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## **TYPES OF SKI RESORTS' SPATIAL ORGANIZATION IN THE LANDSCAPE OF CARPATHIAN MOUNTAINS**

### **SPOSOBY ORGANIZACJI PRZESTRZENI OŚRODKÓW NARCIARSKICH W KRAJOBRAZACH KARPAT**

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#### **ABSTRACT**

The spatial organization of ski resorts in the Carpathians' landscape within Slovakia, Poland, Ukraine and Romania is analyzed in the article. By the method of compositional analysis of existing ski resorts' planning structures the types of ski resorts' spatial organization are formulated. The interaction between natural environment of mountain landscape and planning solution of ski resort is also discussed.

Key words: compositional analysis, Carpathian mountains, landscape and spatial organization, planning elements' location, ski resort.

#### **STRESZCZENIE**

W artykule jest analizowana organizacja przestrzenna ośrodków narciarskich w krajobrazie Karpat w Słowacji, w Polsce, w Ukrainie i w Rumunii. Za pomocą metody analizy kompozycyjnej istniejącej struktury planowania ośrodków narciarskich są określone sposoby organizacji przestrzeni ośrodków narciarskich. Wzajemne oddziaływanie środowiska naturalnego górskiego krajobrazu oraz planowania ośrodka narciarskiego również jest analizowane.

Słowa kluczowe: analiza kompozycji, Karpaty, lokalizacja elementów planowania, organizacja krajobrazu i przestrzeni, ośrodek narciarski.

## 1. INTRODUCTION

The specific feature of ski resort as a complex architectural object is its location in a natural mountain landscape. Consequently, one of the main tasks for the architect is a harmonious combination of ski resort's planning solution and features of the natural landscape. Since middle XX century the construction of ski centers have been started in the Carpathians and both the construction practice and theoretical research in this area have been developed. For today, the thorough research base concerning mountain resorts' design is formed. In particular, in Ukraine the scientific basis of ski resorts' designing was formed during the Soviet Union period and now these studies require updating and further development under the new socio-economic conditions. The current planning process in Ukraine is based on theoretical and practical contribution of the local scientists, architects, designers and sports enthusiasts, including Arkhangelsky A.V., Tikun L.D., Kyzymovych Y.I., Kravtsov V.L., Petryshyn I.M., Trytyak P.R., Seryohin Y., Shulga G.M., Lavytsky A.S., Telep O.L. and others [8].

An important step in the landscape and spatial organization of ski resorts research is the analysis and systematization of existing design experience. The purpose of this paper is to identify typical planning types of the landscape and spatial organization of ski resorts in the Carpathians. The identification process is based on a composite analysis of selected ski resorts in Slovakia, Poland, Ukraine and Romania. Planning types, which are discussed in this article, describe aspects of ski resorts's basic planning elements allocation. Actually, ski resort consists of ski area and development area. In particular, ski area is formed by the ski runs and lifts, and also it includes planning cores, which are formed around the upper and lower lift stations. Development area includes the following components: residential unit, catering unit, cultural block, sports block, block for trade and consumer services, administration and household block and recreation area [7].

