Use of mining FREIGHT Cableway in urban mobility as a part of an integrated transport system

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Due to the extensive economic activities in urban areas, many European cities face multiple problems related to or caused by transport and traffic. Traffic infrastructure in cities and beyond will cease capacitively and qualitatively. This situation can be addressed by building infrastructure with compatible integrated transport systems. The article presents the possibilities of using the route of a high-speed suspended cableway originally intended for the transport of magnesite from the mine Bankov for processing into the former thermal operation in Ťahanovce in urban mobility. The basis of the article is the methodology of designing a personal cableway with capacity and strength calculation. City outbuildings in Kosice are currently expanding beyond the city centre to its periphery, which also changes user needs. Residents demand a new culture of urban mobility. Meeting these needs together with the need to increase the share of green public passenger transport requires a fundamental change in order to provide traffic closer to the sources and the destination of the roads. By using the route of the former mining cableway, a new conveyor system of the suburban cable car would be created. This system could be integrated into the integrated transport system of the city of Kosice. At the end of the article is a case study on the integration of a personal cableway into the integrated transport system of the city of Kosice as an effective and environmentally-friendly alternative to improving mobility in the city.

Keywords: *mining, cableway, transport, city logistics, smart city, urban mobility*

Introduction

The interplant transport of mineral raw materials plays an important role in the mining process carried out in mining companies (Andrejiova, 2015). An important part of this transport is a rope system. Rope systems offer high security, which is confirmed by statistics. This high safety is of course without further consideration, as the rope itself is a redundant element. The rope consists of a large number of wires. The individual wire breaks only affect the boundary length of the rope. Wire fragments and corrosion inside the rope can be detected by diagnostics, thus eliminating the rupture of the rope. Prediction of fatigue fractures diffusion on the cableway haul rope is described by Peterka (Peterka, 2016). Non-destructive testing of steel wire rope analyses Peterka (Peterka, 2014). Testing methods of steel wire ropes are described in the paper Krešák (Krešák, 2012). The special mechanical features of the device are conventional and tested, drives and braking systems. These are still multiple backed up and independent of each other. Rope transport systems do not endanger the environment, they have lower power consumption and cause only minor shocks. Optically do not get the impression of the surroundings because the wires consist of high-strength wires. Therefore, cableways have at least some of the means of transport that are connected with the ground.

In 2010, 73 % of European citizens lived in urban areas. This percentage is expected to increase to over 80% by 2050. As urban population growth, as expected to increase dramatically (Cohen, 2006) in the following years, it is necessary to find solutions for accommodating huge influxes of citizens in a way that is socially, economically and environmentally sustainable (Angel et al., 2011). Improvement of living conditions, working conditions and continual improvement quality of human capital can be achieved by social innovation. Social innovations in the context of a smart city allow achieving sustainable development, which in these days could ensure a higher quality of life (Jurenka, 2016). At the present moment, there is deep uncertainty concerning the strategies and policies that can effectively implement principles of sustainability within urban systems and how these can be measured and monitored (Robinson, 2004). In the attempt of providing a structured answer to these interrogatives, Morelli et al. (2016) present a methodology developed for investigating the modalities through which ICPs and KCPs contribute to the achievement or urban sustainability. Results suggest that ICPs and KCPs efficacy lies in supporting cities achieve a sustainable urban metabolism through optimization, innovation and behavior changes (Morelli, 2016). Feliu et al. (2010) show how city logistics approaches can meet the goals of Sustainable Development. In order to define the notion of sustainable city logistics, the main aspects of each

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sphere of sustainable development, respectively economic, environmental and societal, have been investigated. The main aspects of each sphere are described in order to unify the concept of sustainability related to city logistics (Feliu et al., 2010). Key success factors for city logistics from the perspective of city management were applied by Kiba-Janiak (2016).

However, due to the extensive economic activities in urban areas, many European cities face multiple problems related to or caused by transport and traffic. Social transformation has rapidly increased mobility levels, and the growth of private car use has been accompanied by increased urban sprawl and commuting, whereas public transport networks in many cases have not expanded at the same rate (European Commission, 2017). The number of alternatives to road transportation is nowadays still increasing, as well as the quality of these technologies (Široký, 2014). Life in the city and the areas directly adjacent to cities is becoming more and more burdensome (Cheba et al., 2015). Individual transport in Europe to 2030 increases by 40% according to the forecast (Marasova, 2010). Urban integrated mobility aims to slow down or stop the trend of rapidly increasing urban intensity in cities. Increasing individual transport, congestion, exhaust gas generation, noise, reduced security are the negative impacts of individual transport. These impacts also greatly affect mass transit. In the longer term, the development of transported passengers shows that there is a year-on-year decline in public transport between 3 % and 10 % (Ondruš and Dicova, 2011).

