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Spatial Control of 'Sequina' Slum Area in Alexandria, Egypt

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***Abstract*:** *The major problem of migration in Egypt from rural to urban areas causes the sprawl of slums. However, the social dimension is undermined in the previous research and institutional efforts of upgrading. In this regard, the social logic of 'Sequina' slum area in Alexandria aggregates the discrete spatial system of twenty-sample layouts according to the space syntax measure of control with visible and functional criteria.*
The essence of social structure deduces the 'geno-type' control of 'kitchen' and 'inverted geno-type' of 'living' to alternate as 'inhabitant' or 'visitor' domain with the 'bedrooms' of interactive correlation to the average control of layouts. Meanwhile, the 'inhabitant' subdomains structure the transparent 'children' control between the exposed 'balcony' and 'visitor' centrality, while the control-less 'parent' secures the graph of tree-leaves out of sight. The control measure demonstrates as inverse correlation with the graph order and graph-tail level, which is compensated through the spatial multipurpose and relaxed visibility but restricted rings. The spatial retrieval of layout control clarified at the level of room micro-analysis to address the future planning of redevelopment.

Keywords: *Alexandria, Sequina Slum, Spatial Control, Social Structure*

1. Introduction

The urban sprawl of slum areas in developing countries represents a universal challenge of retreatment. Despite the disgraceful image, the slum issue demonstrates social aspects of urbanism. The slum phenomenon is largely found in Egypt against the building codes and without basic infrastructures [11 & 12]. In particular, the steady migration from rural to urban cities characterizes the Egyptian slums. Job finding clusters fellow migrants in urban slums through social communications. In this respect, each slum area requires social study to clarify the spatial structure of classified migrants by rural zones [6 & 7]. Among the populous slums selected for a detailed survey is 'Sequina' area in Alexandria, of majority laborer migrants from the nearby 'Behera' rural province. Since the area lacks socioeconomic census or building documentation, household survey has been first conducted on a cluster of blocks to stratify layouts of twenty-sample buildings by migrants for detailed room survey "Figs.1-6". The micro-level survey of 'Sequina' area in Alexandria blend with the previous studies on slums of Egypt in extended scope of analysis at different levels of spatial resolutions [for example 13, 9, 1 & 2].

The study of social slums addresses the space syntax methodology [4], where the justified graphs of layouts perform spatial measurements. Meanwhile, the spatial visibility adds another dimension of housing decodes [8]. In this regard, the

Fig.1: Location of 'Sequina'

Fig.2: Survey Samples

Fig. 3: Street

Fig. 4: Market

Fig. 5: Edge

Fig. 6: Access

survey layouts in 'Sequina' slum area analyze the spatial control measure of space syntax with visibility and functional aspects, in addition to the extendable properties of 'Graph Theory' interpretations with collective statistical exploration to determine the social logic of space [for example 5 & 10]. The objective is to define the social dimension for the long-term comprehensive plan strategy of redeveloping slum areas in Alexandria, which lacks the social consideration however [3].

2. Spatial Control Analysis

The massive blocks in 'Sequina' area sprawl along narrow alleys of different depth/height ratio. Multi-storey buildings attach without setbacks in a ‘beady-ring’ urban structure. Common layout of apartment buildings composes one or two flats per typical floor, and accessed through shared staircase down to the alley. The survey sketched the typical floor plans of twenty-sample apartments, which are selected from various blocks in the area “Fig.7”. Each survey apartment, nevertheless, supposes the outdoor staircase to be the carrier of labelled rooms as they function, with bedroom serial numbering in clock-wise direction. Justified graphs are constructed from the staircase (carrier), while the transitional corridor spaces are represented as a bold dot “Fig. 8”. Resulted graphs illustrate the shallow bushy-tree structure of spatial organization, which counts a height of three. The second level of graphs has spatial control of highly non-distributed relationships among the survey rooms. The shallow control spaces concerns less private room functions such as ‘reception & living’ spaces. However, deep spaces function for ‘bedrooms & utilities’ of considered privacy. Although the general syntactic properties are seen in graphs, the logic of control spaces in moving around the shallow graphs is less observed “Table 1”.

