

Structural Analysis  
Of  
250 LB Intelli-Lift Pro Dumbwaiter System

For  
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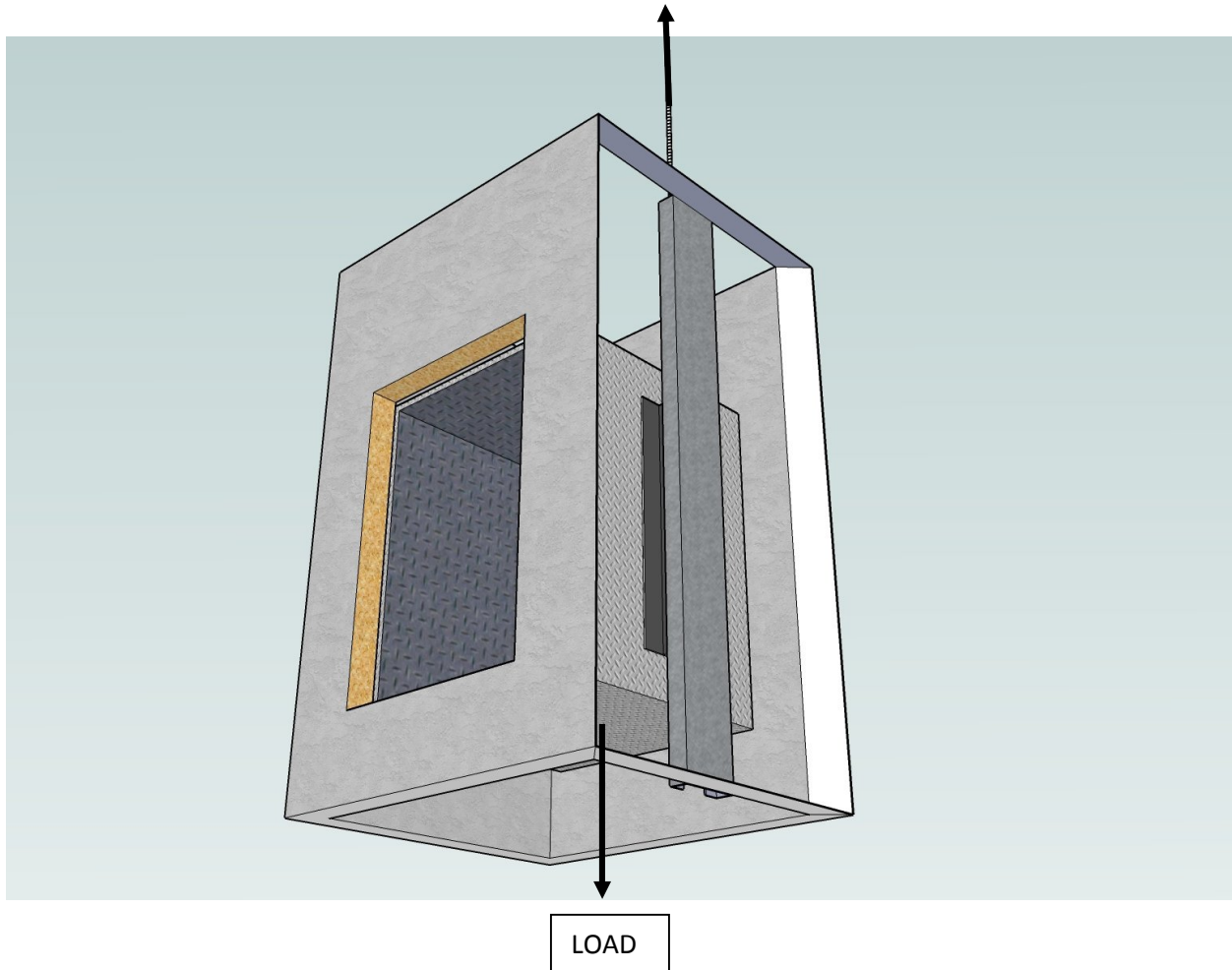


Fig. 1

The purpose of this analysis is to find the reactions at the trolley wheels as they load the c-channel used to guide the dumb waiter car, Fig 7. The car is constructed of steel and fully supported by the trolley. The load from the car body structure and the 250 lb usable load will be considered in the reaction calculations. The trolley has a stabilizer at the top of the car body, but to be conservative, calculations will be performed without the stabilizer attached to see how critical the presence of the stabilizer will be. For the reactions of the trolley wheels and the winching mechanisms, the total load factor will be 2g, for impulse loads. Total load for calculations will be taken as 135 lb + 250 lb.