The basic parameter of choice for the means of transport is the time of shipment. Luminous signalling delays reach values in the range of 10-30 % of the total delay, therefore, the shorter the time of shipment will be the more attractive the mass passenger transport will become. (Kupčuljaková, 2011; Kalašová and Kupulčiaková, 2012) Optimising urban mobility is now very important for the scientific community. Neuenfeldt in his study identifies the scientific context of urban public transport management (Neuenfeldt, 2016).

Traffic infrastructure in cities and beyond will cease capacitively and qualitatively. This situation can be addressed by building infrastructure with compatible integrated transport systems. Making attractive public and non-motorized transport with social security everywhere and a natural choice for journeys in urban agglomerations is also one of the goals of the strategic plan for the development of transport infrastructure of the SR until 2030. (Strategic plan for the development of transport infrastructure of the SR until 2030, 2016). Cableways can become an efficient urban transport system between urban areas. Many places are characterised by this type of mobility.

For the city of Naples, it is also presented a new project for a ropeway between the two famous museums: the Archeological Museum, which is located inside the inner city, and the Capodimonte one which is at the top of the hill of Capodimonte inside the well-known area of the royal palace. For the two biggest Italian cities, there are two ropeways designed. In Milan, the cable car will link urban areas along a path that includes interchanges and stations in major urban hubs, starting from the airport. Cable car in Rome will cross the river Tevere in order to connect two large districts of the city: the EUR and Magliana, historically split by the barrier river" (Fistola, 2011).

Analysis of the problem

Design of a personal cableway along the route of a former freight cableway from Bankov mine to the housing estate of Ťahanovce and its integration into the integrated transport system of Košice is the main objective of this contribution. In addition to ensuring urban mobility, the personal cableway should have sport and recreational significance with the smallest impact on the environment and would enable the development of the city of Košice. An important aspect of the ecological transport policy in Košice is the limitation of passenger car transport. Integrated transport system (ITS) is one way to make better use of bulk passenger transport in cities and regions while making it more attractive to its users. The aim of this system is not only to combine and intermodal use of available transport capacity in the public passenger transport of the region but using state-of-the-art progressive transport technologies to make this mode of transport high-quality, attractive and environmentally friendly. The Kosice Integrated Transport System is designed to provide the aforementioned program tasks for public passenger transport in the conditions of the city of Košice and the Košice self-governing region.

The current state of the original mining freight elevator

Bankov Hill is the historically popular relaxing place of Košice. The mining of magnesite and its subsequent processing began in Banks in the 1950s. However, mining has disrupted this original recreational function of the site. An industrial complex with a ropeway was built in this area, which served to transport magnesite to a treatment plant in Ťahanovce. The mining was stopped in 1995 for environmental reasons. Since then, this industrial complex has been destroyed. After the mining, there was a 120 m deep crater. Of the original cableways, there is currently only a cableway from the thermal service of Ťahanovce (Anička) to the mine of Bankov. It is a costly cableway that was built in 1964 and is now in a desolate state. There are only carrier ropes, supports, tension weights in the return station and the power station building.

Design of a personal cableway along the route of a former freight lift for the transport of magnesite

Ropeways in Slovakia are mainly used for cultural and recreational purposes. Rope transport allows the transport of persons to higher positions during the summer and winter season. Linking the cable transport to the integrated transport system would have a sport-recreational significance, a positive impact on ensuring the necessary transport of people with the least impact on the environment and allowing the development of the city. Suburban tourism is a subsystem of recreational tourism. It is a recreation that is organised in a suitable recreation area, near towns, industrial and residential agglomerations. Recreation is not only a passive relaxation but also emphasises active participation in the interest of multiplying the effect of a favourable environment on a person.

Methods of calculation and results

Planning of a personal cableway

The process of designing not only a personal but also a cableway can be briefly summarised in these steps:

1. Carry up the geodetic terrain measurements.
2. Carry up the longitudinal section of the terrain.
3. Division of the track into powered sections and track sections.
4. Mark the support points.
5. Determine the height of the struts so that the safety clearance is left below the load rope.
6. Calculation of the tow rope.
7. Determination of the nominal load capacity of the ropes from the service life.
8. Determination of maximum permissible strain of ropes according to safety factor *k*.
9. Calculation of the weight of the tensioning weights for each track section.
10. Calculate the angles of the ropes on the supports and plot them into a clear plan. If an angle is unfavourable, the height of the support will change.
11. Calculation of the overload of the loaded rope to check the safe height of the cabin over the terrain.
12. Determination of the lift of the tensioning weights.
13. Static conversion of stations, supports and protective devices.

