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## UNDERSTANDING THE SPATIAL CONFIGURATION OF HOUSING LAYOUTS THROUGH SPACE SYNTAX: CASES FROM PAKISTAN

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### ABSTRACT

Our lifestyle has its effects on the design and layout of house which also in turn affects the housing market. The function of the space is one important factor affecting interactions. In the last few decades, an important change has occurred in the layout of houses in terms of designation of spaces for specific functions as seen, in Pakistan. This study analyzed 15 different cases of house layouts from three major cities of Pakistan. Space syntax was used to quantify the layouts of these houses using DepthmapX software. The measure of integration, space-link ratios and difference factors were calculated for each case in the sample. The average integration and difference factor of the sample range from 0.62-1.02 and 0.52-0.81 with average value of 0.88 and 0.73 respectively. The results showed that underneath the apparent different layouts, there resides a consistent spatial pattern in the order of spatial arrangements of different layouts. The spatial pattern showed Living room as the most integrated space of the layout this found in 14 out of 16 cases. The second most integrated space was kitchen reported in 9 out of 15 cases. The third integrated place was bedroom 9 out of 15 cases. The results of this study may provide insights into the future development of housing layouts based on the existing pattern of use.

**Keywords:** House Layouts; House Design in Pakistan; Space Syntax; Spatial Configuration

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### INTRODUCTION

A house represents our position in a competitive status order (Conviser 1986). The function of the space is one of the important factors affecting interactions (Laing et al 2011; Peponis 2012; Sailer, 2011). The real estate agencies provide house based on personal characteristics, such as the professional status and income level of the buyer (Smith et al 2021). Physical and socio-cultural components of a house are linked with lifestyle, function of space and the period of stay which affect the user's spatial behavior. The built environment is also affected by family structure, household composition and lifestyle (Altman & Chemers, 1980). House

plan and its spatial configuration reflect the social and family structure of the residents. The changes in the morphology, use of dwelling and the furnishing are associated with variations in the social meaning and household life (Lawrence, 1989). The ordering of space in buildings is about the ordering of relations between people (Motamed 2016). In the last few decades, an important change occurred in house layouts is the designation of spaces for a specific function, in Pakistan. In traditional house layout, spaces were designed to be multifunctional (Petherbridge 1978). Rooms were used interchangeably for different activities which was important for joint family system (Pramar 2005). This also encouraged maximum space utilization. Buildings

create and order the empty volumes of space as a result of a specific pattern (Hillier & Hanson 1989). This ordering of space is known as function or the purpose of building. This theory was first introduced by Hillier and Hanson in 1984, as a means of which the relationship between space and its use was formalized by means of topological graphs (Dawson 2008). Space syntax is a theory and set of techniques used for the quantification, representation, and interpretation of spatial configuration of buildings and settlements (Hillier et al 1987). Configuration can be defined as the relation between two spaces in house layout considering at least a third space (Hillier et al 1987). It describes spatial models for layouts in a numerical as well as graphical form, thus provide basis for scientific interpretations. It merges science-based knowledge into design, which constitutes the core of “evidence-based design”.

This study explored the relationship between architectural layouts and the functional systems of housing layout in Pakistan. The research points towards the fact that the relations between the spaces in domestic layout have an important role on the nature of spatial configuration. In addition, the location or placement of the internal spaces also affect spatial configuration, which in turn affect the functional efficiency of these spaces in a layout.

## RESEARCH METHODOLOGY

In this study, fifteen houses from three major cities i.e., Islamabad, Peshawar, and Lahore in Pakistan were analyzed. Floor plans were the basic source of information, as it is an abstraction of architecture that captures essential characteristics of the interior space. All the plans were analyzed through Agraph and DepthmapX softwares developed by Alasdair Turner at University College of London (UCL). space syntax indices of integration, difference factor and space-link ratios were calculated.

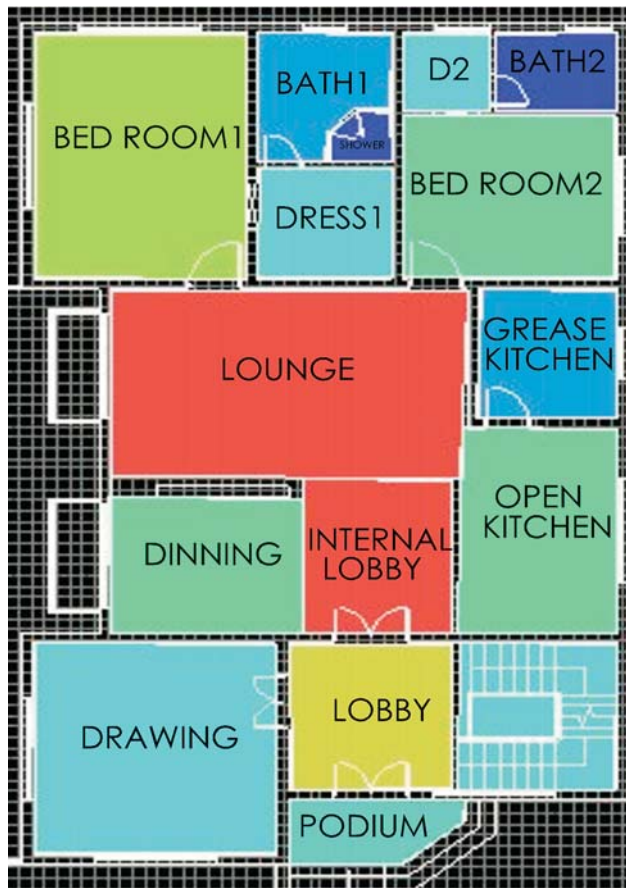


Figure-1A: Covex Map of Case-1.



