MAGLEV PROJECT

Old Dominion University is the site for a first of a kind Magnetic Levitation Transportation System.

The route selected for the Maglev is approximately two-thirds of a mile in length running from Whitehurst and Powhatan residence halls, down the east-west spine of the campus and across Hampton Boulevard to the Constant Convocation Center, thereby bisecting the campus connecting dormitories, academic buildings and student activity centers. The track to be utilized will be elevated.

The project has been facing many challenges. One of the main challenges is related to the violent vibration due to the magnetic system thereby making the ride quality unacceptable. Your team is hired to solve one of these problems. The track and its magnetic coupling need to be investigated, analyzed, and more likely modified to meet the needs to function the Maglev with minimal problems. Magnets are installed at the bottom part of the Vehicle structure and will be pulled towards the track to create a complete air born vehicle, levitating without touching the track. The magnets that are used as the support of the Maglev during levitation need to be operating at a maximum of 1" gap clearance between the magnet and the track.

Figure 1 Current Maglev at ODU

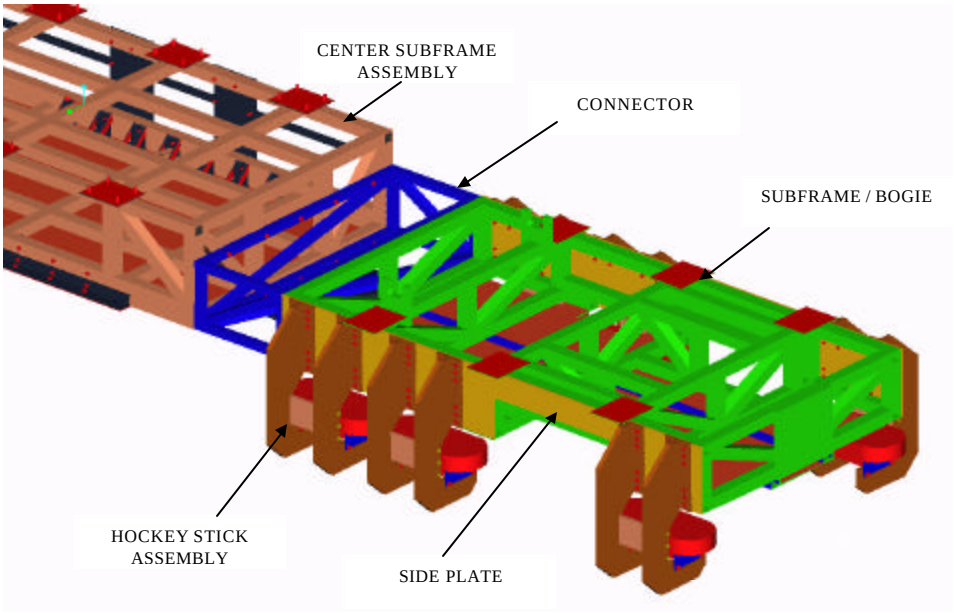


Figure 2 Magnets Location

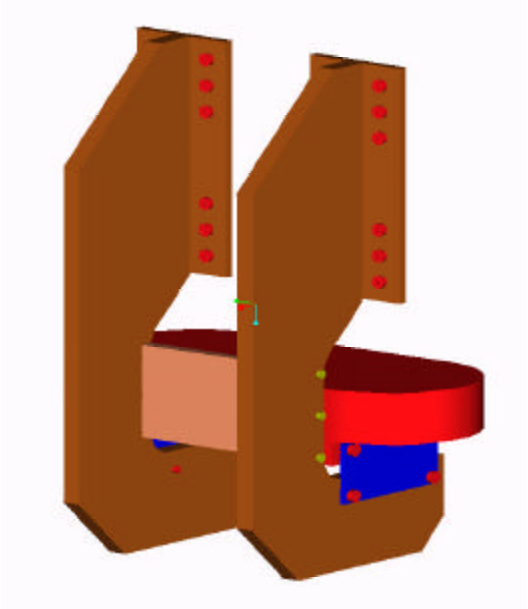


Figure 3 Exploited View of Magnet Suspension

The complete assembly of the lower structure on the track are shown in Figs. 4-8. Appendix A shows the CAD drawings. When the magnets are activated, a maximum of 5,000 lbs are to be applied downward as a result of the load.

Project Requirements for Sub-Teams of Odd Numbers:

1. Sub-Teams ending with Odd numbers are to do the analysis of the track for one bogie (a set of 6 magnets). Create the model. – Due April 8th
2. Results of the track displacement must be minimal in order to allow the magnet to function within the 1 " gap. Apply the load and report stress/displacement of the FEA model. – Due April 15th
3. Optimize the structure to minimize deflection of the track. Produce 3D model and CAD drawings. – Due April 22nd
4. Compile the findings in a technical report. – Due April 27th

