SPATIAL LOGIC OF THE NEO-RURAL HOUSES OF THE MSILIEN GUEBLA IN ALGERIA

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Abstract. This article aim is to define the logic that governs the spatiality of neo rural houses of the "Guebla" axis of the M'sila department in Algeria. Its goal is twofold. On one hand, it is a question of defining the generating planar character of these single-family homes, on the other hand, using the empirical method of space syntax analysis to consider through new cultural contexts, the importance of the human characteristic in the creation and the use of the space. This research was applied to thirty cases using appropriate mathematical and computer tools to determine the hidden socio-spatial structures of the new rural houses built since the decade of the 2000s in an agro-pastoral region of central Algeria. This study has identified several ways of distributing the domestic space through the identification of seven architectural genotypes.

Key words: Neo rural domestic architecture, space syntax, architectural genotype, socio spatial structures, agro-pastoral region, Msila

1. Introduction

From the green edges of the Mediterranean to the immense Algerian desert lies, in a central position, one of the most important steppe areas of Algeria. At the very heart of this agro-pastoral region is Msila, the capital of Hodna. Its eastern side, linking this city to the ancient area of Tobna (present-day city of Barika) via the RN40 national road, is known by the locals as the Guebla". For a long time, this axis has been inhabited by rural people, former nomads, who practice raising livestock and living in tents and modest houses (Fig. 1) (Meouak 2012; Boutabba and Farhi, 2012).

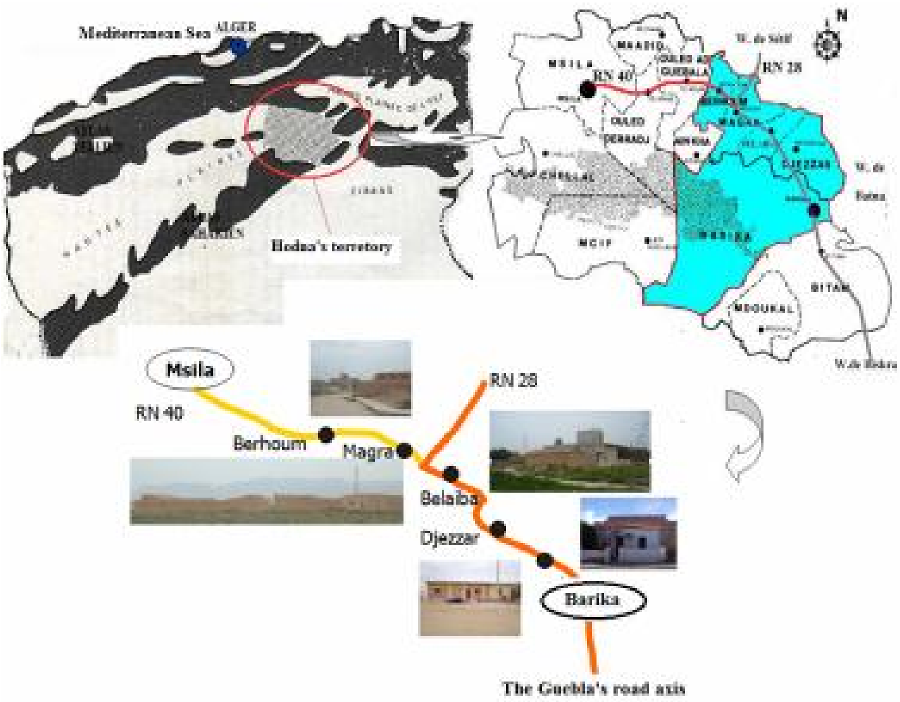

Fig. 1. Location of the study area in relation to the territory of Hodna and typology of old houses along the Guebla road.

Fig. 2. Neo-rural architecture of houses located on the Guebla road.

Since the decade of the 2000s, and like many other Algerian rural areas (Allal *et al.*, 2019; Angadi *et al.*, 2018; Boudalia *et al.*, 2018; Chikh *et al.*, 2019), the localities on the Guebla road, namely Barika, Djezzar, Belaiba, Magra and Berhoum, have been subjected to an accelerated process of socio-economic changes (Delhaye and Le Pape 2004; Gherbi *et al.*, 2016), which had given rise to a new rural domestic architecture, whose conceptual and stylistic typologies (Ilea *et al.*, 2019; Copăcean *et al.*, 2019; Hamma *et al.*, 2018; Bulai *et al.*, 2019; Yakubu 2019) seem to make a clean sweep of native architecture by giving up traditional form (Yin and Sun, 2019; Zhuang *et al.*, 2019; Hamma, 2018b; Lei *et al.*, 2019; Yu *et al.*, 2019; Chen *et al.*, 2019; Lyu *et al.*, 2019). A self-built architecture inspired by its rich sponsors sometimes from castles of medieval Europe, sometimes from Asian countries, especially in roofing using Chinese pagodas (Fig. 2).

This article focuses on the analysis of the spatial logic of this new architecture using the mathematical formulas and ratio of the configuration analysis specifically the gamma-analysis method. This analytical approach draws its methodological basis from the transformation of architectural plans into a set of objective, easily comparable data. The method used is defined as the set of rules governing architectural compositions, as we can apprehend them by the graphs that give the representation by providing appropriate mathematical and computer tools for the processing of a built-up space field that clearly has all the characteristics of a network (Del Mondo *et al.*, 2013; Bostenaru Dan and Dill, 2014; Boussora, 2015).

We find these methods in the books of Hanson (Decoding homes and houses in 1998), Hillier (What do we mean by building function? Designing for building utilization in 1984 and space is the machine. A configurational theory of architecture in 1996) and Steadman (architectural morphology: An introduction to the geometry of building plans in 1983).

This analysis considered an exhaustive sample, covering all the neo-rural houses inhabited during the survey located along the Guebla axis, built since the decade of the 2000s. A total of 30 cases, spread over the five villages of the study area. To facilitate the analysis, a coding was done: to each locality was assigned a code and to each house studied a number. Nine specimens were chosen from Barika (Bk1a, Bk2, etc.), eight from Magra (Mag1, Mag2, etc.), three from Belaiba (Bel1, Bel2, etc.), two from Djezzar (Dz1a, Dz1b) and eight from Berhoum (Bh1a, Bh1b, Bh2).

The fact that these houses are self-built and inhabited by a homogenous social and economic fringe the wealthy traders, native and inhabitants of the same region of Hodna, forming the same socio-spatial class, the initial hypothesis of this research considered that the spatial composition (Iles and Hamma, 2019; Kari *et al.*, 2019; Khemies *et al.*, 2019; Negadi *et al.*, 2019; Sahoui *et al.*, 2019) of these domestic dwellings may have structural similarities that can bring them together into a clearly defined architectural type. However, thanks to the mathematical ratios and computer tools of this method of gamma-analysis, the result of this research has proved that the spatial subdivision of this new neo-rural architecture goes far beyond the simple architectural type and shows seven distinct genotypes.

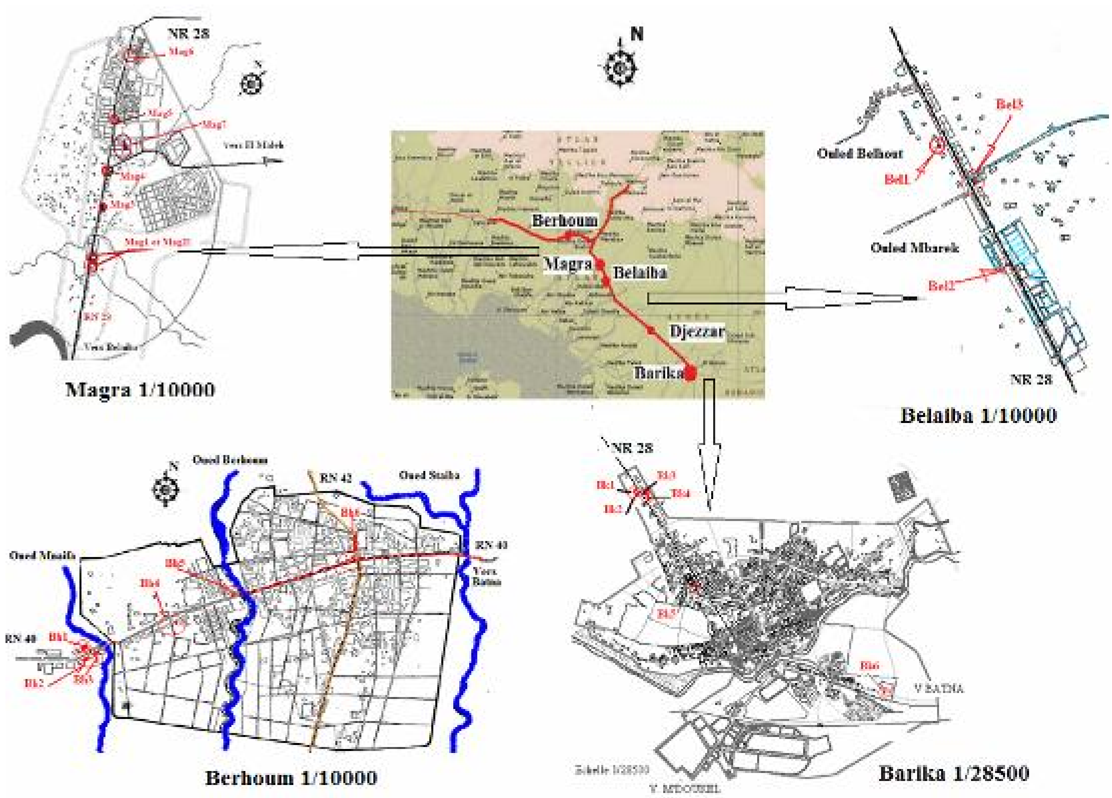

Fig. 3. Location along the Guebla axis.

1.1. Spatial and architectural characteristics of the neo rural houses of the Guebla

These new neo-rural single-family houses of the Guebla appear, according to a first observation, as exogenous in all their formal expressions, stylistic and localization to the domestic architecture of this region that remained landlocked for a many years. Located outside the rural settlements of Hodna, these houses are clustered, not in residential subdivisions and neighborhoods, but in disjointed longitudinal bands, along the commercial axis of La Guebla (Fig. 3), and this, because of the economic importance of this axis (to facilitate the sale of the exhibited material) (Kateb, 2003).