## 2. MATERIALS AND METHODS

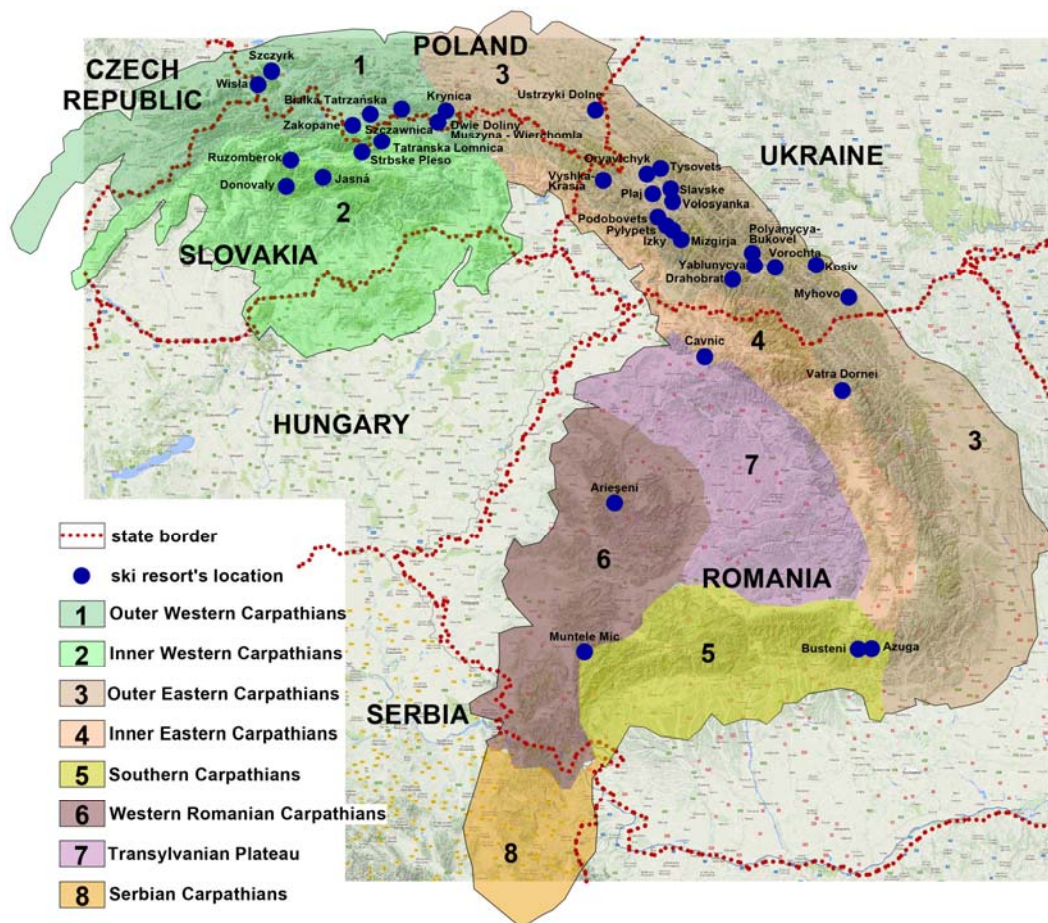
Definition of types of ski resorts' landscape and spatial organization in the Carpathians is conducted by using the following methods: ski resorts' compositional analysis on the basis of satellite maps and physical maps (GoogleEarth, Google maps), analysis of project materials (pre-proposals and masterplans), computer modeling and examination of ski resorts by visiting the locations.

By using GoogleEarth satellite maps the features of ski resort's basic planning elements location in the structure of the Carpathian mountains landscape is analyzed. Satellite data allows to analyze the three-dimensional organization of the ski resort as a whole and to describe the ski resort's main planning elements placement in the structure of the landscape. For more detailed characteristic of ski resort's landscape and spatial organization, as in other cases, architects usually carry out site examinations. In this study the popular ski centers of various sizes, heights and planning structure were selected for further analysis [11][12][13]. Study cases were selected on the basis of ski resorts' location in different types of Carpathians landscapes, in order to examine the effect of landscape structure on ski resorts' planning solutions. 5 ski centers in Slovakia, 8 - in Poland and 6 - in Romania were investigated by analysis of satellite maps. Ski resorts' investigation in Ukraine, in addition to processing physical Google maps, also were carried out by means of field surveys. 16 ski resorts in Ukraine (Eastern Carpathians) during summer and winter 2015-2016 were examined. Then, by computer modeling there were developed three-dimensional landscape spatial models of ski resorts.

Also project materials of Ukrainian architects and engineers (masterplans and pre-proposals for ski resort designing) were analyzed in the article [3].

### 3. THE IMPACT OF NATURAL ENVIRONMENT OF THE CARPATHIANS ON THE SKI RESORTS' PLANNING STRUCTURE FORMATION

The scopes of the study are the ski centers that are located in the geographical boundaries of the Carpathian Mountains. It is known, that the Carpathian Mountains orographically consist of Western Carpathians, Eastern Carpathians, Southern Carpathians, Western Romanian Mountains and Transylvanian plateau. Ski centers were selected for analysis in order to analyze their planning structure in different natural conditions of different Carpathians' orographic areas. 6 ski resorts within the Outer Western Carpathians, 6 ski resorts – in the Inner Western Carpathians, 17 - in the Outer Eastern Carpathians, 2 – in the Inner Eastern Carpathians, 2 - in the Western Romanian Carpathians and 2 - in the Southern Carpathians were analyzed (Fig. 1. ).



