

Ropeways -A Leader in Safe Accessible Transportation

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Abstract- Over recent decades the number of persons with reduced mobility and those using adaptive technologies and equipment in the United States has increased significantly. In its most recent Strategic Plan on Accessible Transportation developed in January 2021, just after the 30th anniversary of the Americans with Disabilities Act (ADA), the United States Department of Transportation (DOT) determined **“The ADA has led to major improvements in transportation across the United States. However, significant barriers still exist ...”**. Ropeway transportation systems and standards in the United States can also boast of significant progress in this area, however there is room for improvement and an opportunity for ropeway transportation to become an accessible transportation leader.

Index Terms- Accessible, ADA, adaptive, disability, reduced mobility, ropeways, tramways, transportation

I. INTRODUCTION

This paper and presentation will focus on: persons with reduced mobility and their use of ropeways; adaptive technologies and equipment in use and under development; current ropeway and adaptive equipment guidelines and standards sections relative to accessibility and persons with reduced mobility used in the United States; ideas on how existing and proposed ropeway infrastructure including stations, carriers, etc. could be improved to increase accessibility for all passengers; ropeway operational considerations relative to persons with reduced mobility and their adaptive equipment and technologies; and make the case for ropeway transportation systems to become an accessible transportation leader.

II. PERSONS WITH REDUCED MOBILITY AND ADAPTIVE TECHNOLOGIES & EQUIPMENT

According to the 2020 U.S. Census¹, there are approximately 40.8 million people with a disability living in the United States. This is approximately 12.7 percent of the entire U.S. population and is increasing by approximately 1 million each year. **Considering most people travel or recreate with family or friends, as much as 50% of the U.S. population will benefit from accessible infrastructure, transportation, and adaptive technologies/equipment.** In addition, the U.S. Census Bureau estimates that in just 6 years, more than 50% of the U.S. population will be more than 55 years of age. This aging of “baby boomers” and continued advances in medical and adaptive technologies means that the percentage of the U.S. population living with a disability will likely increase significantly, and these people will remain active over the next 20-plus years.



Mono-skier

Photo courtesy of All In Sport Consulting

The 2020 U.S. Census also tells us that approximately 20.6 million or a little over half of those reporting some form of disability are reporting an ambulatory difficulty or reduced mobility. These numbers are also increasing from past U.S. Census data and are expected to continue to rise. Additionally, adaptive sports and adaptive sports research² have shown a rapid increase over the last couple of decades. In October 2023, the National Federation of U.S. State High School Associations sports participation survey³ showed that nearly 48,000 students nationwide participated in unified sports, which include students with and without disabilities a number almost 9 times that of just 3 years prior. Another 7,800

reported participating in adaptive only sports -a 163% increase over the same time span. A study⁴ presented in October 2022 by All In Sport Consulting at the Adapted Sport Leadership & Business

Symposium showed the economic impact of adapted sports and para events were up to nearly \$78 million annually -nearly recovering from pre-COVID levels. Also, according to demand analysis market research⁵ published in August of 2023 global disabled and elderly assistive technology market size and share revenue was valued at 46.1 billion in 2021, is expected to be 51.2 billion in 2022, and 66.8 billion by 2030 with a compound annual growth rate (CAGR) of 6.7% between 2022-2030. Participation in international competitive sports by persons with disabilities has also increased dramatically. According to the International Paralympic Committee⁶ athlete participation has increased 11-fold, from about 400 competitors from 23 countries at the first games in Rome in 1960 to 4,400 competitors from 162 countries at the last games in 2021 in Tokyo which featured 539 events in 22 sports.

Along with the increases in numbers of persons with disabilities and those reporting ambulatory difficulty or reduced mobility there has been and will continue to be a corresponding increase in need and variety of adaptive equipment, devices, and technologies. Relative to ropeway transportation in the U.S. the most commonly used devices are wheelchairs and sit-skis including mono-ski and bi-skis (SMB's). Ski bikes (or tri-skis), stand-up skis, nordic bi-skis, wheelchair skates, and adaptive trikes are also increasingly used on ropeway transportation systems⁷. Accommodating these users and their equipment is, and will continue to be, an important responsibility of ropeway transportation owners, operators, and manufacturers.

III. REQUIREMENTS IN LAW & STANDARDS/GUIDELINES FOR PERSONS WITH A DISABILITY

Current requirements in law relative to persons with disabilities in the United States are threefold and date back to 1968. As outlined in FS-703 of 2016⁸ they are as follows:

Architectural Barriers Act (ABA) of 1968 (42 USC 4151 et seq.): this was the first measure passed by Congress to ensure access to facilities. The ABA requires that all facilities built, bought, or leased by, for, or on behalf of a Federal Agency or by an entity operating under a permit from a Federal Agency, comply with the applicable accessibility guidelines and standards.

Rehabilitation Act of 1973 (29 US Code 794 and 794d): More specifically Section 504 of the Act states: "no otherwise qualified individual with a disability in the United State shall, solely by reason of his[her] disability, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance or under any program or activity conducted by any Executive Agency." It should be noted that Section 504 seeks to ensure equal opportunity, but it does not require exceptional opportunity be provided for a person with a disability. In other words, people cannot be denied participation simply because they have a disability. A person with a disability, however, must follow the same regulations and meet the same eligibility criteria that are applied to all other people in order to participate. If the person with the disability does not meet the criteria, or abide by the regulations, that person can be denied participation in that program.

