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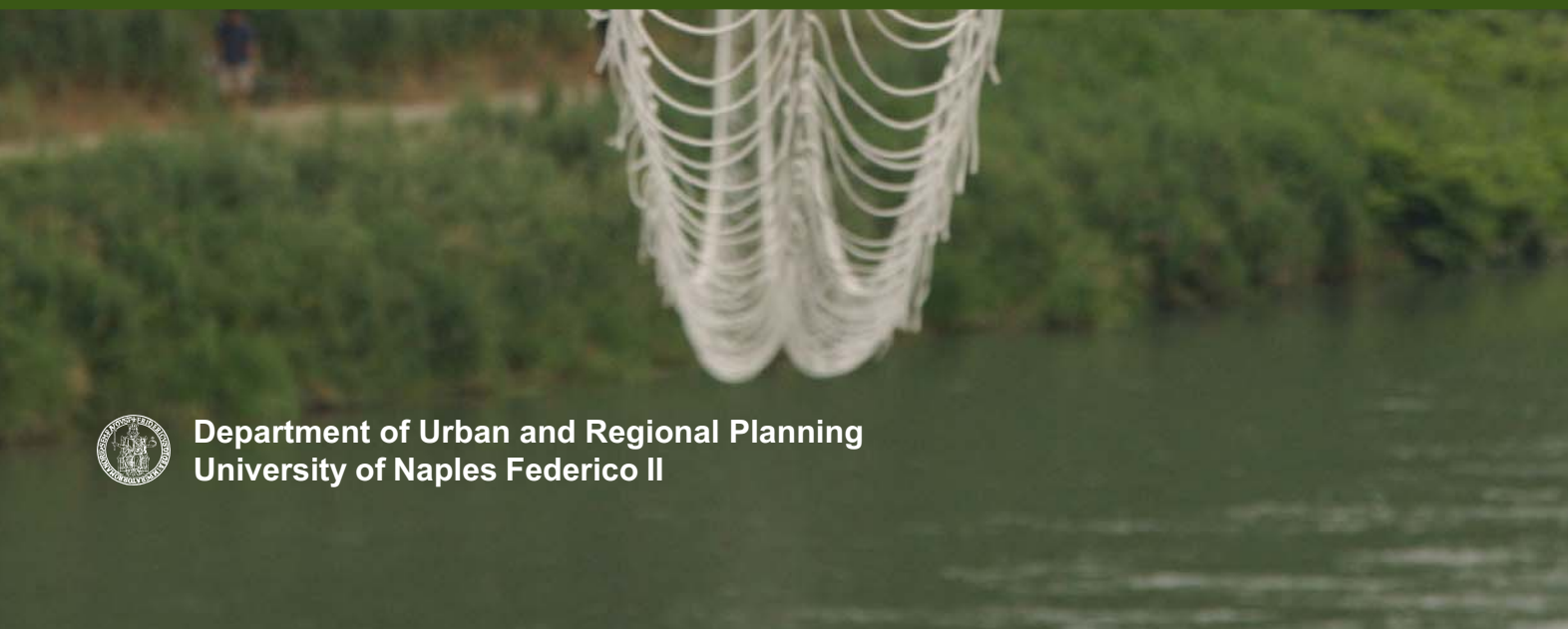

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The City from the Wire the Aerial Cable Transport for the Urban Mobility

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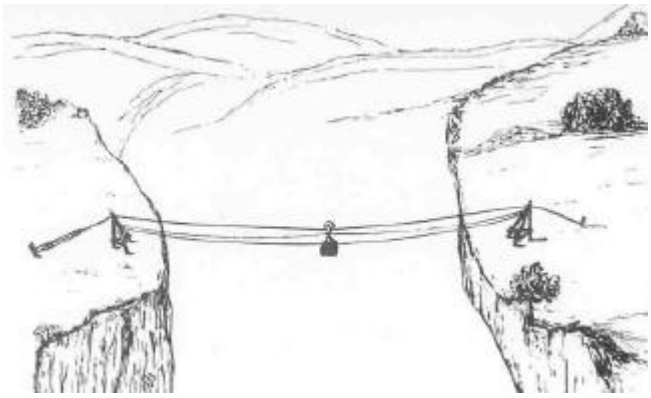
ABSTRACT