Ryc. 1. Mapa badanych ośrodków narciarskich w Karpatach  
 Fig. 1. The map of investigated ski resorts in Carpathian Mountains

Describing the natural environment in which the ski centers are located, we can conclude that it is very diverse across the Carpathians. Characteristics of mountain relief is crucial for the formation of the ski area, as well as residential and recreational units of ski resort (Fig. 2). The structure of the terrain is very varied in the selected examples. Even within the territory of one ski resort the terrain can be very different. In such case, the diversity of relief is a positive factor that causes a greater variety of trails, making the ski resort interesting for a wider range of visitors. Within the mountain landscape of Carpathians there are different types of landscape coverage, including rural and forest types [2]. Fo-

rest cover varies by its density in different mountainous areas and there can be found the following three types of forest cover in the Carpathians: fully forested terrain, partly forested terrain and woodless terrain. Partly forested and woodless areas in low heights of mountains (1000 m above sea level) or middle heights of mountains in its lower zone (1000-1500 m above sea level) are usually situated near or within settlements and it can often be attributed to the village type of landscape covering. Apart from the forest cover of the area, another important characteristic of mountain terrain, when speaking about conditions of ski resorts' placement, is the level of urbanization of the landscape, as well as the relative height of ski resorts' placement.

**MATRIX OF FACTORS' IMPACT**

PLANNING AREAS	ELEMENTS OF SKI RESORT'S PLANNING STRUCTURE	FACTORS														RANK	
		FUNCTION						LOCATION IN LANDSCAPE									
		SPECIALIZATION	WAY OF REST ORGANIZATION	DURATION OF REST	HOLIDAY SEASON	STRUCTURE OF RECREATION	CONTINGENT OF TOURISTS	RELIEF	CLIMATE	WEATHER CONDITIONS	VEGETATION	URBAN CONDITIONS	IMPORTANCE	CAPACITY	THE ALTITUDE OF LOCATION		LIMITED LOADS ON LANDSCAPE
SKI AREA	SKI RUNS AND LIFTS	●	●		●	●	●	●	●	●	○	●	●	●	●	●	1
	PLANNING CORE	●			●			●				○	○	○	●	●	7
AREA OF CONSTRUCTION	RESIDENTIAL AREA	●	●	○	●		●	●					●	●	●	●	2
	PUBLIC CATERING AREA	●	●		●		○					○	●	●	●	●	6
	PUBLIC CULTURAL AREA	●	●		●	●	●						●	●	●	●	4
	SPORT AREA	●	●			●	●	○					●	●	●	●	5
	COMMERCIAL AND HOUSEHOLD AREA	●	●									●	●	●		●	8
	ADMINISTRATION AREA															○	6
	RECREATIONAL AREA	●				●	●	●	●		●	○		●	●	●	3
<b>RANK</b>		2	6	15	8	10	7	9	13	14	12	11	5	3	4	1	⊗

● SIGNIFICANTLY INFLUENCE -2    ○ INFLUENCE -1    □ NO INFLUENCE -0

Ryc. 2. Czynniki wpływające na funkcjonalną i planową organizację ośrodków narciarskich [7]  
 Fig. 2. Factors affecting functional and planning organization of ski resorts [7]

Based on analysis of satellite maps [14] and field surveys of ski resorts in the Carpathians, ski resorts' location in different types of Carpathians' landscapes can be characterized (Fig. 3) by the following parameters:

**1. the degree of forest cover of the areas:**

- fully forested areas;
- partially forested areas;
- woodless areas.

**2. The height of location:**

- in high heights of mountains (over 2000 m above sea level);
- in middle heights of mountains in its upper zone (1500-2000 m above sea level)
- in middle heights of mountains in its lower zone (1000-1500 m above sea level)

- in low heights of mountains (1000 m above sea level).

**3. the level of urbanization of the landscape:**

- in the mountainous natural landscape;
- in the mountainous partly urbanized landscape;
- in the mountainous urban landscape.

