

The new generation of Bicable ropeways, an economic link between Monocable and 3S

Dominic BOSIO / June 2024

1 The Evolution of ropeways



Without wanting to present once again the evolution of ropeways, which had different characteristics throughout the world, depending on the places and the usage of the ropeways, the author makes a brief summary of the evolution of the ropeways, showing that, starting from the invention of the wheel (☺), ropeways went through different stages of development, from funiculars to aerial tramways (jig back technologies using fixed gripping of the vehicles to the cable), to monocable unidirectional systems (allowing a smoother flow of vehicles, and reaching higher capacities independent of the length of the ropeway)



More than 150 years of experiences, research and development have allowed to improve the Ropeway Solution in the way we now know and use in our different situations (for ski resorts, mountain tourism and urban transport):



Nowadays, ropeways have reached their most advanced development, and a large majority of projects worldwide (in numbers and as well as in “magnitude”) are realized in the 2 following forms:

Unidirectional monocable detachable ropeways	Unidirectional Tricable (3S) detachable ropeways
	
<p><u>Advantages / Disadvantages</u></p> <ul style="list-style-type: none"> + Proven universal solution + Low space impact + Low cost of equipment + Easy to install (helicopter) + Easy for O&M - Capacity limited - Size and configurations of cabins restrained 	<p><u>Advantages / Disadvantages</u></p> <ul style="list-style-type: none"> + Most advanced technology + High Capacity + Long spans + Heavy cabins - High CAPEX and O&M costs - Heavy maintenance - Space demanding

2 Bicable re-designed

Bicables have not been mentioned in the previous chapter, as, historically, they were facing some drawbacks which did not allow the technology to really “settle in”.

Although some “famous” realization have been built around the globe and were operating for a while, they all had some flaws preventing a real development of the technology. Bicables had issues related to :

- Complex carriers made of “single” developments for each individual project
- Various issues on the towers (Vibrations, excessive loads on Track cable leading to “pinching”)
- Un-optimized stations, each “one of its kind”
- Issues with line profiles and differential sag between haul and track ropes, not allowing optimal tower configuration

The author further presents the spirit that led our engineering team to redefine and improve the Bicable solution.

Film 1: 2S redesigned (12")



3 The Best of both worlds: Cabins and carriers

Bi-cables (2S) allow an entire range of vehicles to be used, independent from shapes and sizes, from 10 to 20 passengers. Cabins types can indifferently be : Diamond, EVO, Conus, Symphony, Porsche Design, ...

Their high carrying capacity and spacious volumes allows the carriers to be fully equipped and comfortable, with all types of configuration possible, and with all Interior Design possible, with electric sliding doors for better access.

By using dynamos on the carrier wheels, they also allow power generation along the movement, making Sound, Light, and more important Air Conditioning available features in the vehicles.

For the carriers themselves, in addition to an important simplification of the concept (making it similar to a mono-grip), and by using adequate materials (Monobloc machined steel main body, fully plastic wheels) makes the 2S solution a state-of-art equipment:

- Safe and reliable (by having the grip “holding up” the cable)
- Agile in the stations (two auxiliary rollers on the carrier allowing sharp station turns)
- Noiseless along the line
- With limited or no pressure points on track cables at main deflection points
- Low wear equipment using standard components (Monogrip concept, with no compression needles, 4 carrying rollers)

Film 2: Cabins and carriers (26")



4 The Best of both worlds: Line towers

Bi-cable towers must of course carry the efforts from both track rope and haul rope. However, they are, in shape and size, much smaller than any Tri-cable solution, and yet, they allow very long spans, reducing the numbers of elements that any monocable solution would require .

Bicable towers are more simple, with optimized saddles (synthetic track ropes supports -non-greased and maintenance free-) for the track rope sag, and non-vibration sheaves for the guiding of the haul rope, resulting in:

- Smaller towers (single track and narrow line gauges)
- Reduced foundations and less constraints on the structures for different construction methods (lattice, tubular, concrete),
- Low wear equipment with tried-and-tested components (sheaves),
- Easier installation, followed by low operation and maintenance costs along the line.

Film 3: Line towers (25")



5 The Best of both worlds: Stations

Stations of a Bicable technology remain “easy-to-integrate” elements, whether in Urban or Touristic resorts. Similar in shape and size as a big Monocable ropeway, based on 2 pillar geometry, it is possible to adapt width and length to any specific requirement (wind large line gauge or long boarding time for instance), making it easy to propose intermediate stations, or to integrate with any designer ideas.

Maintenance and Operations in the stations is comparable to any Monocable ropeway, with only standard components related to the haul rope (Direct Drive motors, hydraulic tensioning units, modular accel/decel beams, electrical switches and controls, cadencing systems, Stop&Go, Autonomous operation).

Track ropes are positioned and deflected in a simple way, allowing displacement/shortening as easily as any other maintenance procedure, in a far easier way than for a 3S or Tri-cable solution as there are no fixed slack carriers.

Film 4: Stations (2'06")



6 The Best of both worlds: Line profile

Last but not least, Bicable 2S systems allow a wide range of optimized profiles.

They can adapt to any terrain, and jump over any obstacles, with no limitations due to maximum height clearances, as they come with an Integrated Rescue System, avoiding evacuation in all cases.

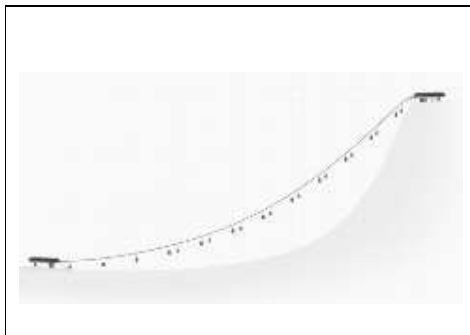
The re-designed Bicable systems now allow:

- Very long spans
- High wind stability and reduced line gauge
- Light line design with non-invasive towers, with reduction of number of towers to the minimum

Among all innovations, the solution brought by movable slack carriers allow:

- Perfect control of position of haul rope versus track rope
- Possibility of de-icing modes of both track and haul ropes
- Ease of control and maintenance of all slack carriers displaceable in the workshop
- No punctual wear and possibility to monitor track ropes along the line (magneto-inspection)

Film 5: Line profiles (45")



7 Bicable redesigned: An economic (missing?) link

Having „downsized“ the Tri-Cable (3S), and at the same time “powered up” the capabilities of Monocable solutions, one of the main advantages of new Bicable technology is ...the Price.

Every project has its own specificity, so it is not easy to make direct cost comparisons. However, on samples of similar complex ropeways (with demanding profiles, where Monocables cannot reach the requirements), the investment for a 2S equipment will be around 60% of the needed value for a comparable 3S, while providing the same transport capacity !

In addition, the construction costs (space requirements, civil works and foundations, bollards and heavy structures) of a Tricable are probably more than double to those of a Bicable.

Finally, on the long run, OPEX costs (Operation and Maintenance), thanks to lesser wear and tear, simplified procedures maintenance and a „light-weight“ proven mechanical system will further increase the difference, making truly the new generation of Bicable ropeways an economic link between Monocable and 3S

Film 6: Bicable ropeways (2'08")



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