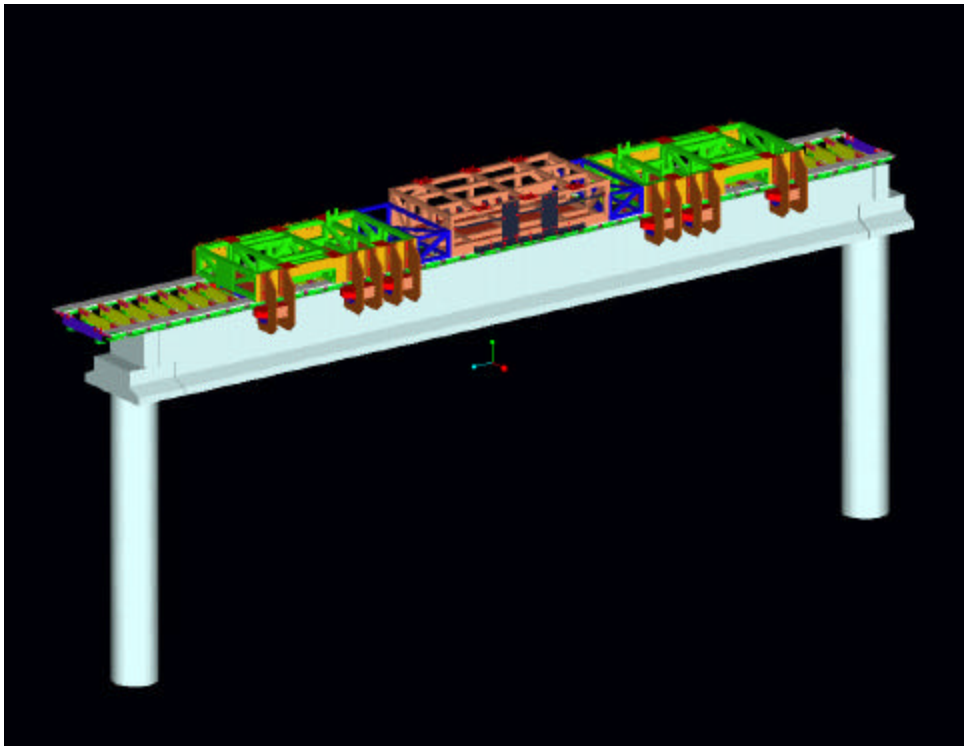


Figure 4 Lower Structure Assembly on Track

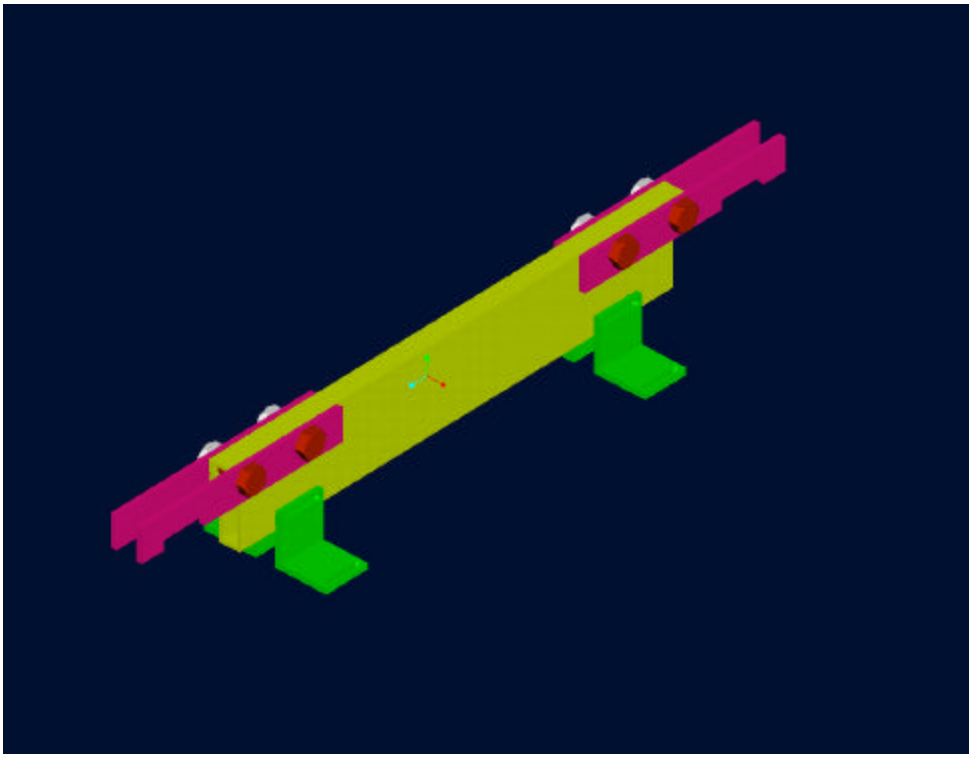


Figure 5 Cross Member of the Track

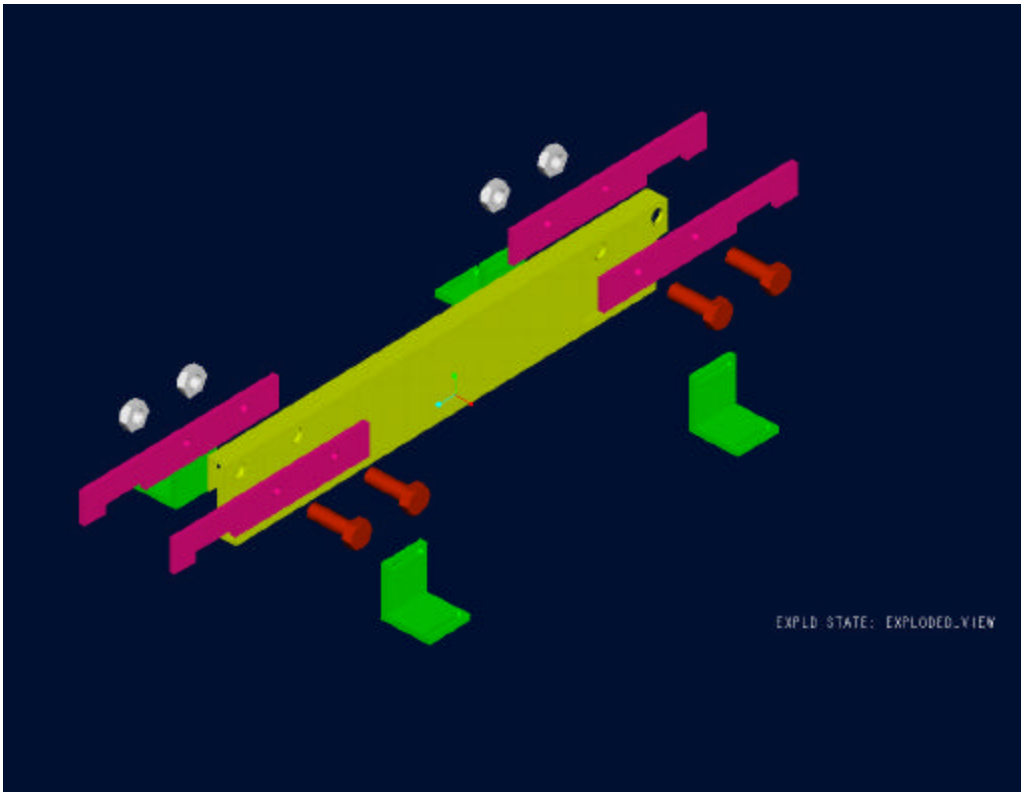


Figure 6 Exploited View of a Cross-Member of the Track

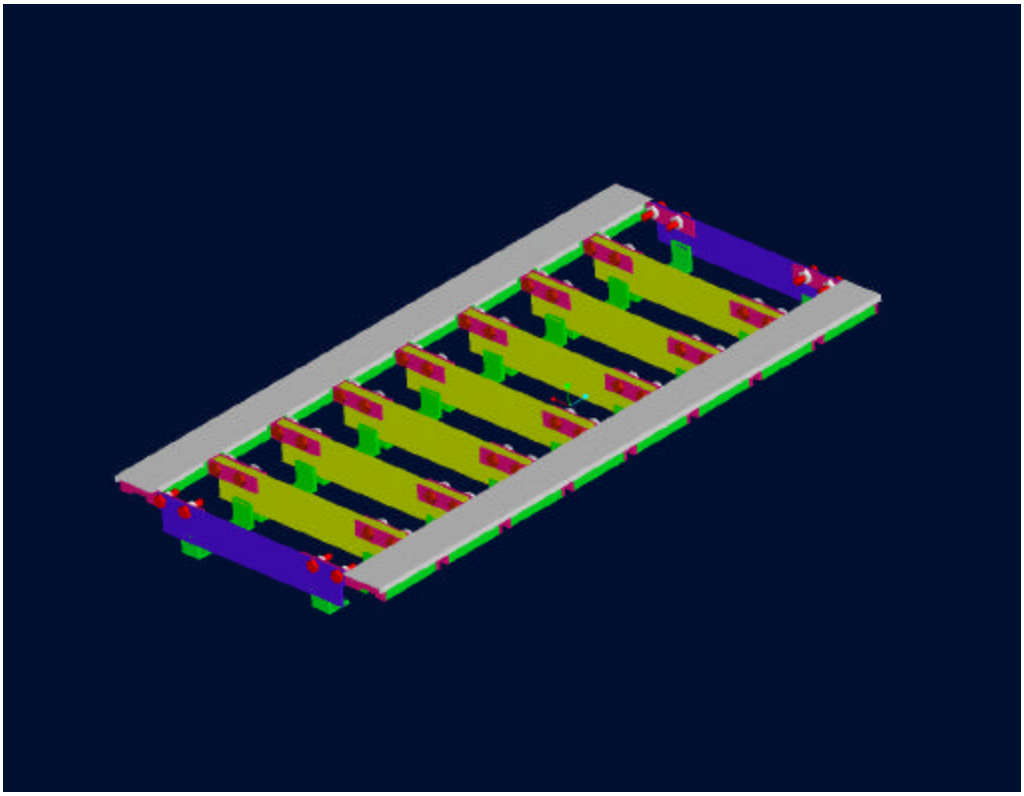


Figure 7 Top Part of the Track

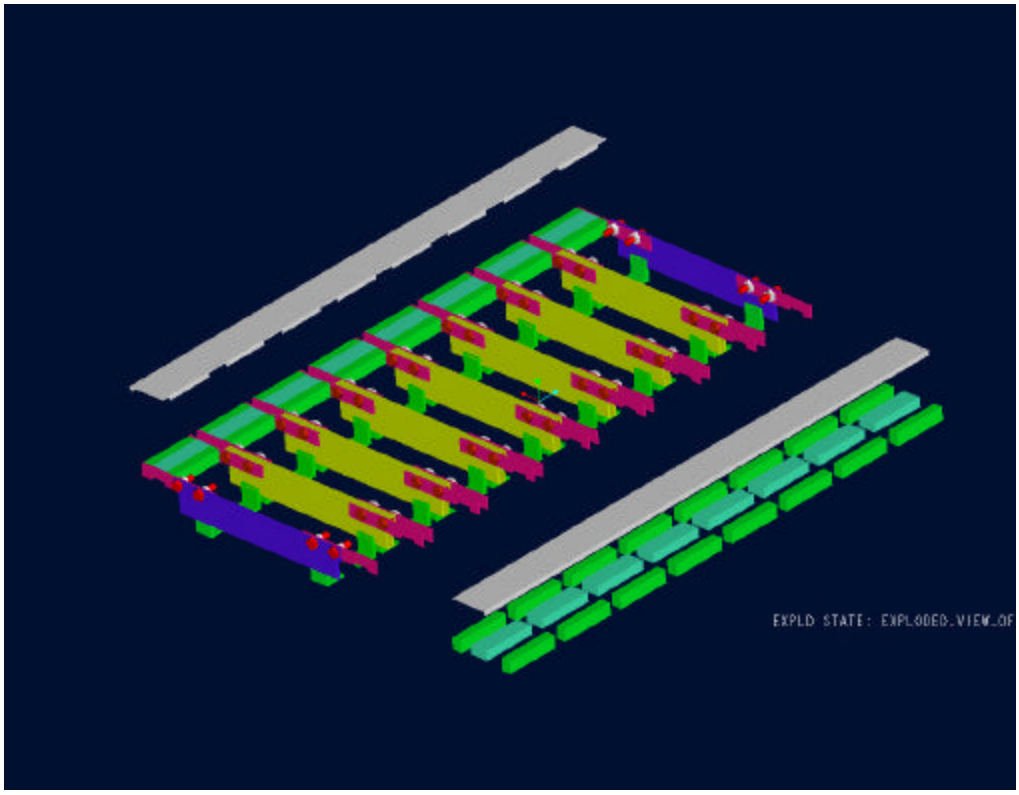


Figure 7 Exploited View of Top Part of the Track

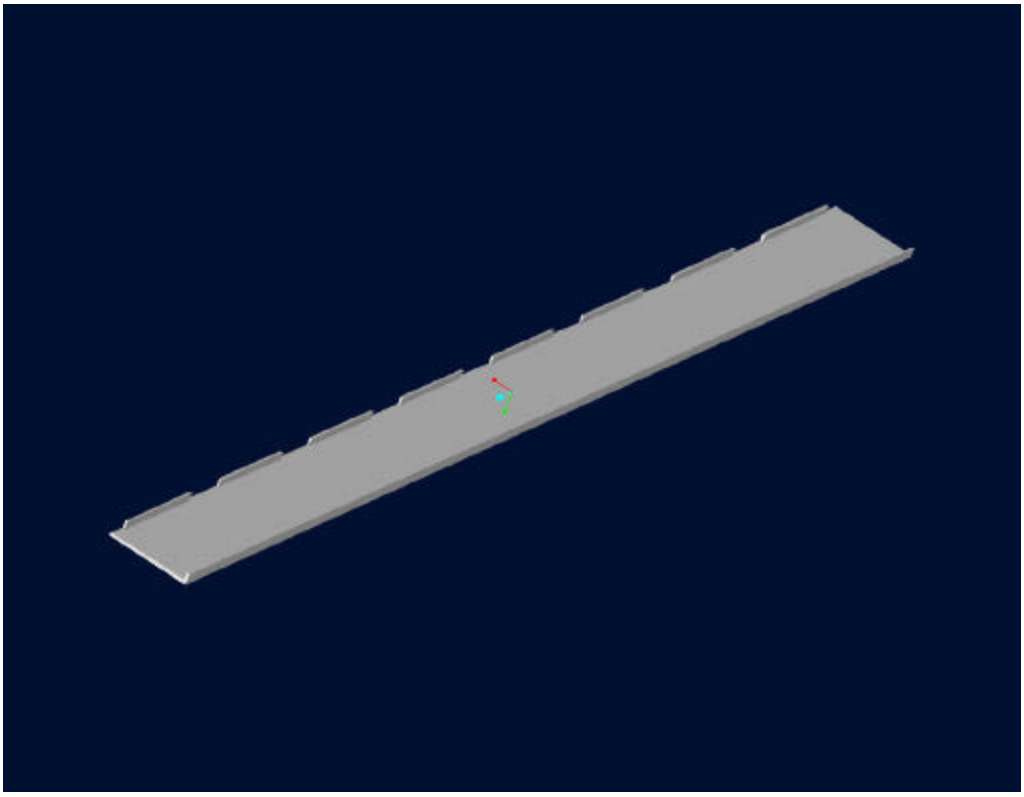


Figure 8 Track

Rig Setup

In order to validate the analysis, it is required to set up a rig where possible loads of up-to 5,000 lbs can be applied. An existing jig that was design and fabricated by Company X is shown in Figure 9.

Overview:
The test rig for the maglev train is to be developed for the study of the forces acting on the track when the magnet is activated. The test rig has to be robust, as a maximum force of 5000lbs would be acting on the whole system. The structure basically consists of 4 major components.

- The frame
- The magnet assembly
- The track
- The weights

FRAME: A frame has to be designed in order to accommodate all the components necessary and to arrive at a feasible conceptual model. Further the frame has to have three divisions.

