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Modern Cableways – The Base of Mountain Sports Tourism

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1. Introduction

Most of the population nowadays lives and works in surroundings that not always healthy and clean. Therefore, the need to take a rest in clean natural environment is so much greater. Mountain regions feature the largest surface of clean natural environment where people go for a holiday. These places are accessible by a road, cableway and via footpaths and cyclist paths. Trends nowadays are active holidays that are offered by mountain sports centres during winter and summer. (Rauzi, 2008) In winter time main activities are alpine skiing, cross-country skiing, sleighing, skating and others performed in natural environment. In summer time, main activities are mountaineering, mountain tracking, cycling and others. Cableways are mostly used by skiers with bigger demands than in the past, this results in greater disturbance of natural environment. Parking places are a special problem. Locations of parking places mostly depend on accessible cableways. In economical and ecological point of view, a difference exists in whether parking places are located at the foothills of the mountain or in hilly or woody areas.

Cableway companies involved in the transport of passengers in mountain areas realize most traffic during the winter months, when passengers are mainly skiers. Ever cableway company tends to offer best quality service and long queues of skiers waiting in front of slow cableways may have very negative influence on the quality of service of mountain tourist centres. The problem of the skiers queuing in front of slow cableways may be solved by limiting the number of sold skier's tickets, but this does not mean the skiers in a major ski centre with several cableways would be uniformly distributed per cableways. Similarly, by selling seasonal ski tickets it would be impossible to determine which would be the peak days, i.e. on which days there would be fewer skiers on the ski slopes.

Most frequently, the problem of queuing skiers at cableways is solved by installing faster cableways with greater capacities, i.e. introducing chairlifts with detachable grips into service. These make possible to detach the chairs in the starting and final station from the carrying-hauling rope, thus providing comfortable loading and unloading. Modern chairlifts with detachable grips enable faster carriage of passengers. They have the possibility of transporting more passengers over the same distances. However, this one-sided solution, the replacement of an older chairlift with fixed grips by the new chairlift with detachable grips can lead also to some unexpected consequences that may have a

negative impact regarding the quality of the entire service of the mountain tourist centre. Such chairlifts with detachable grips allow transport of skiers over greater distances and therefore must have respective ski slopes covering wider areas which in turn affect the expansion of the mountain tourist centres. The cableways with detachable grips require more knowledge and personnel to manage and maintain them.

For safety skiing a skier needs an indispensable ski run area. It depends on different factors, and the most important among them is the skier's speed. Skiing techniques are being changed, and along with them the values for the ski run area a skier needs it for safety skiing. And the ski run capacity also depends on these values. The skies shape and material are being improved, likewise the technique, as well as the ski runs stamping down technique. This enables skiers to achieve higher and higher speeds on ski runs. Thus the thread to all the skiers who ski on ski runs is increased. Injuries due to falls and skiers collisions with others are worse, and this problem is also pointed out by a fatal casualty on the ski runs which happened during this season. During greater visit days (weekends and holidays with snow and nice weather) the ski runs are much more crowded. Thus, it may happen that skiers do not have the safety skiing required area – the ski run capacity is too small.

2. Characteristics of cableway traffic and cooperation or competitiveness with road traffic

Being a subsystem of the traffic system, cableway traffic holds a specific place because it makes accessible those places that are interesting from the aspect of tourism as well as those that due to the specific relief are difficult to access via other traffic subsystems. (Sever, 2002) Cableway traffic is carried out with cableways which encompass all aerial ropeway facilities. With respect to function and legislation, cableways encompass aerial ropeways, surface lifts and funicular railways. Aerial ropeways include reversible aerial ropeways, gondola lifts and chair lifts. (Težak et al., 2011)

Cableway traffic in Slovenia and abroad is characterized by increasing capacities of cableways (especially higher speed which is possible by detachable grips). Carriers of circulating aerial ropeways attain higher speeds on their route (higher rope speeds) and lower speeds at station facilities (boarding and alighting) because they are detached from the rope. (Toš, 1989) High performance aerial cableways can transport 3000 persons/hour and more at the distance of some kilometres and can surmount the vertical drop of 2000 m and more. Cableway traffic is one of the safest and environment-friendly (Oplatka, 2008). Because the possibility of human error is low, the safety is high. In most cases, cableways are driven by an electric motor which is characterized by minimal noise and no hazardous emissions of exhaust gasses.

To access individual mountain sports tourist centres there are generally two possible alternatives. We can build an access road or an access cableway. In Slovenia there is often a combination of the two traffic systems, as in most cases the access to the centre is possible via a road and a ropeway. In practice dilemmas occur as to which facility should have priority, i. e. a reconstruction of the access road or that of the access ropeway. The bellow comparison table illustrates possible advantages of the one or the other system.

	Road traffic System	Cableway traffic system	Notes
Capacity (performance?)	Higher		Due to new technical solutions capacities of cableways increase.
Use of space (natural environment)		lower	Cableways can surmount greater vertical drops, therefore the route is shorter.
Noise		lower	Noise depends on the technological development of road vehicles and on structure of the pavement.
Emissions of exhaust gases		lower	Emissions depend on technological development of road vehicles.
Time of transport		shorter	
Parking lots	Exist	located at the foothill	If there is an access cableway, parking lots can be located at the foothills of the mountain and interfere less with the environment.
Influence of weather snow, ice wind			Road traffic is extremely influenced by snow and ice. Cableways can not operate in windy conditions
Maintenance			Necessary in both systems
Safety		greater	
Comfort			Depends from the point of view: - in transport with a cableway acceleration and deceleration are slower - in transport with a car, there is no need to reload luggage
Length of transport		shorter	
Investments	Lower		The reconstruction of a gondola lift is considered here. The price of the reconstruction of a chair lift with fixed grips is approximately equal.
Transport price	Lower		This is the price paid by the user.
Investments	Lower		
Functional support to local inhabitants	Higher		

Table 1. Comparison of possible advantages of the road and cableway traffic system in assuring access (subjective assessment)

It is evident from Table 1 that crucial criteria for decisions depend on individual judgement. Yet, if we consider important ecological criteria, cableways have the advantage over roads. They are more appropriate due to less noise, lower emissions of exhaust gases, less space requirements and favourable locations of parking lots. They are, however, less comfortable for the user, as he/she has to change twice; a ride in a car is more comfortable.

