ME486C: Senior Design Project
Status Report: January 25, 2004

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Problem Statement:

- Orbital requires a low profile electronics packaging design that will accommodate the specified printed wiring board (PWB) outline, and number of specified modules.

Top Issues:

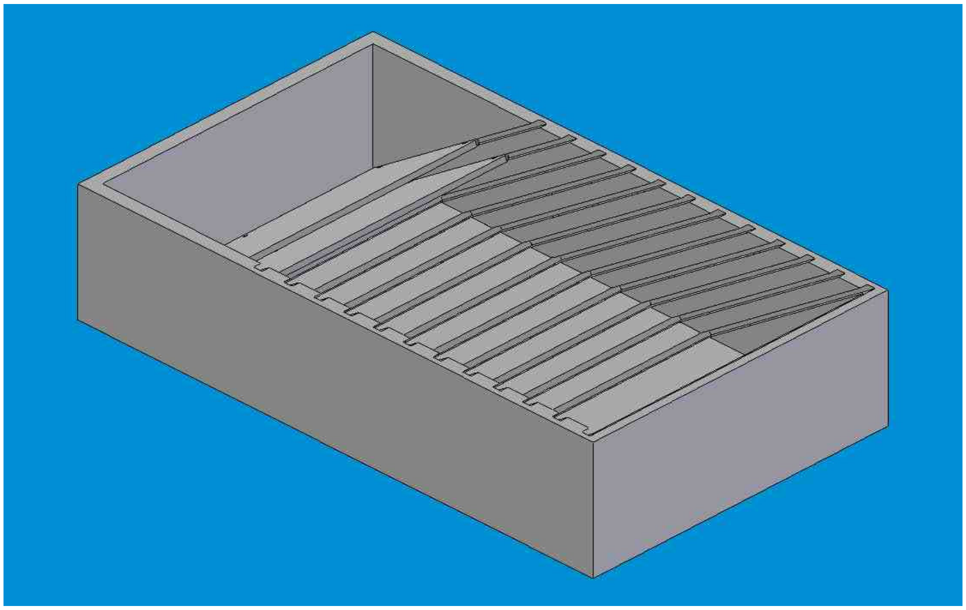
- Vibration Analysis: A hand vibration analysis comparing board mounting methods and other design considerations will help in the choosing of a final design. A Matlab program to compare board natural frequencies with card-loks, simply supported on all sides, fixed on all sides, and screwed on all corners has been created. The results are not quite as expected. This could be a result of the lack of clarity with the following specifications:

  Standoff Effect: The effect of the standoffs on the natural frequency is not known. Steinberg's book has been checked with no luck. This could be

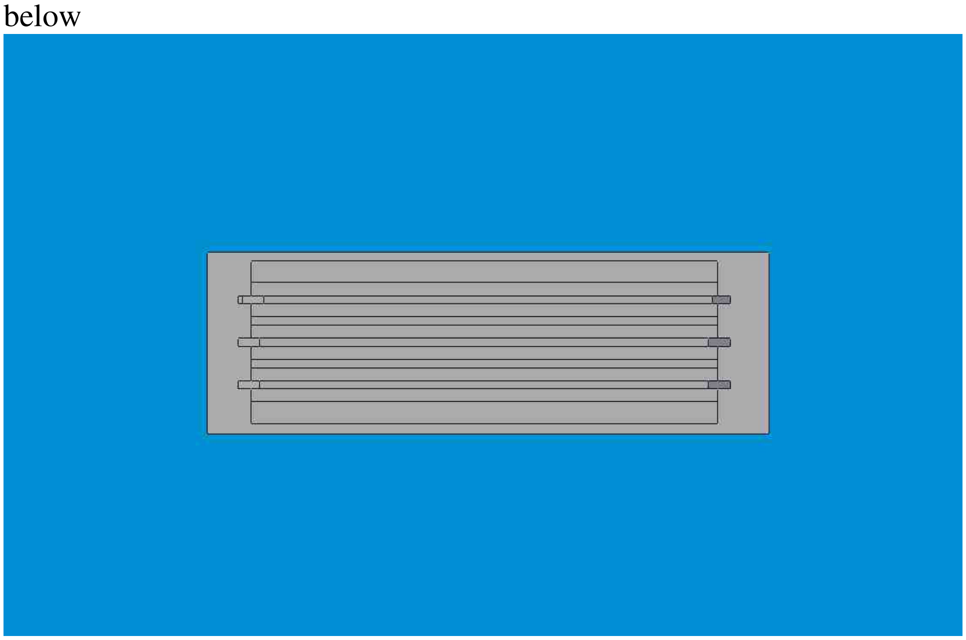
why we are getting very large deflections and low natural frequencies in our calculations.
Which G Levels to Use: We have assumed shock G levels will be the highest at the natural frequency and have used them. But once again, we are afraid this may be too conservative and give us more deflection than is actually present.
PWB Properties: Of special concern are the PWB properties. We have assumed a material of polyimide, but on Matweb.com the values for tensile modulus and other values are only shown with a wide range. This heavily affects natural frequency and deflections. Also, the effect mounted components have on stiffness is unknown presently.
Fastener Sizes: As far as the stiffness fasteners provide, without knowing the size of fasteners used, it is impossible to evaluate fastener stiffness for the current design. Obviously our design will involve selecting a sufficiently stiff fastener, but for evaluation sake, the current fastener parameters could prove useful.
Edge Conditions: As per the guidance of our faculty advisor, we are using an assumption of the two short sides simply supported for the current design, in lieu of fastener stiffness. This may be an incorrect assumption that could be helped by knowledge of fastener parameters.

