Subject: **Boom / Hoist & EM-Tail Mount Design**

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1. Introduction

This report contains a visual description of how the GEBJ Salinity Laboratory designed and fabricated an EM-38 tail-sled system for the Lee Spider Spray Trac vehicle. The purpose of this report is to document the tail-sled system design, so that other interested parties can copy, modify, and/or improve on this design.

Figure 1 shows the entire, finished tail-sled system. This system consists of 3 components; a boom / hoist system (for lifting the PVC tail), a tail-mount platform (for holding the PVC tail in place), and the PVC tail / sled unit itself. This report described how the first two components can be fabricated (the design of the PVC tail is discussed in a separate report).

2. Initial Fabrication of the Main Boom / Hoist System

The backbone of the main hoist system is the boom shown in Figure 2. This boom is created from 2 inch square tubing, and is designed to attach to a square post welded immediately behind the center pivot joint (see Figure 3). The horizontal boom component measures 78 inches, the angled component measures 30 inches. The base of the angled component is welded to a 5 inch cap, which in turn can be secured to the 10 inch high square post (welded to the Spray Trac frame).

Two diagonal support beams ultimately need to be attached to the boom, in order to supply rigidity and stability. We designed these diagonal supports to attach to each end of the back lateral Spray Trac frame using custom made clamping mounts. Figure 4 shows one of these mounts, before the diagonal support beam has been fabricated and attached. (See Figure 11 for a picture of a finished beam mount.)

3. Initial Fabrication of the Tail-Mount Platform

Figure 5 shows our current design for an adjustable tail-mount platform. The bulk of this platform is made out of 2 inch angle iron. Two 28 inch lateral pieces are used to secure the 6 inch center rod (which attaches to the u-joint). These lateral pieces in turn bolt to two 24 inch vertical bars. Both vertical angle iron bars are drilled with 23 half inch holes (spaced 1 inch apart); this allows the lateral pieces to be raised or lowered in

one inch increments (which in turn will ultimately raise or lower the EM PVC tail). The vertical angle iron bars are welded to 13 inch supporting angle iron pieces (see close up view shown in Figure 6) which in turn bolt to the back lateral Spray Trac frame (see Figure 7). Finally, a standard, commercial u-joint taps onto the front of the steel rod, as shown in Figure 8.

Figure 9 shows a side view of the tail-mount platform, in conjunction with the boom. Note that these two components are not physically attached to each other, although they both bolt onto the Spray Trac.

4. Final Fabrication of the Main Boom / Hoist System

Once the boom has been fabricated and put in place, the finishing components can be added to the main boom / hoist system. These components include the 2 diagonal support beams, a winch, two inline pulleys, and the antenna bar with mounting brackets. Figure 10 shows a picture of the diagonal supports; each beam consists of 1 inch steel tubing measuring 72 inches in length. These support beams bolt to either corner of the lateral back frame using the finished diagonal clamp mounts, as shown in Figure 11. The front end of each beam bolts onto to the main boom, as shown in Figure 12.

After the support beams are set in place, the winch can be mounted to the angle component of the boom (see Figure 13). The winch cable should feed through the forward pulley (visible in Figure 13) and then attach to a nylon rope (as shown in Figure 14). This nylon rope will feed through the rear pulley (and down to the PVC tail). In our system, note that both pulleys are welded directly to the boom.

The winch will need to be operated by the driver; hence, it should be operable using an attachable control cable (or wired to the front control system, etc.). In our system we used an X-3 Super Winch, model # 1307. This is a 12 volt DC winch with a 16 foot extension cable / hand control switch; the entire system costs about $375.00 retail. However, any similar winch with an automatic brake should work.

The antenna bar represents the final boom / hoist component. This bar will be used to support the GPS antenna (i.e., to co-locate the antenna directly over the EM-38 instrument). We designed out bar to be removable, by sliding into (or out of) the two mounting brackets welded to the underside of the boom (see Figure 14). As shown in Figure 15, this bar is designed to angle out of the way of the rope once it is fully inserted into the mounting brackets.

Figure 16 shows this antenna bar fully inserted (through the mounting brackets). The ultimate length of the PVC tail will determine the length of this bar. For the system shown here, the bar measured a total of 82 inches, where the first 32 inches side underneath the boom (i.e., through the two mounting brackets). We built this antenna bar out of lightweight, 1 inch square tubing, and use two half inch steel bolts to tighten the bar to the mounting brackets.

