The CABLE Liner - The APM System of the Future

Alexander Klimmer[1]

Abstract

This paper describes a new APM system, known as the CABLE Liner, and the test track installation in Wolfurt, Austria, where the CABLE Liner has now been running under test conditions for over a year.

The CABLE Liner is a detachable funicular railway with vehicles drawn by a continuously moving cable loop integrated into the guideway. Based on the concept of "permanent movement", this system is designed to handle passenger volumes of up to 5,000 PPH in each direction over distances of up to 5 kilometers (3.1 miles), with little or no waiting time.

Introduction

The CABLE Liner is a detachable funicular railway. The present level of technical advance justifies its use in urban areas where permanent passenger flows are considered to be the ideal solution.

The transportation principle of "Permanent Movement" meets the demand for a high level of mobility in today's world by offering the user an exceptionally frequent service.

With an interval of only 21 seconds between vehicles, the CABLE Liner is poised to fulfill this requirement in local transit applications.

The CABLE Liner People Mover System is designed to alleviate traffic congestion in urban areas and tourist resorts and to serve as an addition or link to existing public transport networks.

[1] Development and Product Manager, Doppelmayr Cable Car GmbH, Rickenbacherstraße 11-17, A-6960 Wolfurt, Austria
Tel: +43-5574-604-645 Fax: +43-5574-75590 E-mail: dcc@doppelmayr.com

Figure 1

Figure 1 gives an impression of a possible application for the CABLE Liner in an urban environment. In this case the system features a two-track elevated guideway.

Cooperation between Doppelmayr and Siemens

Doppelmayr is a leading player in the continuous movement ropeway sector with an impressive international track record and a 37% share of the world market. Siemens has major international expertise in the areas of project management, construction engineering and transport technology and was therefore the ideal partner. Doppelmayr and Siemens have utilized this vast pool of specialist know-how to engineer a new passenger transport solution.

Both corporations have established leading positions in the international passenger ropeway market with their own ranges of detachable systems, funicular railways and reversible aerial ropeways. The technology on which the CABLE Liner is based has already been proven on over 1,000 passenger transport installations in every climatic zone around the globe.

Market studies have revealed a gap in the passenger transit market where there is a clear need to maintain a constant flow of up to 5,000 passengers per hour and direction over short distances of up to 5 kilometers (3.1 miles). It is this gap that the CABLE Liner is aiming to fill, in a sector where cable-drawn systems have yet to realize their full potential.

This fact is confirmed by the inquiries received to date, which have been for systems with capacities of between 2,000 and 5,000 PPH in each direction over distances of between 800m and 5 kilometers (0.45 -3,1 miles). Applications have covered urban areas, airports, shopping centers, amusement parks, tourist resorts.

Description of the CABLE Liner System

The CABLE Liner is a detachable funicular railway with vehicles drawn by a continuously moving cable loop integrated into the guideway.

A detachable grip assembly, integrated into the bogie of the passenger vehicle, forms the mechanical connection between the vehicle and the haul rope. The function of the detachable grip is similar to that of a spring-loaded caliper which is closed under normal operating conditions. The opening and closing rail opens the grip mechanically by causing the movable grip jaw to pivot about a fixed point of rotation. The spacing between vehicles is defined by the grips and cannot change outside the stations.

The CABLE Liner is designed for all-weather operation. As the tractive force is generated by the moving haul rope, climatic conditions do not present any hazards in respect of gradients or curves.

As the vehicle enters the station, it detaches from the haul rope and is gently decelerated to a creep speed of 0.28 m/sec by a mechanical conveyor assembly. It continues along the platform to allow passengers to load and unload.

Two vehicles are always moving along the platform zone - one departing and one arriving. (If required, vehicles can slow down and finally stop in the unloading area).

A turntable is provided in each of the end stations to enable the vehicles to change direction. An automatic conveyor system loads the vehicles on and off the turntable.

Figure 2

The CABLE Liner test track installation, located at one of the Doppelmayr sites in Wolfurt, in the western Austrian province of Vorarlberg.

The CABLE Liner test track installation

The CABLE Liner test track installation is located at one of the Doppelmayr sites in Wolfurt, in the western Austrian province of Vorarlberg. It has been operating for test and demonstration purposes since March 1996.

Three "vehicles" run on the test track installation: one fully fledged cab for actual passenger transport, preceded and followed by a bogie carriage supporting suitable ballast weights. The CABLE Liner has already provided a passenger service when it was officially opened to the public for one day on June 16, 1996.

The statistical evaluation for this day records passenger changeover (embarking/disembarking) times of between 15 and 21 seconds for passenger loads of 28 to 34 persons in the vehicle. The test vehicle has seats for 8 passengers and 4.028m² (43.34 ft²) standing room. This corresponds to a space allocation of 0.18m² (1.94 ft²) per person in the case of 22 standing passengers. (These figures relate to a previous vehicle model).

Tests on the CABLE Liner are ongoing and up to now have included amongst others detailed analysis of design parameters, calculation models, static and dynamic loads, noise emission levels and round-the-clock electrical and mechanical fatigue tests over the past 4 months.

The results obtained thus far fully match the projections and expectations of the design team. The complete program of trials is due for completion by the end of the summer of 1997.

Technical specifications of the test track installation

Guideway length:	200m
Guideway layout:	elevated spacing of 24m between supports; tubular lattice construction; min. curve radius 30m
Max. speed:	8 m/s
No. of vehicles:	3
No. of turntables:	2

Figure 3

Layout of the Doppelmayr test track installation in Wolfurt, Austria, where extensive practical trials are ongoing. The system configuration consists of 3 "vehicles" running on an elevated two-track guideway.

