Engineering a Passenger Ropeway On the Cal Poly Pomona Campus

Wayne D. Cottrell
Advanced Transit Association

California State Polytechnic University
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A team of undergraduate students at California State Polytechnic University, Pomona, led by a faculty advisor, planned and preliminarily designed a passenger ropeway as their senior capstone project. The purpose of the ropeway was to connect the main campus, at an elevation of 765 ft (233 m), with Kellogg House and Parking Lot R, at an elevation of 940 ft (287 m). The house and lot are situated on a ledge overlooking the main campus. The ropeway was proposed as an alternative to driving or walking up and down narrow Mansion Lane to access these facilities. The selected alignment had a straight-line length of 1,760 ft (536 m), with an average gradient of 10%. Kellogg House management preferred gondolas over chairs for passenger carriers, although a survey of students, faculty, staff and visitors showed equal preference. The same survey found that up to 76% of the campus community would use the ropeway. The potentially high ropeway demand would overload Mansion Lane with vehicles accessing Lot R, and exceed the lot’s capacity. To mitigate these impacts, a parking structure to replace Lot R, and a traffic control plan to advise drivers of available parking were proposed. With a fixed-grip, continuous ropeway, the operating speed would be 150 ft/min (0.75 m/sec). Four-person gondolas spaced at 71 ft (21.6 m) would enable the ropeway to move up to 400 persons/hr. Six support towers, along with a counterweight, would ensure cable sag of no more than 24 ft (7.3 m).

¹ Job Title: Advance Transit Association
Company Name: Advanced Transit Association
Address: 1853 Santa Rita Drive
City, Postal Code, Country: Pittsburg, California 94565
Phone: 909-204-0260
E-mail: waynecottrell@advancedtransit.net

² Coauthors: undergraduate students in the Civil Engineering Department at California State Polytechnic University, Pomona, 3801 West Temple Avenue, Pomona, California, 91768; 909-869-2488 (phone); 909-869-4342 (fax).
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INTRODUCTION

A capstone, undergraduate senior design team performed planning and preliminary engineering for a passenger ropeway on the campus of California State Polytechnic University, Pomona (Cal Poly Pomona). Over the course of three academic terms (nine months), the team of ten investigated the project site, gathered topographic and other site data, studied and learned about passenger ropeways, surveyed potential campus patrons, toured the nearby Mount Baldy ski lift, analyzed chair and passenger ropeway capacities, made a decision regarding the type of passenger carrier, proposed a ropeway alignment and terminal locations, developed alternative lift capacity scenarios, performed preliminary tower designs, calculated cable sag and tension needs, estimated the parking demand that would be generated, recommended a traffic control plan, suggested improvements for a parallel walkway, and estimated the potential costs. The team also performed preliminary footing, seismic design and environmental impacts analyses, and initiated a discussion of mitigations. Although the project was only an academic exercise, the students’ efforts satisfied the Accreditation Board for Engineering Technology’s (ABET’s) requirement for a comprehensive design project to “cap” their undergraduate program. This paper describes the engineering aspects of the passenger ropeway project. A companion paper (Cottrell et al. 2009) discusses the team’s planning efforts and analysis.

PROJECT DESCRIPTION AND SETTING

The setting for the passenger ropeway project is the Cal Poly Pomona campus, located in western Pomona, California. The 582-ha campus served 21,190 students, 1,025 part- and full-time faculty, and 1,615 staff as of Fall 2008. A passenger ropeway was conceived as a solution to a parking lot underutilization and access issue. The campus is bordered by the I-10 freeway on the north, South Campus Drive on the east (oddly, East Campus Drive is on the north!), Temple Avenue on the south, and the San Jose Hills on the west. Portions of the campus stretch southward across Temple Avenue. While the main campus has an average elevation of 222.5 m, ranging from 216 to 268 m, the San Jose Hills reach to a peak of 402 m (Buzzard Peak) west of campus. The peak elevation of the campus’ western boundary is at 317 m on the flanks of the hills.

