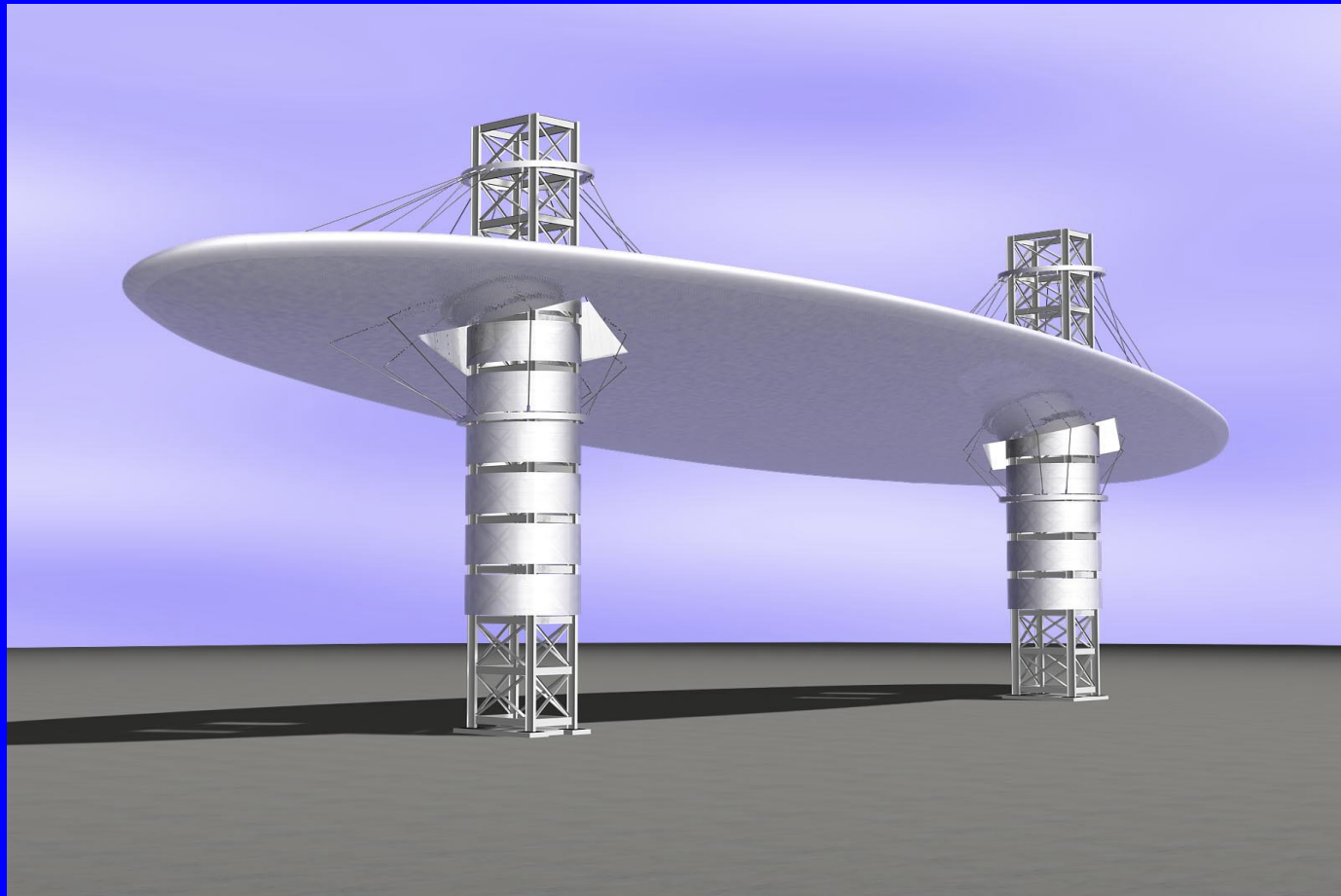


THE CLOUD STRUCTURE

Executive architect: Altoon + Porter

Design Architect :Oren Associates

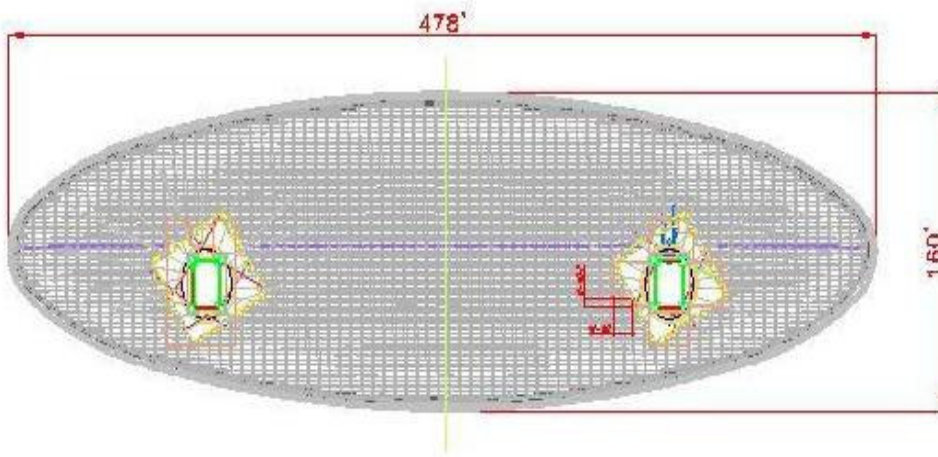
Cloud Structure at Fashion Show Mall in Lasvages