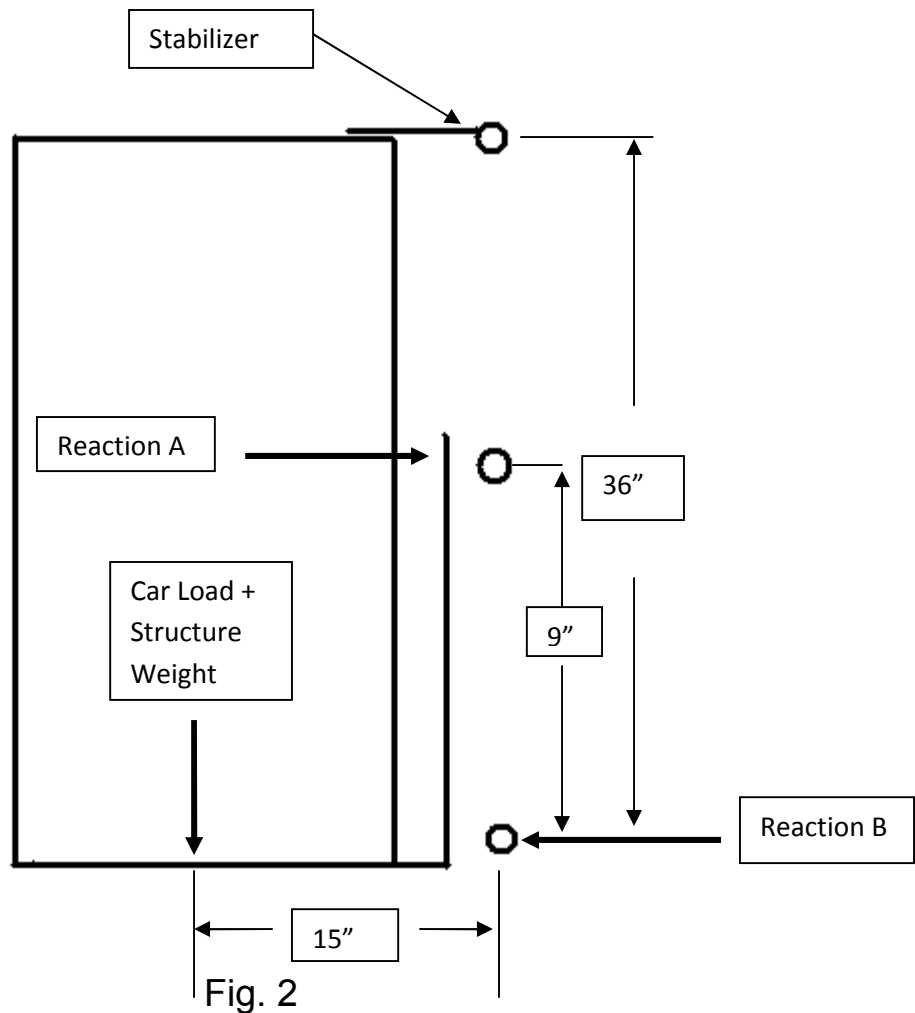


Fig. 2

Sum moments about point A: Without stabilizer

$$R_b \times (9") = \text{Load} \times (15")$$

At 385 lbs,  $R_b = R_a = 641$  lbs; at 2g or 770 lbs  $R_a = R_b = 1,283$  lbs

This translates to 320.5 lbs per wheel at 1g and 641.5 lbs per wheel at 2g. The aluminum channel takes all the reaction load from the trolley wheels. It is made from 6061 T6 Aluminum with a yield strength of 31ksi. The following finite element analysis shows that the highest stress is in the flanges of the channel at the location of wheel contact, is over the 31,000 psi yield of the material.