\textsuperscript{1} Job Title:  
Company Name: Advanced Transit Association  
Address: 1853 Santa Rita Drive  
City, Postal Code, Country: Pittsburg, California 94565  
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E-mail waynecottrell@advancedtransit.net

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At the northwestern corner of campus, I-10 climbs toward Kellogg Hill (a pass through the San Jose Hills). Just east (downgrade) of this pass, just south of I-10, stands the remains of a portal that formerly served as the main entrance to the Cal Poly Pomona campus. The portal is now surrounded by a parking lot (Lot R) that serves Kellogg House during special events. The house and lot sit at an elevation of 287 m, overlooking the main campus. The house – also known as Kellogg Mansion or University House – was built in 1926 and was the former winter home of cereal magnate W.K. Kellogg. Although Kellogg House is active only during events, Lot R is open to faculty and staff at all times. The 42-space lot is underutilized, though, primarily because there is no way to negotiate the descent from Lot R to main campus other than on foot. There are currently three pedestrian routes: a twisting concrete path in need of maintenance and repair, a combined path-staircase that begins in the backyard of Kellogg House, and Mansion Lane (a winding, two-lane road with no sidewalk). Neither option is particularly appealing given the gradient, tricky footing (on the paths), and potential conflicts with motor vehicles (along Mansion Lane). Faculty and staff avoid the lot in favor of main campus locations, although several of the latter are probably farther from certain campus buildings than Lot R. There has been no study of where campus employees park relative to the buildings in which they work, however. Parking is plentiful on campus, although certain lots tend to fill to capacity, which occurs especially during periods in which students are allowed to park in faculty-staff lots.

One solution to the poor access-utilization issue was to improve the connection between Lot R, Kellogg House and the main Cal Poly Pomona campus with an alternative form of passenger transportation. A shuttle bus was considered to be impractical unless the route was to circulate through the entire campus. Cal Poly Pomona's Bronco Shuttle was already serving the campus in this manner, however, and an extension up Mansion Lane would add at least 5 min to the round-trip travel time – negatively impacting travelers not destined for Kellogg House or Lot R. A suitable alignment did not exist for rail infrastructure, such as for an inclined railway. Improved walkways were considered, but needed to be implemented in combination with an alternative mode, rather than as a stand-alone option. A passenger ropeway was ascertained to be the best choice, given the comparatively minimal impact of the infrastructure, and the usefulness of ropeways in climbing and descending hills. The impact was of concern since a 31-ha portion of the northwestern campus, in the San Jose Hills, was designated as the Voorhis Ecological Reserve in 1983. The reserve borders the Kellogg House property line on its western side. The primary constituents of the reserve include coastal sage scrub, some coast live oak woodland, four amphibian species, twelve reptile species, 38 types of mammal, 100 types of bird, and 167 vascular plants. Although the ropeway alignment could avoid the reserve entirely, sensitivity to the ecosystem of the hillside was important.

![Diagram of Voorhis Ecological Reserve, Pomona](image)

**Figure 1. Voorhis Ecological Reserve, Pomona** (outline of boundary)
ROPEWAY ALIGNMENT

A passenger ropeway with upper and lower terminals was designed. The upper terminal was situated approximately midway between, and within walking distance of, Kellogg House and Lot R, in an area that is paved and relatively flat. The lower terminal was situated adjacent Building 94 in the Quad Area, which is used annually for university commencement activities. The terminal site is currently a grass-covered plot that slopes gradually. Although the Cal Poly Pomona campus has neither a designated nor de facto center, the Quad Area was chosen as the lower terminal for its proximity to several key buildings. The lower terminal would be immediately adjacent Building 94, which is the University Office Building, and opposite Buildings 5 (College of Education and Integrative Studies), 6 (College of Business Administration), 8 (College of Science), 97 (Campus Center; eateries, mini-mart), and 1 (mixed use, including Cal Poly Pomona Research Foundation). The length of the alignment is 500 m, extending from a lower elevation of 237 m to an upper elevation of 287 m. The *walking* distance between the two terminals, along Mansion Lane, is 790 m. The average gradient of the alignment is 10%. Adequate space exists at both terminal sites for equipment and passenger storage areas.

