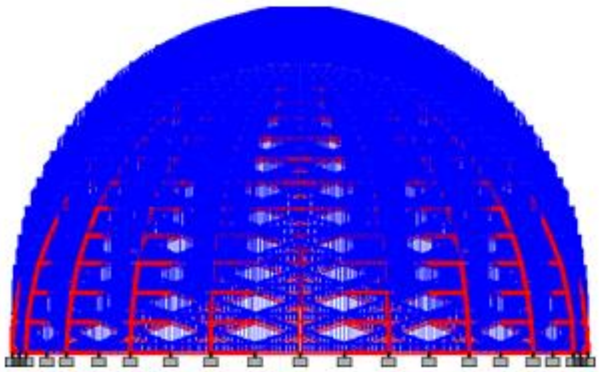


Fig 4:- Member Load including Self-weight

➢ *Wind Load*

The wind load values were generated by software itself as according to IS 875-1987 (Part-III) The design of wind speed and wind pressure is considered based on the height of the structure and as per IS 875- 1987(Part-III) the wind speed is taken as 50 m/sec.

INTENSITY(kn/m^2)	HEIGHT(m)
0.01056	10
0.01056	15
0.01056	20
1.51312	30
1.92893	50

Table 2 : Wind Load

➢ *Live Load*

Live loads were generated in similar manner as done in the case of Dead load and it includes only reduced live load on the floor Live load on the structure.

➢ *Earthquake Load*

Earthquake loads were generated as per IS 1893-2002 and using Seismic definition command and Load case column. Earthquake loads are applied in ± X- Direction and ± Z-Direction in load case command.

ISSN No:-2456-2165

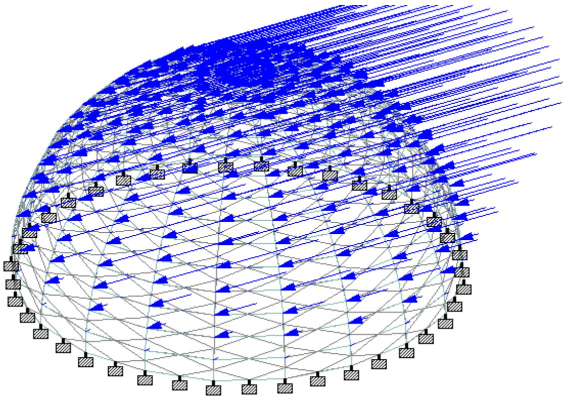


Fig 5:- Earthquake load

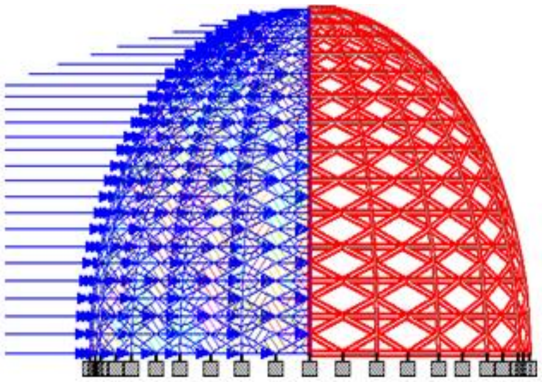


Fig 6:- Wind Loads in X +

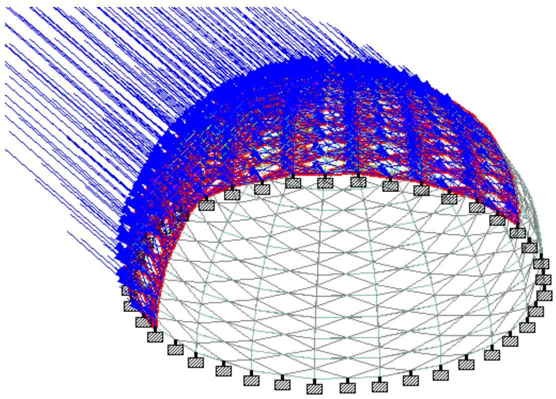


Fig 7:- Wind Loads in Z +

➢ *Load Combinations*

1. C1 - 1.7(DL+LL)
2. C2 - 1.7(DL±EQ X±)
1.7(DL±EQZ±)
3. C3 - 1.3(DL+LL±EQX±)
1.3(DL+LL±EQZ±)
4. C4 - 1.7(DL±WD X±)
1.7(DL±WD Z±)
5.C5 - 1.3(DL+LL±WDX±)
1.3(DL+LL±WDZ±)

V. RESULT AND DISCUSSIONS

The comparison of result is encompassed between maximum and minimum Bending Moment, Shear Forces, Axial forces and Steel take off, Major and Minor Principal Stress which includes Compressive Stress and Tensile Stress of Dome Beams.

➢ *Axial Forces*

Axial force is the compression force or tension force acting in a member. The comparison of axial force is made between maximum and minimum value of lamella and Schwedler 30m dome and also maximum minimum value of lamella and Schwedler 50m dome. The graph is plotted against combination v/s axial forces for different combinations.

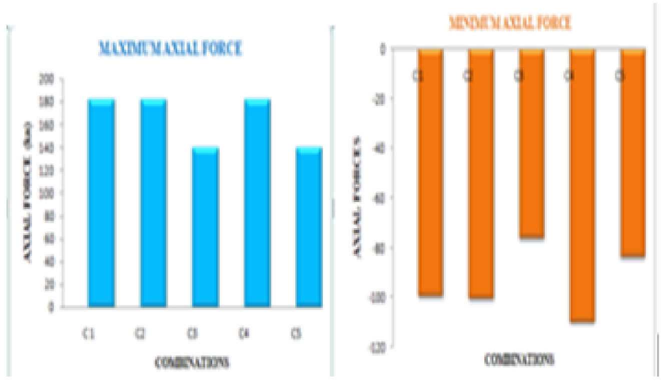


Fig 8:- Axial Forces

➢ *Bending Moment*

Bending moment is developed in the structure when an external force is applied to the element causing the element to bend.

