THE SECTORS' PARADIGM

Understanding modern functionalism and its effects in configuring domestic space

18

Luiz Amorim
Universidade Federal de Pernambuco, Recife, Brasil

18.1

Keywords: modernism, functionalism, design methods, domestic

Luiz Amorim
Departamento de Arquitetura e Urbanismo
Universidade Federal de Pernambuco
Cidade Universitaria, Recife
Pernambuco
Brazil
tel: (55) (81) 271 8303
fax: (55) (81) 271 8311
email: amorim@npd.ufpe.br
(current address as for The Bartlett School of Graduate Studies - UCL, email: ucftlma@ucl.ac.uk)

0 Abstract

Modern agenda gives to function a fundamental position in architecture. This problem is addressed in many architectural texts, either by describing the functional dimension of buildings, or by prescribing design methods to solve and formally express it. This study tries to understand how these ideas are embedded into modern buildings, by observing the effects of the methodological procedure for classifying and grouping activities into sectors in structuring spatial systems.

To explore this problem, a sample of 140 modern houses of Recife, Brazil, built between 1950 and 1970, is examined. The houses are assessed by means of their sectors' organisation, represented as justified graphs, and analysed syntactically. Depth, integration and space type analysis are used to picture the structure of the sectors' arrangements.

The study reveals that modern houses of Recife are submitted to the classification and grouping procedure, arranging domestic life into sectors, interconnected by transitional spaces. As a paradigm, the sectors were an idea which architects thought with. Despite the vast number of possible arrangements, only few patterns were found, represented by two sectors' genotypes. This suggests that generic laws restricted the number of possible combinations of sectors to a number of suitable systems. The paper concludes by proposing that these restrictive laws were generated in order to conciliate architectural concepts to social requirements.

1 On the realm of function

In this paper, we address the relationship between architectural ideas, design procedures and the ultimate realisation of these ideas, in a form of spatial systems. We do so based on some concepts. Firstly, we assume that buildings are classifying devices, instruments that societies use to 'define and reproduce social structures, and to elaborate the meaning of relationships' (Markus, 1987: 468). Secondly, that these devices work by categorising a field into a hierarchical structure of classes and elements, grouped by means of their common properties. This classification procedure is done by means of prescriptive texts - 'briefs' and design methods - which verbalise a functional structure. Thirdly, that, as social objects, they are a source of information about the societies which have created them (Hillier & Hanson, 1984).

The study focuses on a group of modern residences built in Recife, Brasil. It was originated by the interest in understanding how some modern concepts, highly disseminated among Recife's architects, were reified.

18.2

Buildings and architectural discourses are intrinsically linked either to describe what the building is about, or to structure fundamental parameters for designing. Here, we look at the methodological procedure for classifying and grouping domestic activities into sectors, as prescriptively taught at the local school of architecture[1] and referred to by architects and critics in their descriptive texts. This functional classification process, which consists of listing every activity and its requirements, and representing them in a series of relational diagrams, was assumed by many schools of architecture as the scientific approach to replace the *Beaux Arts* stylistic and historicist one. As a framework for thinking and practising, it became a paradigm, the *sectors' paradigm*, as we shall call it, and for some architects, an auto-referential system, which should be expressed by the building itself (Colquhoum, 1985; Hays, 1992)[2].

Kennedy (1956), in his rather curious study on designing modern houses, describes the method in a four step process: first, classification of living activities, according to a particular set of requirements; second, grouping of similar activities, generating sectors; third, providing duplicate facilities to attend activities which may overlap others; and the fourth one, definition of barriers to guarantee the necessary independence of the sectors.

Some tools are also prescribed. Bubble diagrams represent, graphically, the classifying procedure. As relational diagrams, bubble diagrams express a topological dimension of the building, before it has been fully conceived or formalised. By pre-establishing relationships, diagrams help designers to understand the building as a complex and to decide the best solution to match the programmatic requirements.

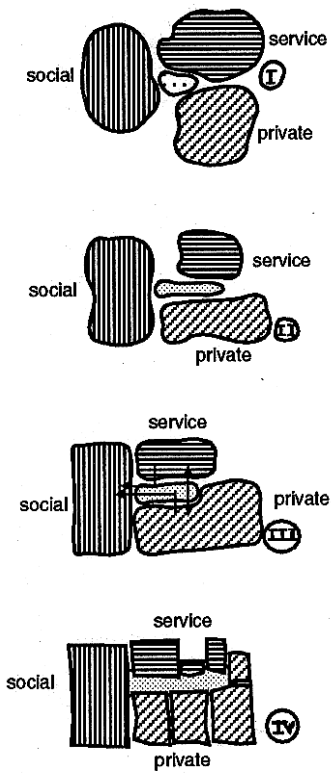


Figure 1. Diagrammatic representation of a functional house (Amorim, 1990).

When applied to prescribe parameters for designing houses, lecturers and professors at Recife assumed the idea of a three sector system, composed by the social, service and private zones[3]. The *Social sector* groups the spaces that allow for continuous interaction among the inhabitants and, fundamentally, the inhabitants and visitors - living, receiving and dining areas. The *Private sector* assures the necessary seclusion of the family and its members - bedrooms and study room. The *Service sector* houses the activities related to the reproduction and maintenance of a dwelling's life - kitchen, larder and servants' accommodation. To connect the three sector system, a meta-transitional unit, called *Mediator sector or space*, is introduced (Amorim, 1995).

