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On Convex Space: Example of an Indoor Ski Center

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Abstract

This study, which examines the relationship between spaces within indoor ski centers, aims to investigate the effectiveness of spatial syntax in spatial organization. The study utilized spatial syntax as a qualitative research method. The floor plans of indoor ski centers were evaluated in two dimensions using a program called DepthmapX, which generated representation maps, enabling access to spatial data from these maps. The aim of this study is to emphasize the necessity of classifying spaces within indoor ski centers that exhibit different features in their layout arrangements. The findings and criticisms obtained from this study also serve as recommendations for researchers and designers. The study evaluated the relationship between the organization of space and the shell that determines the boundaries of the space from the perspective of space syntax. It also demonstrates that this method can be effectively used in the design of indoor ski centers. This method can be employed in future studies to meet user needs, circulation, and promote sustainability in the design of indoor ski centers.

Keywords: *Form, spatial organization, space syntax, convex space.*

Konveks Mekân Üzerine: Kapalı Kayak Merkezi Örneği

Öz

Kapalı kayak merkezlerini diğer yapılardan ayıran nesnel özellikleri kapsamında barındırdığı mekânlarını inceleyen bu çalışma; mekân organizasyonunda mekân dizimi yönteminin etkenliğini aramaktadır. Nitel bir araştırma yöntemi olarak bu çalışmada var olan mekân dizimi, kapalı kayak merkezi yapılarının tasarım değerlendirmeleri için kullanılmıştır. Söz konusu merkezlerin kat planları DepthmapX isimli programda iki boyutlu olarak değerlendirilerek temsil haritaları üretilmiş ve bu haritalar üzerinden mekânsal verilere ulaşılmıştır. Bu çalışmanın amacı, kapalı kayak merkezlerinin yapısal öğelerini anlamak ve doğru bir şekilde sentezlemek için bu merkezlerin yerleşimlerinde farklı özellikler sergileyen öğelerin doğru bir şekilde sınıflandırılmasının gerekliliğini vurgulamaktadır. Bu çalışmanın elde ettiği bulgular, kapalı kayak merkezi tasarımları için eleştirel bir araştırma sunmaktadır. Aynı zamanda da araştırmacılar ve tasarımcılar için bir öneri niteliği taşımaktadır. Mekân organizasyonu ile mekânın sınırlarını belirleyen kabuğun ilişkisini mekân dizimi perspektifinden değerlendirmiştir. Araştırma kapsamında incelenen iki merkez, mekân dizimi yönteminin kapalı kayak merkezi tasarımlarında etkili bir şekilde kullanılabileceğini göstermektedir. Bu yöntem, kullanıcıların ihtiyaçlarını karşılamak, güvenliği sağlamak, akışı optimize etmek ve kaynakları verimli bir şekilde kullanmak için de ileriki çalışmalarda kullanılabilir.

Anahtar kelimeler: *Biçim, mekân organizasyonu, mekân dizimi, konveks mekân.*

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1. Introduction

The design of a space is primarily concerned with the form of the space in parallel with spatial evaluations. Therefore, the design of a space encompasses the characteristics of the space's geometry. Just as forms come together in a cohesive manner, the proper alignment of a space's form with its function cannot be overlooked for the emergence of a space as a product. This study advances through analyses conducted to examine the coming together, coexistence, and formation of spaces resulting from the combination of forms, aiming to define the conceptual and theoretical boundaries of the emerged formal structure.

For social and economic needs, the disciplines of design and planning seek solutions to the technical and aesthetic requirements of spaces. The idea of creating an open and large-scale activity area within an enclosed space leads to spatial fragmentation, while also necessitating the exploration of the evolving requirements of structures that exist from the beginning of the design process and emerge over time.

This study aims to evaluate indoor ski centers, which are artificial snow-covered areas designed and planned by humans, instead of naturally snow-covered mountains, with increased resistance against melting. The evaluation is based on specific criteria to provide usable data for development practices. The study will include the identification of the formal and dimensional characteristics of the space, primarily focusing on physical attributes, in accordance with spatial organization requirements and towards environmental character and visual assessments. In this context, the spatial organization of the indoor ski centers within the scope of the study is examined through the method of space arrangement, and evaluated based on the analysis of convex space, which is one of the parameters of spatial arrangement.

The process of reading a space, which begins with visual perception, leads to the identification of differences and similarities after analyzing the data obtained through the syntax method in the study of spatial organization. The goal of the study is to gain insights for the practice of arrangement, design, and planning through the interpretations developed based on these examples.

In line with this effort, the study aims to objectively examine the movements of users and the relationships between spatial elements within a space, as intended by the method of space syntax. It also emphasizes how users come together in spaces and investigates the characteristics that spaces assume during this process. Since this emphasis will directly affect the potential design process, it is important for design practice to uncover the underlying meanings of spatial fragments.

2. Material and Method

Form is an attribute of an object that distinguishes it from other objects. However, form can only manifest itself in reality when it serves a function. Because formal expression encompasses not only physical characteristics but also relationships with the social and physical environment, it should be suitable for both individual needs and the requirements of the surrounding environment (Onat, 1995).

