

Parabolic Trough-Tracking System

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Team 14

Trough Repair and Replacement Parts

Document

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Introduction (Saad Almonneay)

The parabolic trough tracking system is still inoperable and cannot be moved to a new location. However, the tires have been delivered and three of the four have been installed successfully. The fourth castor was broken while installing the tire and our team will be ordering a new caster. The gearbox was cleaned professionally to remove the rust that had accumulated. A gasket and oil has been selected for the gearbox as well. A new location to an expanded area is required, so extended fencing will be needed to enclose the new location. Exact specifications for the motor have not been determined, however, with assistance from our client, specifications were given. Trim, Mylar, and adhesive have been selected and are ready to be ordered, as well as a new caster/wheel assembly. Most of the parabolic trough will be fixed within the next few days except for the motor and the control box which may take about 7 to 10 days to be delivered once selected and ordered.

Fencing Information (Saad Almonneay)

The client required us to move the parabolic trough to a new area that currently is not fenced in. A new location is required for the parabolic trough for repairing, testing, and operation. The new area will extend the southeast corner by 30 feet in the east direction and run 40 feet in the north direction adding 120 ft² which can be seen in Figure 1. Fencing, posts, and other materials that are needed to build the fence have been quoted from Buffalo Fence and Barn. The height of the current fence is 8 feet and the current posts are 10 feet with spacing between the posts 8-12ft. Figure 2 shows the estimated cost from the company, which was \$1121.27. However, there are some materials that won't be necessary to build the fence. Prices were compared from other companies and this company was the cheapest. Moreover, 70 feet of chain-link fencing will be needed to expand the current fencing area successfully.

