MARS CABLE DESIGN

METC 111

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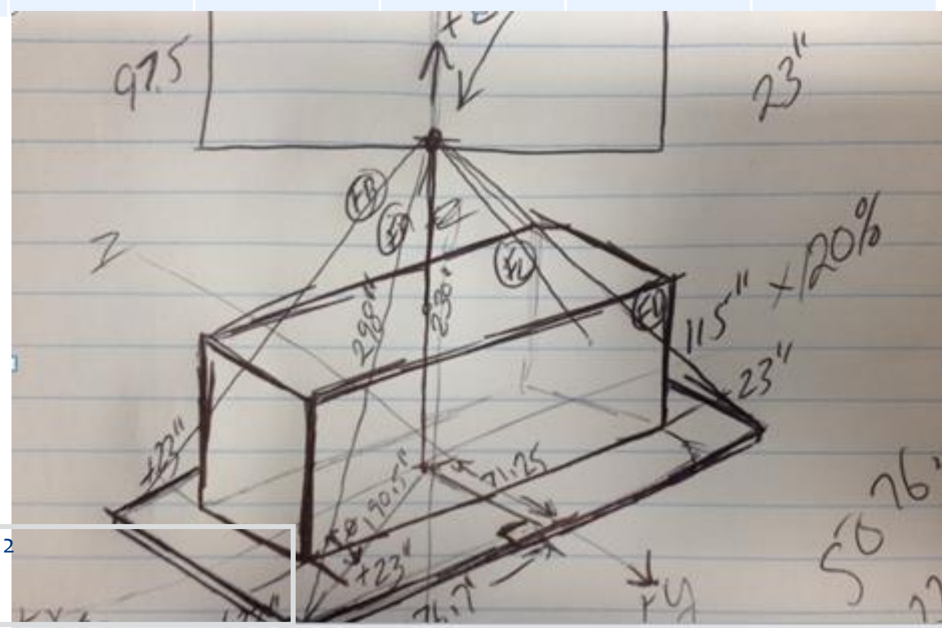
Original Earth Design and Dimensions to Lift A 5 ton Military Truck

	Platform and Cable Dimensions		
Length	**353.4**	**inches**	
Width	inches143.5		
Height	**230**	**inches**	
Distance from Dead Center of Platform to Cable attachment at each corner=		190.7117	inches
Actual Length of Cable=		298.7825	inches
Cable Angle from platform=	**50.33511**	°	

This spreadsheet has been designed to calculate the forces in cables when lifting a M939 5 ton military vehicle that has been driven onto a platform that can be lifted by a 25' cable that splits into 4 individual cables that attach at each corner of the platform. The platform is assumed to be the L*W of the vehicle, plus 20% of the H in all directions. The single supporting cable makes its split into 4 cables at 200% of H above the platform.



Force per Cable=	3245.049	2

Mars Cable Calculations

FA=	176.5	i	71.25	j	-230	k	rAA=	298.5							
FB =	176.5	i	-71.25	j	-230	k	rAB =	298.5	W =	-3773	lb				
FC =	-176.5	i	-71.25	j	-230	k	rAC =	298.5	Fx =	0.591201666	FB	-0.591201666	FC	-0.5912	FD	0.591201666	FA
FD =	-176.5	i	71.25	j	-230	k	rAD =	298.5	Fy =	-0.238657897	FB	-0.238657897	FC	0.238658	FD	0.238657897	FA
									Fz =	-0.770404438	FB	-0.770404438	FC	-0.7704	FD	-0.770404438	FA

This spreadsheet has been designed to calculate the forces in cables when lifting a 5 ton military vehicle that has been driven onto a platform that can be lifted by a 25' cable that splits into 4 individual cables that individually attach at each corner of the platform. The platform is assumed to be the L*W of the vehicle, plus 20% of the H in all directions. The single supporting cable makes its split into 4 cables at 200% of H above the platform.

