Craig E. Nelson - Engineer

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The Great Pyramid-Obelisk or "Pyramobelisk" of Ruth

Overview:

Here is a sketch of a possible substrate for an art car based on an Egyptian theme. Shiny metalized plastic silver or gold tinsel strips would mostly cover the frame allowing wind to pass through and on-board people to see and be seen. A fair amount of water for ritual bathing could gravity feed from the roof rack to people below through lotus blossom shaped spray nozzles (in my dreams!). Rhythmic Arabic music might complete the dance encouraging "tableau". In any case, the view from the top would be pretty nice. Also, smaller vehicles with racks and EMT tubing could be used to create a family of smaller pyramids ... just like those at Giza. This concept might usefully complement the Bedouin Tent Camp theme that is evolving.

Construction:

The structure is made of structural aluminum tube and channel. The platform is assembled by mig welding and the pyramobelisk truss uses 3/8 " stainless steel bolts, 3/16" 6061 - T6 aircraft aluminum gusset plates and 2 x 1 x 1/8 inch 6063 - T5 aluminum channel for the truss members.

Structural Stress:

A detailed stress analysis has not been performed but, rough calculation show that the structure can handle several times the loads that are reasonably expected.

Wind Induced Side Thrust:

A quick analysis assuming a wind side load of 20 lb/sq ft shows a force of about 3600 lb would result. The center of effort for this force would be about 7 feet above the ground. Even though the pyramobelisk "foundation" is a heavy duty Ford "1 ton" truck chassis weighing on the order of 3 tons (Center of gravity of the van-pyramobelisk is about 4.5 feet above the ground),, the maximum amount of side force is enough to tip over the rig if the wind is coming directly from the side (which it, no doubt, would be perverse enough to do). Therefore, it is prudent to use two 50 foot guy wires terminating in 3 foot long rebar stakes. These guy wires and stakes should be able to hold about 600 pounds of side load each. This allows a reasonable margin for safety. The guy wires would diverge 10 or 15 degrees away from a perpendicular to the structure sides to allow a little "fore and aft" stabilization. The guy wires would also prevent the whole shebang from simple being shoved sideways across the playa ... since wheel traction with The Earth is nowhere near adequate to prevent simple sideways skidding movement under the kind of side loads that are being considered.

Installation Options:

Because each level of the structure is its own independent "space frame" truss, it is not necessary that the full height be implemented. If the situation warranted, the top ... or top two levels could remain unassembled. This would ruin the "Pyramid - Obelisk" design effect but .... would ensure any level of safety required.

Also, the lower side panels "hang" from the first level platform on rope hinges. This allows these panels to be easily removed ... or ... as is intentioned ... they may be lifted up, out and away from the sides of the van until they are parallel with the ground. In this position, they form a shade structure "roof" that extends roughly eight feet out from the van sides and about 28 feet along the sides of the van. One or both or neither of these side panels may be deployed in this manner.

Installation Space:

With the lower side panels lifted up into place as a shade roof, the pyramobelisk needs a patch of ground about 30 feet square. Additionally, two "open channels" extending 50 feet from the van to one or the other side are needed for the guy wires. The theme camp where the pyramobelisk will "live" has this space and has agreed to let me have it for this purpose.

