Elk Ridge Ski Area: Poma Lift Stick

Team 17
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Concept Generation and Decision Making

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Introduction

Elk Ridge Ski and Outdoor Recreation Area is in need of a new lift attachment for their Poma surface lift. To meet this need, our team has gone through the process of concept generation to develop five possible design concepts for a new attachment. In developing these concepts, several main components had to be met for the concept to be considered for validation by the team. These main components were:

- The new design must be compatible with the old attachment configuration.
- The concepts must be able to be built within a $200.00 budget per pole
- It must be possible for the design to help carry a skier or a snowboarder while holding some percentage of their weight. (i.e. no riders will be pulled up the line by their arms alone)

Any design ideas that did not meet these components to some extent were immediately scrapped or edited to reflect the most important needs of the client. Once five feasible designs were developed, they were then scored on several other criteria until a final design was chosen.

Concept Generation

The following five designs were the top five feasible designs developed by our team. All of the designs consist of a straight pole assembly with an inner pole that is securely attached to the lift line and slides within an outer pole to allow the height of the attachment to be adjusted for different sizes of people. This is how the current Poma attachment system works and it works effectively so there is no need for modification.

Design #1: Ball and Socket

This design incorporates a ball and socket set up that allows for 360 degree rotation around the Poma stick. This arrangement will benefit snowboarders by allowing them to rotate their bodies parallel to the lift line while also accommodating skiers as well as the original Poma design. Since this design is similar to the one presently in place, the cost to build these lift sticks will be minimal. It might also be possible to retrofit the current Poma sticks with a ball and socket set up to further reduce costs. The main disadvantage associated with this design is the level of comfort

that a snowboarder would experience. Even though snowboarders are able to have their boards oriented correctly, there is a low amount of support in the correct areas. This leads to high amounts of stress on the rider's inner legs. Another issue that this arrangement creates is the wear on the ball and socket. These types of configurations require lubrication to perform well and will eventually need to be replaced, which will lead to increased maintenance costs for the lift.

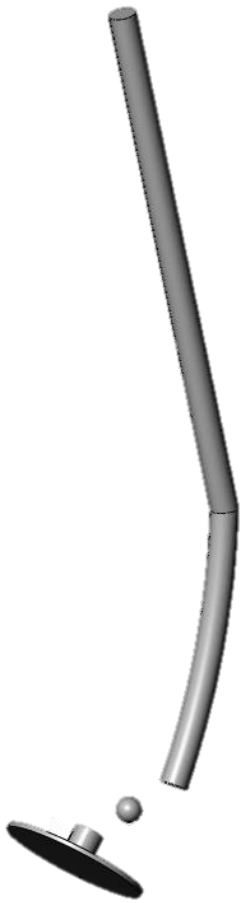

Figure 1 – Ball and Socket Design

Design #2: Fixed Flat Plate

This design consists of a straight pole approximately seven feet long with a 90 degree bend at the bottom. If the pole is held perpendicular to the ground, the turned section will be parallel to the ground. Attached to this turned section is a seat oriented at a 45 degree angle from the vertical

portion of the pole. This will allow riders to lean back on the seat and have it to carry a portion of their weight. This seat will be attached to a small hinge, pin, or bearing that allows the seat to rotate approximately 15 degrees in either direction. This will provide extra comfort for riders of different heights and orientations.

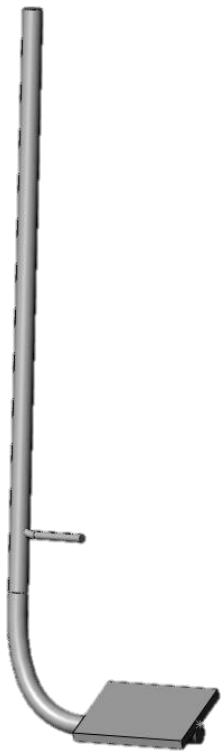

Figure 2 – Fixed Flat Plate Design

Design #3: Harness

The concept behind this design was to have one part that accommodates both skiers and snowboarders without over-complicating the shape or movement of the lift stick. The harness would be checked out or rented by the rider and worn throughout their ride. The rider would put on, and adjust the harness for comfort in both the waist and the legs, as shown in the diagram below, before approaching the lift. With both a hip and leg belt, the rider would be pulled up the lift being fully supported in all necessary areas. The harness has a connection on the front, for skiers, and on the sides, for snowboarders. When the riders approach the lift stick, they simply

attach themselves and are able to be pulled up the lift. When the rider is ready to dismount, they detach themselves from the lift, and begin their ride.