The Americans with Disabilities Act (ADA) of 1990, as Amended & Title 7 Code of Federal Regulations, Part 15B: Title 7, CFR 15b implements Section 504 and applies to all programs and activities that receive Federal financial assistance. The ADA was modeled on the ABA and Section 504. The ADA applies to State and local government services, public transportation, and public accommodations, including businesses that are open to the public.



Wheelchair loading gondola

Photo courtesy of Ischgl Resort

Current standards for passenger ropeways and adaptive equipment, devices, and technologies most relevant to passenger ropeways and their accessibility in the United States are as follows:

American National Standard (ANSI B77.1-2022) for Passenger Ropeways -Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors -Safety Requirements (Ropeway Standard)⁹: which “...establishes a standard for the design, manufacture, construction, operation, and maintenance of passenger ropeways.

American National Standard (ANSI/RESNA WC-1:2019) for Wheelchairs -Volume 1: Requirements and Test Methods for Wheelchairs (including Scooters)¹⁰: which “...specifies vocabulary, disclosure requirements for testing, and test methods and methods of measurement for the following: static stability; wheelchair and seat dimensions; static, impact and fatigue strength testing; flammability requirements; test dummy specifications; and set-up procedures.”

American National Standard (ANSI/RESNA WC-4:2017) for Wheelchairs -Volume 4: Wheelchairs and Transportation¹¹: which “...focuses on products that help people who use wheelchairs travel more safely when seated in a wheelchair [including] Wheelchair containment and occupant retention systems for use in large accessible transit vehicles: systems for reward-facing passengers.”

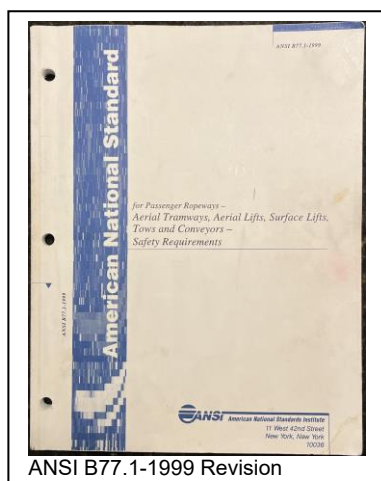
American National Standard (ANSI/RESNA ASE-1:2019) for Adaptive Sports Equipment -Volume 1: Winter Sports Equipment¹²: which “...specifies requirements and test methods for determining adaptive sports equipment performance. It also specifies requirements of the disclosure of the test results. [it contains] Section 1: Requirements and Test Methods for Sit-skis, Mono-skis, and Bi-skis & Section 2: Requirements and Test Methods for Chairlift Rider Restraints.”

2010 ADA Standards for Accessible Design -Standards for Public Accommodations and Commercial Facilities, Title III & Standards for Titles II & III Facilities: 2004 ADAAG (Americans with Disabilities Act Accessibility Guidelines): Public accommodations and commercial facilities must follow the requirements of the 2010 Standards, including both the Title III regulations at 28 CFR part 36, subpart D; and the 2004 ADAAG at 36 CFR part 1191, appendices B and D.

Current guidelines and recommendations most relevant to passenger ropeways and their accessibility in the United States are as follows:

International Organization for Transportation by Rope (OITAF) Book 9-1 Technical Recommendation (Edition 2014) Provisions for Special Transport Cases¹³: which provides that “...certain groups of passengers (persons with reduced mobility, children), animals and goods requires special operational and technical measures before transport begins as well as special terms of transport for them in order to ensure the safety of persons and installations.”

IV. ROPEWAY TRANSPORTATION SYSTEMS ACCESSIBILITY SUCCESSES



After passage of the ADA in 1990 all businesses, transportation systems, and accommodations that were open to the public were now required to comply with its requirements and that of Section 504 and the ABA if receiving federal funds in some way. This set-in motion work on many existing standards, codes, and regulations at many different levels to help define the specific requirements for the wide variety of infrastructure, systems, and programs across the United States.

The 1999 Revision of the ANSI B77.1 Standard for Passenger Ropeways included many provisions to address requirements of the ADA for passenger ropeway systems in the United States -and was the first effort by the standards committee, or more specifically the Accredited Standards Committee (ASC) B77 on Aerial Passenger Ropeways – a consensus body, towards addressing ADA requirements. These 1999 provisions relative to the ADA were as follows:



GENERAL PROVISIONS:

Definition of "ADA Accessible: Describes a site, building, facility, or portion thereof that complies with ADAAG (Americans with Disabilities Act Accessibility Guidelines)."

Requirement of X.1.1.2 Location: "In selecting the location and alignment of an installation, consideration shall be given to the following items, and to any others that may be particularly pertinent to the [ropeway] type and location: [a through n, including] (o) ADA accessibility."

STATIONS, PLATFORMS, AND LOADING/UNLOADING AREAS:

Requirement of X.1.1.9.1 Loading areas: "At least one point of access to the lift shall have a minimum clearance width of 36 inches (915mm) to accommodate skiers using adaptive equipment."

Requirement of X.1.1.9.2 Unloading areas: "For chair lifts, the exit ramp for skiers shall be sloped downward no more than 30 percent."

Requirement of X.3.1.1.2 Additional signs: "The following signs shall be posted: a) ...a sign stating the nominal loading chair height +/- 2 inches (+/- 50mm). The sign shall be posted with the riding instructions."