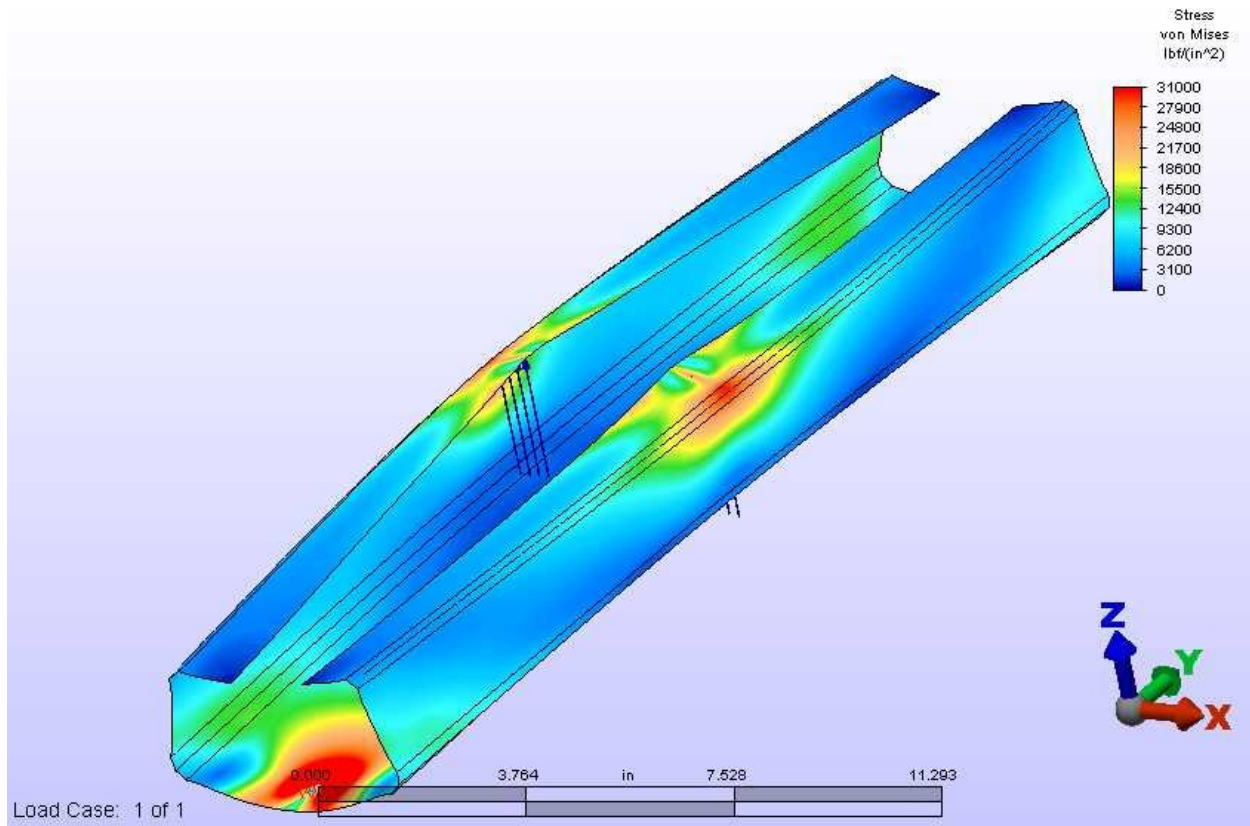


Fig. 3

From the failure of the material in the FEA analysis, it is determined that a stabilizer is mandatory.

Sum the moments about point A: With stabilizer

$$R_b \times (36") = \text{Load} \times (15")$$

At 385 lbs,  $R_b = R_a = 160.4$  lbs; at 2g or 770 lbs  $R_a = R_b = 320.8$  lbs

This gives a reaction of 80.2 lbs per wheel for 1g, and 160.4 lbs per wheel at 2g. A re-analysis of these loads are shown in Fig. 4. The highest stress is at the 22" lag bolt locations, at about 17,000 psi. The analysis above shows that the stabilizer is critical to the design and its attachment to the car is critical. It is recommended that steps be taken to ensure that the stabilizer could not come loose in the time interval between inspection/maintenance.