![Figure 2. Proposed Passenger Ropeway Alignment, Cal Poly Pomona Campus](image)

PASSENGER ROPEWAY DEMAND AND CARRIER NEEDS

As described in Cottrell et al. (2009), the estimated demand for a passenger ropeway between the main Cal Poly Pomona campus and Kellogg House-Lot R would be 5,820 trips per day (including two per person), with 10% (582) occurring during the peak hour. The estimate was derived from a stated preference survey of potential campus patrons, and then adjusted to correct for a limited parking capacity at Lot R (which would be upgraded, as part of the project, to a 400-space garage). A standard formula for passenger ropeway capacity was used, as follows:
\[ C = \frac{(60PR)}{S} \text{, with} \tag{1} \]

\( C \) = ropeway capacity in passengers/hr

\( P \) = number of passengers per carrier

\( R \) = rope speed in m/min

\( S \) = carrier spacing in m

Bonasso (1981) added an efficiency factor to the formula, to reflect the fact that each carrier may not be fully loaded during the peak hour. The design approach considered fully-loaded carriers, however. The project team investigated two- and four-passenger carriers (\( P = 2 \) or \( 4 \)). Only a fixed-grip ropeway was considered, since a detachable ropeway has been associated with a 40% higher cost per unit of capacity (Mulligan and Llinares 2001). The project team anticipated limited funding resources for the ropeway – possibly from student and-or parking fees – so a low-cost solution was preferred. Although a detachable ropeway can move at a higher speed than a fixed-grip lift, the short point-to-point distance (500 m) suggested that the travel time difference would not be great. A survey of potential patrons revealed an equal preference for chairs and gondolas. Kellogg House management indicated a preference for gondolas – in consideration of what the users of special events at the house might prefer – so the project team opted against chairlifts. The project team did not ask about basket or bucket lifts, or cabriolets, both of which are analogous to “open-air” gondolas, but it was presumed that these would be as acceptable as closed gondolas. Each of these has a floor; a cabriolet typically has a roof, while a basket or bucket lift may or may not have a roof.

ANSI B77.1 (2006) recommends maximum speeds of 1.5 m/sec for fixed-grip double chairs, and 1.3 m/sec for fixed-grip chairs carrying more than three persons, for foot passengers. The speeds are appropriate for a continuously moving ropeway. Spacings of 18 m for two-person carriers, and 32 m for four-person carriers, were derived from equation [1]. Dividing the spacings into the round-trip distance of 1,000 m and rounding up, either 56 two-person (at a spacing of 17.86 m) or 32 four-person carriers (at a spacing of 31.25 m) would be required. The travel time for the one-way 500 m distance would be about 5.5 min. The project team found that no fixed-grip four-person carriers were in operation – all were detachable, probably because of the potential difficulties in loading four persons into a continuously-moving carrier. Thus, the project team elected to investigate two-person carriers. The project team had some concern over the accessibility of basket and bucket lifts, which did not appear to have ample room for a wheelchair.

