"A BICYCLE BUILT FOR TWO"

MANUALLY OPERATED TRAMWAY FOR EXPLOSIVES DELIVERY

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ABSTRACT

A low cost avalanche control device for isolated targets or high risk paths where hand placement , artillery, or high pressure gas delivery systems are not appropriate.

The idea of using bomb trams for avalanche explosive delivery is not a new one, but there are actually few 'cost effective' devices in use. "High-Tech" systems are already in use in Europe and throughout Canada as well, and these trams are quite costly. With the scarcity of military weapons and ammunition, and avalauncher type devices in questionable supply, a cost effective delivery system can be built to serve special needs.

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Brighton Ski Resort, a class "A" avalanche area located in the Wasatch mountains of Utah, had such a need. In the summer of 1991, a high-speed detachable quad chairlift, the Crest Express, was constructed. Base terminal elevation is 8,760′ and the top terminal is at 10,020′. We needed to build a cat-track, or "easiest" way off the top. That trail, *Pacific Highway*, was cut directly under a small but active slide path with three starting zones. All three of the paths, *Hackey Chute, Middle Chute* and *Corner One,* have runout zones that directly hit the *Pacific Highway* trail.

Hackey Chute has a north north-east aspect with a vertical fall of 300′. Starting zone slope angle is 43 degrees, track is 36 degrees, and runout is 10 degrees. Vegetation consists of grass and small fir trees.

Middle Chute is north in orientation, with a vertical fall of 325′. Starting zone slope angle is 40 degrees, track is 38 degrees and runout is 8 degrees. Small fir trees are located in the starting zone, with older growth spruce dispersed in the track.

Corner One has a north north-west aspect and vertical fall of 400′. Starting zone slope angle is 42 degrees, track is 38 degrees and runout is 10 degrees. A small talus slope is located in the starting zone and small fir and spruce make up the vegetative species in the track.

All of the mentioned paths load when storms come in with a southerly component.

To control these paths, teams must climb a ridge where deep wind-blown snow would often make this hike a difficult and time consuming task. As a result, late lift openings could be expected. It was decided that we needed to design and build an experimental "Bomb Tram". Steve Jorgensen was chosen to fabricate a system, since he is knowledgeable in both avalanche control and lift design. As with any experminental system, finances were a concern. Materials were obtained from our maintenance building, scrap ends of steel and a bicycle from the town dumpster. Many were skeptical of the feasibility of such a system, and Steve did endure a lot of verbal abuse from the group of doubters.

The success and versatility of this tram all stems from its "free floating" bullwheel or return sheave. The concept for this is not a new one and was actually borrowed from old poma lifts with similar design.

The bullwheel is attached to a tree with a static rope, tension is achieved with a cable hoist. Upon tightening, the hoist pulls the bullwheel both into the tree and down. The lower terminal, or drive, is in a fixed position. During the first season of

operation the drive was set on the snow and was anchored to several trees with rope. One thing we quickly realized was the location of the bottom terminal was susceptible to drifting snow. Many mornings it would take quite a while to dig out the tram for proper operation. In the summer of 1992, I decided that an adjustable base would be more efficient so a 2" by 10' pipe was set in a concrete footing. An adjustable collar system was made to allow us to raise the tram as snow depth increased. The base is also able to pivot, allowing for self alignment with the bullwheel as well as compensation for wind movement of the haul rope. We used 1200' of 1/4" poly-pro rope which served as the haul rope.

A 20' swath was cut through a group of trees to allow clear passage to the target area. I did find, during the first year of operation, that north and northwest winds greatly affected our rope. On several occasions the haul rope had been blown away from the tram and was hung up in near-by trees. That summer I cut a wider path, which remedied the problem.

Delivery of the shot is accomplished by attaching a leader to the haul rope. Three different lengths of rope are used, depending on shot placement. As snow depth varies the length of rope will change as well. We try to maintain an explosive delivery height of 1 meter above the snow surface throughout the year. Two control members are used for safe and efficient delivery of the charge.

One person is at the drive terminal, while the other is uphill at a distance of 30'. The person uphill attaches the explosive, ignites it and radios the drive person to deliver the charge. A standard control length fuse of 90 seconds is used and this works sufficiently for this type of delivery system. Since there are three shot placements on this route, to avoid any confusion on "blind fire" days tape has been wrapped around the haul rope to indicate shots one through three.

Brighton has developed this particular device for our situation. We can't say this will be applicable for other ski areas. This system has worked successfully for us for three seasons with only one derail which was caused by high winds. On the same day there was some human error when the control team taped the shot too close to the haul rope and blew it up. Fortunately for us it was closing day for the ski area. This device has been a great asset to the resort by reducing the cost of control work man hours and allowing the lift to open on time.