Ropeways for Urban and Materials Transport

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Abstract: Ropeways also known as cable cars have traditionally been deployed to facilitate tourism in scenic locations, difficult to access by conventional means. Recent innovations involving faster speeds and larger cabins are transforming ropeways into the realm of urban environment. Ropeways are also providing creative materials transport solutions.

This paper will begin by considering the use of ropeway systems to alleviate congested segments of our cities by providing an additional aerial transit mode. Examples will be given from cities that have already realized urban ropeways and an overview of such projects under development in Kenya. This will then be followed by discussion of ropeways solutions in mining and port operations.

1. Introduction

A ropeway is a type of aerial lift which is supported and propelled by cables from above. It consists of a loop of steel cable that is strung between stations, over intermediate supporting towers. The cable is driven by a bull wheel in one terminal, which is typically connected to an engine or electric motor. The ropeway is the most typical and traditional mountain transportation but recently it has started being taken into serious consideration for use in urban transport and in amusement parks, to access panoramic viewing points and in general in all locations which are difficult to reach[1,2]. In addition, the ropeways are increasingly being applied to solve material transport problems[3].

This paper considers the use of ropeway systems in urban and materials transport. In part 2 ropeway technology is introduced. Part 3 explains the urban applications including the benefits and functions that ropeways perform.Part 4 explains the use of ropeways for materials transport and highlights potential applications in mining and cargo movement in ports. Paper summary and recommendations are given in part 5.

2. Ropeways as a Means of Transport

In the past, ropeways have primarily been used in ski resorts. Due to their non-invasive nature and adaptivity to difficult terrains, ropeways have increasingly been deployed in urban environments. Modern multi-gondola cable cars can be a compelling alternative to conventional means of urban transport, particularly in environments with difficult geographic terrains (such as water or steep inclines) or in areas where limited space is available. Additionally, ropeways material transport systems can be developed for diverse range of applications, be they discrete or continuous loads.

In terms of safety records ropeways are one the safest means of mass transport that exists. Likewise they are also the most environmental friendly and power efficient means of urban transport. Properly maintained such cable cars have a useful life in excess of 25-30 years. Cable cars can be operated night and day and at almost any weather condition (e.g. wind speeds of up to 100km/h are possible).

3. Application to Urban Transport

According to UN Habitat, approximately 50% of the world's population lives in cities, and this figure will increase to 70% in less than a generation[4]. As a result of the growing distance between home and workplace as well as urban sprawl, settlement structures are becoming ever more complex and existing transport infrastructures are increasingly pushing capacity limits. For this reason, it is essential to find new solutions to eliminate the current and future transport problems. Cable cars can be part of the solution by providing an innovative and attractive approach to public transport.

Many cities across the world have implemented urban transit cable cars. In Africa Algeria[5] provides the leading example, where 5 cities have urban cable cars. The largest installed urban cable car infrastructure, however, is La Paz in Bolivia[6] with 12 km of lines now being extended to 32 km. The technology has major uptake in South American cities including Caracas, Rio de Janeiro and Medellin. Others can be visited in London, Koblenz and Singapore. Figure 1, next shows some visuals of urban transit cable systems.

Fig.1. Visuals of Urban Cable Cars

	
Constantine, Algeria	La Paz, Bolivia

	
Medellin, Colombo	Koblenz, Germany

3.1. **Benefits of Cable Propelled Systems**

Cable propelled systems offer various benefits[2] as highlighted below.

a) Cable systems have no problem passing over roads, residential areas, rivers and existing infrastructure. As such more direct and shorter routes can be realized.
b) Dedicated barrier-free transport routes that do not compete with road transport, giving predictability to transit times.
c) Require little ground space only for tower foundations and terminal stations.
d) Low capital costs (typically 1/3 of a light rail system)
e) Ropeways can be installed within a short time frame (under 12 months). In the case of temporary installations, they can even be fully dismantled without a great deal of time and effort, and re-installed at another location. All that is needed are the appropriate foundations for the towers and construction of the stations.
f) Offer unique rides to passengers since they are quiet, reliable, environmental friendly, unhindered by other traffic, absolutely safe and also guarantee a bird’s eye view of the city.
g) Impressive speeds. With three-cable systems, speeds in excess of 7.5m/s (27km/hr) are possible. Unlike a shuttle bus, which shares the existing road system with other vehicles and therefore confronted with numerous obstacles, the cable system saves time and energy because it is a direct, barrier free link.
h) Impressive operational efficiency. In addition to costing many times less than ground based systems, they also have far lower requirements for energy consumption and personnel costs. For example, with very limited staff exclusively manning the stations, cable systems can carry over 10,000 passengers per hour (equivalent to 100 articulated 100-seater buses.) Further, public transport systems are subject to huge fluctuations in capacity utilization. They are overcrowded in peak periods and underutilized in off-peak. Ropeways respond to transport demand by varying the cars on the line (or reducing line speeds.)