- To position the magnets on one end of the overall frame
- A strong rigid post to which the track has to be fixed with the help of some mechanism.
- Room to achieve a total weight of 5000lbs.

MAGNET ASSEMBLY: The magnet assembly is as shown below fitted with a clamp. The clamp has to be designed so that its effectively connected to the guide way. To simplify this a C-channel is used for this purpose. This guide has to be designed to sustain high loads as this undergoes a lot of stress during testing as the whole magnet assembly is connected to it.

TRACK: The track is the tested component and is only fixed to the frame by some mechanism. Basically it consists of sections of laminations over a length and covered with a metal slab. The track mechanism has to be designed in such a way that it allows the track to be right on top of the magnets and also has to maintain a very small gap. The fixture has to be very rigid, as the track would undergo heavy loading.

WEIGHTS: Dead weights have to be used for loading the track. These weights have to placed in a cage or some kind of platform and connected to the track through a mechanism so as to achieve a mechanical advantage of 5000lbs.

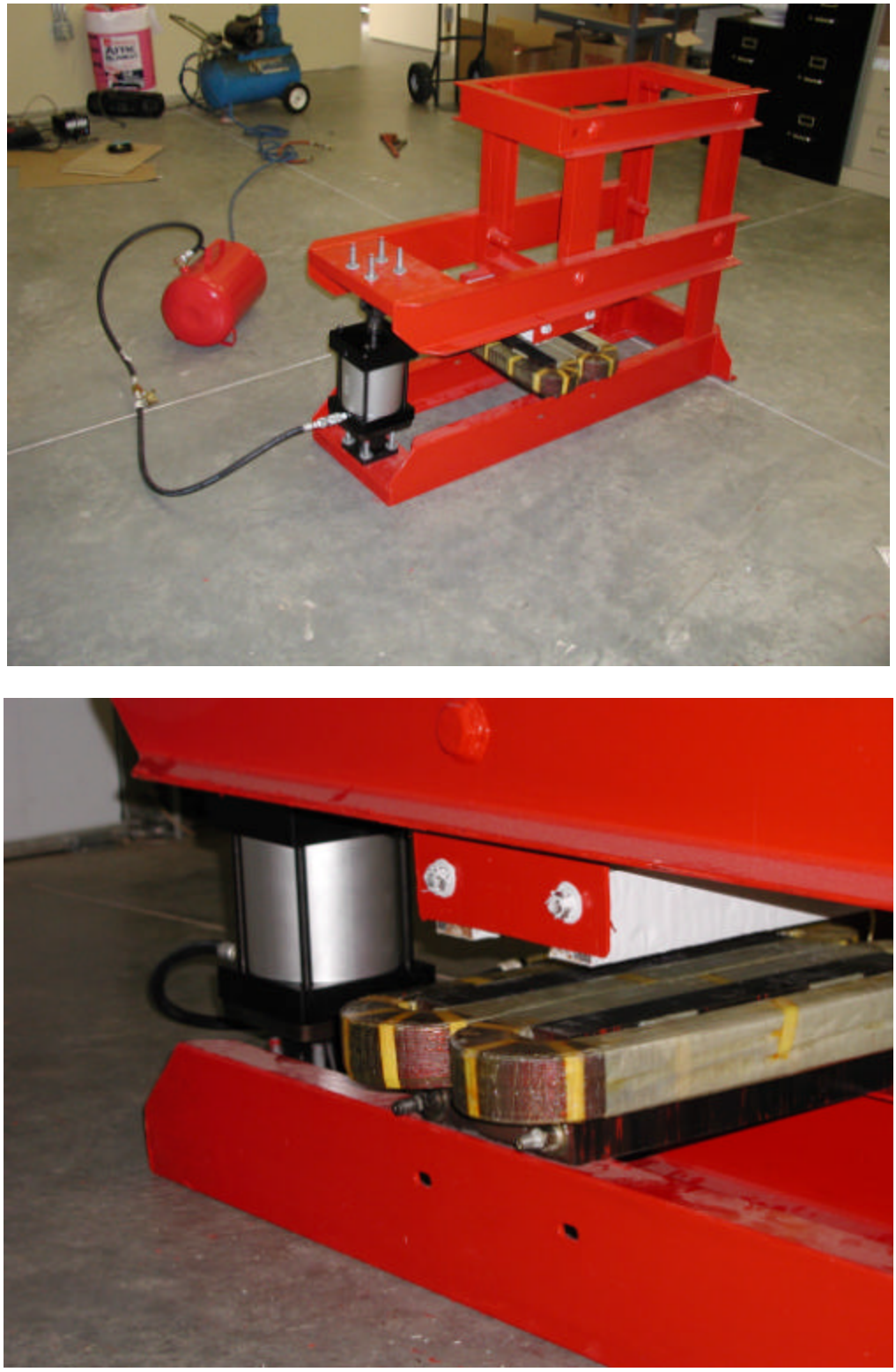


Figure 9 Existing Rig Setup

Magnets

On the test rig the 2 sets of magnets are placed on tow c-channels and are fixed to the frame as shown above. The dimensions for the magnets are as shown.