5. Final Fabrication of the Tail-Mount Platform

To finish the tail-mount platform, a clamping component must be fabricated which can be used to attach the PVC tail to the u-joint. An example of our current "snout" clamp is shown in Figure 17, and a close up of this same clamp is shown in Figure 18. In out design, two half-circle pieces of steel are used to clamp around the 6-inch PVC tube. These half circles are bolted together, and welded to top and bottom flat plates. These flat plates extend beyond the edge of the clamps and bolt to a solid metal plate, which in turn is welded to a short steel rod (that inserts into the front end of the u-joint).

In addition to the clamping action, a single half-inch bolt has been inserted through the top half circle clamp and completely through the PVC tube. This bolt acts like an alignment pin, to keep the PVC from twisting and/or sliding out of the snout clamp.

6. Summary & Conclusion

Once fabricated, the main boom / hoist system and tail-mount platform can be used together to successfully control and deploy the PVC EM tail. In this current design, the tail can be raised and lowered as necessary, or released and allowed to drag freely. The horizontal plane of the tail can also be changed (i.e., moved up to 20 inches above or 2 inches below the horizontal plane of the Spray Trac wheels). For example, this allows the tail to be dragged along the top of a wide bed while the wheels travel in the furrows. The only real limitation to the current design is that the tail must always drag directly behind the center of the Spray Trac (it can not be laterally offset).

Figure 19 shows one other component which we have found to be especially useful; a "z-iron" handyman jack extension. This is simply a piece of tubing which slides into the front or back lateral cross bars on the Spray Trac, and then extends down to a foot-plate about 12 inches off the ground. This allows one to easily insert a handyman jack into the foot-plate, and thus conveniently jack up the Spray Trac in order to change the wheel spacing.

Document Figures (1 - 19)

Figure 1. Finished boom / hoist system and tail support platform (PVC tail also shown).

Figure 2. Fabrication of the primary boom.

Figure 3. Attachment post for boom (located behind center pivot joint).

Figure 4. Custom clamping mount for diagonal support beam (beam not shown).

Figure 5. The adjustable tail-mount platform.

Figure 6. Close up of tail-mount bracket (left side).

Figure 7. Rear view of how tail-mount platform attaches to back lateral frame.

Figure 8. Close up image of u-joint attached to extension rod.

Figure 9. Side view of tail-mount platform and boom.

Figure 10. Diagonal support beams (attached to back lateral frame and boom).

Figure 11. Finished diagonal clamp mount (attached to back lateral frame).

Figure 12. Front end of diagonal support beams (bolted to boom).

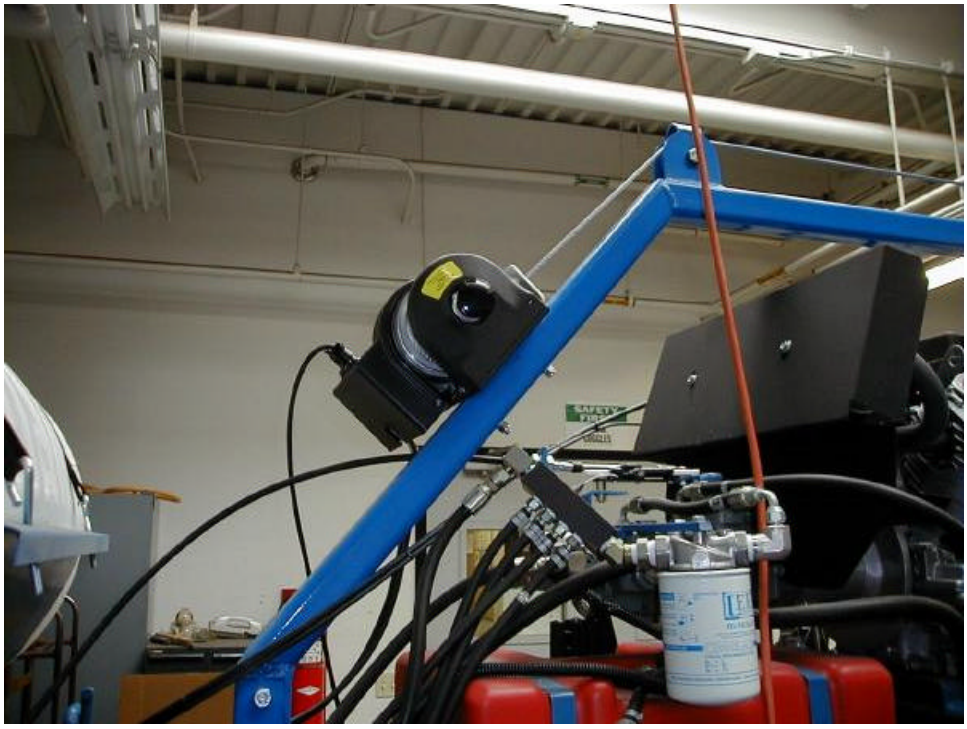

Figure 13. Winch motor (mounted to the forward section of the boom).