Technical parameters for standard specification

Guideway length (definition):	Transportation length, in the case of parallel tracks between turntable centers of the two end stations.
Guideway length per system:	up to 4 km, i.e. a spliced rope length of 8 km; sum of curve deflection angles max. approx. 270°.
Number of stations per system:	max. 5 stations (2 end stations and 3 intermediate stations in each direction)
Guideway type:	elevated and/or tunneled
System speeds:	8 m/s (28.8 km/h) or 6m/s (21.6 km/h short stretch) (control speed of vehicles on haul rope)
Operating mode (definition):	**Continuous mode:** Continuous mode means that the vehicles enter the passenger loading and unloading zones of the platform at a creep speed of 0.28 m/s with opened doors (22 s) and pass without stopping.
Operating mode (definition):	**Stopping mode:** Stopping mode means that the vehicles enter the passenger loading and unloading zones of the platform at a creep speed of 0.28 m/s with opened doors (22 s) and stop.
Vehicle interval:	21.5 sec in continuous mode (development target) 25 sec in continuous mode (current development status) 35 sec in stopping mode.
Max. transport capacity:	5000 PPH in each direction in continuous mode (4 P/m□) 3000 PPH in each direction in stopping mode (4 P/m□**)**.
Cabin capacity:	33 passengers (10 seated and 23 standing at 4 P/m□).
Rope diameter:	25mm or 30mm.
Max. track gradient:	approx. 10% for urban transit applications approx. 15% for tourist resort applications.

Track centers:	Elevated 2.8m; in tunnel 3.05m.
Tunnel cross section:	Width = 5.8m, height = 4.4m (for parallel track including emergency escape route).
Max. guideway support spacing:	24m
height:	3.5m to 15m. In the case of bridge construction with towers, possible span up to approx. 200m.
Noise emission:	approx. 52 dBA on line; **<** 65 dBA in vehicle.

Specific Features of the Cable Liner

- **Corridor system**
  The guideway is normally elevated with on-line stations.
  A tunneled version is also an option.
  The track itself is based on a modular design.

- **No waiting time**
  In the case of continuous operation, there is a minimum interval of 22 seconds between vehicles. If vehicles are required to stop at stations, the minimum interval is 35 seconds.

- **Maximum system and vehicle capacity**
  The system can transport 5,000 passengers per hour in each direction. Each cabin can hold 33 passengers, 10 seated and 23 standing, with a passenger density of 4 per square meter. The system speed is approximately 30 km/h.

Figure 4

Passenger capacity and clearance dimensions of the CABLE Liner vehicles.

- **Guideway length**
  The guideway has two tracks and covers a distance of between 0.5 and approximately 5 kilometers from end station to end station. This corresponds to a trip time of between 1.5 and a maximum of 10 minutes. The minimum curve radius is 30m. In the case of an elevated guideway, the spacing between supports is 24m.

Figure 5

The clearances required in the case of a tunneled guideway with either straight or curved track.

- **Eco-friendly**
  The rope drive system is very quiet and the compact design of the CABLE Liner means that it only occupies a minimum surface area and volume.

- **Economical**
  The CABLE Liner requires a low initial investment and is economical to run.

Applications of the CABLE Liner

The CABLE Liner closes the gaps by transporting passengers over the distances they would normally cover on foot or on moving walkways.

In the capacity range up to 5,000 passengers per hour and over a track length of up to 5 kilometers, the CABLE Liner ensures maximum mobility in the urban environment.

As well as providing connections to existing transport systems such as railway and subway, the CABLE Liner can fulfill a "channeling" function or open up new possibilities for access to inner city districts.

In conjunction with a Park + Ride system the CABLE Liner can be used to form a corridor between an out-of-town car park and areas in the city center, offering the motorist maximum availability (with a service every 22 to 35 seconds).

The CABLE Liner can be used wherever there is a need for a direct transfer system offering frequent, high-volume transport between two points (for example airports, exhibition centers and shopping centers).

In tourist resorts and leisure centers, the CABLE Liner is not only an additional attraction but also contributes towards reducing traffic volumes and emission levels in town centers.

Safety Equipment of the CABLE Liner

The design and execution of the CABLE Liner's electrical equipment satisfies the highest demands with regard to safety and availability. The complete control system is based on PLC technology with fail-safe features in compliance with international safety standards.

Availability of the CABLE Liner

All essential system functions are safeguarded by redundant components. This design feature, combined with highly efficient diagnostics and monitoring systems, ensures optimal availability of the CABLE Liner.

Conclusion

The CABLE Liner represents a totally new approach to efficient, automated people movement based on proven ropeway technology and equipment. Detachable grip systems, which lie at the heart of the "Permanent Movement" concept, already ensure safe, fast, passenger transport on over a thousand of express chair lifts and gondolas around the globe.

Market research has identified a clearly defined gap in the APM market. There is a requirement to transport up to 5,000 PPH in each direction over track lengths of up to 5 kilometers which Doppelmayr and Siemens wish to address with the CABLE Liner. The CABLE Liner will form the missing link in existing local transport systems in urban areas and tourist resorts.

The results of practical trials on the CABLE Liner test track installation to date confirm the technical capabilities of the system. The current status of project inquiries indicates that APM market prognoses have also been correct.

Against this background, and the ever growing problems of traffic congestion, it can be assumed that the CABLE Liner will be successful in breaking new ground in the APM sector in the future.

Key Words

Availability
CABLE Liner
Capacity
Corridor system
Detachable funicular railway
Detachable systems
Doppelmayr
Eco-friendly
Economical
Grips
Mobility
No waiting time
Permanent movement
Ropeway
Siemens