The subheadings proposed in Maki's "Some thoughts on collective form" provide different approaches to establishing relationships and connections among individual elements in architectural design. Alongside all these approaches to form, Maki's theory of collective form emphasizes the importance of establishing connections between individual elements in architectural design to achieve a coherent and cohesive whole (Maki, 2015).

In Ching's book "Architecture: Form, Space, and Order," various types of spatial organization and form are discussed, and different categories are used to analyze them. Each of these categories, in turn, represents a different approach to organizing space and utilizing form in order to create meaning and function in architecture. According to Ching, in every case, these elements and systems should be interconnected to form an integrated whole with a unifying or cohesive structure. The organization of the parts creates architectural order when it reveals their relationships with each other and with the entirety of the structure. When these relationships reinforce each other and contribute to the singular nature of the whole, it signifies a relational order (Ching, 2002).

The relationships between forms existing in a two-dimensional plane are realized through surfaces that give rise to the third dimension. Therefore, to achieve formal continuity and ensure functional transitions between spaces, the mentioned functional effects should be properly orchestrated. If the composition of space is the result of an organization, then coming together both in form and spatially and functionally means integration and coherence. This coming together creates intersections between spaces and defines boundaries at the points where different areas converge or intersect, thereby creating a sense of space. This is a design approach related to the division and delineation of space. At the intersections where areas with different functions come together, concepts such as boundaries and permeability become important. These points are defined by structural elements in a way that preserves the integrity of function and circulation. As a result, the spatial intersections that occur at these points create a distinct spatial effect and provide users with different experiences. This approach brings a different perspective to the division and delineation of space (Dinçer, 2005). The coming together of different geometric forms, which represent spaces, actually emerges in the process of creating spaces to meet different user needs. The volume, which represents the three-dimensional perception of space, the structure, which expresses the supporting system and structural integrity of a space, and the function, which refers to the design of a space for a specific purpose, come together in different forms to form this process.

Hanson (1988), based on the theory that spatial relationships can only occur through connections between two spaces, evaluates the relationship with a third space and argues that it will be through configuration. The analysis of these configurations is carried out through spatial syntax. This method aims to provide a scientific foundation to space by analyzing the configurations formed when spaces come together in various ways on a plane, using numerical and graphical expressions.

Space, in simple terms, is an environment in which physical and social amenities are enclosed by boundaries and traces of life are present (Demirci, 2017). Experiencing a space is related to the elements existing around the person experiencing it. It is as if they are at the center of the world, perceiving the space based on their own understanding and creating their own perception of the world or the space itself (Hesselgren, 1969). In each perception, they accumulate memories for that space, experiencing the space and also giving life to the space itself.

Design decisions arise from being experienced and measured by the user, serving as performance indicators that provide references for proper usage. These values are utilized in meeting the desired qualities of the system (Sanoff, 2016). Regardless of the scale of architectural design, performance values in design are directly associated with the physical environment. This is because the performance and quality of a structure are directly linked to its user, the actions taking place within it, and the physical formation that allows for such activities (Esin & Özsoy, 2003). When the concept of performance is equated with the entirety of design decisions we reach at the end of the process, it becomes clear that achieving the right design relies on effectively utilizing the components of the process (Demirci & Arabacıoğlu, 2022).

2.1. Analysis of The Space Syntax of Indoor Ski Centers

Nature, which has been attempted to be incorporated into enclosed spaces, meets users as an artificial environment in indoor ski centers. These centers are specifically designed to be used in locations and times when temperatures and snow levels may not be sufficient. They provide users with snow-based activity experiences throughout the year, regardless of the season.

The study focuses on the analysis of two indoor ski centers, ChillFactore in the UK and Snow Arena in Lithuania, based on the discussion of the key features of the space syntax method. The purpose is to apply the space syntax method to evaluate and improve the designs of indoor ski centers or provide data for new designs. By examining these two centers, it enables a discussion on the applicability of space syntax for evaluating and enhancing the designs of indoor ski centers.

The spatial configuration method is an approach that relies on spatial data for conducting structural analyses. It is used for the classification and comparison of the formal qualities of a space.

The starting point of spatial layout is the way people organize themselves within a space and use it as a tool for placement. This method, which is a way of reading a space, consists of a numerical model. It is used in the classification and comparison of formal features. Form is scientifically based on numerical data. As emphasized by Lynch, visual cues, including symbolic structures and boundaries, that assist humans in perceiving complex spaces have altered the perspective of many designers (such as urban planners, interior designers, or architects) regarding the identity of spaces (Lynch, 1960). Since then, numerous studies have been conducted to seek new significance beyond predictions and to further develop data following perceptual cues. Statistical approaches are used to obtain this data. By bringing together and analyzing these data, the ability to make decisions based on similarities, differences, and divergences can be acquired.

This study employs the parameters of the spatial syntax method to reach spatial evaluations by making inferences based on the similarities and differences found in two different indoor ski centers.

2.2. Convex Space Analysis in Spatial Syntax Method

Convex space analysis is believed to be effectively utilized for direction finding, routing, and visibility exploration for users in a closed ski center. This is because convex space analysis is fundamentally based on accessibility relationships dependent on human movement (Turner, 2006).