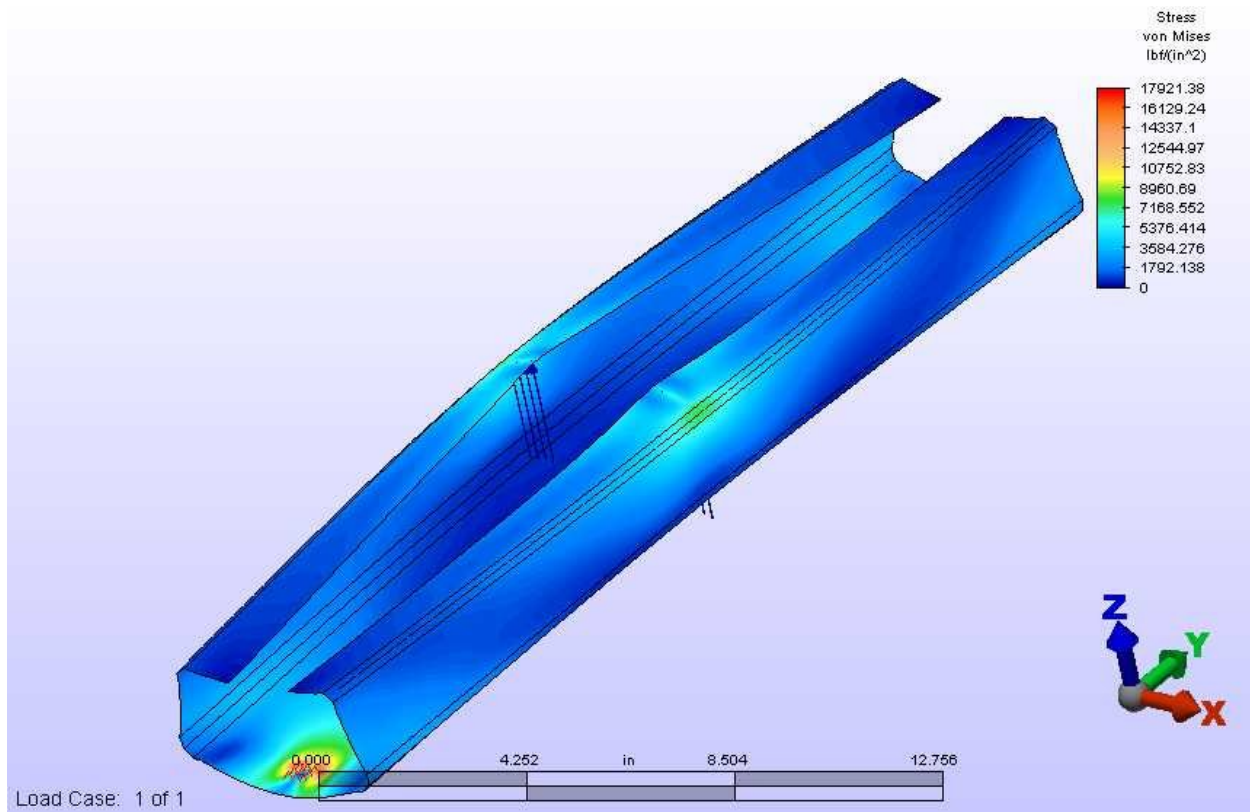


Fig. 4

For this type of dumb waiter, the lifting mechanism can be mounted either at the bottom of the elevator shaft or at the top, Fig. 6. In both cases the winch motor is mounted with four lag bolts. These lag bolts go into laminated 2 x 12 structural members in the shaft wall. The worst case for loading the lag bolts is shown in Fig. 5, where the cable is at the end of the drum and a 2g load is applied. The distance between bolts is assumed at 7.5" and the total distance to the cable load is 13" from the pivot point. Summing the forces and solving for the load on the lag bolt yields a lateral load of 1,334.67 lbs on 3 lags. Each lag can carry roughly 950 lbs, this gives a load carrying capability of 2,850 lbs. This gives a factor of safety of 2.1.