Figure 1 shows a group of diagrams as used at that school of architecture. Stage I, top left, shows the sectors. At this point, the relation among them is of adjacency. In stage II, the forms become more architectural-like. Stage III introduces the connections. It defines which neighbours should be connected to and how. The final stage, IV, is the plan itself, denoting that the spatial solution is a direct consequence of the distribution of functions. A diagram is almost architecture.

The bubble diagrams above represent the functional distribution of a house, being topological, shapeless. By having this property, they become the basic topological instrument in design and their outputs define the overall characteristic of the house, as its *topological gene*, which carries the information of how the spatial complex will organise activities and generate social encounters.

Theoretically, in a degree of dependence, different types of buildings will be more or less susceptible to this basic topological layer. On the one hand, highly programmatic buildings require a detailed diagrammatic classification and distribution of activities. On the other hand, buildings which are less dependent on restrictive briefs, would be more permeable to cultural patterns in which they are embedded. Also, different buildings may share the same topological information, although differentiated by area, programme or the plan, itself.

Taking this argument for granted, we observe to what extent this functionalist attitude, called by Deleuze as *abstract machine*, or the function and matters' domination (Deuleze & Guatari, cf. Hays, 1992)[4], operates in the conception of modern houses of Recife, overlapping architectural ideology and social requirements.

2 The sample

We have defined a sample composed of 140 houses, built between 1950 and 1970, selected from a larger sample of 250 modern houses, from 1930 to 1980, as our object of study. These two decades were selected because they represent the process of introduction, development and popularisation of modern architecture in the town. Although modern experiences can be found since the 1930's, it is just at the end of the 1940's and beginning of the1950's that modern architecture was generally introduced and accepted as the contemporary architectural expression. In a way, modern buildings were remarks of a new society, enthusiastic about the rapid process of industrialisation and urbanisation of the country. This modernising process was synthesised by the construction of the new capital, Brasília, which became Brazilians' paramount architectural and urban reference.

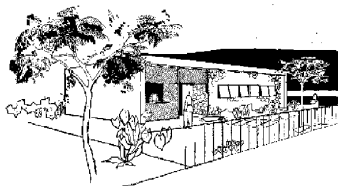


Figure 2. Middle class house - Beltrão House, designed by Reginaldo Esteves, in 1955. Drawing by Reginaldo Esteves.

The sample comprises houses with different topological and geometrical sizes, social classes (middle class, high middle class and upper class - figures 2 and 3) and architectural types (terraced, semi-terraced and detached, one and multi storeys height). It includes renowned houses cited by critics and architects as seminal references, houses published by local and national periodicals, as well as anonymous suburban buildings. They were created by 67 designers (architects, engineers and draftsmen), working sometimes in association, defining a ratio of 2.09 buildings per designer. In sum, the sample tries to represent with the best fidelity the architectural panorama of the city.

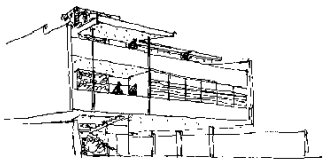


Figure 3. Upper class house - Machado House, designed by Delfim Amorim and Heitor Maia Neto, in 1969. Perspective by Delfim Amorim (Amorim et al 1981: 57).

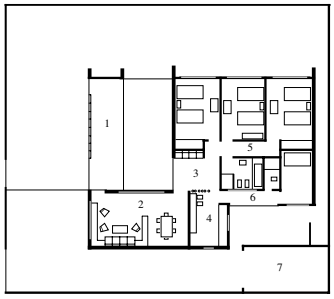
Table 1

	Social class				*Levels*		
	Middle	*High middle*	*Upper*	*ground*	*basement*	*mezzanine*	*storeys*
period	1954-70	1950-70	1953-70	1954-70	1955-70	1954-68	1950-70
total	52	64	24	45	9	2	84
%	37.14	45.71	17.14	32.14	6.43	1.43	60

Table 1. Sample classified according to social class and storeys.

3 A syntactic representation of sectors

To investigate if there is a sectors' topological layer grounding modern houses, we defined a representational procedure, assuming that architectural briefs and bubble diagrams can be represented as relational graphs. Topological measurements can then be applied and comparative analysis developed, as in traditional space syntax analysis. This procedure redoes the classification procedure. The spaces are identified with their functional category in order to group them into sectors and then, the connections between the sectors are drawn.



18.4

Figure 4. Melo House - plan
1. terrace 2. living/dining 3. hall 4. kitchen
5. bedrooms 6. servants 7. garage

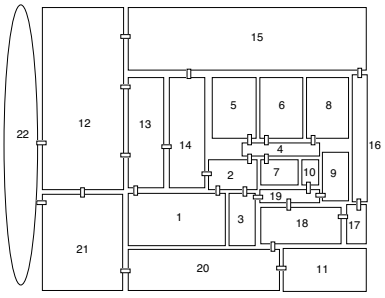


Figure 5. Melo House - convex break up
1. terrace 2. living/dining 3. hall 4. kitchen

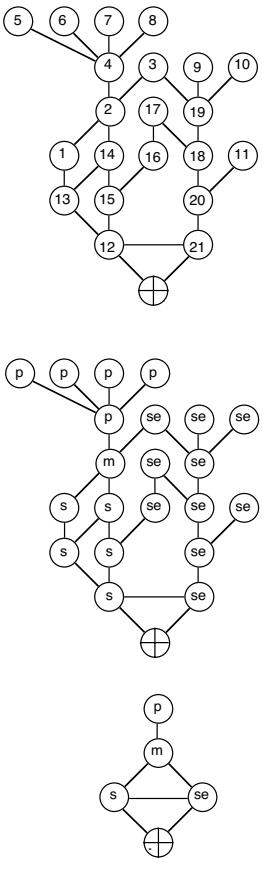


Figure 6. Melo House - justified graphs.
s - social; se - service; p - private; m - mediator

Figures 4 to 6 show, step by step, the sectors' representation of Melo House, a middle class modern house designed by Vaz, in 1959. Firstly, a convex break up map is created. In our sample, we have broken up gardens and yards into convex spaces, as areas spatially structured to attend functional requirements.

