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Analysis and Design of Dome Structure

Kiran P. Khandare [1], Dr. Sachin B. Mulay[2]

[1] *Postgraduate student,*
Depatment of civil engineering,Sandip university,Nashik.

[2]*PhD, Master of Technology,Department of civil Engineering,*
Sandip university,Nashik.
Nashik,India

Abstract—Navi Mumbai the city in Maharashtra where the unique structure name Dr Babasaheb Ambedkar Udyan is held in the center of attraction for the Mumbai city. The Lotus Temple well-renowned structure is been awarded for its unique design & structure by Seven Epic, the height of the structure are 49m, The structure is spread along 48.9m wide. Maharashtra has been hit by a mega-quake of 6.2 Richter scale on Sep 30, 1993, and recently on July 14, 2018, Indian metrological department (IMD) confirm that earthquake of magnitude in Mumbai 2.8 Richter scale and 30 August 2017 due to heavy rainfall was noted. That is the reason being analyzing and design Dr Babasaheb Ambedkar Udyan for earthquake forces. The research is done on Dome shaped structure subjected to seismic loadings. To assess the seismic vulnerability of buildings with large domes, the dynamic characteristics and behaviour of large reinforced concrete domes with long spans need to be studied and their susceptibility to damage need to be evaluated. This study presents the first step towards assessing the seismic vulnerability of buildings with large reinforced concrete domes.
Keywords: Dome Structure, ETABS, Seismic effect, Drift, Displacement, Reinforced concrete domes.
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I. INTRODUCTION

Dome are stand without support of column that is the superiority of domes and this stand on own stiffness and strength. When all realistic situations would probably still stand when all conventional structures had fail, domes are very durable and strong. In the roof s Structure domes are very efficient structure. Sometime design and fabrication also come in complexity of analysis. . In a roof structure main force is its own weight and it can bear its own weight. Thus it's so much affected by its size shape and geometry. Reinforced concrete shell structure (Dome) comes under so many different load combinations with 3-dimentional geometrical complexness moreover 3 dimensional behavior and its material. Mainly domes may be constructed in seismic zone and therefore they will be subjected to dynamic load. Maximum the dynamic forces on a concrete dome generally cannot control design however in earthquake zone almost disastrous force that can be applied on a dome is earthquake load. This paper is a study of the linear static and dynamic behaviour of reinforced concrete dome and behaviour in the vibration of their thickness, span and height on dynamic characteristics such as vibration frequencies. The evaluation of susceptibility of dome structure earthquake damage and assessment of their seismic risk and vulnerability due to earthquakes. this is the first step. Dome is an architectural element which is the upper half of the sphere is hollow. Various material used for the construction of dome has a long architectural lineage extending into prehistory. The first advanced true dome constructed in the Romen architectural revolution, when they were frequently used by the Romans to shape large interior spaces of temples and public buildings, such as the Pantheon. This tradition continues unabated after the adoption of Christianity in the Byzantine (East Roman) religious and secular architecture, culminating in the revolutionary pendentive dome of the 6th-century church Hagia Sophia. The Sassanid Empire started the construction of the first large-scale domes in Persia, with such royal buildings as the Palace of Ardashir, Sarvestan and Ghal'eh Dokhtar. Dome may be defined as a thin shell generated by of regular curve about only one axis. The dome shape and size depend upon the type of curve and direction of the axis. Mostly shell roof is used when inside of that structure is open and does not contain wall or column. Domes are used in a variety of structure such as circular tank, exhibition hall, auditoriums, the roof of circular area etc. Dome may be constructed may be RCC, masonry, steel, timber.

