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**The Visibility Graph and Syntactical  
Analysis of Spatial Organisation  
in Traditional Buca Houses**

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## **The Visibility Graph and Syntactical Analysis of Spatial Organisation in Traditional Buca Houses**

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### **Abstract**

Buca (İzmir - Turkey) harboured many different social, cultural and spatial buildings in its past and most of these spatial settlements have been protected despite the changes over the course of time. Today, Buca is a settlement that has been able to survive by being protected within the old city structure called protected area.

The aim of this study is to provide data related to the spatial organization, space use and function of Buca houses.

In the study, eight house plans in Buca were examined and measured by the space syntax and visible space analyse methods.

By describing the features of the houses' spatial and visible space structures, the conclusion of the study presents objective data related to the effects of these features on the construction of the spatial organization of society's social and cultural structure and formation of the intensity of space use.

**Keywords:** Buca, space syntax, spatial analysis, visual analysis, space, space - user relation.

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## **Introduction**

Houses, which can reflect social, cultural structure and architectural features of society, are considered to be spaces where individuals spend most of their lives. Their lives determine the organization of space. The users' directions of movement and their spatial relations, related to where and how often they communicate, privilege some spaces in the house over others. Spatial differentiations always emerge and improve within the needs of the society and their cultural values and provide us with related information.

Buca harboured different social, cultural and spatial structures in the past, and most of the spatial structures have been able to survive by being protected within the old city structure. This space is still called a protected area today, despite the changes it has gone through over the course of time.

In this study, Buca houses have been examined using space syntax and visible space methods to question the relationships between space and user. The space features of accessibility, based on users' movements, and visibility, based on users' perceptions, display the users' manners of experiencing the space.

Therefore, the aim of the study is to concretize the spatial relations belonging to traditional Buca houses with numerical data and to obtain an objective output related to the kinds of effects users' daily lives have on the formation of intensity of use in these spaces. Space syntax and visible space analysis studies are based on the building survey drawings in Cem Bilginperk's specialization thesis (1999).

### *Buca*

Buca is a settlement home to local Christian minorities, mostly Greek people and wealthy businessmen and their families. They are alien citizens called Levantines [1]. Erpi (1987) states that we have insufficient information about when and by whom this settlement was founded, but adds that data was found about its presence during Roman and Byzantium times.

Colonialism began in the 17<sup>th</sup> century and accelerated towards the middle of the 18<sup>th</sup> century. Over the course of time, a deportation policy was replaced by a migration policy with the support of governments. The population of Greek people in Buca increased over time. 60.000 people who ran away from Orlof uprising in 1770 and migrated to Anatolia from Morea and Aegean Islands settled down to Hacilar and Buca in the İzmir vicinity. The second migration emerged when İbrahim Pasha suppressed the rebellion in Morea between 1826 and 1827. During the Balkan War in 1912-1913, a small group of Rumeli migrants came to Buca and probably settled down around Tingirtepe. During the Republic period in the 1950s, Buca protected its old urban structure and scale. The most important change in Buca's urban history was its connection to İzmir with the railway line.

The extension of the İzmir-Aydın railway to Buca was another important improvement. As the senior executives of the company settled in Buca, life in the suburban area was revived [1].

*Traditional Buca Houses*

When we look at the historical settlement generally, we observe Western architecture in southern areas with respect to architectural construct, system and material choices (brick accumulation and stone material). Architectural texture constituted by the Levantines and the Greek-Jewish and Armenian minorities in the south has also been observed in the present. Other architectural textures, composed of wooden houses belonging to Muslim community's living spaces situated in the south of the settlement, were observed to disappear over the course of time.

Buca houses can be grouped into 2 categories. In the first category, there are houses belonging to local people, most of whom are from the Greek, Jewish and Armenian minorities. In the second category, there are mansions built by alien Levantine families who settled in İzmir [1].

**Houses belonging to local people (Greek, Jewish, Armenian):** Buca's urban texture mostly consists of those Chios-style houses from the first category.

1. Floor plans display a clear geometrical order close to a square. In the plan typologies, the hall is either situated in the middle or on one side. Other spaces are accessed from the hall. The houses in which the entrance is in the middle have the feature of middle hall and the houses in which the entrance is on only one side either have the feature of an outer or side hall.