- Critical Location Analysis: This analysis will focus quantitatively on trouble areas for the proposed designs. Board interfaces, thin material sections, clearance issues, etc. will be considered when selecting a final design.
- Current Design Choices: The five design choices have been generally modeled and are being examined for final design selection. They can be seen in screenshots and explained in detail on the following pages:

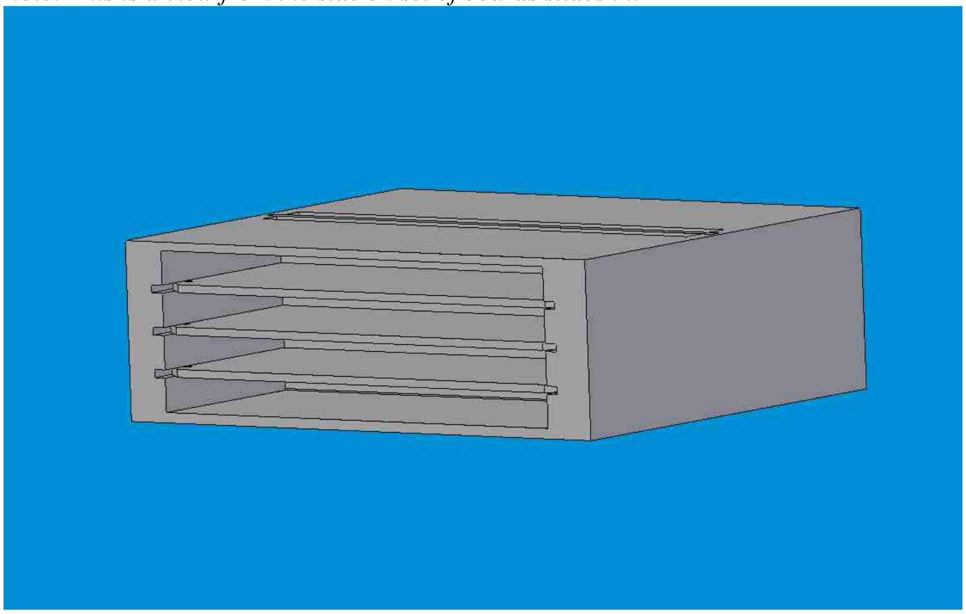
1) Single Housing with Slanted Slots: This design simply creates one housing for all PWBs and mounts them slanted so as to reduce head height. It preserves current board designs for the most part, but would most likely require card-loks. Connector locations would still be on top of the unit, and the box would have feet to mount to the bulkhead on bottom. A screenshot CAD model can be seen below.



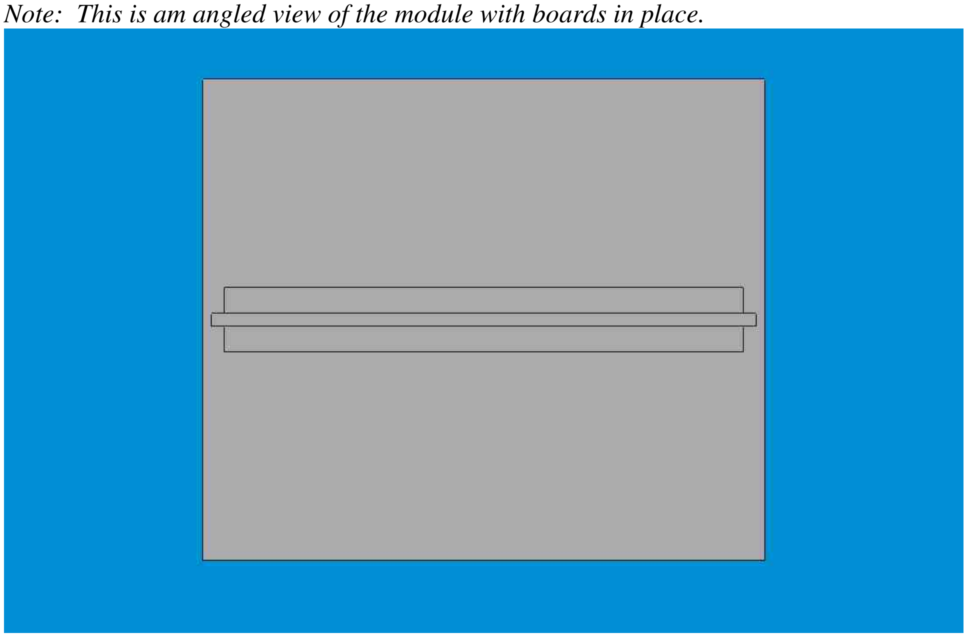
2) Single motherboard configuration: This design takes a two-sided motherboard, inserts it vertically into a module, and then slides boards in from each side to connect to the small motherboard. It saves a great deal of space and weight, but requires the creation of a compact and efficient motherboard, and possibly some function board changes. Connector locations would be on the sides of the module, saving head height. Some screenshots can be seen below



Note: This is a view from the side on set of boards slides in.