II. METHODOLOGY

Analysis and design Dome Structure is generally done using the specifications provided by the code of practice.
For earthquake forces analysis of structure the method used is
Static Method Equivalent Static Lateral Force Method
It is a simplified technique to replace the effect of the dynamic loading of an unexpected earthquake with a static force distributed laterally in a structure for design purposes. The applied total seismic force is generally evaluated in two horizontal directions parallel to the main building axes, it is assumed that the building responds in its fundamental lateral mode. To design and analyze a structure capable of resisting the effect of an earthquake, it is necessary to first specify the

forces on the structure. This method is the simplest and requires fewer calculation attempts and is based on the formula provided in the code of practice.

i)STRUCTURAL SPECIFICATION

Structure description	
Length and width	48.9X48.9M
Total height of structure	50.504M
Story Height at GL	0.000M
Plinth level	2.400M
Museum	3.750M
Podium	8.700M
Prayer hall	10.800M
Crown Edge	26.665M
Top most Point of Dome	50.504M
Column size	300X1005, 450X450, 500X500, 750X750, 900X900, 1200x1200 (mm)
Beam Size	300X450, 300X700 450X700, 530X900, 350X600, 750X750(mm)
Thickness Of wall	230 (mm)
Support condition	Fixed

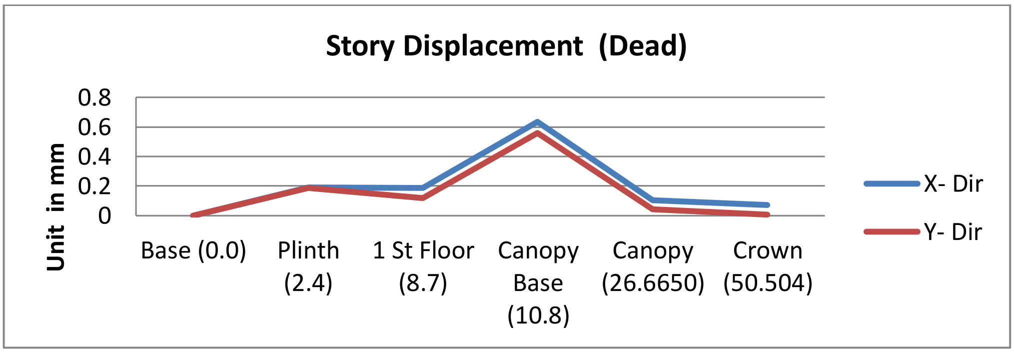
ii] Material Properties:
Grade of concrete : M30
Grade of Steel : Fe500

iv] Design Spectrum: (Source IS:1893:2016)
Type of Soil:
Soil type 1: Soft,
Soil type 2:Medium
Soil type 3: Hard
Earth quake Zone: III
Zone Factor, Z : 0.16
Importance Factor: 1
Response Reduction Factor: 5
iv]Load Combinations considered for the building analysis :
I]Static equivalent method:
1. DLLL- Dead load + live load
2. DLEQX- Dead load + earthquake loads in x direction
3. DLEQXN- Dead load + earthquake loads in negative x direction
4. DLEQY- Dead load + earthquake loads in y direction
5. DLEQYN- Dead load + earthquake loads in negative y direction
6. DLLLEQX- Dead load + Live load + earthquake loads in x direction
7. DLLLEQXN- Dead load + Live load + earthquake loads in negative x direction
8. DLLLEQY- Dead load + Live load + earthquake loads in y direction
9. DLLLEQXN- Dead load + Live load + earthquake loads in negative y direction
10. DLWLX- Dead load + Wind load in x direction
11. DLWLXN- Dead load + Wind load in negative x direction
12. DLWLY- Dead load + Wind load in y direction
13. DLWLYN- Dead load + Wind load in negative y direction
14. DLLLWLX- Dead load + Live load + Wind load in x direction
15. DLLLWLXN- Dead load + Live load + Wind load in negative x direction
16. DLLLWLY- Dead load + Live load + Wind load in y direction
17. DLLLWLYN- Dead load + Live load + Wind load in negative y direction