Design #4: Two Part Roller

This design concept separates the original lift stick in to two parts, with a roller (or bolt) connection between them so that the two parts can rotate freely. There is a handle on each part of this design, when the rider holds on to the handles; they can rotate their position to accommodate the stick to their equipment. As the lower part and the support disk are the same as the original ones. It will provide same support and comfort as before.

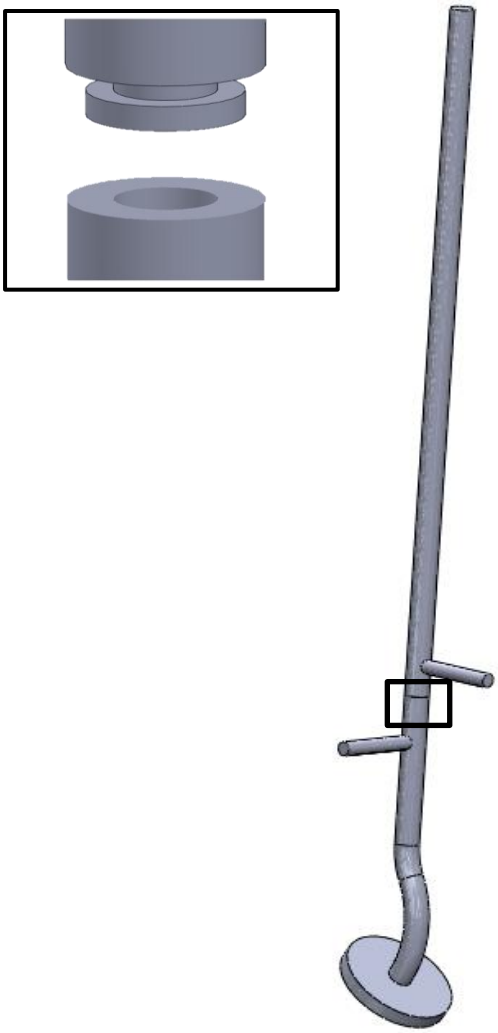

Figure 3 – Two Part Roller Design

Design #5: U Hook

This design contains a "U" bend in the pole. For comfort measures, padding will cover the U portion of the stick. For snowboarders, this U would be placed around the snowboarder's waist. The hook portion of this design would hook around both legs of a snowboarder. This allows the snowboarder to be able to lean of their side on the pole for better support. Snowboarders are also able to ride up with either their left foot or right foot (goofy or straight) in front up the lift line. For skiers, the design is similar to the current design except that the U portion will become a back support. Skiers will simply lean back on the "U" with the pole positioned on their lower back or what is the most comfortable for the rider. The U does not necessarily need to be a

complete U shape, but the bent portion does need to be curved enough to fully support snowboarders while riding up the lift line.

Figure 4 – U Hook Design

Decision Matrix

To choose the most appropriate design for this application, a decision matrix was developed based on the following criteria all of which were given a weight or percentage importance out of 100%.

- Safety: This was chosen because in a moderate risk environment such as a snowy mountain, it is essential that as much possibility for injury is reduced. The health and safety of customers is always the top priority for sports and entertainment providers such as ski resorts. Accordingly, safety was assigned the highest importance at 30%

- Ski and Snowboard Comfort: This criterion was chosen because the need for a new design was based upon the fact that the old design did not allow for snowboarders to ride the lift without excess stress on their bodies. As a result, ski and snowboarder comfort was assigned the next highest weight of 20%.

- Wear and Life: Because Elk Ridge Ski Area operates on a limited budget due to past seasons of low snow fall, it is essential that the new poles last a long time and do not have to be repaired or replaced regularly. This is also important because excess wear that is not addressed quickly enough could lead to injuries for lift riders. Similarly, this criterion was assigned a weight of 20%.