Figure-1B: Covex Map of Case-2.



Figure-1C: Covex Map of Case-3.



Figure-1D: Covex Map of Case-4.

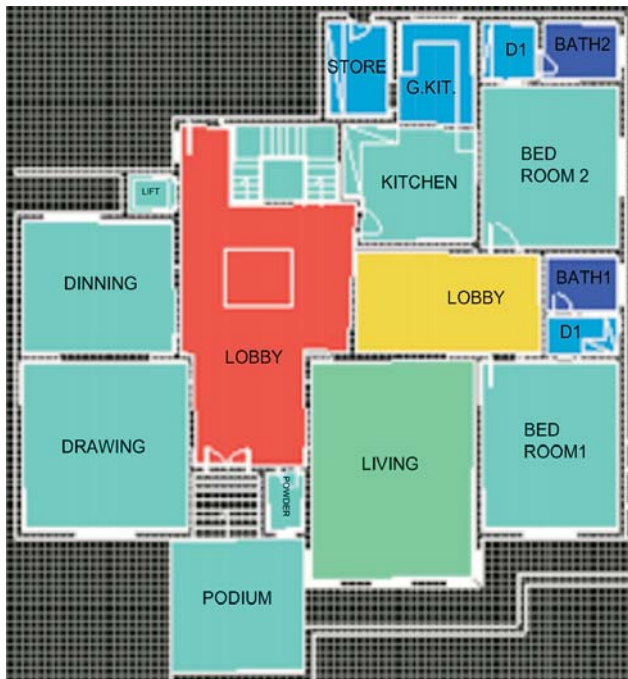


Figure-1E: Covex Map of Case-5.

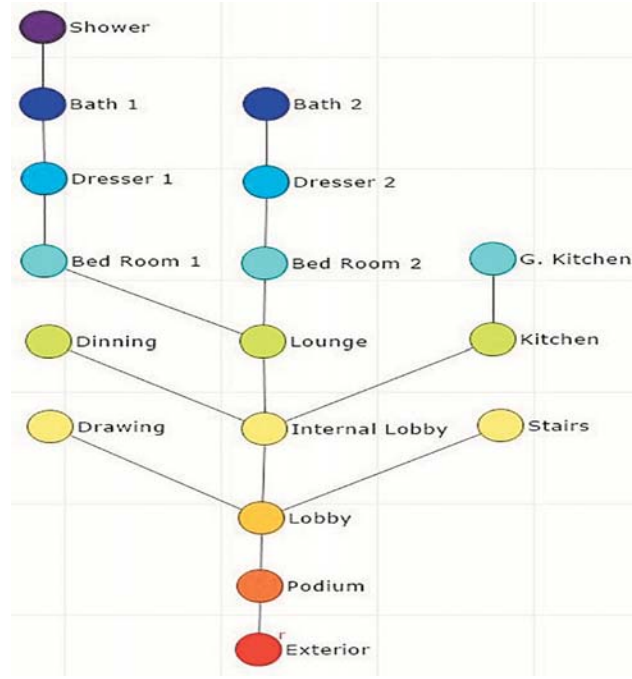


Figure-2A: Justified Permeability Graphs of Case-1.



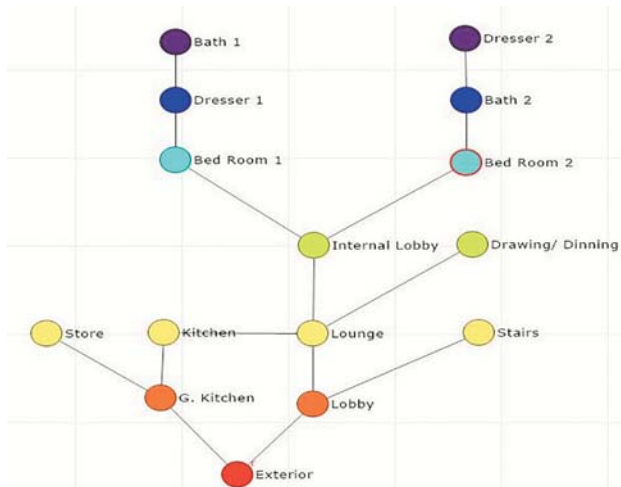


Figure-2B: Justified Permeability Graphs of Case-2.