In the past, the priority was given to road access to sports centres in Slovenia. Access cableways were built only in regions where road access was not possible (Kanin, Vogel, Velika planina) or the costs for the erection of a quality access road would be excessive. An

exception to the rule was the Pohorje aerial ropeway at the Maribor Pohorje, with additional road going to the upper cableway station.

With the development of the snowmaking machines technology ski trails started to be built on lower slopes towards the valley. In these cases, the cableway does not have the function of access only, but also the function of the transport of skiers. Although the costs for the erection of a new cableway facility are higher than those for the reconstruction of an access road, the economic calculation speaks for cableways also in this case. Such an example can be seen in the sports centre Rog Črmošnice, where a decision was made to build a chairlift and a ski trail to the foothills of the mountain with necessary parking places also being located there. There is a macadam road going to the upper station which has not been reconstructed yet. The same situation can be observed in the sports centre Stari Vrh.

Decision making about whether to reconstruct the access road or to erect a new cableway facility going to the foothills of a mountain is influenced also by the largeness of a sports centre and density of permanent population in the vicinity of a sports centre. An asphalt two-lane access road to a big ski centre costs as much as a road to a small ski centre. A cableway facility of high performance (circulating gondola lift with detachable grips) on the other hand can cost three times as much as a cableway facility with low performance (two-chair lift with fixed grips). Where there are numerous inhabited villages around the ski centre, this road has also a social function enabling access for local inhabitants.

3. Modern chairlifts with detachable grips

Chairlifts cableways are devices in which chairs are fixed to the carrying-hauling rope, travelling in the same direction. At the beginning of the appearance of chairlifts, the chairs were fixed to carrying-hauling rope. The possibility of fast transport of skiers in such chairlifts is low, since the maximum speed is limited (2 m/s for passengers - pedestrians or 2,5 m/s for skiers) due to the method of entering the cableway, since the passenger has to sit on a chair which is moving at the speed of the carrying-hauling rope.

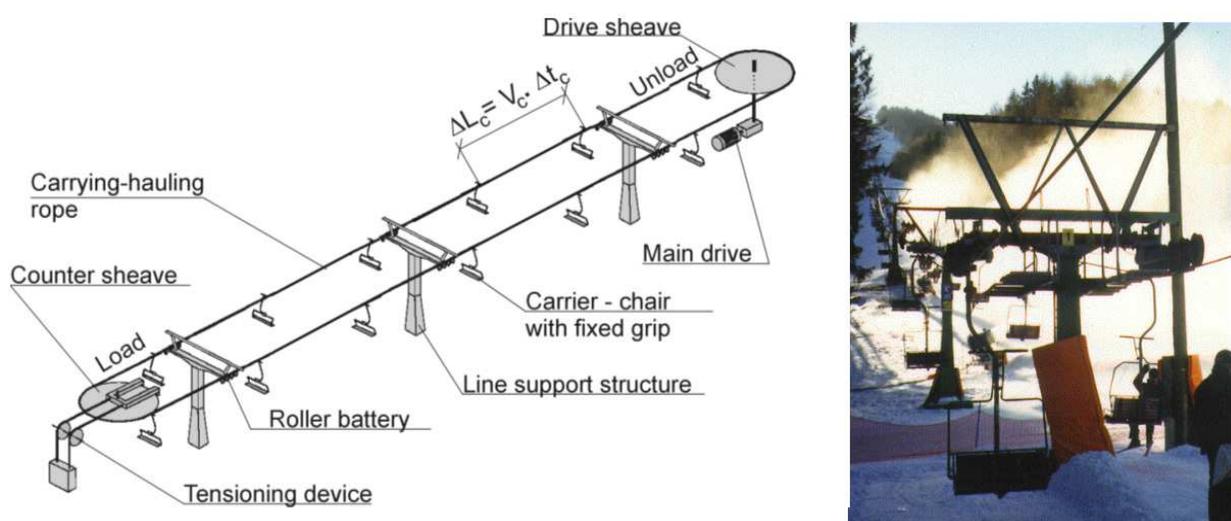


Fig. 1. Chairlift with fixed grips (Günthner, 1999)

The appearance of detachable grips on the chairlifts has made it possible to reduce the speed at loading and unloading of passengers. This facilitates greater comfort, since the passenger

can sit on a chair that at loading or unloading moves at very low speed (max 1m/s for passengers – pedestrians or max 1,3 m/s for skiers) (EN 12929-1, 2005). The possibility of fast transport of passengers in this example, because the speed of the carrying-hauling rope is higher (5 m/s). (Günter, 1999)

The mentioned advantages result from the possibility of detaching the grips of the carrier at the station from the carrying-hauling rope, which allows the chair at the station to move at a lower speed by means of the conveyor.

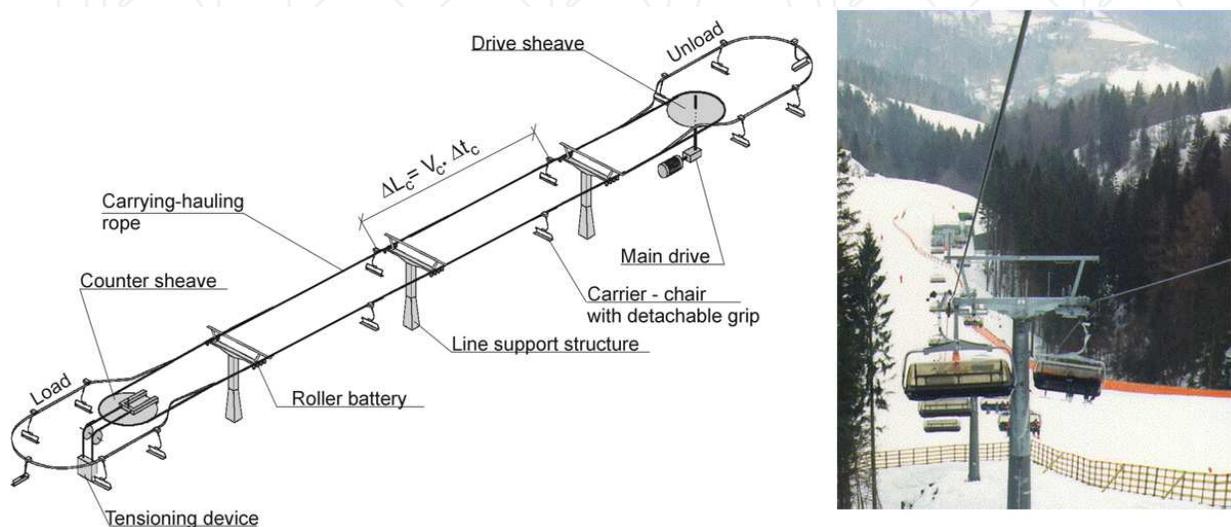


Fig. 2. Chairlift with detachable grips

The detaching of the chairs is provided by the detachable grips and all the other mechanical and electric equipment at the station.