The convex break up is then represented as a justified graph, the exterior (public space) taken as its root, and each convex space is identified by the functional category or sector to which belongs (figure 6). Note that the private spaces (4 to 8) are grouped in a deep and isolated bunch, connected to the other spaces of the house by means of space 2. The same happens to the spaces identified as social units (1 and 12 to 15). They form a sequence of rings, directly connected to the exterior and to the same space 2, the indoor access to the private sector, as well as to the service spaces (3, 9 to 11, and 16 to 21). Space 2, as the system's connector, is the mediator unit. To reach a simpler and more accurate representation, classified spaces are grouped as vertices, connected to each other by the remaining links.

Presumably, we will be dealing with a simple combination of 5 elements: 3 functional sectors, 1 transitional area and the public domain. In terms of combinatorial possibilities, 5 labelled elements connected by single links generate 420 different arrangements. Theoretically, this can be taken as the paradigmatic sectors' repertoire.

This representational procedure allows a syntactic analysis of sectors' distribution according to their configurational properties. Two syntactic measures are of fundamental importance. First, depth from the exterior, expressing the topological distance which visitors and inhabitants face while approaching the system. Second, integration (here used as its pure RRA value - high values, less integration) expresses, as a global measure, the relative position of the sectors and the public domain.

A large number of studies applying space syntax worldwide showed that social relations are deeply embedded in spatial systems (Hanson, forthcoming). This study takes a step forward investigating the relationship between groups of convex spaces, united by means of functional categories. It is expected that this meta-syntactic analysis, will picture the more primary and basic formulation of the domestic universe, the ideal conception (or prototypical) of what a modern house might be. Albeit being non-formal, non-geometrical and non-programmed (meaning no definition of numbers of rooms, area or costs), it seems to be spatially qualified.

4 The abstract machines

The result of the sectors analysis (figure 7) presents a wider spectrum of possibilities than expected, either by including secondary sectors (6 and 7 element graphs) or by suppressing the mediator sector (4 element graph). On the one hand, from the architectural viewpoint, it suggests designers are not strictly subordinated to paradigmatic expressions. On the other hand, 24 types of graphs in a sample of 140 (ratio of 5.88) is quite an inexpressive picture of a flamboyant collection of architectural experiments. Restrictions should have acted.

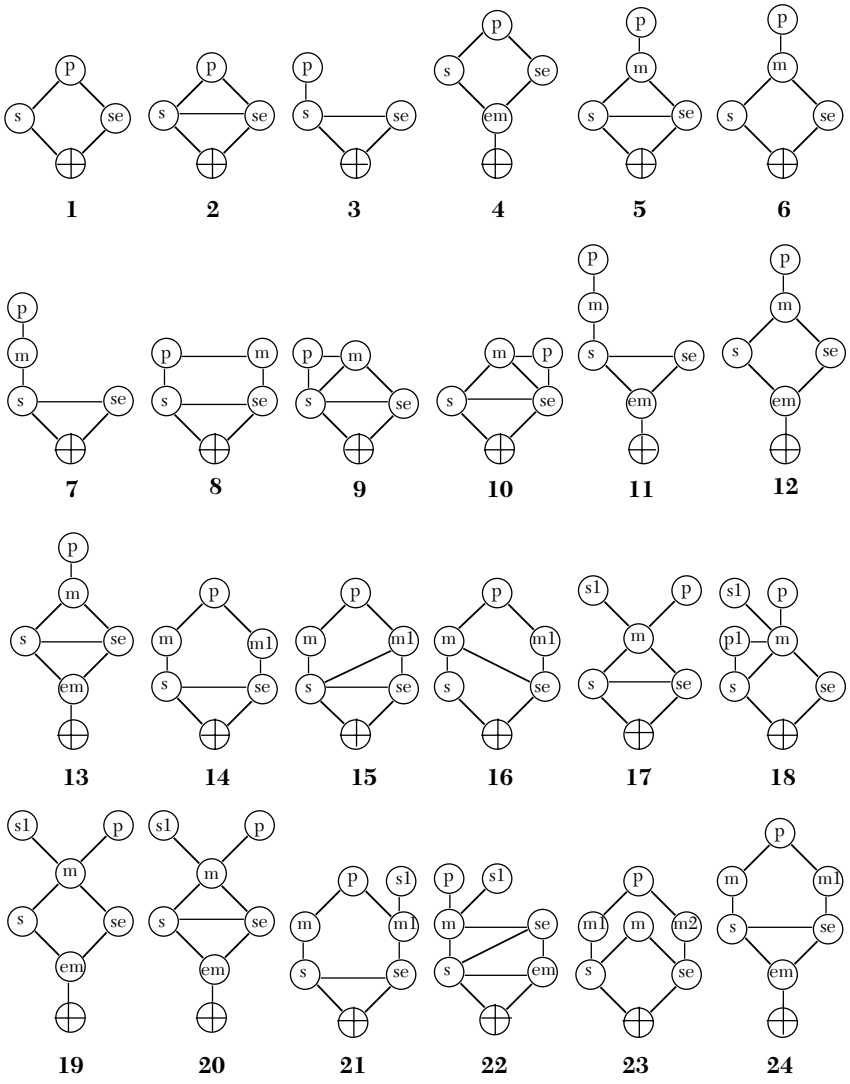


Figure 7. Sectors' graphs
s - social; se - service; p - private; m - mediator; em - external mediator.