TABLE I: Spatial Control of Survey Layouts in 'Sequina' Slum Area

Layout	S	R	L	D	K	T	BI	BII	BIII	AI	AII	C	Aver.
No.1	0.25	2.7	2.25		0.33	0.25	0.33	0.33		2.25		0.33	1
No.2	0.25	3	1.25	3	1.25	0.5	1.25	0.25				0.5	1.25
No.3	0.2	3.8	0.2		0.33	0.33	1.2	0.2		2.2		0.5	1
No.4	0.25	2.7	2.25		0.33	0.33	0.33	2.25	0.25	2.25		0.33	1.125
No.5	0.2	4	0.2		1.2	0.5	1.2	0.2				0.5	1
No.6	0.25	2.8	2.25		1.5	0.5	0.33	0.25		0.75		0.33	1
No.7	0.2	4.5	1.2		0.2	0.2	0.2					0.5	1
No.8	0.2	4	0.2		1.2	0.5	1.2	0.2				0.5	1
No.9	0.2	3.3	0.7		0.33	0.33	0.7	0.2		2.2		1	1
No.10	0.33	1.8	1.33		1.83	0.33	1.33	0.33		2.33		0.5	1.12963
No.11	0.83	1.5	1.33	1.5	0.33	0.5	0.33			2.33	1.33	0.5	1.05
No.12	0.5	1.3	1.25		0.25	0.25	0.25			3.5			1.035714
No.13	0.2	4	1.2		1.5	0.5	0.2	0.2		0.7		0.5	1
No.14	0.25	3.3	0.25		0.33	0.33	0.25			2.25			1
No.15	0.25	2.8	1.25		0.5	0.25	0.25	0.5	0.25	2.75	1.25		1
No.16	0.2	0.5	4.5		4.5	0.2	1.2	0.2				0.5	1.475
No.17	0.25	3	3		1.25	0.5	1.25	0.25				0.5	1.25
No.18	0.2	4.3	0.2		0.33	0.33	0.2	0.2		2.2			1
No.19	0.25	3.5	1.25		3.5	0.25	1.25	0.25				0.5	1.34375
No.20	0.2	3.8	0.2		0.33	0.33	1.2	0.2		2.2		0.5	1
Aver.	0.27	3.03	1.31	2.3	1.07	0.36	0.72	0.38	0.25	2.15	1.29	0.5	1.1

In this spatial control measure, every two adjacent spaces swap control of varying ratios according to the property of graph degree. Each space adds the fractions received from adjacent ones, where the higher the value the more is the spatial control. As a rule of thumb, the space of value above 'one' indicates a high control measure over the surrounding and vice versa. The spatial meaning of control measure determines whether a space has a distributed structure of less control or non-distributed one of higher control. The more distribution of a space (less control) indicates its diffused control with the higher probability of allowing ‘ringy’ routes to circulate between spaces [4]. The resultant control measure of the surveyed layouts in 'Squina' area shows differences between collective layouts and among rooms of the individual layouts as well. The most controlled layout is ‘no. 16’ of ‘1.475’ average control value. The graph of this case has the least number of vertices at the third-level, which is the only ‘balcony’ space. Meanwhile, it is the only graph with four-vertices at the second-level with multifunctional first-level vertex. Compared to other layouts, the graph has exceptional function of the