Before the inclusion of the current overhead cableway, it is necessary to change the cable car to the passenger lift, that is to say, the city's cableway. For the processing of the infrastructure project, the technical parameters of the personal suspended cableway are defined at the beginning. The length of the cableway course is to be divided into sections (A, B, C) due to the unevenness of the track and the obtaining of relevant results.

Calculation of the section length on the map

Now we divide the route of the cableway to the required number of sections depending on the terrain.
The created new sections are called: section A, section B and section C.

The inclination angle of the section is calculated based on Eq. 1:

$$tg\alpha_X = \frac{h_X}{LX} \text{ [-].} \tag{1}$$

Calculation of the actual length of the section is as (Eq. 2):

$$L\acute{}_x = \frac{L_X}{cos\alpha_X} \text{ [-].} \tag{2}$$

Tab. 1. Given and calculated parameters.

	Horizontal projection of the length of the section L_X [m]	Segment elevation h_x [m]	Inclination angle of section α_x [°]	Actual length of section L'_x
Section A	724	10	0,79	724
Section B	1292	120	5,30	1298
Section C	403	31	4,39	404
Total	2419	-	-	2426

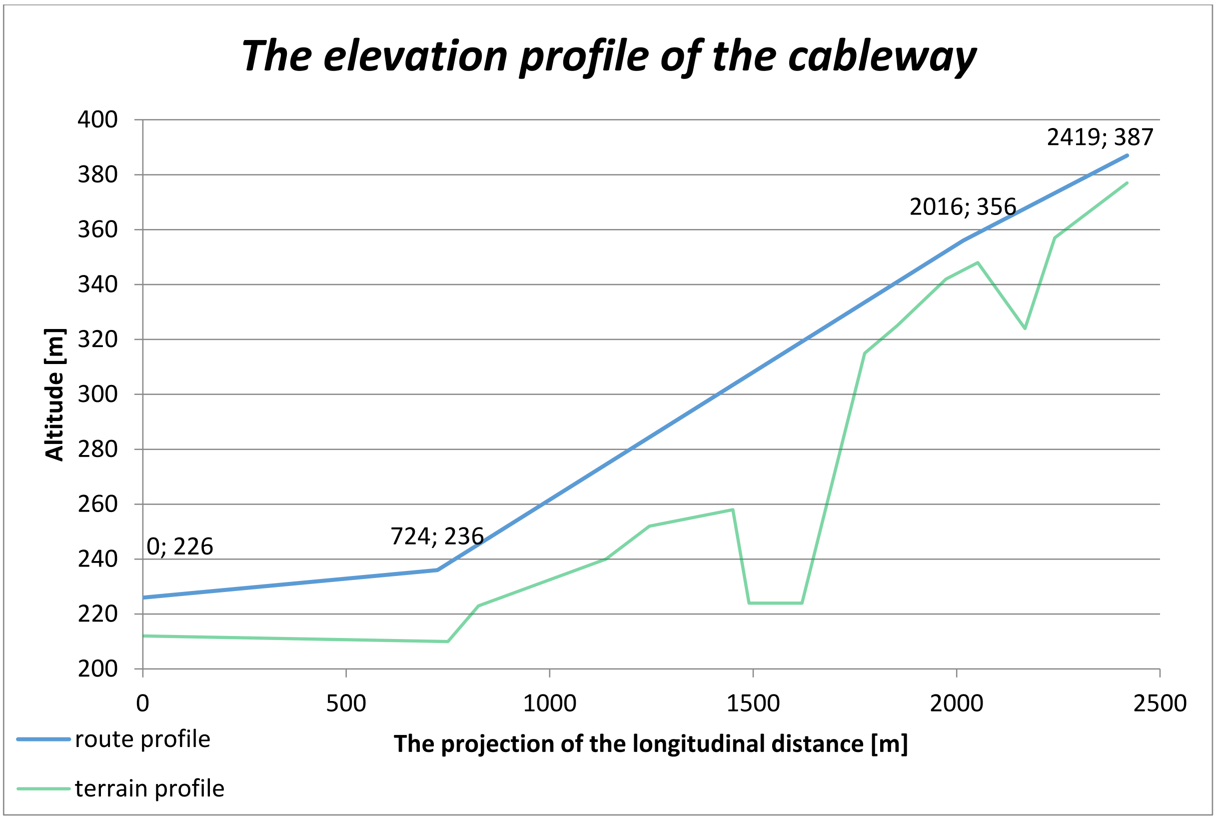

Fig. 1. The elevation profile of the designed suburban passenger cableway.