The urban transfer by using ropeways can produce impacts and externalities which, if well-managed, can trigger processes reliever, sustainable development and promoting tourism inside the city. The article starts from the consideration of urban transport by ropeways as a viable, effective alternative to the collective transfer among different areas of the city, particularly in those cities characterized by unique morphological or hydrographic territory which are fit for being overcome by mobility systems at high altitude. These features, in many international urban contexts, also contribute to enhance the amenity and the urban appeal. The paper intends to underline how the ropeways can become an efficient urban transport system between urban sites, often placed at different heights and for which there is a less accessibility by ground, and at the same time, a fascinating way of tourist mobility that allow people to observe the city from above (moving on it), in a sort of dynamic view. This interesting functional convergence has been often highlighted in the studies conducted on this mode of transportation, ,which in the past was considered one of the real possibilities for urban moving. Many cities are characterized by this type of mobility and within which existing systems of lifts, oblique connections between parts of the city are provided by urban systems, lifts, cable cars, escalators, moving walkways, etc.. A focus is also provided in relation to the ropeways, currently operating in many cities around the world, highlighting the effectiveness of mobility solutions at high altitude, although not necessarily intended for the slope, taken in metropolitan contexts outside of Europe since the Seventies. Furthermore a specific attention it is payed to the plants currently disused in Turin and in Naples with a special regard to the possible recovery prospects in a new urban mobility system. For the city of Naples it is presented also a new project for a rope way between the two famous museums: the Archeological Museum, which is located inside the inner city, and the Capodimonte one which is at top if the hill of Capodimonte inside the well known area of the royal palace. Finally some new projects are presented regarding the cities of Rome and Milan. For the two biggest Italian cities there are two ropeways designed that will, in the case of Milan, link urban areas along a path that includes interchanges and stations in major urban hubs, starting from the airport; in the case of Rome the “link” will cross the river Tevere in order to connect two large districts of the city: the EUR and Magliana, historically splitted by the barrier river".

A romantic vision of the urban transfer

The possibility to overcome the laws of gravity flying over the city, floating in the spaces between buildings and landing at stations located very high and marked by futuristic architecture, has always been one of the main feature of the visions of city science fiction.
Flying over the city or using transport systems, which allow a free and impressive mobility "floating", are actions that characterize the movement of the protagonists of many nineteenth-century fantasy novels, whose authors have frequently exercised in the provision of urban amenities of the future, for instance the foreshadowing of Jules Verne predicted in city (Paris), in addition to air travel, use of the Internet, air conditioning, magnetic levitation transport, etc.
The aim of this paper is to bring the attention of engineers, urban decision-makers and users to the ropeway as a viable, effective alternative to the public transport between different areas of the city; that consideration should be formulated especially for those cities characterized by hilly ground, slopes or geomorphologic uniqueness and/or hydrographic peculiarities that are fit for being overcome by cable mobility systems. These infrastructures in many cities worldwide, helping to increase the amenity and, like in some Italian cases, the urban appeal. The story of the "ropeway" begins with the human need for overcoming the rough topography. The use of vegetable strings and animal fibers to overcome cliffs and precipices is ancient and it is believed that already in Mesopotamia and Egypt people did use them specifically for this purpose. Later, in the Roman era, it seems that pulley-systems have developed mainly used for moving soil and other materials.



A first ropeway built on the border between Colombia and Venezuela by Spanish in order to transport passengers.

In the Renaissance many construction machines provided for the pulley of baskets containing the blocks for building and around the first half of the XVI century you can place the construction of cableways for passenger transport. The evolution of these plants was long proportionally related to the ability of tension ropes. Only in 1800 drawn steel wire ropes were produced being capable of supporting high voltages and thus capable of supporting substantial weight.

