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MODERNIST DWELLINGS IN LISBON, PORTUGAL

A Syntactic Approach to Living Use Analysis

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ABSTRACT

This paper deals with the relationship between domestic space built in the early 60's and the users way of living in the late 70's, which is assessed by analyzing public housing apartment in Lisbon and the switch-over made by the users.

The study is based upon the differences between the built apartment layouts and the modified apartment's layout that result from different ways of living or use(s) proposed by the occupant families as a reflection of their space needs. The paper analyzes five different apartment typologies and respective user modifications, having based the apartment plans (both original and modifications made by the users) in the *Inquérito à Habitação Urbana*, organized by *Laboratório Nacional de Engenharia Civil (LNEC)*, in the late 70's, which aim was to ascertain dwelling tendencies and to create a basis for future designs. The results of this research were based on a comprehensive analysis of family structure, previous dwelling, house activities, family member characterization, apartment typologies distribution in the building and the apartment interior layout.

The concepts and methods used in this paper are based on the theory of social logic of space. The analysis aims at understanding the extent to which some attributes of society redefined families' social behavioral patterns, particularly their ways of living and use of house spaces and how these impacted the apartments' spatial layout. Syntactic measures, namely those of integration and depth will be analyzed to better understand how the modifications made by the families best serve their ways of living and spatial needs. Apartment layouts will be analyzed by means of justified graphs. Visual graph analysis will also be carried out as a comparative assessment as a mean of validation of the former's results. This comprehensive analysis will help understand why the modifications took place and how they reflect the occupants' effective use of space and needs.

The paper discusses how the original dwellings do not seem adequate to families ways of living and use but also that in the majority of the analyzed apartments the interior spatial adaptations seem to be more appropriate to the their needs and patterns of living.

KEYWORDS

Housing, Dwelling Adequacy, Space Use, Spatial Adaptation, Visual Graph Analysis

1. INTRODUCTION

This paper proposes an analysis of housing units through space syntax theory. The proposed analysis consists on the study of housing units, carefully selected, examining the project design and two different user's modifications (functional, spatial or both) of each case-study. These modifications were observed by Valente Pereira and Corrêa Gago, published in *Inquérito à Habitação Urbana*, in 1971, by *Laboratório Nacional de Engenharia Civil* (LNEC).

The buildings that support the case studies are a part of Olivais Sul housing development, an important plan in Portuguese architecture, being the first formal application of modernist principles expressed by the Athens Charter in housing design. It is also notable by the array of architects invited to design new building's for the plan, the most significant at the time. Developed by public funding, this plan was designed to accommodate social housing and is considered to be (...) *the biggest social housing ensemble (...), 'neighbourhood' to house almost 50000 people in Lisbon (...), and a real collective domestic design school to many professionals (...)*¹(Almeida and Fernandes, 1993, p. 153).

Intended to serve different households (in both economical and sociological aspects), the plan proposed a total of 6458 units, to house 31000 inhabitants. The selected units were analyzed in the *Inquérito à Habitação Urbana* carried out a decade later by Valente Pereira and Corrêa Gago. This document illustrates plans of the units and plans that show users modifications and, more importantly, attests for user satisfaction towards the lived-in dwelling.

By selecting case-studies that have been previously analyzed and having access to inhabitants' uses and opinions about the dwellings, as described in the *Inquérito à Habitação Urbana*, a more substantiated and supported investigation is allowed.

2. DATASETS AND METHODS

As mentioned previously, space syntax is the chosen methodology, defined as '(...) a set of techniques for the representation, quantification, and interpretation of spatial configuration in buildings and settlements (...)'(Hillier, Hanson and Graham, 1986, p. 363). As per Hanson (1998), the first studies in housing using this theory support the notion that there is a correlation between spatial configuration and space use, stating that because of its complexity Housing is fundamental in Space Syntax.

The main goals of this paper are, on the one hand, the assessment of the housing unit as designed with the lived-in housing unit (two different uses) in order to understand the differences between design plan's and effective use and also which solution – original design or use – enables better living conditions for the family; and on the other hand, the analogy between the results of the *Inquérito à Habitação Urbana* and the outcomes of the space syntax analysis, so to identify if both methodologies document the same conclusions or, if not, what relevance could this theory have in the analysis of housing typologies.

In order to achieve these goals, some space syntax methods were considered relevant – convex maps, justified graphs and Visual Graph Analysis (VGA) – as well as output calculations

¹ Author's free translation from '(...) o maior conjunto de habitação social (...), 'bairro' para alojamento de quase 50000 pessoas em Lisboa (...), e verdadeira escola do projecto doméstico colectivo que foi para muitos profissionais (...)' (Almeida and Fernandes, 1993, p. 153).

regarding qualitative features of *depth*², *integration*³ and *choice*⁴. Two different softwares were used in this research – *Depthmap*⁵ for VGA and *AGRAPH*⁶ for justified graphs.

As case studies, five units were selected intended to be as diverse as possible, with typologies ranging from a two bedroom to a four-bedroom unit. It was also important to analyze all the units in the Inquérito à Habitação Urbana (Vol. I and Vol. II) and choose the ones which had been modified by the inhabitants. The identification (ID) of the case studies is the same as the one found in the Inquérito à Habitação Urbana (Vol. II) so that it is easier to make a direct relation between the apartments' design plan and better compare the results.

As aforementioned graphic elements to be used in this research are simplified design plans, convex break-ups, VGA representation and justified graphs. The latter are considered paramount for they allow for a clearer reading and analysis and more validated results.

When analyzing the justified graphs it was important to identify the dwelling layout – compartment layout and functional sector (social, private and service) layout. According to space syntax theory it is possible to encounter two different layouts – tree-like layout and ringy layout. According to Hanson (1998), tree-like layout is the most common in several cultures' dwellings and it is the one that enables a greater control of inner movement and movement in relation with the exterior, making them more predictable. Apart from that, '(...) tree-like domestic space arrangements produce strongly programmed forms of domestic space arrangements (...)' (Hanson, 1998, p. 278). Unlike the tree-like, a ringy layout allows for choice, or route choice, and the spaces where the rings intersect tend to be the more important ones where the more important functions and people are based (Hanson, 1998).

When drawing the graphs, options were made that can influence the results: it was decided that there should be an outer space (IN) as root of the graph, as the entrance to the dwelling; transition spaces were deemed relevant as mediators (as classified by Amorim, 1997). Hanson (1998), and, Hillier, Hanson and Graham (1986) characterize them as such:

Transitions have the effect of insulating spaces from one another (...). (...) Strong arguments have been adduced that link the use of transitions in houses with the intent to assure that social separations within the home are strictly maintained. (Hanson, 1998, p.285)

The transition space type works by more uniformly segregating interior functions through a central transition space which controls both interior relations and relations with the outside. (Hillier, Hanson and Graham, 1986, p. 385)

Amorim (1996, p.18.11) validates these affirmations, stating the following:

It seems that mediator units were introduced to compose different configurations, assuring one or another requirement, as segregating sectors (...) or integrating systems (...). 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.