Capacitive calculations

The hourly transport capacity of the cableway can be determined by the relationship

$$P = 1{,}1\frac{P_C}{T_C} = 1{,}1\frac{1440}{12} = 132\ [t.h^{-1}]. \quad (3)$$

where:

P - is the hourly capacity of the cableway [t.h^{-1}]
P_C - is the required transport amount per day [t.day^{-1}]
T_C - the number of hours of operation of the cable car; 12 [hours]
1,1 - is the coefficient of transport inequality; 1,1 [-]

The operation time, in that case, will be 12 hours during 2 work shifts. The number of people per hour is stated as 1200 people/hour considering the weight of 1 person 100kg. The speed of the cableway according to STN 27 3200 will be 4 m.s^{-1}. According to the same standard, we can choose the next higher cableway performance as P = 160 t.h^{-1}.

The number of cabins that must pass from the lower station to the upper station of the cableway per hour n_v shall be calculated:

$$n_v = \frac{1000.P}{m} = \frac{1000.160}{1000} = 160\ [pcs]. \quad (4)$$

where

m - useful load carrying capacity; 1000 [kg]

The time interval between the cabins is calculated as:

$$t = \frac{3600}{n_v} = \frac{3600}{160} = 22{,}5\ [s]. \quad (5)$$

Distance between cabins on route l is:

$$l = v.t = 4.22{,}5 = 90\ [m]. \quad (6)$$

The calculated distance of the cabins by Eq. 6 is as 90 m.
The number of cabins n_x can be calculated according to Eq. 7

$$n_X = \frac{L'_X}{l}\ [-]. \quad (7)$$

Tab. 2. Calculations on the number of cabins.

	Actual length of section ***L'x*** [m]	**Distance between cabins on route** ***l*** [m]	**Cabin no.** n_x [pcs]
Section A	724	90	8
Section B	1298		15
Section C	404		5
Total	2426	-	28

Calculation of the haul rope

In order to determine the appropriate rope structure and check the safety of the haul rope, we have to calculate:

- a weight suspended on the rope,
- resistances against the movement of cabins – for full cabins side,
- resistances against the sheaves and cable wheels taking into account pull T_{min},
- pull on haul rope and motor power.

The weights weighing on the rope are determined from the results obtained by the calculations above.

For the side of the full cabin

$$m_{pl} = n.(M_v + m) = 28.(635 + 1000) = 45780\ [kg]. \quad (8)$$

where:

n – no. of cabins
M_v – the weight of the empty cabin; 635 [kg] (according to the manufacturer's prospectus)
m – useful load carrying capacity

For the side of the empty cabin

$$m_{pr} = n.M_v = 28 \times 635 = 17780\ [kg]. \quad (9)$$

Calculation of the haul rope

$$m_l = q_l.(2.L'_{A+B+C} + L_Z) = 2{,}8.(2.2426 + 250) = 14285{,}6\ [kg]. \quad (10)$$

where:

q_l - is the nominal weight of the haul rope, [kg.m^{-1}] (choose from 0,5 to 3 kg.m^{-1})
L_Z – backup length of the rope (it is required to wrap the cable wheels in the drive and return station - estimate) [m].
$2.L'_{A+B+C}$ – the actual length of the cableway route for both cabin sides [m].

A static load of the rope Fs:

$$Fs = g.(m_{pl} + m_{pr} + m_l) = 9{,}81.(45780 + 17780 + 14285{,}6).$$
$$Fs = 763665{,}34\ [N]. \quad (11)$$

The calculated cross-section of the rope is calculated from a known equation

$$N = Fs.b = S.R_m\ [N]. \quad (12)$$

so that

$$S = \frac{F.b}{R_m} = \frac{76366.5}{1770} = 215{,}72\ [mm^2]. \tag{13}$$

where:

N - is the load of the rope [N],
F - static load of the rope [N],
S - a nominal cross-section of the rope [mm²],
R_m - tensile strength [N.mm^{-2}],
b - the safety of the rope [-]

where F = 76366 N and is calculated as a 10% from total static load Fs.
(Note: 10% is selected because of the way of a load of the haul rope|
b = 5 by STN 27 3205, article 47
R_m = 1770 N.mm^{-2} by ON 27 3201, article 7, letter b.

Furthermore, according to the CASAR catalogue, we use the rope with the following parameters for our cableway. For the purpose of the suburban passenger cableway, we select the following rope:

Casar Stratoplast M 22 8x26 EPIWRC 1770 B zZ

Cross section of the rope S = 227,5 mm^2
Rope diameter d = 22,0 mm
Nominal weight of the haul rope q_l = 2,01 kg.m^{-1}
Load capacity of the rope N = 402,6 kN

The basic and smallest pull of the haul rope is selected according to ON 27 3202 as follows:
$T_o = T_{min}$ = (600 až 1000).g.q
$T_o = T_{min}$ = 900.9,81.2,01 = 17746,3 N
The weight is 1,81 t.