In convex space analysis, each center is represented by a single space (ski area). Then, these areas are associated with each other based on their transition relationships with other spaces. Once all these stages are completed, the software starts calculating various measurements and generating maps based on these measurements.

In the analysis, outdoor spaces were included for each center, focusing on the changes occurring within their internal structures. To ensure clear interpretation of the results and changes, the interior spaces of each center were compared by connecting the corner points within the scope of convex maps. In these maps, the spaces were positioned within a color range that tends to vary from red to dark blue based on their values.

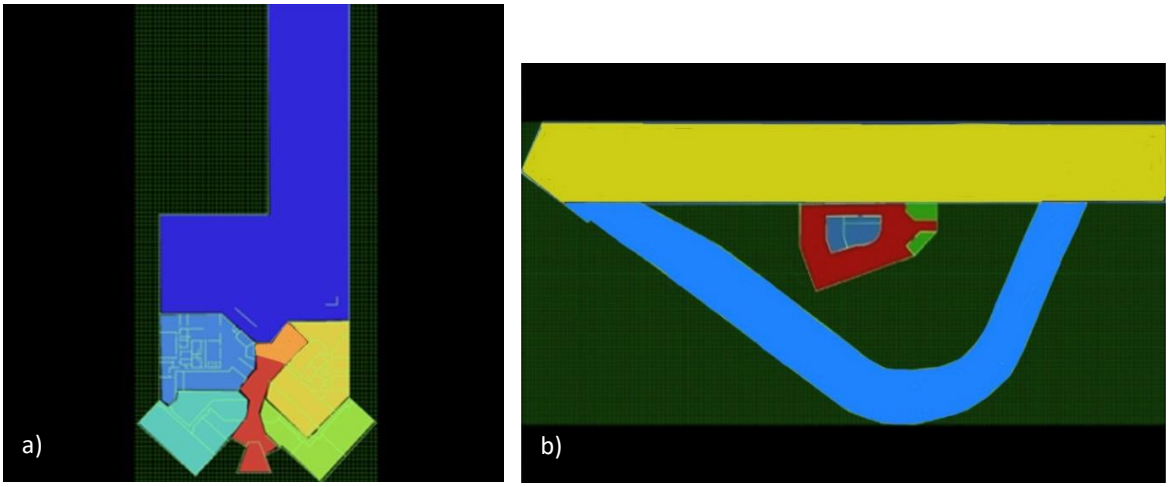

Figure 1. Convex space maps (a: Chill Factore-United Kingdom; b: Snow Arena-Lithuania)

As seen in Figure 1, both buildings exhibit a cohesive structure where the central atrium is surrounded by other spaces. Access to the spaces is provided through the central atrium. In these maps, the spaces are represented by a color range that varies from red to blue based on their accessibility levels. The color red represents the easiest accessible space, while dark blue represents the most challenging space in terms of accessibility.

2.3. Axial Maps Analysis in Spatial Syntax Method

Axial analysis is based on all possible straight walking lines within the structures of the ski center. These potential walking lines are initially drawn as straight lines on the floor plan and intersected with each other before conducting the analysis. Then, the complete line analysis is performed, revealing the accessibility characteristics. Additionally, a space is considered convex if straight lines can be drawn

within the space from any point to any other point within the space without crossing the boundary of the space. In this case, Chill Factore in the United Kingdom can be considered convex, while Snow Arena in Lithuania can be considered concave.

The higher the integration of an axis, the more it is colored in red, indicating that there are minimal changes in direction across all other axes in the space. Conversely, the lower the integration, the more the axis is colored in blue.

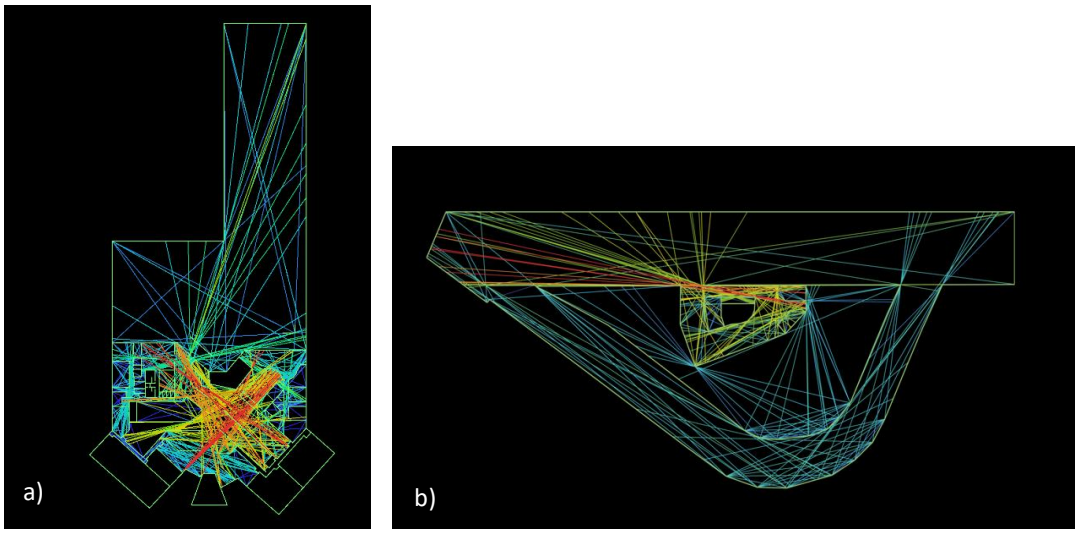

Figure 2. Axial maps. (a: Chill Factore-United Kingdom; b: Snow Arena-Lithuania)

