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Low-Cost Housing Using Monolithic Dome and Cylindrical Structure

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Abstract: *Dome is an element similar to the hollow half of a sphere. It can also be defined as a thin shell generated by the revolution of a regular curve about one of its axes. The type of the curve and the direction of the axis of revolution determines the shape of the dome. Monolithic dome structures are cast in a one-piece form. The paper aims to do a comprehensive study of Monolithic Domes and the various advantages and key aspects of these structures and to determine whether they are more energy efficient, eco-friendly, cost effective and durable housing options compared to conventional structural systems.*

Keywords: *Low Cost Housing, Monolithic Domes, Cylindrical Structures, Structural analysis, paper review*

I. INTRODUCTION

Dome structures belong to the category of self-supporting structures that take the form of an arch. Loads are distributed around the sides and down towards the foundations. Domes are compacted by gravity and the external loads are carried by the compressive forces that develop internally. Dome structures have been in existence since ancient times as round huts and ancient tombs in the shape of solid mounds that have been found in the Middle East, Mediterranean region and India. In Modern times, domes come in various forms or types of latticed domes such as the Schwedler domes, geodesic domes and monolithic domes. Among the various types, the geodesic and monolithic domes are used widely today in various structures.

A Monolithic Dome is an element similar to the hollow half of a sphere built in one block. Not only Monolithic Structures are more energy efficient, eco-friendly, cost effective and durable housing options compared to conventional structural systems, a well-designed monolithic structure consisting of shear walls may decrease the overall project cost. They are also pretty disaster resistant, their strength and stability making them virtually immune to climatic catastrophe, or earthquakes, as well as to fire, or corrosion hazards.

A. Advantages Of Monolithic Dome Structure

- 1) Cost efficient
- 2) Low maintenance.
- 3) Provides good air circulation
- 4) Fire Resistant
- 5) Resistance against most adverse weather conditions

B. Disadvantages Of Monolithic Dome Structure

- 1) Narrow corners can lead to waste of space
- 2) Lack of seams

II. NEED OF STUDY

Urban life spaces are the needs of modern time and Monolithic Dome Structure can fulfill this need. There is a huge need for lowcost housing in India as a large percentage of the population is still lingering under poverty. Monolithic Dome Structures are cost effective, energy efficient and can easily be constructed in various weather conditions. With proper study and research, we can efficiently incorporate dome structures in today's construction world, be it residential buildings or more commercial buildings.

III. LITERATURE REVIEW

A. Nuzul Azam Haron *et al.* (2005)

This paper talks about the cost comparison of conventional system and industrialized building system of formwork system (monolithic structure system). It allows us to draw a comparison between both to determine which one is cheaper and better among the two. The data for research were collected from questionnaire surveys and case study.

B. H. G. Vivek Prasad *et al.* (2015)

Author talks about conventional, monolithic and precast construction techniques. The comparison is majorly based on construction materials and time, cost if the house was constructed based on conventional precast and monolithic methodologies. New alternative methods have been developed to reduce the construction cost and the overall time for the completion of the construction project. The alternate approach is fast track construction involving monolithic and precast construction.

C. Lakshmy G. Das *et al.* (2017)

In this study maximum principal stress, deflection, and crack pattern is determined by the analysis of the different models created. This paper discusses numerical analysis of a dome structure which is made up of four different geometries. In this project a finite element analysis is carried out through ANSYS 17.0 software.

D. David B. South *et al.*

Author talks about the analysis of a monolithic dome built as a residential structure using a previous airform technique. The building was made of an outer airtight form, comprising locally available materials using various alternatives, polyurethane foam insulation, and reinforced concrete. The process and options were evaluated according to their application for the production of biological containment facilities. They concluded that monolithic dome technique can be an effective alternative to today's conventional methods.

E. Mostafa Refat Ismail *et al.* (2017)

Author researched the acoustics of monolithic dome structures. The paper described monolithic structures as being cost- efficient, extremely durable, earth-friendly, and easily maintained. Regarding climate, the monolithic domes are pretty resistant to adverse weather conditions.

F. Kalaiselvi M *et al.* (2018)

This paper analyzes the Monolithic Concrete Dome as a low cost housing alternative and compares its cost and energy efficiency with a conventional building structure. The study highlights the current need for low cost housing in India and with emphasis on monolithic concrete domes as the best solution that are not only cost efficient but also have been proved to be disaster resistant over the years.

G. Riya Anna Abraham *et al.* (2016)

This paper summarizes the history of various dome structures using a general analysis of dome structures and a comparison of domes with flat roofs. The paper also studies the possible future aspects of domes by evaluating two main types - monolithic and geodesic domes. The paper talks about the various advantages and key aspects of these types of domes.

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