2 *Depth*, among a set of spaces always expresses how directly the functions of those spaces are integrated with or separated from each other. (Hillier, Hanson and Graham, 1986, p. 365)

3 (...) the distribution of integration gives a rather good account of the relative organization of the plan. (Hanson, 1998, p.43)

4 (...) the existence or otherwise of alternative routes from one space to another. (Hillier, Hanson and Graham, 1986, p. 364)

5 *DepthmapX* is a multi-platform software platform to perform a set of spatial network analyses designed to understand social processes within the built environment. Available at <https://varoudis.github.io/depthmapX/>

6 *Software for Drawing and Calculating Space Syntax "Node-Graphs" and Space Syntax "Axial-Maps"*. Available at <http://www.ntnu.no/ad/spacesyntax>

Apart from the dwelling layout, this study contains graphs that illustrate integration (absolute and relative⁷) and depth of compartments and functional zones. Depth was analyzed under two different lights: using the entrance as root and the living room as root (this space was chosen above all the others because it is the backdrop of family life and the social gathering space).

2.1. THE RESULTS OF INQUÉRITO À HABITAÇÃO URBANA

Being an exemplary and ground-breaking study, the *Inquérito à Habitação Urbana* was able to assemble countless information and present important conclusions, analysing various housing facets and dwellers satisfaction, also intending to correctly social characterize the latter. In the instructions given to the interviewers some objectives are made clear: '(...) characterize and interpret the different modes of inhabiting a dwelling through the knowledge of who are the people (...), how they inhabit the dwelling (descriptions and interpretation of the unit's use) and which unit they inhabit (project design characteristics) (...)' (Valente Pereira and Corrêa Gago, 1984, p. 245).

This paper focuses in a few of those information and conclusions that are relevant to the proposed analysis. Thus, it is paramount to reference the aspects that cause dislike and that the inhabitants most stated as not satisfactory. Firstly, *compartment distribution* (18%), being also important the mention to the *entry of the dwelling* (12%), living room crossing (5%) and *violation of the living room in relation to the interior* (4%) (Valente Pereira and Corrêa Gago, 1984, p.110). It is essential to highlight that the primary complaint is compartment distribution, result supported by space syntax analysis namely in types 23 and 25 in which the original layout plan unit does not present the best functional layout. Living room crossing and its violation with relation to the rest of the dwelling were also pointed out in type 25 and partly in types 23 and type 28B, where the living area is treated as a transition space to one of the bedrooms. Another question relates to modifications having been registered a percentage of 42% of modifications to the initial design (Valente Pereira and Corrêa Gago, 1984, p. 112)⁸. Of these 38% corresponds to the creation of new compartments (as seen in Type 21 - Use 02, the creation of a compartment – home office – by reducing kitchen area, and in Type 25 – Use 01, the creation of a new transition space by reducing and enclosing one bedroom). One of the appointed motives for altering the initial layout was *poor plan distribution* (10%), also being stated, though less representatively, *isolation and privacy* (4%)⁹ (Valente Pereira and Corrêa Gago, 1984, p. 112). Poor layout plan distribution is also substantiated by space syntax analysis, especially in types 23, 25 and 28B.

7 When applying "Colour by RA" for comparing different graphs, the "Colouring by RA, absolute" is useful. If analysing only one graph the "RA-relative" is better as this gives a larger range of colour and thereby a more differentiated information. (Manum, 2009, p. 3)

Relative integration can also be denominated *Relative Asymmetry*: *The Relative Asymmetry (RA) describes the integration of a node by a value between (or equal to) 0 and 1, where a low value describes high integration. RA is calculated by the formula $RA = 2 * (MD - 1) / (k - 2)$. (Manum, 2009, p. 2) The RA-value is defined to be 0 when a node is as integrated as possible. (...) Contrary, RA is defined to be 1 when a node is as segregated as possible. (Manum, 2009, p. 6)*

In AGRAPH, warmer colors (reds) equate to values of more integration (RA near or equal to 0) and colder colors (blues) to those of less integration (equal to or near 1).

Absolute integration (i) is said to be the opposite of RA, the highest the value, the more integrated. *This is the integration value of RA. Integration might be defined as the inverse of other asymmetry parameters than the RA. The most usual is to invert the RRA, the Real Relative Asymmetry, as described by Hillier and Hanson, 1984, p.111-113. (Manum, 2009, p. 6)*

8 Of all these answers, only *compartment distribution* and *dwelling entry* were given as choices, the rest were referred freely by the inhabitants (*vide* question 64 of the inquest that, combined with question 63, reflects the *Opinion of the Dwelling. Important to infer judgement on the dwelling* (Valente Pereira and Corrêa Gago, 1984, p.253)).

9 Also mentioned by the inhabitants, not given as possible answer (*vide* question 20; along with question 19 explains the reasons for alterations that have been made to dwelling project and that are to be registered in plan (Valente Pereira and Corrêa Gago, 1984, p. 251)).

The need for isolation and privacy was largely studied in depth and integration graphs being noticeable that types 23, 25 and in some degree type 28B are the units that present greater problems with regards to bedroom privacy, specifically original layout plan unit 23 (and to some extents Use 01 of the same type) and original layout plan unit 25.

It is important to consider these findings when conducting and reading the space syntax analysis that follows, in order to better compare the two methodologies and their scopes and potential.

3. ANALYSIS AND RESULTS

Five apartment units, from the *Inquérito à Habitação Urbana (Vol.II)* (Valente Pereira, Corrêa Gago and Lopes, 1984), were selected and analysed as case-studies – Type 19, Type 21, Type 23, Type 25 and Type 28 – having also been selected two different user modifications per each type, except for Type 28 where two project variations and two uses of each variation were analysed. The graphic representation of these units is presented in both simplified plans (Fig. 01) and convex maps (Fig. 02), depicting the changes from the project unit to the two uses. These alterations can be either spatial or functional, or in some cases, both.

In Type 19, a two-bedroom small unit, the noticeable modifications in Use 01 are spatial – the asserted adjoining of the two living areas – and functional – the specialization of these living areas, dividing them functionally into living room and dining room; in Use 02 the alteration is carried out in the opposite direction – the once part of living area is closed off and created a bedroom and one existing bedroom is transformed into a living area.

Type 21, a three-bedroom dwelling, is modified in Use 01 in the following way – the closing of one of the living room entrances and the conversion of a bedroom into a home office; and in Use 02 the making a home office by reducing the kitchen area. In both Uses, the kitchen ceases to have two accesses, remaining the one furthest from the dwelling entrance.

Type 23 is a four-bedroom unit, with a three-bedroom unit variation. In Use 01 the alterations lie on the closing of the bedroom adjoining the living area and, also the closing of the visibility between the kitchen and living space. Use 02 corresponds to the three-bedroom variation and displays the same modifications.