The following rule applies to the choice of tow rope: ON 27 3201, no. 7., letter b. The rated wire strength is 1570 or 1770 MPa. The rope must always be mutilated and evenly wound.

Resistance against cabin movement

The route of the cableway is divided into sections A, B and C thus for each section we have to calculate the resistance against the movement of the cabins separately.

$$Rv = g.L'\left(\frac{M_{v+m}}{l} + q_l\right)\ (\mu.cos\alpha + sin\alpha)[N]. \tag{14}$$

where:

R_V – is the resistance against cabin movement
μ - coefficient of rolling resistance when riding a cabin on a cable in a closed circuit [-]
g - Earth gravity acceleration [m.s^{-2}]
M_V – the weight of the empty cabin [kg]
m – a mass of people [kg]
q_l – the Nominal weight of the haul rope [kg.m^{-1}]
£ - the slope of the route of the relevant section of the cableway [°]

Calculations for the cabin sides
Full cabin side, direction up
Section A:

$$R_{VA} = g.L_A'\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_A + sin\alpha_A).$$

$$R_{VA} = 9{,}81.724.\left(\frac{635+1000}{90} + 2{,}01\right).(0{,}01.cos0{,}79° + sin0{,}79°). \tag{15}$$

$$R_{VA} = 7102{,}44.\ (20{,}18).(0{,}0238) = 3411{,}19\ [N].$$

Section B:

$$R_{VB} = g.L'_B\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_B - sin\alpha_B).$$

$$R_{VB} = 9{,}81.1298\left(\frac{635+1000}{90} + 2{,}01\right)(0{,}01.cos5{,}3° + sin5{,}3°). \quad (16)$$

RVB = 12733,38 . (20,18).(0,1023) = 26286,97 [N].

Section C:

$$R_{VC} = g.L'_C\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_C + sin\alpha_C).$$

$$R_{VC} = 9{,}81.404\left(\frac{635+1000}{90} + 2{,}01\right)(0{,}01cos4{,}39° + sin4{,}39°). \quad (17)$$

RVC = 3963,24. (20,18).(0,0865) = 6918,11 [N].

Total resistance is as following:

RVplh,A,B,C = RVA + RVB +RVC = 36616,27 [N]. (18)

Full cabin side, direction down

Section A:

$$R_{VA} = g.L_A'\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_A - sin\alpha_A).$$

$$R_{VA} = 9{,}81.724\left(\frac{635+1000}{90} + 2.01\right)(0{,}0045.cos0{,}79° - sin0{,}79°). \quad (19)$$

RVA = 7102,44. (20,18).(-0,009288) = -1331,22 [N].

Section B:

$$R_{VB} = g.L'_B\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_B - sin\alpha_B).$$

$$R_{VB} = 9{,}81.1298\left(\frac{635+1000}{90} + 2{,}01\right)(0{,}0045cos5{,}3° - sin5{,}3°). \quad (20)$$

RVB = 12733,38. (20,18).(-0,0878) = -22561,05 [N].

Section C:

$$R_{VC} = g.L'_C\left(\frac{M_{v+m}}{l} + q_l\right)(\mu.cos\alpha_C - sin\alpha_C).$$

$$R_{VC} = 9{,}81.404\left(\frac{635+1000}{90} + 2{,}01\right)(0{,}0045.cos4{,}39° - sin4{,}39°). \quad (21)$$

RVC = 3963,24.(20,18).(- 0,072) = -5758,43 [N].

Total resistance is as following:

$R_{Vpld,A,B,C} = R_{VA} + R_{VB} + R_{VC} = - 29650{,}7$ *[N].* (22)

Empty cabin side, direction up

Section A:

$$R_{VA} = g.L_A'\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_A + sin\alpha_A).$$

$$R_{VA} = 9{,}81.724\left(\frac{635}{90} + 2{,}01\right)(0{,}01cos0{,}79° + sin0{,}79°). \quad (23)$$

RVA = 7102,44.(9,07).(0,0238) =1533,18 [N].

Section B:

$$R_{VB} = g.L'_B\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_B - sin\alpha_B).$$

$$R_{VB} = 9{,}81.1298\left(\frac{635}{90} + 2{,}01\right)(0{,}01cos5{,}3° + sin5{,}3°). \quad (24)$$

RVB = 12733,38.(9,07).(0,1023) = 11814,81 [N].