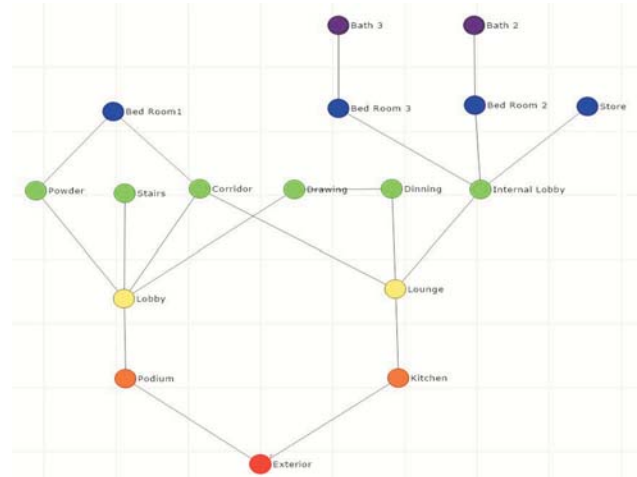


Figure-2C: Justified Permeability Graphs of Case-3.

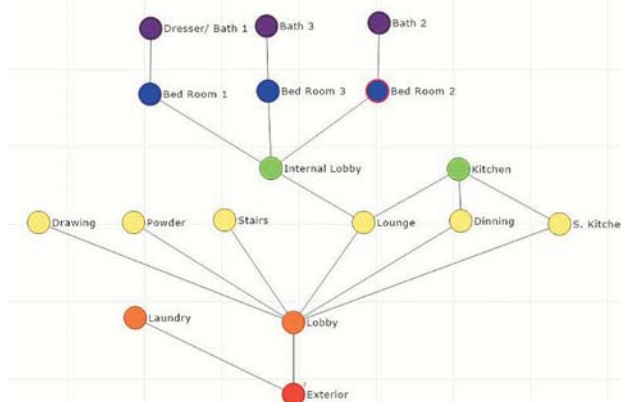


Figure-2D: Justified Permeability Graphs of Case-4.

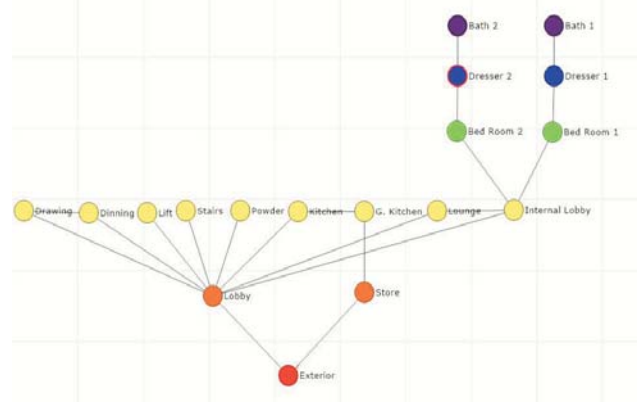


Figure-2E: Justified Permeability Graphs of Case-5.



Figure-3A: Convex Map of Case-6.

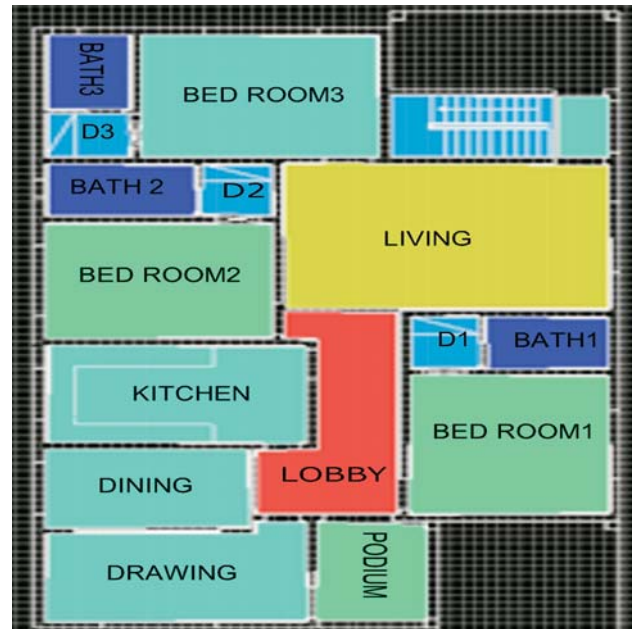


Figure-3B: Convex Map of Case-7.



Figure-3C: Convex Map of Case-8.



Figure-3D: Convex Map of Case-9.