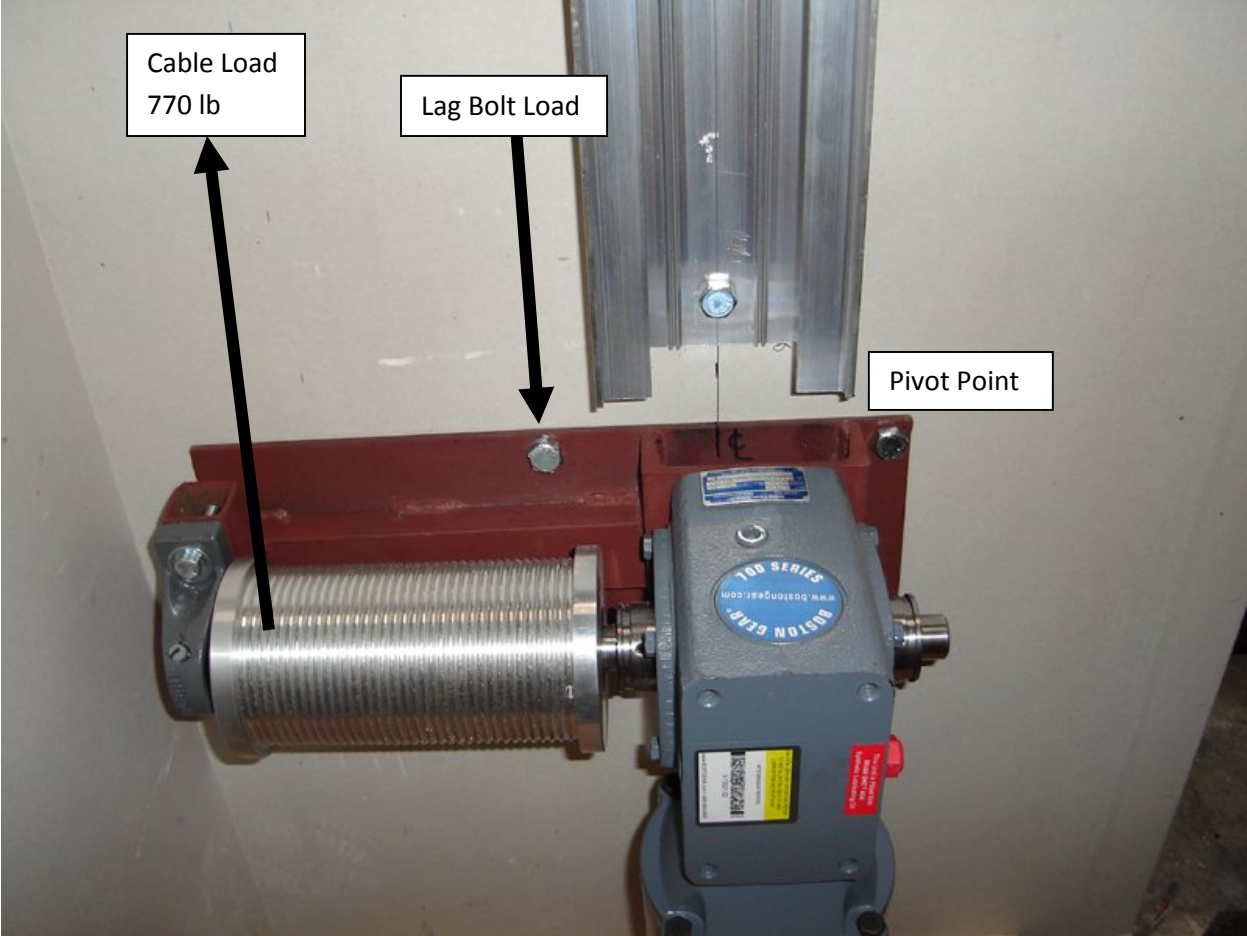


Fig. 5

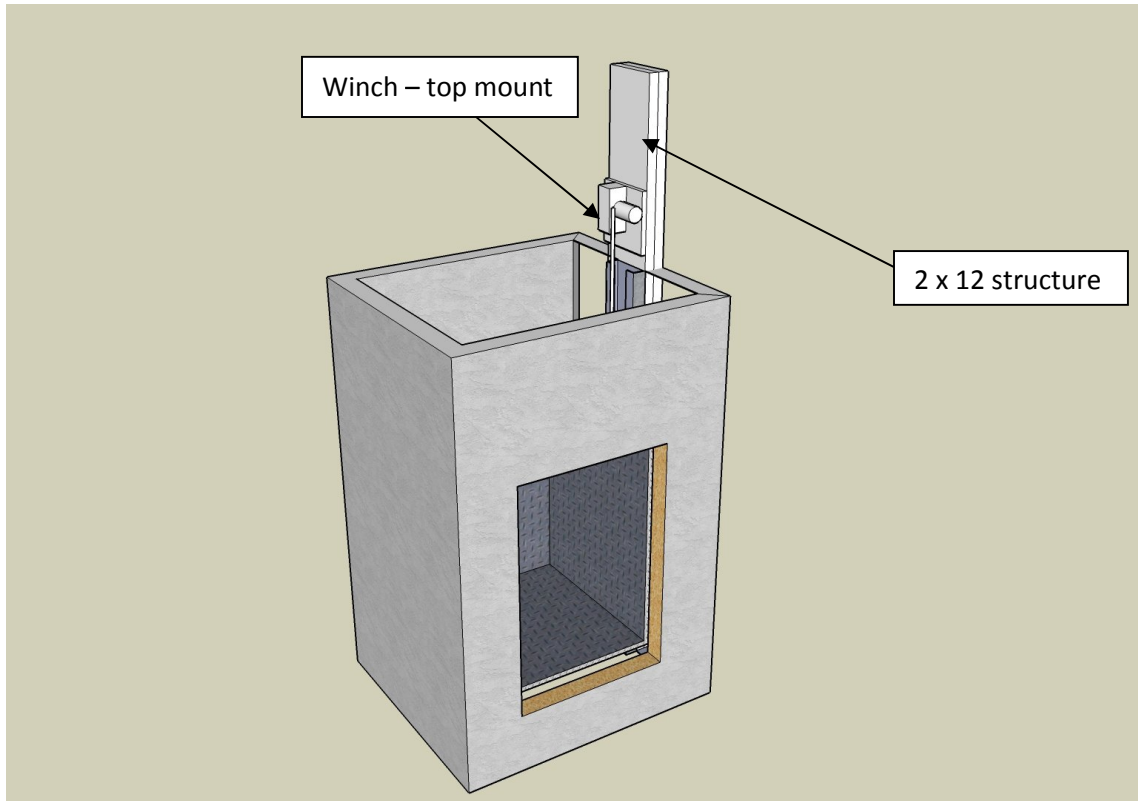