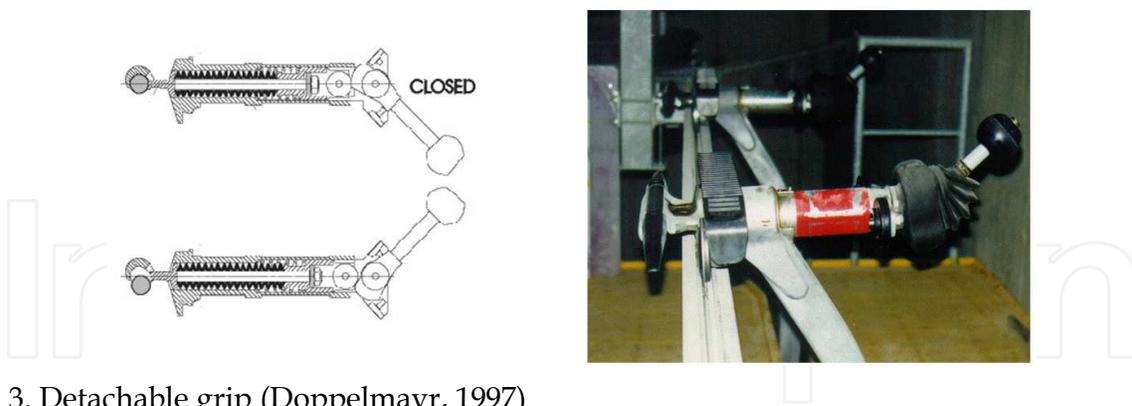
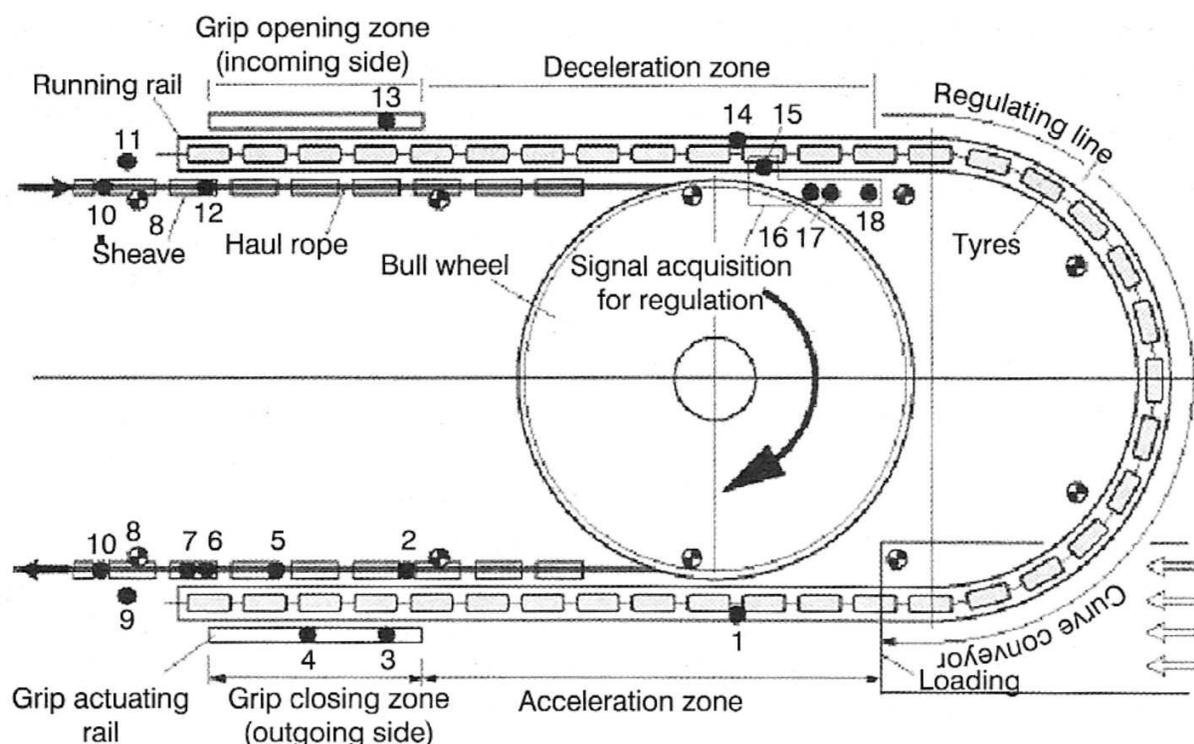


Fig. 3. Detachable grip (Doppelmayer, 1997)

In case cableways with detachable grips various procedures are performed in different zones at the station (Fig. 4):

- *Grip opening zone:* when the carrier (cabin or chair) arrive at the station, it is detached from the rope in the grip opening zone. The carrier reaches the running rail, actuating then the signal for opening the grip and detaching from rope. Thus the carrier can move independently of the rope speed.
- *Deceleration zone:* when the grip is open and lies with its bottom surface on the sheaves and lies with its bottom surface on the sheaves which lie along the running rail guides

- the carrier through the station. The braking force is transferred by means of the sheaves and the friction to grip which causes the carrier to decelerate.
- *Regulating line:* regulating line maintains the necessary spacing between the carriers. The more recent cableways have in this section a detached conveyor with its own propulsion
 - *Curve conveyor:* in this zone the carrier moves at the transit speed, which is much lower than the speed of the ropes through the station. The curve direction of the carriers is determined by the conveyor. The carriers move by means of a conveyor. In this zone the carrier is loaded.
 - *Accelerating zone:* when the carriers are loaded with passengers they reach the accelerating zone. The grip is still open, the accelerating force is transferred over the sheaves to the bottom friction surface of the grip. The speed of the carrier increases up to the speed of the carrying-hauling rope.
 - *Grip closing zone:* in this zone the grip closes onto the carrying-hauling rope. Before the carrier leaves the station the closure of the grip in the rope is controlled.