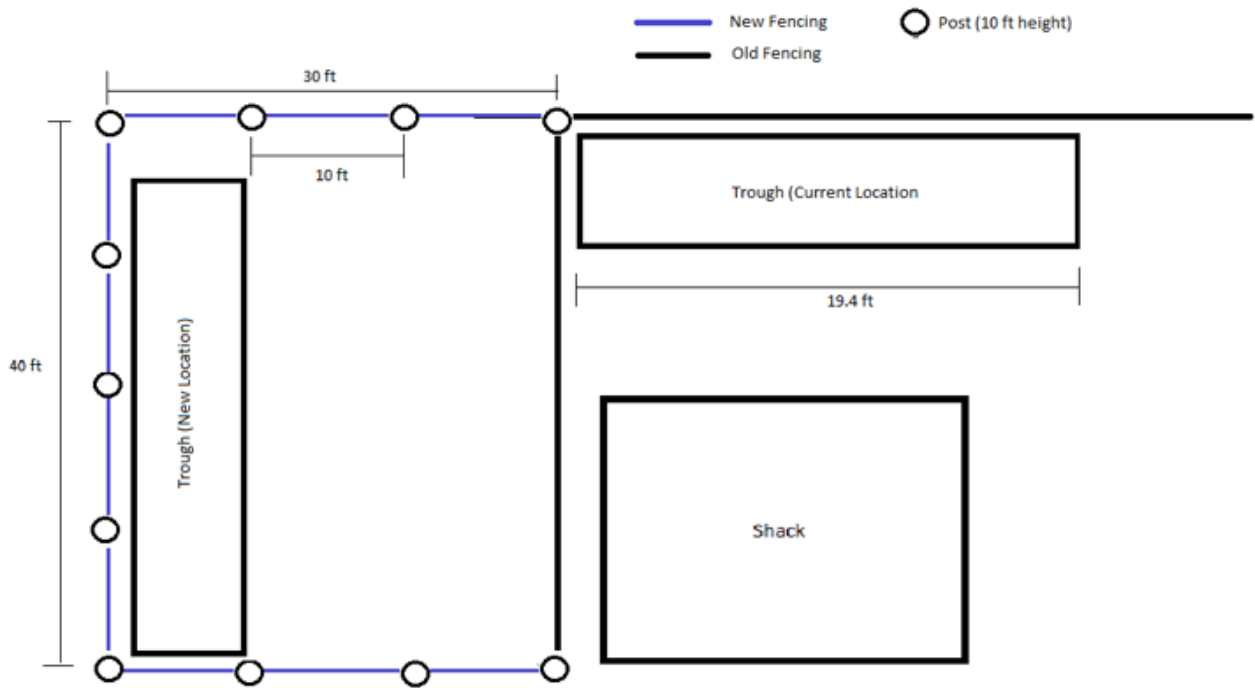


Figure 1- The new area of the shack

70' - 96" high 9 GA. GALVANIZED (2" Mesh) CHAIN LINK FABRIC Fencing			
QTY.	PART #	ITEM	AMOUNT
70	CL969	96" 9 GA. GALVANIZED (2" Mesh) CHAIN LINK FABRIC @ 4.79 /Ft. =	335.30
4	PP158DQ40252	1 5/8" X 21' DQ-40 PIPE TOP RAIL @ 42.42 /Ea. =	169.68
2	PP278DQ40126	2 7/8" X 10'6" DQ-40 PIPE POST @ 55.18 /Ea. =	110.36
6	PP238DQ40126	2 3/8" X 10'6" DQ-40 PIPE POST @ 40.28 /Ea. =	241.68
2	BB278	2 7/8" REGULAR BRACE BAND @ .77 /Ea. =	1.54
14	TB278	2 7/8" REGULAR TENSION BAND @ .67 /Ea. =	9.38
2	PSRE158	1 5/8" PRESSED STEEL RAIL-END @ 1.49 /Ea. =	2.98
6	PSET238158	2 3/8" X 1 5/8" PRESSED STEEL EYE-TOP @ 3.21 /Ea. =	19.26
2	PSDC278	2 7/8" PRESSED STEEL CAP @ 1.55 /Ea. =	3.10
3	TRS158	1 5/8" SLEEVE @ 1.42 /Ea. =	4.26
50	STW99	8 1/2" 9 GA. STEEL TIE WIRE @ .13 /EA =	6.50
50	STW79	7 1/2" 9 GA. STEEL TIE WIRE @ .13 /EA =	6.50
16	CB516114	5/16" X 1 1/4" CARRIAGE BOLT @ .34 /Ea. =	5.44
1	TW9GA	9 GA. 10# (170') SMOOTH TENSION WIRE @ 15.04 /ROLL =	15.04
50	HRS9GA	9 GA. STEEL HOG RING @ .028 /Ea. =	1.40
27	PREMIX	60LB BAG SACK PREMIX @ 3.76 /Ea. =	101.52
MATERIALS TOTAL:			\$ 1033.94
8.446% STANDARD TAX:			87.33
TOTAL:			\$ 1121.27

Figure 2- Buffalo Fencing and Barn quote

Motor Replacement Information (Jacob Seitzer)

Determining the motor size and specifications has been one of the most challenging problems encountered with this project. Since the old motor had no specifications or labels attached to it, determining its size has been difficult. The motor was first brought to various companies in the Phoenix area in hopes that professionals on electric motors would be able to help in determining the size of the motor. Unfortunately, each company has given different information that contradicts another company's advice. The majority of companies claimed the horsepower was less than 1 HP, which has been the only consistent information given. However, it was determined that the old motor is a 56 C Face type motor, which is the type of mount the motor has, so this will help in the selection of a new motor.

Another method used to try to determine the motor size was to calculate the weight and torque of the trough to the motor. Due to the lack of information about the specifications of the trough, this proved to be of no use. Since materials are unknown, along with unknown counterweight information, this method was unsuccessful in finding the required motor size to rotate the parabolic trough.

Although our team was not able to specifically determine the size of motor needed, a 56 C Face, 1 HP, 90 V DC motor will be ordered, ensuring that there will be enough power to rotate the shaft as desired. A 1 HP motor was chosen since each company stated the previous motor was less than 1 HP. This may be more power than needed, but it will not affect the movement of the trough due to the control box.