Fig. 7: Survey of 'Sequina' Building Layouts in 2015

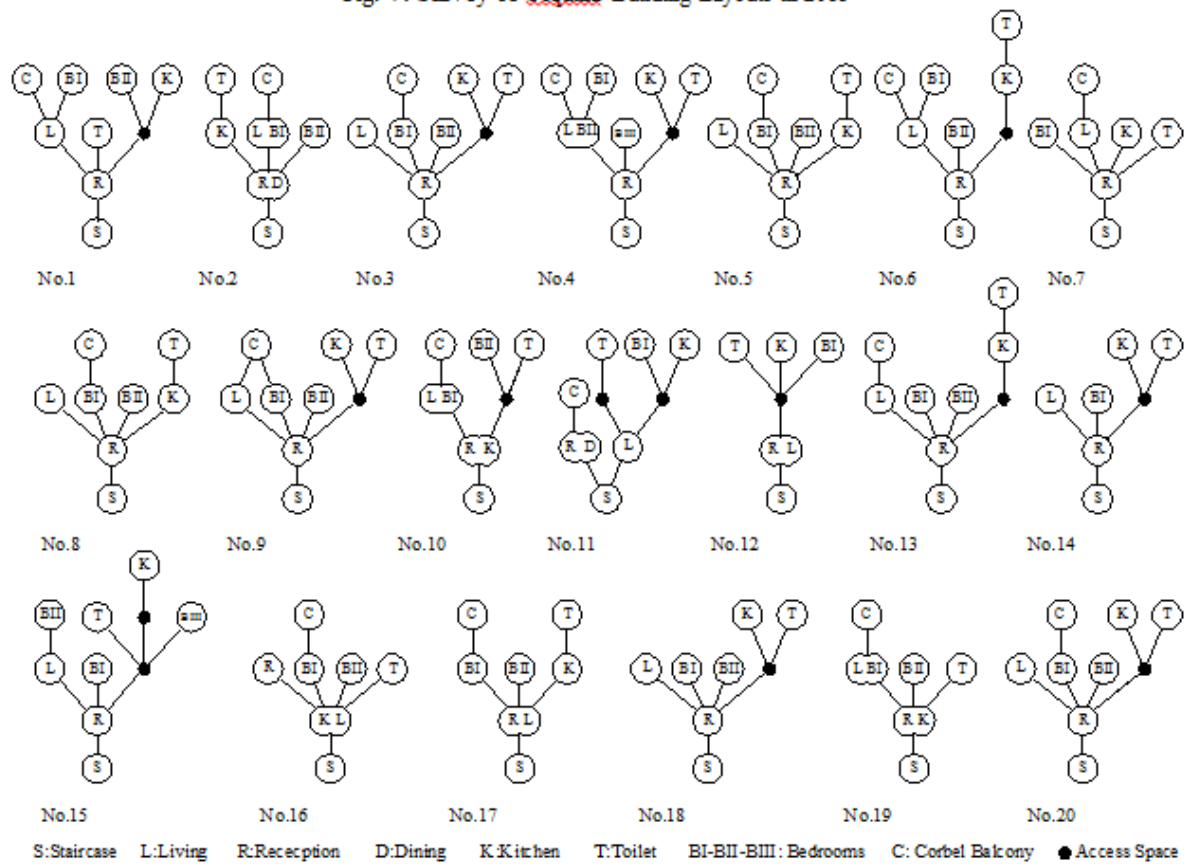

Fig. 8: Graphs of Survey Layouts in 'Sequina' Slum Area

‘reception’ space at the second-level of graph instead of the first like all others. Moreover, the graph is free of access corridors (bold dot) among the four vertices of the second-level, which is unlike others of similar number of vertices at the same level with at least one ‘access corridor’ space or a single first-level function. These graph observations distinguish the high control measure in comparison to the rest of layouts.

Further case ‘no.19’ has a less value of ‘1.24’ in average, but still counted as a layout of strong control. The graph is identical to the previous case of top control, but differs in one point of combined two vertices at the second-level to form one space. In this respect, the functional merge at the second-level of graph correlates with the reduced control of layout. This is regardless of the functions assigned to the spatial vertices. This case, nevertheless, maintains the supposition of high control for fewer vertices at the third-level of graph with multipurpose first-level space. The following control measure of ‘1.25’, which is still counted as high, belongs to the two layouts ‘no. 2 & 17’. Both layouts add a second space to the third-level of graph, while preserves the combined functions at the first-level. Although one of the two cases again combines two spaces at the second-level, it did not affect the average control of the layout when compared to the other. In this regard, the third-level multifunctioning of space caused difference in control for the earlier two cases but not this pair. When seen together, the former compares four-with-three vertices at the second-level, while the latter pair has three in common. Accordingly, the phenomenon of more vertices at the third-level with fewer at the second one correlates with the less spatial control for the so far detailed layouts. In another dimension, the latter two cases structure visibility between the central ‘reception’ space and the branching ‘kitchen’ room in association with the decreased control more than the previous cases. This transparency is treated by restructuring the ‘toilet’ deep inside the ‘kitchen’ control for sanitary reasons while maintaining its privacy. It appears that the social logic of spatial control performs diverse ‘geno-type’ space syntax of the discrete spatial system in ‘Sequina’ slum area by virtue of comparative graph structure with visible and functional interaction, which underlays the first glance of ‘pheno-type’ structure for the preliminary ‘bushy-tree’ graph appearance.