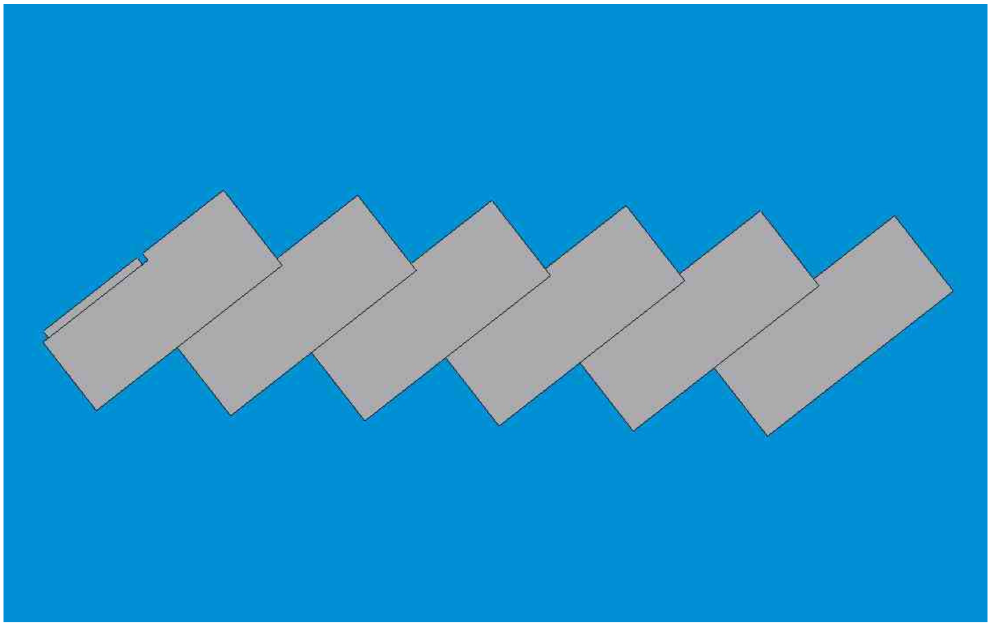


Note: This is am angled view of the module with boards in place.

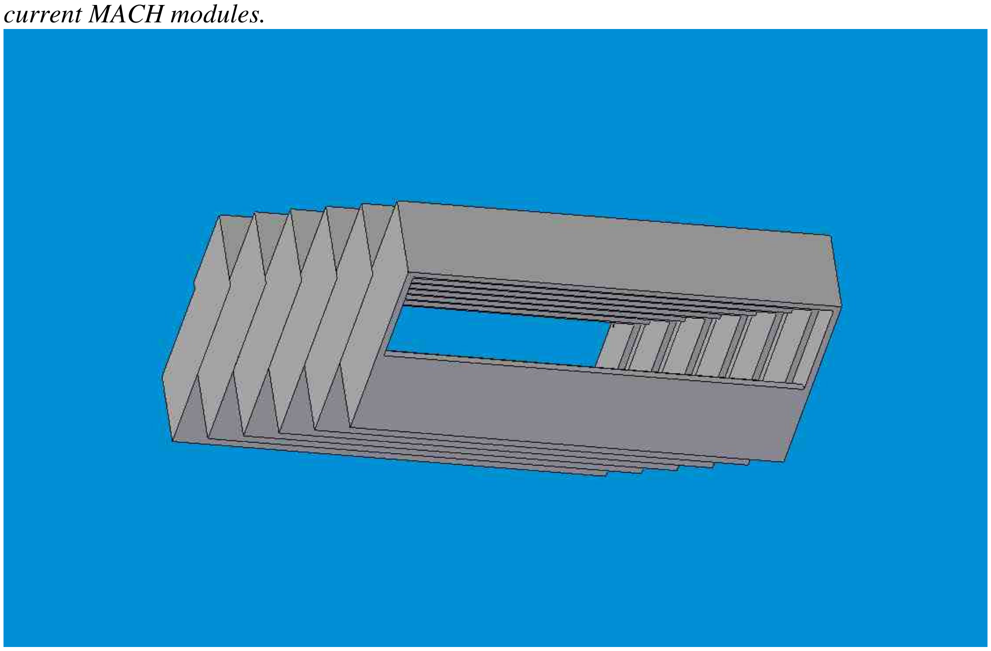


Note: This is a top view where the motherboard slides into the module.

