Efficient Design and Detailed Analysis of RCC Dome

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Abstract— A Dome is a convex roof. Dome are categorized according to the shape of both the base and the section through the center of Dome. Many memorable structure throughout the history have been built using thin shell hemisphere shape of the Dome. These time tested monuments surpass many in beauty and longevity. Continuing in the tradition of these magnificient edifices Dome Technology engages the latest engineering and architectural technologies to produce aesthetic functional and economical schools, gymnasium, water parks, community centers and facilities. At a fraction of the cost of conventional structures each building benefit from unobstructive views, seating efficiency, great acoustics and space utilization. Modern insulated concrete Dome construction combines several materials to concrete a strong, efficient, and weather-proof. In this paper we analyze different dimensions of parameters for modern Concrete Dome.

Key words: STAAD.Pro, Dome, Diameter of Column, Beam, Plate thickness, Analysis

I. Introduction

In the past and recent years, there have been an increasing number of structures using RCC domes as one of the most efficient shapes in the world. It covers the maximum volume with the minimum larger volumes with no interrupting columns in the middle with an efficient shapes would be more efficient and economic. Dome roofs are the lightest structure to cover circular shape.

A dome may be defined as a thin shell generated by the revolution of a regular curve about one of its axes. The shape of the dome depends up on the type of the curve and direction of the axis of revolution. The roof is curved and used to cover large storey buildings. The shell roof is useful when inside of the building is open and does not contain walls or pillars. Domes are used in variety of structures such as roof of circular areas, circular tanks, exhibition halls, auditoriums etc. Domes may be constructed of masonry, steel, timber and reinforced cement concrete.

Stone and brick domes are one of the oldest architectural forms. However, reinforced concrete domes are more common now a day since they can be constructed over large spans.

II. Scope and Objective of the Work:

- The scope and objective of the dome is to analyze and design a RCC dome
- The minimum thickness we take 125mm for RCC dome
- Dead load and Live load as pwer IS 456:2000 are considered

This study helps the long span construction of rcc domes. The key objective of rcc domes is to build a strong and safe roof structure. [1]

III. Dimensional Analysis

In the analysis of the problem of RCC dome the variables considered were as follows:

Dimensions/ parameters	D (m) (1)	D X 1.5 (m) (2)	D X 2 (m) (3)	D X 2.5 (m) (4)	D X 3 (m) (5)
Circular column(dia.)	0.25	0.375	0.5	0.625	0.75
Tie beam	0.2x0.2	0.3x0.3	0.4x0.4	0.5x0.5	0.6x0.6
Roof beam	0.2x0.1	0.3x.15	0.4x0.2	0.5x0.25	0.6x0.3
Plate thickness	0.12	0.18	0.24	0.3	0.36

Table 1: dimensional analysis of dome

IV. Materials and Methods

For the analysis of the dome researcher use concrete beams, columns and plate thickness.

A. Define Load to following process

The loadings were calculated partially manually and rest was generated using STAAD.Pro load generator. The loading cases were categorized as: Self-weight, Dead load from slab, Live load.

1) Self-weight:

The self weight of the structure can be generated by STAAD.Pro itself with the self weight command in the load case column.

2) Dead load:

Dead load can also be generated by STAAD.Pro by specifying the plate thickness and the load on the floor per sq m. Calculation of the load per sq m was done considering the weight of horizontal beam, weight of vertical column, weight of steel plate.

3) Live Load:

The live loads were generated in a similar manner as done in the earlier case for dead load in each floor. This may be done from the member load button from the load case column. [2]