3.2. **Functions Performed by Ropeways**

Fill Gaps: Ropeways are well suited to filling gaps between facilities that generate traffic such as commercial zones and outlying infrastructures. By acting as links, they enhance the existing network.

Bridge: Ropeways cross barriers that cannot be passed using conventional means, or at great expense.

Createnew networks: in urban networks with inadequate transport infrastructure, ropeways can create new networks by linking up several ropeway lines.

Extend: Ropeways provide a practical means of extending existing public networks (bus lines, rail etc.)

Relieve: When conventional means of transport and existing infrastructure reach their limits, ropeways can be used to alleviate traffic congestion.

3.3. **Urban Cable Car Projects in Kenya**

There are two projects currently under development in Kenya, the Likoni Cable Express (LCE) and Nairobi Cable Transit (NCT) briefly described next.

Likoni Cable Express

This project seeks to offer an aerial complimentary passenger facility across Likoni Channel. When completed, the facility will have a capacity of 11,000 passengers per hour both directions, with a crossing time of under 3 minutes[7,8]. This crossing is expected to form the pilot of the extended Mombasa Cable Transit (MCT) master plan, shown in Fig.2 below.

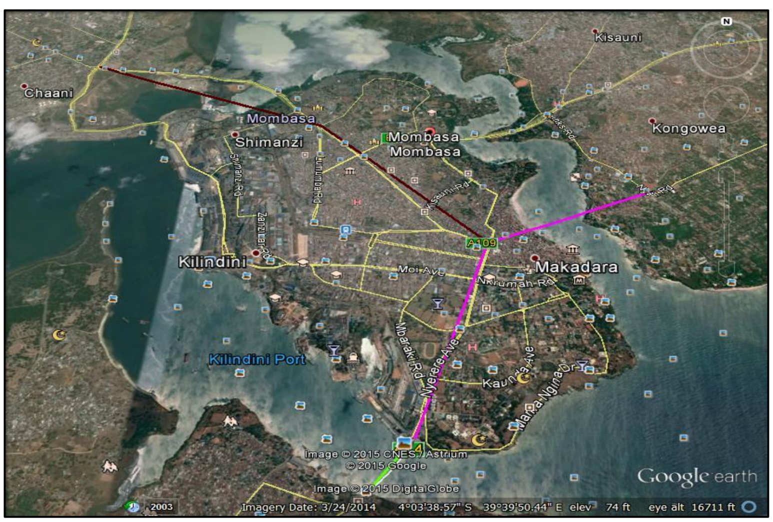


Fig. 2. Potential MCT master plan

Nairobi Cable Transit

This project seeks to alleviate some of the congested segments of the city, by offer commuters an alternative. It has 6 corridors, as indicated in Fig. 3 below. The first two corridors will be Jogoo Road and Kibera lines, expected to come to operation Q2 2017.

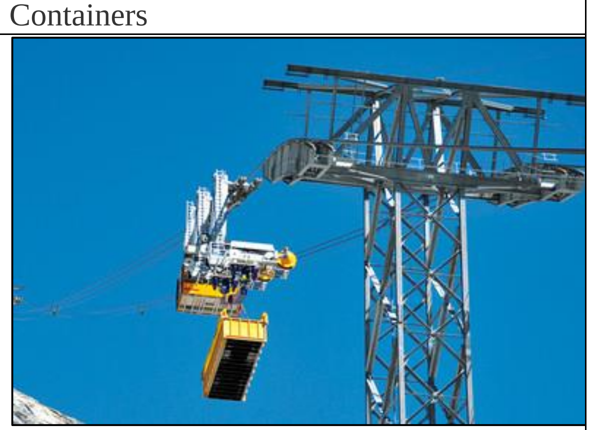
Fig. 3. NCT Master plan

4. Application to Materials Transport

Ropeways have been adapted for materials transportation. Amongst the benefits of these systems are:

- Extremely narrow line corridors required
- Straight conveying lines
- Ease of crossing of buildings, roads, rivers or other obstacles.

Figure 4, below shows images of materials ropeways.

Unit Loads	Containers
	

	
Over delicate habitats	Limestone across River Nile

It is clear from the photos in figure 4 that the technology can be adopted to solve problems in very varied environments. In particular, it is extremely well suited for mining applications where the ores have to be transported for long distances across delicate habitats. Additionally, the ability to move unit loads (pallets, containers) for long distances allows better space utilisation around maritime ports.

5. Summary

This paper has presented the case of ropeways in urban and materials transport. It has been explained that ability to utilise the additional aerial space creates an additional dimension for transportation, easing pressure on the conventional transport modes. The paper recommends that as new infrastructure is built, ropeways solutions be considered for incorporation where appropriate.

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