CARRIERS

According to www.lift-world.info, there were 842 gondola ropeways worldwide as of 2008, including 49 in the U.S. The majority of the settings were ski resorts, but applications were also found at amusement parks, fairgrounds, mountaintop attractions, and in urban landscapes. The number of cabriolets in this group was unknown. Nearly all of the gondola lifts were detachable. There were also 23 basket or bucket lifts. Only three of the gondola lifts, but all of the basket lifts, were fixed-grip. In keeping with the projected budget and stated user preferences, the project team pursued a fixed-grip open-air gondola or basket lift. There were 26 of these worldwide as of 2008, including 15 in Italy, four in the Ukraine, two in France, and one each in Portugal, Russia, Saudi Arabia, Switzerland, and Uzbekistan (none in the U.S.). All of the carriers accommodated two persons. The proposed Cal Poly Pomona ropeway, at 500 m, would be shorter than the average length of these, which was 1,249 m. Three of the lifts are shorter than 500 m, though, including two in France (Flaine, 220 m; Palavas, 83 m), and one in the Ukraine (432 m). Italy featured the greatest variety among the 26 lifts, including the oldest (1960, Gubbio), newest (2006, Pesaro), greatest vertical rise (730.7 m, Laveno), and longest (2,235 m, Pedace). The average speed of the 26 lifts was 1.64 m/sec. Examples are displayed in Figure 3 (basket lift with roof) and Figure 4 (basket lift with no roof). Figure 5 shows an 8-person cabriolet; the project team did not identify any two-person cabriolets. The project team leaned toward using small cabriolets, for passenger comfort (covered, with a floor), space for small cargo (such as a book bag or backpack), and accessibility to the disabled.
Figure 3. Basket Lift (with Roof) at Jardim Zoologico, Lisbon, Portugal
(www.graffer.it/prod_telecabine.asp)

Figure 4. Basket Lift (No Roof) at Laveno-Poggio S. Elsa, Italy
(www.seilbahntechnik.net/en/lifts/13723/datas.htm)
PRELIMINARY CABLE SAG AND SPAN ANALYSIS

ANSI B77.1 (2006) suggests designing for 110% of the full carrier passenger load, at an average passenger weight of 77.1 kg. The tare weight of a two-person cabriolet was assumed to be about 100 kg. One aspect of the design is cable sag, and the adequacy of vertical clearance beneath the carrier. As shown in Figure 2, the proposed alignment passes through an area that includes coastal oak, California black walnut, and gnatcatcher habitats, the latter of which is a protected species of bird. The project team decided to mitigate the potential impact of the ropeway on local flora and fauna by clearing the tops of the trees, and avoiding tree removal. Although the team did not measure tree heights, a 25 m tower height was used to check cable sag.

Although a dynamic analysis of rope and carrier motion would produce the most accurate results, the team elected to perform a static analysis. The complexities of a dynamic analysis were beyond the scope of the project. Renezeder et al. (2005) discussed cable sag oscillations, noting that periodic changes in the amplitude of cable sag could be measured in meters, and might make passengers uncomfortable. A total of 56 cabriolets were distributed at 17.9-m intervals around the ropeway. The team decided to let the static analysis dictate the number of towers needed to avoid excessive cable sag. The general formula for cable sag along a single span with multiple loads is:

\[
y = \frac{(G/t)\{x(n – u) – m[(xn/s) – u] – a[(bx/s) – c]\} + [wx(s – x)/2t]}{[2]
\]

- \( y \) = vertical deflection or sag at point xy, as measured from the left support
- \( G \) = loaded carrier weight * 110% = 254.2 kg (559.2 lb) * 1.1 = 279.6 kg (615.1 lb)
- \( t \) = horizontal component of cable tension
The formula uses English system units of ft and lb. The cable tension and unit weight are variables selected to limit the deflection. Also, the cable tension can be controlled with a counterweight at the end of the lower terminal. Cable deflection was estimated for a worst-case condition in which the carriers were 100% occupied on one side of the lift (i.e., uphill or downhill), and a carrier was at the midpoint of each span. A static analysis was performed to find the cable sag at the span’s midpoint. Although more than one combination of tension and weight can produce desirable results, the team found that the cable deflection would not exceed 2 m if there are four spans, with a cable tension of about 9 kN and unit weight of about 3 kg/m. The critical design result is four spans, requiring three intermediate towers spaced at 125-m intervals.