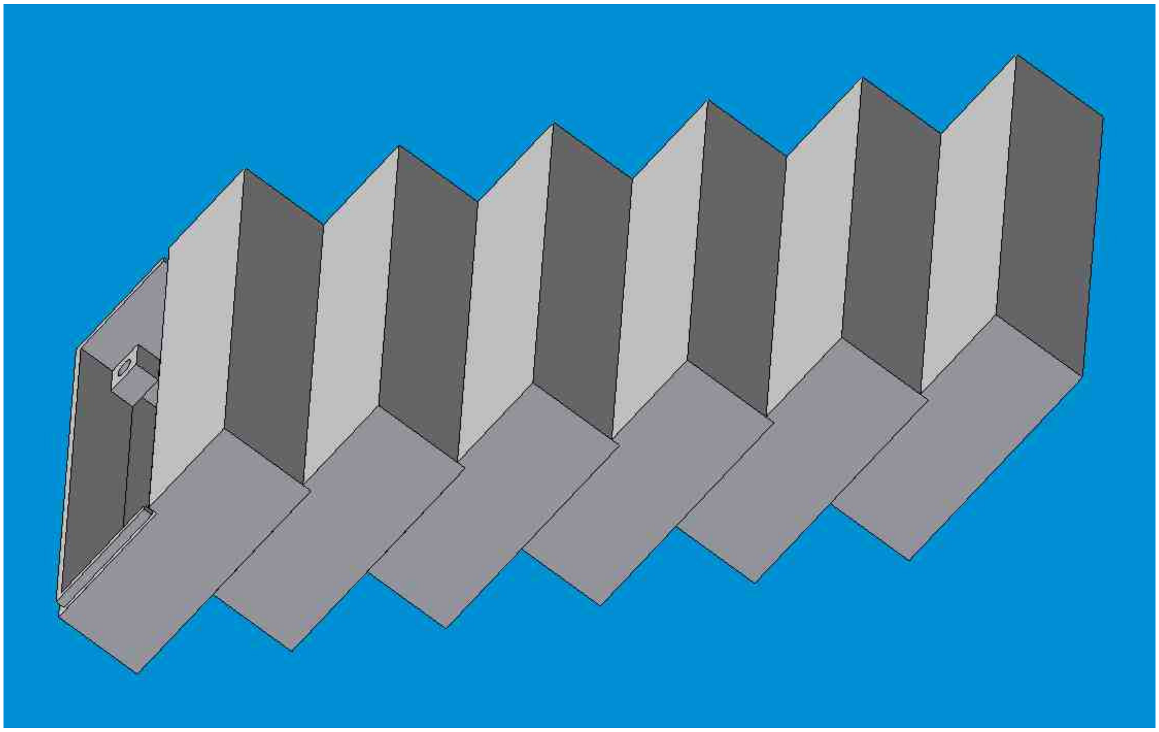
3) Slanted housings: One simple way of modifying the current MACH design is to slant the current housings and mount them appropriately to reduce head height. This actually creates more room for cable strain (connectors would be at an angle) and keeps the modules almost exactly the same. However, clearance issues from added housing material (to cover gaps) raise concerns. A base plate to accommodate the slanted modules would also be necessary, creating a need for very low head height. With such an extreme module angle, this design has some issues. Screenshots can be seen below:



Note: This is a side view of the modules. It can be seen that they look very similar to the current MACH modules.

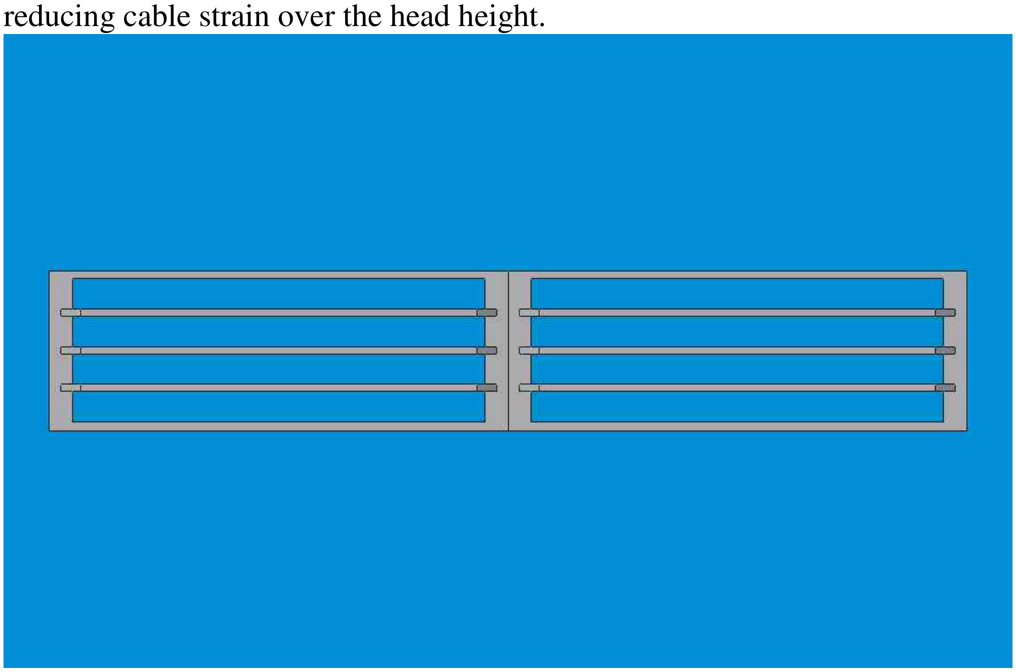


Note: This is a view from one end of the stack. The interior clearance issues can be understood well from this angle.