Section C:

$$R_{VC} = g.L'_C\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_C + sin\alpha_C).$$

$$R_{VC} = 9{,}81.404\left(\frac{635}{90} + 2{,}01\right)\ (0{,}01cos4{,}39° + sin4{,}39°). \quad (25)$$

$$R_{VC} = 3963{,}24.(9{,}07).(0{,}0865) = 3109{,}38\ [N].$$

Total resistance is as following:

$$R_{VprhA,B,C} = R_{VA} + R_{VB} + R_{VC} = 16457{,}37\ [N]. \quad (26)$$

Empty cabin side, direction down
Section A:

$$R_{VA} = g.L_A'\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_A - sin\alpha_A).$$

$$R_{VA} = 9{,}81.724\left(\frac{635}{90} + 2{,}01\right)\ (0{,}0045os0{,}79° - sin0{,}79°). \quad (27)$$

$$R_{VA} = 7102{,}44.(9{,}07).(-0{,}009288) = -598{,}32\ [N].$$

Section B:

$$R_{VB} = g.L'_B\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_B + sin\alpha_B).$$

$$R_{VB} = 9{,}81.1298\left(\frac{635}{90} + 2{,}01\right)\ (0{,}0045cos5{,}3° - sin5{,}3°). \quad (28)$$

$$R_{VB} = 12733{,}38.\ (9{,}07).(-0{,}0878) = -10140{,}18\ [N].$$

Section C:

$$R_{VC} = g.L'_C\left(\frac{M_v}{l} + q_l\right)(\mu.cos\alpha_C - sin\alpha_C).$$

$$R_{VC} = 9{,}81.404\left(\frac{635}{90} + 2{,}01\right)\ (0{,}0045cos4{,}39° - sin4{,}39°). \quad (29)$$

$$R_{VC} = 3963{,}24.\ (9{,}07)\ .\ (-0{,}072) = -2588{,}15\ [N].$$

Total resistance is as following:

$$R_{VprdA,B,C} = R_{VA} + R_{VB} + R_{VC} = -\ 13326{,}65\ [N]. \quad (30)$$

In order to calculate force on the drum F_{ob} and the engine power, we have to select the most unfavorable case, i.e. movement of full cabins up and empty cabins down. The formula to calculate force on the drum will be:

$$F_{ob} = R_{Vplh,A,B,C} + R_{Vprd,A,B,C} = 36616{,}27 - 13326{,}65 = 23289{,}62\ [N]. \quad (31)$$

Drive power of the estimated transmission efficiency η = 70% is calculated as:

$$P = \frac{F_{ob}.v}{1000.0{,}7} = \frac{23289{,}62.4}{1000.0{,}7} = 133{,}08\ [kW]. \quad (32)$$

Based on the calculations, the Siemens engine type 1LG4313-4IMV1 with a power of 152kW and 400V supply is selected from the catalogue.

Results discussion

Design of the use of a personal cableway in tourism

From the ropeway, there will be only supports on which new roller batteries will be installed. On supports, it will need to perform NDT tests to determine their status and then perform maintenance. The boarding station can be located in the Anička area, next to the beach swimming pool Ryba, which would help the development of suburban tourism.

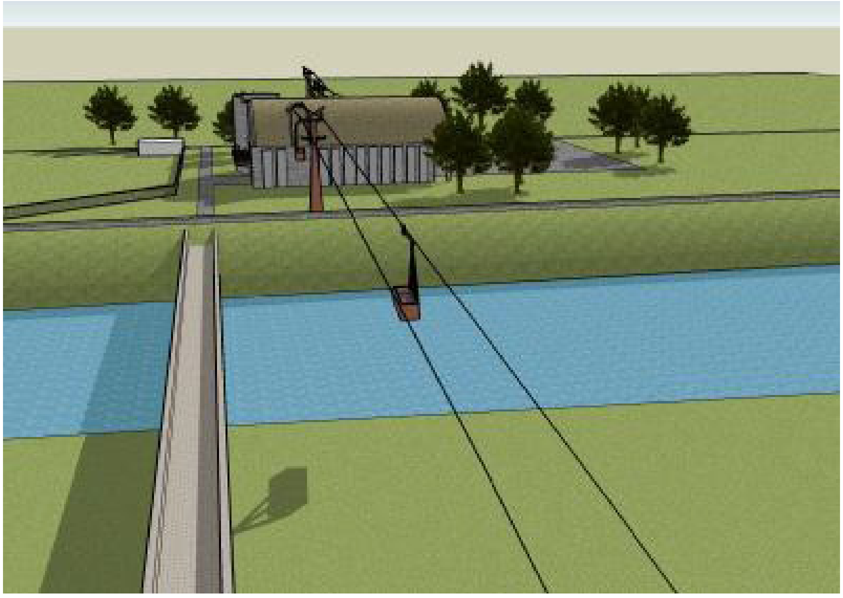

Fig. 2. View of the planned cableway and the Anička station (Balog et al.,2010).