Table 2

Type	*Cases*	*%*	*ground*	*basement*	*mezzanine*	*storeys*	*M-C*	*H-M-C*	*U-C*
1	3	2.14	3	0	0	0	3	0	0
2	9	6.43	5	1	0	3	5	3	1
3	4	2.86	2	1	0	1	2	2	0
4	3	2.14	2	0	1	0	2	1	0
5	33	23.57	16	2	0	15	17	12	4
6	5	3.57	1	0	0	4	0	5	0
7	33	23.57	5	2	0	26	11	19	3
8	3	2.14	2	1	0	0	2	1	0
9	2	1.43	1	1	0	0	0	2	0
10	5	3.57	1	1	1	2	3	1	1
11	7	5.00	0	0	0	7	1	3	3
12	2	1.43	1	0	0	1	0	2	0
13	6	4.29	3	0	0	3	3	1	2
14	8	5.71	1	0	0	7	1	1	6
15	1	0.71	0	0	0	1	0	0	1
16	1	0.71	0	0	0	1	0	0	1
17	4	2.86	1	0	0	3	1	3	0
18	1	0.71	0	0	0	1	0	1	0
19	1	0.71	0	0	0	1	0	1	0
20	4	2.86	0	0	0	4	1	2	1
21	2	1.43	0	0	0	2	0	2	0
22	1	0.71	0	0	0	1	0	1	0
23	1	0.71	1	0	0	0	0	1	0
24	1	0.71	0	0	0	1	0	0	1
Total	*140*		*45*	*9*	*2*	*84*	*52*	*64*	*24*

Table 2. General table - types of sectors and their occurrence within the sample.

18.6

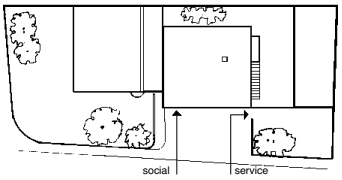


Figure 8. Petribu House, designed by Acácio Gil Borsoi, in 1968 - general plan.

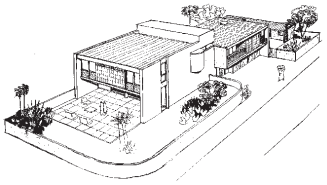


Figure 9. Petribu House, designed by Acacio Gil Borsoi, in 1968. Drawing by Borsoi.

4.1 Graphs by size

Let us explore the topological nature of the types of sectors' graphs, aiming at the clarification of these restrictive laws. Firstly, by grouping them according to their sizes. The first group (types 1 to 3) is formed by 4 element graphs and it is found in 16 cases, mostly one storey middle class houses. There are 38 possible arrangements in a 4 labelled system (Steadman, 1983), reduced to 26 when we apply the mediator constraint, and 3 (10.71%) of the mediated ones are represented in the sample.

The second group, composed of types 4 to 10, introduces the mediator sector, matching accurately the diagrammatic functional paradigm. By far, this is the most popular set in the sample, grouping 60% of the houses. It is found in single and multiple stories, as well as in different social classes.

The 6 element graphs are the second in terms of occurrence (20.71%). Types 11, 12 and 13, introduce an external mediator, which in fact is a recessed area from the pavement, however inside the plot, reinforcing the control of access to the house (figures 8 and 9).

Types 14 to 16 have two indoor mediator units. They are found mostly in upper-class houses, where private access from service sector to the bedrooms is required. Type 17 has a second social sector, which is, in fact, the visitors' rooms premises. They were represented as a second social sector because they are set apart from the inhabitants' accommodations (in most of the cases in different plans) and easily accessible from the social area.

Finally, the last group comprises the 7 element graphs. They combine doubled sectors and mediators. Types 23 and 24, use 3 mediator units, being the most complex systems in the sample. This group is the least popular among the sample suggesting either experimentalism or particular requirements.

Table 3. Graphs grouped by size

Table 3.

size	*cases*	*%*	*ground*	*basem.*	*mez.*	*storeys*	*M-C*	*H-M-C*	*U-C*
4	16	11.43	10	2	0	4	10	5	1
5	84	60.00	28	7	2	47	35	41	8
6	29	20.71	6	0	0	23	6	10	13
7	11	7.86	1	0	0	10	1	8	2

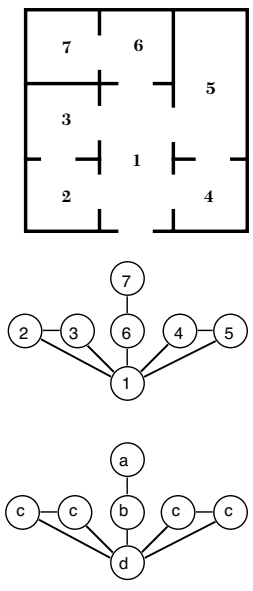


Figure 10. Justified graph of a hypothetical building and its space types.

4.2 Space type analysis

Before going through integration and depth analysis, we introduce a topological space type classification, as recently proposed by Hillier (1996). Let us consider the justified graph of a hypothetical building presented in figure 10. Space 7 is a single linked space, a dead-end cell. Space 6 has two links and it is the way through from space 1 to space 7. If one of these connections is cut, then the graph is split. Spaces 2, 3, 4 and 5 have two links, but differently from space 6, they lie into rings. Closing a link will not break up the graph. Space 1 has more than two links, and lies into two rings.