Type 25 is again a two-bedroom unit which modifications occurred only in the spatial sense and regarding the bedroom near the entrance – Use 01 encloses the bedroom but allows for the existence of a circulation and transition space, whereas Use 02 enlarges the same bedroom by enclosing it near the entrance transition space.

The last case, Type 28a and 28b are both two-bedroom units. Use 01 of 28a consist of the removal of the connection between the living area and the kitchen support area; Use 01 of 28b preserves this link but ends the one between the living area and the circulation and transition space near the dwelling's entrance.



Figure 1 - Simplified plans of all dwellings types

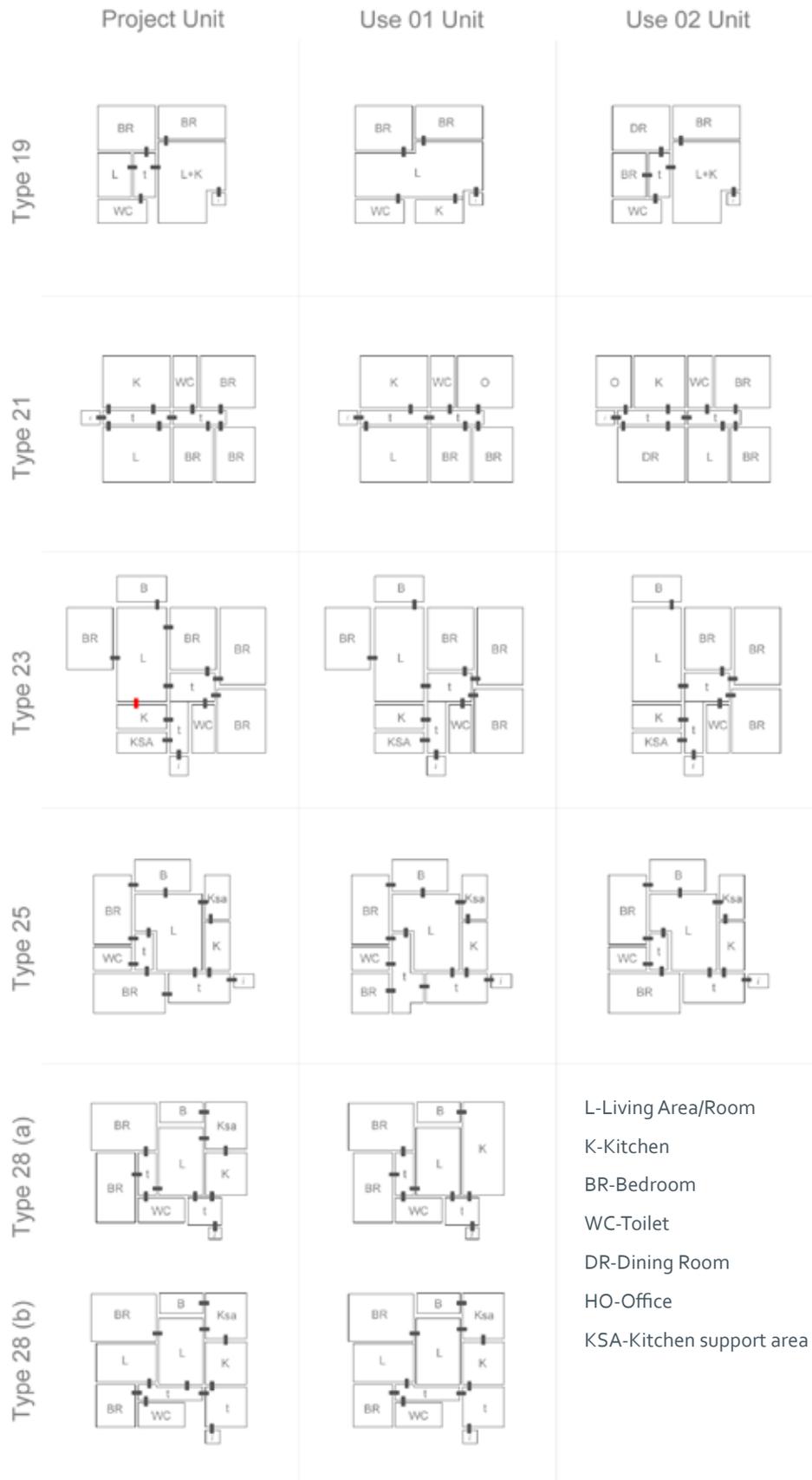


Figure 2 - Convex break-up of all dwellings types

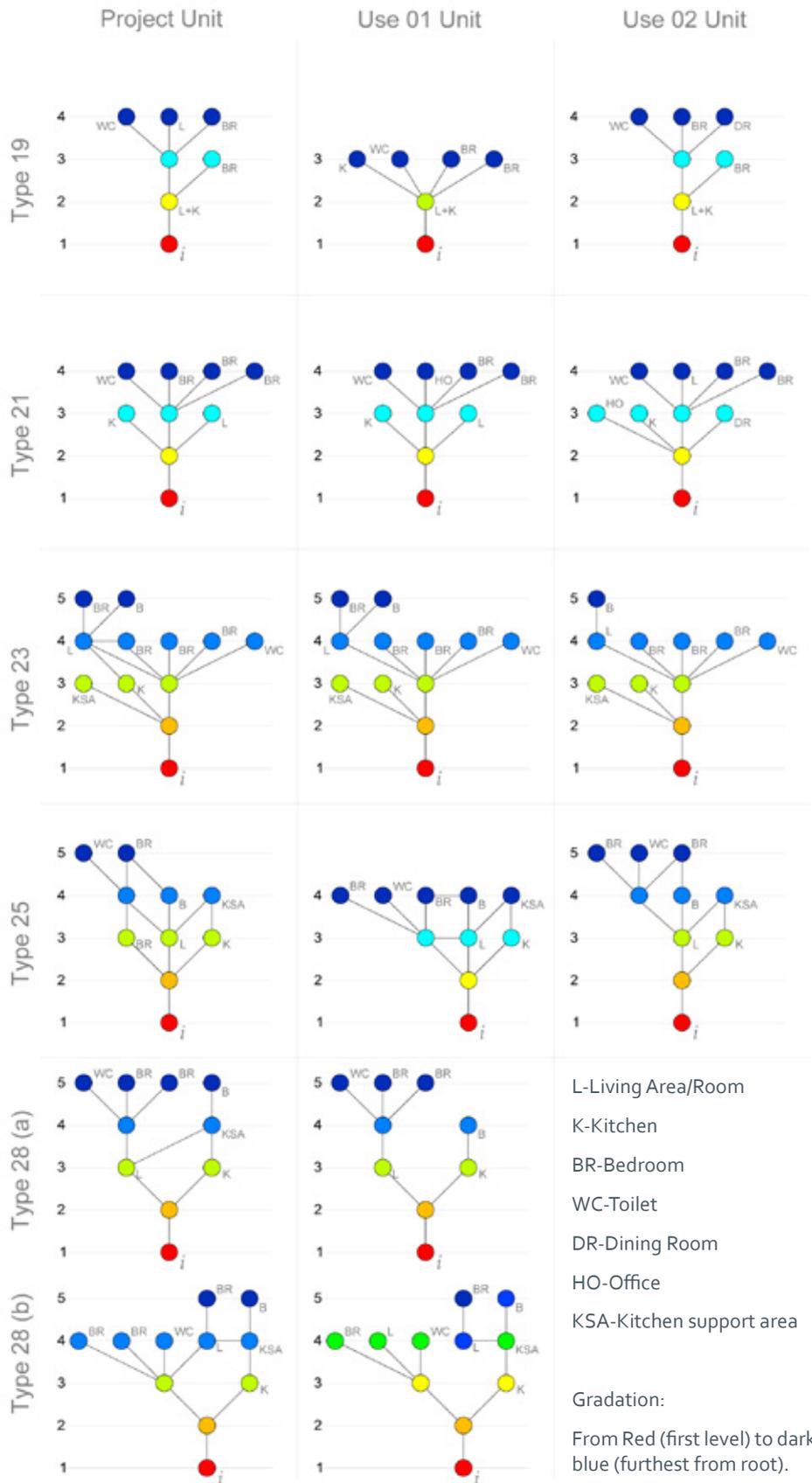