- | | | |
|--------------------------------------|---------------------------------------|--|
| 1 GRIP OPEN monitor | 8 Spacing monitor | 15 Reference chair detector |
| 2 Rope position monitor (horizontal) | 9 GRIP NOT CLOSED switch | 16 Space measurement (detects deviations for regulation) |
| 3 GRIP NOT OPEN switch for reverse | 10 Rope position monitor | 17 Regulating line switch |
| 4 Grip force tester | 11 GRIP NOT CLOSED switch for reverse | 18 Regulating counter |
| 5 Rope position monitor (vertical) | 12 Geometrical gauge for reverse | ⊕ Anti-collision sensors |
| 6 Geometric gauge | 13 GRIP NOT OPEN switch | |
| 7 Chair catcher (CH) | 14 GRIP OPEN monitor for reverse | |

Fig. 4. Mechanical equipment and safety devices in station of cableway with detachable grips (Doppelmayer, 1997)

For proper functioning of all described procedures safety devices and signalling devices are necessary and they control all the described procedures. Should these devices register a malfunctioning, they have to alarm the workers or automatically stop the cableway.

4. Reconstruction of chairlift and influence on the quality of mountain tourist centre offer

Recently new cableways are constructed most frequently as 4-seat chairlifts or 6-seat chairlifts with detachable grips or chairlifts with fixed grips and conveyor belt for skiers at the entrance. These cableways can be installed as new construction with new accompanying ski slope or as reconstruction i.e. change of the old chairlift into a new one. Most often the new chairlift is installed on the tracks of the existing one – as reconstruction and the existing ski slopes are used, since in this case the installation of the chairlift does not represent such a great intervention into the nature. This may be a wrong way of thinking since the more recent chairlifts also feature higher speeds and higher capacities, which may disturb the balance in the capacity between the cableway and the ski slope.

This balance is very important for the quality of service, which can be seen from the following:

- chairlift capacity (persons/h) = ski slope capacity (skiers/h): no queues in front of the chairlift and the ski slope is not overcrowded,
- chairlift capacity (persons/h) < ski slope capacity (skiers/h): queues in front of the chairlift in case of greater number of skiers and ski slope is not maximally loaded,
- chairlift capacity (persons/h) > ski slope capacity (skiers/h): in this case there are too many skiers on the ski slope and the skiing safety is reduced.

The following example shows the influence of the special characteristic of the chairlift type on the respective ski slope, which is in any case the same. These examples show a case of reconstruction i.e. replacement of the old chairlift by a new one.

Example: The ski centre has 2-seat chairlift with fixed grips in the length of 1,2 km and one ski slope in the length of 1,2 km, which can accommodate at a time a maximum of 200 mid-skilled skiers.

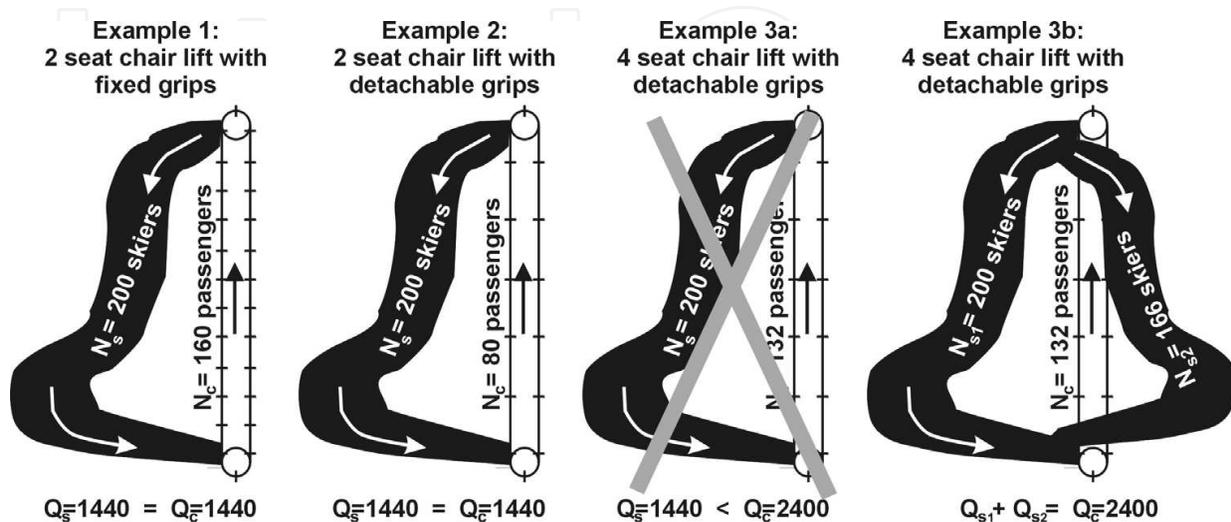


Fig. 5. Example of installing three different chairlifts along the same ski slope

Type of data	Symbol and equation for calculation	Existing 2-seat chairlift with fixed grips	New 2-seat chairlift with detachable grips	New 4-seat chairlift with detachable grips
Number of seats on carrier	n	2	2	4
Chairlift length	L_C	1000 m	1000 m	1000 m
Max. allowed chairlift speed	V_C	2,5 m/s	5 m/s	5 m/s
Minimum interval between the carriers	$\Delta t_C = 4 + \frac{n}{2}$	5 s	5 s	6 s
Distance between carriers attached to the carrying-hauling rope (Fig.1, Fig.2)	$\Delta L_C = \Delta t_C \cdot V_C$	12,5 m	25 m	30 m
Chairlift capacity	$Q_C = \frac{n}{\Delta t_C} \cdot 3600$	1440 persons/h	1440 persons/h	2400 persons /h
Number of skiers who are carried by the chairlift	$n_C = \frac{L_C}{\Delta L_C} \cdot n$	160 persons	80 persons	132 persons
Ski slope length	L_S	1200 m	Ski slope is in all cases the same $L_S=1200$ m $n_S=200$ $V_S=2,4$ m/s $\Delta t_S = 2,5$ s $Q_S=1440$ persons/h	
Max. number of skiers on ski slope	n_S	max. 200		
Ski slope capacity (it balanced it equals the cableway capacity)	$Q_S = Q_C$	1440 persons /h		
Average interval between the skiers on the ski slope	$\Delta t_S = \frac{3600}{Q_S}$	2,5 s		
Average speed of the skiers on ski slope (including stops)	$V_S = \frac{L_S \cdot \Delta t_S}{n_S}$	2,4 m/s		
Number of skiers on ski slope and chairlift	$n_C + n_S$	360 persons	280 persons	332 persons
Number of downhill runs per hour of one skier per ski slope	$n_{HS} = \frac{3600}{\frac{L_S}{V_S} + \frac{L_C}{V_C}}$	4 downhill runs/h	5,14 downhill runs/h	5,14 downhill runs/h
Occupancy of chairlift at 100% occupancy of ski slope	$\eta_C = \frac{\Delta t_C}{n \cdot \Delta t_S} \cdot 100$	100%	100%	60%
Occupancy of ski slope at 100% occupancy of chairlift	$\eta_S = \frac{n \cdot \Delta t_S}{\Delta t_C} \cdot 100$	100%	100%	166,6%
Ski centre capacity if additional ski slope is set	$n_C + n_S \cdot \eta_S$			465