Space 7 is called a-type space. Its relative position does not allow through movement and for that reason privileges functional occupation rather than movement. Space 6, b-type space, intermediates accessibility between two spaces, adding depth to the system. Spaces 2, 3, 4 and 5, are c-type spaces. They have more than one link and lie

into rings where the number of spaces is the same as the number of connections. Finally, space 1, a d-type space, has more than two links and lies into more than one ring. It allows choice for movement and increases accessibility to the graph.

These spaces form subcomplexes of given types. A subcomplex is a system formed by a space of a particular type and the adjacent and non-adjacent cells which qualify the particular space. In our graph, spaces 7 and 6 form an a-type subcomplex; spaces 6, 7 and 1, a b-type subcomplex; spaces 2, 3 and 1, and spaces 4, 5 and 1, c-type subcomplexes; finally, spaces 1 to 5, a d-type subcomplex.

Global properties of systems depend on the local configuration of cells, or the types of space found in the system. Hillier summarises:

"In other words, depth minimising processes will tend locally to a-type complexes and globally to d-type complexes..., while depth maximising processes will tend globally to b-type complexes and locally to small residual c-type complexes. ... Essentially, a- and d-type spaces create integration, while b- and c-type spaces create segregation. In other words, segregation in a complex is created almost entirely by the sequencing of spaces." (Hillier, 1996: 321)

Bearing these properties in mind, we have redrawn the sectors' graphs, presenting each sector as space types (figure 11). By doing this we hope that their topological properties will suggest potentialities for occupation and movement.

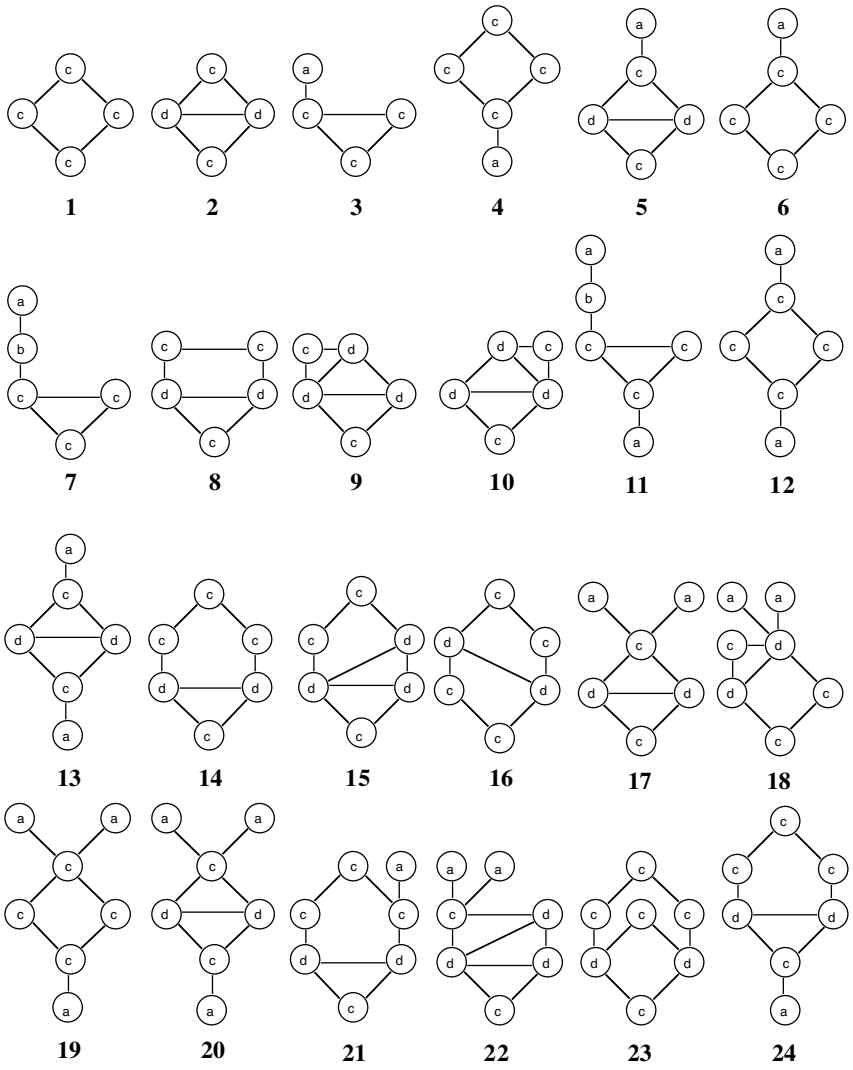


Figure 11. Sectors graphs by space type.

Social and service sectors are always included in a ring, being c- or d-type spaces. The graphs are configured in order to guarantee them the same topological position. If the social sector is included in a c-type complex, then the service will be. If it is included in a d-type complex, the same will occur. Two exceptions are found. Types 16 and 18 have c-social and d-service, and d-social and c-service, respectively. Knowing that d-type complexes are depth minimisers, service and social sectors have the role of integrating the system.

18.8

Private sector is consistently found as c- and a-type spaces. They appear as a-type space to reinforce seclusion, while c-type when access to and from service and social zones is necessary. However, if the servants' connection is locked, as usually happens, private rooms assume their a-type space position.

The public domain is dominantly c-type space, included in a ring with service and social areas. It becomes an a-type space when an external mediator is created, as a buffer zone to isolate public movement to the main entrances of the house.