Technological development was driven by the need for having the availability, in the mining sites, of cable cars capable of handling large volumes of material extracted by the appropriate transport trucks for which the automatic detachable system was created. The XIX century was an era of great progress but the first products of modern passenger lifts should be placed at the beginning of the XX century. In Italy the first ropeway: linking Lana and S. Vigil (Alto Adige region) was built in 1912 by the company Cerretti & Tanfani and included a cabin holding 16 passengers and travelling at a speed of 2.5 mt per second. As it often happens, the war needs led to new progress in this field, being more modern and efficient, but by the end of the 2nd World War there will be a new requirement: the tourism one, particularly skiing, which will drive the research and technological development in ropeway field. After the 2nd World War the ropeway was considered as an efficient transport system even within cities and in particular inside hill towns. Then Ropeway transfer becomes effective urban transport system between urban places (often placed at different heights and with a difficult access by land), and at the same time a fascinating way of tourist mobility that is, the ability to observe the city from the top (moving on it), one of the famous sights. This interesting functional convergence has been repeatedly highlighted in the studies conducted on this transport modality that in the immediate past has been considered one of the real alternative for urban travel. Translating the above assumption on a scientific level, and referring to the systemic logic for the interpretation of the city, we can say that in the specific contingency mobility function can simultaneously refer to both the sub-functional system, consisting of the features and functions allocated in the space and functions moving through space (mobility), and the perceptive sub-system, because the individual is able to have a dynamic perception of the city by a particular viewpoint. In the following pages the matter will be carried out, with specific reference to cableway installations made in urban areas that may still represent a valid alternative for sustainable mobility in the city.

The urban ropeways

Many cities and metropolitan areas are now reconsidering the possibility of creating local public transport connections by using the ropeway. The cable transport also provides for other transport systems, in particular the cable cars which allow the overcoming of strong gaps and slopes inside urban areas. Unlike the “funicular”, cable cars do not foresee a shift in "pending" but overland and the cars run on tracks that pass through the drop by means of a driving force exerted by a "pull and release" cable , which pulls the downstream car and at the same time releases the upstream cabin. Naples is definitely the most famous Italian city for funicular public transport. Currently there are four different funiculars allowing to reach the hills of Vomero and Posillipo from the old city and from the areas of Chiaia and Mergellina. Funicular installations are active in many other “oblique” Italian cities, like: Genova, Bergamo, Biella, Como, Trieste, Livorno (solar powered), etc.

A post card about the Vesuvius funicular.

There are many others in the world especially in those countries (like in Latin America), where cities are often built on hills and hilly areas. One interesting example is Chile, which has 15 funiculars;

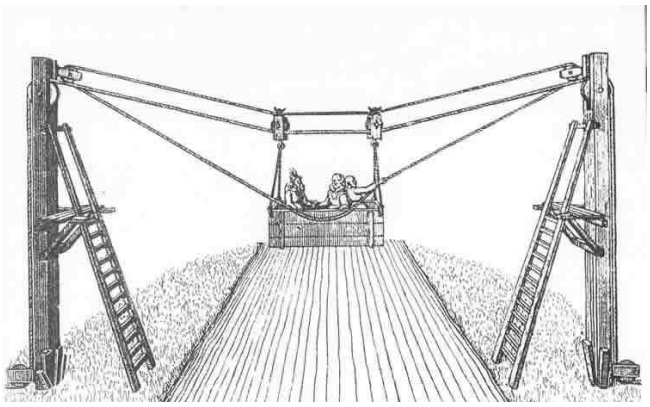
probably the best known of which is in Valparaiso, described in the movie "The Motorcycle Diaries" by Walter Selles. The historic cable cars are also facilities for going up the slopes of volcanic mountains like the case of Vesuvius funicular (Italy), opened in 1880 and destroyed by the last great eruption of 1944, and for which many times it was thought to restore through the redesign of the system. Even for the city of Naples, which will be discussed later, there are recent projects of new ropeways, but at the moment there are no concrete actions towards effective implementation. Ropeways and funicular had a particular period of boom around the first decades of the XX century. The specific mode of transport was the preferred choice for all those cities in which the accessibility depended on the capability to overcome specific sloping areas inside urban context. As mentioned before there are many examples but with the passage of time this mode of public transport has been superseded by other installations, mainly because of security requirements in the transfer. From a technical point of view we can distinguish two different types of urban ropeways:

- "down-up", which allow to overcome height gaps, slopes and altitude inside the city (among them also funicular railways are included;
- "links", which represent urban suspended-rope connections, mainly developed horizontally, and reaching the stations placed at the same altitude. They are generally designed to overcome specific "barriers" or interruptions, to bypass urban rivers, to reach islands situated within the city, to overcome mobility infrastructures that block direct accessibility, etc..
- This installation may also vary depending on the type of traction, the characteristics of the cables, modality of traction truck, and so on.

In general it is possible to distinguish 5 different types of ropeways.

1. Aerial Tramway system (ropeway): classic cable car consisting of one or more cable cars suspended by a vertical metallic jaws and connected with two carrying ropes by a pulley truck and moved by a traction rope. This system involves some problems especially in urban area because of the stability of the cabins.
2. Funicular system: it consists of two cabins on railway tracks moved “up and down” by a haul rope. There is usually a single track route with an exchange area where the track is doubled to let the ascent train go up.
3. Funifor: made up of two suspended cabins, each of them is equipped with a four -cable truck.
4. Cable-car: they can be one-cable, or two-cable or three-cable facilities and are sufficiently stable in the wind and because of this chosen, even in the past, for urban realizations. They entail the detachable chairlift to the haul rope for movement at high altitude.
5. Funitel: it is an extremely stable way thanks to the dual system of ropes deployed at more than 3 meters far from each other.

This distance allows two vertical trucks to clamped safely to the drive system and to stand wind loads exceeding 100 kmh. At the moment the main problem in order to build up urban ropeways is related with the safe requirements of the system. In order to build up a ropeway inside the city, an appropriate area is necessary that must be cleared of buildings, plants or human presence. It is therefore difficult to find free corridors within the existing urban contexts where the fabric is characterized by a substantial building density. A possible solution could be reached by the advanced technology that could allow the execution of safety equipment capable of preventing or quickly stopping disaster. The European standards for the safety of cableways are the EN 1709 and EN 12397. It should however be noted that similar considerations, regarding the need for security may be made for the aircrafts takeoff and landing corridors near the municipal airports, now besieged by buildings.



A ropeway useful to cross over a river in 1600.

The ropeways as urban icons

It seems interesting, at this point, to describe some famous realizations in the urban settings of the new and the old continent, which have become part of the iconic heritage of the city. In Europe, as mentioned, there are numerous cableways in the hill towns and it would be difficult to list them all. There are also cases, including Barcelona, Naples, Seville, Turin, etc. .., where the urban ropeway was built on the occasion of the expo meant to represent one of the attractions of international exhibitions and to allow a bird’s eye view of the entire expo settlement. In the following pages the relationship between shift rope and cities will be described with specific reference to the case of Naples, and will analyze the reasons of abandonment or, as in the case of Seville, the sale of