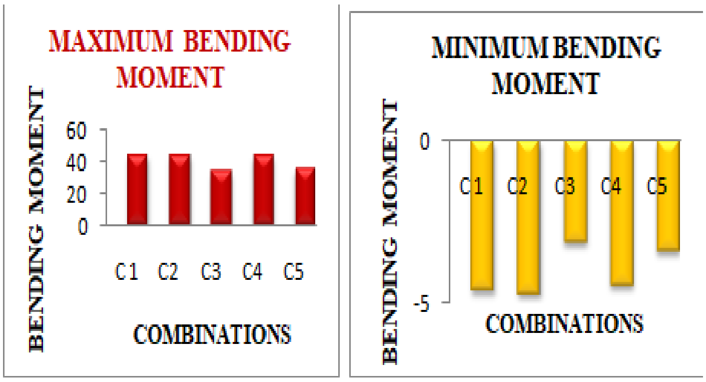
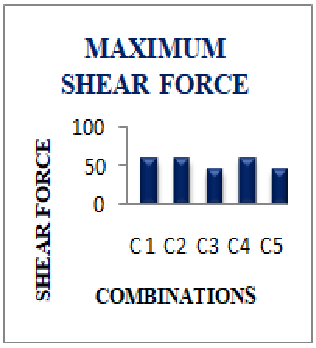


Fig 8 : Bending Moment

➢ *Shear Force*

Shear force is a force is applied perpendicular to a surface in opposition to offset force acting in the opposite direction.



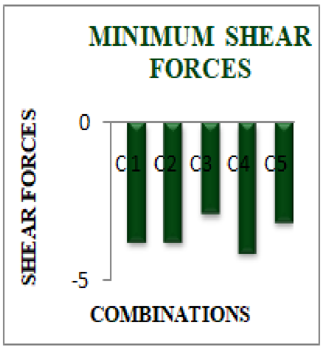


Fig 9 :- Shear Force

➢ *Stresses*

Stresses in the structures are either in Tensile or Compressive stress. The result for tensile and compressive stress for Lamella dome and Schwedler dome of different diameter The principal stresses for top and bottom is also shown in below figures.

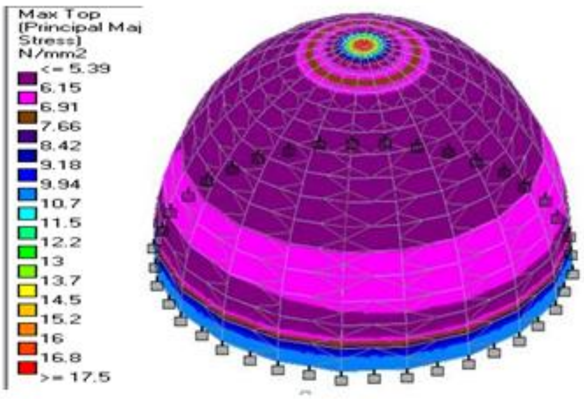


Fig 10 :- Principle Stresses

VI. CONCLUSIONS

- ➢ The maximum axial force of lamella dome of 30m is more than schwedler dome of 30m by up to 5.897% and the minimum axial force of lamella dome of 30m is more than schwedler dome of 30m by up to 2.890%. And also The maximum axial force of lamella dome of 50m is more than schwedler dome of 50m by up to 18.537% and the minimum axial force of lamella dome of 50m is more than schwedler dome of 50m by up to 10.110%.
- ➢ The maximum bending moment of lamella dome of 30m is more than schwedler dome of 30m by up to 23.128% and the minimum bending moment of lamella dome of 30m is more than schwedler dome of 30m by up to 18.547%. And also The maximum bending moment of lamella dome of 50m is more than schwedler dome of 50m by up to 12.417% and the minimum bending moment of lamella dome of 50m is more than schwedler dome of 50m by up to 4.90%.
- ➢ The maximum shear force of lamella dome of 30m is more than schwedler dome of 30m by up to 8.101% and the minimum shear force of lamella dome of 30m is more than schwedler dome of 30m by up to 17.30%. And also The maximum shear force of lamella dome of 50m is more than schwedler dome of 50m by up to 12.199% and the minimum shear force of lamella dome of 50m is more than schwedler dome of 50m by up to 39.674%.
- ➢ The construction of schwedler dome may became fast because the members of construction is less when compared to lamella dome, so schwelder dome is more efficiency for construction.

REFERENCES

[1]. Anuj Chandiwala, (2014) “Analysis and design of steel dome”, International Journal of Research in Engineering and Technology, Volume: 03, Issue: 03.

[2]. Shah Yash Jayminkumar, Vaibhav Doshi (2016) “A parametric study on steel dome structures”, International Journal for Technological Research in Engineering, Volume: 03, Issue: 09.

[3]. Chun Wai Hung, (2009) “A comparative study of structural material for dome construction”, Massachusetts Institute of Technology, USA.

[4]. H. S. Jadhav, Ajit S. Patil, (2013) “Parametric study of double layer steel dome with reference to span to height ratio”, International Journal of Science and Research, Volume: 02, Issue:08.

[5]. Xiuli Wang, Jiyun Chen, Chang Wu, (2008) “Dynamic analysis of single layer lattice shell with BRBs”, 6th International Conference on Computation of Shell and Spatial Structures, Beijing University of Technology