Table 2. Calculation of data for different types of chairlifts that relate to the same ski slope

The capacities of the cableways and ski slopes are the same which means that the chairlift supplies precisely the chairlift with detachable grips can be performed with no additional problems. If there are no queues at the chairlift, the skiers have the possibility of skiing more. The total capacity of the ski centre is reduced, since there are fewer skiers at the same time on the chairlift. This would reduce the number of sold ski tickets, so that in practice the 2-seat chairlift with detachable grips are not used. In case of constructing a 4-seat chairlift with detachable grips one can see that both the speed and the capacity of the this cableway are much higher. Therefore, if this cableway were constructed the capacity of the existing ski slope would be exceeded by 66 percent, which would be very risky for the skiing safety on this slope. The problem can be solved by expanding the existnig ski slope or by constructing an additional ski slope along the newly constructed chairlift (figure 5, example 3b)

5. Influence of chairlift with detachable grips on the expansion of mountain tourist centres

Chairlifts are cableways with open chairs and therefore the passengers are more exposed to weather elements, wind, rain and frost. The transport of passengers is time-limited to 10 minutes (600 s). Maximum speed of the chairlift with detachable grips is 5 m/s. It is higher than the speed of chairlift with fixed grips (2,5 m/s for two-seat chairlift if the passengers are with skiing equipment), and therefore the length of the line of the chairlift with detachable grips is greater.

Maximum length of the chairlift:

- for the chairlift with detachable grips:

$$L_{C_{max2}} = t_{max} \cdot V_{C1} = 600 \text{ s} \cdot 5 \text{ m/s} = 3000 \text{ m}$$

- for the chairlift with fixed grips:

$$L_{C_{max2}} = t_{max} \cdot V_{C2} = 600 \text{ s} \cdot 2,5 \text{ m/s} = 1500 \text{ m}$$

Based on these results one can conclude that modern chairlifts enable reaching greater lengths and therefore the skiers have better possibilities for skiing. For better skiers this possibility is necessary, since this is made possible by the latest skiing equipment, preparation of ski slopes and compact snow. The skiers` speed are higher, the average speed being 45 km/h and $V_{85} = 59 \text{ km/h}$. (Lipičnik&Sever, 2000)

Considered from the aspect of economy, the construction of the longer cableway is certainly more economical, since the most expensive cableway assemblies are precisely at stations where the most of the mechanical and electrical equipment is concentrated. The investments costs per km also lower in case of longer cableways.

By constructing several chairlifts with detachable grips allows the mountain tourist centre to cover larger areas (Figure 6). In this way the quality of offer is increased, since they can offer more kilometres of ski slopes and the skiers can ski longer, wasting less time on the cableway ride. However, such expansion would also mean greater intervening with the environment in which the mountain tourist centres are located.

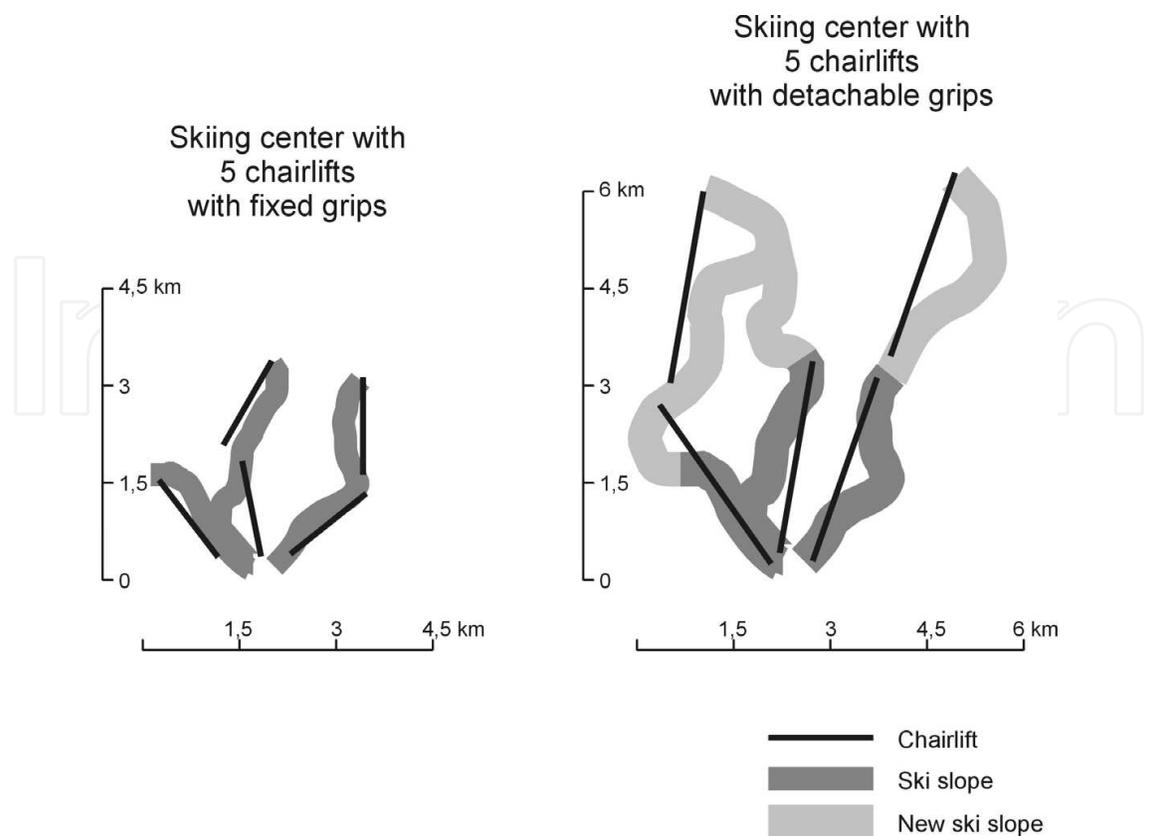


Fig. 6. Occupancy of the mountain tourist centre area by chairlifts with fixed grips and chairlifts with detachable grips (Težak et al., 2005)