Craig E. Nelson

8/11/99

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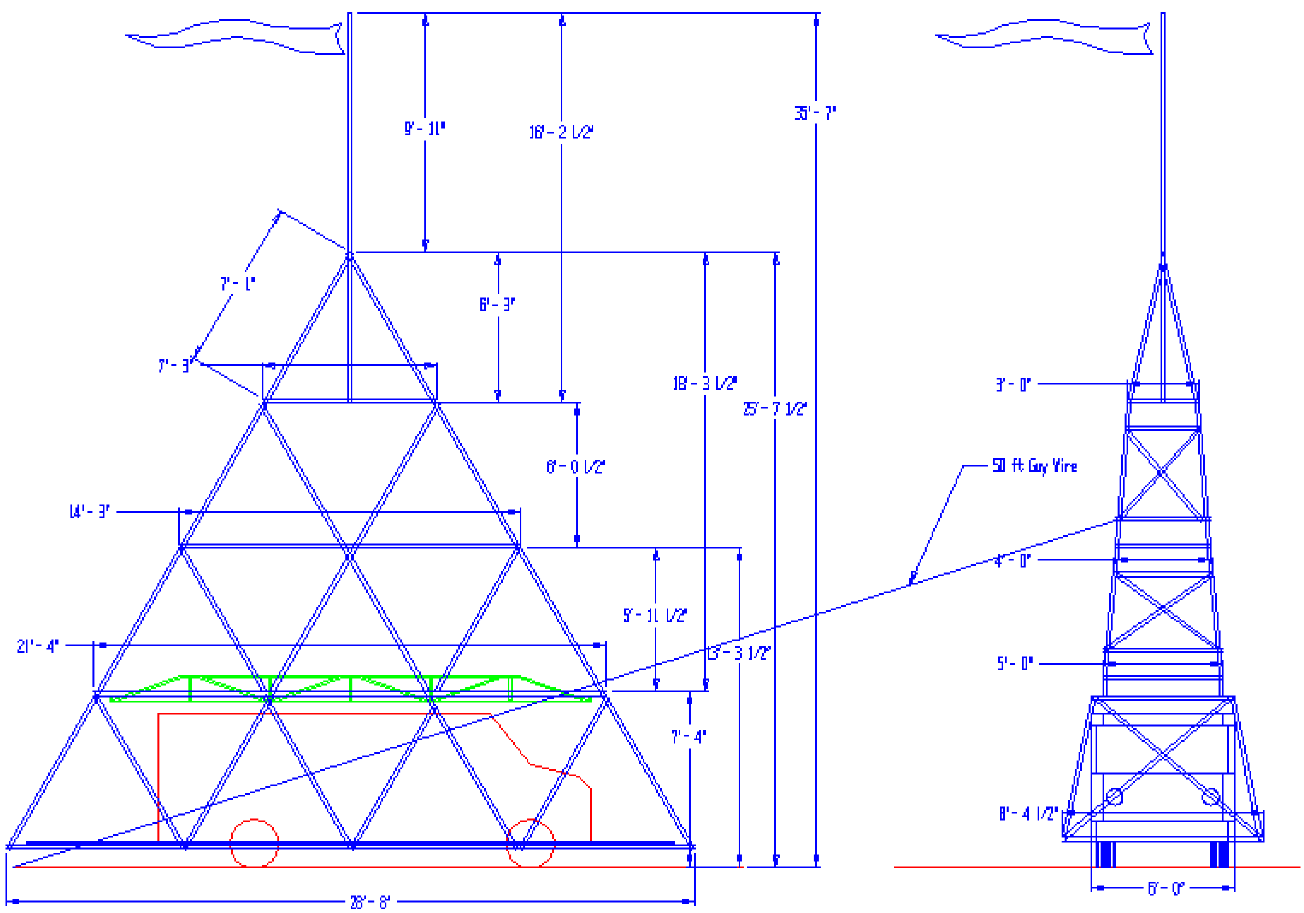