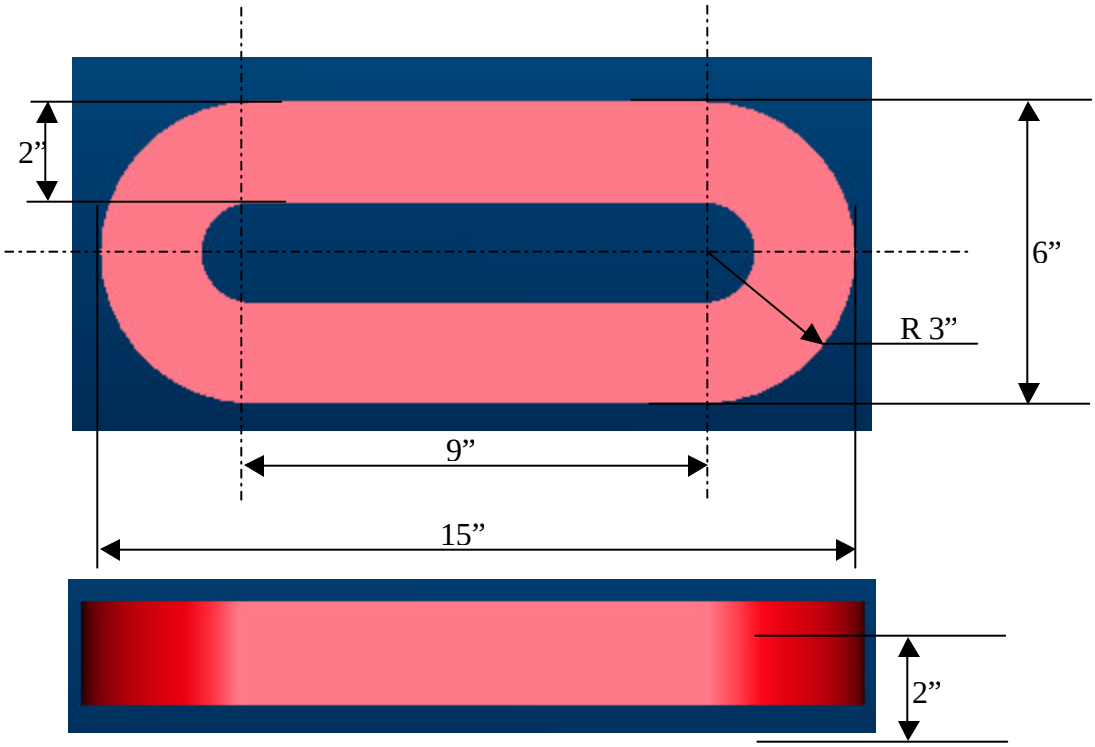


Figure 10 Magnet

Laminates

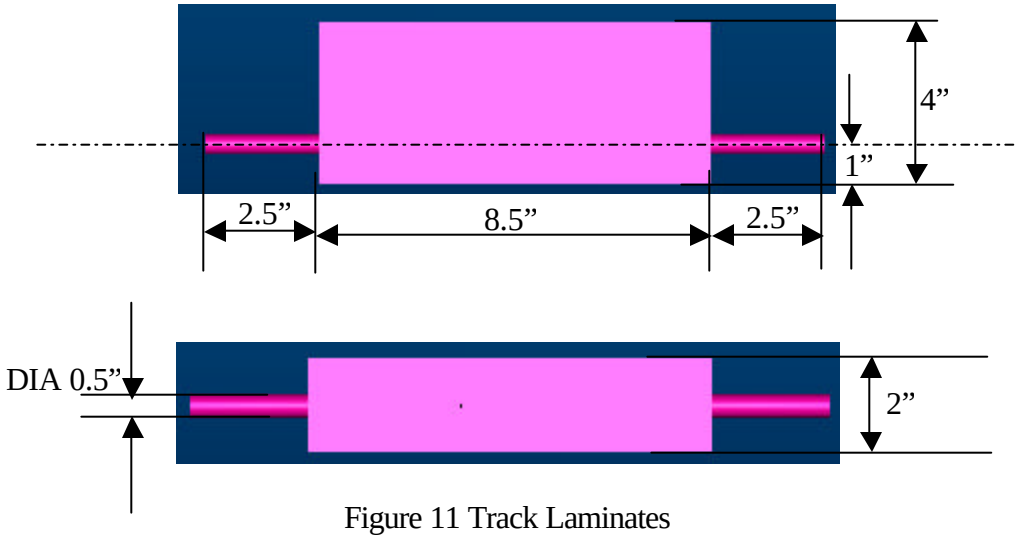


Figure 11 Track Laminates

The laminates are made of a stack of metal pieces, which are glued and placed inside the hollow portion of the magnet. The whole stack is connected with a bolt protruding at each end, which is further connected to the clamps.

Clamps

The clamps are used each end of the laminates to be fixed to form the magnet assembly which is subsequently connected to the guides.

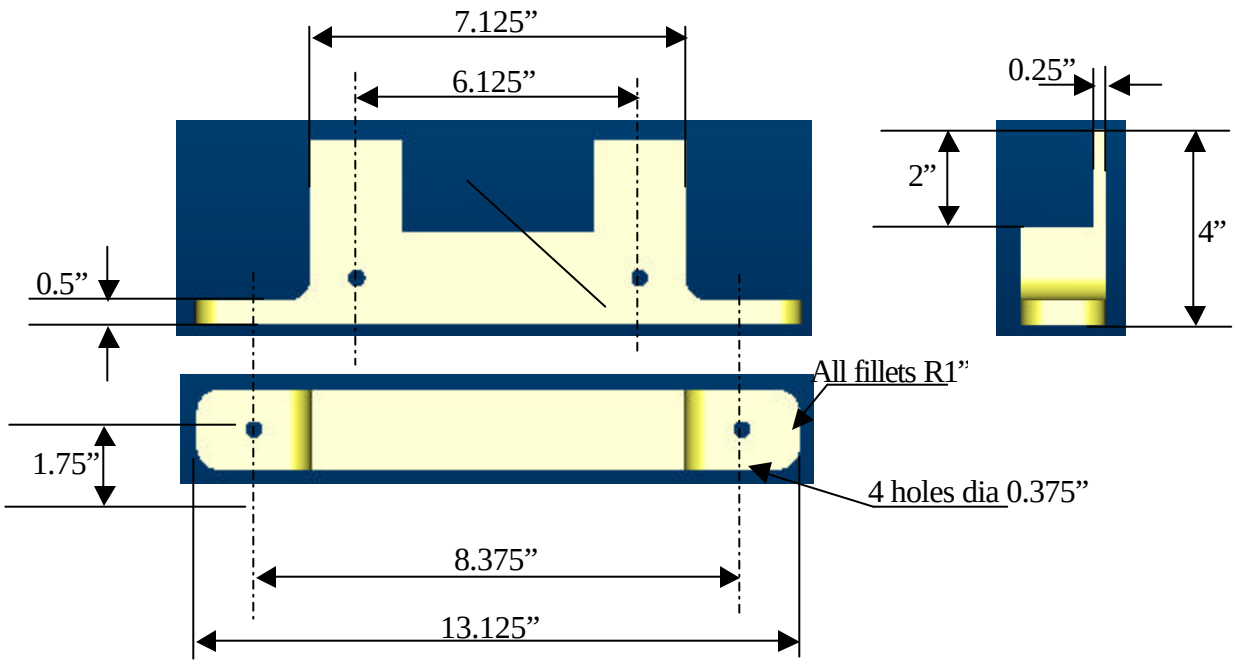


Figure 12 Clamps

Track

The track to be tested is made of sections of laminates, which are glued and bolted together. Number, of such laminates are used to build the entire length of the track. For testing purpose either one or three sections of the track are considered and positioned right on top of the magnet in such a way that it is exactly at the center of the gap maintained in between the base frame.