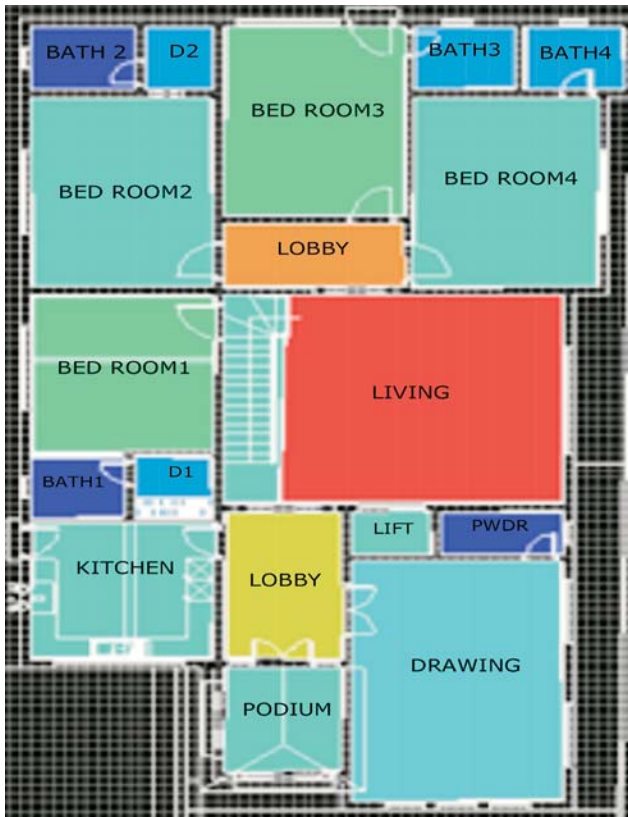


Figure-3E: Convex Map of Case-10.

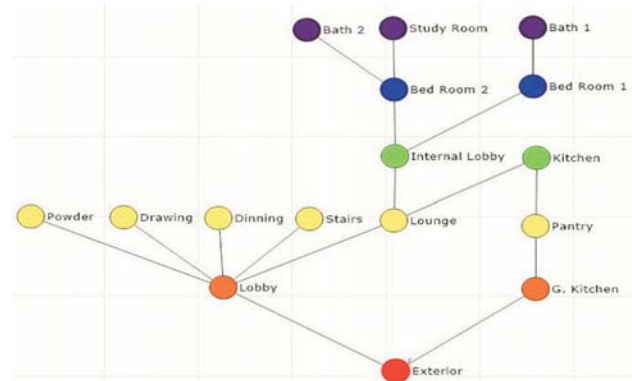


Figure-4A: Justified Permeability Graphs of Case-6.

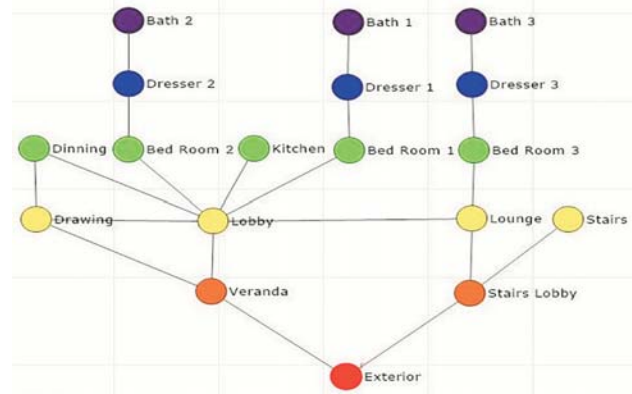


Figure-4B: Justified Permeability Graphs of Case-7.

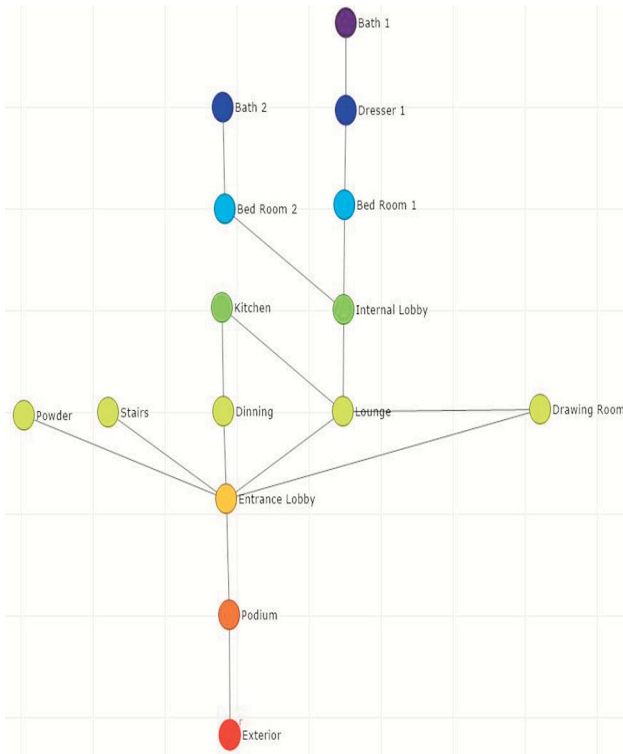


Figure-4C: Justified Permeability Graphs of Case-8.