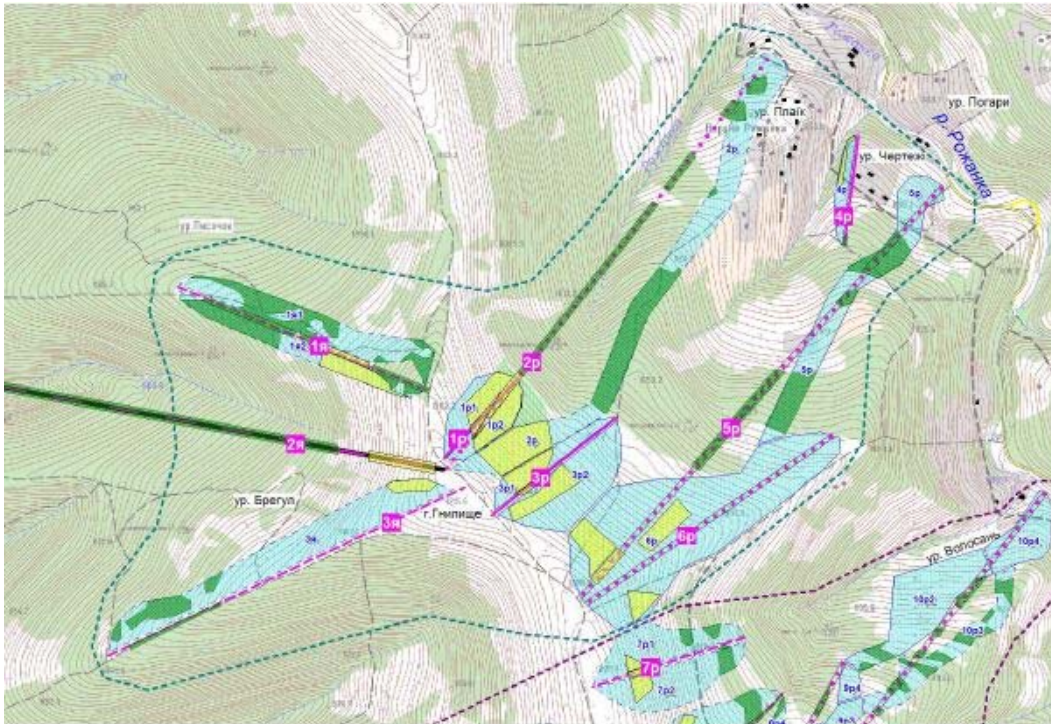
SKI CENTERS LOCATION IN DIFFERENT TYPES OF LANDSCAPES IN CARPATHIAN MOUNTAINS				
	TYPES OF LANDSCAPES	PLANNING SCHEME	3D SPATIAL MODEL	PHOTO
THE DEGREE OF FORESTED AREAS	FULLY FORESTED AREAS	POLYANYTSYA-BUKOVEL (UKRAINE)		
	PARTLY FORESTED AREAS	ORYAVCHYK (UKRAINE)		
	WOODLESS AREAS	YABLUNYTSYA (UKRAINE)		
THE ALTITUDE OF LOCATION	HIGH ALTITUDE (over 2000 m above sea level)	TATRANSKA LOMNYCYA (SLOVAKIA)		
	MIDDLE ALTITUDE OF UPPER BELT (1500 -2000 m)	DRAGOBRAT (UKRAINE)		
	MIDDLE ALTITUDE OF LOWER BELT (1000 -1500 m)	PYLYPETS (UKRAINE)		
	LOW ALTITUDE (under 1000 m)	MYHOVO (UKRAINE)		
THE DEGREE OF URBANIZATION	MOUNTAIN NATURAL LANDSCAPE	KOSIV (UKRAINE)		
	SEMI NATURAL LANDSCAPE (NEAR THE SETTLEMENT)	VYSHKA (UKRAINE)		
	URBANIZED LANDSCAPE (INSIDE THE SETTLEMENT)	SLAVSKE (UKRAINE)		

Ryc. 3. Lokalizacja ośrodków narciarskich w różnych typach krajobrazu Karpat

Fig. 3. Ski resorts' location in different types of Carpathians' landscapes <sup>1</sup>

<sup>1</sup> 3D model of Tatranska Lomnycya, source/ źródło: [10]; photo of Tatranska Lomnycya, source/ źródło: [13].

Degree of forest cover of the area influences at most on the planning solution of recreational area, ski slopes and lifts construction. In practice, the choice of locations for ski lifts and runs is conducted with maximum consideration of existing woodless sites in order to minimize clearcuts during the construction of ski slopes (Fig. 4).