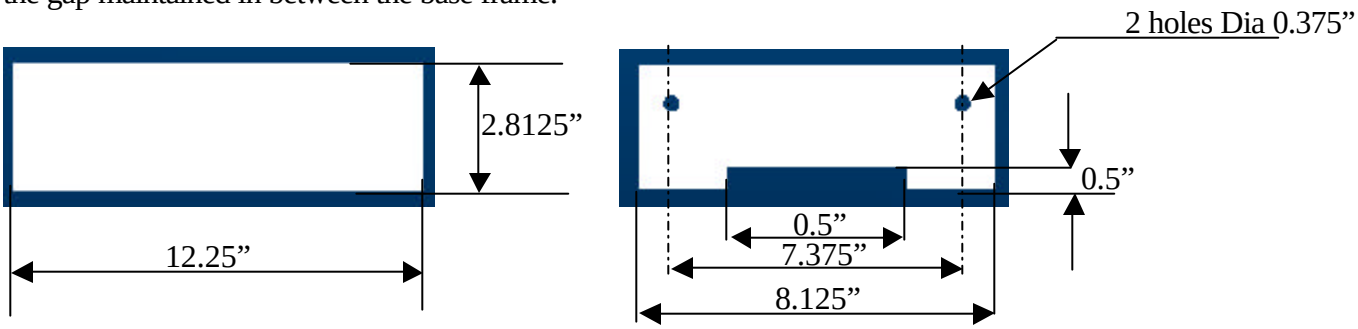
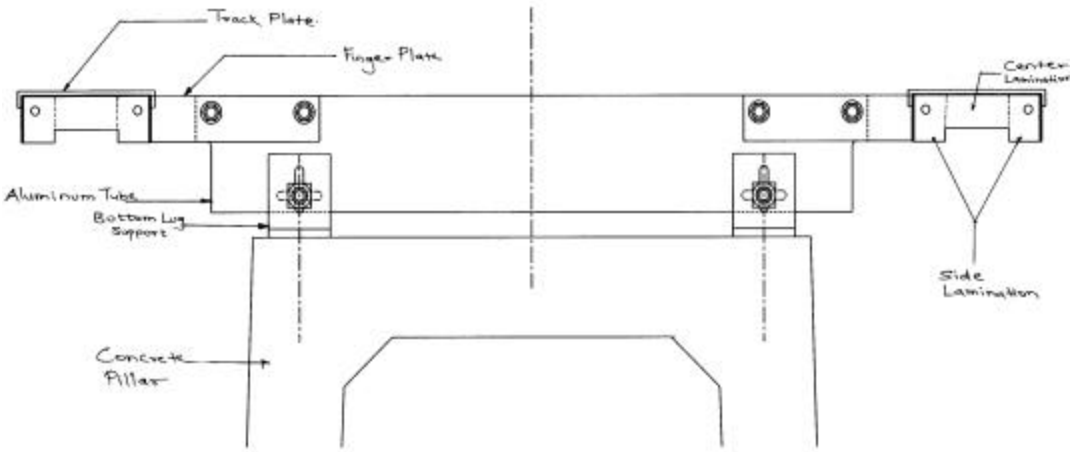


Figure 13 Track

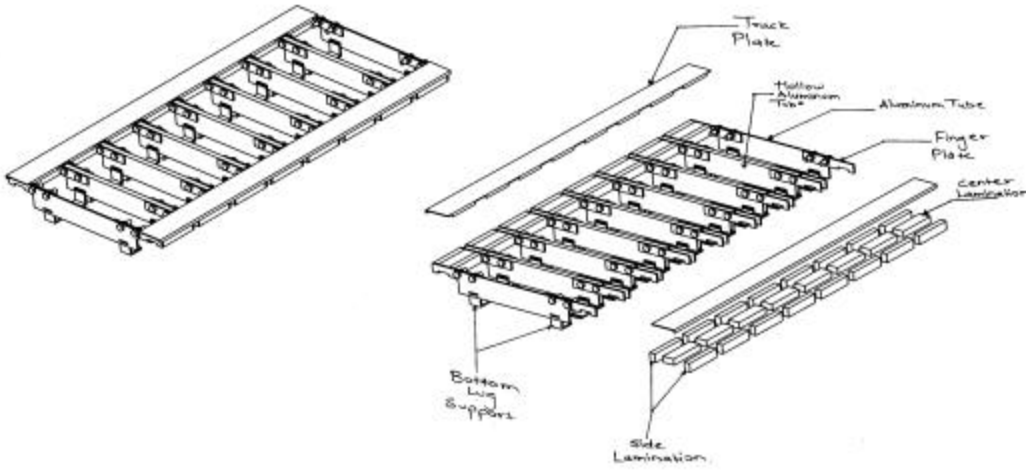
Project Requirements for Sub-Teams of Even Numbers:

1. Design a rig that can be initially set at set clearances between the track and magnets. Measure the vertical and one lateral force produced for that clearance or gap. Adjust the gap at incremental values and redo the experimental work to measure the forces. It is suggested to incorporate load cells into the design. (This work is more-or-less kinematics) – Due April 8th
2. For a selected design, analyze the structure and detail design to make sure that the complete rig is extremely stiff. Report FEA results, in particular stress and displacement. – Due April 15th
3. Produce 3D model and CAD drawings – Due April 22nd
4. Compile the findings in a technical report – Due April 27th

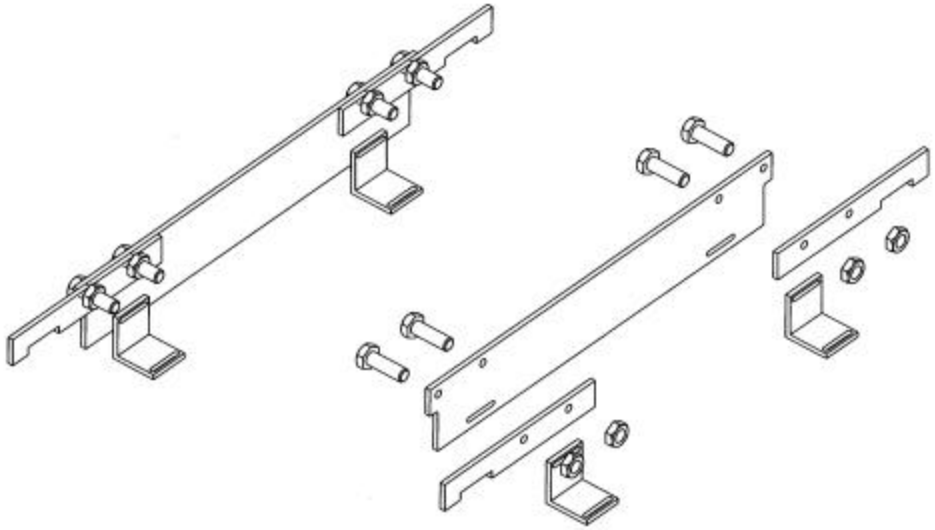
Appendix A

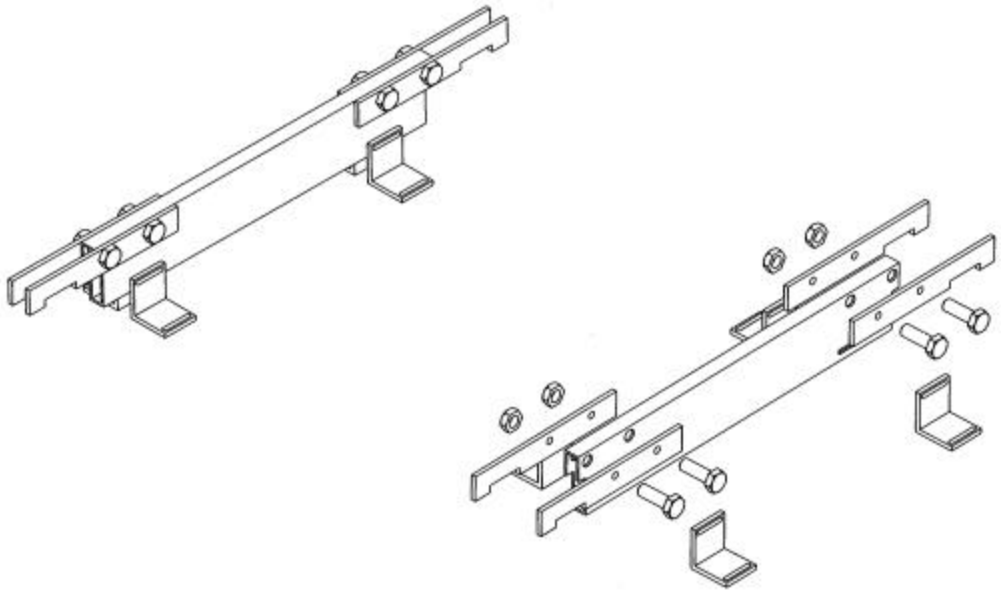

Track Plate
Finger Plate
Center Lamination
Aluminum Tube
Bottom Lug Support
Side Lamination
Concrete Pillar

