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TECHNO-ECONOMIC ANALYSIS OF THE SAME HIGH AND DIFFERENT RINGS LAMELLA DOMES USING BY LRFD AND ASD LOAD COMBINATIONS

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ABSTRACT:
The using of dome roofs is increasing with every day because of economical solution for covering large column and free net precious area for utilization. This research based on the techno-economic analysis of same high and 4, 5 and 6 rings lamella domes using lrfd and asd load combinations. In present paper the analysis of steel dome is compared by the use of computer software Sap 2000.

KEYWORDS: Structural system, Lamella steel domes, Steel bracing, Steel analysis, optimal decision.

INTRODUCTION

Steel space domes are formed of carrier parts on the rotational surface forming the dome or smooth linear elements whose joints are on this surface. The domed carriers, which allow the forces to spread throughout the space, are divided into various groups in terms of their constructive structures. This paper contributes lamella steel domes analyses. The stability of the dome surface is provided by these diamond-shaped elements used as roofing or purlins. The main purpose of the design of steel space dome systems is to obtain the optimum solution that will safely transfer the loads that will affect the system and fulfill the expected task. The main purpose of this researches is to find the best system that can cross large gaps to the extent possible by the lightest and most economical system by using the least tools. Many types of software are available to analysis these types of structure. Sap 2000 has gone a step further in model building, modification and handling of analysis and design. Analytical properties are also very strong as recent research in numerical techniques and solution algorithms.

MATERIAL AND METODS

2.1 Geometry

The diameter of dome was used 20 m and every high is constant 5 m. To effectively calculate, the elements of the dome are divided into groups, such as rings and crossbars.

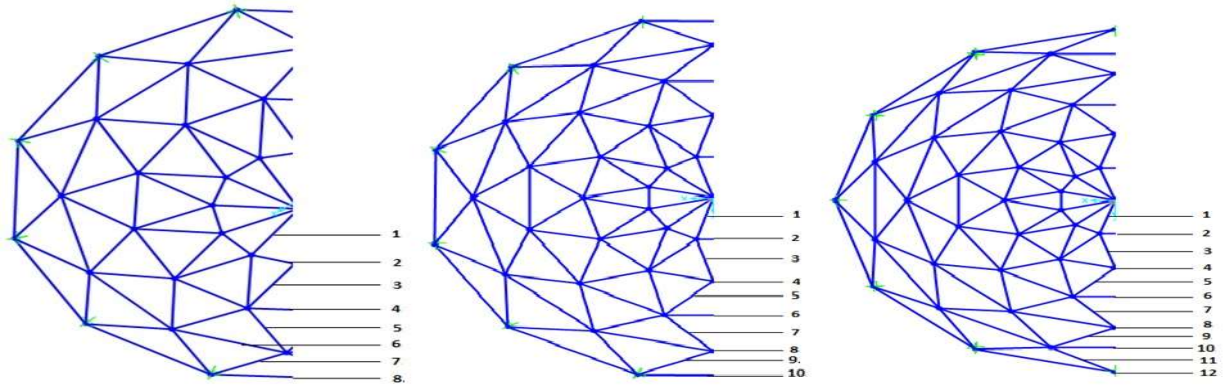

Figure 1. Element grouping of the domes

2.2 Define Load to following process

The loadings were calculated partially manually and rest was generated using Sap 2000 load generator. The loading cases were categorized as Dead load (DL=15 kq/m^2), Snow load (SL=1.5 kN/m^2), Positive and negative temperature load (TP= +17 C, TN= -33 C) Wind load effects such as wind external pressure (WEP), wind negative internal pressure (WIN) and wind positive internal pressure (WIP) (V=44 m/sec ~ Q(z) =3.12 kN/m^2) Load and load combinations are very important to achieve the best behavior characteristics of the structure under real effects. The following load combinationsare suitable for dome design.

Table 1. Load combination for analysis and design

ASD	LRFD
○ DL+SL	○ 1,4DL
○ DL+TP	○ 1,4DL+1,6SL
○ DL+TN	○ 1,4DL+TP
○ DL+WE+WIP	○ 1,4DL+TN
○ DL+WE+WIN	○ 1,4DL+1,6SLB+TN
○ DL+0,75(WE+WIN)+0,75SL	○ 1,2DL+1,6SL+0,8(WE+WIN)
○ DL+0,75TN+0,75SL	○ 0,9DL+1,6(WE+WIN)
	○ 0,9DL+1,6(WE+WIP)

DESIGN RESULTS

Static analysis are made in accordance with the applicable Turkish Standards and International Standards relating to loads and design. All static calculations integrate in terms of loading values, combination sizes, carrying capacities and design methods. Characteristics of snow load and dead load are identical and represent gravity. However, to calculate the exact impact of the wind load, it is possible to look at the impact of the load by dividing the dome structures into smaller parts. During the analysis of the dome, these loads are transmitted to joint loads, such as semi-cargoes, and are calculated accordingly. For steel dome take various types of steel section used and compare with number of rings to construct steel dome The design result based on the choosen crossection is given in the table 2.