Live load on the dome structure is shown in the figure-1

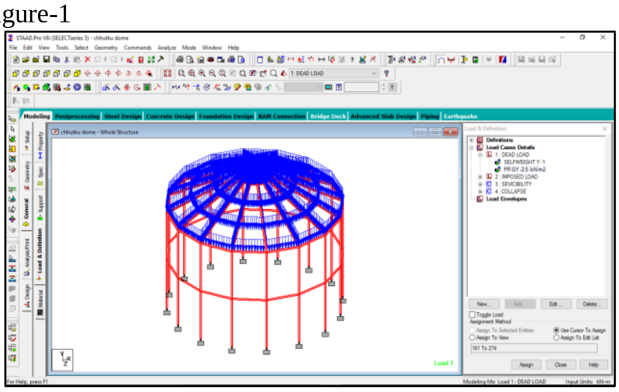

Fig. 1: live load on dome structure

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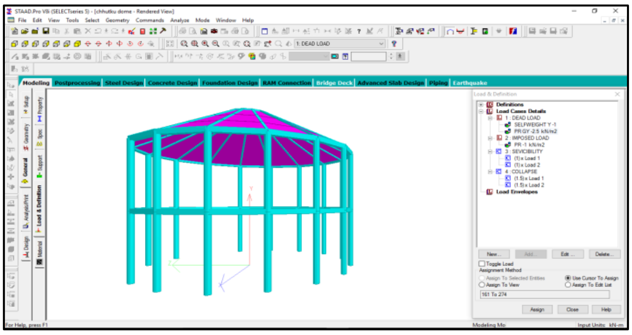

Fig. 2: 3D view of dome structure

V. DESIGN RESULTS

For the sample analysis and design results have been shown below for beam number 112 of RCC dome:

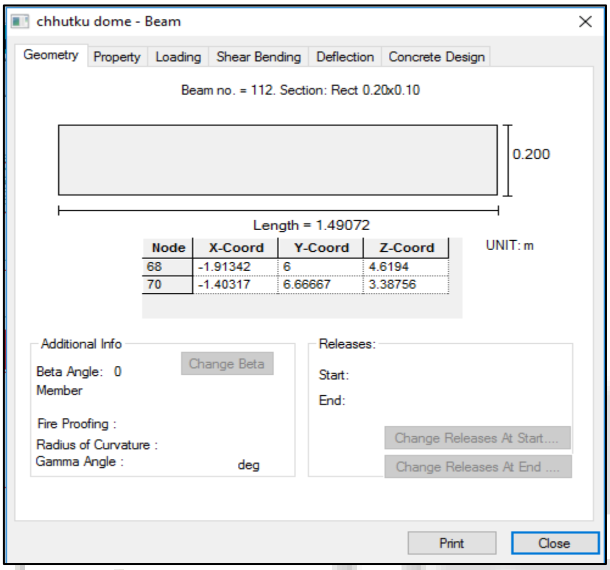

Fig. 3: geometry of Beam 112

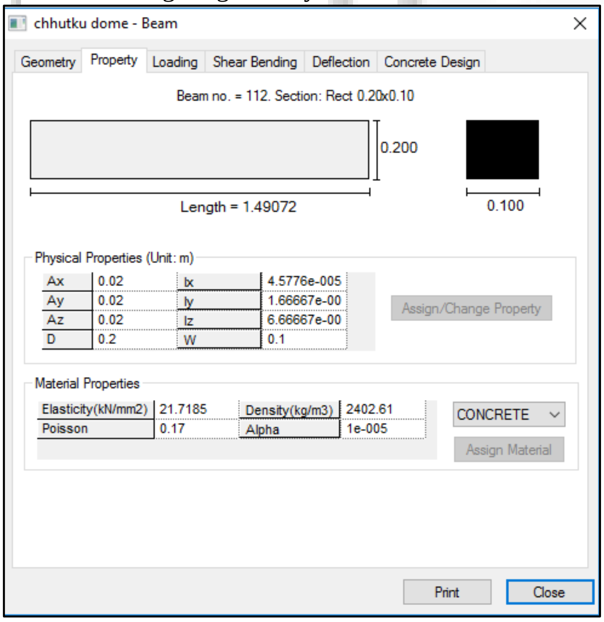

Fig. 4: Property of Beam 112

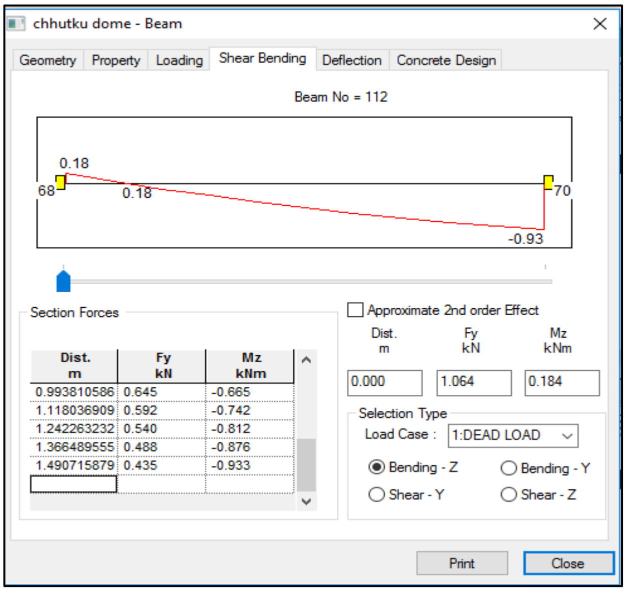

Fig. 5: Shear Bending of Beam 112

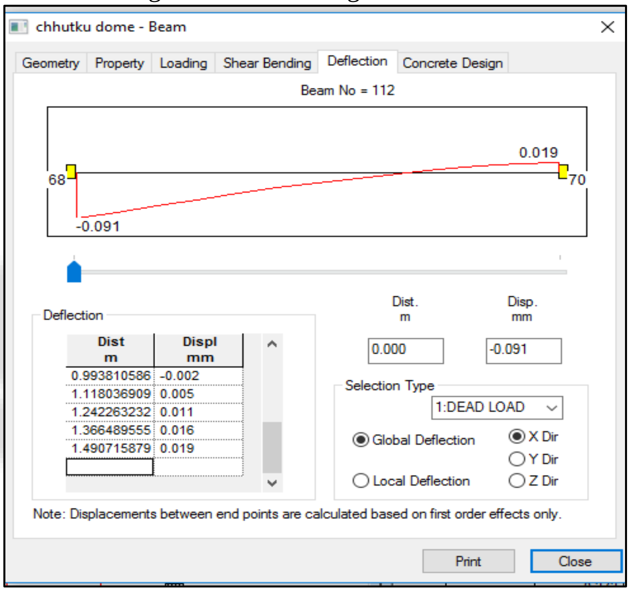

Fig. 6: Deflection of Beam 112

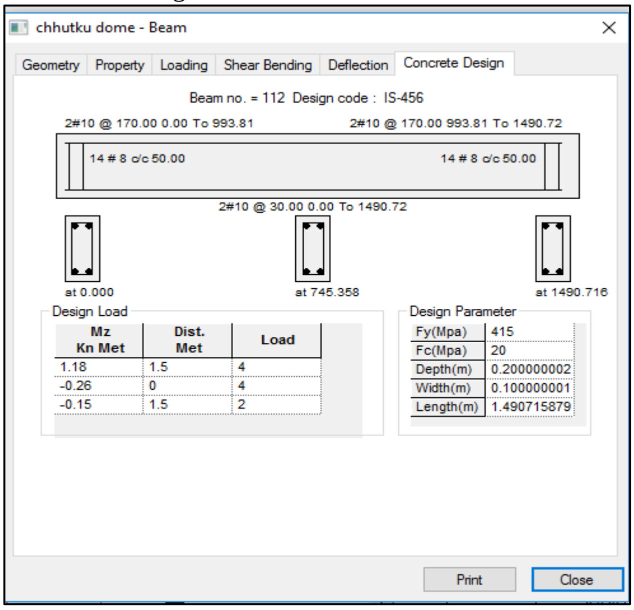

Fig. 7: Concrete Design of Beam 112

VI. CONCLUSION

For a Concrete Dome take different dimensions of beam and Column section to construct Dome. Relative percentage change in Axial Force, Shear Force, and Bending Moment due to change in dimensions are shown in tabular form below:

S.no.	Dimensions	Axial Force	Relative % increase
1.	D_1	5.967	0.00
2.	D_2	8.118	36.05
3.	D_3	11.271	38.83
4.	D_4	15.368	36.34
5.	D_5	20.364	32.51

Table 2: Relative % change in Axial Force

S.no.	Dimensions	Shear Force	Relative % increase
1.	D_1	1.435	0.00
2.	D_2	3.573	148.98
3.	D_3	6.617	85.19
4.	D_4	10.542	59.31
5.	D_5	15.336	45.47

Table 3: Relative % change in Shear Force

S.No.	Dimensions	Moment	Relative % increase
1.	D_1 +ve	0.171	0.00
	D_1 -ve	-0.786	0.00
2.	D_2 +ve	0.92	43.80
	D_2 -ve	-1.577	100.06
3.	D_3 +ve	2.343	0.92
	D_3 -ve	-2.36	50.31
4.	D_4 +ve	6.786	189.62
	D_4 -ve	-4.539	92.33
5.	D_5 +ve	11.287	66.327
	D_5 -ve	-5.252	15.70

Table 4: Relative % change in Bending Moment

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