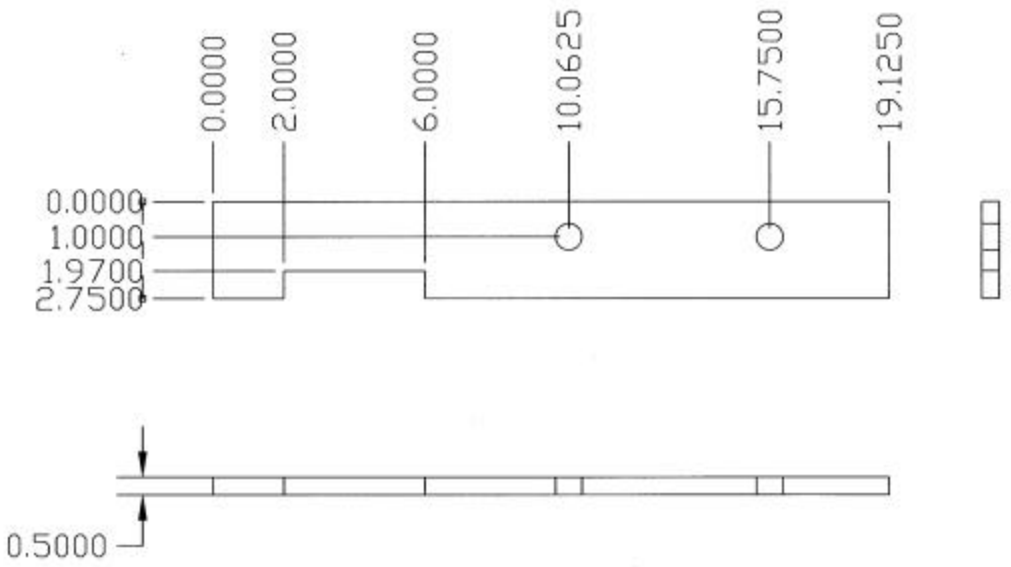
1


Track Plate
Hollow Aluminum Tube
Aluminum Tube
Finger Plate
Center Lamination
Bottom Lug Supports
Side Lamination