Next control measure of cases ‘no. 4 & 10’ reduces the value to ‘1.125’ in average. Interestingly, the graphs add more vertices at the third-level than the second for the first time, which enforces the previous assumption. Furthermore, both cases add a deep ‘access corridor’ to the ‘utility’ rooms for the first time as well. Each corridor structures a binary graph relation that terminates at the third-level. Despite the graph of two-binary spaces in case ‘no. 4’, the other graph of single-binary has an equal control measurement in average, owing to the fewer vertices of level-two and multifunctional space of level-one. The increase of visibility opens the ‘reception’ to the space of ‘living/bedroom-II’ in one case, while attaches the ‘kitchen’ to the ‘reception’ and the ‘living’ to the ‘bedroom-I’ spaces in compensation for the other to breakeven. Thus the two spatial cases demonstrate the logic of ‘geno-type’ beyond the same ‘pheno-type’ control structure in comparison. Nevertheless, the unique cases ‘no. 11 & 12’ form corridors of triple-graph relation at the second-level, which reduces the average control to ‘1.05’ of their corresponding layouts. The two, however, continue the ‘geno-type’ structure of corridors through the graphs of one-binary and one-single relation in the former case versus the latter equivalency of just one-triple relation. The change of access corridor between the two layouts is met with the unique breakdown of the ‘reception’ from the ‘living’ at the root ‘staircase’ accessibility to measure more distribution of double corridors for triple branching, which balances with the other comparable case of non-distributed single corridor for triple branching as well.

The remaining layouts have a constant average of ‘1’ control value for cases ‘no. 1, 3, 5, 6, 7, 8, 9, 13, 14, 15, 18 & 20’ that form the wide range of neutral measure. This neutrality, however, supposes the ‘geno-type’ extensions into possible spatial alternatives, which can rebalance into various configurations towards the neutral measure of control value. The common theme is the single functioning per space among this whole group of neutral control, whereas all of the above cases had at least one multifunctional space per layout. The other observation fixes the single ‘reception’ at the first-level of graph, which differs from others of more dynamic relocation and plural graph structure with some visibility relaxation in return of higher control. This is evident by structuring the access corridor in narrow angle of vision, which allows some binary-graph distributiveness, while

in the meantime controls the direct transparency. Even the space of open wall such as the 'kitchen' of case 'no. 3' is located at the crossing circulation of doorways, so as the 'reception' has no choice of furnishing except the deep zone away from the wall opening. The exceptional 'ring' of the 'balcony' room in case 'no. 9' holds the same structure of central furnishing away from the open wall 'kitchen' with minimum effect of the spatial ring itself on the interior control due to the already exposed 'balcony' to the outside. The occurrence of this ring at the 'leaf' of the tree-graph reduces its effect on the layout that keeps comparable to the other neutral layouts. In fact most of the layouts suppose this 'balcony' ring through the 'window' transparency to complete the ring of door access for rooms on the façade side. The differences in cases of 'neutral-1' measure exhibit a free 'leaf' of binary or linear graph up to the fourth-level to keep balanced without significant change of control. Meanwhile, there is no 'below-1' average control measure in the discrete spatial system of 'Sequina' slum area, which reflects the determinant social structure of layouts free of spatial distributiveness. This is clearly demonstrated by not exploiting the chances of 'ring' spaces, but with some visual and multifunctional tolerance however. This favors the restricted random process to have control over the various social domains of 'inhabitants' and 'visitors' through the logic of spatial organization, thus overcoming the space limitation. Though achieves unique diversity of 'geno-type' structure through the interrelated observation of graph, function and visibility in three-sided covariance.