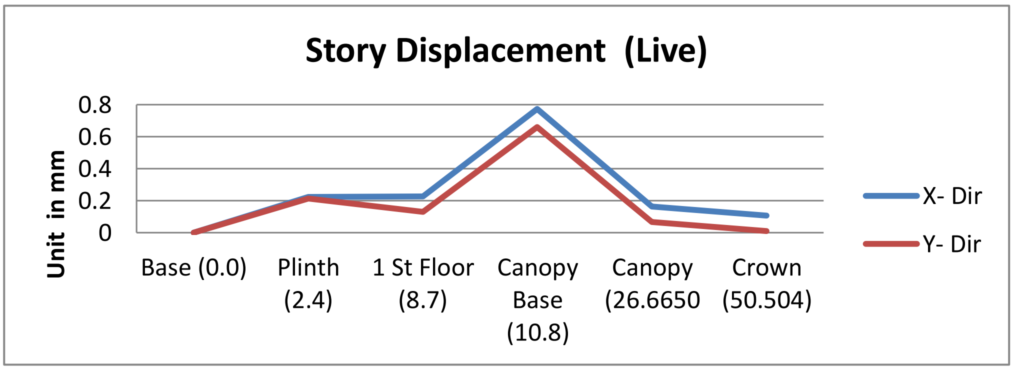
III RESULT

1) DISPLACEMENT OCCURED IN DOME STRUCTURE:
(Height vs. Displacement)