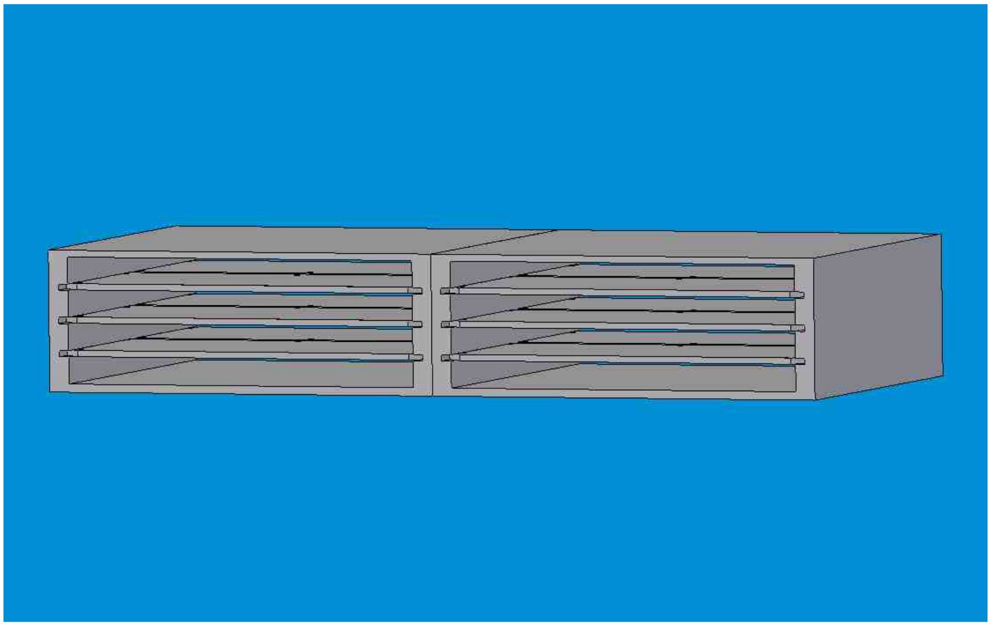


Note: This is a view from the top angle of the housings. It gives a good view of how the modules are angled.

4) Back to Back mounting configuration: By mounting function boards back to back, space can be saved since odd numbers of boards can exist in stacks. As can be seen here two modules with three function boards and three bus boards are possible to reduce head height. Also, the connector locations move, reducing cable strain over the head height.

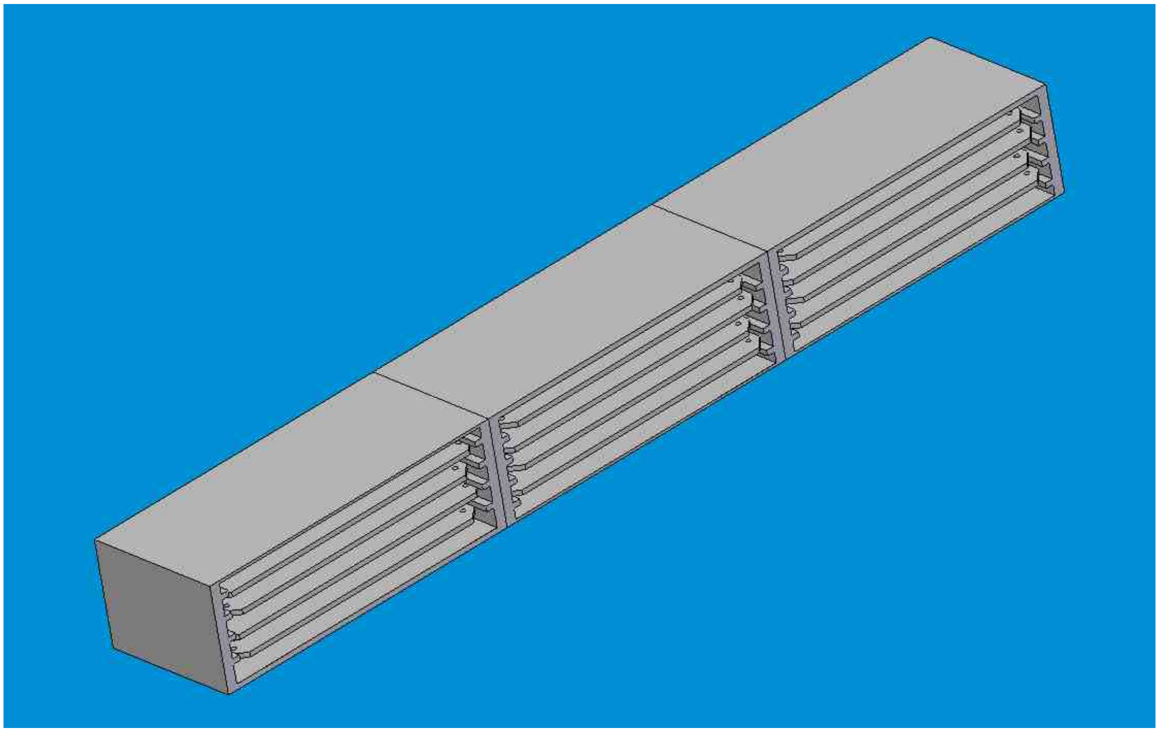


Note: This view is from one of the sides the boards slide into. Notice the large amount of empty space to work with in this design.