AERIAL TRAMWAY CABINS, GONDOLA CABINS, AND CHAIRLIFTS:

Requirement of X.1.4.4.2 Cabin [Gondolas new construction only]: "The minimum opening door width shall be 32 inches (815mm)." [and] "The horizontal gap between the cabin door opening floor edge and platform edge shall not be greater than 1 inch (25.4mm). The height of the cabin floor to the platform shall be within +/- ½ inch (+/- 12.7mm). Where it is not operationally or structurally practical to meet these requirements, platform devices, vehicle devices, system devices, or bridge plates shall be provided for independent loading." [and] "The minimum clear floor space in accessible cabins shall be 48 inches by 30 inches (1220mm x 760mm). Where special accessible cabins are used, it is recommended the waiting interval should not exceed 10 minutes."

Requirement of 2.1.4.4.2 Cabin [Aerial Tramways new construction only]: "The minimum opening width shall be 32 inches (815mm)." [and] "The horizontal gap between the cabin door opening floor edge and platform edge shall not be greater than 1 inch (25.4mm). The height of the cabin floor to the platform shall be within +/- ½ inch (+/- 12.7mm). Where it is not operationally or structurally practical to meet these requirements, platform devices, vehicle devices, system devices, or bridge plates shall be provided for independent loading." [and] "A minimum clear floor space for wheelchairs of 48 inches by 30 inches (1220mm x 760mm) shall be provided."

Requirement of 3.1.4.4.4 Chairs & 4.1.4.5.4 Chair safety details [new construction only]: "For aerial lifts operating primarily for skiers, the thickness of the chair seat front, including padding, shall not exceed 5 inches (125mm) from the top of the seating surface to the bottom of the curl. Tilt back angle of the seat bottom should be a minimum of 7 degrees when loaded. Loaded shall mean an evenly distributed load using load test criteria."

OPERATIONS, INCLUDING EVACUATION AND PASSENGER RESPONSIBILITIES:

Requirement of X.3.2.1 Personnel: "Procedures for loading and unloading passengers with common adaptive equipment, shall be included in training."

Requirement of X.3.2.5.7 Evacuation: "A plan for evacuation of passengers from each aerial lift shall be developed and documented. The plan shall include: [a through l, including] h) the methods of evacuation to be used for a typical passenger, incapacitated passenger, common adaptive ski equipment, and non-ambulatory passengers."

Requirement of X.3.6.1 Dexterity and ability: "All passengers who use an aerial lift shall be presumed to have sufficient skiing ability, physical dexterity, or personal assistance to negotiate and be evacuated from the aerial lift safely. Each passenger shall maintain control of his/her speed and course while loading and unloading the aerial lift."

Requirement of X.3.6.2 Embarkation and disembarkation: "A passenger shall get on and off an aerial lift at designated areas. No passenger shall embark without first understanding the proper loading, riding, and unloading procedures (see X.3.1.1)."

Additional provisions relative to the ADA were not added to the Standard again until the 2017 Revision (skipping the 2006 and 2011 Revisions) and which contained the following changes:

GENERAL PROVISIONS:

Definition of “SMB (Sit-Ski, Mono-Ski, Bi-Ski): Common Adaptive Ski Equipment. Includes (Sit-Ski) structures in which the skier sits with the metal edges attached underneath for control and maneuverability, skiing equipment consisting of a body support structure mounted over one ski (Mono-Ski) or two skis (Bi-ski) that articulate when the device leans side-to-side (ref. ANSI/RESNA ASE-1: 2016).”

OPERATIONS AND EVACUATION:

Requirement of X.3.2.5.7 Evacuation: “A plan for evacuation of passengers from each aerial lift shall be developed and documented. The plan shall include: [a through m, including] h) the methods of evacuation to be used for a typical passenger, incapacitated passenger, passengers using common adaptive ski equipment (e.g., SMB’s), and non-ambulatory passengers.”

Requirement of X.3.2.3.3 Attendant: “The duties of the attendant shall include: [a through h, including] g) to advise and assist passengers with adaptive equipment, as assigned;”

The current revision of the ANS B77.1-2022 which has now been adopted by most Authorities Having Jurisdiction (AHJ’s) around the United States contains the following additional provisions relative to the ADA and accessibility:

STATIONS, PLATFORMS, AND LOADING/UNLOADING AREAS:

Requirement of X.1.1.9.1 Loading areas: “For loading of skiers, the chair height of an empty chair, measured from the highest point at the center of the front edge of the seat surface to the surface at the load point, shall not exceed 22 inches (560mm) nor be less than 16 inches (406mm). Exception -For aerial lifts serving beginner terrain the chair height limits above may be reduced.”

Requirement of X.1.1.9.2 Unloading areas: “For unloading of skiers on a snow surface, the unloading point shall be at the breakover point where the exit ramp starts. The chair height of an empty chair, measured from the highest point at the center of the front edge of the seat surface to the surface at the load point, shall not exceed 22 inches (560mm) nor be less than 16 inches (406mm). The exit ramp for skiers shall be sloped downward no more than 30 percent. Exception -For aerial lifts serving beginner terrain the chair height limits above may be reduced.”



Requirement X.3.2.5.3 Loading and unloading platforms [makes above requirements apply to all aerial chair lifts]: “The maze or corral, loading platform surface, breakover point, and the load/unload seat height shall be reasonably maintained according to the prevailing weather conditions and established procedures (see X.1.1.9.1 and X.1.1.9.2).”

OPERATIONS AND EVACUATION:

Requirement X.3.2.5.7 Evacuation: “A plan for evacuation of passengers from each aerial lift shall be developed and documented. The plan shall include: [a through m, including] c) provisions for adequate training in the functions performed in the evacuation process at least once each operating season. The training shall address variables including, but not limited to, the type of carriers and grips, passenger demographics, adaptive equipment, and topography as well as evacuation systems and equipment. Training shall be recorded in the evacuation log (see X.3.5.5).”