Ryc. 4. Mapa, która pokazuje ukierunkowanego wyrębu i czyszczenia krzewów dla budowę infrastruktury transportowej kablowej i organizację pól narciarskich (wg materiałów projektu "HorizontAL", 2006) [3]

Fig. 4. The map, that shows targeted logging and cleaning the bush for the construction of cable transport facilities and the organization of ski fields (according to project materials of "HorizontAL", 2006) [3]

Height of ski resort's location is a factor that significantly affects the ski area and construction area planning. With the change in height of placing ski resort's planning elements, the plant cover is changing. The natural upper limit of the forest in the Carpathians differs and depends on the specific microclimatic features of mountainous terrain. For example, the upper limit of the forest in the Ukrainian part of Carpathians is the highest on the mountain Stajky (in the Chornogora landscape) at an altitude of 1680 m above sea level, and in some other areas the upper limit of the forest is at an altitude of about 1200 m above sea level [1].

The level of urbanization of the landscape influences on the placement of ski trails and lifts, as well as on trade and economic zone placement. In particular, the placement of ski objects is influenced by such urban factors: transport; the proximity of settlements; presence of the utilities; availability of recreational resources for year-round use and tourist popularity of complexes in the surrounding areas; the possibility of territorial development of the ski area and others.

### 4. SKI RESORT'S PLANNING ELEMENTS LOCATION IN THE LANDSCAPE OF CARPATHIAN MOUNTAINS

Types of ski resorts' planning solutions and its location in the landscape structure are discussed in order to generalize the existing experience in ski resorts' designing in four states within the Carpathian Mountains. The following ten types of ski resort's planning elements location in the structure of the landscape were found (Fig. 5):

1. Pyramidal location;
2. one-slope location;

SKI RESORTS' PLANNING ELEMENTS LOCATION IN THE LANDSCAPE OF CARPATHIANS			
TYPE OF LOCATION	PLANNING SCHEME	SECTION DRAWING	GEOSPATIAL MODEL
PIRAMIDAL LOCATION	YASNA-CHOPOK (SLOVAKIA) 		
ONE-SLOPE LOCATION	BUSTENI (ROMANIA) 		
ONE-SLOPE LOCATION (REACHING THE TOP)	BIALKA TATRZANSKA (POLAND) 		
ONE-SLOPE LOCATION (REACHING THE VALLEY)	WISLA (POLAND) 		
ONE-SLOPE LOCATION (REACHING THE TOP AND VALLEY)	AZUGA (ROMANIA) 		
TWO-SLOPE LOCATION (SINGLE CENTER)	ZAKOPANE (POLAND) 		
TWO-SLOPE PARALLEL LOCATION (DIFFERENT CENTERS)	USTRYKI DOLNE (POLAND) 		
MULTI-SLOPE LOCATION	KRYNICA (POLAND) 		
CASCADE LOCATION	RUZOMBEROK (SLOVAKIA) 		
SUBALPINE MEADOW LOCATION	MUNTELE MIC (ROMANIA) 		

Ryc. 5. Lokalizacja elementów planistycznych ośrodków narciarskich w krajobrazie Karpat  
 Fig. 5. Ski resorts' planning elements location in the landscape of Carpathians

3. one-slope location (reaching the top);
4. one-slope location (reaching the valley);
5. one-slope location (reaching the top and the valley);
6. two-slope location (single center);
7. two-slope parallel location (different centers);
8. multi-slope location;
9. cascade location;
10. subalpine meadow location.

In case of pyramidal location of ski resort, ski trails are located on the slopes of a mountain, which are oriented on different sides of the world. Trails on opposite slopes are integrated by planning core placed on top of the mountain. This planning core is a kind of hinge that connects two or more ski areas in a single complex. Other planning cores are placed on both slopes of the mountains and in the valley. An example of such location is ski resort "Jasna-Chopok", located in the Low Tatras in Slovakia. Spatial and planning dominant of this ski resort is a mountain peak Chopok, on which the upper station of ski lifts, mountain shelter, restaurant and other facilities are located. On the northern slope of the mountain the ski area has transport connection with the settlement Liptovský Mikuláš and a south-facing ski area has a connection with the locality Bystrá Valley. Each of ski areas has a separate recreational village.