**METEOROLOGICAL AND GEOLOGICAL CONDITIONS**

According to data from the National Oceanographic and Atmospheric Administration, the average wind speed during the peak month (March) in the interior of the Los Angeles region was 10.5 km/h (2.9 m/sec), based on 28 years of data. The maximum recorded wind speed as of 1993, based on 36 years of data, was 79 km/h (22 m/sec). Using information in Hong Kong’s code of practice, the ropeway wind load is:

\[ P_w = \frac{V_w^2}{16}, \]

where \( P_w \) is the wind pressure in kg/m², and \( V_w \) is the wind speed in m/sec. Substituting the maximum recorded wind speed, \( P_w = 30.25 \text{ kg/m}^2 \). To avoid excessive lateral or longitudinal oscillation, dynamic absorbers that dampen the motion can be outfitted on each carrier (Janocha 2007). Hoffmann and Liehl (2003) studied the use of sensors, noting that midspan carriers were the most susceptible to wind-induced oscillations. At least one carrier with a sensor could be used to alert ropeway operators to high-wind conditions. The best strategy, however, might be to shut down operations until winds subside. Further study would be needed to recommend an effective “shutdown” strategy. Only traces of snow have fallen within the Los Angeles urbanized area during the past 85 years; hence, there was no need to consider snow loads in the ropeway design.

Geologic studies indicate that the proposed ropeway alignment traverses bedrock (basement Mesozoic rock). The bedrock is not exposed, and is overlain with poorly sorted conglomerate and conglomeratic sandstone known as “Buzzard Peak conglomerate.” Alluvial fan deposits are immediately to the west and east of the alignment corridor. As an indication of the stability of the slope, Figure 6 displays the landslide and liquefaction potential of the area. The proposed alignment traverses bedrock with some landslide potential, toward the upper terminal, as well as soil with liquefaction potential, toward the lower terminal. The mapping in Figure 6 is based on historic occurrences of landslide and liquefaction events, which were generally induced by ground movement. Regarding the latter, the San Jose Fault runs north-northeast near the Cal Poly Pomona campus. Its exact location has not been identified. Investigations in 1998 and 1999 indicated that there has been some movement near the fault, but the studies were inconclusive as to whether the fault was active.

During the January 17th, 1994 Northridge earthquake, the peak ground acceleration (PGA) in downtown Pomona, about 6 km from the Cal Poly Pomona campus, was 0.07g. The quake measured 6.7 on the Richter scale, and the epicenter was located about 75 km from central Pomona. Pomona’s PGA would be associated with a quake of magnitude less than 5.0. This was the last major earthquake to strike the Los Angeles region. The hazard potential (i.e., for landslides and liquefaction) of the study slope was rated VL (very low) in Seismic Hazard Zone Report 032. However, the proximity of the San Andreas Fault (about 35 km) and numerous smaller faults places the proposed ropeway within the U.S.’ highest earthquake risk zone.
TRESTLE LOADING AND FOOTINGS

As part of the preliminary nature of the ropeway design, the project team performed a static (rather than a dynamic) analysis of loading on the trestles and towers. To simplify the analysis, the entire ropeway was treated as a single structure at equilibrium. The entire ropeway was fully loaded; however, only one side was loaded for a “worst-case” sag analysis. A schematic of the ropeway profile is shown in Figure 7. The lower and upper terminals are at A and E, respectively. The distances EF, FG, GH and HA are 125 m, each. The incline of 5.71° is equivalent to a 10% grade. The dashed line is the ground, which is not part of the “structure.” Black arrows indicate tension in the cable, while open arrows indicate the directions of compression and concentrated point loads. The values of the loads are not shown to avoid cluttering the figure. Although the representation is overly simplified, it is evident that the entire facility would collapse without secure footings under the three towers; these are needed to resist the moments caused by the carrier weights, gravitational pull, shear, and overturning forces.