ΣFz= -3.081617752

Positive

Force per Cable= 1224.36 lbs

Platform and Cable Dimensions

Length	353.4	inches
Width	143.5	inches
Height	230	inches

Distance from Dead Center of Platform to Cable attachment at each corner= 190.71 inches

Actual Length of Cable= 298.78 inches

α= 0.000023 | ΔL=α*L*ΔT

Orignal Temp 68°F | Orignal Length 300 in

Cable Angle from platform: 50.33511 °

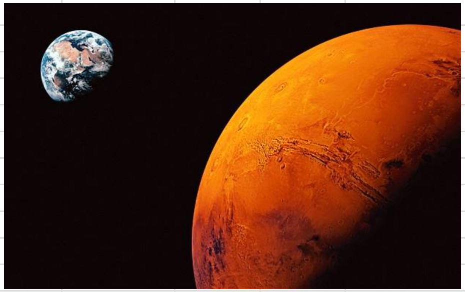
OBJECT	ACCELERATION DUE TO GRAVITY	GRAVITY
Earth	9.8 m/s^2 or 32 ft/s^2	1 G
the Moon	1.6 m/s^2 or 5.3 ft/s^2	.16 G
Mars	3.7 m/s^2 or 12.2 ft/s^2	.38 G
Venus	9.5 m/s^2 or 31 ft/s^2	.88 G
Jupiter	24.5 m/s^2 or 80 ft/s^2	2.54
the Sun	275 m/s^2 or 896 ft/s^2	28 G

Cable design with consideration for usage on Mars.

1.) Convert the 5 tons to kg for easier conversion. 5 Tons = 4535.92 kg→4535.92 kg times acceleration due to gravity on Mars of 3.7 m/s^2 = 16783 Newtons = 3773 pounds

2.) Aluminum was selected as the cable material because of its stability in the extremely cold(*-195°F) conditions present on Mars because of its Face Centered Cubic crystaline structure.

3.) Based on the cold temperature, the aluminum will shrink 1 3/4 inches, in order to maintain the angles indicated, this shrinkage needed to be taken into account, so the aluminum cable needs to be cut at a length of 300.53 inches at 68°F.



Cable design with consideration for usage on Mars.

1.) Convert the 5 tons to kg for easier conversion. 5 Tons * .38 = 1.9 Tons.

OBJECT	ACCELERATION DUE TO GRAVITY	GRAVITY
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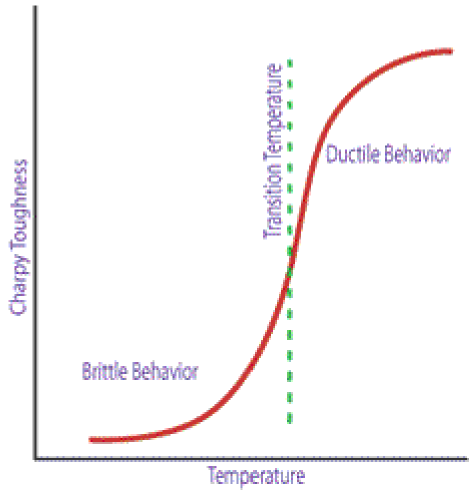
α=	23.0E-6		ΔL=α*L*ΔT	Orignal Length	300.53	in	-1 3/4
Orignal Temp	68°F						

3.) Based on the cold temperature, the aluminum will shrink 1 3/4 inches, in order to maintain the angles indicated, this shrinkage needed to be taken into account, so the aluminum cable needs to be cut at a length of 300.53 inches at 68°F.

Why not a steel cable?

Steels with ferritic or martensitic structures show a sudden change from ductile (safe) to brittle (unsafe) fracture over a small temperature difference. Even the best of these steels show this behavior at temperatures higher than -100 deg C and in many cases only just below zero

This produces a graph of impact toughness for the material as a function of temperature. An impact toughness versus temperature graph for a steel is shown in the image. It can be seen that at low temperatures the material is more brittle and impact toughness is low. At high temperatures the material is more ductile and impact toughness is higher. The transition temperature is the boundary between brittle and ductile behavior and this temperature is often an extremely important consideration in the selection of a material.



The cable size on Mars is 1/16 in. with Aluminum

	E = σ/ε				For Al
Al =	10,000,000	PSI		CSA =	1.2E-3
Vehicle weight =	1	ton		Cable size =	1/16
Vehicle weight =	1,200	lbs			
Given =	25	ft			
Maximum Allowed elongation =	10%				
max final length =	27.5	ft			
no plastic deformation					
all materials cost the same					
ignore cost of material					
ignore weight of structure					
Assumptions	10%				
Allowed Strain =	0.10				

* **1.) Aluminum was selected as the cable material because of its stability in the extremely cold(*-195°F) conditions present on Mars because of its Face Centered Cubic crystalline structure.**

Conclusion

- With a truck that weighs 5 tons on Earth it will only weigh 1.9 tons on Mars.
- Aluminum is the ideal metal for use the aerospace industry.
- Overall an 1/16 cable would do the job to carry a 2 ton truck on Mars.

Cable Design