The exterior appearance of this habitat shows an extrovert typology using balconies, terraces, loggias and large windows that disagree with the habits, customs and morals of this semi-nomadic introvert society that has recently settled on the ground. Consisting of two to three floors, the facades of this habitat express an amalgam of architectures as diverse as varied, reminiscent sometimes occidental medieval architecture of castles (Zhang, 2019; Aytac and Karaca, 2019; Man, 2019; Gregory and Rogerson, 2019; Soltani *et al.*, 2019; Hamma, 2018a; Reisi *et al.*, 2019; Micek and Staszewska, 2019; Szczepańska and Pietrzyk; 2019; Benliay *et al.*, 2019; Turel, 2019) following the borrowing of architectural elements similar to dungeons and towers to shelter the stairwells, to the barbican ones to materialize the main entrance and, sometimes even stone walls of fence with a pace and dimensions of ramparts; sometimes to neoclassical European architecture respecting order and symmetry.

The building materials are very varied, to the point where often we find on the same facade: solid brick, stone, faience, wrought iron, tiles, marble, mosaic, plaster elements, reflective "sun-stop glass". Kitsch elements expressing the rowdy arrogance of the new rich. As for the volume, it expresses an impressive complexity with a multi-slope roofing that is similar to the pagodas, reminiscent of the Asian roof, may be Chinese, or rather an interpellation of what Charles Moore (1978) designated by architectural fairy tales.

The spatiality of this habitat also reveals new elements, strange to the ancestral home of this region. The land surface of this habitat reaches an average of 2000m^2 distributed between a soil constructed surface: the body of the house (500m^2) and a non-built, undeveloped rear space which constitutes its extension. The ground floor of the house consists of large premises dedicated to lucrative activities (sale of building materials, spare parts of all types of vehicles) and storage of goods of the owner (broken vehicles). In rare cases, it also includes the male reception space. The domestic space is located on the first floor, access to which is via a stairwell which occupies a frame either of the main facade or the side facade. This floor is usually the only one to be exploited. It is inhabited by the extended family of the owner of the house. The rest of the floors are separate apartments, served by a common stairwell. They are reserved to house the future families of the owner's sons. The spatial organization of all floors is identical. The distributive logic is reminiscent of the Middle Eastern architecture in vogue: monumental distribution halls (H) called "Westeddar" by the inhabitants of the region, corridors (Clr) called "Sabet" and vestibules (v) called "Dakhla". Comprising a multitude of architectonic elements of ostentation, the reception spaces are of distinct attendance, according to the two genres. Thus, we distinguish the living room (sej), a space intended for the feminine daytime reception as well as the night accommodation of the grandparents; while the male reception is done in another space: the lounge (Sl), called "Dar Dhiaf". The lounge (Sl) is extended, in most cases, with a toilet block (Bs) for the specific use of male guests, while female guests use the family ablution space, consisting of two separate spaces: bathroom (Sdb) and a toilet (Wc), separated by an intermediate space. The interior space is also formed by a large kitchen (Cu) extended by the courtyard (Co), as well as spacious bedrooms. Three main rooms are observed: A common room for boys (Chg), another specific for girls (Chf) and a room for parents (Chp). Grandparents occupy either a separate room (Cha) or the living room (sej). Although fully completed, the spatial components of the upper floors were not considered in the syntactic analysis, as they are not used. In this study, we limited ourselves to analyzing the level actually inhabited by the family. The body of the study therefore consists of houses of the same spatial size

1.2. Methodology

The analytical tools of the method emanate from two main principles which constitute the very basis of the space syntax, namely: The qualitative and quantitative data of the justified graphs of a building. By qualitative data Hillier and Hanson (1984) designate all the characteristics of an architectural plan, made possible by its corresponding graph, which constitutes a first source of information (Boutabba *et al.*, 2019). The building spaces are abstractly represented by circles and are called nodes. The permeability relation that unites them is represented by a line called connection. This graph, to which a preorder has been associated and by which the outside has been selected as the root, is called justified graph or justified permeability graph.

In graphs justified by topological types, the spaces of a single building can be differentiated according to the movement they present. The "a" type spaces are located in the terminal position on the graph, they are called "dead-end spaces". This type of space does not accept any other movement than that which leads to it. These are spaces of occupation by excellence. They have only one link to the rest of the graph. Spaces of type "b" materialize a tree-like structure where the elimination of one of the links entails the separation of one or more spaces of the system. Type "c" spaces embody a ring configuration. The "d" type spaces also embody a ring configuration and must belong to at least two rings where they constitute their points of intersection.

Quantitative data are those calculated using mathematical formulas on the basis of the graph of the architectural plan of the studied building. These are several mathematical formulas and ratios:

- Mean Depth: MD (n) = TD (n)/ K-1;
- Relative Asymetry: RA=2 (MD-1)/K-2
- Real Relative Asymetry:
- RRA=RA/X, X= {6.644K.log10(K+2)-5.17k+2}/(K^2 – 3K+2).
- Base difference factor BDF:
- H= - ∑ [a/t In (a/t)] + [b/t In (b/t)] +[c/t In (c/t)], H* = H- In2/ In3- In2

The plans and facades of the houses will be drawn by Autocad software. The syntactic analysis will be established by AGRAPH software developed at Oslo School of Architecture.

2. Syntactic analysis of the neo-rural houses of the Guebla axis of M'sila

The syntactic approach considers spatiality as a complex system (Orthurn *et al.*, 1995; Mustapha *et al.*, 2010; Boutabba and Farhi 2011; Eloy and Guerreiro, 2016). It tends to discover the underlying configurations of architectural space. The analysis generally considers mathematical tools to identify the internal logic of space via the identification of a possible existence of an architectural genotype (Bafna, 2012).

Drawn from the biological sciences, the architectural genotype is a concept used by Hillier and Hansson to try to make intelligible the spatial distribution of particular buildings and to identify the mechanisms that govern the production and reproduction of architectural types. The recurrence of certain structural features is considered as the genotype index (Bustard, 1999). In other words, a qualitative constancy, demonstrated by a constancy of the justified plans of the studied buildings, and another qualitative, translated during the interpretation of the numerical data (RA, RAA, SLR, H * or BDF), would imply the existence of a genotype.

To facilitate analysis and syntactical comparison, each domestic architectural space (Fig. 4) has been designated by a symbol: Hall (H), vestibule (V), hallway (Clr), stairwell (C), Intermediate space (I), Carrier (Ext), posterior space (Ep), Interior road (Ri), living room (Sej), lounge (Sl), sanitary block (Bs), bathroom (Sdb), toilet (Wc), kitchen (Cu), Courtyard (Co), parent's room (Chp), girl's room (Chf), boy's room (Chg).

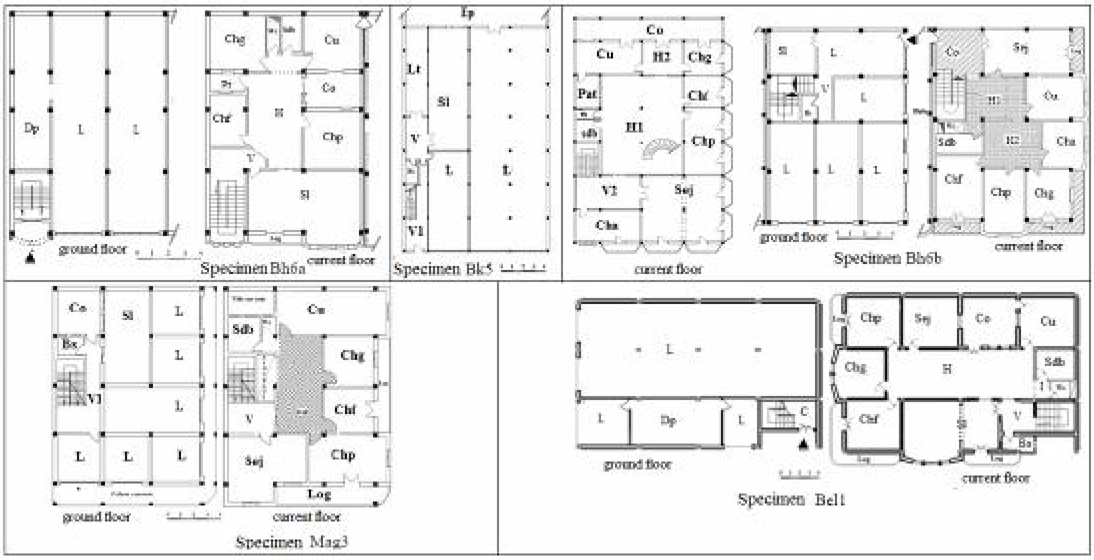

Fig. 4. Spatial configurations of some specimens of the corpus.

Table 1. Calculation of the basic syntactic parameters of the specimen examples of Bk1.

Bk1c agx_summary, Exterior included							Bk1c agx_summary, Exterior not included						
		TDn	MDn	RA	i	CV			TDn	MDn	RA	i	CV
0	C	46	3.28	0.35	2.84	1.33	0	C	45	3.46	0.41	2.43	0.33
1	V	35	2.50	0.23	4.33	1.75	1	V	33	2.53	0.25	3.90	2.25
2	Clr	28	2.00	0.15	6.50	2.53	2	Clr	25	1.92	0.15	6.50	2.53
3	Sl	48	3.42	0.37	2.67	0.33	3	Sl	45	3.46	0.41	2.43	0.33
4	H	27	1.92	0.14	7.00	3.08	4	H	23	1.76	0.12	7.80	3.08
5	Chg	41	2.92	0.29	3.37	0.25	5	Chg	37	2.84	0.30	3.25	0.25
6	Chp	41	2.92	0.29	3.37	0.25	6	Chp	37	2.84	0.30	3.25	0.25
7	I	36	2.57	0.24	4.13	2.20	7	I	31	2.38	0.23	4.33	2.20
8	Co	38	2.71	0.26	3.79	1.20	8	Co	33	2.53	0.25	3.90	1.20
9	Chf	40	2.85	0.28	3.50	0.20	9	Chf	35	2.69	0.28	3.54	0.20
10	Cu	40	2.85	0.28	3.50	0.20	10	Cu	35	2.69	0.28	3.54	0.20
11	Sdb	49	3.50	0.38	2.60	0.33	11	Sdb	43	3.30	0.38	2.60	0.33
12	Wc	49	3.50	0.38	2.60	0.33	12	Wc	43	3.30	0.38	2.60	0.33
13	Co	51	3.64	0.40	2.45	0.50	13	Co	45	3.46	0.41	2.43	0.50
14	Ext	59	4.21	0.49	2.02	0.50							
								Min	23.00	1.76	0.12	2.43	0.20
	Min	27.00	1.92	0.14	2.20	0.20		Mean	36.42	2.80	0.30	3.75	1.00
	Mean	41.86	2.99	0.30	3.64	1.00		Max	45.00	3.46	0.41	7.80	3.08
	Max	59.00	4.21	0.49	7.00	3.08							
	H (Difference factor)				= 0.48			H (Difference factor)				= 0.48	
	H* (Relative difference factor)				=-0.50			H* (Relative difference factor)				=-0.51	
					Specimen Bk 1c								

The analysis used the AGRAPH software and its AGX formats, developed at Oslo School of Architecture. Thanks to a careful calculation that allows this computer tool, a series of measurements of the degree of integration of the spaces constituting each studied specimen has been identified. And since spatial syntax makes it possible to dissect the bipolarity uniting the architectural framework with the human framework, the degree of integration of each activity assigned to each architectural space has become possible. This provides us with a powerful and reliable tool to inform not only the spatial logic, but also the social logic that prevails for a domestic habitat that characterizes a time, a region and a class of user. Thus, types of domestic dwellings are no longer identified by morphology, but by the space syntax prevailing in the spatial and social configuration order of places.