Spread footings are commonly used to support towers. The preferred design is a concrete slab placed on bedrock, with the tower anchored to the slab. The project team learned that there is no method for determining the exact dimensions of a concrete footing. A depth to width ratio of about 1.4 is suggested. The depth can be estimated from the load bearing pressure of the soil. A commonly-used load bearing pressure for crystalline bedrock is 12,000 lb/sq ft, or about 4,960 N/m². One recommended design load would be 1.4 times the dead load (cable, carriers, towers) plus 1.7 times the live load (passengers). These have the following values:
Figure 7. Ropeway Profile Schematic

Dead load
- 56 carriers * 100 kg/carrier = 5,600 kg
- 1,000 m rope length (actually 1,020 m) * 3 kg/m = 3,060 kg
- 3 latticed steel towers * 2,415 kg = 7,245 kg

Live load
- 56 carriers * 2 passengers/carrier * 77.1 kg/passenger * 1.1 = 9,500 kg

The self-load of the towers was estimated from an equation developed by Ryle (1946), wherein the tower height and moment are key variables, as follows:

\[ W_T = 0.648H\sqrt{M + 450}, \quad \text{where} \]

\[ W_T = \text{tower weight (kg)} \]
\[ H = \text{tower height (m)} \]
\[ M = \text{moment experienced by tower (N-m)} \]

A moment would develop at each footing, caused in part by differing directions of tension in the trestle, as well as by wind loads. The project team’s static analysis did not fully characterize the dynamic moments that would develop at the trestles and footings. But, a more significant force – wind loading at the maximum recorded wind speed – was incorporated. The largest moment would occur at the base of the first tower (i.e., nearest the lower terminal), at an estimated 147 kN-m (94% attributable to wind loading). Substituting values, the tower weights were estimated to be 2,415 kg each. The effective design load of the entire ropeway was estimated to be 38,417 kg (377 kN), distributed over three footings. Structures at the lower and upper terminals, including equipment such as bullwheels and power supply, would represent separate loads that would not directly impact the footings. A separate, specially designed footing would be needed for the counterweight, however, which would be located adjacent the lower terminal. This footing was not studied.

SEISMIC DESIGN CONSIDERATIONS

The proposed ropeway is located within seismic risk zone 4, as defined by the Uniform Building Code (UBC) and as discussed above. The project team applied seismic design principles to the three towers. A seismic zone factor of 0.4, occupancy category of 5 (miscellaneous structures), seismic importance factor I of 1.00, soil type \( S_B \) (rock), seismic source classification A, near-source factors of \( N_a = 1.5 \) and \( N_v = 2.0 \), and seismic response coefficients of \( C_s = 0.60 \) and \( C_v = 0.80 \) are applicable. The ropeway towers can be classified as nonbuilding structures according to ASCE Standard 7-05. The project team noted that tower heights are not limited by the ASCE codes. Steel truss telecommunications towers have a response modification coefficient \( R \) of 3, a system overstrength factor \( \Omega_0 \) of 1.5, and deflection amplitude factor \( C_d \) of 2.5. The Pomona Valley has
a maximum considered earthquake (MCE) ground motion $S_s$ of 0.275g for a 0.2-sec spectral response acceleration, and an MCE of $S_1 = 0.75$ g for a 1.0-sec spectral response acceleration. The corresponding site coefficients are $F_a = F_v = 1.0$ for short (0.2 sec) and long (1.0 sec) periods. Design spectral accelerations are, therefore, two-thirds of the $S_s$ and $S_1$ values (i.e., $S_{DS} = 0.183$g and $S_{D1} = 0.50$g). The design response spectrum values are $T_0 = 0.2$ sec, $T_s = 1.0$ sec, and $T_L = 8.0$ sec for the Pomona Valley region. The seismic design categories are B for a short period response acceleration (0.2 sec), and D for a long period (1.0 sec).