Fig. 6

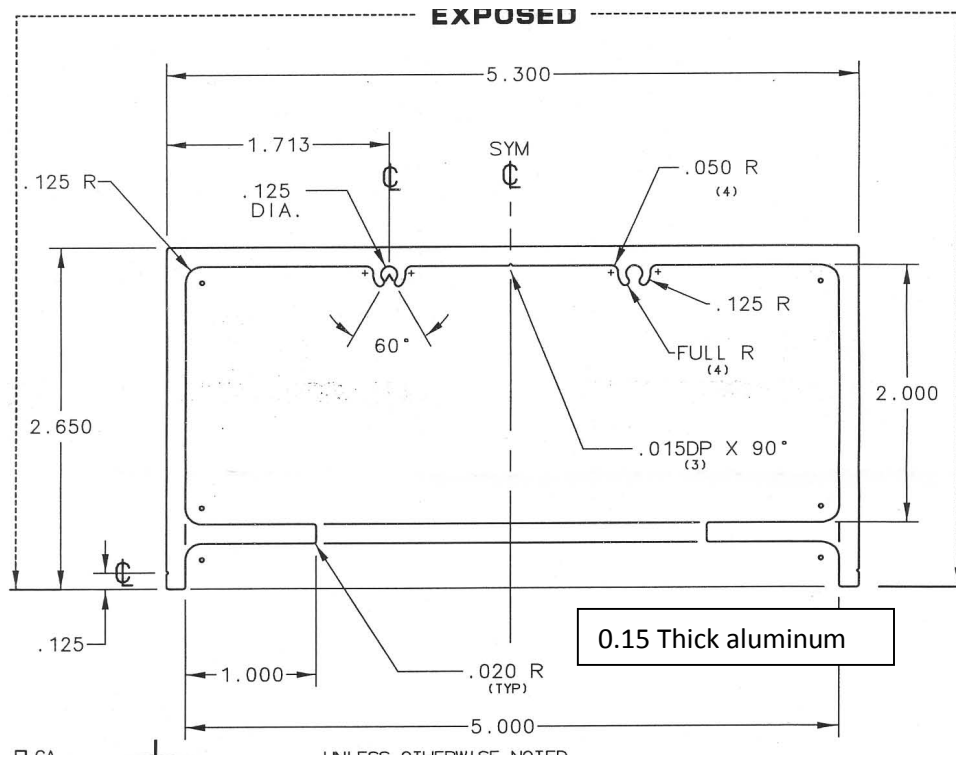


Fig. 7