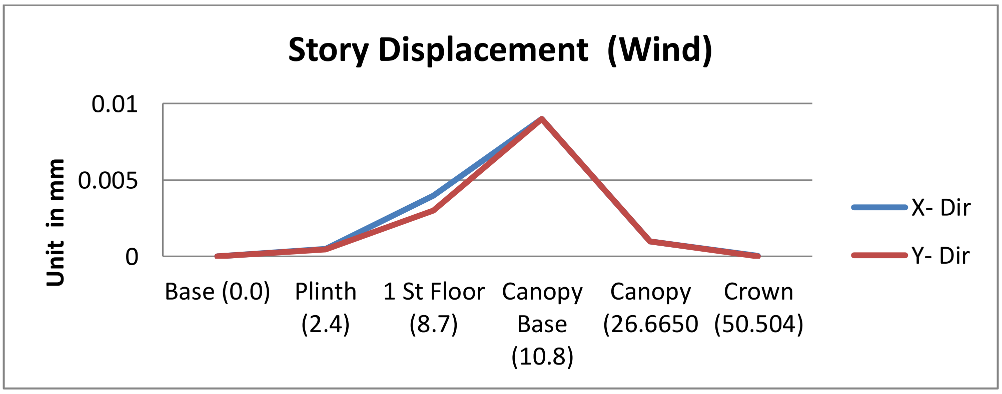
I. Dead Load



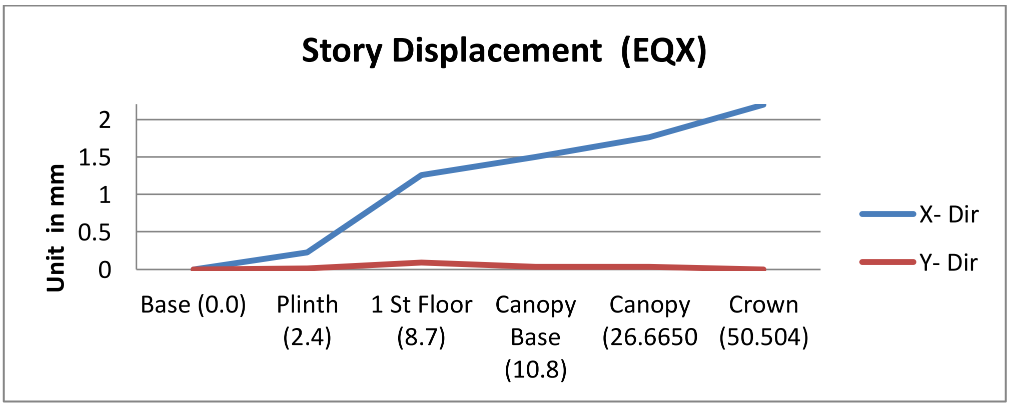
II. Live Load



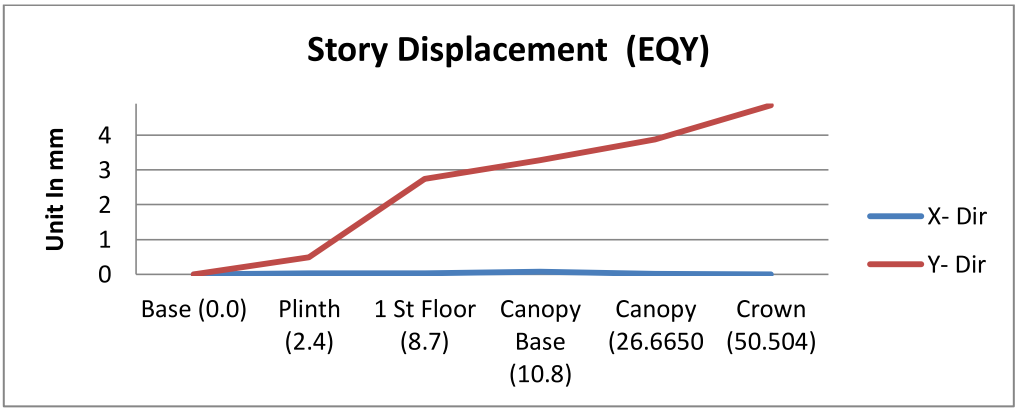