Once a motor is chosen, a control box will need to be ordered next. The control box will have to be compatible with the selected motor, as well as be able to function as desired. The input voltage will either be 120V or 240V, which will be selected once the types of outlets in the solar shack are determined. Our team would like to input controls into the control box using a computer, so a control box with programming capabilities will be needed. A programmable control box is desired in order to run the motor for certain lengths of time during the day, as well as perform different tasks under certain conditions (remove snow, rain, etc. from trough). Boston Gear and Baldor are two companies that are currently being looked into. Boston Gear has many varieties of motor and control box configurations and compatibility should not be an issue since the gearbox already mounted is Boston Gear product. A company in Flagstaff recommended Baldor due to their lower costs on motors and availability, so research on their selection of motors and control boxes is being looked into. Based on information given from Applied Industrial Technologies, shipment of a motor from Baldor could take at most ten days.

The motor is the main concern in this project and cannot be completed without it. As soon as a new motor and control box assembly is chosen, ordering of the two will be done as soon as possible to ensure the project is completed on time.

Mylar Information (Daniel Chief)

Mylar is the brand that makes the material biaxially-oriented polyethylene terephthalate (BoPET). Mylar has many uses: Flexible packaging and food contact applications, covering over

paper, insulating material, solar, marine and aviation applications, science, electronic and acoustic applications, and graphic arts.

The current material covering the parabolic trough is made of similar Mylar material. The trough currently has a few damages to its surface. The team is going to use Mylar to patch the damaged areas to limit further damages. Mylar is cheaper in price compared to other similar materials used for the same purpose. For example, 1500 square feet of Reflectech mirror film is priced at \$32.29 from the company website. Another similar material, Monokota chrome sheets from Amazon.com, cost \$23.99 for 1872 square feet. The cost for Mylar from Amazon.com is \$20.02 for 100 square feet. The surface area that needs to be repaired isn't a big area so, a lot of material is not needed.

Information about the ordering process for Mylar was forwarded to the client. When the material is in, the team will begin its process in repairing the damaged surface areas.

Wheel Information (Daniel Chief)

Our team had a few difficulties in replacing the wheels on to the parabolic trough. The first obstacle was the space between the tire and the bracket on the casters. One side of the tire was rubbing against the tire. To resolve this problem, four spacers were purchased so the tires will not rub against the bracket. The second problem was the preset tire pressure wasn't enough to hold the trough up. When the parabolic trough weight was applied to the tire, the tire went flat. The team used a portable air compressor, but it wasn't building enough pressure to inflate the tire to its correct capacity. To get it to the highest allowable tire pressure the tires were taken to Jiffy Lube. The tires work and hold pressure once the correct tire pressure was achieved. Another complication encountered was when replacing the wheels one of the casters fell apart. The team came up with three solutions to this problem. The first solution is to replace the whole tire and wheel assembly since the casters are not sold separately. The tires and caster will cost \$65.99. The assembly is sold locally and can be bought and replaced within a day. The second option is to order four assemblies to replace all of the casters which will cost \$263.96. The wheels previously purchased can be returned to get a refund. The last option is to repair the broken caster. This option will cost us nothing since can use the facilities and equipment to weld the broken piece back on.

The solution decided was to buy a one tire and caster assembly. Our team will also repair the broken piece and use that as a spare since it is unknown how long the current casters will last. At this time our team is in the process of buying the assembly. The tire and caster should be replaced within a week.

Trim Information (Christopher Mesko)

The trim that will be used to enclose the edges of the parabolic trough is a U-shaped channel with sharp corners made of 6063-T52 aluminum. Aluminum was chosen instead of plastic because of its good strength to weight ratio, inexpensive cost, and durability in outdoor weather conditions. This trim is to be installed with a permanent adhesive such that the trim will not

need to be catered to for many years to come. The adhesive chosen to hold the trim in place will be Loctite PL375 Heavy Duty adhesive, which is a common industrial grade adhesive found at a local hardware store such as Home Depot. Three bottles will be purchased and more can be purchased if needed.