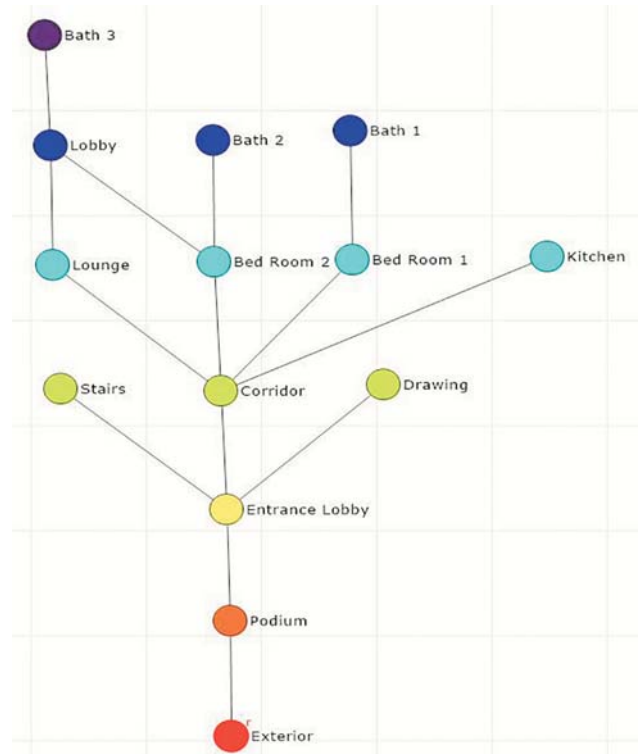


Figure-4D: Justified Permeability Graphs of Case-9.

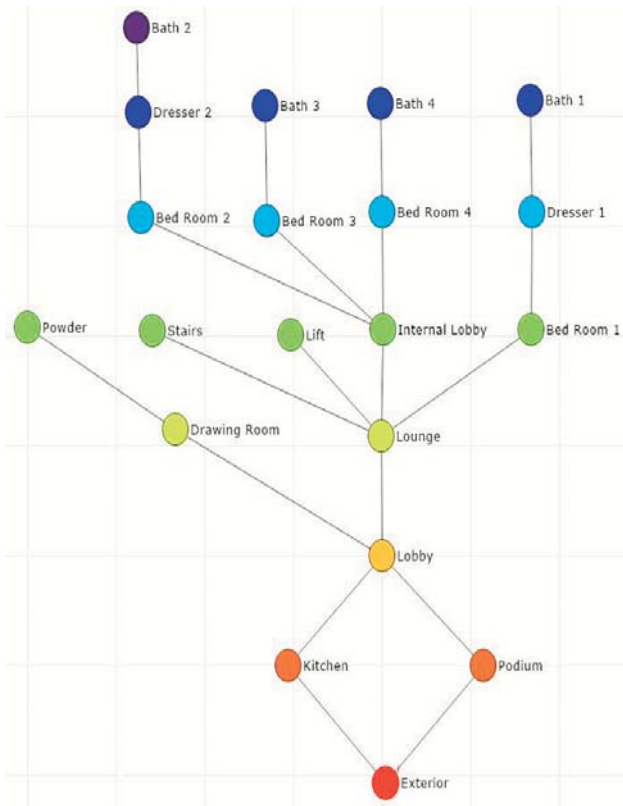


Figure-4E: Justified Permeability Graphs of Case-10.

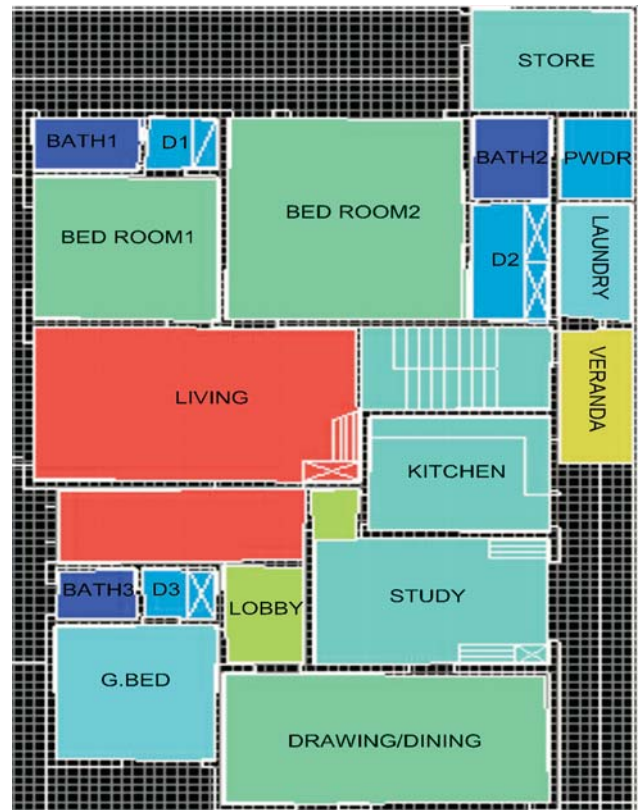


Figure-5A: Convex Map of Case-11.