The indoor mediator space is the only element to appear in three different topological situations. Predominantly as c-type space, it defines rings, but maximises depth. Secondly, as b-type space (the only one in the sample), it connects the main sectors to the private one. Thirdly, as d-type space, it is included in the same d-type complex as social and/or service sectors. Despite these occurrences, mediation tends to maximise depth.

Table 4.

Type	*Sectors*									
	social	*social 1*	*service*	*private*	*private 1*	*mediator*	*external mediator*	*mediator 1*	*mediator 2*	*exterior*
1	c	•	c	c	•	•	•	•	•	c
2	d	•	d	c	•	•	•	•	•	c
3	c	•	c	a	•	•	•	•	•	c
4	c	•	c	c	•	•	c	•	•	a
5	d	•	d	a	•	c	•	•	•	c
6	c	•	c	a	•	c	•	•	•	c
7	c	•	c	a	•	b	•	•	•	c
8	d	•	d	c	•	c	•	•	•	c
9	d	•	d	c	•	d	•	•	•	c
10	d	•	d	c	•	d	•	•	•	c
11	c	•	c	a	•	b	c	•	•	a
12	c	•	c	a	•	c	c	•	•	a
13	d	•	d	a	•	c	c	•	•	a
14	d	•	d	c	•	c	•	c	•	c
15	d	•	d	c	•	c	•	d	•	c
16	c	•	d	c	•	d	•	c	•	c
17	d	a	d	a	•	c	•	•	•	c
18	d	a	c	a	c	d	•	•	•	c
19	c	a	c	a	•	c	c	•	•	a
20	d	a	d	a	•	c	c	•	•	a
21	d	a	d	c	•	c	•	c	•	c
22	d	a	d	a	•	c	d	•	•	a
23	d	•	d	c	•	c	•	c	c	c
24	d	•	d	c	•	c	c	c	•	a

*Table 4. Sectors as **s**pace types.*

4.3. Depth analysis

Social and service sectors are the shallowest functional sectors in every graph (depth 1 and 2). They are also at the same distance from the visitor's viewpoint, with the exception of type 22, where service is deeper than social, due to an exterior mediator

unit. Providing shallow service zones is so fundamental that, even in narrow terraced houses, all efforts are made to offer double and separate entrances to the house.

The private sector is the deepest one, always positioned at the top of the graph. Access to bedrooms is highly controlled, being linked to the rest of the house through indoor spaces, even when there are shaded areas (pergolas and terraces) beside them. Only few exceptions were found in the sample, all of them ground floor houses built after 1968. Direct contact with the open air is provided when access is denied. Private verandas, in multi-storey houses, and enclosed gardens, in ground floor ones, are common solutions. This contrasts strongly with social areas, frankly opened to the outside spaces, shaded or not.

Types 8, 9 and 10, however, are organised differently. Here the private sector becomes as deep as the mediator sector, due to a link to social premises. These graphs are the shallowest 5 element graphs, with a total mean depth of 5.6, 5.2 and 5.2, respectively, but represent only 5.71% of the sample.

Figure 12 clarifies the role of the mediator sector by plotting depth values per type of graph. In every single graph (apart from types 8, 9 and 10, already referred to above), this sector stays in between social and service sectors and the private one. As a depth maximiser, the mediator sector is introduced into the system to increase the necessary secrecy for the private units. The necessity for concealing the private units is so clear, that in the set of graph which does not use the internal mediation unit (1 to 4), social and service sectors ensure its seclusion.

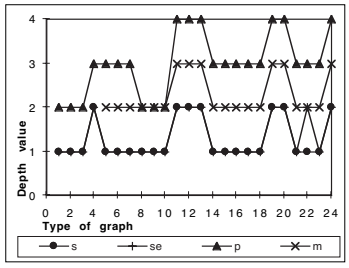


Figure 12. Depth value per sector.

Summing up, the sample shows a consistent depth pattern. Access is allowed through social and service sectors, then movement is distributed and controlled by mediator spaces, and private sector is the deepest element of all.

4.4 Integration analysis

At this final stage, let us investigate, how each sector is positioned in relation to the others. Table 5 shows the rank order of integration of all sectors, ordering the RRA values, from the most integrated to the most segregated, following the procedures used by Hillier, Hanson and Graham (1987). What appears clearly is the polarity between the social and service sectors, highly integrated, and private sector and exterior, highly segregated.

To have a better picture of what is happening, the main functional sectors - social, service and private, were isolated, and two genotypes appeared. In both cases, the social sector is the most integrated and the private the most segregated.

Genotype, $s=se<p$, which appears in 57.85% of the sample, integrates the service activities, while genotype $s<se<p$, 34.28%, segregates them. These genotypes are followed by 3 phenotypes, representing 7.85% of the sample. The exception of these cases is expressed by the high integration value of the service sector.

Table 5

Type	*N° cases*	*Order of integration*	*Genotype*	*Total*	*%*
2	9	s=se<p=e			
4	3	em<s=se<p<e			
5	33	s=se=m<p<e			
6	5	m<s=se<e<p			
8	3	s=se<p=m=e			
12	2	s=se=m=em<e=p			
13	6	s=se<m<em<e=p	s=se<p	81	57.86
14	8	s=se<m=m1<e=p			
17	4	m<s=se<s1=e=p			
19	1	m<s=se<em<s1=p<e			
20	4	s=se=m<em<s1=p<e			
23	1	s=se<m=m1=m2=e<p			
24	1	s=se<em<m=m1<p<e			
3	4	s<se=e<p			
7	33	s<m<se=e<p			
9	2	s<se=m<e=p			
11	7	s<em<se=m<e<p	s<se<p	48	34.29
15	1	s<se=m1<m<e=p			
18	1	m<s<se=p1<e<p=s1			
22	1	s=m<se<em<e<s1=p			
10	5	se<s=m<e=p	se<s<p	7	5.00
21	2	se=m1<s<m=p<e<s1			
1	3	s=se=p=e	s=se=p	3	2.14
16	1	se=m<s=m1=e=p	se<s=p	1	0.71