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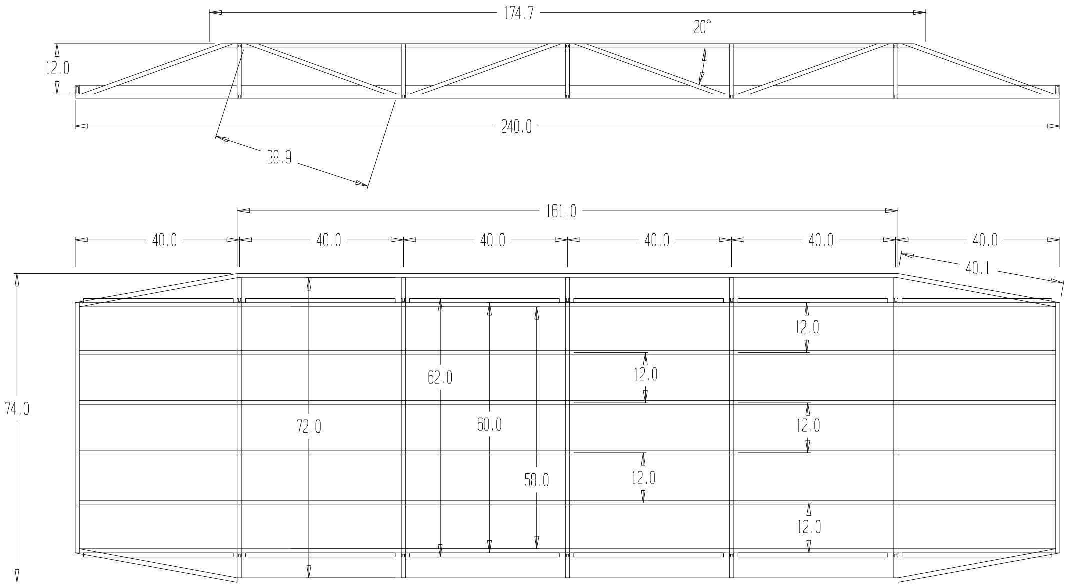
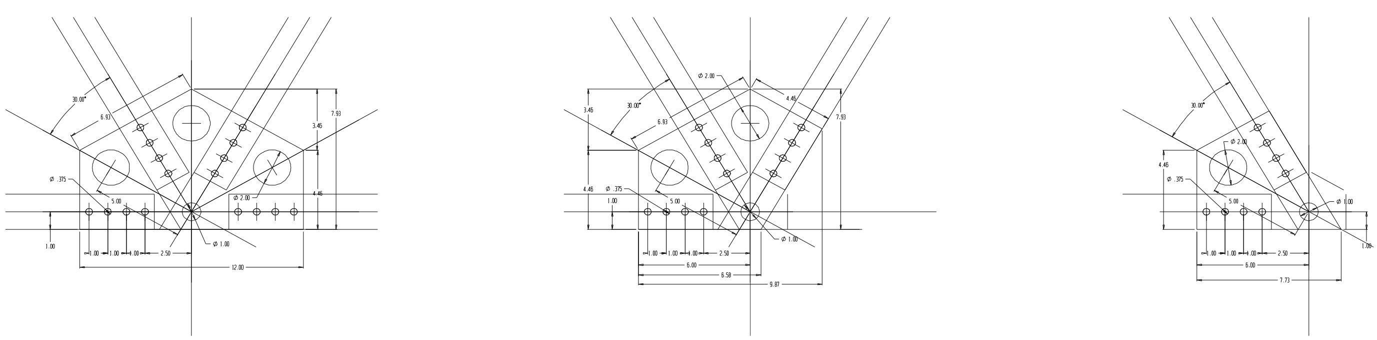
First Level Platform Details:



Truss Structure Gusset Plate Details:



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Calculation of Buckling Strength for the Gusset Plates:

Aluminum - 1/8 inch thick										
								Edge		
Width	Length	Thickness	Young's	Poisson	C	Term2	Term3	Area	Stress	Force
(inches)	(inches)	(inches)						(in^2)	(PSI)	(pounds)
2.5	1	0.125	1.00E+07	0.33	0.95	9.23E+06	1.56E-02	0.3125	1.37E+05	3.43E+05
2.5	2	0.125	1.00E+07	0.33	0.95	9.23E+06	3.91E-03	0.3125	3.43E+04	1.71E+05
2.5	3	0.125	1.00E+07	0.33	0.95	9.23E+06	1.74E-03	0.3125	1.52E+04	1.14E+05
2.5	4	0.125	1.00E+07	0.33	0.95	9.23E+06	9.77E-04	0.3125	8.56E+03	8.56E+04
2.5	5	0.125	1.00E+07	0.33	0.95	9.23E+06	6.25E-04	0.3125	5.48E+03	6.85E+04
Aluminum - 3/16 inch thick										
Width	Length	Thickness	Young's	Poisson	C	Term2	Term3		Stress	Force
(inches)	(inches)	(inches)							(PSI)	(pounds)
2.5	1	0.1875	1.00E+07	0.33	0.95	9.23E+06	3.52E-02	0.46875	3.08E+05	7.71E+05
2.5	2	0.1875	1.00E+07	0.33	0.95	9.23E+06	8.79E-03	0.46875	7.71E+04	3.85E+05
2.5	3	0.1875	1.00E+07	0.33	0.95	9.23E+06	3.91E-03	0.46875	3.43E+04	2.57E+05
2.5	4	0.1875	1.00E+07	0.33	0.95	9.23E+06	2.20E-03	0.46875	1.93E+04	1.93E+05
2.5	5	0.1875	1.00E+07	0.33	0.95	9.23E+06	1.41E-03	0.46875	1.23E+04	1.54E+05
Aluminum - 1/4 inch thick										
Width	Length	Thickness	Young's	Poisson	C	Term2	Term3		Stress	Force
(inches)	(inches)	(inches)							(PSI)	(pounds)
2.5	1	0.25	1.00E+07	0.33	0.95	9.23E+06	6.25E-02	0.625	5.48E+05	1.37E+06
2.5	2	0.25	1.00E+07	0.33	0.95	9.23E+06	1.56E-02	0.625	1.37E+05	6.85E+05
2.5	3	0.25	1.00E+07	0.33	0.95	9.23E+06	6.94E-03	0.625	6.09E+04	4.57E+05
2.5	4	0.25	1.00E+07	0.33	0.95	9.23E+06	3.91E-03	0.625	3.43E+04	3.43E+05
2.5	5	0.25	1.00E+07	0.33	0.95	9.23E+06	2.50E-03	0.625	2.19E+04	2.74E+05

Based on the above analysis and common sense, 3/16 inch thick 6061 - T6 aluminum was selected for the gusset plates.

Wind Force on and Static Stability of Pyramobelisk

Force on the Space Frame:

2 x 85 Frames per side	Sides	Length of Frame (in)	Width of Frame (in)	Area of one Frame (in^2)	Total Area (in^2)	Total Area (ft^2)	Force per Ft^2 (lbs)	Total Force (lbs)
42	2	85	2	170	14,280	99.2	20	1,983

Force on the Van Side Panels and Windows:

Average Length (feet)	Average Height (feet	Area (feet ^ 2)	Force per Ft^2 (lbs)	Total Force (lbs)
16	5	80	20	1,600

Total Lateral Force on Van plus Pyramobelisk Structure: 3,583 lbs

Center of Lateral resistance to the wind:

Space Frame Center of Effort Hight:	10	ft
Van Sude Panel Center of Effort Height	3.5	ft
Overall Center of effort Height:	7.10	ft.

Center o f Gravity:

Space Frame Center of Gravity Height:	10	ft	Space Frame Weight:	500	lb
Van Side Center of Gravity Height	4	ft	Van Weight:	6,000	lb
Overall Center of Gravitry Height:	4.46	ft.	Gross Weight	6,500	lb

Lateral Tip Over Force Applied at Height of the Center of Effort:

Distance between Outside of Wheels:	78	in
Overall Center of effort Height:	85.17	in
Horizontal distance between center of lateral resistance and outside wheel edge:	36	in
Gross Weight:	6,500	lb

Tip over force: 2,747 lbs

Additioanal Guy Wire Restraining Force Needed: 836 lbs

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