In case of one-slope ski resort's location planning elements are located on one of the slopes of the ridge or mountain without reaching the peaks and valleys. An example of ski resort that illustrates this type of placement can be seen in resort town Busteni in Southern Carpathians (in Romania) and in Slovakian resort Štrbské Pleso, which is located in the High Tatras.

One-slope location (reaching the top) differs from the previous type in a way, that top planning core is placed on peak of the mountain, from where ski slopes stretch on the slope, not reaching the valley. An example of such location is ski resort in Byalka Tatranska Kotelnitsa located in Podhulno-Mahursky ridge of the Carpathians in Poland. Lower planning elements are not in the valley but are located upper on a gentle slope.

One of the examples of one-slope location (reaching the valley) can be ski resort in Wisła, located in the Western Beskid in Poland. In Wisła there are about seven ski areas that are dispersed in the structure of the settlement. Among these, two ski areas illustrate the type of one-slope location (reaching the valley), where the lower planning core is located in the valley of the eponymous river Wisła, and top planning core - on the hillside.

In case of one-slope location (reaching the top and the valley) ski trails are placed on one of the slopes of the mountain range. Unlike previous types of one-slope location, upper and lower lift station are located respectively on the mountain top and in the valley. One of the examples of such placement can be ski resort in Azuga (Southern Carpathians, Romania).

Another type of ski resort placing in the landscape structure is two-slope location (single center). In this case ski trails are located on slopes that face each other and converge into a single valley, thus forming a spatially unique "amphitheater". Planning cores are placed on the top and in the valley. Such ski areas are united by single recreational village with a common transport and tourist infrastructure. An example of this type of spatial organization can be resort Zakopane in the High Tatras (Poland).

In case of two-slope parallel location (different centers) ski trails are on different slopes that are oriented to one side of the world and their lower planning cores are in different valleys. And also both planning cores are placed on the peaks and valleys. Ski resort in Ustrzyki Dolne (Eastern Beskidy, Poland) illustrates this planning type.



Multi-slope location of ski resort is characterized by placing ski trails at several slopes of two mountain ranges with different orientation. Planning cores are placed on the peaks and valleys. An example of such placement can be found in ski resort Krynica-Zdroj, in the Eastern Beskid in Poland. In this case there is a combination of two-slope parallel location and single center location, forming together a multi-slope location.

The cascade type of location can be found in the example of ski resort in Ruzomberok, located in the Low Tatras (Slovakia). Ski area is located on one of the slopes of the mountain Malino Brdo (altitude is 1209 m above sea level), which has a distinct terraced character. Planning cores are placed on top of the terrace and in the valley, forming cascade planning type. The complex has two separately located development areas - on the terrace and second in the valley, where one can get by the paved road from the town Ruzomberok.

Subalpine meadow location can be considered as a separate type, despite the fact that it is a kind of one-slope location (reaching the top) of ski resorts. This type is distinguished by the height characteristic of ski resort location (over 1500 m above sea level). One of the examples of such placement can be ski centers on Mount Mic (Western Romanian Carpathians) and Dragobrat (Svydovets massif, Ukrainian Carpathians).

Planning types, which are found, do not reflect fully the three-dimensional measurement of ski resorts' space. In the development of the previous planning schemes one can generalize such types of spatial organization of ski resorts (Fig. 6):

- radial organisation with compositional center in the valley;
- radial organisation with compositional center at the top of the mountain;
- successively linear organization;
- parallel location of ski trails;
- combined organization.

Radial organisation with compositional center in the valley can be found in case of the two-slope location with single center and one-slope location. In the demonstrated examples of radial organisation (ski centers Izky and Podobovets in Ukraine) can be noticed actually one-slope location of ski area. This type of placement, when the composition is formed around a mountain valley, in scientific literature is also called "amphitheater" and it is recommended to design the diameter of the amphitheater maximum 1200 m length [4].

Radial organisation with compositional center at the top of the mountain is characterized by placing the ski fields at slopes with different exposure. In case of such placement, ski fields converge at the top that distinguishes this type from the previous type of spatial organization. Another feature of this type of placement is the presence of two or more recreational settlements and, accordingly, automobile access roads. Examples of such organization are ski resorts Yasna-Chopok in Slovakia and Trostyan mountain in Slavske (Ukraine).