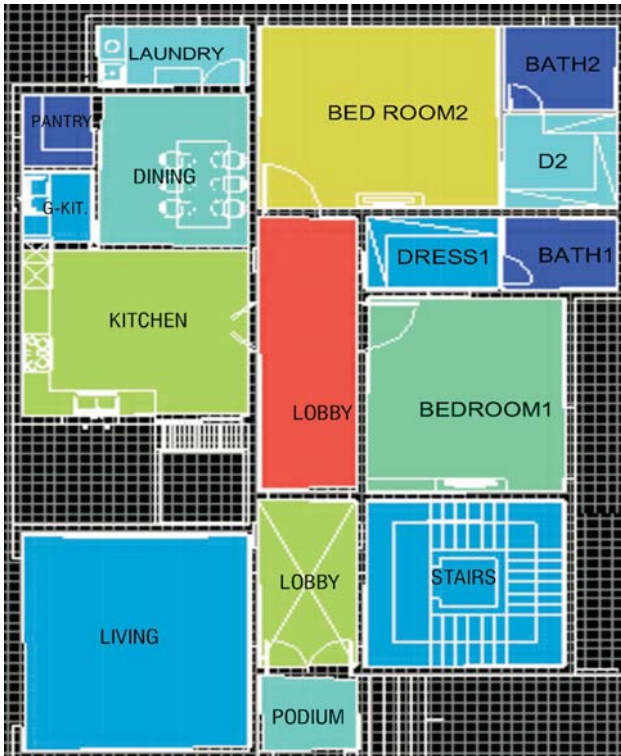


Figure-5B: Convex Map of Case-12.



Figure-5C: Convex Map of Case-13.



Figure-5D: Convex Map of Case-14.



Figure-5E: Convex Map of Case-15.

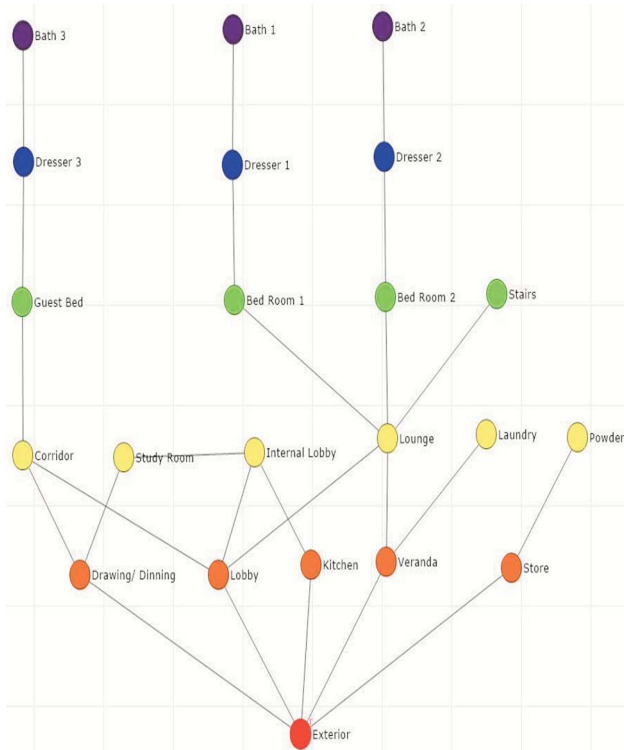


Figure-6A: Justified Permeability Graphs of Case-11.

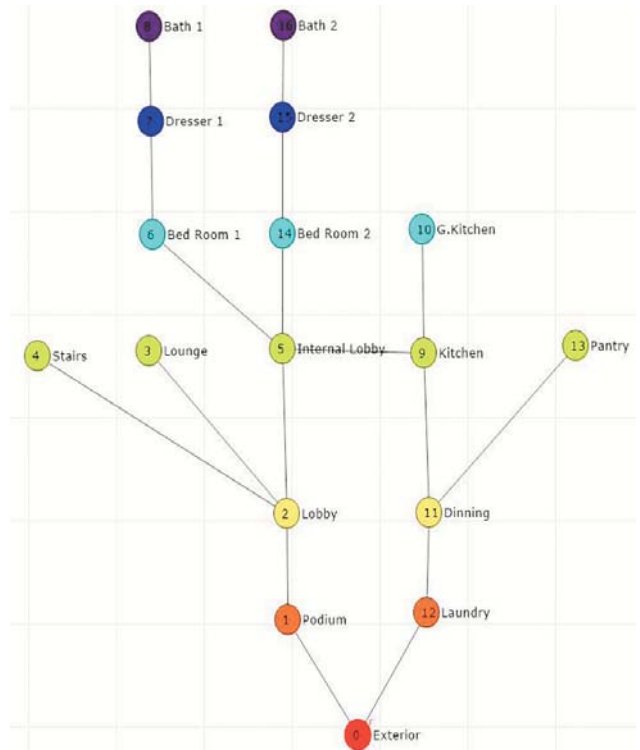


Figure-6B: Justified Permeability Graphs of Case-12.