There is no doubt that the preceding changes to the Ropeway Standard in the United States after passage of the ADA in 1990 have had a very positive effect on mobility for persons with disabilities and adaptive use of passenger ropeways for general transportation, recreation, and other activities. These are certainly success stories to be celebrated -however, as with anything, there is always room for improvement and unexpected issues also come to light with new innovations and designs. The next section of this paper will detail challenges and barriers still being faced along with some possible areas for further improvement

in passenger ropeway universal accessibility and also the ongoing work of operators, adaptive programs, manufacturers, and authorities working together on these.

V. ROPEWAY TRANSPORTATION SYSTEMS ACCESSIBILITY CHALLENGES AND OPPORTUNITIES

The U.S. DOT's Strategic Plan on Accessible Transportation (Strategic Plan)¹⁴ states further in its Introduction that "...the [U.S.] transportation system is experiencing unprecedented innovation. New technologies such as automated vehicles and urban air mobility have the potential to enhance mobility and improve safety for people with disabilities. There is an opportunity to leverage numerous new technologies, emerging data sources, and public and private partnerships to identify and address remaining needs." Also, "...Under-Secretary for Transportation Policy led the development of the Strategic Plan, which [also] focuses on Department-wide initiatives as well as strategies and actions taken by operating administrations with direct responsibility for accessibility initiatives [as follow]: Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), Federal Motor Carrier Safety Administration (FMCSA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), National Highway Traffic Safety Administration (NHTSA), [and] Office of the Secretary. The Strategic Plan further outlines five goals as follows:



Goal 1: Remove unnecessary barriers for people with disabilities to seek licensure for, operate, and/or ride in passenger and commercial motor vehicles.

Goal 2: Remove unnecessary barriers to multimodal accessibility of public rights-of-way.

Goal 3: Enhance opportunities for people with disabilities to walk, roll, cycle, and use micromobility services and other innovative mobility technologies to the greatest extent possible.

Goal 4: Support the Nation's public transit systems and mobility providers in providing accessibility for people with disabilities.

Goal 5: Advance accessible air, motorcoach, and rail intercity transportation systems for people with disabilities.

If ropeway transportation systems in the U.S. -public, or privately operated for the public, were to align with the goals in the DOT Strategic Plan, then focusing efforts under Goal 4 and its associated objectives and strategies as outlined further in the Strategic Plan would probably make the most sense. In particular, objectives and strategies as follows:

Objective 4.1 Transit Facilities, Strategy 4.1.1 Increase the number of accessible rail transit stations: this could easily apply to ropeway tram car, gondola, and chairlift platforms and how they connect to other facilities nearby. There are likely many pre-ADA platforms across the U.S that still pose mobility challenges for older passengers and those with disabilities. This is also important due to the increased pedestrian summer use of ropeway systems.

Objective 4.2 Improved Service, Strategy 4.2.1 Consider harmonizing the accommodation of service animals: A service animal is a dog that is individually trained to do work or perform tasks for a person with a disability. Generally, passenger ropeways must permit service animals to accompany people with disabilities in all areas where they are allowed to go.

Objective 4.2 Improved Service, Strategy 4.2.2 Improve the means by which wheelchair users are accommodated in transit service: There are existing requirements in the Ropeway Standard with regard to accessibility at loading areas and carriers. Methods to reduce potential conflict between passengers using wheelchairs and other passengers at stations, platform, and aboard carriers has largely not been addressed.

Objective 4.3 Vehicle Standards, Strategy 4.3.1 Collaborate with stakeholders to review accessibility standards for vehicles and systems: As stated above, starting with the 1999 Revision of the Ropeway Standard, collaboration with stakeholders and the general public on improving access for persons with disabilities and implementing requirements of the ADA has occurred over the years, including in 2017, 2022, and 2027 (current revision work). However, ADA accessibility is not a permanent subcommittee of the ASC B77 on Passenger Ropeways.

Objective 4.4 Mobility Innovation, Strategy 4.4.4 Improve mobility for individuals with disabilities and older adults by removing barriers to transportation service and expanding transportation mobility options: The Federal Transit Administration (FTA) supports transportation services that are planned, designed, and carried out to meet the transportation needs of individuals with disabilities through grant programs. Funds can be used on investments such as wheelchair lifts, mobility management programs, micromobility devices (electric scooters, etc.), technology systems, and wayfinding technologies.



In recent years several challenges relative to passenger ropeway accessibility for persons with disabilities have come to light. One, as stated above, is the increased use of ropeways by persons with disabilities and corresponding demand for services and also the accommodation of new types of adaptive equipment, devices, and technologies. Another is changes in chair design of aerial chairlifts to improve safety for younger, smaller passengers; and to also provide more comfort features for all passengers. And lastly, there is an increase in year-round use and corresponding need to accommodate pedestrians, bikers, and other user types including those with disabilities.

The following themes provide guidance for further discussion on ropeway accessibility opportunities:

- General planning, organization, and definitions.
- Stations, platforms, and loading/unloading areas.
- Carriers -including tramway and gondola cabins, chairlifts, and other devices.
- Operational considerations.
- Urban ropeways and mobility innovation.



GENERAL PLANNING, ORGANIZATION, AND DEFINITIONS:

It's observed that through the 30-plus years since passage of the ADA there seems to be somewhat of a lack of a coordinated and sustained effort to continue to address existing and emerging issues relative to persons with disabilities access to passenger ropeways. This is evidenced by new technologies or designs outpacing standards development; lack of adequate ADA expertise at companies, organizations, and authorities; and as a result, some new installations built with accessibility challenges.