In addition, as seen in Figure 2, the two-dimensional representation of the curve in Snow Arena, Lithuania does not consider the variations in elevation. It is observed that there is an increase in axial line density in areas with high circulation within the structure. Furthermore, when straight lines can be drawn from any point within a space to other points without crossing the boundaries of the space, convexity can be referred to. In the case of Snow Arena, if a line drawn from one point to another within the space passes through the exterior of the space, it is defined as a concave space. The analyses conducted also indicate that concave spaces exhibit higher integration and a more homogeneous distribution.

The comprehensibility of the area can be seen by looking at the axial maps graph. If the points in this graph go in a straight line from bottom right to top left below 45 degrees, the area is both interconnected and integrated. According to Hillier, in this case "the system is almost perfectly graspable". The local field, represented by clustered points, is "graspable". If the regression line for this cluster is steeper, within the whole system, as well as global and local integration are strongly correlated. This effect can be read from the cluster appearance of the points representing the area on the graph (1996).

As seen in Figure 2, the red axes show density in the space starting from the transportation area, passing through the ski preparation area, and then leading to the slopes.

2.4. Integration Analysis in Spatial Syntax Method

The connectivity and integration of a space with other spaces can be interpreted based on the depth of the space (Aksoy et al., 2020). Depth analysis was conducted for each closed ski center based on the depth levels in the transition graphs prepared for the designated study areas. In these analyses, the connectivity of spaces with each other was examined, considering two scenarios: one where the outdoor space is included and another where it is excluded. The spaces were arranged in a sequence starting from the root space in both cases. Following this sequence, depth values were assigned, and it was investigated whether the spaces were integrated into the system based on these values and whether they exhibited a tendency to separate from the system.

In the example of Chill Factore, the depth of the ski area is at the fourth level, while the average depth of the system is 2.869.

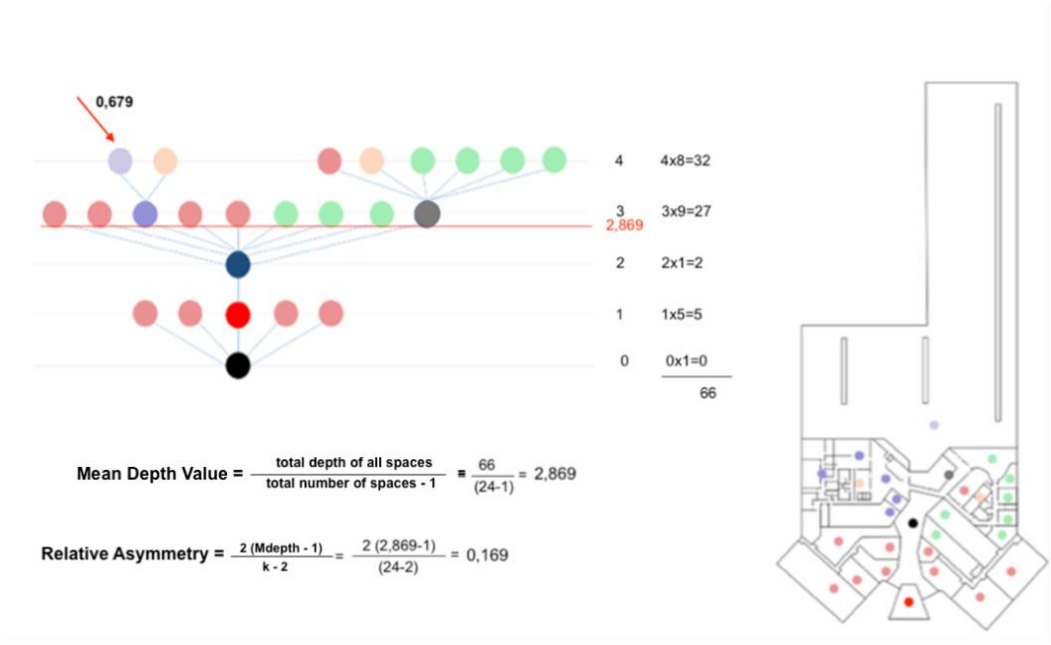

Figure 3. Depth analysis of Chill Factore, United Kingdom.

Therefore, as shown by the arrow in Figure 3, the ski area has a significantly high depth value. The integration of the space into the structure was obtained by multiplying the depth level with the relative asymmetry value.

In the case of Snow Arena in Lithuania, where depth is gained through an open skiing curve, as seen in Figure 4, the entrance area provides access to the toilet, dining areas, and ski preparation area. However, access to the open ski area is only possible through the closed ski area, resulting in the closed ski area being at the third depth level.