The syntactic analysis of the houses of the Guebla axis was carried out in four main phases:

- The first phase was concerned with the conversion of the house plans of the studied corpus into justified graphs by topological types, in order to identify any representative recurrences after calculation of the basic syntactic parameters. The aim of this phase is to classify the studied specimens in groups.
- The second phase considered the exploration of recurrence groups, as highlighted in the previous phase, by the basic difference factor (BDF).
- The third phase involved a preliminary genotypic identification through the use of Choice by the exploration of the space link ratio (SLR).
- The last step was interested in genotypic research using the nature of graphs (NG).

2.1. Phase I: The conversion of plans into justified graphs and the search of their structuring modes

This first phase is that of the representation and the preliminary calculation of the basic syntactic data. This is the transformation of the spaces in nodes "breaking spaces into elements" in order to draw the justified graphs by topological types (Fig. 5), as it is to calculate the integration value or Real Relative Asymetrie (RRA) for each space constituting the dwelling.

Two sets of measures were needed. The first series was limited to the calculation of syntactic parameters, only for residential (Hamma *et al.*, 2016) cells having a direct relationship with the interior, in other words, the body of the building under its internal connections: the "minimum living system" without taking into consideration the root of the plan.

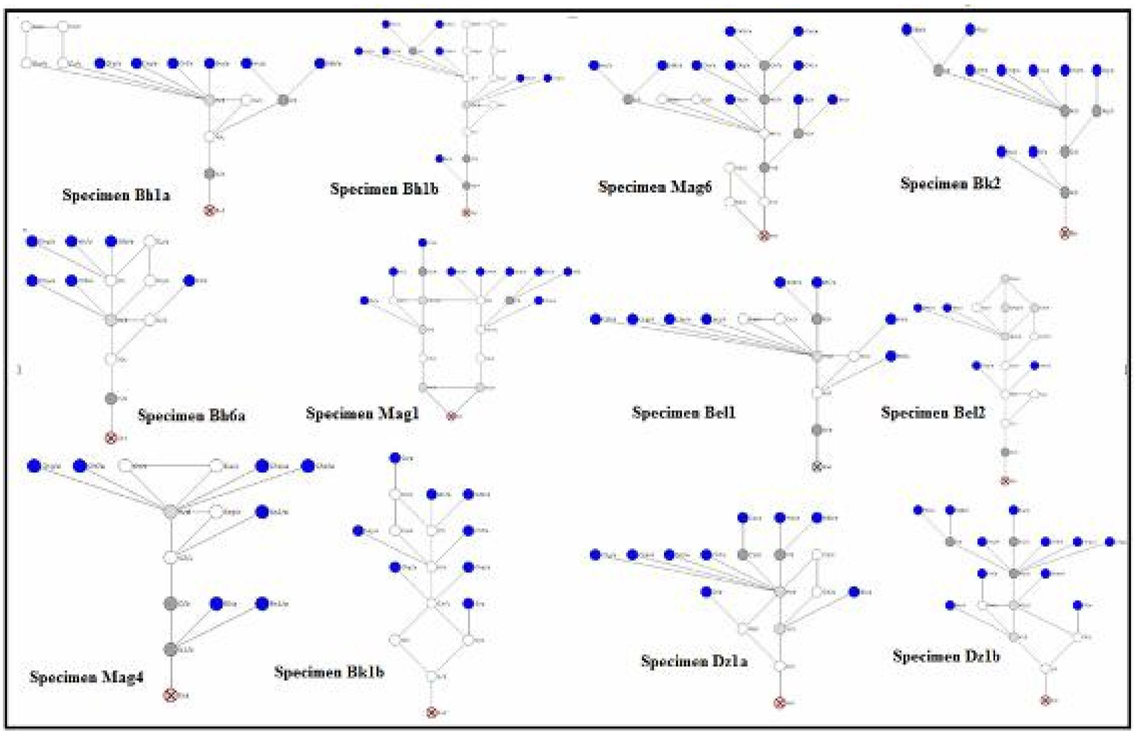

Fig. 5. Justified graphs by topological types of some houses of the studied corpus.

Table 2. Calculation of the basic syntactic parameters of the specimen examples of Bk2.

Bk2 agx_summary, Exterior included							Bk2 agx_summary, Exterior not included						
		TDn	MDn	RA	i	CV			TDn	MDn	RA	i	CV
0	Ext	47	3.35	0.36	2.75	0.25	0	V	33	2.53	0.25	3.90	2.33
1	V	34	2.42	0.21	4.55	3.33	1	C	25	1.92	0.15	6.50	1.00
2	C	27	1.92	0.14	7.00	0.91	2	Sl	45	3.46	0.41	2.43	0.33
3	Sl	47	3.35	0.36	2.75	0.25	3	Bs	45	3.46	0.41	2.43	0.33
4	Bs	47	3.35	0.36	2.75	0.25	4	H	23	1.76	0.12	7.80	4.66
5	H	26	1.85	0.13	7.58	4.66	5	Sej	35	2.69	0.28	3.54	1.33
6	Sej	38	2.71	0.26	3.79	1.33	6	Sej	47	3.61	0.43	2.29	0.50
7	Sej	51	3.64	0.40	2.45	0.50	7	Chp	35	2.69	0.28	3.54	0.16
8	Chp	39	2.78	0.27	3.64	0.16	8	Cu	35	2.69	0.28	3.54	0.16
9	Cu	39	2.78	0.27	3.64	0.16	9	Chg	35	2.69	0.28	3.54	0.16
10	Chg	39	2.78	0.27	3.64	0.16	10	Chf	35	2.69	0.28	3.54	0.16
11	Chf	39	2.78	0.27	3.64	0.16	11	I	31	2.38	0.23	4.33	2.16
12	I	35	2.5	0.23	4.33	2.16	12	Sdb	43	3.30	0.38	2.60	0.33
13	Sdb	48	3.42	0.37	2.67	0.33	13	Wc	43	3.30	0.38	2.60	0.33
14	Wc	48	3.42	0.37	2.67	0.33							
								Min	23.00	1.76	0.12	2.29	0.16
	Min	26.00	1.85	0.13	2.45	0.16		Mean	36.42	2.80	0.30	3.75	1.00
	Mean	40.26	2.87	0.28	3.86	1.00		Max	47.00	3.61	0.43	7.80	4.66
	Max	51.00	3.64	0.40	7.58	4.66							
	H (Difference factor)				= 0.47			H (Difference factor)				= 0.49	
	H* (Relative difference factor)				=-0.54			H* (Relative difference factor)				=-0.50	
					Specimen Bk 2								

The second series will extend, in addition to the body of the building, to the "outside". The latter will be treated as an undifferentiated spatial field, a neutralized platform that will be taken as the root of the justified graph (Tables 1 and 2). The latter is identified in the literature by the term "Carrier".

To know the structuring mode of the domestic interior of the studied dwellings, each space of each specimen was compared to the other spaces of the same specimen, according to its degree of integration and thus took a rank on a scale (Table 3). Such ordinations according to the graphs would not only lead to a better understanding of morphology and therefore of spatial logic, but insofar as the functions of each space, the activities which are regularly associated with it, are well known, these ordinations would lead to the understanding of the social logic that prevails there. If these ordinations remain in a coherent order through a sample, Hillier and Hanson (1987) state that cultural patterns can be traced "[...] and also, the means by which architecture can carry culture". The recurrence of certain structural features of the specimens is considered to be the index of genotype while the variety of observed architectural compositions is considered as phenotypes. The careful observation of Table 3 reveals a certain recurrence of the spatial structuring mode of the specimens. Thus, the specimens Bh1a, Bel1, Dz1a, Mag6, Bk4, Bk5, Mag1, Bk1c, Bk2, Bk3, Bh6b, and Bh6a are exclusively structured around the Hall H, the "West-eddar" considered as the best integrated space. This is the dominant group I (Table 4). Whereas the Bh1b, Bh2, Bh3, Mag2, Bel2, Bel3, Bk1a, Bk6b, Mag5a and Mag5b specimens are strictly structured around the Hallway Clr "Sabet", the space with the highest integration capacity.

Table 3. Function integration order outside included.