Some possible areas for improvement in the future are:

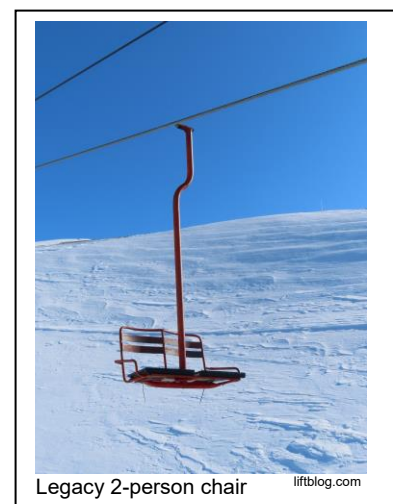
- Increase communication and cooperation between owner/operators of passenger ropeways and persons with disabilities/ adaptive communities and programs. It is important that when decisions are made regarding facility upgrades or new installations that the disabled and adaptive user communities are made aware and consulted to the extent possible to ensure their ideas and concerns are heard.
- Encourage passenger ropeway manufacturers to improve expertise on ADA accessibility in all aspects of passenger ropeway design.
- Better define ADA accessibility and related adaptive equipment, devices, and technology requirements in the Ropeway Standard and to stakeholders. Currently the Ropeway Standard does not have up to date general information or requirements on ADA design or adaptive equipment requirements -these would be helpful for clarity.
- Consider universal design¹⁵ for passenger design elements. Universal design is a concept in which products and environments are designed to be usable by all people, to the greatest extent possible, without adaptation or specialized design. Universal design “..aims to give all users a seamless experience while respecting their diverse abilities and limitations”.¹⁶
- Consider making ADA Accessibility a permanent subcommittee within the ASC B77 consensus body. Currently ADA work of the ASC B77 falls under the Operations Subcommittee and is a temporary Ad-hoc group. It would perhaps make sense to have it be its own subcommittee to ensure improved long-term continuity as issues arise.
- Promote passenger ropeway systems as a leader in safe accessible transportation -encouraging persons with disabilities and their families and friends and adaptive programs and sports to participate and provide feedback. This can be promoted and marketed by owner/operators, manufacturers, and ropeway and related organizations.

STATIONS, PLATFORMS, AND LOADING/UNLOADING AREAS:

Like for other passengers, the stations, platforms, and load/unload areas are the first experience persons with disabilities have before loading a ropeway. Having good audiovisual information and instruction is important as well as level or slightly sloped surfaces. While newer facilities are being designed and built to ADA standards there are still many existing facilities and facilities undergoing upgrades that could use improvements.

Some possible areas for improvement in the future are:

- Encourage accessibility upgrades to existing stations, platforms, and areas connected to accessing passenger ropeways and ensure they are provided for major improvement projects similar to requirements for new construction. A recent example of an upgrade project¹⁷ that increased accessibility is the Peak 8 gondola deck at Breckenridge, CO.
- Improve safety for all passengers at loading/unloading and areas nearest the passenger ropeway structure or other ropeway related structures or equipment. There are currently small changes to the Ropeway Standard being considered related to 90-degree loading and unloading and improving guarding and padding of elements in the load/unload areas.
- Investigate ways to reduce potential conflict between passengers using wheelchairs or other adaptive devices and other passengers at stations and platforms. As users of mobility assistance devices increase there will be a need to accommodate any extra space needs, cueing organization, storage, or other needs.
- Provide increased guidance online and through signing, audio/visual, or other communication modes at entry points, stations, and platforms relative to access for persons with disability and those using adaptive equipment including service animals.



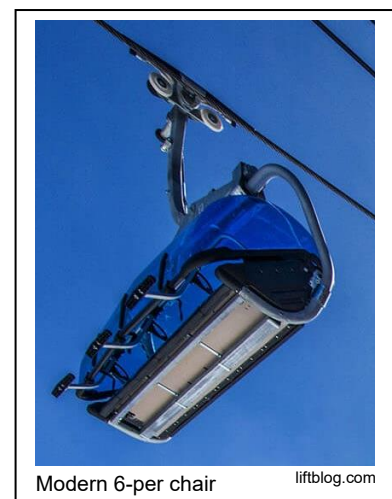
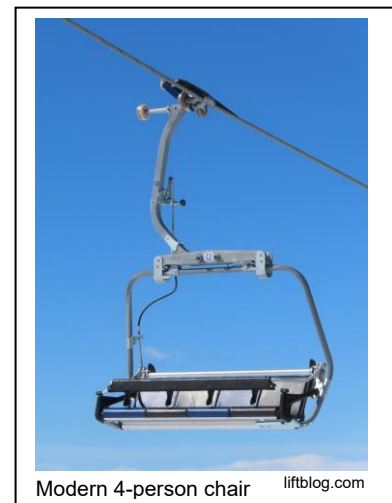
Legacy 2-person chair liftblog.com

- Ensure services provided at and around passenger ropeways continue to include persons with disabilities with consideration of their adaptive equipment including service animals.