The detailed control measure of each room counts the frequency of encounters in the spatial discrete system, which determines the aggregated prototype of the study area. The resulted average control per room of layouts sets into the non-distributed order of 'R, D, AI, L, AII, K, BI, C, BII, T, S, BIII' functions. The three rooms of 'dining (D), access corridor-II (AII) and Bedroom-III (BIII)' have only two encounters among the twenty survey samples, hence counted as statistical outliers of dummy-like vertex in the graph structure. The order of spatial control measure clearly demonstrates the social structure of 'visitor' and 'inhabitant' domains with distinctive control ranges of '3.03 – 2.15' and '1.31 – 0.25' respectively. Thus the 'reception, dining-dummy and access corridor-I' set up as 'visitor' domain of most controlling spaces against the remainder room-set of 'inhabitant' domain in less control. The 'kitchen' space of '1.07' average control approaches the '1.1' total average of the whole spatial system, which represents the generative abstraction of the discrete spatial system. The 'living' space follows by '1.31' average control frequency with the other dummy of 'access corridor-II'. Also 'bedroom-I' of '0.72' value appears in the average control system from a wider perspective. In this respect, the only neutral 'kitchen' space is liberated form any one specific domain to act as 'visitor' or 'inhabitant' structure, whereas the 'living & bedroom-I' spaces provide a non-distributed background of the 'visitor' domain. However, the 'balcony, bedroom-II & toilet' spaces have the least control structure of '0.5' average control or less. While the 'balcony' space is understood to expose in 'end-leaf' of the tree-graph structure, the other two rooms contrast with the prior 'inhabitant' set of more control rooms. In this regard, the 'inhabitant' domain interprets two sets of strengthened control for 'living & bedroom-I' and eased for 'bedroom-II & toilet' spaces. The former is observed in the survey plans to cluster at the façade threshold with the 'children' occupation for 'bedroom-I', while the latter clusters deep inside with service wells for utilities and 'bedroom-II' for parent occupancy. Therefore, the logic of 'inhabitant' structure differentiates between the private 'parent domain' of terminal space distribution from the tolerable exposure of 'children domain' towards both the outside 'balcony' and the inside 'visitor & living' spaces with higher control, visibility and functional interaction. The root 'staircase' of the most distributiveness measure, however, forms a semi-space of logical control easiness between the outside 'strangers', inside 'inhabitants' and the invited 'visitors' in common.

Despite the aggregated logic of control measure, each room exhibits a certain structure within the individual layouts of the discrete spatial system. The 'visitor' domain has an inverse control relation with the layout, where the more the 'reception' control the less is the layout control. The exceptional cases 'no. 11 & 12' have low 'reception' control with average layout measure. The exclusive occupation of the 'visitor' domain in these two cases on the façade side has dissolved the plan centrality with more 'inhabitant' convenience of corridors in triple-branching to balance with the lost central distributiveness. Also the case 'no.19' increases the 'reception' control at the center, but still with a high layout control of over '1.3' value. This special case counts the least

graph order of only six-vertices without any ‘corridor’ distributiveness, which explains the high control of layout due to less amount of graph centrality. The ‘kitchen’ space has a more stable positive correlation with the average control measure of layouts. The main observation is the extensive variance of ‘kitchen’ structure from a high controlling to a low controlled space with oscillating frequencies. Nevertheless, the recession of ‘kitchen’ control keeps the layout at neutral control in average. Some exceptions, however, occurred in cases ‘no. 6 & 13’ where the increased ‘kitchen’ control corresponds to the still neutral layout measure. The graph clarifies the situation with the only cases having the ‘kitchen & toilet’ in graph-tail up to the fourth-level, thus the high control tail but not the layout centrality and binary graph structure. The ‘living’ space observes a different model of inverted structure where the increase or decrease of its control measure does not affect the layout control average, but whenever the layout itself increases the control measure the ‘living’ follows suit. Accordingly, the layout structures the ‘living’ and not the inverse, which concludes an ‘inverted geno-type’ for this special space. In this sense, the ‘living’ is given more freedom to adjust as of ‘visitor’ or ‘inhabitant’ belonging without affecting the layout control structure.