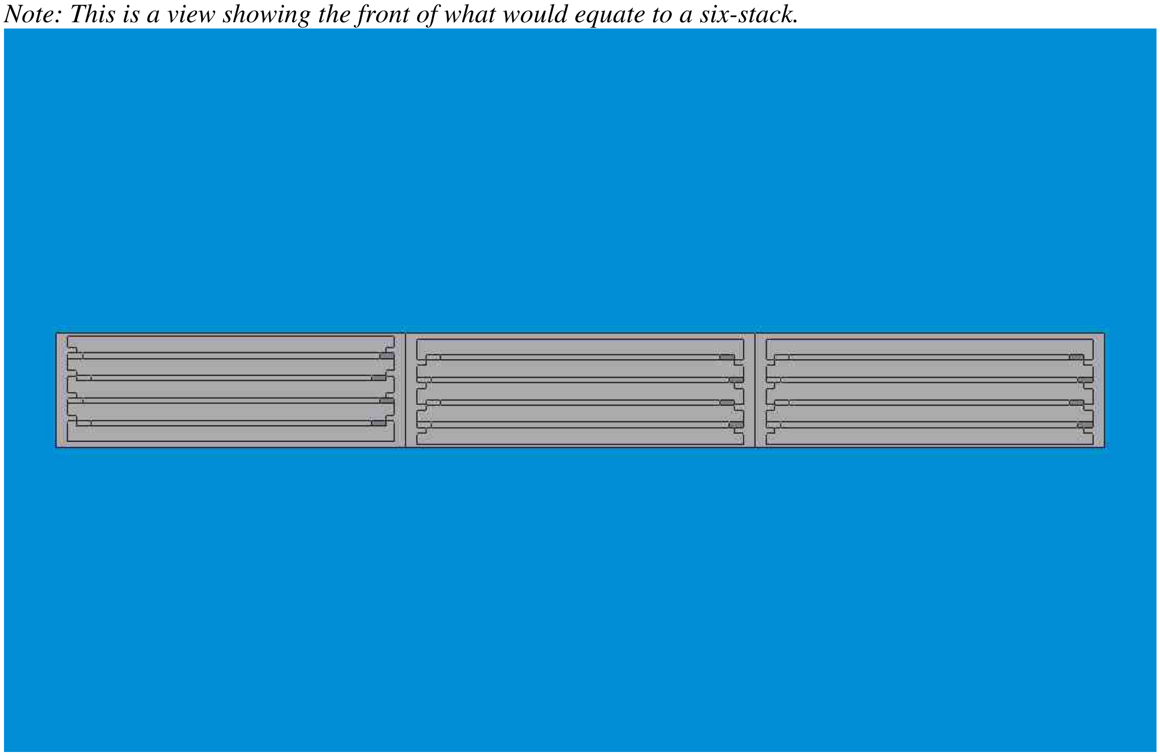


Note: This view shows how the boards are mounted back to back.

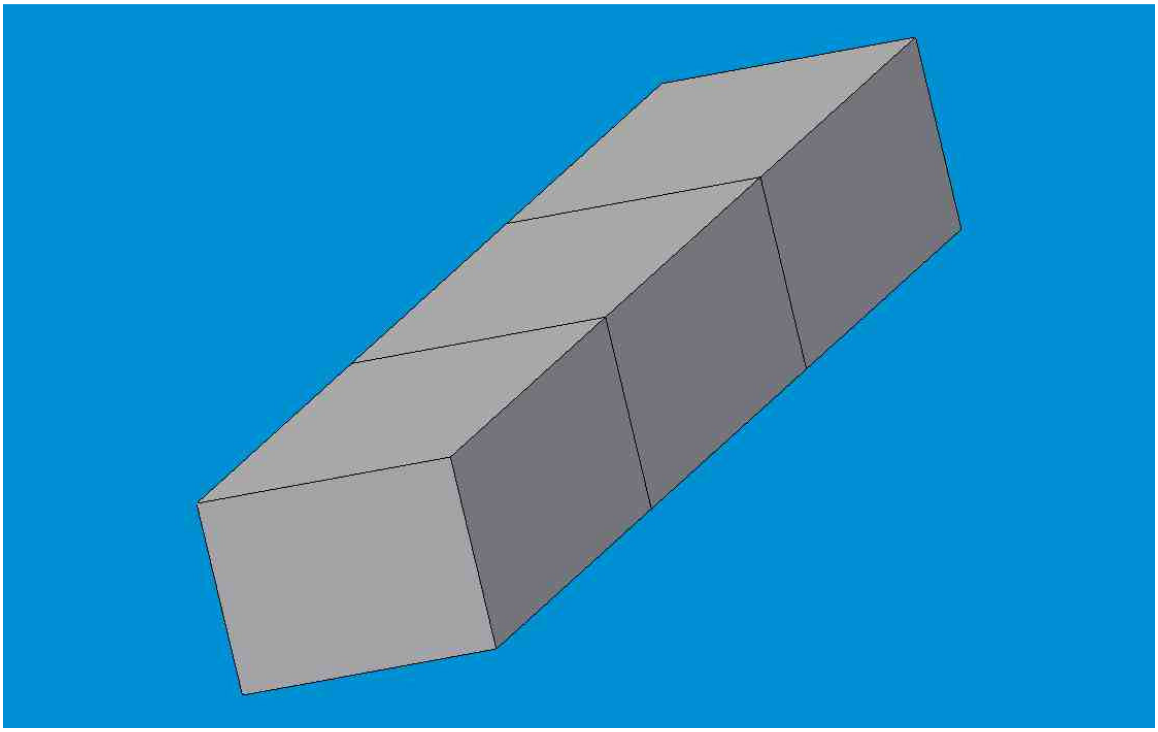
5) 2-Stacks design: This semi-modular design puts two modules into one, reducing interface clearances and allowing for more boards in less head height. Also, connectors are moved to the front of the modules to reduce cable strain on head height. One issue arising from this and the back to back design is how to connect between modules, as the current flex cables will have trouble connecting properly. One idea involves building flex cable ports into the housings and running more flex cables by running them from the board to the housing, from the housing to the next housing, and then from inside the next housing to the next module. This complicated method could use refinement and more definition.