2. The entrances to the houses are generally elevated by the stairs and taken into the niche. In the examples where the ground floor was elevated, its platform and stairs give way to an entrance. In the example with the garden, the garden gives way to the entrance. In some examples, there are two entrances, one from the front of the house and one from the garden.

3. Houses without bay windows have 1, 1,5 and 2 floors. They usually have a basement half or fully embedded into the soil or an elevated basement storey used for living space.



Figure 1.1. An example of an elevated basement storey house without bay windows and with an entrance on one side placed into the niche. Figure 1.2. An example of an embedded basement house with an entrance in the middle placed into the niche. Figure 1.3. An example of an elevated basement storey house with an entrance through the platform. Figure 1.4. An example of a one storey house with a wide front.

4. In the houses with bay windows, bay windows activate the fronts of houses and facilitate the visual relationship with the street. The bay windows are generally of wooden construction and rectangular form.

5. The houses with bay windows have 2 floors. The bay window is on the upper floor. There is a basement storey totally embedded into the soil. However, this storey is not used for living space. It generally has storage function and the part over the soil is not more than 1 meter long. The small openings, fixed to the window axes on the frontage, secure the air conditioning [1]. In addition, it is possible to see two examples of houses where basement storeys were planned as a workplace.



Figure 1.5: An example of a house with an entrance through side garden, without bay windows. Figure 1,6,7 and 8: Examples of houses with entrances through side garden and frontage with bay windows.

### *Method*

In this study, the space syntax method was used to determine the relationship of the space with the user. Houses were examined by spatial analysis based on permeability relations and visual analyses based on visibility relations.

The relation between visibility and permeability is a vital component of how houses work spatially and are experienced by their occupants [2]. Space syntax and visible space analysis are two important tools used to identify this change concretely. Analyses related to using this process are presented using space syntax and visible space analysis based on space organization.

Space syntax focuses on exterior features like buildings' connections, their relations with all spaces within the system rather than interior features like buildings' forms, scales and textures [3]. In this respect, space syntax is a method used to explain the relationship of space with social and cultural structures in the space organisations of a city or building and to analyse the spatial construction.

On the other hands, visible space is a set of points in a space that can be seen from a specific point. The form and the size of the visible space can change from the user's point of view. There are numerical criteria proposed to quantify these forms and dimensions. Visible spaces constitute the alternative definitions of the environment. This method is approved in terms of perception and behaviour studies in architecture, particularly vision control, privacy and defensibility judgement [4]. In contrast to space syntax analysis, both the door-window openings that enable access between spaces inside the building and the sizes of these openings should be considered important in a visible space analysis.



### Convex Space and Visible Space Analyses of Buca Houses

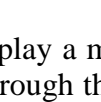
Eight houses were investigated in the study. The positions and the sizes of the hall, living spaces, the garden and the bay window in the examined houses differ in each example of a house, and these differences reflect on the analysis maps in the study.

**Table 2.1.** *The number of floors and plan features of the traditional Buca houses in the study*

House No	Floor	With Mid-Side Hall	Entrance Count	Bay Window	Garden
1	Ground	Mid	1	-	-
2	Ground	Mid	1	-	-
3	Ground	Mid	2	-	+
4	Ground	Side	2	-	+
	Upper	Mid	-	+	-
5	Ground	Side	2	-	+
	Upper	Mid	-	+	-
6	Ground	Side	1	-	+
	Upper	Mid	-	+	-
7	Ground	Side	1	-	-
	Basement	Side	2	-	+
8	Ground	Mid	1	-	-
	Basement	Mid	2	-	+

Table 2.2 displays important spatial features related to the houses in the study. Any information about a plan related to the basement floors could not be found in these houses. However, it is thought that the basement floors are fully or half embedded, and that they were not used as living spaces. The other two examples were included in the analysis since their basement floors were elevated and used as living spaces.

**Table 2.2.** *Sample plans and plan typologies of Buca houses in the study*

House No	1	2	3	4	5	6	7	8
<b>Basement Floor</b>								
<b>Ground Floor</b>								
<b>Upper Floor</b>								
<b>Basement Floor</b>								
<b>Ground Floor</b>								
<b>Upper Floor</b>								

The plan features in the studied house samples display a mid- or side-hall feature. Access to all spaces on all floors is generally through the hall. You can go in and out of the house through the hall. There is a mid-hall in one storey houses. The basement floor of two storey houses with bay windows have side halls, and the upper floor has a mid hall. Access to the upper floor is through the stairs situated in the mid hall. In the houses with a basement floor, the ground floor and the basement floor display the same hall features.