Figure 3 - Depth justified graphs by dwelling rooms

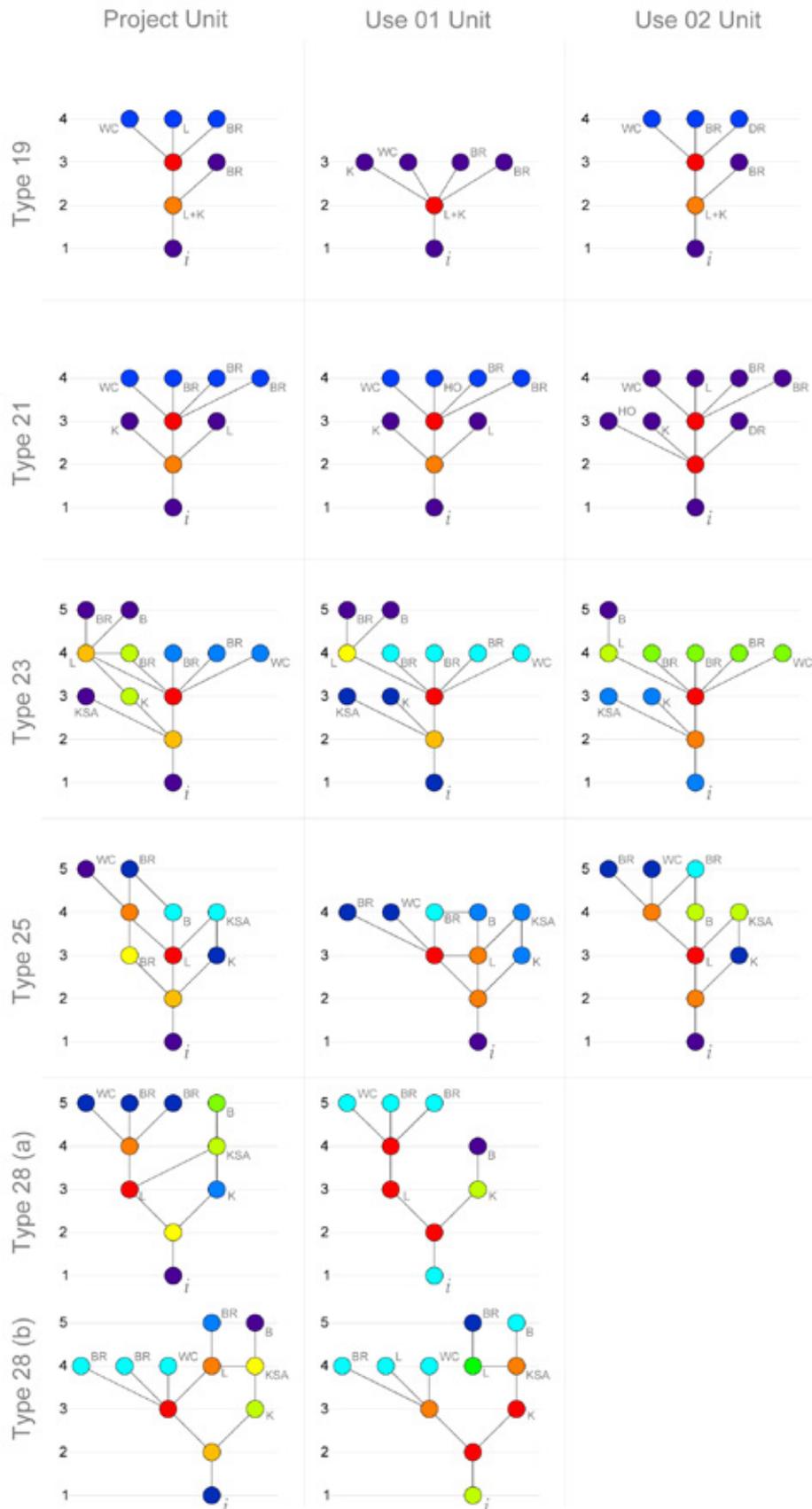


Figure 4 - RA justified graphs by dwelling rooms

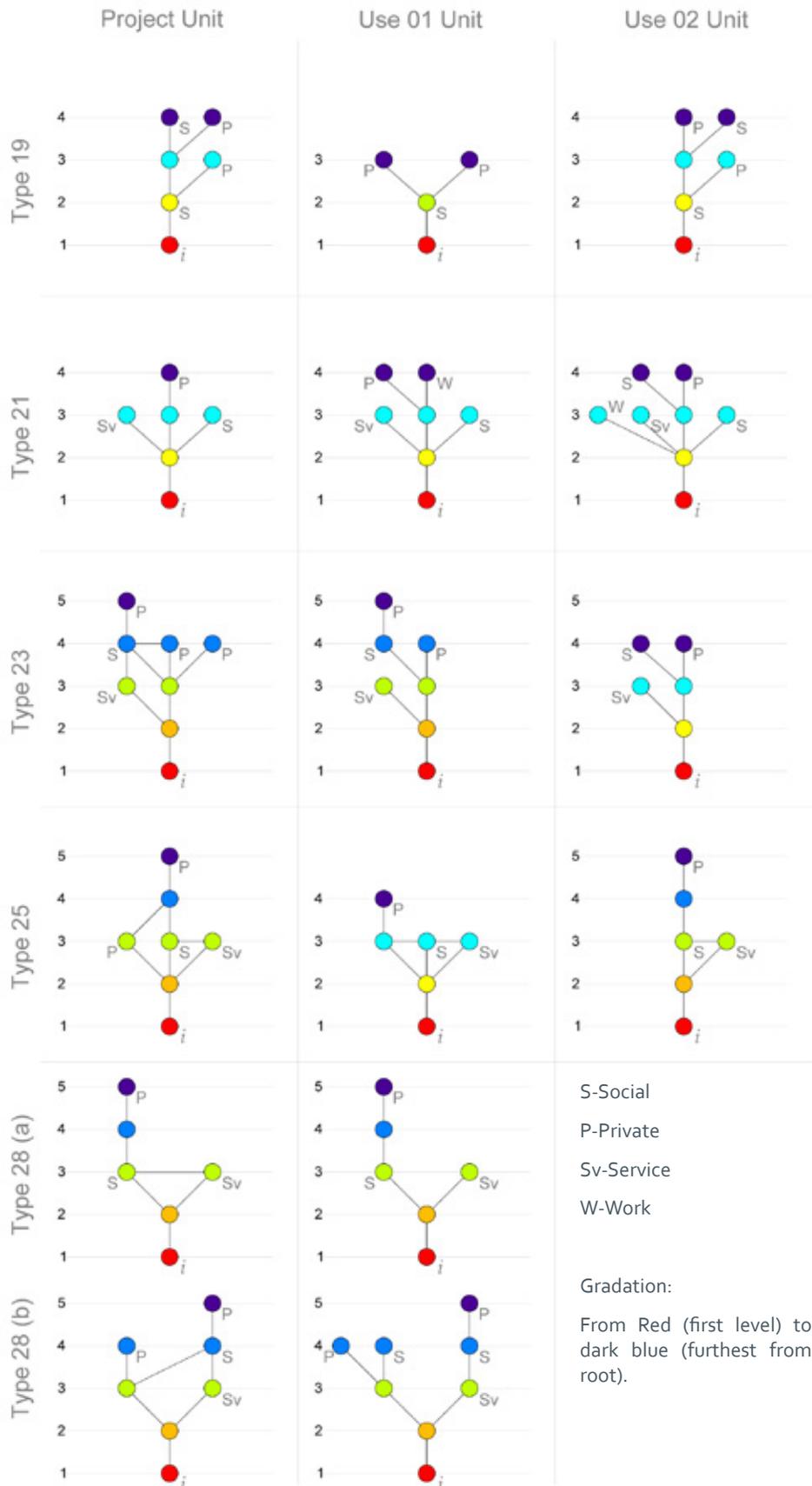


Figure 5 - Depth justified graphs by functional zone (social, private, service and work)

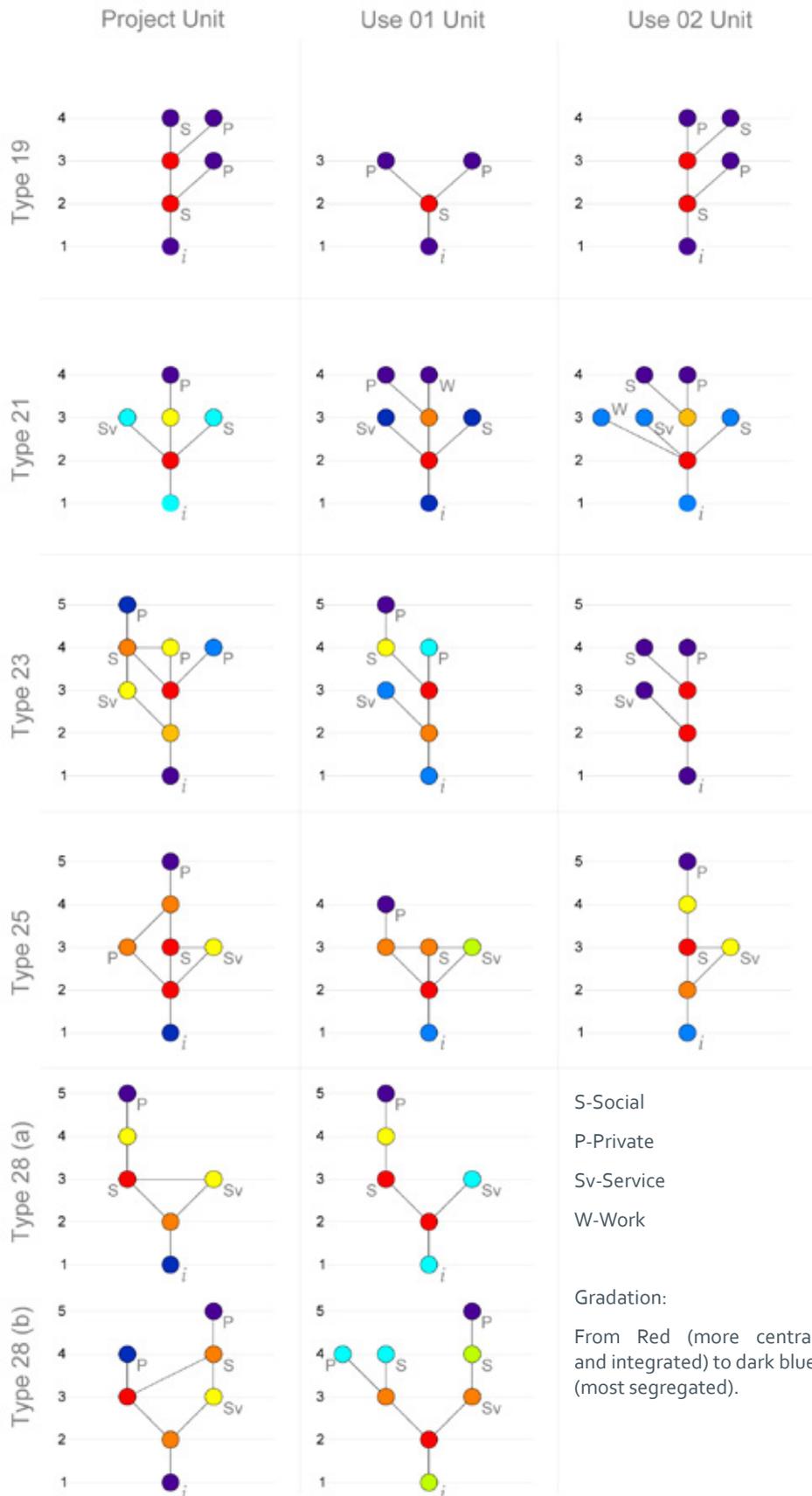


Figure 6 - RA justified graphs by functional zone (social, private, service and work)