III. Wind Load



IV. EQX Load

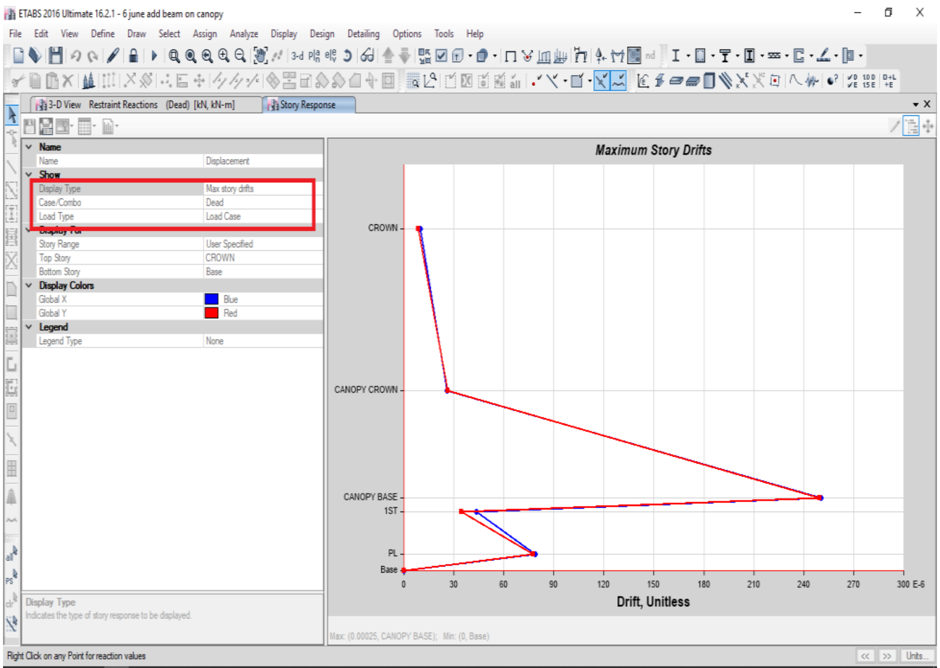


V. **EQY Load**

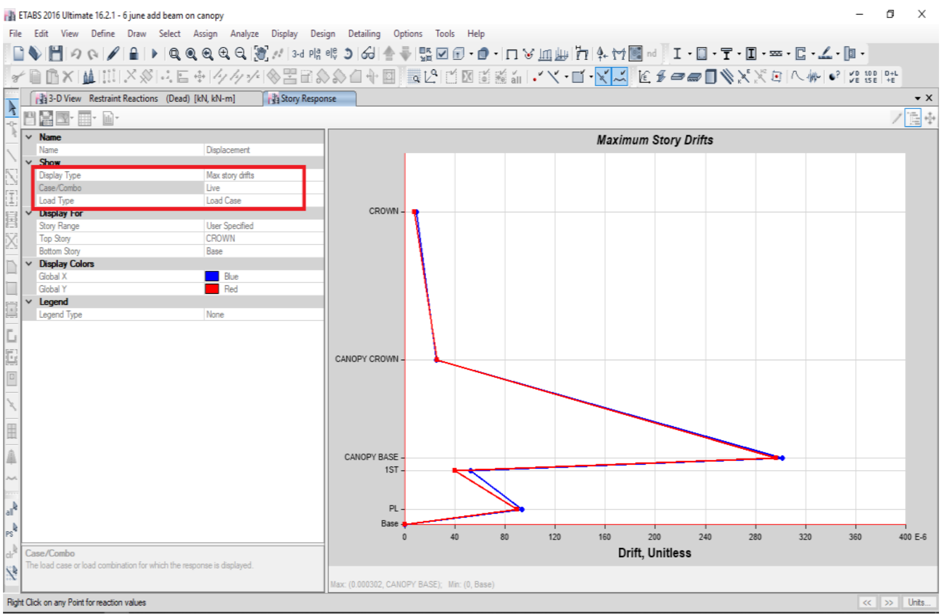


2) STORY DRIFT (HEIGHT VS. DRIFT)