- Easy Board and Dismount: A Poma lift is a constantly moving lift line with multiple exit points. This feature causes the need for riders to be able to get on and off of the lift quickly to avoid missing their exit or becoming an obstruction to lift riders behind them. However, because missing an exit is not a large concern for injury, this criterion was given a slightly lower weight of 15%.

- Feasible to Build: This criterion is related to cost. As stated earlier, the ski resort operates on a limited budget so all designs must be able to be built with relative ease. As these designs were developed within the limits of the current Poma system, there was not a huge concern of the ability to construct them. Accordingly, this criterion was assigned a weight of 10%.

- Least Amount of Material: This criterion is also related to cost. The amount of material an object is made from has an impact on the cost. However, because these designs were developed under such a strict set of constraints, this was not a large concern. As a result, this criterion was assigned a weight of 5%.

Below is the decision matrix used and all five designs scored according to the criteria and weights described above.

		Design Options									
		Ball & Socket		Fixed Flat Plate		Harness		Two Part Roller		U Hook	
Design Criteria	**Weight**	**Raw**	**Weight**	**Raw**	**Weight**	**Raw**	**Weight**	**Raw**	**Weight**	**Raw**	**Weight**
Safety	0.3	8	2.4	7	2.1	6	1.8	7	2.1	6	1.8
Least Amount of Material	0.05	9	0.45	7	0.35	5	0.25	8	0.4	7	0.35
Ski and Snowboard Comfort	0.2	5	1	8	1.6	9	1.8	7	1.4	7	1.4
Wear and Life	0.2	5	1	7	1.4	8	1.6	6	1.2	9	1.8
Easy Board and Dismount	0.15	9	1.35	7	1.05	6	0.9	8	1.2	7	1.05
Feasible to Build	0.1	7	0.7	7	0.7	5	0.5	7	0.7	8	0.8
	Totals		6.9		7.2		6.85		7		7.2

Figure 5 – Decision Matrix

From the table above, it is clear that there are two designs with the highest scores and two with the lowest. The Ball and Socket and the Harness designs are the lowest. The harness has the lowest score because it was determined that it was simply not practical. From a safety standpoint, it would be too easy for rider's harnesses to remain attached to the lift if they fell. That causes a major concern for injury. In addition, the amount of material required to have enough harnesses for every rider on the mountain on a busy day would cost far above our clients budget. As a result, this design was ruled out first. The design with the second lowest score was the ball and socket joint. Though this design is the safest, it is too similar to the current Poma design and would be the least comfortable for snowboarders. This design also raised a high concern for the life of the attachment. Because of the wet and wintery conditions, a ball and socket joint would be likely to rust very quickly and no longer rotate. Without the free movement

of the ball and socket, this design becomes almost exactly the same as the current Poma design and would prevent snowboarders from using the lift again.

The two highest scoring designs from above are the U Hook and the Fixed Flat Plate. As both designs provide different types of support for riders, it was decided that a combination design incorporating a U hook and a flat plate would be developed.

The rotation mechanism from the two part roller will be retained with the intent to incorporate it into the final design. The seat and pole configuration from this design, however, is also too similar to the current design and would provide some of the same discomfort for snowboarders as the current design. The round seat with the pole in the middle would still be difficult for snowboarders to carry any weight on and the side would dig into a snowboarder's leg as they were pulled sideways up the mountain. Then free rotation of the roller is also a safety concern for smaller or younger riders who cannot hold the mechanism in place. A safety locking pin will need to be installed in the roller system to make it applicable for all riders.

Conclusions

The preliminary design our group has decided to pursue will incorporate a U Hook with a flat bar "U" shaped portion instead of a round pole. A flat plate will be attached to the hook to provide lower back and hip support for riders. A handle will also be incorporated to ensure that riders feel safe on the lift and have extra support to keep them balanced. An initial design model of this design is included below.

Figure 6 – Final Design

References

1. *Elk Ridge Ski and Outdoor Recreation Area*, 2009, http://www.elkridgeski.com/, Accessed October 20th,2012

2. *Pomagalski S.A.*, 2009, http://www.poma.net/, Accessed October 20th,2012