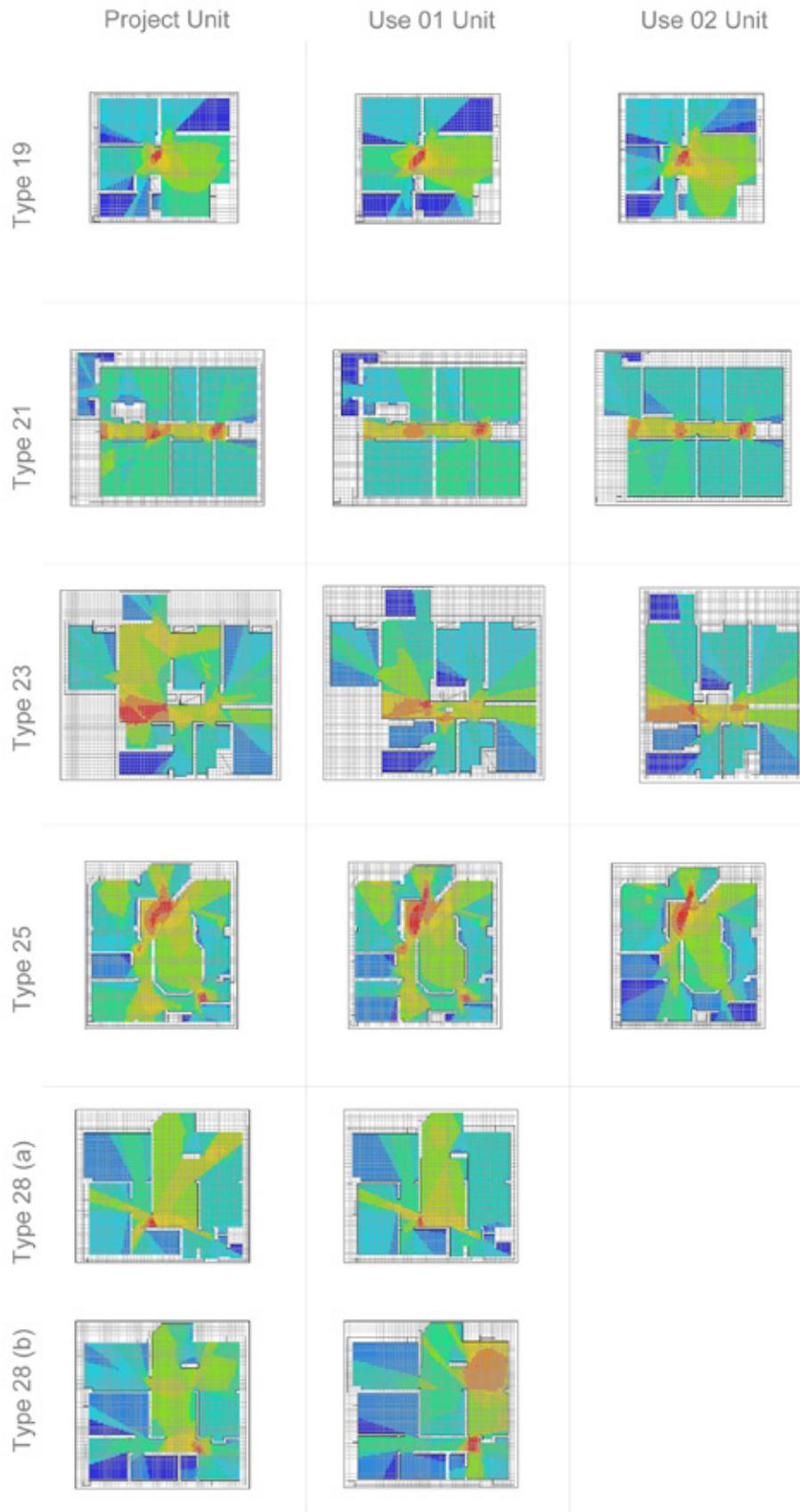


Figure 7 - Visual Graph Analysis (VGA) using *DepthmapX* software

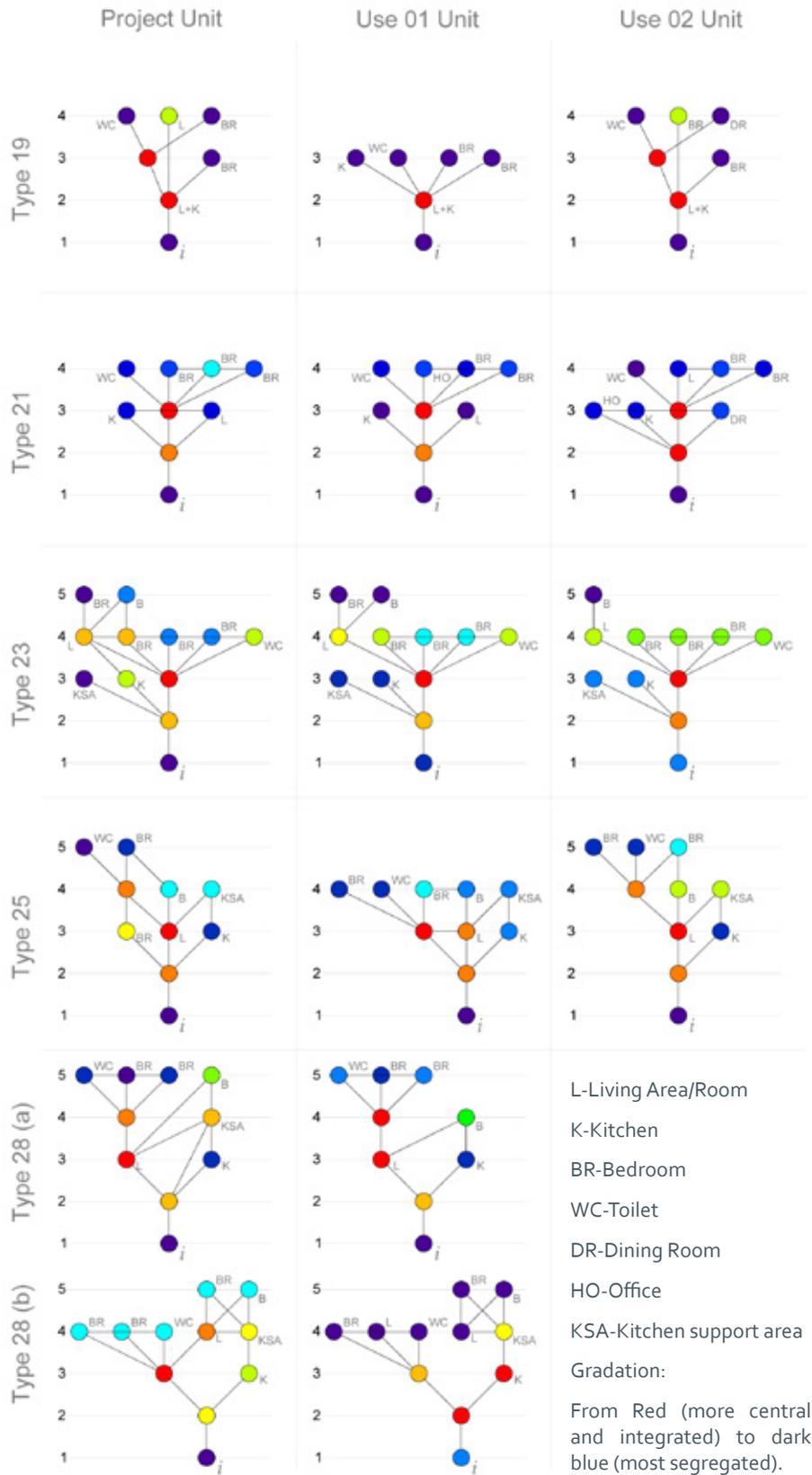


Figure 8 - Visibility justified graphs (RA)

(It is interesting to notice that in Type 25 apartments the accessibility graph is the same as the visibility graph, as is Type 19 – Use 01 apartment, indicating less complex interiors.)