Sp	No	Order of integration
Bh_{1a}	1	H<V<Sl<Cu=Chp<I<Chg=Chf=Sej<C<Co<Wc=Sdb<Ext
		0.09 0.12 0.17 0.20 0.21 0.22 0.23 0.30 0.35 0.37
Bh_{1b}		Clr<H<V<Sl=Cu<Chg<I<Sej=Cha<Chp=Chf=Chf <C<Cu<Co<Co=Wc=Sdb<Ep<Ep=Ext
	2	0.12 0.13 0.17 0.19 0.20 0.21 0.22 0.23 0.24 0.26 0.27 0.31 0.32 0.42
Bh_2	3	Clr<H=V<Cu=Sl<I<C<Co<Chp=Chg=Chf=Sej<Sl<Ext=Sdb=Wc<C2<Ep
		0.11 0.17 0.19 0.20 0.25 0.26 0.29 0.30 0.32 0.33 0.39
Bh_3	4	Clr<H<V<Sl< I=Chf<Sej<Cu<Co<Chp=Chg=Chg=Co<Cha=Bs< Sl<Sdb=Wc<Ex
		0.08 0.13 0.14 0.15 0.16 0.17 0.21 0.22 0.24 0.25 0.26 0.28 0.35
Bh_4	5	H1<H2=V<Sl<Co<S ej=Cu<Cha=Chg<Chp=Chf=Sdb=Wc<Bs<Sl <Ext
		0.07 0.13 0.15 0.18 0.19 0.20 0.24 0.25 0.27 0.36
Bh_5	6	H<Clr<Sl<V<I<Cu<Cha=Sej=Chf=Chp<Chg<C<Sdb=Wc<V1<Ext
		0.13 0.14 0.17 0.18 0.22 0.24 0.25 0.26 0.27 0.35 0.38 0.50
Bh_{6a}	7	H<I<V<Sl <Co<Chp=Chf<Cu<C=Chg=Sdb=Wc<Sl<Ext
		0.10 0.15 0.17 0.19 0.23 0.25 0.28 0.30 0.34 0.46
Bh_{6b}	8	H1<Co <H2<Sej=C<I <Cu <V1<Chp= Chf=Cha<Sdb=Wc <L<Bs< Sl=Ext
		0.16 0.19 0.22 0.23 0.25 0.28 0.29 0.34 0.37 0.38 0.41 0.50
Mag_1	9	H<Clr1<Clr2 <V< Sl<C2< I =Chp=Chf=Cu=Sej<Ep=C1<Ri=Chg<Bs< Sl=Ext< Sdb=Wc=Co
		0.13 0.14 0.15 0.18 0.20 0.21 0.23 0.24 0.25 0.26 0.28 0.30
Mag_2	10	Clr<H<V<Sl<I<Cu<Co=C<Chp=Chf=Sej<Bs <Sl<Ri<Sdb=Wc<Ep= Ext
		0.13 0.14 0.16 0.19 0.22 0.23 0.24 0.25 0.28 0.30 0.32 0.33 0.43
Mag_3	11	V<H<C<V1<Sej=I<Chp=Chg=Chf=Cu <L<Sl=Bs =Co<Sej= Sdb=Wc<Ext
		0.16 0.17 0.19 0.23 0.26 0.29 0.33 0.35 0.38 0.45
Mag_{g4}	12	V2=H<C<Sej<Co=Cu=V<Bs2= Chp=Chg=Chf=Cha<Sl=Bs1=Ext
		0.14 0.19 0.20 0.27 0.28 0.41
Mag_{g5a}	13	Clr <V<H<I<Cr <Sej<Sl=Bs<Cu=Co=Chp=Chg=Chf<C< Wc= Sdb<Ep<Ext
		0.13 0.16 0.18 0.22 0.24 0.25 0.28 0.30 0.32 0.33 0.43 0.55
Mag_{g5b}	14	Clr<V<H<Sl=Cr<Co=I<Sl=Sej <Bs=Cu<Chp=Chg=Chf<C<Wc= Sdb<Ep<Ext
		0.13 0.15 0.16 0.20 0.22 0.24 0.26 0.28 0.29 0.33 0.39 0.50
Mag_6	15	H1<V<H2<I<Sej=C=Cu=Co<Sl <Clr<Cha=Chf=Chg<Sdb=Wc<Ex=V1<Sl=Bs<Chp<Ep
		0.10 0.13 0.14 0.18 0.20 0.21 0.22 0.24 0.28 0.29 0.30 0.31 0.37
Mag_7	16	H_1<H_2 <V<Clr<Sl=Chp<Cu=Chg=Chf=Sej<C< Sl <I<Cha<Co=Chp<V_1<Sdb=Wc<Co<Bs=Ext
		0.13 0.15 0.18 0.20 0.21 0.22 0.24 0.26 0.28 0.30 0.31 0.32 0.38 0.40 0.41
Bel_1	17	H<V<Sl<I<Cu=Co<Sej=Chp=Chg=Chf<C<Bs<Sl<Sdb=Wc<Ext
		0.06 0.12 0.14 0.16 0.19 0.20 0.23 0.25 0.27 0.29 0.37
Bel_2	18	Clr<H=H_2<Chf<C<Co<Sl<Cu=Chg<Chp=Sej=Sdb=Wc<Co <V<Ext
		0.15 0.17 0.24 0.25 0.26 0.27 0.28 0.30 0.36 0.37 0.50
Bel_3	19	Clr=H_1<H_2<V<Sl=Cu<I<Co<Sej=Cha<C<Chp=Chf=Chg< Bs <Sl< Sdb=Wc< Ext
		0.12 0.16 0.17 0.18 0.20 0.21 0.22 0.25 0.26 0.27 0.28 0.30 0.44
Dz_{1a}	20	H<V<Sl <I<Co=Cu<Sej=Chp=Chg=Chf<C<Clr <Bs <Sl<Sdb=Wc<Cu<Ext
		0.06 0.12 0.13 0.15 0.16 0.18 0.19 0.22 0.24 0.25 0.27 0.28 0.31
Dz_{1b}	21	H_1=H_2<V<Clr=Sl<I<Cu<Sej=Chp= Chg= Chf=Cha<C<Bs <Co=Sl<Sdb=Wc<Cu <Ex
		0.10 0.16 0.17 0.18 0.19 0.21 0.23 0.26 0.28 0.29 0.30 0.33
Bk_{1a}	22	Clr<H_1<H_2 <V< Sl<Sej=I<Cu<Chp=Chf<C=Cha=Chg=Co< Sl<Sdb=Wc<Co1<Ex
		0.10 0.12 0.16 0.17 0.18 0.21 0.22 0.23 0.26 0.28 0.31 0.32 0.37
Bk_{1b}	23	H<Clr<I<Sl<Cu<V<Sej=Chf<Chg=Chp<Co<C<Sdb=Wc<Sl<Co<Ext
		0.13 0.14 0.19 0.21 0.22 0.23 0.25 0.26 0.28 0.30 0.31 0.34 0.40 0.43
Bk_{1c}	24	H<Clr<V<I<Co<Cu=Ch f<Chp=Chg<C<Sl<Sdb =Wc<Co<Ext
		0.14 0.15 0.23 0.24 0.26 0.28 0.29 0.35 0.37 0.38 0.40 0.49
Bk_2	25	H<C<V<I<Sej<Chp=Chg=Chf=Cu<Ext=Sl=Bs<Sdb=Wc<Sej
		0.13 0.14 0.21 0.23 0.26 0.27 0.36 0.37 0.40
Bk_3	26	H<C<I<V= Sej<Chp=Chg=Chf=Cha<Cu<Co=Sdb=Wc<L<Bs=Sl<Ext
		0.11 0.15 0.18 0.21 0.24 0.28 0.30 0.32 0.34 0.45
Bk_4	27	H<V<C=Sej<V1=Cu<Chp=Chg=Chf=Cha=Sdb=Wc<Sej<Co<Sl<Ext=L<Bs
		0.1 0.13 0.16 0.21 0.22 0.25 0.29 0.3 0.31 0.41
Bk_5	28	H_2=V_2<C<H_2=V_1<Sej=Cha<Chp=Chf=Sdb=Wc<V<Co=Ext<Cu=Chg<L<Sl=Bs
		0.16 0.19 0.24 0.27 0.28 0.31 0.33 0.34 0.41 0.42
Bk_{6a}	29	V=H_1<C<H_2<Clr_2=Clr_1<V_1=L_1=Sl<H_3<Cu<L_2=Sej=Chp<Ep=Ext<B_s=B_m=Sl=Co<Chg=Sdb=Wc<Ext
		0.15 0.18 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.29 0.31 0.32
Bk_{6b}	30	Clr_1<C_2<H<H_1<L_2 <Clr<Cu_1=Sl_1<Clr_2=Sl<Ep=Sej<Ext=V_1=L_1<Chp=Chg=Cu=Sdb=W_c=Sl=B_s=B_m
		0.14 0.15 0.16 0.18 0.19 0.21 0.23 0.24 0.25 0.26 0.30

Table 4. Dominant Group I structured specimens around the Hall H.

Sp	N°	Order of integration
Bh$_{1a}$	1	H<V<Sl<Cu=Chp<I<Chg=Chf=Chg=Sej<C<Co=Co<Wc=Sdb<Ext
Bel$_1$	17	H<V<Sl<I<Cu=Co<Sej=Chp=Chg=Chf <C<Bs<Sl<Sdb=Wc<Ext
Dz$_{1a}$	20	H<V<Sl<I<Co=Cu<Sej=Chp=Chg=Chf<C<Clr<Bs<Sl<Sdb=Wc<Cu<Ext
Mag$_6$	15	H1<V<H2<I<Sej=C=Cu=Co<Sl<Clr<Cha=Chf=Chg<Sdb=Wc<Ext=V1<Sl=Bs<Chp Chf2<Ep
Bk$_4$	27	H<V<C=Sej<V1=Cu<Chp=Chg=Chf=Cha=Sdb=Wc<Sej<Co<Sl< Ext=L< Bs
Bh$_4$	05	H1<H2=V<Sl<Co<Sej=Cu<Cha=Chg<C<Chp=Chf=Sdb=Wc=Bs<Sl<Ext
Mag$_7$	16	H1<H2<V<Clr<Sl=Chp<Cu=Chg=Chf=Sej<C<Sl<I<Cha<Co=Chp<V1<Sdb=Wc<Co <Bs=Ext
Dz$_{1b}$	21	H1=H2<V<Clr=Sl<I<Cu<Sej=Chp=Chg=Chf=Cha < C < Bs < Co = Sl < Sdb = Wc < Cu < Ext
Bk$_{1b}$	23	H<Clr <I<Sl<Cu<V<Sej =Chf<Chg= Chp <Co<C< Sdb=Wc <Sl <Co< Ext
Bh$_5$	6	H<Clr<Sl<V<I<Cu<Cha=Sej=Chf=Chp<Chg<C<Sdb=Wc<V1<Ext
Mag$_1$	9	H<Clr1<Clr2<V<Sl<C2<I=Chp=Chf=Cu=Sej<Ep=C1<Ri=Chg<Bs<Sl=Ext<Sdb= Wc = = Co
Bk$_{1c}$	24	H<Clr<V<I<Co<Cu=Chf<Chp=Chg<C<Sl<Sdb=Wc<Co<Ext
Bk$_2$	25	H<C<V<I<Sej<Chp=Chg=Chf=Cu<Ext=Sl=Bs<Sdb=Wc<Sej
Bk$_3$	26	H<C<I<V=Sej<Chp=Chg=Chf=Cha<Cu<Co=Sdb=Wc<L<Bs=Sl<Ext
Bh$_{6b}$	7	H1<Co<H2<Sej=C<I<Cu<V1<Chp=Chg=Chf=Cha<Sdb=Wc<L<Bs<Sl=Ext
Bh$_{6a}$	8	H<I<V<Sl<Co<Chp=Chf<Cu<C=Chg=Sdb=Wc<Sl< Ext
Total: 16 specimens (53,33%)		

Table 5. Dominant Group II structured specimens around the Hallway Clr.