In one sample house, access to the basement floor is through the stairs situated in a separate space in the hall, and in another sample house, access is through the garden, independent of the basement floor.

There are usually two entrances in the houses with gardens. One of these entrances is on the street and the other is through the garden. The houses with a basement floor have two different entrances, either from the rear front or side front through the garden.

All of the two storey houses have bay windows. In two sample houses, there is one entrance to the bay window, from only one room. In the other sample house, the entrance to the bay window is through two rooms.

*Findings of Convex Space and Visible Space Analyses*

**Table 2.3.** Average integration values obtained from the convex space analysis with and without external space in traditional Buca houses

House No	Without External Space (Integration HH)			Mean Depth	Controllability	Relative Asymmetry (RRA)	House No	With External Space (Integration HH)			Mean Depth	Controllability	Relative Asymmetry (RRA)
	min.	mean	max.					min.	mean	max.			
1	0,69	1,37	3,49	1,66	0,24	0,95	1	0,76	1,83	6,89	1,82	0,23	0,83
2	0,69	1,37	3,49	1,66	0,24	0,95	2	0,76	1,83	6,89	1,82	0,23	0,83
3	0,63	1,21	1,69	1,8	0,28	0,95	6	0,45	1,4	6,89	2,03	0,35	1,05
6	0,38	1,06	3,49	1,93	0,3	1,33	3	0,59	1,33	2,95	1,97	0,2	0,87
5	0,33	0,98	3,49	1,69	0,35	1,52	5	0,42	1,23	5,09	1,8	0,34	1,23
4	0,33	0,93	3,49	1,76	0,45	1,62	4	0,5	1,22	4,02	2	0,39	1,28
7	0,42	0,87	2,11	1,93	0,27	1,51	7	0,49	1,14	3,49	1,93	0,3	1,2
8	0,32	0,73	2,11	2,4	0,25	1,77	8	0,35	0,74	1,69	2,59	0,25	1,6

**Table 2.4.** Average integration values obtained from the visible space analysis in traditional Buca houses

House No	Visibility (Integration HH)			Visibility Mean Depth	Visibility Controllability
	min.	mean	max.		
2	0,15	0,23	0,33	37,98	0,46
1	0,12	0,21	0,31	45,34	0,46
3	0,11	0,2	0,28	46,76	0,46
5	0,12	0,19	0,29	48,46	0,45
4	0,1	0,18	0,27	54,39	0,45
6	0,1	0,18	0,27	54,04	0,45
7	0,1	0,18	0,26	55,11	0,45
8	0,09	0,15	0,23	68,79	0,45

*Comparison and Interpretation of the Results of Convex Space and Visible Space Analysis of Traditional Buca Houses*

**Table 2.5.** Comparison of traditional Buca Houses based on the measurement values obtained from the convex space and visible space analysis

House No	Floor Count	Spatial Integration	Visibility Integration
1	1	1,37	0,21
2	1	1,37	0,23
3	1	1,21	0,2
6	2	1,06	0,18
5	2	0,98	0,19
4	2	0,93	0,18
7	2	0,87	0,18
8	2	0,73	0,15

**Table 2.6.** Comparison of traditional Buca Houses based on the integration maps obtained from the space syntax and visible space analysis

House No	Without External	With External	Visibility Place	House No	Without External	With External	Visibility Place
1				6			
2							
3				7			
4							
				8			
5							

Table 2.5 presents integration values and Table 2.6 presents integration maps in order to better identify the mutual interaction between spaces and visibility in all houses. The houses were put into order according to spatial integration values, from the highest value to the lowest. It is observed that spatial integration values and visual integration values are generally parallel. While five of the houses (Houses 1, 2, 3, and 6) display an introverted structure in terms of spatial integration, they display an extroverted structure in terms of visual integration. However, houses 5, 4, 7 and 8 have an extroverted structure in both analyses.