To better analyse all the units, and the design layout plans unit and uses of each case study, it is firstly important to read the justified graphs, being proposed different analysis using this method – depth and integration (relative asymmetry – RA) concerning dwelling spaces (Figs. 03/04) and, also depth and integration (RA) concerning functional sectors (Figs. 05/06). It is also proposed a Visual Graph Analysis, illustrating visual integration by means of isovists (Fig. 07) and justified graphs considering relations of visibility and not only accessibility (Fig. 08), as proposed by Griz and Amorim(2015).

When analysing each type unit and comparing the design layout plan unit with the modified dwellings it is possible to understand which layout apparently better serves familiar way of living in this context and time.

Regarding the apartment Type 19, Use 01 seems to be the one that better organizes the dwelling spaces, by centralizing the living area and segregating the private spaces. Both the original design layout plan Unit and Use 02 place part of the social area in a segregated space, thus not enabling in full its social character. In these two units, part of the living area is not only segregated but also on of the deepest levels in the dwelling, which equates (?) to visitors having to enter in these deeper and traditionally more private levels, which takes away some of the bedrooms' privacy.

When reading layout, depth and integration results of apartment Type 21 it is possible to state that of all solutions the design layout plan unit is the one which better organizes functional sectors allowing for privacy to the spaces to which it is inherent (bedrooms) and a social character to social spaces (living areas and services). With regards to the two uses, several criticisms can be observed: in Use 01, the social area is the most segregated (lowest RA value) even though it is the most accessible from the entry (on the one hand it doesn't allow for privacy in the living room in relation to the outside, on the other hand, since it functions as a gathering area its location and lack of privacy can be positive); in Use 02 it is evident the lack of privacy of the bedrooms in relation to the living room (a social and gathering space) and also the fact that they constitute the most segregated compartments.

Looking at apartment Type 23, Use 02-Unit is the one with less difference between compartments: it presents only two integrated spaces (both of them transition spaces, highly integrated) and four segregated compartments (social, service and private sectors, all equally and highly segregated, at the same level as the outside). When comparing this case with Use 01-Unit it is possible to state that the existence of the fourth bedroom (adjacent to the living room) has an integrating role regarding the system as a whole, allowing all the spaces to be more integrated, with more degrees of integration/segregation. In this unit, the transition spaces are the most integrated, followed by the dwelling social area (living room; level 1), the private sector 1 (level 3), the service sector and exterior (level 4) and lastly private area 2 (bedroom adjacent to the living room; level 5). It is note-worthy that the compartment responsible for global integration is the one that is more segregated in the system. In the design layout plan unit it is relevant the greater integration of the compartments that compose the ring, being the social sector the second most integrated of the system, followed by the service and private area 1 (both in level 3). The rest of the private area shows a gradation of integration: private area 2 is less integrated that private area 1 but more integrated than private area 3. In this unit, the most segregated space is the exterior of the dwelling which demonstrates a more evident separation inside-outside, or family-visitors, than the other two cases. It is also interesting to note that comparing the original design layout with the modifications, one of the latter (end of visual connection between the kitchen and living room) acts as a segregating factor by dissolving an integrating ring-layout that linked transition, social and service areas, whereas the other (definitive separation between living room and bedroom) contributes to the increased privacy of the private area.

As for apartment Type 25, reading layout and depth results, it is possible to infer that both Uses correspond to a better hierarchized interior, improving interior functional distribution and establishing increasing levels and degrees of privacy which signifies that a progressive infiltration inside corresponds to access to increasingly private spaces. Comparing these, the original layout plan unit places part of the intimate area in an intermediate level, which leads to it being less private, more vulnerable to the outside. Of the two uses, Use 01 is the one that better organizes interior circulation, foreseeing transition spaces between entry hall and bedrooms and living room and bedrooms, differing from Use 02 in the fact that it doesn't treat the living area as a circulation space that acts as a transition space, allowing for a better use of the living area and its furnishing. Concerning global integration, there is a difference between the units of apartment Type 25 as opposed to the previous case-studies: the transition spaces are not the most integrated in all units. In the original layout plan unit the most integrated (central) spaces are a transition space and the social area; in Use 01 the transition space of the entry hall is the most central; in Use 02 the social area reappears as the most integrated node of the graph. In all units, the private area appears as more segregated than the exterior of the dwelling, thus reinforcing its intimate character. Integration analysis supports the findings of the previous ones: inhabitant's uses are more appropriate to standard family life, allowing for greater privacy to the private areas (bedrooms) and centrality to social spaces.

Lastly, Type 28A and 28B, when compared, the most visible difference, and an important one, is the separation of the private area into two in type B, being one of these areas accessible only through the living area (in Use 01B, it implies a first access through the kitchen), without a transition space as seen in type A. In Use 01B there is also a division of the social area, also into two areas, each one near the private areas. Integration analysis of type A units demonstrates that the social areas (common living room) is the most integrated, *i.e.*, central of the system in both cases. The ring in the original layout plan unit A has also an integrating character regarding the service area (namely the service support space). In Use 01A, the dissolution of the ring results in a lesser integration of the service area (almost at the same level as the exterior). In both units, the private sector is the most segregated, therefore, more intimate. Being more complex than type A units and having been altered spatially and functionally, type B units suggest more dissimilarities between them. The most integrated spaces are in both cases two different transition spaces: in original layout plan unit a transition space that takes part of the ring layout and connects the entry hall, the living area and the bedrooms; in Use 01B the entry hall (where the dwelling layout bisects). In original layout plan unit B the social area is the second most central, followed by the entry hall and the service areas (all of which compose the ring layout). The private areas and the exterior are the most segregated, although bedroom 3 (adjacent to the dining room) consist in the most segregated of all spaces, being the furthest from the most central space¹⁰. In Use 01B, without the existence of the ring, the bisection determines the integration of the different spaces: the service areas and the bedroom transition space are in level two of centrality, followed by the part of the social area. The second social space – the formal living room – lies in the third level of centrality, as does the bedroom adjacent to it. The bedroom contiguous to the common living area is the most segregated of the system.