6. Modern cableways as an important support to skiing

In mass transport, cableways have mostly the function of a support to skiers. Demands in skiing sports have greatly changed in the last few years. Due to better skiing techniques, skiing equipment, artificial snow and new technology for preparing ski trails, the speed of skiing has greatly increased. Average skiing speeds are above 40 km/h, while speeds up to 70 km/h are quite normal. (Toplak, 2000; Renčelj, 2000). The increase of speeds resulted in higher skier's demands. They can cover large distances per a day, therefore the transport with cableways must be as fast and as time-efficient as possible.

Cableways, too, have greatly developed. The application of detachable grips on chair lifts has greatly enhanced the efficiency, as transport speeds have increased from 2.5 m/s to 5 m/s. A modern four-chair lift has thus four times higher capacity than older two-chair lifts. The transport time for skiers taking a chair-lift is very short.

In the past, ski trails were designed for lower skiing speeds and slower cableways sufficiently handled transport. Now that skiing speeds are higher, it is desirable that a new faster cableway (higher capacity) is built along the skiing area to give skiers support of high quality.

In skiing, however, every skier needs a certain skiing surface so as to be undisturbed and safe when skiing. How many m² of the terrain are needed per a skier depends especially on his/her speed. Austrian guidelines from the year 1978 (Österreichisches Seilbahnkonzept,

1978) define the average surface of the terrain per a skier for safe skiing in dependence on skiing speeds. The figures are evident from the bellow table and diagram (fig. 7).

Sort of skiers	Speed of skiers (km/h)	Necessary area of ski slope (m ²) per skier
Beginners		226
Average skiers (1. level)	12,3	226
Average skiers (2. level)	17	332
Average skiers (3. level)	21,5	520
Good skiers	25,9	1174
Very good skiers	33,6	2000

Table 3. Types of skiers, their speed and necessary skiing surface per one skier for safe skiing (Österreichisches Seilbahnkonzept, 1978)

In 2000, speeds of skiers were measured by the team of the Faculty of Civil Engineering (Lipičnik&Sever, 2000) who found out that the average skiing speed was 45.3 km/h (V85 = 59.75 km/h), which is much more than speeds established by Austrian guidelines from 1978. It is evident from the diagram that the surface needed per a skier increases with his/her skiing speed. This interdependence is shown with a polynomial function of the second order (regression function).

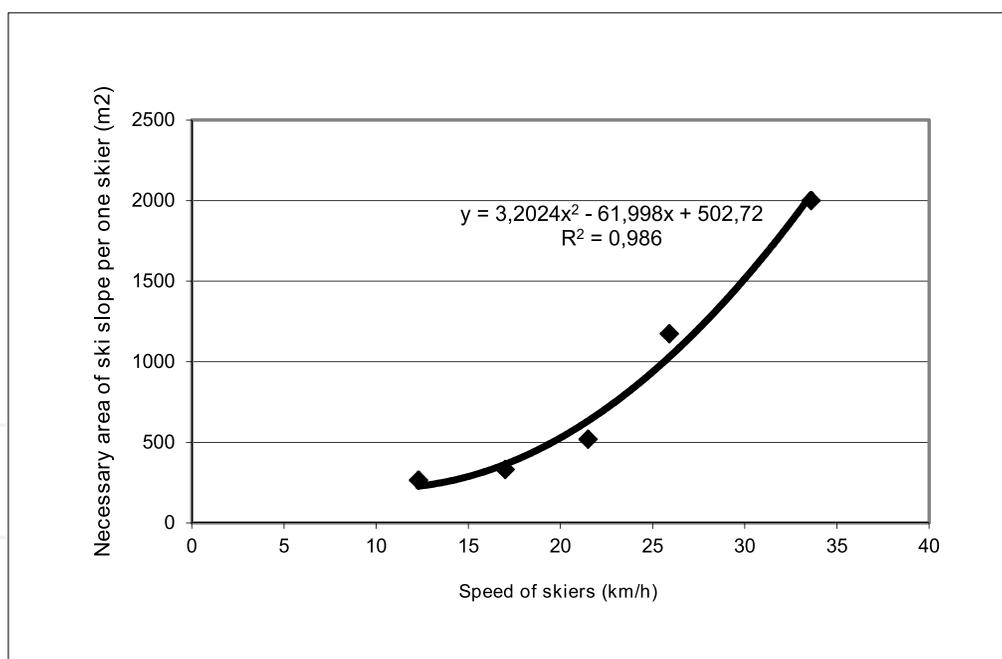


Fig. 7. Necessary area of ski slope per one skier (table 3)

It is evident from the diagram that a skier needs about 300 m² at the speed of 15 km/h for safe skiing, while this number increases to 1500 m² at the speed of 30 km/h, which is 5 times more. These findings are valid up to the speed of 35 km/h, which is low for skiers of today. We still do not know the amount of surface needed per a skier at speeds of 45 km/h or 60 km/h. (Težak, 2002)

We can conclude from what was said above that in the case of a reconstruction or replacement of an old cableway with a new, modern and faster one an additional ski trail must be prepared for safe skiing. The preparation of a new ski trail, however, greatly disturbs the environment because it requires cutting down forests and mining of rocky regions.