The equivalent lateral force procedure was applied to the tower design. The critical concern, regarding seismic forces, would be the seismic base shear ($V = C_sW$). The seismic response coefficient $C_s$ was determined according to the following procedure:

$$C_s = \frac{S_{DS}}{(R/I)} \quad \text{[5]}$$

$$= \frac{0.183g}{(3/1)}$$

$$= 0.60$$

The value of $C_s$ is not to exceed:

$$C_s = \frac{S_{D1}}{[T(R/I)]}, \text{ where} \quad \text{[6]}$$

$T$ is the fundamental period of tower. Amiri et al. (2007) estimated the fundamental period of the first mode of a 16 to 67 m four-legged, latticed steel tower as $0.0102H^{0.958}$, where $H$ is the tower height. Substituting an $H$ of 25 m yields a period of 0.22 sec. Equation [6] produces a $C_s$ of 7.33, which exceeds the $C_s$ from equation [5]. Finally, $C_s$ is not to be less than the following in locations where $S_1 \geq 0.6$g:

$$C_s = \frac{0.5S_1}{(R/I)} \quad \text{[7]}$$

$$= \frac{0.5(0.75g)}{(3/1)}$$

$$= 1.226$$

The latter value of $C_s$ was applicable, and was multiplied by the effective design load on each footing (~377/3 = 126 kN) to find the design base shear (i.e., $C_s = 1.226 \times 126 = 154$ kN). The project team did not continue the seismic analysis, but it was recognized that the base shear would be distributed over the heights of the towers, and that the towers would be analyzed for P-$\Delta$ effects (i.e., secondary axial loading effects of lateral displacement) and the overturning effects of seismic forces (Lindeburg and Baradar 2006).

**TERMINALS**

The project team elected to place the lower and upper terminals at ground level, thereby requiring the cable to ascend to and descend from a height of about 25 m. The key components of each terminal would be a passenger queuing area, bullwheels enabling the cable to turn through 180°, a passenger loading area, signing and information, and operating personnel. Power sources and a counterweight would also be located at the lower and-or upper terminal. A boarding time of 3 sec/person is recommended in the Hong Kong Code of Practice. For a continuously-moving two-person carrier, the distance of movement during the 6-sec boarding time would be 9 m at 1.5 m/sec. Thus, the loading area at each terminal would have a length of 10 m.

The size needs of the passenger storage areas were estimated based on a Poisson process of passenger arrivals during the peak hour. With 582 patrons during the peak hour, the average arrival rate would be 9.7 persons/min. With 56 carriers circulating at a speed of 1.5 m/sec on a 1,020-m circuit, the service rate would be about one carrier every 12 sec. There would no more than a 5% probability that all 582 peak hour patrons would arrive at one terminal within 36 minutes (i.e., an arrival rate of 16 per min). This would generate a queue length of 222 persons. Using a “personal comfort” queue space of 0.8 m²/person (Fruin 1971), the passenger storage area needed would be 177.6 m² (e.g., 14 m x 13 m). Site investigations confirmed that adequate space would be available to accommodate passenger storage.
CONCLUSION

Cost information on passenger ropeways is limited because of the variety of installation types and settings. Wood (2007) reported an average cost of $18 million/mi ($11.2 million/km) for three gondola lifts. This would translate to estimated cost of $5.6 million for the 500-m Cal Poly Pomona ropeway, although not all costs would be proportionate to the ropeway length. In comparison, the 3.0-km Peak 2 Peak tri-cable gondola lift in Whistler, British Columbia was built for Canadian $51 million. The proportionate cost for the Cal Poly Pomona ropeway, would be U.S. $7.8 million. The monocable project ropeway would be cheaper than a tri-cable ropeway, however, so the $5.6 million estimate may be reasonable. The use of fixed-grip rather than detachable carriers might further lower the cost. The project team was encouraged by the apparently reasonable cost, and the possibility of funding the ropeway through a combination of student fees, parking charges, and gifts. A passenger ropeway was thus considered to be a feasible alternative mode of transport for the setting.

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