It is thus possible to state that original layout plan unit A is the one that appears to serve family life better by integrating in a ring-like layout the most social areas (entry, living and service) and segregating and therefore protecting the bedrooms as the most private compartments. The alteration in Use 01A has little impact in the system apart from a lesser integration of the service areas.

10 This should indicate that this is the most private space of the dwelling when in fact this statement is fallacious when considering that the only access to it is one of the most central and integrated (more public) compartments – the common living area.

Comparing original layout plan unit A and original layout plan unit B the latter due to the division of the private area seems less appropriate: the bedroom adjacent to the primary living area is greatly vulnerable to social activities and thus less private and intimate, as it should. The alterations in Use 01B aggravate the dwelling's functioning: by abolishing the access to the social area through the entry, the bedroom adjacent to the living room is placed further from the other bedroom and the toilet facility, the problem of its privacy regarding the living area persisting. Furthermore, the functional alteration (the creation of a formal living room in a bedroom compartment) causes integration issues: the living area is not central in the system causing the visitors to enter deep in the dwelling to access it, which also conflicts with the need for privacy of the contiguous bedroom.

4. CONCLUSION

4.1. CASE-STUDIES

The previous examination of all dwelling types, both original layout plan units and Uses-Units, demonstrates unity between VGA and Graph analysis. In general terms, it is important to emphasize that the transition space (or spaces) appears to be the most integrated in the system, especially in the present case-studies that consist of smaller dwellings where a single or a couple of transition spaces are paramount in the distribution of the entire dwelling. Moreover, if one disregards these transition spaces, the social area tends to be the most integrated and central in the dwelling, more so in some units than in others nonetheless. This is especially made clear by the VGA analysis that allows for a more immediate reading. Which leads us to highlight the difference between the VGA and the Graph analysis: the former by implying integration through visibility and not only a physical link allows for an enhanced centrality of some spaces, which could prove to be misleading.

In general terms the analysis also supports that the ring layout has an integrating effect on the compartments and functions that compose it, whereas the tree-like layout tends to stratify and hierarchize dwelling interiors, creating increasingly deeper and more private levels.

When comparing the original layout plan units to the Uses-Units the findings differ from one case-study to another, a general result being inexistent: original layout plan units of Type 21 and Type 28 appear to be the ones that better serve the needs of social activities and privacy of the family¹¹ in terms of compartment distribution and layout; Use-Units of Types 19 (Use 01 only) and 25 (both Use 01 and Use 02) seem more appropriate to family living; in Type 23 none of the units fully serves said needs. This assessment is based upon the level of segregation of the private area, *i.e.* the bedrooms, and the level of integration/centrality of the social area, *i.e.* the living area, being considered that the privacy needed in the bedrooms is consistent with higher levels of segregation and the social functions of the living area with higher levels of relative integration (RA). Whenever the modifications made to the dwellings or the original layout plan unit itself didn't hierarchize functions and areas according to this premise they were considered less adequate.

4.2. COMPARISON WITH THE RESULTS OF INQUÉRITO À HABITAÇÃO URBANA

Comparing the two different methodologies and the results made possible by each it is noticeable the coherence of conclusions, as aforementioned. Although the *Inquérito à Habitação Urbana* has a broader scope in what relates to dwelling layout its analysis is confirmed by the space syntax analysis presented in this paper. The later methodology allows for a more objective and analytic investigation of dwelling layout, hence permitting an ample and extensive reading of

¹¹ A space syntax analysis' scope is the investigation of design and layout aspects, not taking into account dwellers' opinions and their needs satisfaction.

its functioning as a whole and the relation between the various compartments. The advantage of this methodology (Space Syntax) is the possibility to review and equate the adequacy of alternative solutions and designs¹² and immediately verify their validity. As a further and more extensive development it would be beneficial a Post-Occupancy Evaluation as the work developed by Sungur and Çagdas¹³ (2003), that would serve as an additional investigating methodology by adding information regarding dwelling use and inefficiency in terms of user satisfaction.

12 As stressed by Mustafa, Hassan and Baper (2010, p.157) when mentioning that data obtained by space syntax analysis should be used as project auxiliary in future processes.

13 *Effects on Housing Morphology on User Satisfaction*

REFERENCES

- Almeida, P. V. and Fernandes, J. M. (1993). *História da Arte em Portugal. A Arquitectura moderna*. Lisboa: Alfa
- Amorim, L. (1997). The sector's paradigm. Understanding modern functionalism and its effects in configuring domestic space. *Proceeding of the First International Space Syntax Symposium*. [online]. Space Syntax Network website accessed December 2014, at http://www.spacesyntax.net/symposia-archive/SSS1/sss1_proceedings.htm
- Griz, C. and Amorim, L. (2015). When Luxury is Necessary. Apartment Projects in Recife. *Proceeding of the Tenth International Space Syntax Symposium*. [online]. Space Syntax Network website accessed October 2016, at <http://www.sss10.bartlett.ucl.ac.uk/>
- Hanson, J. (1998). *Decoding Homes and Houses*. Cambridge, UK: Cambridge University Press
- Hillier, B., Hanson, J. and Graham, H. (1986). Ideas are in things: an application of the space syntax method to discovering house genotypes. [online]. UCL Discovery website accessed November 2014, eprints.ucl.ac.uk/1399/1/hillier-hanson-graham-1987.pdf
- Manum, B. (2009). AGRAPH, Software for drawing and calculating Space Syntax Graphs. [em linha]. NTNU website accessed November 2014, <http://www.ntnu.no/ab/spacesyntax/>
- Mustafa, F. A., Hassan, A. S. and Baper, S. Y. (2010). Using Space Syntax analysis in detecting privacy: A comparative study of traditional and modern house layouts in Erbil city, Iraq. Academia.edu website accessed September 2014, <http://www.academia.edu>
- Pereira, M. L. V. and Gago, M. A. C. (1984). *Inquérito à habitação urbana. Volume I. Informação Técnica Arquitectura e Urbanismo (DIT12)*. Lisboa. LNEC.
- Pereira, M. L. V., Gago, M. A. C. and Lopes, M. J. (1984). *Inquérito à habitação urbana. Volume II. Informação Técnica Arquitectura e Urbanismo (DIT12)*. Lisboa. LNEC.
- Portas, N. (1979). *Funções e exigências de áreas da habitação*. Lisboa: LNEC
- Sungur, C. A. and Çagdas, G. (2003). Effect of housing morphology on user satisfaction. *Proceeding of the Fourth International Space Syntax Symposium*. [online]. Space Syntax Network website accessed December 2014, http://www.spacesyntax.net/symposia-archive/SSS4/shortpapers-posters/Sungur_Cagdas.pdf
- Software - Manum, B., Rusten, E. and Benze, P. (2009). AGRAPH, Software for drawing and calculating Space Syntax "Node-Graphs" and Space Syntax "Axial-Maps", Network website. accessed November 2014, <http://www.ntnu.no/ab/spacesyntax/>