The measurements of the U-channel are shown in Figure 3 below where $A = 1.25''$, $B = 1.25''$, and $C = .125''$. If you use Equation 1, the inner width, W , can be solved for. The inner width needed is $1''$, which is the inner width needed. The leg length is $1.25''$ which should be enough area to adhesive onto the trough. Since this trim needs to enclose a curved surface, the thickness isn't too large allowing for a small bend in the material.

$$W = A - 2C \quad (1)$$

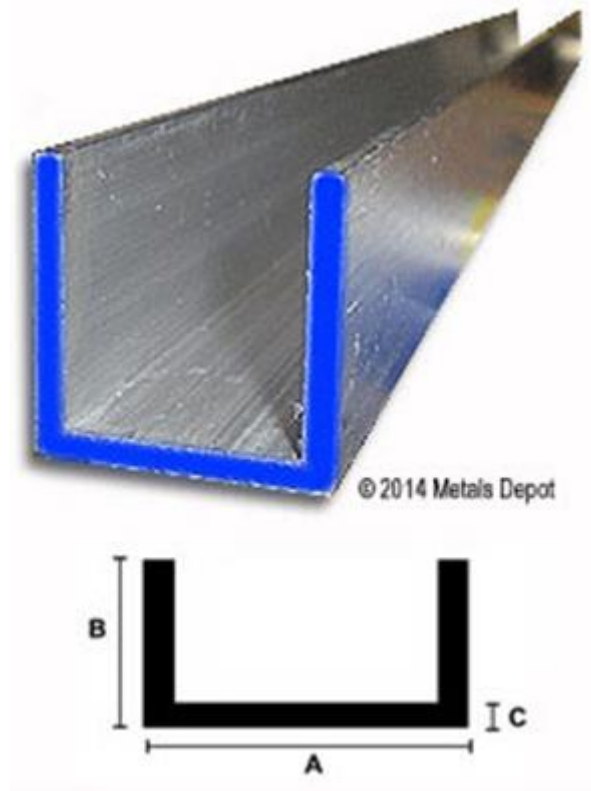


Figure 3- Aluminum Channel

The amount of trim that needed is shown in Figure 4 and Equation 2. As calculated below, 80 feet of trim will be required to enclose all open edges of the trough. The trim comes in 16 foot sections, so 5 sections of 16 feet will be ordered. This will sum to 80 total feet of trim.