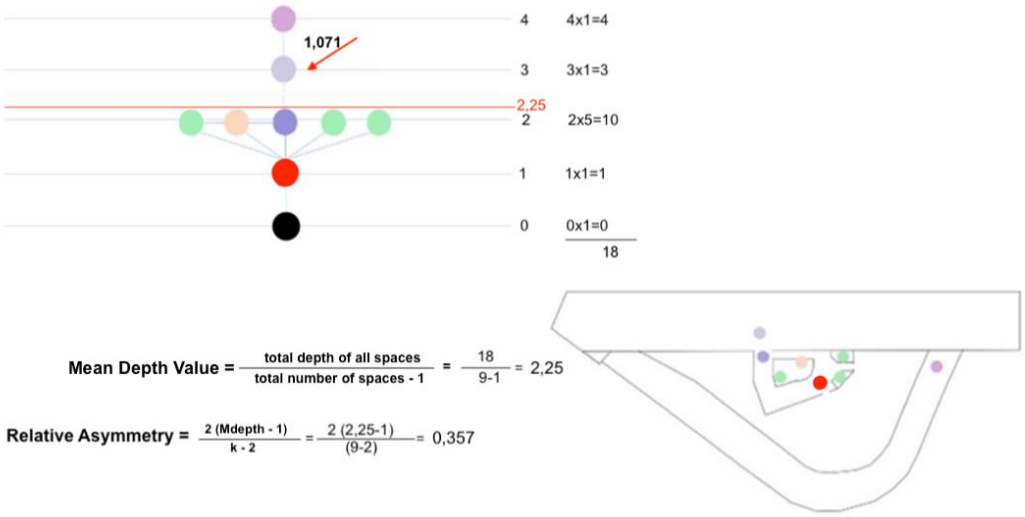

Figure 4. Depth analysis of Snow Arena, Lithuania.

Due to the relatively smaller number of spaces in the other closed ski center within the scope of the study, the high asymmetry value gained and the depth level of three contribute to achieving a high integration value for the space. In this case, the integration of the open ski area is 1.428.

3. Findings and Discussion

While interior design is defined as the process of organizing time, space, meaning and communication (Gür, 1996), it is also known that the built environment, environmental factors, the effects of people's lifestyles, their use of time and communication methods have an impact on interior design.

Configuration analysis, on the other hand, offers a systematic way of understanding the relationships between spaces and how they affect the overall experience of the environment (Hanson, 1988). This approach emphasizes the importance of considering the sequence and spatial relationships of spaces to create a coherent and meaningful experience for users.

McLean (1999), who evaluates the visitor experience through spatial satisfaction, mentions the importance of providing spatial organization with a functionally rational spatial layout, while also advocating the prediction of the experience to be obtained when this spatial layout is provided with numerical data. For this reason, the analysis of indoor ski centers as a place of experience has clearly shown that indoor ski centers have specific rules for their spatial organization. These rules determine the visitor experience and form the basis of the design. (Yuan & Wang, 2016). Moreover, these rules define the characteristics of indoor ski centers, which also have an impact on the human and environmental environment. Because with the method of space syntax, the design quality of buildings can be understood and how visitors use the building can be determined (Yeşildal, 2019). In fact, both design and analysis require a holistic approach. In both cases, the important thing is to reveal or define the common expressive power of architecture. The modern tradition is that geometric volumes are held together by the relevant literature (Thiis Evensen, 2020). herefore, uncovering the basic ideas underlying the coming together of geometric volumes is based on the act of accessing the terms in line with the purpose of this study and bringing them together in a correct and guiding way.

As Aksoy et al., (2020) emphasize, in order to define spatial relationships, it is necessary to have control over the connectivity and integrity of spaces. Within the scope of this study, convex maps diagrams were prepared to illustrate the spatial relationships of the analyzed structures. The generated convex maps for this analysis are designed to define the spatial relationships of both structures. Because in a convex map diagram, the sizes of the spaces are not important. This diagrams aims to determine spatial configurations by revealing the existence of spaces and their relationships with each other (Ostwald, 2011).

One of the analyses used in this study is spatial depth analysis. The mean depth analysis, referred to as "MD," is defined as calculating the area that needs to be traversed to reach from one point to another (Huang et al., 2019). A deeper area indicated that it had a higher influence compared to other areas. In other words, as the number of places or spaces that need to be passed through to reach a specific location increases, the level of influence also increases. Indeed, these analyses empower the user to have a say in the integration and coherence values of the spaces within the structure. By analyzing the spatial relationships, connectivity, and depth, users can gain a better understanding of how the spaces are integrated within the overall structure and assess their level of coherence.

Because according to the space syntax method, integration values not only demonstrate consistency with the circulation within the system but also serve as the primary determinant of circulation, even in very large systems where axes cannot be accurately identified. These measurements are localized integration measurements limited to calculations in the spaces where each axis is located. The connections of all parts of the structure with the system can be read through the integration map. This map is created to indicate where the most integrated axes are located and what is more important in densely integrated areas (Baç, 2012).