The bedrooms of ‘inhabitant’ domain exert a controversial rather than complementary control structure. The ‘children’ domain of ‘bedroom-I’ at the shallow façade has as twice control as the ‘parent’ domain further deep. In case ‘no. 2’, the low control of ‘bedroom-II’ with the high control of ‘bedroom-I’ corresponds to the high control of the layout average in favour of the ‘children’ domain. The inverse case ‘no. 4’ of high control for ‘bedroom-II’ and low control for ‘bedroom-I’ results in a high control of the layout average this time to favour the ‘parent’ domain. Further cases ‘no. 10, 15, 16 & 19’ revert to the former model of low ‘bedroom-II’ and high ‘bedroom-I’ with high layout average of spatial control. The most stable cases ‘no. 1, 6, 13 & 18’ have a similar or very close control measure among the two bedrooms in question with exactly ‘1’ average control of the layouts. Nevertheless, the layouts of single bedroom in cases ‘no. 7, 11, 12 & 14’ correlate with the eased control of the single ‘bedroom-I’ and with the layout kept at neutral average control. Moreover, in the left cases ‘no. 3, 5, 8, 9, 17 & 20’ whenever the second bedroom is added to the layout, the first bedroom increases the control measure, while also maintaining the neutral average of layout. The phenomenal variety of the spatial control for bedrooms extends the ‘geno-type’ structure from uni- to multiple-space configuration with interactive prototype retrieval. Therefore, the productive ‘pheno-type’ retrieves at different levels of spatial resolutions from the zoomed-out layout of ‘visitor-inhabitant’ structure to the most revealed ‘inhabitant-wings’ of ‘children’ and ‘parent’ subdomains with the ‘kitchen & living’ surfing along with the centrality of ‘visitor’ domain. Constant spatial control structures the ‘staircase, toilet & balcony’ at ‘root-leaf’ extremities without control, while the ‘access corridor’ stabilizes a high control for the ‘inhabitant’ domain.

3. Conclusion

The survey of ‘Sequina’ slum area in Alexandria at the detailed room-level with analytical space syntax of control measure concludes the social structure of the discrete spatial system as follows:

1- The less investment of spatial vertices at the third-level of graphs, with multifunctional space at the first-level maintains a strong control of the layout. The tolerance of some visibility at the central space of interchanging functions compensates the layouts of high spatial control measure. Meanwhile, the dominance of neutral control measure in layouts locates the ‘visitor’ domain at the center with one function per space and screened visibility. The graph-tails are set free in binary and linear structures without forming spatial rings, except for the ‘balcony’ of only one spatial ring but many visual rings through the ‘window’ structure. The less investment in spatial rings supposes the restricted random process from shortcuts and distributed circulation to overcome the limited space, while in the meantime achieving the ‘geno-type’ variety through the three sided correlation between graph, function and visibility of interactive spatial structure.

2- The measured control at the detailed room level clusters the room set into a high control ‘visitor’ versus the less control ‘inhabitant’ in aggregate. At this global resolution only the ‘kitchen’ measures a neutral control to liberate form any one specific structure, which alternates between ‘visitor’ or ‘inhabitant’ social domain.

Meanwhile, the ‘inhabitant’ domain splits into two sets of children and parent subdomains. The high control of ‘living & bedroom-I’ forms the children domain between the exposed ‘balcony’ and the ‘visitor’ centrality with visible and functional interaction. However, the low control of ‘bedroom-II & toilet’ forms the private parent domain of terminal space distribution. The most eased control measure logically specifies the access ‘staircase’ for all social domains of public strangers, inhabitants and visitors in common.

3- The two bedrooms of ‘inhabitant’ domain demonstrate an alternating ‘geno-type’ structure of ‘parent’ and ‘children’ subdomains. The covariance of bedrooms changes form positive to negative or equal control measure with respect to the other rooms. Meanwhile, the ‘living’ space demonstrates another model of ‘inverted geno-type’ structure where the layout average dictates the spatial control structure of the ‘living’ space and not the inverse. Thus, the ‘living’ and ‘kitchen’ spaces generate a dynamic structure of ‘visitor’ and ‘inhabitant’ domains with the ‘bedrooms’ of interactive structure. Overview of retrieving the spatial system changes from the global ‘pheno-type’ of ‘visitor’ centrality between the ‘inhabitant-wings’ to the ‘geno-type’ with its inversion of the ‘kitchen & living’ in correlation to the ‘bedrooms’ at the detailed resolution of individual layouts. The recommendation for redevelopment extends from the specific consideration of social structure in the future of ‘Sequina’ layout to the universal context of slum areas, which clarifies only through the spatial methodology of micro-level analysis at the detailed room resolution.

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