CARRIERS -INCLUDING TRAMWAY AND GONDOLA CABINS, CHAIRLIFTS & OTHER DEVICES:

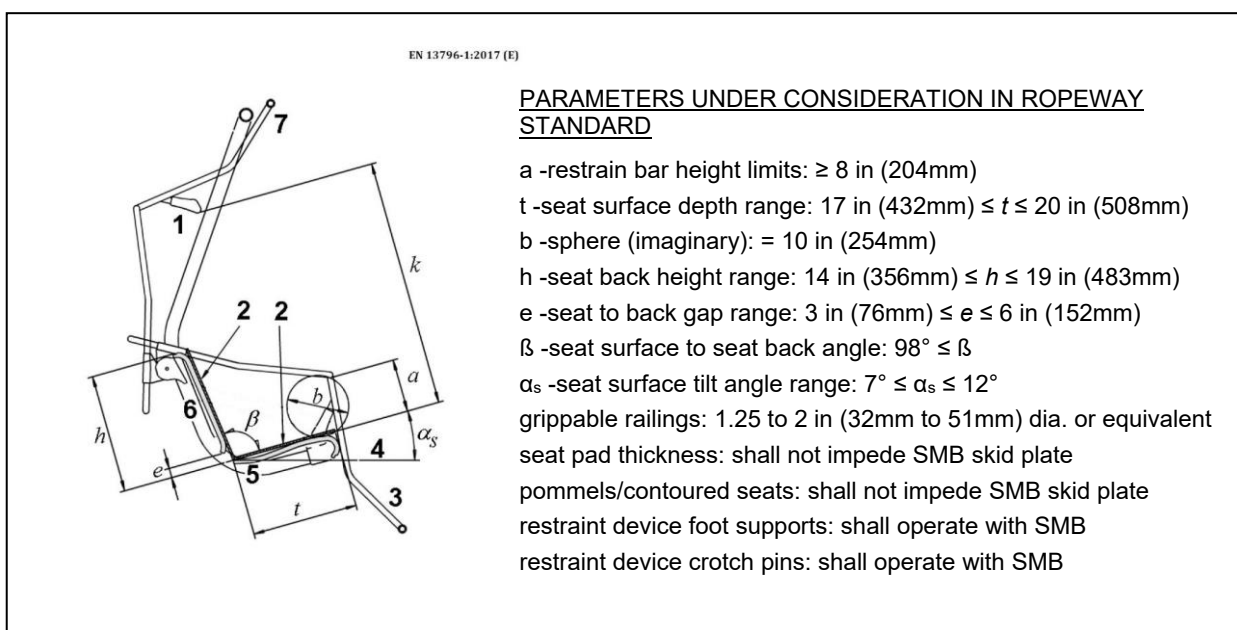
Of all the components that make up a passenger ropeway probably none is as important to any passenger as the carrier and their experience loading, riding, and unloading from it. Some areas for possible improvement relative to accessibility and safety of passengers with disabilities are as follows:

- Investigate ways to reduce potential conflict between passengers using wheelchairs or other adaptive devices and other passengers loading, riding, and unloading carriers. Providing adequate space and securing points within cabins and for wheelchairs and other adaptive equipment users and also providing chairlift carriers that can accommodate all users in a more “universal design” should be considered.
- Provide securing points for wheelchairs and adaptive equipment/devices within tramway and gondola cabins and on certain chairlift installations. The recommendation for securing points in cabins in the OITAF Book 9-1 is being considered for the Ropeway Standard. Additionally, securing points are also being considered for newer chairlifts without an easy way to attach a rider retention device per ANSI/RESNA ASE-1.
- Provide a minimum number of spaces with securing points for passengers utilizing wheelchairs or other adaptive equipment/devices within tramway cabins based on overall cabin passenger capacity. To be consistent with other transit systems like rail or busses the Ropeway Standard is considering a minimum number of spaces with securing points for those using wheelchairs or adaptive equipment based on the overall cabin capacity.
- Allow for access into all tramway and gondola cabins without removal of adaptive equipment/devices where cabin dimensions would allow. Provide clear guidance at loading point relative to cabin dimensions and if adaptive equipment can be accommodated or not. This is currently being considered for the next revision of the Ropeway Standard.
- Provide for a minimum 48 inches x 30 inches clear floor space in all new gondola and tramway cabins for wheelchair access positions with an exception for smallest capacity gondola cabins that allows for a minimum of two special cabins at no more than 10-minute intervals that meet the clear floor space requirement. This is currently under review in subcommittees of the Ropeway Standard.
- Provide universally accessible chair parameters to accommodate common adaptive equipment/devices built to accepted standards (ANSI/RESNA for example), and to be accessible with those same chair parameters -and consider an exception for some limited chairlift installations that allows for a minimum of two universal access chairs at no more than 10-minute intervals. This is currently under review in subcommittees of the Ropeway Standard and a chairlift survey was sent to all adaptive programs in the U.S. for feedback on chairlifts in operation to help determine which are working well and which are not.



- The following should be considered for universal design (see figure and table below):
 - a) Seat surface effective depth (t) that allows for SMB skid surface

- b) Seat to back angle (β) that allows SMB to use effective depth (t)
- c) Seat surface tilt (α_s) that allows SMB to unload effectively
- d) Seat back heights (h) or other device that allow temporary holding point while restraint device is up
- e) End railings or similar structure that provides holding point that can be gripped while loading, riding, and unloading
- f) Gap between seat surface and back (e) or securing point for use of retention strap
- g) Ability to use restraint device while in designated seat without interference between SMB and foot supports, pommels, pins, or other items
- h) Restraint device that is equally effective for SMB and other passengers riding the same carrier



➤ Note: Assumes SMB complying with ANSI/RESNA ASE-1(2019)

- Investigate accessibility needs for passengers with disabilities and those using adaptive equipment, devices, or technologies utilizing surface lifts, tows, and conveyors. Consult OITAF Book 9-1 guidelines 2.1.2.1 and 2.2.2 special provisions.