Sp	N°	Order of integration
Mag$_4$	12	V_2 = H < C < Sej < Co = Cu= V < Bs_2 = Chp = Chg = Chf = Cha < Sl =Ext
Bk$_5$	28	H2 = V_2 < C < H2 = V_1 < Sej = Cha < Chp = Chf = Sdb = Wc < V < Co = Ext < Cu = Chg < L < Sl = Bs
Bk$_{6a}$	29	V = H_1 <C < H2 < Clr_2 = Clr1 < V1 = L1 = Sl < H_3 < Cu < L_2 = Sej = Chp <Ep = Ext < Bs = Bm = Cu1= Sl = Co < Co < Chg = Sdb = Wc
Total: 3 specimens (10%)		

Table 6. Minor Group I simultaneous structured specimens around the Vestibule V and the Hall H.

Sp	N°	Order of integration
Bh$_{1b}$	2	Clr<H<V<Sl=Cu<Chg<I<Sej=Cha<Chp=Chf =Chf<C<Cu<Co<Co=Wc = Sdb < Ep<Ep=Ext
Bh$_2$	3	Clr<H=V< Sl=Cu <I<C<Co<Chp=Chg=Chf=Sej<Sl<Ext=Sdb=Wc <C_2 < Ep
Bh$_3$	4	Clr<H<V< l<I=Chf<Sej<Cu<Co<Chp=Chg=Chg=Co<Cha=Bs<Sl<Sdb=Wc<Ext
Mag$_2$	10	Clr<H<V<Sl<I< Cu<Co=C<Chp=Chg=Chf=Sej<Bs<Sl<Ri <Sdb=Wc< Ep=Ext
Bel$_2$	18	Clr<H=H_2<Chf <C<Co < Sl< Cu=Chg<Chp=Sej=Sdb=Wc<Co<V< Ext
Bk$_{1a}$	23	Clr<H_1<H_2<V<Sl<Sej=I<Cu<Chp=Chf<C=Cha=Chg=Co=Chg<Sl<Sdb=Wc<Co_1 <Ext
Bk$_{6b}$	30	Clr1<C_2<H<H_1<L_2<Clr<Cu_1=Sl1<Clr2=Sl<Ep=Sej<Ext=V1=L1<Chp=Chg=Cu =Sdb=Wc=<Sl=Bs=Bm
Mag$_{5a}$	13	Clr<V<H<I<Cr<Sej<Sl=Bs<Cu=Co=Chp=Chg=Chf<C<Wc=Sdb<Ep<Ext
Mag$_{5b}$	14	Clr<V<H<Sl=Cr<Co=I<Sl=Sej<Bs=Cu<Chp=Chg=Chf <C<Wc=Sdb< Ep<Ext
Total: 9 specimens (30%)		

Table 7. Minor Group II structured specimen jointly around vestibule V and Hallway Clr.

Sp	N°	Order of integration
Bel$_3$	19	Clr = H_1 < H_2 < V < Sl = Cu < I < Co < Sej=Cha < C < Chp = Chf = Chg = Chg < Bs < Sl < Sdb = Wc < V_1 < Ext
Total: 1 specimen (3,33%)		

Table 8. Minor Group III structured specimen around vestibule V.

Sp	N°	Order of integration
Mag$_3$	11	V < H < C < V_1 < Sej = I < Chp = Chg =Chf = Cu < L < Sl = Bs= Co < Sej Sdb = Wc < Ext
Total: 1 specimen (3,33%)		

This is the dominant group II (Table 5). The remaining specimens, Mag4, Bk5, Bk6a, and Bel3, are minor groups. The first three are jointly structured around hall H and vestibule V "Dakhla". This is the minor group I (Table 6). The last Bel3 is simultaneously structured around hall H and Hallway Clr. This is minor group II (Table 7). The eleventh specimen of the study Mag3, because it is absolutely structured around vestibule V, does not seem to belong to any subset (Table 8). It is a phenotype of another genotype.

2.2. Phase II: the exploration of Groups by the Space Link Ratio SLR

At this stage of analysis, we will not be able to talk about genotypes but only about structuring mode of specimens. To refine the search for the genotyping of specimens we must review all the observed groups, whether dominant or minor, highlighted in the first phase by another syntactic parameter: the choice or paths, expressed by the space link ratio. To go from one space to another in a justified graph, several paths present themselves. The "Space Link Ratio" provides information on the choice of the itinerary. It is calculated by a mathematical formula relating the number of links increased by one unit, to the total number of nodes in a complex: SLR= L+1/ K. If the complex offers a guided path, without any alternative, the SLR report indicates a value equal to 1. If this value is > 1, then the system is equipped with more than one alternative of circulation, and contains closed circuits within it (Table 9, 10, 11, 12 and 13) (Taking into account the SLR in the partition of groups of modes of structuring the specimens).

In Table 9 which represents the dominant group I, and unlike the other specimens of the group, two specimens: Bk1c and Bk2, display an SLR equal to 1, and therefore register a tree-like structure. Although all these specimens share an important recurrence which is their mode of structuring around the Hall H, they will not be able to be part of the same genotype, because of their qualitative differences inherent to the nature of their justified graphs. Similarly, Table 10 structured around the hallway presents as "intruder" the Mag5a specimen which differs, because of its SLR, from the rest of the specimens of this second dominant group (Fig. 6). For the rest of the other minor groups namely 10 and 11, the SLR>1, identifies a single qualitative type.

Table 9. Dominant group I structured around Hall H.

Sp	N°	SLR
Bh_{1a}	01	1.25
Be_{l1}	17	1.12
Dz_{1a}	20	1.11
Mag_6	15	1.09
Bk_4	27	1.15
Bh_4	05	1.15
Mag_7	16	1.04
Dz_{1b}	21	1.05
Bk_{1b}	23	1.11
Bh_5	06	1.17
Mag_1	09	1.14
Bk_{1c}	**24**	**1.00**
Bk_2	**25**	**1.00**
Bk_3	26	1.05
Bh_{6b}	07	1.05
Bh_{6a}	08	1.14

2.3. Phase III: The exploration of groups by the basic difference factor as an identifier for the solidity and homogeneity of genotypes

After checking the recurrence of the structuring mode and degree of ringiness through the SLR, there remains the verification of another determining factor in the declaration of genotype that verifies the solidity and the homogeneity. Tables 13, 14, 15, 16 and 17 (Taking into account the basic difference factor for the determination of the robustness of the groups that are candidates for genotyping) indicate that all groups that are candidates for genotyping have low BDF values.

In this regard, Hillier, Hanson and Graham (1987) state "To give a feel of this measure, the difference factor for, say, 0.4, 0.5, and 0.6 is 0.97 (that is, close to1 or very weak), whereas thet for 0.3, 0.5 and 0.7 is 0.84, or considerably stronger, and that for 0.1, 0.5, and 0.9 is 0.39, or much stronger still".

Table 14 shows all the specimens structured exclusively around the hall spreads BDF values between 0.51 as a minimal value (Bel1) and 0.84 as the maximum value (Mag1).

Table 10. Dominant Group II structured around the Hallway Clr.

Sp	N°	SLR
Bh_{1b}	2	1.09
Bh_2	3	1.11
Bh_3	4	1.11
Mag_2	10	1.10
Bel_2	18	1.25
Bk_{1a}	23	1.05
Bk_{6b}	30	1.13
Mag_{5a}	**13**	**1.00**
Mag_{5b}	14	1.10

Table 11. Minor Group I structured around the Vestibule V and the Hall H.

SLR	N°	Sp
1.13	12	Mag_4
1.15	28	Bk_5
1.16	29	Bk_{6a}

Table 12. Minor Group II structured around the Vestibule V and the Hallway Clr.

Sp	N°	SLR
Bel_3	19	1.09

Table 13. Minor Group III structured around the Vestibule V.

Sp	N°	SLR
Mag_3	11	1.00

The second dominant group with the hallway as the most integrator space, shown in Table 15, exposes BDF values within a range of 0.63 (Mag5a) to 0.86 (Bk6b).

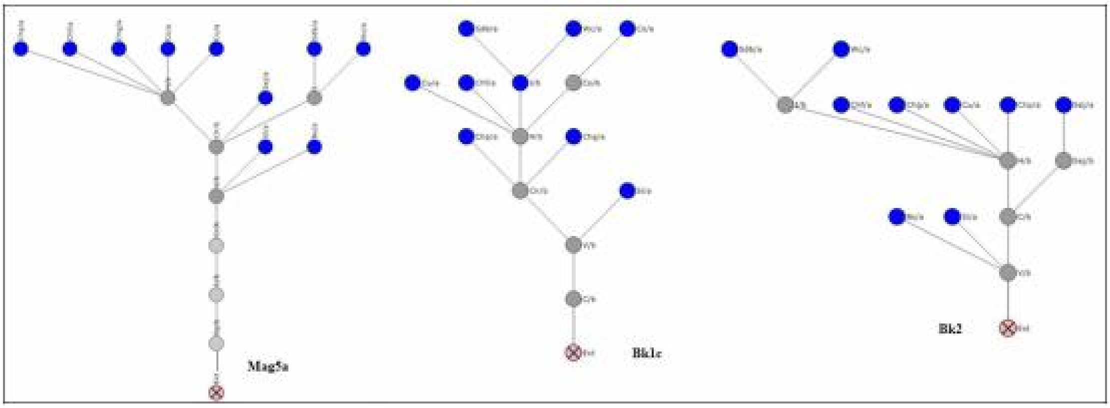

Fig. 6. Justified graphs of tree-like complexes SLR = 1 belonging to dominant groups I and II.