Successively linear organization of ski resort is characterized by consistent placement of ski fields, where each ski field is connected to the next one. Examples of such organization can be found in Shtchyrk (Western Beskidy, Poland) and Mugyna-Verchomla (ski complex "Two Valleys", Eastern Beskidy, Poland). These examples illustrate the sequential combination of ski fields, connected by using planning cores.

Parallel location of ski trails on the slope is quite common in the Carpathians. These ski fields are usually functioning as separate ski areas that are combined by recreational village, where the service facilities are located. Examples of this type of three-dimensional organization can be complexes in Vatra Dornei and Aryeseni, located in Romania.

The combined organization of ski resorts is characterized by a combination of different types in a three-dimensional organization. Examples of combined space organization of

ski resort can be such complexes: "Tysovets" (Lviv region, Ukraine), "Bukovel" (Palyanytsya, Ivano-Frankivsk region, Ukraine), Krynitsa-Zdruj (Poland) and others.

TYPES OF SPATIAL ORGANIZATION OF SKI RESORTS			
TYPE OF ORGANIZATION	PLANNING SCHEME	SPATIAL SCHEME	EXAMPLES
RADIAL ORGANIZATION WITH COMPOSITIONAL CENTER IN THE VALLEY	<ul style="list-style-type: none"> <li> road</li> <li> ski facilities</li> <li> ski lift</li> <li> planning core</li> <li> resort village</li> <li> forested hills</li> </ul>		<p>IZKY (UKRAINE)</p> <p>PODOBOVETS (UKRAINE)</p>
RADIAL ORGANIZATION WITH COMPOSITIONAL CENTER ON THE TOP OF THE MOUNTAIN			<p>YASNA-CHOPOK (SLOVAKIA)</p> <p>TROSTYAN MOUNTAIN, SLAVSKE (UKRAINE)</p>
SUCCESSIVELY LINEAR ORGANIZATION			<p>Dwie Doliny Muszyna-Wierchomla (POLAND)</p> <p>SZCZYRK (POLAND)</p>
PARALLEL LOCATION OF SKI TRAILS			<p>VATRA DORNEI (ROMANIA)</p> <p>ARIESENI (ROMANIA)</p>
COMBINED ORGANIZATION			<p>TYSOVETS (UKRAINE)</p> <p>KRYNICA (POLAND)</p>

Ryc. 6. Typy organizacji przestrzennej ośrodków narciarskich

Fig. 6. Types of spatial organization of ski resorts

## 5. CONCLUSIONS

The diversity and heterogeneity of the Carpathian mountains' landscapes are displayed in various planning types of ski resorts. Analyzing the structure of mountain landscape it can be concluded that the relief characteristics have a great importance for ski resort planning and they are regulated by international rules and requirements of the FIS [9], and, in particular, in Ukraine – by state rules and regulations[5][6]. Regulations are needed to determine slope values, forms and settings of hillsides for the construction of ski trails and lifts. The relative height of the terrain where the ski resort is located may be different - from low height mountains to high height mountains. Type of natural coverage of landscapes such as the forest or grasslands, and indicators of forest cover density of the territory are not governed by regulations. Ski centers are designed on the areas with different natural coverage. In a situation when ski resort is constructed in the forested areas, architects are trying to pave the ski trails so as to minimize cutting trees. Fully forested areas are found in middle heights and in low heights of mountains in areas outside settlements or close to them. Woodless areas are in case when ski resort is located at subalpine meadows, above the upper boundary of the forest, and when it is placed in the structure of settlements, mostly in pastures. Based on a composite analysis of satellite maps and 3-D models with the location of ski resorts in the Carpathian Mountains, it can be concluded that planning of ski complexes in forested areas requires from the architects to pay more attention to the impact of the construction on the visual perception of landscapes. Instead, design process on woodless areas much less violates existing visual-spatial structure of the landscape. Most ski resorts are located either in the structure of settlements or are adjacent to them, which can be explained in terms of the convenience of engineering services and labor proximity. This article attempts to systematize the existing types of planning and spatial organization of ski resorts that can be found within the Carpathian mountain system. Examples of ski resorts, that were analyzed, reflect the main existing planning types in Slovakia, Poland, Ukraine and Romania. The conducted systematization of ski resorts can serve as a basis for more detailed studies of spatial characteristics of the ski resorts in the future in order to improve the approaches to the design of mountain recreation areas in Carpathian Mountains.

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