When we look at the Table 2.6, we see that spatial and visual integration maps seem to support each other. The visual integration map of the most integrated space in the spatial integration map is observed to have both integrated and segregated points in itself. The reason for this situation is that more sensitive measurements were carried out in a visible space analysis and that openings that were not considered in a spatial analysis were included in a visible space analysis. For example, in spatial analysis, all the openings in the house were covered and the spaces were considered within themselves. Yet, in a visible space analysis, door-window openings and their sizes were taken into account, and the spaces were considered within the boundaries of the house.

In both of the analyses, the most integrated space is the hall, which is used as a transfer area between spaces, up to the floors, to the street or the garden,

and has the most intensive circulation. The other integrated spaces are the living rooms, which are used for sitting or sleeping. The segregation tendency is observed in spaces used for different purposes.

Segregated spaces in a convex space analysis display a more segregated structure in visual integration. The spaces that tend most towards segregation are kitchens, the WC, or spaces used for both the bathroom and the WC with a living room, which close to the entrance of the house. Moreover, bay windows in two storey houses are one of the spaces that have the feature of segregation.

**Table 2.7.** *Integration values obtained from the convex space analysis in the interior spaces of the traditional Buca Houses*

House No	Hall	Living Room	Bathroom +WC	Guest(Living) Room	Bay Window	Kitchen
1	3,49 (mid)	1,16	0,69	0,87	-	0,87
2	3,49 (mid)	1,16	1,16	0,69	-	0,87
3	1,69 (mid)	1,69	-	1,27	-	0,63
4	3,49 (upper floor-mid)	1,16(upper floor)	-	0,33	0,49	0,33
5	3,49 (upper floor-mid)	1,16(upper floor)	-	0,33	0,69	0,33
6	3,49 (upper floor-mid)	1,74(upper floor)	0,38	0,49	0,58	0,49
7	2,11 (ground floor-side)	0,87 (basement floor)	0,43	0,52	-	0,42
8	2,11 (basement floor-mid)	1,05 (basement floor)	0,52	0,32	-	0,76
mean	2,92	1,24	0,63	0,6	0,58	0,58

Table 2.7 displays the average integration values based on the spatial analysis related to house spaces. In the evaluation stage, it was found that living rooms used for the purposes of sleeping and sitting by house users have high integration values, but that guest rooms used by visitors have low integration values. Moreover, wet spaces are being considered in terms of the bathroom and WC functions, or bathroom functions alone.

At this point, it was identified that spaces used as a bathroom and WC, and the kitchen in houses 6 and 8, are situated in the basement floor and the ground floor respectively in similar house plans. Since no space was identified with the bathroom and WC functions in houses 3, 4 and 5, the related data was not presented in the table.

The relationship between the houses and users designates the spatial sustainability inside the house and influences the forms of operation in the spaces. In this respect, when we interpret the houses in terms of spatial and visual aspects, common features emerge. Even if they have different values in

spatial and visual analyses, the most integrated and the most segregated spaces are generally observed in the spaces used for the same function.

In terms of integration, spaces in the traditional Buca Houses are as follows: hall>living room>bathroom+WC>living room for guests >bay windows>kitchen.

Hall: The hall is an important circulation area that holds all the spaces together, connects the floors with each other, enables the relationship with the street and the garden, and shapes the house plan. Living rooms and the other spaces are organized around the hall. Stairs are also situated in the hall.

In some houses, the stairs are connected to three spaces and in others they are connected to eight spaces. All spatial and visual relations inside the house are secured based on the hall. All houses have a planning order centred around the hall.

When we investigate Table 2.7, we see that the basement floor hall in one storey houses, the upper floor hall in two storey houses, the basement floor hall or the ground floor hall in houses with a basement floor display a high integration tendency. When we consider the positions, the mid hall order in the plans stand out.

Living room: These are one of the spaces that form the house plan. All the living rooms are opened into the hall. Living rooms that are used for sleeping or sitting by the users are close to the garden or connected to the kitchen in one storey houses. They are situated on the upper floor in two storey houses and depending on their position, on the ground floor or the basement floor in houses with a basement floor. When we look at Table 2.7, we observe that living rooms integrated according to the floors are parallel with the hall in all sample houses except house 7. As for their position on the plan, they come after the space that is generally used as a guest room.