Figure 14. Winch cable attached to nylon rope (cable feeds through forward pulley, rope feeds through rear pulley). Note that the bracket mounts for the antenna bar are also visible in this picture.

Figure 15. Angled antenna bar (inserted into antenna bracket mount).

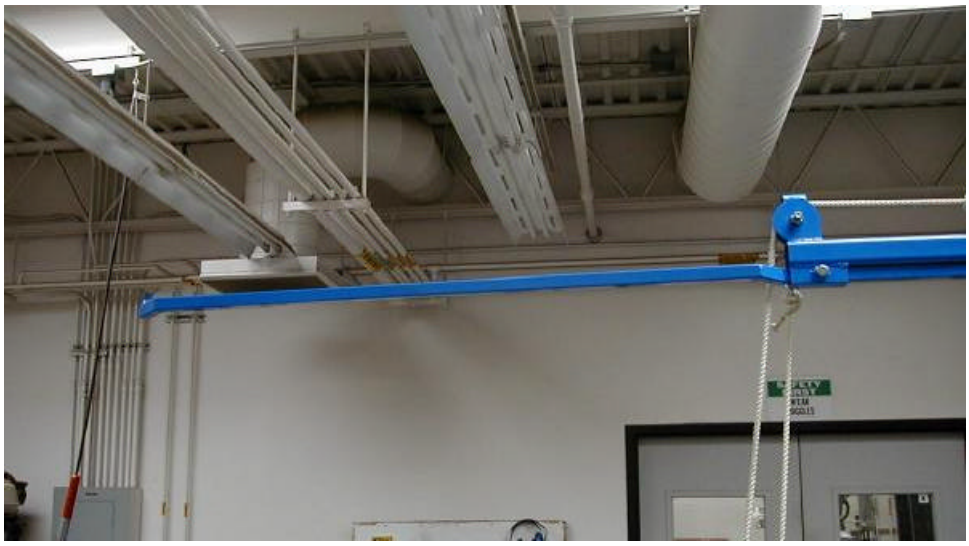

Figure 16. Antenna bar (extending out beyond boom).

Figure 17. Snout clamp (for holding PVC tail).

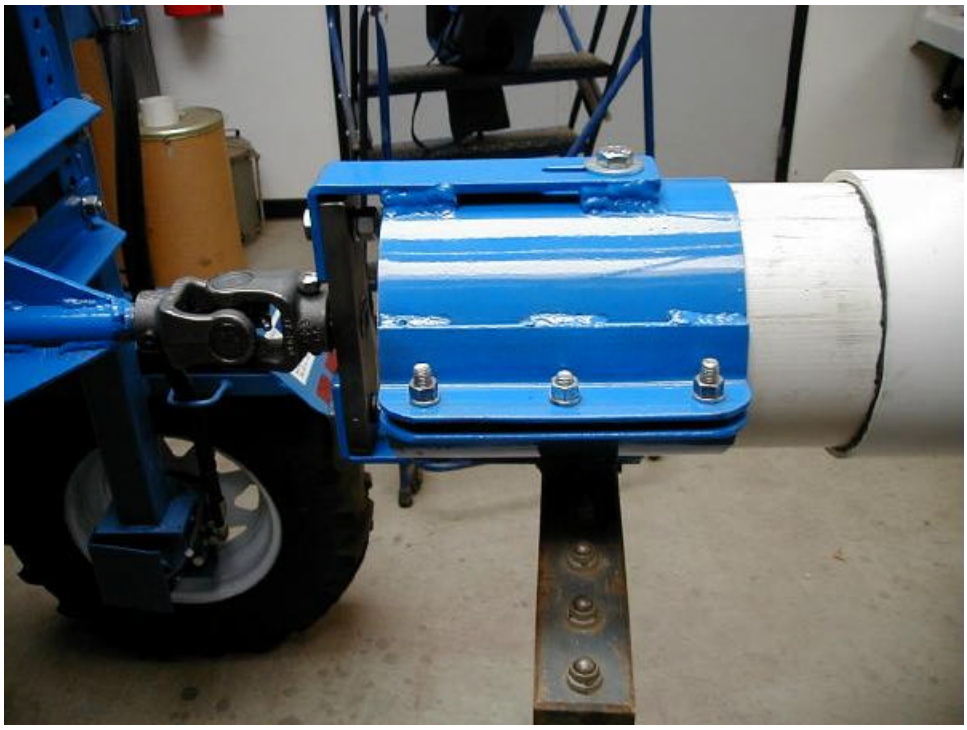

Figure 18. Close up view of snout clamp (attached to u-joint).

Figure 19. "Z-iron": for use with handyman jack.