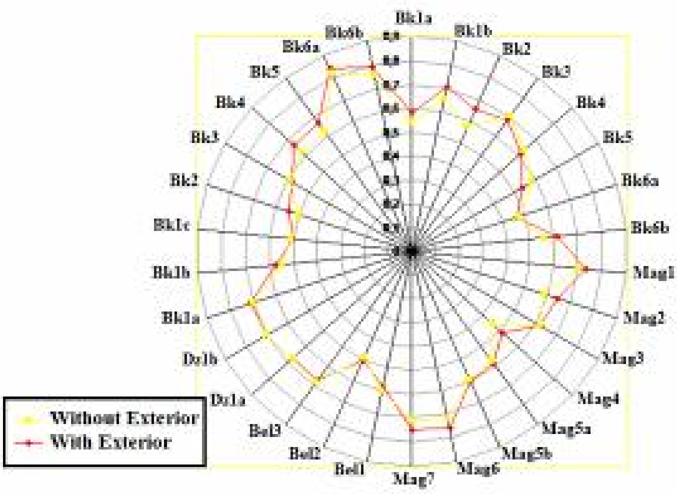

Fig. 7. Variation of the Base Difference Factor BDF with and without Exterior of all the specimens of the studied corpus.

Similarly, the other minor tables unanimously show BDF values between 0.79 (Mag4) and 0.89 (Bk6a) for the specimens in Table 16 arranged simultaneously around the vestibule and the Hall, as well as values of 0.69 and 0.89 respectively for Tables 17 and 18 (Fig. 7).

Table 14. Group structured around the Hall H.

Sp	N°	SLR	BDF
Bh_{1a}	1	1.25	0.67
Be_{l1}	**17**	**1.12**	**0.51**
Dz_{1a}	20	1.11	0.60
Mag_6	15	1.09	0.71
Bk_4	27	1.15	0.71
Bh_4	5	1.15	0.58
Mag_7	16	1.04	0.79
Dz_{1b}	21	1.05	0.75
Bk_{1b}	23	1.11	0.71
Bh_5	6	1.17	0.67
Mag_1	**09**	**1.14**	**0.84**
Bk1c	24	1.00	0.73
Bk_2	25	1.00	0.81
Bk_3	26	1.05	0.67
Bh_{6b}	7	1.05	0.77
Bh_{6a}	8	1.14	0.62

Table 15. Group structured around the Hallway Clr.

Sp	N°	SLR	BDF
Bh_{1b}	2	1.09	0.72
Bh_2	3	1.11	0.73
Bh_3	4	1.11	0.64
Mag_2	10	1.10	0.74
Bel_2	18	1.25	0.73
Bk_{1a}	23	1.05	0.71
Bk_{6b}	30	1.13	0.86
Mag_{5a}	**13**	**1.00**	**0.63**
Mag_{5b}	14	1.10	0.67

Table 16. Group structured around V and H.

BDF	SLR	N°	Sp
0.79	1.13	12	Mag_4
0.84	1.15	28	Bk_5
0.89	1.16	29	Bk_{6a}

Table 17. Group structured around the Vestibule and the Hallway Clr.

Sp	N°	SLR
Bel_3	19	1.09

These values, which are highlighted for the different groups, reflect, according to Hillier, Hanson, and Graham (1987), strong BDF, which argues in favor, on the one hand, of configurations that tend to favor a functional differentiation of the spaces which constitute them, in other words, that they effectively gather the spaces whose activity must, or may be associated and move away from each other, the spaces that must be kept separate; As they affirm on the other hand, a solidity of the spatial configurations.

Table 18. Group structured around the vestibule V.

BDF	SLR	N°	Sp
0.80	1.00	11	Mag_3

At this stage, and despite the recurrence, observed for each identified group, inherent to the structuring mode and the weakness of the Base Difference Factor values, the SLR "Space Link Ratio" shows some disparities. Even if we proceed to correct “intruder” domestic complexes to the formed groups, we cannot yet declare their genotype, since we have not yet determined the number of rings or circuits they envelop, nor identified, precisely, the node that divide these rings. For this reason and via the paths they offer, the examination of their qualitative considerations is required as the last phase.

2.4. Phase IV: The exploration of specimens via qualitative considerations

Qualitative considerations take into account the way in which the different nodes of a justified graph are arranged. The analysis of the thirty specimens allowed us to classify them according to the nature of their justified graphs (NG) into two big categories: tree-like graphs (TlG) and ring graphs (RG). The latter are subdivided into three other sub-categories: internal ring graphs (IR G), external ring graphs (ER G) and complex ring graphs (CR G).

- The tree-like graphs are characterized by a sequence of spaces of topological type "b" which end up serving spaces of type "a". The internal movement is relatively predictable and highly controlled from the outside, so the path taken on the way out can only be that of the way back. Indeed, the spaces of topological type "a" have the characteristic of never being traversed, while those of type "b" are defined only by transient movements "trough movement" and are considered the most constraining (One way in one way out spaces). 13.33% of the specimens of the studied corpus have a tree-like spatial articulation. These are Mag3, Mag5a, Bk1c and Bk2.
- The internal ring graphs have exclusively limited rings inside the building, excluding any passage through outside. 60% of the studied specimens have an internal ring spatial articulation; they are Bh4, Bh6b, Mag4, Mag7, Bel1, Bel3, Dz1a, Dz1b, Bk1a, Bk3, Bh1a, Bh1b, Bh3, Bh5, Bh6a, Mag5b, Bel2 and Bk1b.
- The external ring graphs have an arrangement in which one or more rings appear which must imperatively pass through the outside. From a spatial point of view, this is reflected in the existence of at least two entries in the house. Only the specimen Bk6b (3.33 %.) Belongs to this category.

Complex ring graphs are characterized by the presence of both internal and external rings. The spatial configurations of which they are the graphic expression are the most elaborate. 23.33% of the buildings considered in this study are equipped with a complex articulation: Bh2, Mag1, Mag2, Mag6, Bk4, Bk5 and Bk6a (Fig. 8).

3. Discussion

After studying in depth the quantitative considerations of all the specimens constituting the corpus and identifying the different groups of mode of structuring of the complexes, now, the search for the genotyping must look at the examination of the qualitative recurrences related to the nature of the justified graphs.

It is a question of making the results synthesized in tables 13, 14, 15, 16 and 17 with those summarized in Fig. 7, by replacing the space link ratio SLR by the detailed nature of the graphs according to the nature of their justified graphs (NG).

Table 19. Group structured around the Hall H.

Sp	N°	BDF	NG
Bh$_{1a}$	1	0.67	I$_R$G
Bel$_1$	17	0.51	I$_R$G
Dz$_{1a}$	20	0.60	I$_R$G
Mag$_6$	15	0.71	C$_R$G
Bk$_4$	27	0.71	C$_R$G
Bh$_4$	5	0.58	I$_R$G
Mag$_7$	16	0.79	I$_R$G
Dz$_{1b}$	21	0.75	I$_R$G
Bk$_{1b}$	23	0.71	I$_R$G
Bh$_5$	6	0.67	I$_R$G
Mag$_1$	9	0.84	C$_R$G
Bk$_{1c}$	24	0.73	T$_I$G
Bk$_2$	25	0.81	T$_I$G
Bk$_3$	26	0.67	I$_R$G
Bh$_{6b}$	7	0.77	I$_R$G
Bh$_{6a}$	8	0.62	I$_R$G

Table 20. Group structured around the Hallway Clr.

Sp	N°	BDF	NG
Bh$_{1b}$	2	0.72	I$_R$G
Bh$_2$	3	0.73	C$_R$G
Bh$_3$	4	0.64	I$_R$G
Mag$_2$	10	0.74	C$_R$G
Bel$_2$	18	0.73	I$_R$G
Bk$_{1a}$	23	0.71	I$_R$G
Bk$_{6b}$	30	0.86	E$_R$G
Mag$_{5a}$	13	0.63	T$_I$G
Mag$_{5b}$	14	0.67	I$_R$G
Sp	N°	BDF	NG
Bh$_{1b}$	2	0.72	I$_R$G
Bh$_2$	3	0.73	C$_R$G
Bh$_3$	4	0.64	I$_R$G
Mag$_2$	10	0.74	C$_R$G
Bel$_2$	18	0.73	I$_R$G
Bk$_{1a}$	23	0.71	I$_R$G
Bk$_{6b}$	30	0.86	E$_R$G
Mag$_{5a}$	13	0.63	T$_I$G
Mag$_{5b}$	14	0.67	I$_R$G

Table 21. Group structured around the Vestibule V and the Hall H.

Sp	N°	BDF	NG
Mag_4	12	0.79	I_RG
Bk_5	28	0.84	C_RG
Bk_{6a}	29	0.89	C_RG

Table 22. Group structured around the Vestibule V and the Hallway Clr.

Sp	N°	BDF	NG
Bel_3	19	0.69	I_RG

Table 23. Group structured around the Vestibule V.

Sp	N°	BDF	NG
Mag_3	11	0.80	T_lG

Table 24. Dominant.

Sp	N°	BDF	NG
Bh_{1a}	1	0.67	I_RG
Be_{l1}	17	0.51	I_RG
Dz_{1a}	20	0.60	I_RG
Mag_6	15	0.71	C_RG
Bk_4	27	0.71	C_RG
Bh_4	5	0.58	I_RG
Mag_7	16	0.79	I_RG
Dz_{1b}	21	0.75	I_RG
Bk_{1b}	23	0.71	I_RG
Bh_5	6	0.67	I_RG
Mag_1	09	0.84	C_RG
Bk_{1c}	24	0.73	T_lG
Bk_2	25	0.81	T_lG
Bk_3	26	0.67	I_RG
Bh_{6b}	7	0.77	I_RG
Bh_{6a}	8	0.62	I_RG

Table 25. Subgroup A of the dominant group I.