Parking cars can be on land between Anička and route II. the class of Košice - Kysak, under the Podhradová settlement. At the boarding station, a return and tensioning system of the cableway can be placed, and at the same time, a museum devoted to the history of mining and freight cable transport of raw materials in Košice. The exit station of the cableway will be in the area of the amphitheatre, on the mine of Bankov in the places of the former building station and the hopper. The exit station can be a cableway drive, a restaurant, and a garage carriageway. The station can be directly connected to the building of the amphitheatre. In the building of the exit station, there could also be the start-up station of the cableway at the Kamenný Hrb in the future. (respectively Alpínka). A new cableway to the Jahodná through the Kamenný Hrb will be connected to the reconstructed cableway (resp. Alpínka), where it will be necessary to build a station to continue the cableway towards Jahodná and towards Alpínka and Kavečany – Hrešná. Presumed transport capacity of the individual cableway to the Alpínka and the cableway to the zoo in Kavečany will be around 1200 persons/hour and a cableway to Kamenný hrb – Jahodná around 600 persons/hour. Based on statistical data, it is reported that Bankov would visit 340,000 tourists each year, Jahodná 100 000 tourists and Kavečany (ZOO and Hrešná) 180 000 tourists.

From the market offer, one can choose the Sigmacabins, which meets the requirements of modern cable systems. Reliability and comfort of these cabs were appreciated by passengers in New York (USA), Rio de Janeiro (Brazil) and Medellin (Colombia) (Sotomayor, 2013). It is adapted to mountain conditions, but also to urban conditions as well as fun parks. Cabs provide a "standard" level of comfort with a wide opening of the doors. The cabin has glass plates and offers a nice view of the countryside.

Proposal to integrate a personal cableway into integrated urban mobility

City outbuildings in Košice are currently expanding beyond the city centre to its periphery, which also changes user needs. Residents demand a new culture of urban mobility. Meeting these needs together with the need to increase the share of green public passenger transport requires a fundamental change in order to provide traffic closer to the sources and the destination of the roads. By using the route of the former mining cableway, a new conveyor system of the suburban cable car would be created. This system could be integrated into the integrated transport system of the city of Košice.

The basic principles of the Kosice integrated transport system are based on the use of the transport capacities of all types of public passenger transport (train, bus, urban) within the common transport system - integrated. Figure 3 shows the design of an integrated transport system in Košice (Šarák, 2011).