OPERATIONAL CONSIDERATIONS:

No matter what changes we make to policy, standards, design methodologies, etc. it is hard to make a real improvement in passenger ropeway systems accessibility if the corresponding operational methods, direction, oversight, and training do not complement those efforts. Some operational items that should be considered are:

- Improve training of operators and attendants with regards to accommodations for persons with disabilities and those using adaptive equipment, devices, or technologies.
- Improve on operating plans and procedures to ensure all aspects of passenger ropeway planning, programs, and operations consider needs of the disabled community and adaptive use. This is currently under review in subcommittees of the Ropeway Standard.
- Improve on development of essential eligibility criteria/requirements for use of their passenger ropeways and ensure they are communicated to the public. This is currently under review in subcommittees of the Ropeway Standard.
- Improve on training and practicing of evacuation of passengers using adaptive equipment, devices, and technologies from ropeway carriers.

URBAN ROPEWAYS AND MOBILITY INNOVATION:

Most ropeways in the United States provide transportation for recreation and for scenic rides to mountain vistas. However increased population densities and demand for relief from automobile traffic is increasingly making aerial tramways a potentially attractive alternative to more ground-based solutions. According to Smart Cities Dive¹⁸ -a leading publication providing in-depth journalism and insight into the most impactful news and trends shaping cities, “Aerial cable cars remain rare for U.S. urban transportation, but cities and private groups see them as a novel solution to traffic woes.”



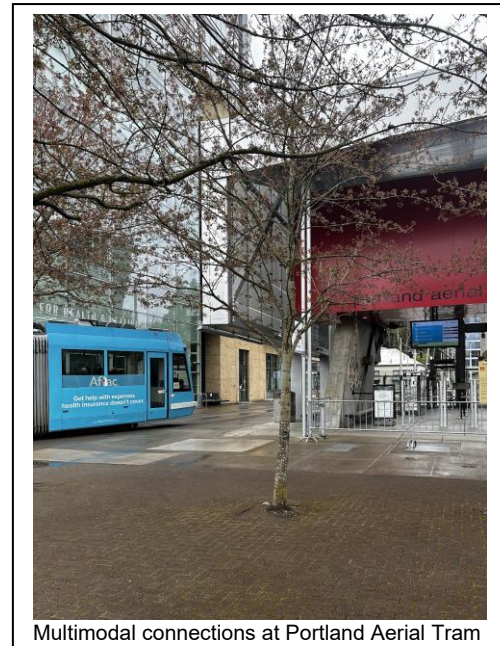
Portland Aerial Tram

John Landolfe and GoByTram.com

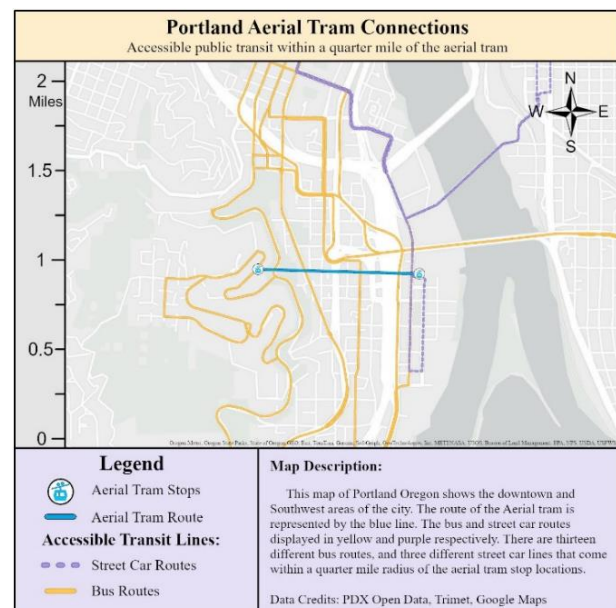
There are currently only two urban aerial tramway transportation installations in the U.S. The Roosevelt Island Aerial Tramway in New York City was the first commuter aerial tramway in the U.S., having been opened in May of 1976, to connect residential areas of the island and nearby Brooklyn to the Upper East Side of Manhattan. In 2023 it averaged approx. 5,880 passengers per day and 2.2 million per year -close to it’s high of 2.7 million prior to the Covid-19 pandemic. The other urban aerial tramway is the Portland Aerial Tram which opened in 2006 and connects the South Waterfront district of Portland with the Oregon Health & Science University campus -Portland’s largest employer, Shriners and Veterans Administration hospitals, and residential areas on Marquam Hill. Prior to the Covid-19 pandemic the tram averaged approx. 10,000 passengers per weekday. The only other transportation to the Marquam Hill area of Portland is via two relatively small roadways. **The keys to success for these urban tramways are their multimodal and accessible connections to other transportation including bikes/e-bikes and other micromobility hubs, rideshares, subways, streetcars, and busses. They also provide what other urban transit systems cannot -reliable traffic free transportation with great 360-degree views.**

Further in their article on US aerial trams, Smart Cities Dive highlights ongoing planning for urban tramway systems in:

- the Plano and Dallas- Fort Worth area by the Regional Transportation Council of North Texas and developer Swyft Cities with a federal grant to study viability starting in mid-2024;
- a proposed aerial transit line that would travel from the city of Los Angeles’ Union station and other existing transit to Dodger Stadium in Elysian Park;
- an 8-mile aerial tramway being planned to transport skiers and resort employees from a suburb of Salt Lake City to resorts in Little Cottonwood Canyon to be funded and built by the Utah Department of Transportation; and
- ongoing talks between tramway developers and government officials in Miami, Boston, Chicago, and New York City about building aerial cable cars there.