In the case of Snow Arena in Lithuania, integration develops around the functional use area of the space, there is a strong fictional differentiation between spaces, and there are strong spatial relationships with the outside, resulting in a more integrated interior space and a more integrated exterior space.

In the case of Chill Factore in the United Kingdom, unlike Snow Arena, integration with the outside is not established based on functional similarity, but it is considered within the values of the structure. Therefore, the integration is lower compared to Snow Arena.

Both ski centers exhibit a holistic structure formed by a central hall surrounded by other spaces. Access to the spaces is provided from the central hall. In these maps, the spaces are given a color range from red to blue according to their degree of accessibility. In these maps, spaces are located within a color range that tends to differentiate from red to dark blue according to their value, with red representing the easiest space in terms of accessibility, and dark blue representing the most difficult space. Although ski curves constitute the blue-colored spaces that are difficult to access due to the controlled entrances and the places that include the preparation phase for skiing, in the Lithuania-Snow Arena example, the limited number of total spaces in the center facilitated the accessibility of the ski curves.

The concept of integration, or coherence, is used in conjunction with the concept of depth and is mutually dependent. In other words, in order to define the concept of integration, it is necessary to first understand the concept of depth (Jiang & Claramunt, 2002). Additionally, within this concept, there is another fundamental analysis method that contributes to integration, which is Relative Asymmetry (RA).

Table 1. Comparison of depth values in closed ski centers.

	Total Number of Spaces	Mean Depth Value	Relative Asymmetry	Integration Value
İngiltere- Chill Factore	24	2,869	0,169	0,679
Litvanya- Snow Arena	9	2,25	0,357	1,071

The relative depth of a space in relation to other spaces within a graph is mathematically expressed as the "relative asymmetry" value, which indicates whether the space is unifying within the configuration. The RA value, similar to the MD value, varies according to the depth of all spaces from the entrance. The integration or isolation of a space within a system is represented by its RA value. The higher the RA value, the lower the integration value (Czerkauer-Yamu, 2010).

Table 1 shows the relative asymmetry values of the examined centers within the scope of the research. The relative asymmetry value will always take a value between 0 and 1. The magnitude of this value indicates the tendency of the organization towards integration or segregation (Hillier & Hanson 1984). Both centers fall within this range. In the case of Chillfactore in the UK, its value is closer to 0, indicating that it is internally integrated. On the other hand, Snow Arena in Lithuania is more differentiated. This situation suggests that Snow Arena has a more inward-focused structure.

The integration value, which reveals the value of the connection between a specific space and other spaces, has been described as the measure of controlling direct access to connected spaces (Klarqwist, 2015). This value is directly proportional to the spatial connectivity, meaning that as this value increases, the spatial connection also increases (Baç, 2012).

Based on this information, areas with high integration values obtained through spatial layout analysis have high mobility and are also perceived as more accessible. The integration value decreases from red to blue and is adapted to a Likert scale with colors ranging from red, orange, yellow, green, to blue (Körmeçli, 2022). It is also observed that red axes tend to concentrate in areas that contribute to circulation in the axial maps of the examined structures.

Relative Asymmetry (RA) is a value that allows for the comparison of the depth of the visibility axes map, depending on the concepts of depth and proximity therewithal (Özbek, 2018). From the perspective of circulation, this value can manage how easily different spaces can be interconnected and how the transitions take place. A higher relative asymmetry value may indicate a more complex circulation pattern with longer and winding paths between spaces. Conversely, a lower relative asymmetry value can indicate a more direct and faster circulation. In this case, the example of the

Snow Arena in Lithuania, being used and included in circulation during specific time periods, has led to an increase in the RA value of the open skiing curve.

Similar to relative asymmetry, average depth also varies from space to space within the system, depending on the depth of all other spaces from the original space. The depth degree of each space is determined based on how connected it is to the original space or to what extent it is directly connected to other spaces (Hillier & Hanson,1984).

The Relative Asymmetry value of the space also indicates whether this space is unifying within the configuration (Jiang et al., 2000). Relative asymmetry and mean depth values are the values from which spatial inferences can be made without the need for a systematic theory (Bafna, 2012). They are factors that affect the decisions to be taken in the design phase in order to be able to think in advance the genetic description of the structure as well as the phenotype, which is the realization of this genetic description (Hiller et al., 1987).

As seen in also Table 1, there is a direct proportion between the number of spaces in the structures and their average depths. It should be noted that the ski areas, which are the prominent interactive areas of the indoor ski centers, are not transformed into deep spaces in the overall design and direct access is provided. This is an inference that needs to be considered in this context.

The result of the design process of an architectural structure, its impact on people and the environment, shows that the final product also has an impact on human and environmental structuring (Kahn, 1998). Achieving this final product involves different qualities of decision-making stages and these stages define a process (Alexander, 1964).

Space designers, like other designers, feed on standards that can be "taken as an example or as a basis" and sometimes form the basis of standards (Arabacıoğlu, 2008). So, when a design product emerges, it is shaped according to the expectations and wishes of the user, and these expectations and wishes determine the decisions of this design.