Sp	N°	BDF	N G
Bh_{1a}	1	0.67	I_RG
Bel_1	17	0.51	I_RG
Dz_{1a}	20	0.60	I_RG
Bh_4	5	0.58	I_RG
Mag_7	16	0.79	I_RG
Dz_{1b}	21	0.75	I_RG
Bk_{1b}	23	0.71	I_RG
Bh_5	6	0.67	I_RG
Bk_3	26	0.67	I_RG
Bh_{6b}	7	0.77	I_RG
Bh_{6a}	8	0.62	I_RG

The observation in Table 9 shows, like Table 14, that the specimens Bk1c and Bk2 are distinguished, by the nature of their corresponding justified graphs (SLR=1), from the rest of the systems that compose this first group, and therefore must be excluded. However, through the use of NG instead of the SLR, exclusion is not limited to these two specimens, but to many others. The careful examination (Identification of dominant and minor groups through the qualitative considerations of the corresponding constitutive systems) of Table 19 (other results are presented in the Tables20, 21, 22 and 23) reveals the existence of three subgroups with common features: the exclusive structuring mode around the Hall as well as a strong basic difference factor, but differ by the existence of three natures of justified graphs: IRG (green columns), TlG (gray columns), CRG (orange columns).

Table 26. Subgroup B of the dominant group I.

Sp	N°	BDF	N G
Bk_{1c}	24	0.73	T_lG
Bk_2	25	0.81	T_lG

Thus, the dominant group I structured around the hall will be split into three subgroups A, B, C (Table 24, 25, 26 and 27) Subgroups of the dominant group I).

The subgroup A, whose constitutive complexes are only arranged around the hall and whose justified graphs are of internal Ringiness nature, consists of eleven specimens: Bh1a, Bel1, Dz1a, Bh4, Mag7, Dz1b, Bk1b, Bh5, Bk3, Bh6a and Bh6b. It will be identified as follows:

A= {H, 11, IRG, BDF<1}. Where the first element in curly brackets characterizes the most integrated and integrator space, the second one identifies the number of complexes of the subgroup, the third specifies the nature of the justified graphs, while the fourth indicates the values of the basic difference factor.

The subgroup B, whose constituent systems are exclusively structured around the hall and whose justified graphs are tree-like, comprises two specimens: Bk1c and Bk2. It will be identified as follows: B= {H, 2, TlG, BDF<1}

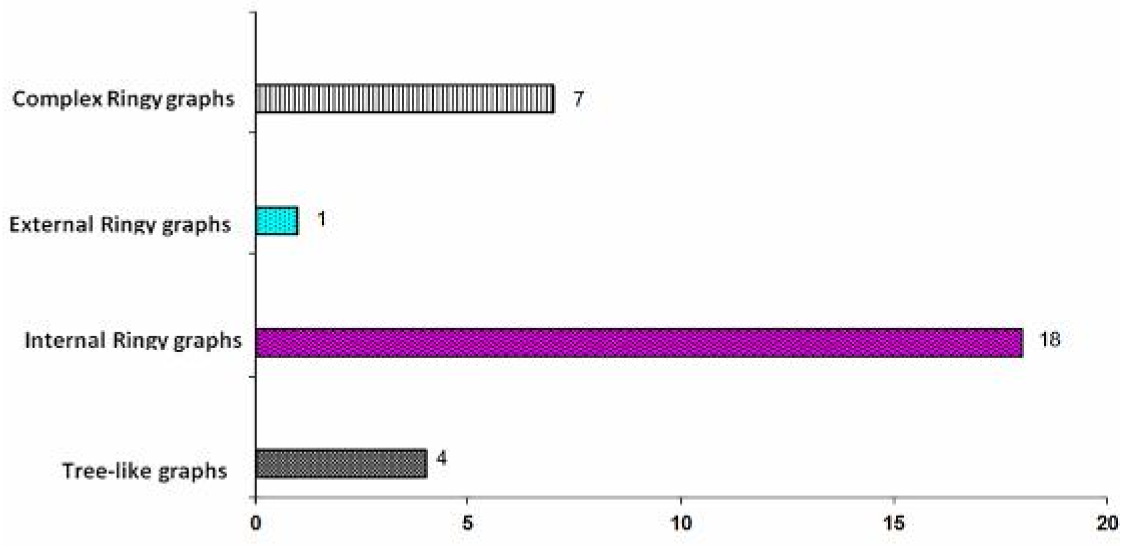

Fig. 8. Nature of graphs according to qualitative considerations.

Subgroup C, whose constitutive complexes are also strictly structured around the hall, and whose justified graphs belong to a complex ringiness, has three specimens: Mag1, Mag6 and Bk4. He will be recognized by: C = {H, 3, CRG, BDF<1}

Table 27. Subgroup C of the dominant group I.

Sp	N°	BDF	NG
Mag_1	9	0.84	C_RG
Mag_6	15	0.71	C_RG
Bk_4	27	0.71	C_RG

Table 28. Dominant group II.

Sp	N°	BDF	NG
Bh_{1b}	2	0.72	I_RG
Bh_2	3	0.73	GC
Bh_3	4	0.64	I_RG
Mag_2	10	0.74	GC
Bel_2	18	0.73	I_RG
Bk_{1a}	23	0.71	I_RG
Bk_{6b}	30	0.86	GE
Mag_{5a}	13	0.63	AR
Mag_{5b}	14	0.67	I_RG

Similarly, the observation in Table 18 demonstrates the existence of four other subgroups with similar specificities, namely, the unique structuring mode around the hallway as well as a strong basic difference factor, but diverging by the existence of the four natures of justified graphs: IRG, CRG, TlG, ERG. Thus, the dominant group II structured around the hallway will be split into four subgroups D, E, F, G (Tables 28, 29, 30, 31 and 32) (Subgroups of the dominant group II).

Table 29. Subgroup D of the dominant group II.

Sp	N°	BDF	NG
Bh_{1b}	2	0.72	I_RG
Bh_3	2	0.72	I_RG
Bk_{1a}	4	0.64	I_RG
Bel_2	18	0.73	I_RG
Mag_{5b}	14	0.67	I_RG

Table 30. Subgroup E of the dominant group II.

Sp	N°	BDF	NG
Bh_2	3	0.73	C_RG
Mag_2	10	0.74	C_RG

Table 31. Subgroup G of the dominant group II.

Sp	N°	BDF	NG
Mag_{5a}	13	0.63	T_IG

Table 32. Subgroup F of the dominant group II.

Sp	N°	BDF	NG
Bk_{6b}	30	0.86	E_RG

The subgroup D consists of five complexes exclusively structured around the hallway, whose justified graphs show internal ringiness and display a strong BDF. This subgroup has five specimens; Bh1b, Bh3, Bel2, Bk1a and Mag5b. He will be identified by: D = {Clr, 5, IRG, BDF<01}; The subgroup E is materialized by two systems of a complex ringiness nature: Bh2 and Mag2 structured around the hallway. It is identified by: E = {Clr, 2, CRG, BDF<1}.

As for the other 3 minor groups, they will also be separated according to their corresponding justified graphs and taking into account their structuring mode. Thus, the complexes whose justified graphs are of a complex annularity structured jointly around the vestibule and the hall (Table 19), ie Bk5 and Bk6a, will be added to the subgroup C since they share the same syntactic specificities. As for the remaining specimen Mag4 whose qualitative nature is internal annular, it will be annexed to group A. This increases the number of dwelling of group C to 5 and group A to 12. Given the internal ring nature of the complex Bel3 (Table 20) arranged jointly around the vestibule and hallway, it will be annexed to subgroup D, whose number of constituent systems will now have 6 dwellings. Because of its arrangement around the vestibule, the last minor group, formed by Mag3 will form a new subgroup: H, which will be identified as follows: H = {V, 1, TIG, BDF<1}

After this exploration of the qualitative and quantitative data of all the specimens of the study corpus and following the definition given by Hillier (Space is the machine. A Configurational Theory of Architecture in 1996) to the architectural genotypes and phenotypes, summarizing them in a qualitative constancy, translated by a persistence of justified plans, and another qualitative, related to the interpretation of numerical data, we can affirm that the new type of domestic habitat of Eastern Hodna (Gunawan *et. al.*, 2019; Mebarka *et. al.*, 2019; Sochacki *et. al.*, 2019; Moulai-Khatir *et. al.*, 2019; Janpourtaher, 2019; Narayanmugam *et. al.*, 2019; Mostadi and Biara, 2019; Ugong *et. al.*, 2019; Hamma, 2017b) is divided according to two great mode of structuring of the space where the hall "Westeddar" and the "Sabet" hallway are the most integrated and integrator spaces, generating seven genotypes.

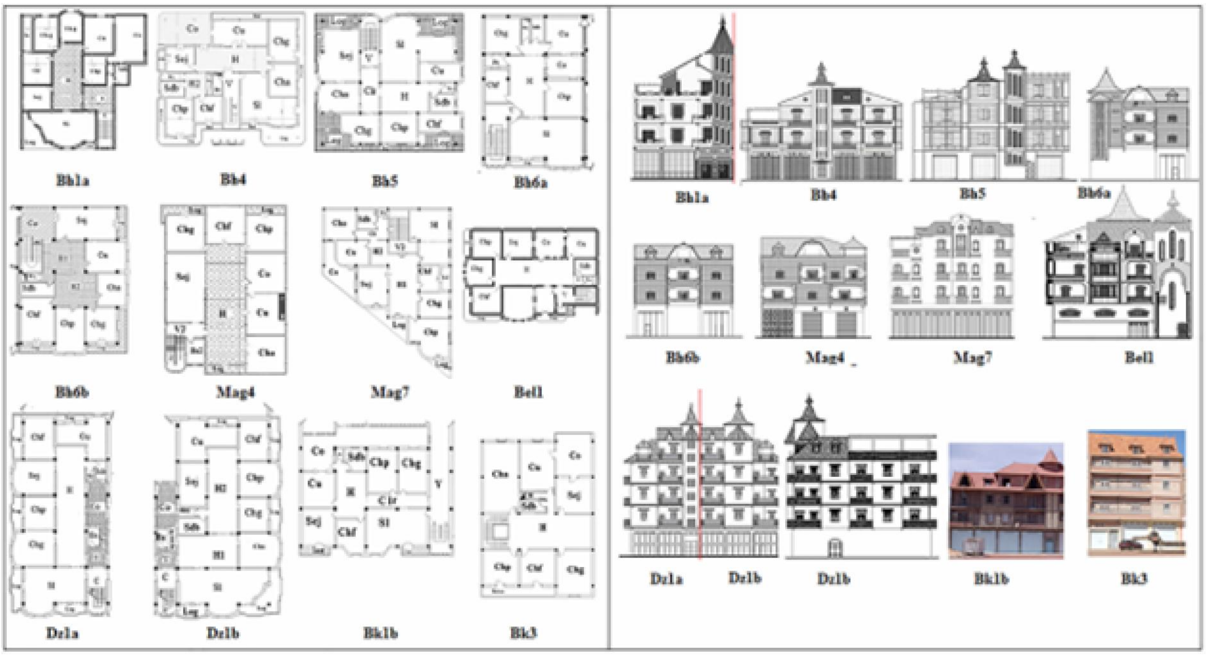

Fig. 9. Dwellings of genotype A.