Multimodal connections at Portland Aerial Tram



VI. CONCLUSION

Multiple sources of information herein provided make it clear that over recent decades the number of persons with disabilities, reduced mobility, and those using adaptive equipment, devices and technologies in the United States has increased significantly. Additionally, like other transit modes, accommodating these users will continue to be an important responsibility of passenger ropeway transportation owners, operators, manufacturers, and authorities.

Like other transportation systems in the U.S., passenger ropeway systems and standards in the United States can boast of significant progress over the past almost 34 years since passage of the ADA with respect to providing access for those with disabilities and complying with its requirements. The Ropeway Standard as adopted by federal, state, and private entities, is the minimum standard and set of requirements that passenger ropeway systems must meet with regards to persons with disabilities. It is therefore vitally important that the Ropeway Standard, in concert with its many stakeholders, constantly strives to improve -not only as the state-of-the-art for ropeway safety but also for ADA ropeway access.

Passenger ropeway systems can use and build upon some of the already developed goals, objectives, and strategies of the U.S. DOT's 2021-25 Strategic Plan on Accessible Transportation to make improvements for persons with disabilities in concert with other transportation systems around the country. This paper has highlighted some of these goals and objectives and suggested specific strategies for passenger ropeway systems for further consideration, discussion, and maybe eventual implementation by stakeholders. Universal design should also be a goal to implement for passenger ropeway systems. It could give all passengers a seamless experience while respecting their diverse abilities and limitations, and while creating an environment that is accessible to everyone, regardless of their background or circumstance.

Working together and considering all passenger needs equally, we can make a big impact on all of our lives and move passenger ropeway transportation further towards becoming an accessible transportation leader.



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REFERENCES

- [1] U.S. Census Bureau. "DISABILITY CHARACTERISTICS." American Community Survey, ACS 5-Year Estimates Subject Tables, Table S1810, 2020, . Accessed on March 20, 2024.
- [2] Liu, T.; Wassell, N.; Liu, J.; Zhang, M.; Mapping Research Trends of Adapted Sport from 2001 to 2020: A Bibliometric Analysis. *Int. J. Environ. Res. Public Health* 2022, 19, 12644. <https://doi.org/10.3390/ijerph191912644>
- [3] 'Yes, you can do this': The story behind the rapid rise in sports for youth with disabilities by Jacqueline Kantor, Posted on February 27, 2023.
- [4] "Adapted Sport: Economic Impact Survey" findings were conducted by All In Sport Consulting in partnership with the Stitch Marketing Research and Huddle Up Group, and presented at the Adapted Sport Leadership & Business Symposium on October 19-20 2022.
- [5] Austin, TX, USA, Aug. 04, 2023 Globe Newswire: Custom Market Insights research report titled "Disabled and Elderly Assistive Technology Market Size, Trends and Insights.
- [6] International Paralympic Committee: <https://www.paralympic.org/ipc/history>
- [7] Chown, A., Gerardi, S. M., & Ebner, C. (2023, April 21). Adaptive Sports Equipment: A Resource for Clinicians, Coaches, & Athletes. Poster presented at the Virtual OTD Capstone Symposium, University of St Augustine for Health Sciences. Retrieved from <https://soar.usa.edu/otdcapstonesspring2023/12>
- [8] Accessibility Guidebook for Ski Areas Operating on Public Lands, 2016 Update; United States Department of Agriculture Forest Service FS-703 Revised July 2016.
- [9] ANSI B77.1-2022 Revision of ANSI B77.1-2017 American National Standard for Passenger Ropeways – Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors -Safety Requirements, Approved May 5, 2022 American National Standards Institute, Inc.
- [10] ANSI/RESNA WC-1:2019 American National Standard for Wheelchairs – Volume 1: Requirements and Test Methods for Wheelchairs (including Scooters), Approved 2019 American National Standards Institute, Inc.
- [11] ANSI/RESNA WC-4:2017 American National Standard for Wheelchairs – Volume 4: Wheelchairs and Transportation, Approved 2017 American National Standards Institute, Inc.
- [12] ANSI/RESNA ASE-1:2019, 2019-11-06 American National Standard for Adaptive Sports Equipment – Volume 1: Winter Sports Equipment, Approved 05 November 2019 American National Standards Institute, Inc.
- [13] International Organization for Transportation by Rope (OITAF) Book 9-1 Technical Recommendation (Edition 2014) Provisions for Special Transport Cases.
- [14] United States Department of Transportation Draft Strategic Plan on Accessible Transportation, January 2021. <https://www.transportation.gov/mission/accessibility/strategic-plan-accessible-transportation>
- [15] Copyright © 1997 NC State University, The Center for Universal Design, Ron Mace (<https://design.ncsu.edu/research/center-for-universal-design/>)
- [16] Unlocking Inclusivity: The power of universal design, Yasmin Abdullayeva 2/24/24 (<https://parametric-architecture.com/unlocking-inclusivity-the-power-of-universal-design>)



- [17] Gondola in Colorado gets accessible with a Genesis Enclosure (<http://www.garavalift.com/news/gondola-colorado-genesis-enclosure/>)
- [18] Smart Cities Dive article "For US aerial trams, the sky's the limit -Aerial cable cars remain rare for U.S. urban transportation, but cities and private groups see them as a novel solution to traffic woes.", published Feb. 9, 2024 by Adina Solomon. Smart Cities Dive is a leading publication operated by Industry Dive.