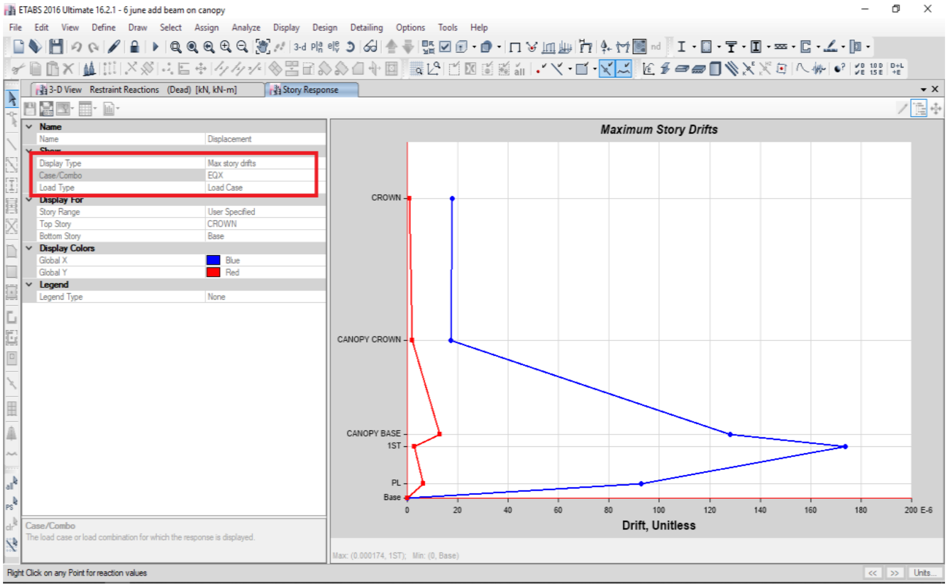
1) Dead Load



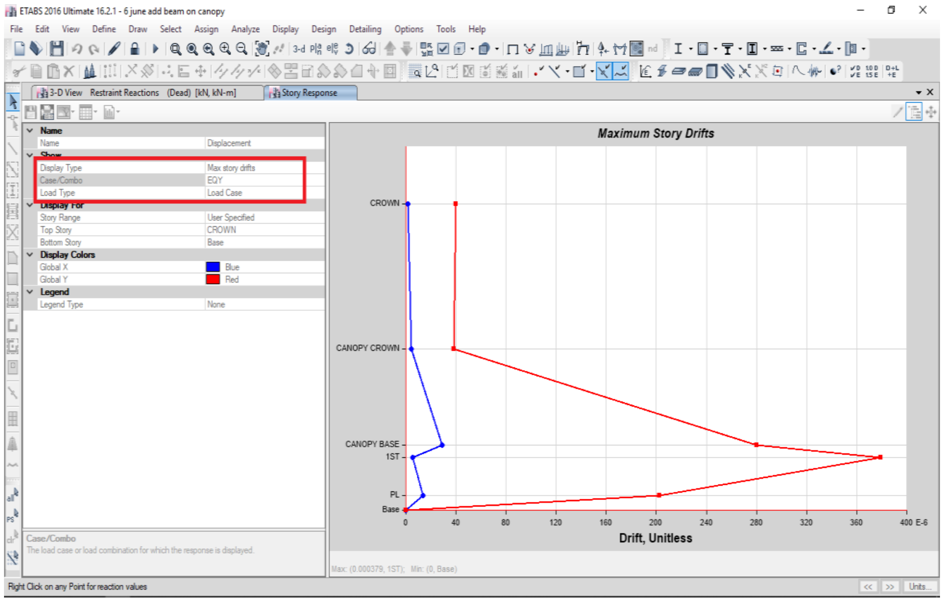
2) Live Load



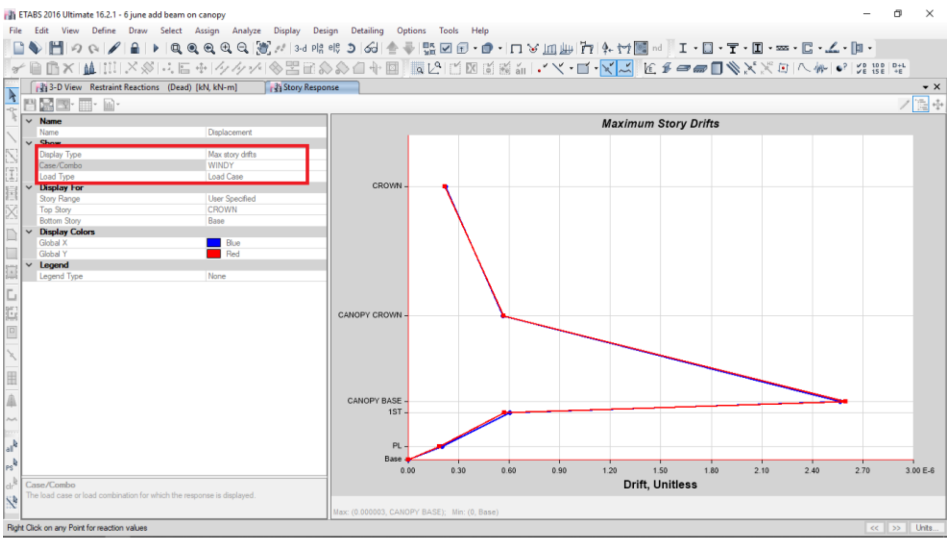
3) EQX Load



4) EQY Load



5) Wind X and Y Load



III. CONCLUSIONS

- From the detailed analysis and all the work, this thesis has been give following points as:
- Meditation hall using a dome structure is designed and analysed by taking various aspects and norms into considerations as prescribed in the Indian standard code books. The dome structures are designed with the help of the software AUTOCAD and its analysis are dome using ETABS.
- The construction of dome structure makes use of the materials in an effective and economical way, shells have a great economic potential for the construction of low-cost buildings to cover large areas.
- Long spans are more expansive to build because they must usually be constructed with a single use form.
- However, they have other advantages that may outweigh the initial cost of the structure and also the duration of the construction period is less.