2

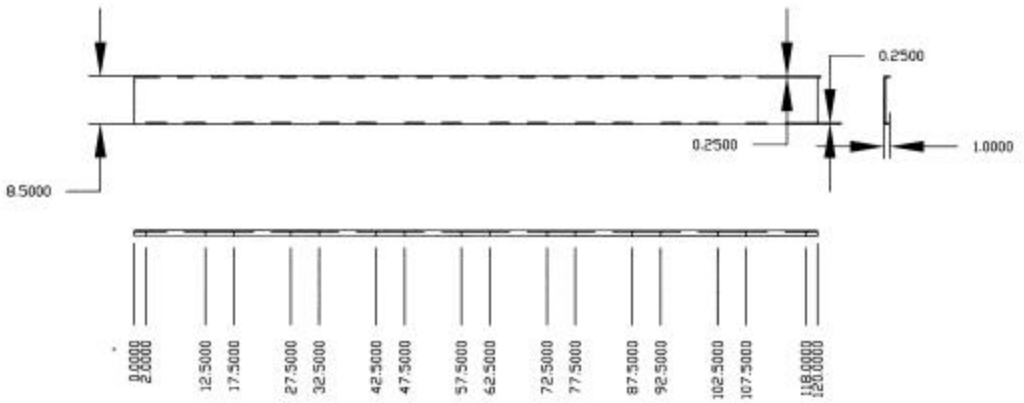






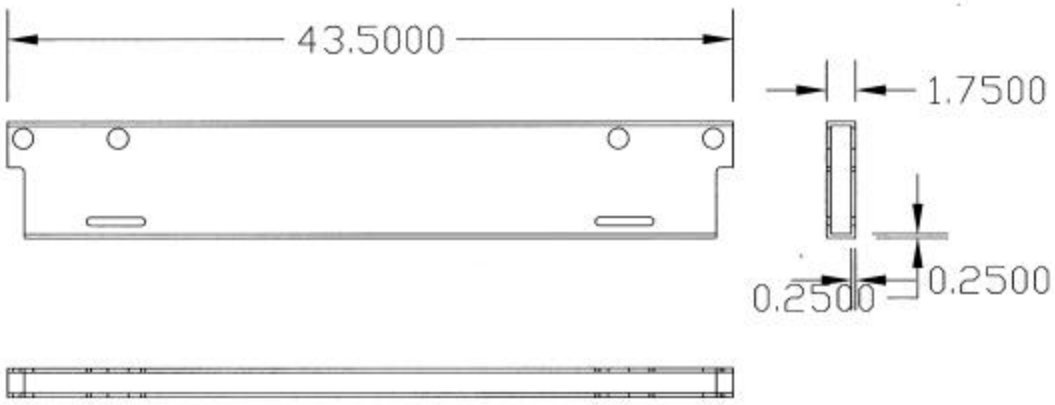
Finger Plate

5

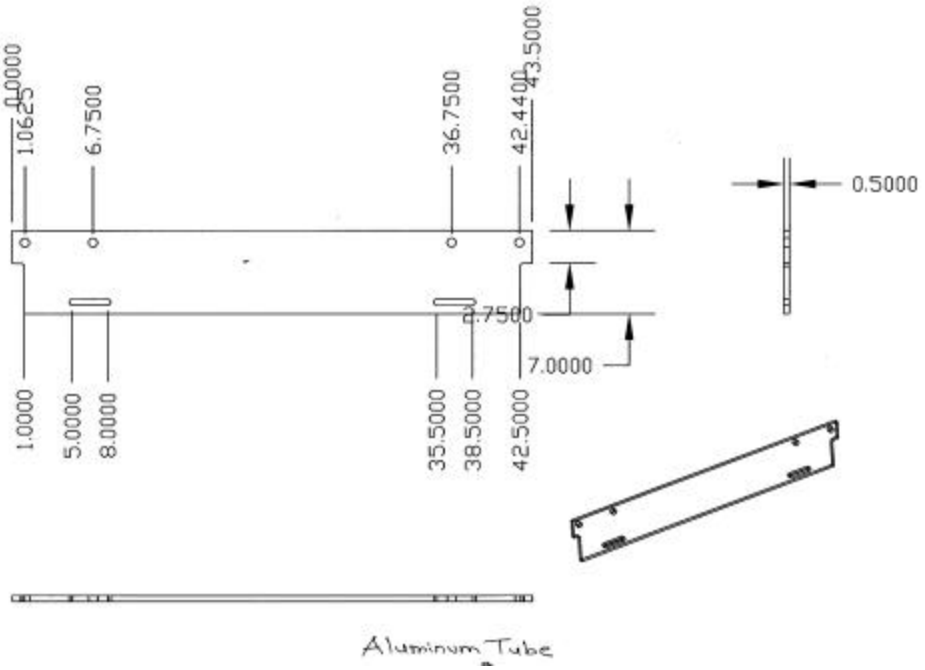


Track Plate

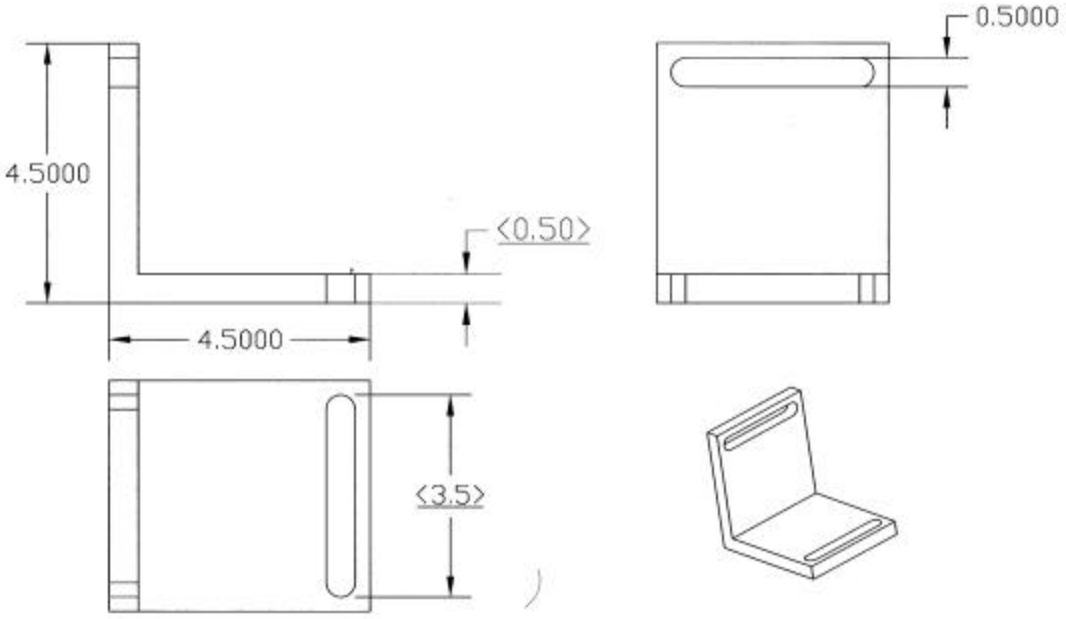
6



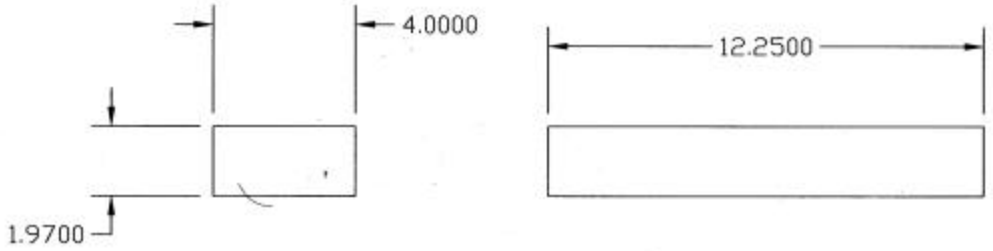
Hollow Aluminum Tube



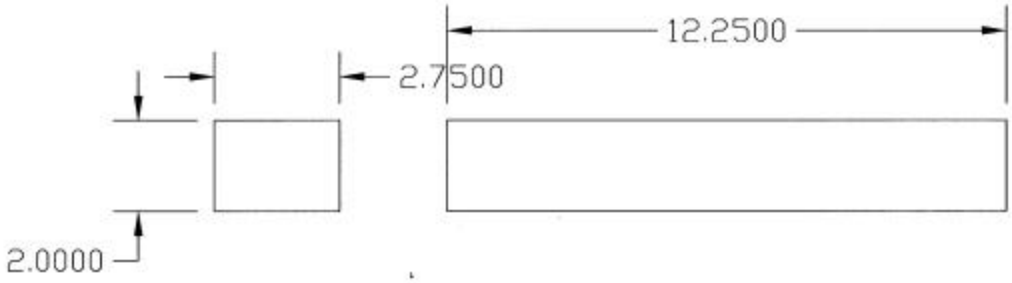
Aluminum Tube



Bottom Lug Support.



Center Lamination



Side Lamination

655			STUDENT	Sub-Team	Team
Last Name	First Name	E-mail			
BORADE	NILESH	nbora001@ODU.EDU	1	1	1
BUSSA	DILIP	dbuss001@ODU.EDU	2	1	1
DESAI	SUNDEEP	sdesa001@ODU.EDU	5	2	1
DHAYAGUDE	SWANAND	sdhay001@ODU.EDU	6	2	1
CARROLL	FRANK	FCARR002@ODU.EDU	3	4	2
CHEN	WENJUI	WCHEN004@ODU.EDU	4	4	2
DROSHE	RICHARD	rdros001@ODU.EDU	7	3	2
DUMBALA	SRIDHAR	sdumb001@ODU.EDU	8	3	2
HATTON	NATASHA	NHATT001@ODU.EDU	9	6	3
HOANG	TUAN	THOAN002@ODU.EDU	10	6	3
KULKARNI	SHEKHAR	skulk002@ODU.EDU	13	5	3
LEWIS	TIFFANY	tlewi008@ODU.EDU	14	5	3
HONRAO	ABHIJIT	ahonr001@ODU.EDU	11	7	4
KING	MICHELE	MHASK002@ODU.EDU	12	7	4
MADHINENI	PAVAN	pmadh001@ODU.EDU	15	8	4
NANJANGUD	RAVINDRA KUMAR	rnanj001@ODU.EDU	16	8	4
SANGOLLI	GIRISH	gsang001@ODU.EDU	17	9	5
SHAH	PRITESH	pshah002@ODU.EDU	18	9	5
TIPNIS	AKHIL	atipn001@ODU.EDU	21	10	5
VAN IRVIN	RAMONA	RRAND003@ODU.EDU	22	10	5
SHEEHAN	JASON	JSHEE002@ODU.EDU	19	11	6
SMITH	ROBIN	RSMIT016@ODU.EDU	20	11	6