At the same time, the analyses conducted in this study provided what Turner calls a heuristic method of spatial analysis (Turner, 2003). Using DepthmapX 0.50 (developed by Tasos Varoudis), the analyses reduced to a two-dimensional plan were evaluated as a representation of three-dimensional spaces.

Following these analyses, genotype research, that is, the search for compatibility in the defined organizational relationships (Bafna, 2012), was carried out by searching for similarities between the data obtained from the analyses. for this, various inferences were made based on the relatedness of the centers' organizations.

4. Conclusion and Suggestions

The findings of this study provide a critical investigation of the structural elements of indoor ski centers and the accurate classification of elements showcasing various characteristics of their locations. This research serves as a valuable resource for both researchers and designers in presenting a synthesis for the design of enclosed ski centers.

The comprehensive framework of this study has been established by arranging individual forms and emphasizing their organization with respect to two-dimensional plans. It has been revealed that the consistent and harmonious wholes are derived from the connections behind individual elements.

Here, the following question can be asked: Do the forms of spaces and their interaction with interior spaces support or hinder the connection with the user?

When answering this question, we can refer to the analysis of convex spaces, which involves discussing concavity and convexity. According to the analysis conducted on Snow Arena in Lithuania, it is determined that it has a concave form. The analysis also reveals that integration is higher in concave spaces and these spaces are homogeneously distributed. Therefore, it is found that both the form of the space and its interaction with interior spaces have an impact on the integration value, which consequently affects the relationship with the user.

According to the findings of the study, in the case of Chill Factore in the UK, the integration with the exterior is not established through functional similarity, but it has been considered within the values of the structure. It is located within a shopping center and does not have a direct connection with the outside.

In the case of Snow Arena in Lithuania, integration is developed around the functional use area of the space, and there are strong fictional differentiations between the spaces. The structure has strong spatial relationships with the exterior, which results in a more integrated interior space and a more integrated exterior space. The spatial evaluations of this structure have shown that additional spaces used in different time periods enhance the integration value of the structure.

Indeed, the additional space that also contributes to the concavity of the structure demonstrates the influence of temporal use on the design. This is particularly relevant in the case of Lithuania, which experiences winter seasons. The consideration of an open skiing area that can be used when snow is available during the design phase of the structure has led to the integration of the skiing curve with the space.

In other words, places with the same number of places, but integrated into higher depth levels and thus generating a higher average depth level, tend to segregate because they generate a high relative asymmetry value. However, ski preparation areas, which are passed before reaching the ski curve, create a connection between each other and thus raise the ski curve to a higher depth level. However, spaces that are directly connected to the ski curve (such as another ski curve) increase the depth of the space and make the value of the ski curve shallower. Since each different function creates a new characteristic and the organization of these functionally different spaces creates a different pattern, different genotypes are formed.

The emerging genotypes of indoor ski centers are not associated with their volumetric size. It was supported by the analysis of the relationships between the spaces in the plan plane. Analyzing the relationships between the functional tendencies of the spaces revealed that when these spaces are considered as a product, it is through these analyses that various design decisions can be reached to provide a new product. Which function will be integrated where in the organization, the effect of this integration on the overall value of the building can be predicted and design decisions can be implemented according to these predictions.

All these steps contribute to the research process, which involves the collection, analysis, interpretation, and discussion of data related to the design and operation of indoor ski centers.

With the idea that form is decisive in structuring the silhouette in the genotype-phenotype relationship, it is necessary to construct the coming together of forms in a coherent and coordinated manner. This takes the organization beyond the concept that expresses the boundaries of the shell -building envelope-.

Analyzing the struggle between differences in the context of the practice of sovereignty, this study focuses on explaining the spatial consequences of this struggle. Therefore, the maintenance and constant reproduction of difference is critical for the struggle to continue. It is important to see space not only as a system or image, but also as an element produced in interaction with users. With this interaction, user-oriented design, integration of space with society, user satisfaction, quality of life and sustainability can be effective and shed light on future studies.

It is thought that this process can be a guide for future Indoor Ski Center designs and can help minimize environmental impacts with new studies to be developed.

Acknowledgements and Information Note

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References

Aksoy, E., Aydın, D. & İstifoğlu, G. (2020). Analysis of the correlation between layout and wayfinding decisions in hospitals. *Megaron.* 15(4). https://doi.org/10.14744/megaron.2020.21797

Alexander, C. (1964). Notes on the Synthesis of Form (Vol. 5). Harvard University Press.

Arabacıoğlu, B.C. (2008). Etkileşimli Mekân Tasarımı, *KMİM* 3, 43-51.

Baç, S. (2012). *Tarihi kentlerde koruma kavramının mekân-dizim yöntemi üzerinden araştırılması-Bergama örneği* (Doctoral dissertation), DEÜ, Fen Bilimleri Enstitüsü.

Bafna, S. (2012). Rethinking genotype: Comments on the sources of type in architecture. *The Journal of Space Syntax,* 3(1), 69-80.

Ching, F. D. (2002). *Architecture: From, Space and Order*. New York.

Czerkauer-Yamu, C. (2010). *Space Syntax Understanding, HILLIER's Concept of Spatial Configuration and Space Syntax Analysis.* Universite de Franche-Comte, University College London, England.