REFERENCES

1)Ranzi, G & Gilbert, RI 2015, Structural Analysis - Principles, Methods and Modelling, CRC Press, Taylor & Francis Group, Boca Raton, London, New York.

2)Anuj Chandiwala Mar-2014, "ANALYSIS AND DESIGN OF STEEL DOME USING SOFTWARE", International Journal of Research in Engineering and Technology

3)JA Abdalla, AS Mohammed 2008, "Dynamic characteristics of large reinforced concrete domes", The 14th World Conference on Earthquake Engineering.

4)Prof. Lei Guo, Jinjiang Zhang , Bo Zhang July 2008 "Structures, kinematics, thermochronology and tectonic evolution of the Ramba gneiss dome in the northern Himalaya" The Key Laboratory of Orogenic Belts and Crustal Evolution, Ministry of Education, China School of Earth and Space Sciences, Peking University, Beijing 100871, China.

5)Xingfei Yuan , Lianmeng Chen, Shilin Dong, August 2006, "Prestress design of cable domes with new forms" Space Structures Research Center, Zhejiang University, Hangzhou 310027, China.

6)Deepti Kumari 2014 "Parametric Study and Optimization of Steel Dome", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 3 Issue 7, July – 2014

7)Gaurav Pandey, Mandeep Kaur Arora Institute of technology Korba, CG, India 2017, "Efficient Design and Detailed Analysis of RCC Dome", International Journal for Scientific Research & Development| Vol. 5, Issue 04, 2017

8)Riya Anna Abraham, G. Kesava Chandran el at 2016, "Study of dome structure with Focus on Monolithic and Geodesic Dome for Housing", International Journal of Emerging Technology and Advanced Engineering Volume 6 August 2016

9)Mostafa RefatIsmail, Hazem Eldaly 2017, " Acoustic of monolithic dome structures", Department of Architecture Engineering, Faculty of Engineering, Ain Shams University, Egypt.

10)Sylwester Kobielak, Zenon Zamiar 2017, " Oval concrete domes", archives of civil and mechanical engineering 17 Elsevier.

11)G. Arun Yildiz Technical University 2006, " Behaviour of Masonry Vaults and Domes: Geometrical Considerations", Structural Analysis of Historical Constructions, New Delhi 2006

12)Feng Fu, City, University of London, "Structural behavior and design methods of Tensegrity domes", Journal of Constructional Steel Research · January 2005

13)Shaik Tahaseen M.Tech, Department Of Civil Engineering, Visvodaya Engineering College, Kavali, "Reinforced Cement Concrete (RCC) Dome Design", International Journal of Civil and Structural Engineering Research, - March 2016.

14)Shengyuan Gong 2017, "The research of suspen-dome structure", College of civil and safety engineering, Dalian Jiaotong University, China. IOP Conf. Series: Materials Science and Engineering. ICAMMT 2017

15)Bureau of Indian Standards: IS-875, part 1 (1987), Dead Loads on Buildings and Structures, New Delhi, India.

16)Bureau of Indian Standards: IS-875, part 3 (1987), Wind Loads on Buildings and Structures, New Delhi, India.

17)Bureau of Indian Standards: IS-875, part 5 (1987), Special Loads and Combinations, New Delhi, India.

18)Bureau of Indian Standards IS 456: 2000, Plain and Reinforced Concrete – Code of Practice

19)Bureau of Indian Standards IS 800:2007, Code of practice for general construction in steel

20)Bureau of Indian Standards IS 1893 (part 1): 2016: Criteria for Earthquake Resistant Design of Structures: Part 1 General Provisions and Buildings (Sixth Revision)