Table 5. Sectors' genotypes

5 Understanding the classifying device and its restrictive laws

We have found in the sample 24 different arrangements of sectors, as 4, 5, 6 and 7 element graphs. The realm of combinatorics shows us that there are 26 ways of combining 4 labelled element graphs and 420 of 5 ones, when the mediation requirement is applied. In our sample of 140 houses, 11.43% used a 3 sector system and among them, only three graphs were found, corresponding to 10.71% of the possible combinations. On the other hand, 60% used a 4 sector system, but only 7 types of graph were found, corresponding to 1.66% of the repertoire. It is not necessary to go further in this analysis to realise what would be the percentage of occurrence within the 6 and 7 element graphs.

If the combinatorial system referred to above is the topological field from where a classifying machine would operate, it becomes clear that restrictive rules were in command. To clarify them, let us discuss the results of the syntactic analysis.

Topological size seems to have a strong correlation with social class and verticality of the building so that middle-class houses are mostly 4 and 5 sized graphs and one storey height. High middle-class houses follow a similar pattern, but the number of 6 element graphs is proportionally higher (15.63% against 11.53%). Upper-class buildings are basically 5 and 6 sized graphs and multi-storey height.

Upper-class dwellings have more sophisticated programmes, requiring specific purposed spaces (such as music room, library, sewing room or even oratorio) and housing complex social events. When we go down in the social structure, superimposition of different functions in the same space tends to be acceptable, generating less complex programmes, which can be easily classified and grouped into the general

sectors - social, service and private. So, single functional spaces tend to be grouped into specific sectors (visitor's accommodation or office area), while multi-functional spaces tend to be grouped into general sectors.

Table 6

Social Class	*Total*	*s=se<p*		*s<se<p*		*se<s<p*		*s=se=p*		*se<s=p*	
		cases	*%*	*cases*	*%*	*cases*	*%*	*cases*	*%*	*cases*	*%*
Middle-class	52	32	61.54	14	26.92	3	5.77	3	5.77	0	0
High middle-class	64	34	53.13	27	42.19	3	4.69	0	0.00	0	0
Upper-class	24	15	62.50	7	29.17	1	4.17	0	0.00	1	4.17

Table 6. Genotypes' distribution per social class.

But, if these differences between social classes are obvious, suggesting a general background for a classification process according to social status, some syntactic properties showed to be consistent along the sample.

By observing the space type analysis we notice a correlation between sectors and space types. All a-type spaces are found as private and public spaces. Even being antagonist realms, they have the same spatial requirements. In terms of integration values, they assume the most segregated positions, exceptionally when substituted by secondary sectors. The figure that we got is public and private zones deep from each other, but assuming similar configurations.

Depth analysis also pictured a general property. Service and social sectors are shallower from the street than any other functional sector. If the social sector is the main entrance of the house, as daily inhabitants' entrance and visitors' reception, service access is provided to guarantee independent movement for servants and vehicles. This is to establish, at the limits of the plot, a fundamental differentiation between servants and inhabitants, strongly embedded in the social structure of Northeast Brazil. In this sense, double access is placed to express status.

These sectors are, fundamentally, the locus for interaction among dwellers, while entertaining, eating or cooking. For this reason, they are strongly related to each other, demanding movement and controlled operations. As places which demand local and global movements, they are c- and d-type spaces, placed in the configurational centre of the system, being shallow from every space. The rank order of integration shows how they operate and the genotypes s=se<p and s<se<p, are the clear picture of how these machines were conceived.

Transitionality, however, has assumed different positions in the graphs. It seems that mediator units were introduced to compose different configurations, assuring one or another requirement, as segregating sectors (as b- and c-type spaces) or integrating systems (as d-type spaces). As a joker in some card games, mediation spaces assumed different roles, according to the interest of the player, but under the general rules of the game. Even with this *joker effect*, it has to be said that its main purpose was to increase segregation.

Now that we have understood how the sectors' graph operates, we are able to enumerate the rules in action.

1 - Social and service sectors as movement generators. Social and service sectors must be part of a movement generator system (d-system), globally integrating the house, being equidistant from the street.
2 - Private sector as occupational space. Private sectors must be the deepest sector in the house. Bedrooms, as spatial units for resting, sleeping or studying, just to refer to some private ac tivities, must be the most secluded elements. They must be dead-end spaces (a-type space) or included in a ring (c-type space), allowing secluded access to the servants, when required.
3 - Mediator as depth maximiser. The mediator unit has the role of assuring the necessary seclusion for the private sector, as well as operating access to inhabitants'/ visitors' territories. As generators of segregation they must be b- and c-type spaces.
4 - Public space must be set apart from the house. It must offer free access to social and service sectors, forming a shallow c-complex. Private and public domains must assume opposite positions, but be equally segregated in the system.
5 - The more complex programmes become, the bigger and more complex the graphs will be.

These generic laws can be fully understood by observing carefully types 5 and 7, the mode of our data, with 33 occurrences each. They operate the more general requirements found in the sample and they are well dispersed in terms of social classes. In sum, they are the models of modernity.