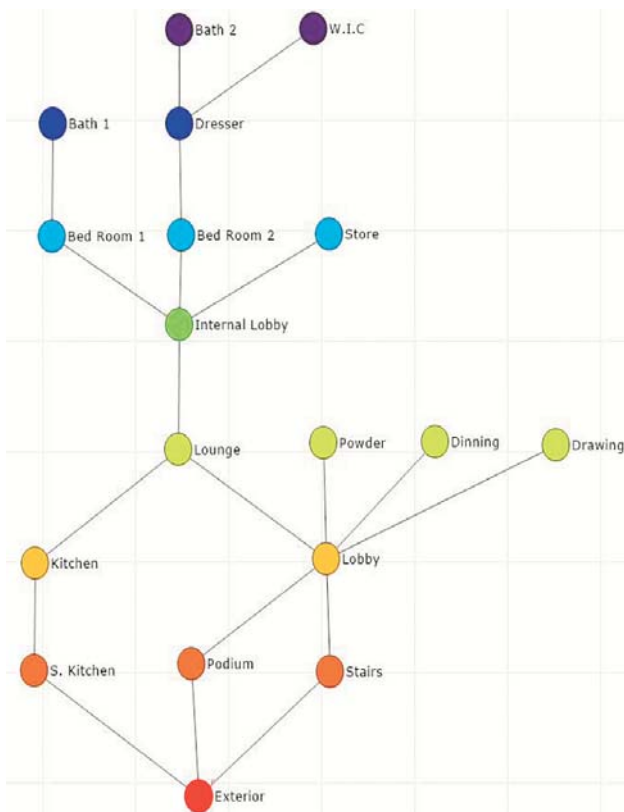


Figure-6C: Justified Permeability Graphs of Case-13.

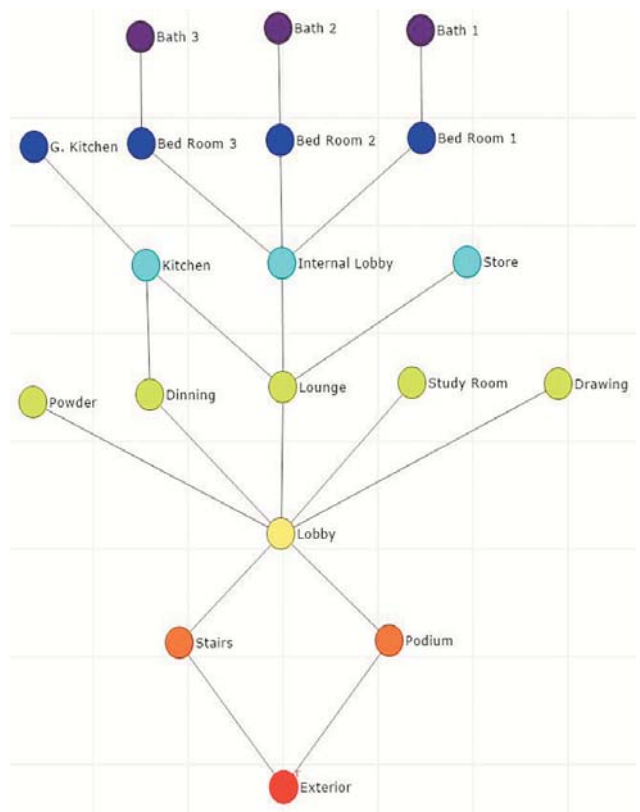


Figure-6D: Justified Permeability Graphs of Case-14.



The reasons for using this methodology are as follows:

- Space syntax methodology combines physical and social parameters to explain the morphology and to identify differences and similarities in a configuration. This help in detecting the functional strengths and weaknesses in each layout.
- It uses the syntactic measures for the interpretation of different spatial structures.

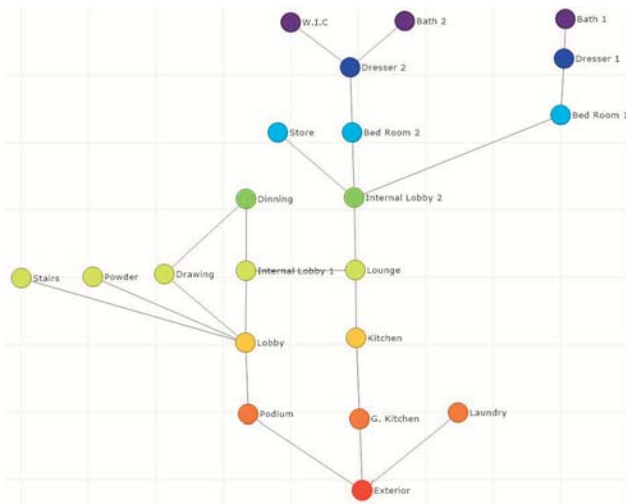


Figure-6E: Justified Permeability Graphs of Case-15.

- This, in turn, facilitates the process of analyzing, evaluating, and comparing these various systems.
- This methodology describes and models formal and spatial systems, thus establishing research credibility.

### Limitations

This research is limited to the spatial configurations and functional efficiency of house layouts only. Other aspects like style, aesthetics, climatic considerations, 3-dimensional design of house are not covered in this research. Furthermore, the houses selected for this study belong to upper middle class within formally planned urban areas in primary cities of Pakistan. Thus the results are not applicable for low income households.