plants that could have still effectively carried out their role. The story that has characterized the Roosevelt Island Aerial Tram is totally opposite to those just mentioned. THE RIAT is definitely one of city ropeways that has most contributed to the construction of a subway in New York. The cableway, built in 1976, had to temporarily allow commuters to reach residents on Roosvelt Island, above the East River, until the completion and opening of the subway station. The RIAT has resisted time and at the presence of other means of travel on the same journey and now represents a "link", between Roosevelt Island and Manhattan, New York symbol of mobility. The track runs for a length of about a mile and reaches a maximum height of 80 meters, with travel at an average speed of 20 kmh. Each shuttle can carry up to 125 passengers but with only 10 seats; in one day the RIAT makes a total of 115 rides and up to now its implementation has allowed the movement of more than 26 million people. The distance between the island and New York is covered in about 5 minutes and the cab, in the final segment of the route, flies over city streets and buildings of the Second Avenue in Manhattan. This famous cableway allows a unique look at New York and represents one of the best known system of tourist mobility in the world. The image of the RIAT has often been used in the iconographic association to the city of New York. The distinctive elongated shuttle flying over the city, wedged between skyscrapers, appears in numerous films of which, perhaps, the best known is "King Kong". Even some well-known American comic book heroes, like Spiderman, have waged fierce battles with deadly enemies, on the roof of the cabins of RIAT, risking falling on the city streets. Even in the film "Moonraker" James Bond was fighting inside and outside of an urban cable car, in that case it was the Pao de Acucar in Rio de Janeiro. The European city that is remembered in particular for its multimodal transport system, which includes urban cable car and funicular railway, is Barcelona. In the Catalan capital it is possible to understand the texture of the fabric of the city by going up, from the southern edge of town, the slopes of Mont Juice (215 meters). To move along this direction is necessary to take the first funicular Avinguda Paral-lel and then the gondola of Mont Juice: "El Cable Car." The urban cable car, the flagship of the International Exposition of 1992, was built in 1970 and renovated in 2007 by architect Joan Forgas. Currently it includes a fleet of 55 cabins, with facilities for IDIS and redesigned with large glass areas to promote the views of the city from above; the cabins are at a distance of 752 meters from the downstream station to the new upstream station being advanced compared to the old track, to mitigate the impact in the park of the castle. Each cabin is able to cover the journey in about 4.5 minutes moving at a speed of 5 m/s. The gondola of Mont Juic it is able to overcome a height difference of about 85 mt. enlivening the cabins along the traction rope stretched over 12 pylons being moved to a maximum height of 24 mt. For some years the movement has also adopted a rope in an urban environment in developing countries such as the cable car in the city of Constantine in Algeria. A cable system, the only one of its kind in Africa, was inaugurated in 2008 and consists of 33 egg cabins capable of transporting 15 passengers each and covering the distance of a mile in less than 10 minutes flying over the deep gorge of Sidi M'cid. In total, the cable car can carry about 500 passengers per hour representing a valuable support for local public transport in general experienced by urban bus routes.

Turin and Naples: Back to the Future

As already pointed out the urban cableways were often made on the occasion of international exhibitions in response to a threefold need: to create a symbolic infrastructure for the expo that would become a real attraction, allowing the perception from the above of the entire settlement exhibition, promoting a type of original furniture and, in some way close to the city's futuristic visions. There are many examples of urban lifts installed at the expo and which still exist in many cities such as Barcelona, Lisbon, etc.. Sometimes, as in the above-mentioned case of Seville, also plant a few years of operation and are in full working order abandoned because of management problems, whereas, in general, are owned by private entities. Even in Italy the problem of disposal and sometimes of abandonment has characterized some urban cable cars that had become a part of the image of the city and represented also a popular mode of transport and connection between urban areas. The case of Turin and Naples, cities often united by events related to urban innovation, is of particular interest since both cableways were settled on the occasion of international exhibitions: the "Mostra d'Oltremare" in Naples and the international expo "Italy 61" in Turin. Considering the case of Turin first, it will be told that a cable system, consisting of a cable car, connecting the hilly area of Cavoretto (Europa Park), with the area of exposure, in an area south of the current urban center, obtained by cleaning up the banks of the river Po, which had allowed the construction of a new exhibition celebrating the centenary of the unification of Italy. The cable car system was formed by the two upstream and downstream stations, among which, suspended from a cable about 10 feet high, sixty eagerly drawn cabins ran capable of carrying about 700 passengers per hour. The great exhibition was also part of another transport advanced system, "the monorail Alweg" futuristic icon of the exhibition which, after various events, was definitively abandoned in the late seventies. Currently in Turin there are proposals to recover the cableway station by recuperating the

Valentino and Cavoretto stations, also to recall, 150 years from the Unification of Italy, the sense of the 1961 exposure which tried to propose a new modernity for Country being also an expression of a century of unity of its people. Even in the case of Naples the cableway connecting the hilly area of Posillipo to Fuorigrotta district was released at the inauguration of the "Overseas Exhibition." The great international exposition, with the original title of "Triennial Exhibition of Overseas Italian countries, collected the products of the art of Italian colonies in North Africa and the Mediterranean. The large exhibition center, which gave rise to extensive changes in our urban area west of Naples, was built as a twin settlement of the EUR in Rome and was inaugurated by King Vittorio Emanuele on 9 May 1940.