From a non-ecological point of view it must be pointed out, however, that the Slovenian countryside is getting overgrown with forests. Additional grassy areas for ski trails will thus keep the balance. Outside the skiing season, grassy areas also offer fine possibilities for natural pasture of cattle, which is nowadays of great importance. (Težak, 2009)

7. Proposals to control ski runs with an objective to prevent ski runs overcharging

The ski run capacity should be adjusted to the belonging cable device capacity (persons/hour). By reconstruction of the cable device the capacity of this device is most often increased, while the ski run capacity is forgotten, and beside this newer device a new ski run is not constructed. In this case, during a greater visit day the cable devices “supply” more skiers than ski runs can accept (sources are greater than sinks). In this case there are no lines in front of cable devices, but safety on ski runs is threatened.

The ski run whereupon a skier is skiing offers ideal options to analyse the picture, as the grounding of the photograph is white, and there is a skier who is usually of a darker colour and represents a “stain” on the white grounding (Fig.8). On the basis of this picture analysis (Lep&Težak, 2008), and by means of a computer, we can define parameters which are of essential importance to calculate the ski run capacity.

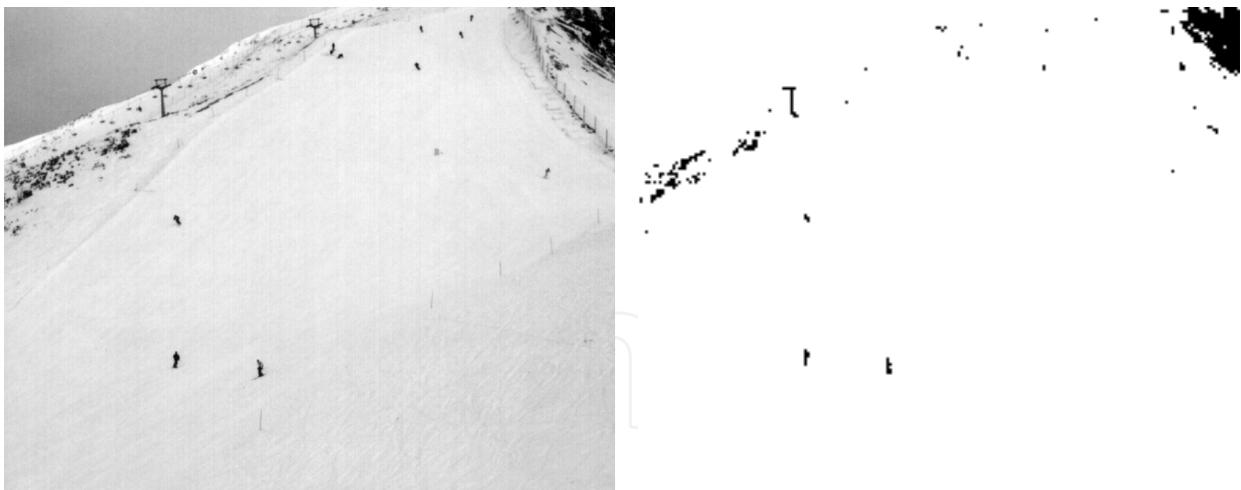


Fig. 8. Picture (left) and black&white raster image (right) of the ski run

7.1 Static visual-computer system to determine the ski run occupation

This system requires a digital camera, a computer with the programme to analyse raster images, and a warning system for skiers. The number of skiers who can safely ski on a certain ski run can be calculated according to the aforesaid method provided the skiers pertaining to sport is evaluated from experience. By means of the ski run photograph, and by its computer analysis (an empty ski run image comparison with the picture being

analysed) the number of skiers on the ski run can be established. When this number is greater than the calculated ski run capacity, it means that the ski run is satiated.

7.2 Dynamic visual-computer system to determine the ski run occupation

This system works similarly as the static one. To analyse the ski run picture whereon there is a skier, the computer detects the skier and calculates the skier coordinates in the picture. Certainly, these skier coordinates in the picture are only a projection (perspective) of the skier position. The skier position correct coordinates can be obtained by means of the ski run 3D model (the most accurate possible geodetic photograph of the ski run). Such a system operation is illustrated in Fig. 9. The equipment for such a system is equal as for the static system, but there is additionally required a geodetic photograph of the territory the coordinates of which are in the computer.

The system should first be calibrated. The points on the ski run which of we know the x, z, y coordinates should be defined the x_p, y_p coordinates in the picture – projection by calibration. Since we have several known points which define the territory 3D model, and their coordinates in the projection (x_p, y_p) known, we can calculate the skier coordinates in the projection (photograph) by means of a linear interpolation (which is the simplest one), and thus indirectly the skier coordinates in the territory 3D model. In this way we can determine the skier position with certain accuracy by means of the territory image (photographs).

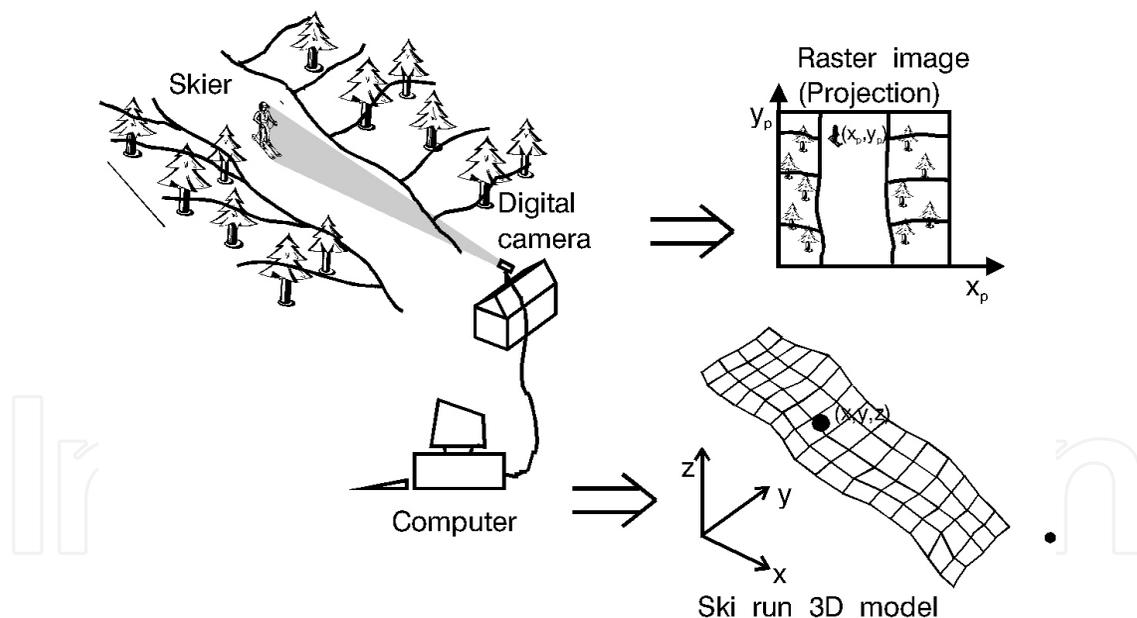


Fig. 9. Monitoring skiers by means of the dynamic visual-computer system (Težak & Lep, 2008)

If the procedure is repeated in certain time intervals, the skier position change in the picture (photograph) can be determined, and consequently the position change in the territory 3D model. In this way it is possible to determine the skier's speed. By prompt enough computers which quickly analyse images (projections) of the ski run with skiers, and determine the skier position in the picture, and also in the ski run area 3D model, we can determine the route, speed, acceleration, charges,... of skiers.