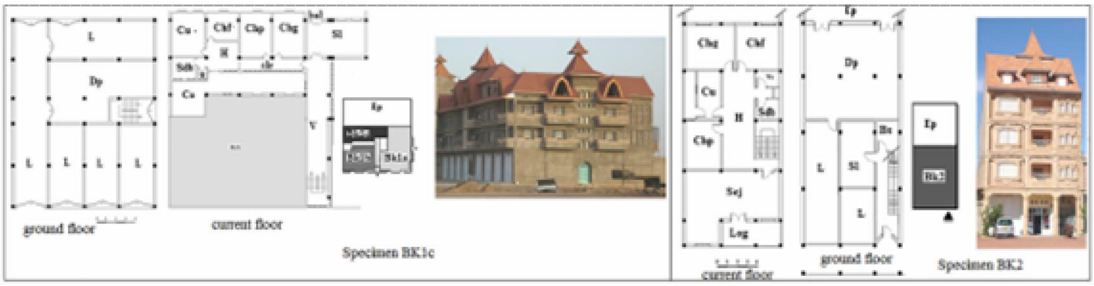

Fig. 10. Dwellings of genotype B.

Fig. 11. Dwellings of genotype C.

Fig. 12. Dwellings of genotype D.

The three genotypes structured around the Hall are identified by:

- A = {H, 12, IRG, BDF< 01} (Fig. 9)
- B = {H, 2, TlG, BDF< 01} (Fig. 10)
- C = {H, 5, CRG, BDF< 01} (Fig. 11)

The four genotypes structured around the corridor are identified as follows:

- D = {Clr, 6, IRG, BDF< 1} (Fig. 12)
- E = {Clr, 2, CRG, BDF< 1}
- F = {Clr, 1, ERG, BDF< 1}
- G = { Clr, 1, TlG, BDF< 1} (Fig. 13) .

The specimen Mag3, identified by the subgroup H = {V, 1, TlG, BDF <01}, because of its isolated structure around the vestibule "Dakhla", seems distinctly non-genotypic. It is a phenotype of another genotype (Fig. 14).

The genotypes A, B and C include 63, 33% of the whole studied corpus. They are structured around the Hall, which is a space of both traffic and occupation. This space is neither neutral nor informal and geometrically orders the shape of the domestic space built. It is used to serve other private spaces of the house. It is also the family meeting space (watch television, review lessons to children, spread couscous and weave). This space, because of its location as the heart of the private space of the domestic sphere, recalls the central courtyard of the ancestral house of Hodna (Boutabba and Farhi, 2014; Kedroussi *et al.,* 2018; Boutabba *et al.,* 2019; Djedid 2019; Belkaid *et al.,* 2017; Hamma, 2017a). The genotypes D, E, F and G include 33,33 % of the total studied corpus. They are structured around the corridor, a transitional space only, a space considered intrusive to ancestral home and encourage individualism.

4. Conclusion

Using the "gamma analysis" method, the results of this research show that by converting the different convex spaces of studied specimens into nodes and their spatial and functional permeability into bonds, spatiality can be translated by graphs.

This graphical representation allows, thanks to an arsenal of mathematical ratios, a reliable and efficient spatial comparison. Space is no longer explained by a simple typo-morphological reading, which reduces the domestic space to a simple place of refuge, devoid of any social and contextual connotations, but by syntactic analysis. By exploring the morphological structure of the spatial arrangements of dwellings, the space syntax helps to discover their underlying spatial configurations by defining the genotypes of the architecture.

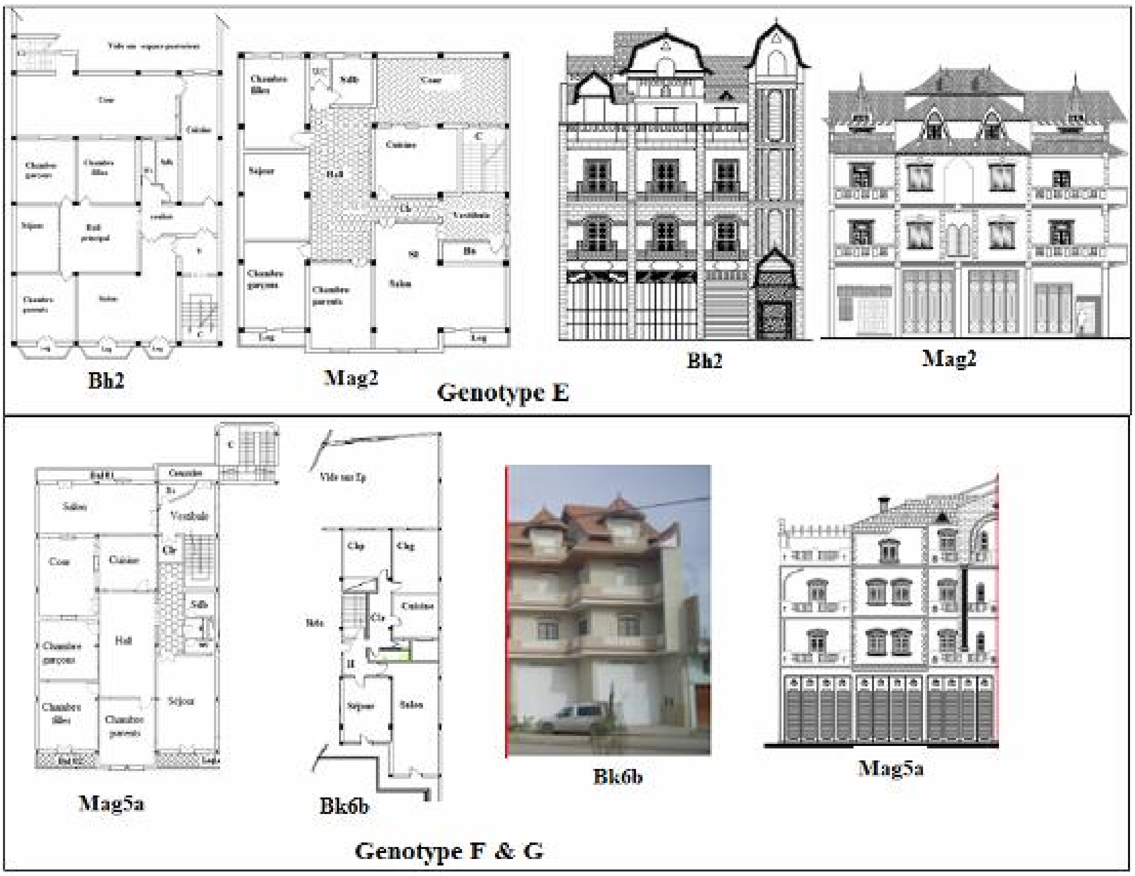

Fig. 13. Dwellings of genotypes E, F and G.

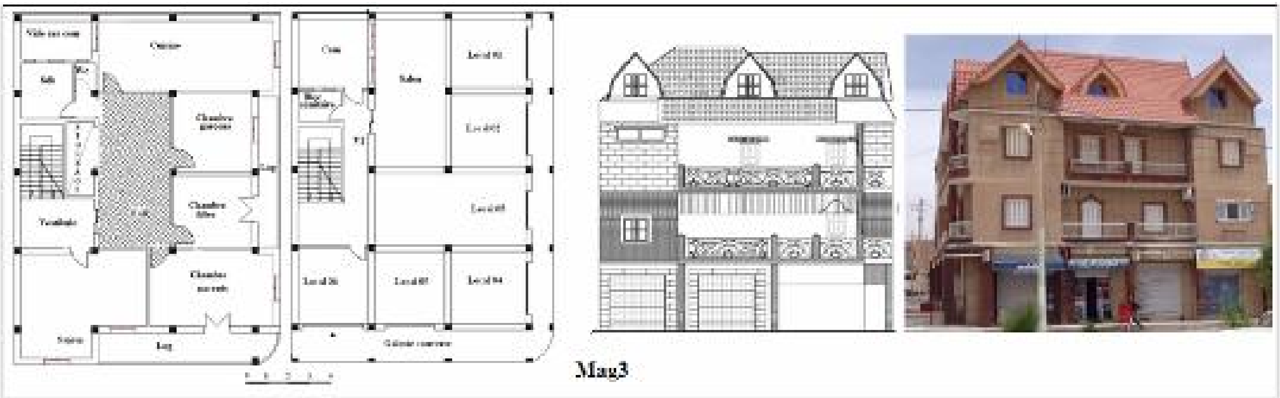

Fig. 14. Phenotype H.

Like other syntactic research carried out in other cultural contexts, this research has shown that the neo-rural domestic spatiality of the Guebla axis is a complex system that exposes several underlying, hidden relationships that are very difficult to perceive by the specialist and the layman. Indeed, it is through the replacement of the "space link ratio" by the "nature of topological types of graphs" that the houses of the Guebla, whose spatial details of distribution (Lehene, 2019a; Hamma and Petrişor, 2018; Coman, 2019; Lehene, 2019b) seem at first sight so commonplace, could be divided according to two major modes of structuring of the architectural space. The hall and hallway are, respectively in 19 specimens (63.33%) and 10 specimens (33.33%), the most integrated spaces and the most integrators.

Thanks to qualitative study by topological types, these two large groups have been split into 7 genotypes. Unlike the other Guebla specimens, only one system Mag3 displays the vestibule as the nucleus. By this distinction of its mode of grouping, this house is identified as non-genotypic or at least to be treated, as a phenotype of another genotype (Peragine, 2019; Mutică, 2019; Hamma and Petrişor, 2017; Usai, 2019). On the other hand, the values generated by the BDF showed a low values for all seven identified genotypes. This finding argues in favor of spatial configurations that tend to favor a functional differentiation of the spaces that constitute them, as they testify, at the end, of an extreme coherence and solidity of these genotypes.

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