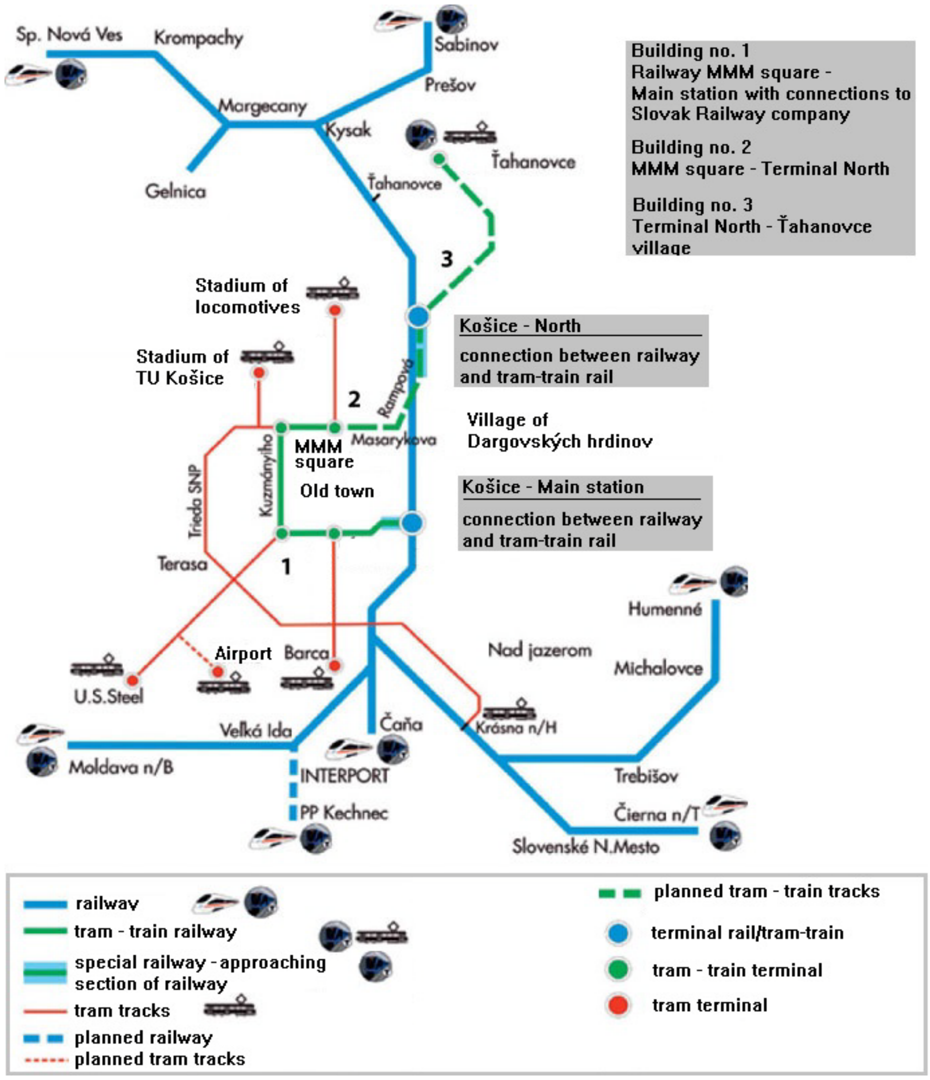

Fig. 3. The integrated transport system in the city of Košice.

The planned cableway for tourism will be able to connect other cableways in the Anička area, for example, from the settlement Furča and Bankov locality from the settlement KVP. These cableways could also serve as a means of public transport. At the same time, there is the possibility to integrate this transport system into the integrated transport system Košice in Terminal Sever-Ťahanovce (Figure 4).

Fig. 4. Terminál Sever- Ťahanovce (Šarak, 2011).

Terminal Sever – the settlement of Ťahanovce, is referred to as the Construction in the framework of the technical and technological solution of the construction of the Integrated system of Košice designated as Building 3 and budget costs amount to 31.4 million euros. The construction will be included in the OPD planning period 2014 – 2020. The track is to lead direct rail traffic from the city centre to the Ťahanovce settlement with 23,000 inhabitants. The tram-train system should also be used to directly connect the settlement with the US Steel and Kechnec industrial centres and the regions. The track is new construction of a double-track line with a length of 2.80 km and follows the building no. 2 (Terminal Sever – Peace Marathon Square (Košice Old Town)). The first part of the new building, 1.3 km long, is located on a separate building. The Section at the Ťahanovce settlement runs in the separate middle class of the American Class. The track will use tram-trains and trams, and five stops will be placed on it. Interestingly, the track will be 317 m long after the estacade. The ongoing process of project preparation for three buildings and their financing from the OPD gives the assumption that the planned objectives can be realised. It is very important to secure the necessary funds in the current OPD relocation process and to set up the OPD 2014-2020 (Šarak, 2011).

Conclusion

The city's overall transport strategy includes a proposal for the principles of transport subsystems in line with the overall transport strategy and sustainable mobility principles. The visions and objectives of the transport development and transport infrastructure of the city of Košice are aimed at reorganising transport and adding infrastructure for walking, cycling, mass and individual car transport. On the basis of the outputs from the analytical part, a proposal for the overall transport strategy of the city was prepared for the target period of 2030 with the stages 2020 and 2025, and also with a view to 2040. The development of transport from the point of view of the current territorial development of the city, focusing on the tasks of the new territorial plan of the city of Košice, characterises the authors Iglódy and Kolesárová (Iglódy and Kolesárová, 2015). The new territorial plan should be approved in 2017, and valid should be at least until 2040. In this proposal, sports and recreation are being proposed at the Anička and Allsport Area; a new idea is the placement of sports and recreational functions in Bankov area, which seems to be appropriate considering the location in relation to the city and the forest park. The proposed city cableway could also have an end station in the existing loading station of the suspended cableway in mine Bankov area.

Obtaining financial resources for the construction of the city lane would be possible from the Operational Program Integrated Infrastructure, in which more than $ 320 million is earmarked to support public transport itself in cities or from the Integrated Regional Operational Program to support bus transport, integrated transport, non-motorized transport and so- soft measures (on non-motorized transport, including cableway transport, is allocated 24 million €) (Dekánek, 2015).

The integration of the city cableway into the public transport system in Košice would make it possible for public transport to make an attractive choice and part of a lifestyle. Taking advantage of the current heavy-duty cableway would not only make it easier to improve urban mobility, but also a more efficient use of the recreational potential of the territory and the development of tourism in Košice. This activity will increase the share not only in income growth but also in total employment in the region.

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