But this system does not function if the digital camera is not set up correctly. In this case there appears singularity, as to one point in the projection can correspond 2 or more points in the 3D model in the original. This example is shown in Fig. 10.

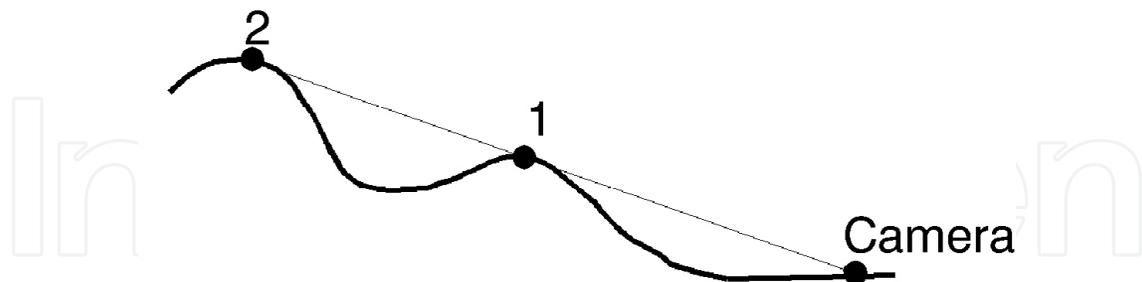


Fig. 10. Example when the digital camera is not set up correctly (Težak, 2000)

On the basis of this system each skier recorded by the digital camera on the ski run can be determined the skiing speed, and this speed is added the required ski run area for safety skiing. In this way the then ski run capacity can be calculated. If on the ski run there are fast skiers, this ski run capacity is smaller as if there are slower skiers.

In case when the static or dynamic visual-computer system perceives the ski run capacity overcharging, a signal is activated, and launches warning systems like:

- electronic inscription SKI SLOW – SKI RUN IS FULL at the entrance of the ski run, or
- red light is lit up on traffic lights, and it bans on entrance of new skiers to the ski run,
- in the extreme case a temporary stop signal to the cable device belonging to this ski run can be sent.

8. Conclusion

The influence of cableways on the environment can be discussed from two points of view. Being a part of the traffic system, cableway traffic is one of the most friendly to the environment. From the point of view of ecology, cableways have advantage over access roads, because of lower emissions of noise and exhaust gases. They also use up less natural space than roadways (shorter lengths due to higher rise).

The construction of new chairlift or replacement of older chairlift by a newer one which features the technique of detaching grips on carriers from the carrying-hauling rope at the station can generate various problems. The cableway companies are trying to solve the problem of queues in front of cableways by replacing the older cableways with the newer ones which are faster and have higher capacities. By installing such chairlifts with detachable grips the balance between the capacities of the ski slopes and chairlifts is disturbed, which results in the overcrowded ski slopes in the peak days, so the quality of offer is reduced. Chairlifts with detachable grips are faster and enable carriage of passengers over greater distances, which on the other hand results in the need for larger areas in the nature.

Bearing in mind the support to skiing, we can conclude that modern cableways of high capacities can transport more skiers who, on the other hand, need larger surfaces for their activity. So, additional ski trails must be built, which is a disturbance to the environment, especially in woody areas.

From the economic point of view, it pays to build cableways that go as far as the mountain foothills. There, also parking places for cars can be located. The function of these cableways is twofold: the access and indirect support to skiers.

Safety on ski runs is quite a serious problem. The non-compatible cable devices and ski runs construction can cause a safety decrease on ski runs. Cable devices can be reconstructed into more efficient on the same line without greater complications, while the existent ski run widening, or construction of an additional ski run is difficult (collecting of all approvals, intervention into the natural environment – wood cutting, blasting, etc.).

When deciding about building additional skiing capacities, i. e. high performance cableways, several new ski trails, accommodation and other infrastructure, a compromise should be found between the interest to protect the environment and the interest to develop the local community. This should be included into state plans. We must be aware that tourism of high quality (lately also in agreement with the environment) is one of good possibilities for quality local and regional development. (Težak et al., 2010)

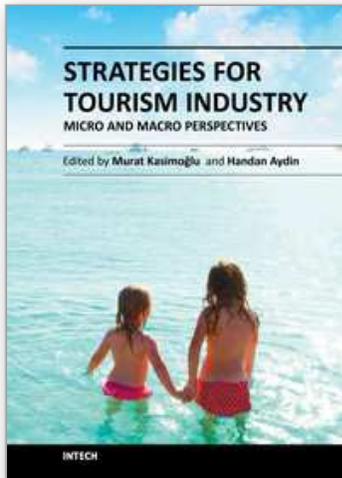
To establish the ski run occupation it is possible to decrease, by the modern technology, the skiers accidents probability which occur due to the ski super-satiation. A significant contribution to this is a possibility of the territory digital photograph application. The raster image computer analysis programmes already exist, and have already been applied (e.g. assessment of cars number which stay in front of traffic lights). They just need to be adjusted to the skiers monitoring application.

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Today, it is considered good business practice for tourism industries to support their micro and macro environment by means of strategic perspectives. This is necessary because we cannot contemplate companies existing without their environment. If companies do not involve themselves in such undertakings, they are in danger of isolating themselves from the shareholder. That, in turn, creates a problem for mobilizing new ideas and receiving feedback from their environment. In this respect, the contributions of academics from international level together with the private sector and business managers are eagerly awaited on topics and sub-topics within Strategies for Tourism Industry - Micro and Macro Perspectives.

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