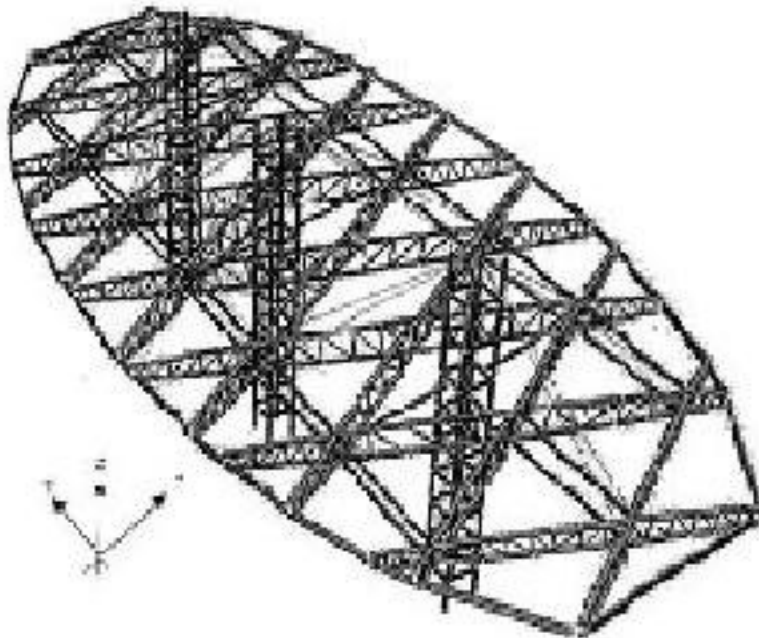
The cloud project is one of the first large-scale cable supported spaceframe projects in the United States, at approximately 60,000 square feet of covered area on each face

Making of the Cloud Structure

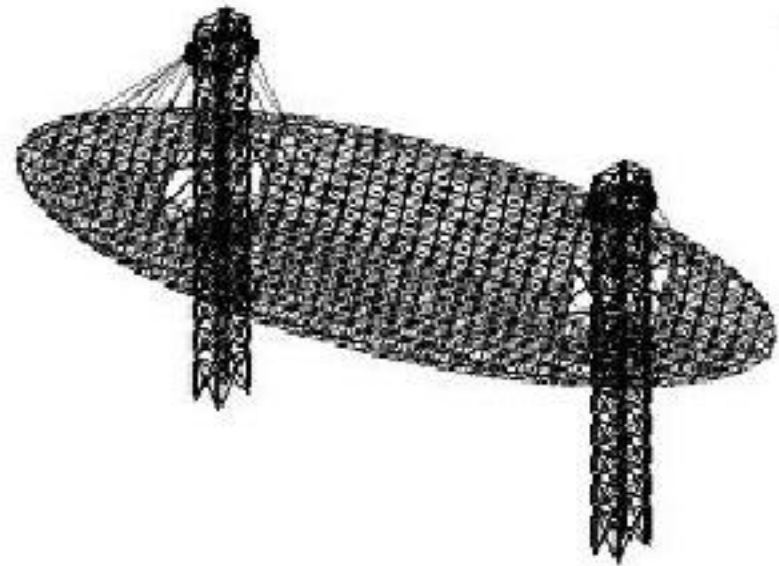
The cloud structure is an articulated entrance portal to the existing Fashion Show Mall. The main body of the structure has an ellipsoid shape that is 478 feet long, 160 feet wide, and up to 20 feet thick. The main body of the structure sits between 90 and 120 feet off of the ground level. It slopes 12 degrees in the transverse direction and 4 degrees in the longitudinal direction, and its two support columns are set approximately 250 feet apart and approximately 16 feet off of its center longitudinal axis



Cloud Plan View



Original framing concept structure weight (23 psf)



Final framing concept structure weight (13 psf)

Computer Modeling and Analysis

- **The space frame cloud and the two supporting towers are analyzed by SPACE-GASS and SPACE which are finite element computer programs for the three dimensional analysis and design of space frames with geometric non linearity**
- **Due to the nonlinear nature of the problem the principles of superposition does not hold. Hence the load analysis should be carried out independently**

Summary of list of Strut and Node type

Strut Type	Description	Qty.		Node Type	Description	Qty.
ST-3	2 3/8" O.D	1481		1	5" Diameter Ball	299
ST-5	3 1/2" O.D	1057		2	6" Diameter Ball	269
ST-7	4 1/2" O.D	859		3	7" Diameter Ball	11
ST-10	5 9/16" O.D	269		4	8" Diameter Ball	300
ST-12	6 5/8" O.D	295		5	11" Diameter Ball	74
	Total	3961		6	14" Diameter Ball	8
					Total	961



ASI also provided fabrication for the space frame and cable elements.





Strut Test

Five strut type (ST3, ST5, ST7, ST10 & ST12)

The failure load was well over the allowable load, giving us great confidence in the strut design. The effect of bending moment due to self-weight on the smallest strut ST3 type was minimum. However the bending moment had effect on the ST5 strut type even in this case the safety factor was higher than the theoretical.





Installation Procedure

- Foundation
- Towers
- Rings
- Cables
- Spaceframe Segments





Connecting the north and south segments

- Spaceframe sections were completed around each of the column towers first
- The center sections were placed between the column sections
- This created a stable system of space frame, connector struts, cables, and the tower columns





Cladding Installation

- The nosing frame sections were first installed
- Later the cladding framing and cladding was installed





Project Remarks

- There were numerous difficult engineering issues to solve on this problem, with the eccentric cable supported nature of the design
- The final result is a mammoth sized, sleek looking, shade and sign structure that provides visual impact for both the day and night times



THANK YOU