$$P = 4(10ft) + 8(5ft) \quad (2)$$

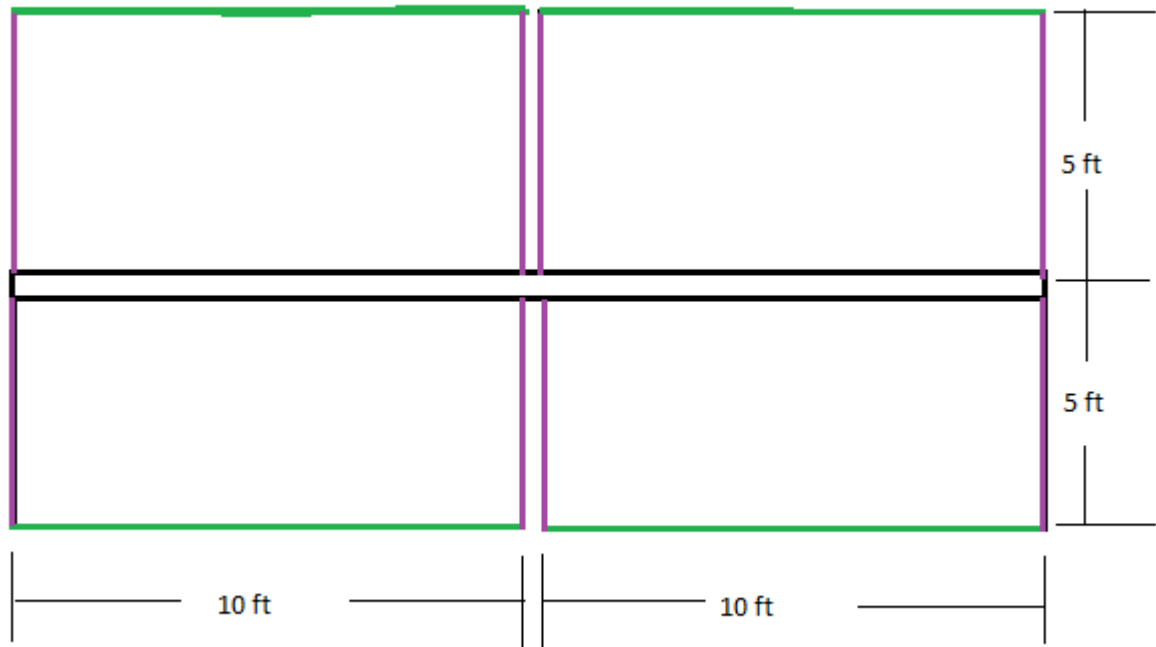


Figure 4- Perimeter Calculation

The 5 sections of 16 feet aluminum trim will cost \$206.40 itself, and the shipping will add on \$13.98 for a total of \$220.38.

Gearbox Information (Robert Blaskey)

The gear box is a double speed reducer gear box that has worm gears to rotate shafts for a 17 tooth sprocket output. The gear box was inspected by motion industries and K&M Tools and Machinery that determined that the gear box was still operable. The original gear box had a lot of rust and dirty oil in it, so it was necessary to give the gear box a deep cleaning, preferably by a professional. In order to get it cleaned, we made sure all the oil was drained, and everything was taken apart previously to delivering it. The gear box was professionally cleaned at Coconino Auto Company for \$35.00. The top section of the gear box in figure 5 displays a before and after picture of excessive rust within this section. The oil and most of the rust was removed from the gears and the box. However, there is still a little rust on the worm gear. This is not an issue because the rusted part of the worm gear does not make contact with the gear attached to the horizontal shaft, making it irrelevant to the function of the shaft.



Figure 5- Top Gearbox before (left) and after (right) cleaning

The other section of the gear box did not require as much cleaning. Due to oil being present in this section, the gears were preserved, so there was minimal rust. However all of the excessive oil was removed from the worm gear, and gears leading to the sprocket. Figure 6 shows the before and after picture of the box itself. The shaft leading to the output sprocket was separated from the rest of the gear box. In figure 7 it shows the before and after picture of the sprocket assembly. Similarly, there was minimal rust on the assembly. There was an excessive amount of dirt and dried oil on the outside of the gear box. After cleaning, there is a big difference between the before and after gearbox, as shown in figures 5-7. The next tasks are to get a new gasket for the upper section of the gearbox. This gasket needs to be custom made. We will purchase a section of gasket material, \$8.00 and cut the proper dimensions in order to fit it into the sectional plate.



Figure 6- Lower gearbox before (left) and after (right) cleaning



Figure 7- Sprocket assembly before (left) and after (right) cleaning

The only other steps, in order to make the gear box operable, is to place 75W-90 oil in the box for \$8.50. This oil will sustain the gear box for temperatures down to 0°F. Oil type 75W-110 would also work for the gear box. Once this is done, the gear box can be assembled together again. The only other critical step is to place the correct motor on the 3/8 inch vertical shaft into the gear box.

Conclusion (Jairo Rivera)

The gear box for our tracking system only needs a gasket and oil which will be purchased once the motor and control box is ready to be re-assembled on the trough. The extended fencing to the solar shack to accommodate for the trough's new location, although important, is not preventing progress on tracking system. Currently, our team and Northern Arizona University are looking for a more reasonable quote for the extended fencing. In conclusion, aluminum trims, Mylar, adhesive, and one wheel caster with tire will be purchased within the next week. Once the parts have arrived our team will install them accordingly. Further research on an applicable motor will be done and our team is expected to have a motor chosen within the next week. Once the motor is chosen, our team will decide on a control box specific to our motor and needs.