Note: This is a view showing the front of what would equate to a six-stack.



Note: This is a view from directly in front of the 6-stack.



Note: This angled view shows the back of the module, which would have flex cables run behind it connecting modules.

New Board Fastener Design: This section describes a method devised for attaching printed wiring boards (PWB's) to their housing. The design comprises of a cylindrical piece of material with a tapering slot that constricts on the PWB as the cylinder is turned on its axis. A transverse groove will be cut along the axis of the cylinder to allow for the board to slide down to the groove, and a lip on the bottom side of the slot will assure that the board will be in the correct position. These cylinders could be stacked in order to accommodate more than one board. Figure 1 below shows a print of the cylinder lock with a few arbitrary dimensions.

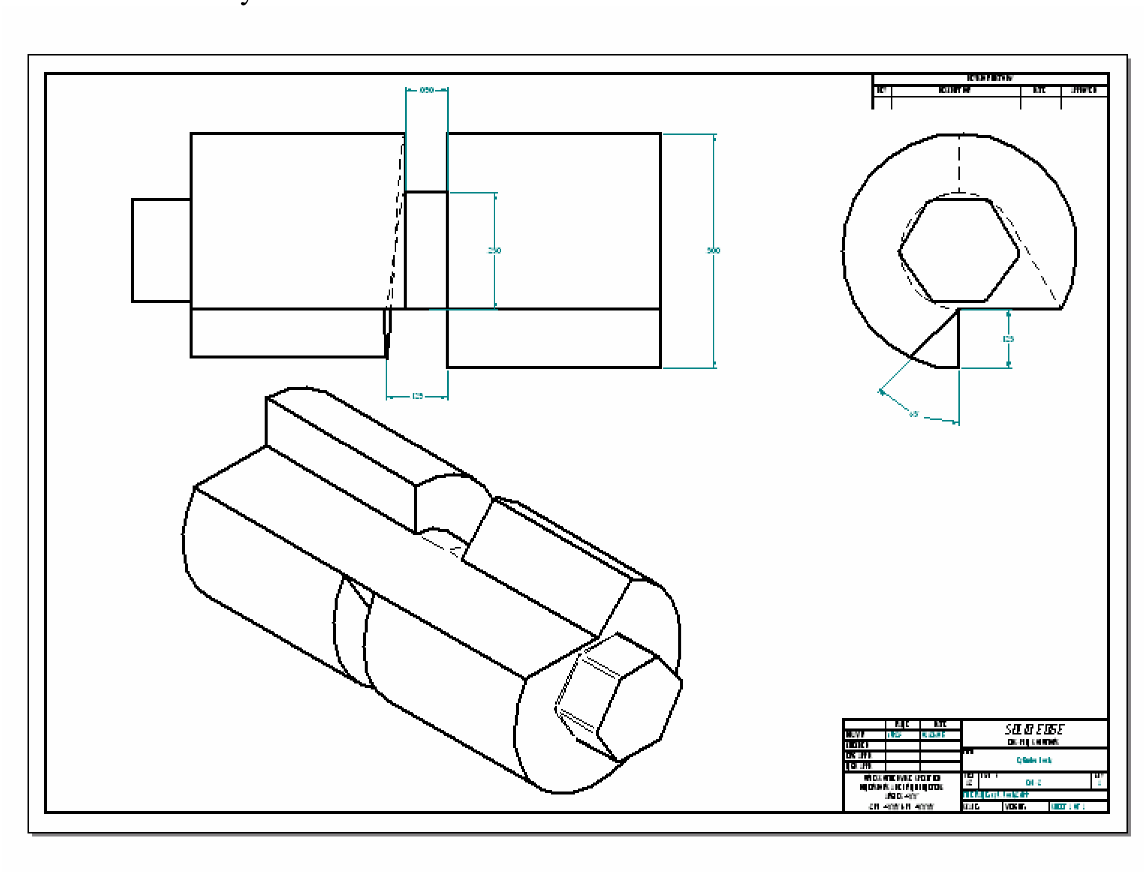
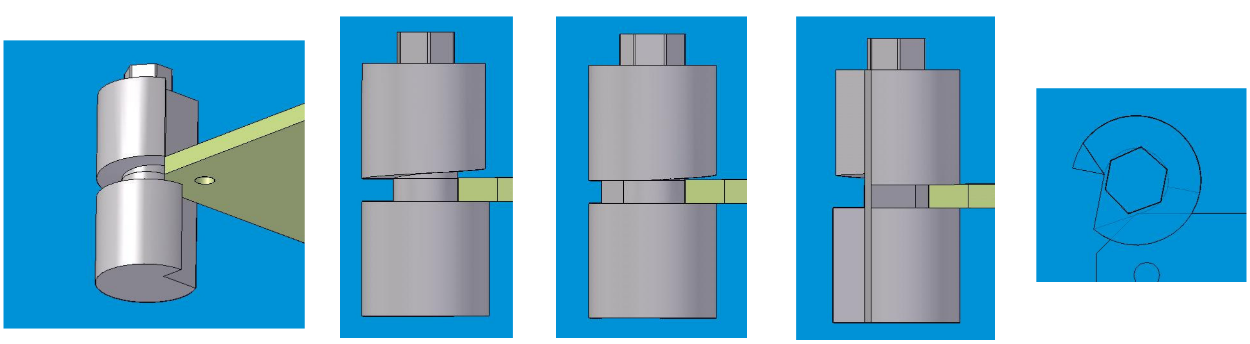