An image of the Posillipo ropeway (Naples) during the last operating period.

The location of the new exhibition, celebrating the Italian colonial activity, required the adaptation of transport systems to the west area of the city, which had been separated from the historic center because placed beyond the natural barrier of the hill of Posillipo. This obstacle was overcome either by means of a series of tunnels that allowed the crossing of the hill or by realizing the cable that connected the current area of Virgilian Park to the great Exhibition District consisting of 36 pavilions. The ropeway covered a distance of 1,170 meters. and exceeded a height of 107 meters from the reference station, located near the entrance of the Mostra D'Oltremare, and now turned into a flower shop whose owner has curiously the same last name of the architect. Giulio De Luca, designer of the system. The two booths could carry 20 passengers (for a total of about 175 units per hour), traveling at a speed of 5.5 m / s and were able to cover the distance between the two stations in about 8 minutes. The cable car was first stopped during the Second World War, which caused its partial destruction. Rebuilt in 1953 remained in operation until 1961 when the Board Show was forced to close the plant because of the excessive proximity between the cabins and buildings constructed after the World War II. In 1970, the support and traction cables were dismantled and the suspended safety nets disarmed. Currently, the support pillars are still present on the old track, which after a liner run inclined towards the hill of Posillipo, and which remain as urban totem to report one of the many discrepancies in Naples. Within the downstrem station, whose architectural structure crosses " the Circumflegrea track line by means of a "bridge, there is still one of the cabins abandoned for about 50 years. The upstrem station, built on the slope of the hill of Posillipo is structured through a reinforced concrete box-body, which after the transfer was used as a bar for a period of time. The recovery and reuse of this ropeway has been proposed several times with various ideas for the redesign of the line. Nothing has been done partly because of security problems when moving at high altitudes remained unresolved at present. It is undoubtedly clear the importance and tourist appeal that the restoration of that ropeway line could have, without forgetting the important contribution that it could provide to the mobility between hilly area and flegrean area, also considering that the bus of local public transport take about 30 minutes (on average) to connect the two parts of the city by road, compared with about 5 minutes that new technologies could provide. One possible solution to the problem of excessive proximity of buildings to the path and the pylons could be to design greater heights innovative supports and to restore the original networks to protect the corridor below. In fact in the city of Naples there have been many proposals for ropeway installations, including those made by Aldo Capasso around the late 70s, which regarded possible links between the area of the Albergo dei Poveri and 'Botanical Gardens (east area of the city) with the Capodimonte hill, one from Marechiaro to Posillipo, and the circle one that starting from Fuorigrotta reached the hilly areas of and Capodimonte and Colli Aminei and went back down to Piazza