Demirci, G. (2017). *Kapalı kayak merkezlerinin mekân algısının sporcu davranışı üzerindeki etkileri* (Master's thesis, Fen Bilimleri Enstitüsü).

Demirci, G. & Arabacıoğlu, B. C. (2022). Mekân tasarımı üzerine sistematik bir süreç araştırması. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi*, 13(1), 272-281. https://dergipark.org.tr/en/pub/gumus/issue/68497/1008993

Dinçer, Ö. (2005). Mekânsal hemyüzey birleşim ve entegrasyon kavramları ve mimari mekân organizasyon süreci, *Egemimarlık*, Cilt:2, Sayı:54, Sayfa 24-27. https://www.egemimarlik.org/cevirim-ici-okuma/54/900

Esin, N. & Ozsoy, A. (2003). *Environmental Quality: Concepts. Contradictions, and Some Questions, Quality of Urban Life Policy Versus Practice*, Edited by Nuran Zeren Gülersoy, Nur Esin, Ahsen Özsoy, Istanbul Technical University, Istanbul, 24-32.

Gür, (1996). Mekân Örgütlenmesi, Gür Yayıncılık, Trabzon.

Hanson, J. (1988). *Decoding Homes And Houses*, Cambridge University Press, United Kingdom.

Huang, B. X., Chiou, S. C. & Li, W. Y. (2019). Study on courtyard residence and cultural sustainability: Reading Chinese traditional Siheyuan through space syntax. *Sustainability,* 11(6), 1582. https://doi.org/10.3390/su11061582

Hesselgren, S. (1969). *The Language of Architecture, 1*, Studentlitteratur, Lund, Sweden.

Hillier, B. & Hanson, J. (1984). *The social logic of space.* Cambridge: Press Syndicate of the University of Cambridge.

Hillier, B., Hanson, J. & Graham, H. (1987). 'Ideas are in things: An application of the space syntax method for discovering house genotypes', *Environment and Planning B: Planning and Design*, Vol. 14, p.363-385. https://doi.org/10.1068/b140363

Jiang, B., Claramunt, C. & Klarqvist, B. (2000) Integration of space syntax into GIS for modelling urban spaces. *International Journal of Applied Earth Observation and Geoinformation*, 2(3-4), 161-171. https://doi.org/10.1016/S0303-2434(00)85010-2

Jiang, B. & Claramunt, C. (2002). Integration of space syntax into GIS: new perspectives for urban morphology. *Transactions in GIS*, 6(3), 295-309. https://doi.org/10.1111/1467-9671.00112

Kahn, L. (1998). Conversations with Students, Architecture at Rice Publications, (97-102), Eds. Dung Ngo. Houdston, Princeton Architectural Press, New York.

Klarqvist, B. (2015). *A space syntax glossary.* NA, 6(2).

Körmeçli, P. Ş. (2022). Üniversite yerleşkelerinde ulaşım ağının mekân dizimi ve coğrafi bilgi sistemleri ile değerlendirilmesi: Çankırı örneği. *Journal of Architectural Sciences and Applications,* 7(1), 248-262. https://doi.org/10.30785/mbud.1074617

Lynch, K. (1960). *The Image of the City*, MIT Press.

Maki, F. (2015). On collective form. *Docomomo journal,* (53), 4-11. https://doi.org/10.52200/53.A.C4GWDAQ3

McLean, K. (1999). Museum exhibitions and the dynamics of dialogue, *Daedalus,* 128(3), 83-107. https://www.jstor.org/stable/20027568

Onat, E. (1995). Mimarlık, Form ve Geometri, Yem Yayınevi, İstanbul

Ostwlad, M. J. (2011). A justified plan graph analysis of the early houses (1975-82) of Glenn Murcutt, *Nexus Network Journal,* 13, 737-762. https://doi.org/10.1007/s00004-011-0089-x

Özbek, M. Ö. (2018). İstanbul Hanlar Bölgesi'nde doğal yaya hareketliliğinin morfolojik bir yöntem olan mekân dizimi ile incelenmesi. *Marmara Coğrafya Dergisi,* (37), 183-193. https://doi.org/10.14781/mcd.386365

Sanoff, H. (2016). *Integrating Programming, Evaluation and Participation in Design* (Routledge Revivals): A Theory Z Approach. Routledge.

Thiis Evensen, T. (2020). Archetypes in architecture. Scandinavian University Press (Universitetsforlaget).

Turner, A. (2003). Analysing the visual dynamics of spatial morphology. *Environment Planning B: Planning Design,* 30(5), 657-676. https://doi.org/10.1068/b12962

Turner, A. (2006). *Depthmap v6* (Computer Program).

Yeşildal, Ö. (2019). Nöroloji Ve Mekânsal Biliş Arasındaki İlişki Bağlamında Space Syntax Eleştirisi*,* (Yüksek Lisans Tezi), MSGSÜ Fen Bilimleri Enstitüsü.

Yuan, R. & Wang, D. (2016). From 'functional space' to 'experience space': The analysis and thinking about contemporary museum space. *Huazhong Architecture,* 34, 15-19. https://doi.org/10.14246/irspsda.8.2_86