Bathroom+WC: The spaces used as bathrooms and WCs are named in only three house plans. Their positions are identified using similar plan features in other houses. Bathroom and WC functions can be used together or separately. They are generally situated in a position far from the entrance, at the rear front. They have a weak connection with the hall. The WC or bathroom is located on the basement floor in sample houses with a basement floor and in the ground floor in sample one storey houses. Its location could not be identified in two storey sample houses.

Living room for guests: Because the living room has a low integration value and is situated close to street entrance, we believe the living room is not intensively used by house users and that is generally used for hosting guests. They are as big as living rooms in terms of their size on the plan.

Bay windows: This space secures the relationship between interior and exterior space. Where, the entrance to one or two living rooms is situated on the upper floor, and is used for sitting as well. Although the living room that it is connected generally has an integration tendency, the use of bay windows is not intensive within the house.

Kitchen: The kitchen is the most segregated space, usually far from the entrance in the house plan situated at the rear front. It's not as open to use as

the hall within the house. It's possible to access this space directly through the entrance hall and also through a separate area or room. It was designed to be able to serve for both the interior and exterior space in some houses. Moreover, the cellar found in house sample 7 is a space that has the same integration value as the kitchen. This space, where various items or materials are kept so as to make use of coolness of the basement floor, is not included in the interpretation study, since it doesn't exist in most of the houses.

## **Discussion and Results**

When we look at the development of types of houses in a settlement, we see that they are influenced by the social and cultural changes that the society living in the settlement went through. The spatial organization of the house, sizes of the space and its functions, that is, all the parts that constitute the space, are reflections of habitants' life styles.

In order to define the relations between space and user within the house, it is necessary to identify spatial areas based on user actions and visible areas based on visual perception. With the distributions of these areas, we determine the relations of the users, between themselves, their relations with guests, and the relation of the house with the exterior space.

In this respect, during the analysis of traditional spatial organization, the space syntax method and visible space analysis were stated as the method of the field study carried out in a Buca city settlement. The most important reason for preferring this method is to determine the strategies intended for space use. The analysis techniques in use can make significant contributions to formulating the spatial models concretely, and to analyse and evaluate the spatial relations quantitatively and visually.

As a result of the analysis of traditional Buca houses, similar features and differences in houses' spatial structures and visible area structures were displayed. Half of the houses that were examined display an introvert structure and integration tendency in terms of the way the spaces were combined. The other half displays an extrovert structure and segregation tendency as well. It was concluded that the hall has a considerable place in the house due to the fact that it both enables the entrance to the house; it is connected with the floors or the garden and is used very often. Furthermore, living rooms are the other spaces that are used most widely. These rooms are usually used for sleeping or sitting. On the other hand, the bathroom, WC, and kitchen display a segregation tendency because they do not connect directly to the hall. Use of garden and bay windows is also widespread, besides spaces in the houses. The kitchen, living room, hall on the ground floor, or spaces in the basement floor are generally connected with the garden and the living rooms on the upper floors are connected with the bay windows. In this respect, it is seen that house users tend to use the garden at the rear front rather than spaces in the front of the houses during their daily lives.

Furthermore, independent from the basement floor and the ground floor, there is a direct connection from the garden in some houses, which shows the presence of garden use. The visual relationship with street life is mostly obtained through the bay windows. Since living rooms for guests, which are close to the street, display a segregated structure, it is possible to say that these rooms are not used often by users in daily life.

As a result, in accordance with the concrete data obtained, it is seen that the social and cultural structure of society has a significant role in the formation of spatial organization and use. In this respect, this study aims at making contributions to similar studies and promoting the use of space syntax and visible space techniques in house planning in the future.

## Reference

- Erpi, F., (1987). *House Architecture in Buca*, ODTU Press, Ankara.
- (2)Tahar, B. and Frank, B., (2003). The Visibility Graph: An Approach for the Analysis of Traditional Domestic M'zabite Spaces, Proceedings Fourth International Space Syntax Symposium, London.
- Hillier, B. and Hanson, J., (1984). *The Social Logic of Space*, Cambridge, University Press.
- Benedikt, M. L., (1979). 'To Take Hold Of Space: Isovists and Isovist Fields'. *Environment and Planning B: Planning and Design*, 6, 47-65.