6 Conclusion

Building design procedures invest a huge effort in solving and managing all sorts of inputs, from technical to social, geographic to topological, general to particular. Despite these requirements, it seems that all efforts were used to assure that the sectors' grouping should be achieved, perhaps, almost unconsciously. As a paradigm, the sectors were an idea which architects thought with (Hillier, 1996).

Despite the vast number of possible arrangements, only some patterns were found, consistently reproduced among the sample. What we suggest, then, is that architects used a set of criteria to choose, from a set of architectural possibilities, the ones which could be applied locally. After all, it seems that the universal concept does carry inherently the germ for regional interpretations. As Hillier and Leaman (1974) suggest, there is no such thing as an impersonal act of designing. In fact, remembering Popper's conception of 'inductive fallacy' architects have their own designing preconceptions, applied to classify and select building requirements, and it is exactly because of these preconceptions or 'prestructures', as the authors prefer, that 'design is possible'.

The restrictive laws, as presented above, point to a strong interference of social requirements. Social rules seem to have defined the precise set of suitable architectural schemes to attend the conceptions and preconceptions of house use. If that is true, modern architects' houses were not only an expression of individuality, which is generally affirmed, but also carried in themselves genotypical information as significant as in vernacular manifestations. In this sense, architectural experimentalism would be expressed in the pattern of space-to-space accessibility and visibility, while sectors' organisation would be their *paradigmatic gene*, the carrier of the most fundamental spatial properties of buildings. After all, there could be a state of concretion in the realm of the diagrammatic abstraction.

The research in course is currently dealing with historical data concerning urban, suburban and rural houses, from the eighteenth to the first decades of this century. Although the whole sample has not been properly analysed, some suggestive findings indicate consistent changes in the domestic patterns with the introduction of modernism. With the conclusion of this phase, we hope to fully understand in what way functionalist principles have been introduced and absorbed. It would be interesting to see further investigation of sectors' organisation, exploring its potentialities in understanding larger spatial complexes (museums, hospitals or school buildings), as well as an operative tool to structure architectural briefs.

We can conclude by saying that modern houses of Recife reflect two dimensions. Architecturally, the residences classify and group domestic activities in very precise and definite realms, but they do so to answer new social requirements.

Acknowledgements

I would like to thank Geovana Martins for helping me in collecting and processing the data, the staff of Urb-Recife, for giving me access to its archives, and to the architects who kindly discussed and offered their projects for my studiy. This research has been sponsored by Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES.

Notes

[1] Faculdade de Arquitetura da Universidade do Recife, currently Curso de Arquitetura e Urbanismo da Universidade Federal de Pernambuco.

[2] De Zurko (1957) in his study on the origins of functionalism refers to this concept as *moral analogy*. Two other analogies are proposed by the author. The *mechanical*, as an analogy of the characteristics of buildings and machines, and the *organic*, related to biological processes of growth and organisation.

[3] Similarly, there are other systems. Kennedy (1956) proposes a five zones complex (public, semi-public, operative, semi private and private), while Breuer's bi-nuclear houses use two basic cores, the social and the private .

[4] "An abstract machine in itself is not physical or corporeal, any more than it is semiotic; it is diagrammatic ... It operates by matter, not by substance; by function, not by form. Substances and forms are expressions "or" of content. But functions are not yet "semiotically" formed, and matters are not yet "physically" formed. The abstract machine is pure Matter-Function - a diagram independent of the forms and substances, expressions and contents it will distribute." (Deuleze & Guatari, cf. Hays, 1992: 110 - 111).

References

Amorim, L. (1990), *Memória do Curso de Arquitetura e Urbanismo* . Research report Departamento de Arquitetura e Urbanismo - UFPE.

Amorim, L. (1995), *A Cultural Reification of a Diagrammatic Idea - the introdution of modernity in Recife, Brasil*. Pilot Study, Bartlett School of Graduate Studies, University College London.

Amorim, L., Oiticica, D., Sales, M., Santos, P., Silva, G. G., (1981), *Delfim Amorim - arquiteto*. Recife: Instituto de Arquitetos do Brasil.

Colquhoum, A. (1985), *Essays in architectural criticism: modern architecture and historical changes*. Massachusetts: The MIT Press.

Dalton, N. (1990), *Netbox 1.0d1(computer programme)*, London: Unit for Architectural Studies, University College London

Dalton, N. (1990), *Netbox 4.1(computer programme),* London: Unit for Architectural Studies, University College London

De Zurko, E. (1957), *Origins of Functionalist Theory.* New York: Columbia University Press.

Hays, M. (1992), *Modernism and the Post humanism Subject: the Architecture of Hannes Meyer and Ludwig Hilberseimer.* Cambridge: MIT Press.

Hanson, J. (forthcoming), *Decoding Dwellings.* Cambridge: Cambridge University Press.

Hillier, B., & Hanson, J. (1984), *The Social Logic of Space.* Cambridge: Cambridge University Press

Hillier, B. & Leaman, A. (1974), "How is design possible?", in: *Architectural Research and Teaching* **3** 4 - 11.

Hillier, B. (1996), *Space is the Machine*. Cambridge: Cambridge University Press.

Hillier, Hanson and Graham (1987) Ideas are in things an application of the space syntax method to discovering house genotypes. In: *Environment and Planning B: Planning and Design* **14** 363 -385

Kennedy, R. W. (1956), *The House and the Art of its Design* . New York: Reinhold Publishing Corporation.

Markus, T. (1987), Buildings as classifying devices. In: *Environment and Planning B: Planning and Design* **14** 467 - 484.

Steadman, P. (1983), *Architectural Morphology*. London: Pion Limited.

18.14