Garibaldi, where the Naples railway station it is located. The proposal partly took the route of the cable car of the show overseas to engage in a new location, which reached and passed over the crown of the hills surrounding the historic center of Naples. Another proposal has recently polarized the attention of the Neapolitan community and the regional administration, wihch in 2009 approved an allocation of € 1.348.000 to make a feasibility study for a new cableway in the old city. The project, known as the " 2 museums ropeway", should connect the Archaeological Museum, located in the historical center of Naples to the Capodimonte Museum located on the homonymous hill area. According to the meta-project submitted by the Agency for Mobility (ACAM), there are two possible routes: the first route would connect Piazza Cavour, near the Archaeological Museum, to Via Capodimonte, flying over the Sanità district, the second provides that the Archaeological Museum could be connected through a treadmill to the station located in Piazza S. Giuseppe dei Nudi. From here the ropeway line could start, following the roads via S. Teresa Scalzi and Via Amedeo d'Aosta, and get the upstream station in via Colli Aminei from which, through an underpass, the Museo di Capodimonte could be reached. The trail is about 1.5 km and could be covered in less than 10 minutes by cab suspended 22 meters in height. It is estimated that the plant, the type Funifor Tandem, could handle a maximum of 3,300 passengers per day for a total of about 168,000 passengers a year. It has also been thought about possible fee charges, which should be a round-trip ticket of about 7 euros. At the moment very little is known about the proposal, for the achievement of which a financial commitment of 25 to 29 million euro has been estimated, but the recent financial difficulties of the Campania Region and a certain hostility from public opinion seem to have permanently invalidated. It should however be notified the attention that the transport community pays to this mode of travel especially in Naples, which could benefit greatly, in terms of relieving traffic congestion and reduction of pollutant emissions, from the installation of a rope system of mobility. the security issues, already mentioned above, still remain, in particular with regard to the overflight of built-up areas. The pre-project of ropeway seems not to worry too much about this aspect, in particular with regard to the proposed route passing over most of the Sanità district built-up area. Also other Italian cities are proposing interesting mobility projects based on cableways. One of the most interesting regards the construction of a large cableway, called "Project ALTAVISTA", to be implemented during 2015 Milan Expo and which is expected to connect the areas of Linate, Pero with Rho for a total track length of 18 Km. The vertical structures provide ten mushroom towers 130 meters heigh with 9 piers. The stations are located inside different districts: Linate Airport, Politecnico, Giardini Via Manin , Parco Sempione, Vigorelli, P.le Lotto, Stadio Meazza, S. Leonardo, Pero Exhibition Centre, Expo village of Rho. The plant, the type Doppelmayr, would be able to carry about 3,100 passengers every 52 minutes, which represent the travel time. Another interesting initiative for the construction of a ropeway is that of the urban design of the Magliana cable in Rome proposed by the Roma Metropolitane company. The system is a "link" which is entrusted with the task of overcoming the Tiber to allow traffic between the EUR and Magliana districts, and which will allow residents of that area to use the Metro mobility systems (station Eur Magliana Line B) and the Roma-Lido railway. The roadmap entails a development of about 700 meters with ropes supported, in the central part, by a single pylon about 40 meters high, located near the viaduct Magliana. The cableway system would allow about 17 trips per hour with a carrying potential of about 2,200 passengers per hour in each direction direction. The investment value amounts to approximately 22 million of euros, but this project, presented with great fanfare in 2007 by the past city government, has gone missing. Recently, the deputy mayor with responsibility for tourism, assured his personal commitment on the initiative for whose final launch; the inauguration would be finally scheduled for 2012.

Conclusions

Some final remarks can be developed at the close of this article.
In the past the urban ropeway have represented one of the iconic elements for many cities, particularly the hilly ones, it provides an effective opportunity to link urban areas with poor accessibility. One of the most outstanding features of the shift is to be found in the tourist attraction, particularly in the possibility of allowing a view of the urban complex being difficult enjoyable otherwise and which gives the possibility of taking a view while moving. The development of urban links could allow the overcoming of obstacles and barriers, either natural or anthropogenic, in the area and to connect points of the city not reachable by different systems of mobility. The urban ropeway surely meet the new demands for sustainability in urban travel showing a relatively economical performance, low-impact installation, zero emissions, without any significant noise impact, etc. A recent survey of the Climate Partners Austria GmbH on the comparison of emissions between cableways and other nodal urban transport systems has highlighted the benefits of urban cable cars, concluding with the following statement: "The cable car opens a new level of transportation flying over the streets and making themselves independent of the congestion and is so much faster than the traffic. Furthermore, given the continuous motion of the cabins, passengers can go at

any time without waiting time and travel not only faster but, as highlighted by the study, also in an environmentally friendly way. " However, its limitations should be reported. The most negative element of this mean of transport lies in the necessary safety requirements. These requirements are mainly related to the need for ground areas, not built, corresponding to the corridors of moving boxes and for safety performance which should ensure the stability of trains in adverse weather conditions.

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