Figure 1: Cylinder Lock for Printed Wiring Board.

Shown below is a series of pictures showing the operation of the cylinder lock.



The first picture shows the board in position, the second shows the amount of taper for positioning, the third shows the cylinder midway through turn, the forth shows the cylinder about three quarters through turn, and the fifth shows an overhead view of the cylinder at the locked position.

Another feature of the cylinder is the flat portion at the end of the turn. This prevents the cylinder from turning too far, and also provides more contact surface area. Another consideration is preventing the cylinder from turning back and loosening the board. This could be solved by placing a spring pin or latch that would engage on the side of the housing when the cylinder was fully turned.

An alternate design is shown in Figure 2 below. This design has tapers on both sides of the slot to further ease positioning, however, it would be more difficult to position more than one board with this design.

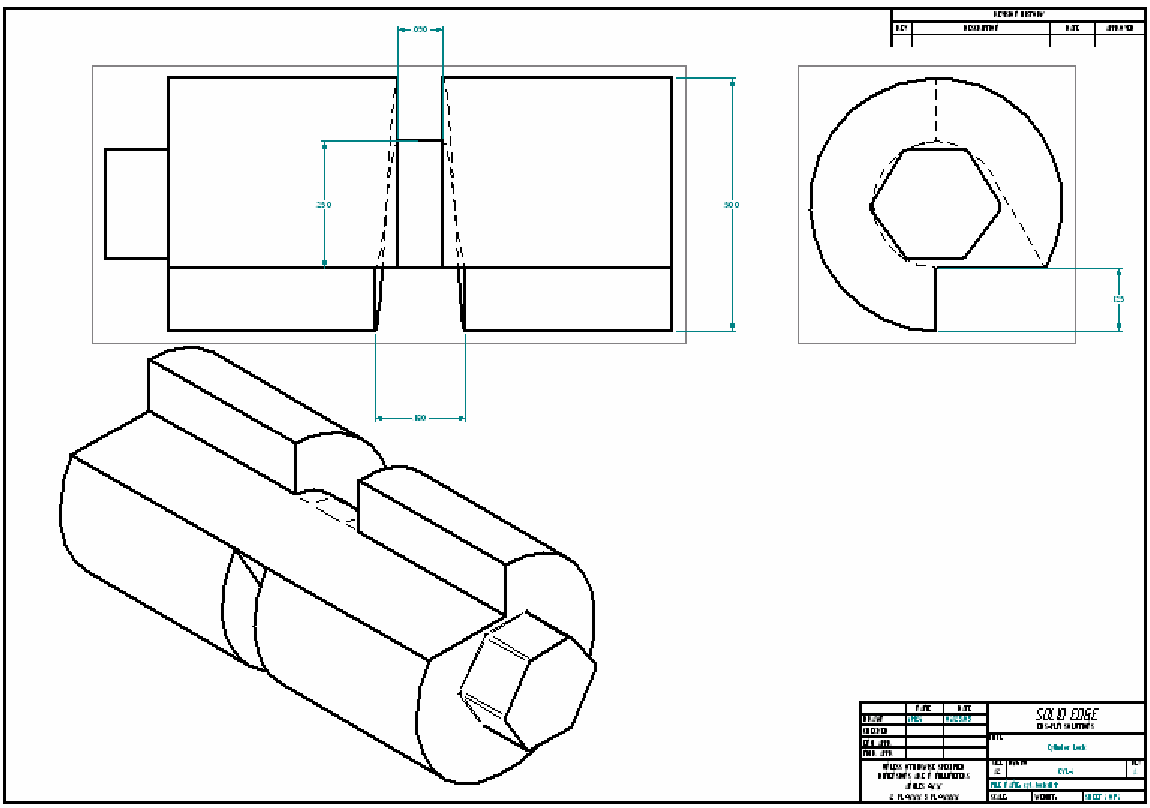


Figure 2: Alternate design, note there is no angle protrusion to position the board.

Time Report:

- Below is a summary of the hours worked so far this semester on the project.

Time Report: January 13, 2005- January 24, 2005

Task	Ryan Talbott	Daniel Morin	Brandon Thayer	Brittany Knaggs	Team Total
Meetings	5.75	6.25	3.5	4.5	20
Webpage	3.5	0	0	0	3.5
Modeling	2	7	0	0	9
Documentation	1	2	0	0	3
Research	0	0	0	1	1
Vibration Analysis	0	2	0	0	2
Critical Location Analysis	0	0	1	0	1
Client Contact	0	1	0	0	1
Total	12.25	18.25	4.5	5.5	40.5