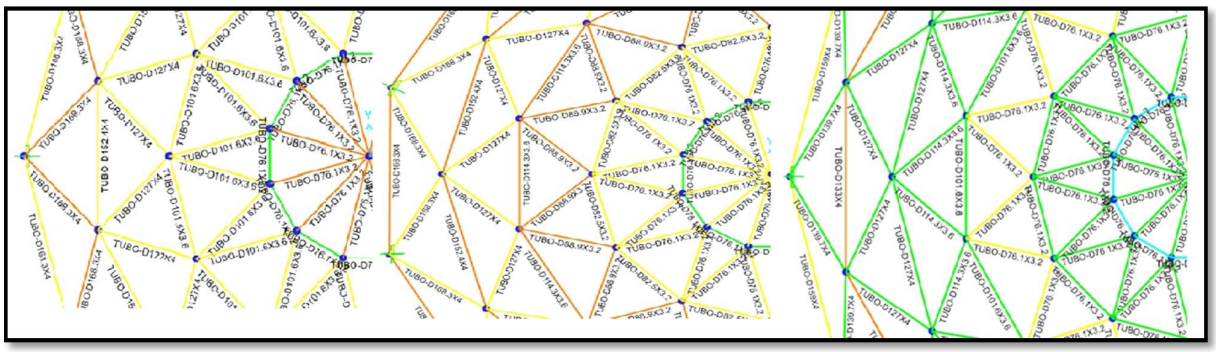

Figure 2. Design result for LRFD load combinations suitable 4, 5 and 6 rings domes

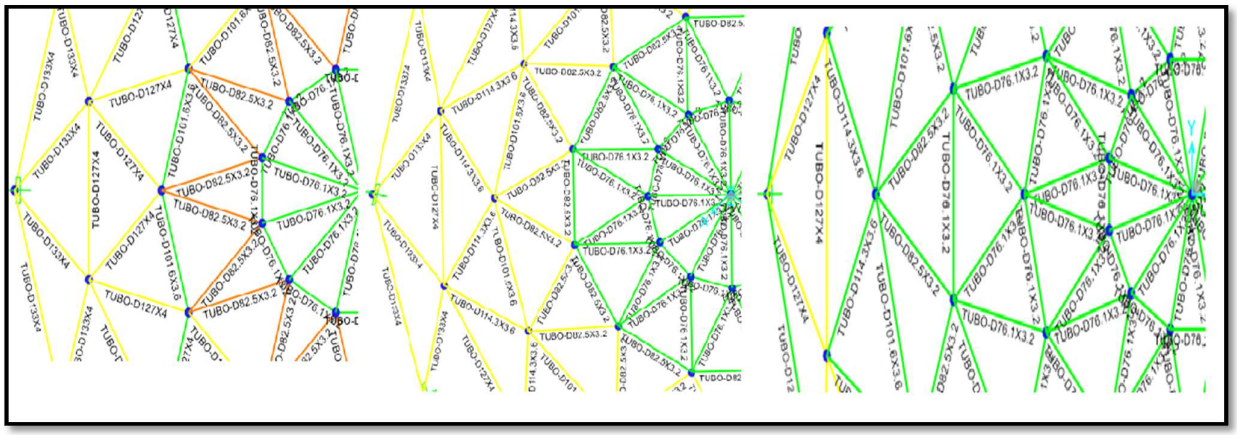

Figure 3. Design result for LRFD load combinations suitable 4, 5 and 6 rings domes

The domes are double-curved systems. These systems are the most rigid systems using at least material. Because the elements meet loads directly. While all elements in the same group are the same profile during design, almost every group consists of different profiles. If desired, the structure can be created with 3-4 profile types but the economic size may change. When the number of rings increases, the smallest cuts will be chosen every rings. Almost, due to the number of items is high, the total weight will most of over weight.

Table 2. Selected cross-sections (all sections are TUBO)

RİNGS	LOAD COMB.	GROUPS											
		1	2	3	4	5	6	7	8	9	10	11	12
4	ASD	76.1x3.2	76.1x3.2	82.5x3.2	101.6x3.6	127x4	127x4	133.4	133.4	X	X	X	X
	LRFD	76.1x3.2	76.1x3.2	101.6x3.6	101.6x3.6	127x4	152.4x4	168.3x4	168.3x4	X	X	X	X
5	ASD	76.1x3.2	76.1x3.2	76.1x3.2	82.5x3.2	82.5x3.2	101.6x3.6	114.3x3.6	127x4	133.4	133.4	X	X
	LRFD	76.1x3.2	76.1x3.2	76.1x3.2	82.5x3.3	88.9x3.2	114.3x3.6	127x4	152.4x4	168.3x4	168.3x4	X	X
6	ASD	76.1x3.2	76.1x3.2	76.1x3.2	76.1x3.2	76.1x3.2	76.1x3.2	82.5x3.3	101.6x3.6	114.3x3.6	127x4	127x4	127x4
	LRFD	76.1x3.2	76.1x3.2	76.1x3.2	76.1x3.2	76.1x3.2	101.6x3.6	114.3x3.6	127x4	127x4	133.4x4	139.7x4	159x4

CONCLUSION

In this comparisons made with the same diameters and different ring numbers and is observed that single-layer domes are not economical after a certain number of rings.So, 4-ring domes with a diameter of 20 meters yielded more economic results.

Table 3. Design weights

Number of rings	Total Weight (kg)		Weight per m^2 (kg)	
	ASD	LRFD	ASD	LRFD
4	4542	5384	14.4576	17.13776
5	4712	5631	14.99873	17.92399
6	4847	5716	15.42844	18.19455

It is also clear that under these conditions, analyzes with ASD load combinations are ~15 % more economical than LRFD load combinations. LRFD load combinations is more realistic in considering uncertainties and real behavior of steel elements than ASD load combinations. But both approaches are essentially the same in terms of destroyed modes

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