### RESULTS

Table 1 shows mean integration of the sample ranges from 0.62-1.02 with an average of 0.88 and the difference factor of the sample ranges from 0.52-0.81 with average of 0.73. The space link ratios show that there are few rings in the spatial configurations which can also be seen in justified permeability graphs. Table 2 show that, the order of integration of the layouts follows a consistent pattern, where in 14 out of 15 cases, the most integrated space is living

Table-1: Space Syntax Indices of Space-Link Ratio, Integration and Difference Factor.

| Case No. | Location    | No. of Spaces | Space Link Ratio | Integration |      |         |      |
|----------|-------------|---------------|------------------|-------------|------|---------|------|
|          |             |               |                  | Minimum     | Mean | Maximum | D.F  |
| 1        | Lahore      | 17            | 1.0              | 0.41        | 0.75 | 1.33    | 0.74 |
| 2        | Peshawar    | 15            | 1.07             | 0.46        | 0.80 | 1.38    | 0.77 |
| 3        | Peshawar    | 17            | 1.12             | 0.58        | 0.97 | 1.72    | 0.77 |
| 4        | Peshawar    | 17            | 1.12             | 0.60        | 0.96 | 1.72    | 0.78 |
| 5        | Islamabad   | 18            | 1.15             | 0.55        | 0.62 | 2.30    | 0.52 |
| 6        | Islamabad   | 16            | 1.06             | 0.57        | 0.91 | 1.64    | 0.78 |
| 7        | Islamabad   | 18            | 1.17             | 0.51        | 0.98 | 2.02    | 0.65 |
| 8        | Islamabad   | 15            | 1.13             | 0.46        | 0.89 | 1.56    | 0.73 |
| 9        | Peshawar    | 14            | 1.07             | 0.58        | 0.99 | 2.08    | 0.67 |
| 10       | Lahore      | 20            | 1.05             | 0.53        | 0.94 | 1.74    | 0.73 |
| 11       | Lahore      | 22            | 1.18             | 0.48        | 0.91 | 1.61    | 0.73 |
| 12       | Islamabad   | 17            | 1.06             | 0.53        | 0.87 | 1.60    | 0.76 |
| 13       | Lahore      | 18            | 1.11             | 0.53        | 0.88 | 1.53    | 0.78 |
| 14       | Lahore      | 19            | 1.11             | 0.65        | 1.02 | 1.86    | 0.78 |
| 15       | Lahore      | 21            | 1.10             | 0.49        | 0.78 | 1.30    | 0.81 |
|          | Sample Mean | 17.6          | 1.10             | 0.53        | 0.88 | 1.69    | 0.73 |

**Table-2:** Order of Integration First Five Values of Integration for Each Case.

| Case No. | Order of Integration First to Fifth Value |         |         |         |                |                |
|----------|---|---------|---------|---------|----------------|----------------|
| 1        | Living                                    | Kitchen | Bed     | Dining  | Bed            | Grease Kitchen |
| 2        | Living                                    | Kitchen | Bed     | Bed     | Dining         | Drawing        |
| 3        | Living                                    | Dining  | Kitchen | Drawing | Bed            | Grease Kitchen |
| 4        | Living                                    | Kitchen | Dining  | Bed     | Grease Kitchen | Drawing        |
| 5        | Living                                    | Kitchen | Bed     | Drawing | Dining         | Store          |
| 6        | Living                                    | Kitchen | Bed     | Dining  | Drawing        | Store          |
| 7        | Living                                    | Kitchen | Drawing | Bed     | Bed            | Bed            |
| 8        | Living                                    | Drawing | Kitchen | Bed     | Bed            | Dining         |
| 9        | Living                                    | Bed     | Bed     | Kitchen | Drawing        | Drawing        |
| 10       | Living                                    | Bed     | Kitchen | Bed     | Bed            | Bed            |
| 11       | Living                                    | Drawing | Bed     | Bed     | Store          | Kitchen        |
| 12       | Bed                                       | Kitchen | Bed     | Dining  | Laundry        | Laundry        |
| 13       | Living                                    | Kitchen | Bed     | Bed     | Store          | Dining         |
| 14       | Living                                    | Kitchen | Dining  | Bed     | Drawing        | Drawing        |
| 15       | Living                                    | Kitchen | Bed     | Bed     | Grease Kitchen | Grease Kitchen |

room. The second most integrated space is kitchen which occurs in 12 out of 15 cases. The third most integrating space is dining room which occurs in 11 cases out of 15. It mostly occurs at third or fourth place. While in two cases each it occupies second and fifth place of integration value.

## CONCLUSION

The result of this study shows that different layouts of houses in Pakistan follows a consistent spatial pattern in their configuration. This consistency means a regular pattern of use across a specific social and cultural community. With very little inconsistency in few instances, the overall sample shows that housing layouts in Pakistan are arranged around living room as the overall integrating space of the house. This implies that family gathering is an important consideration in the design of houses in Pakistan. The second most integrating space is kitchen. As opposed to the trend of last century where kitchen was segregated from the main functional areas of the house, kitchen is again gaining its

traditional key position in house layout as an important space. Dining and drawing rooms are the third and fourth integrating spaces in the layouts carrying second to fifth place of integration value. This developing consistency in the housing layout shows, that a specific lifestyle is persistent in the major cities of Pakistan. This study will help to determine the overall layout consistency for future house planning in Pakistan. Conclusively, this study helps to desipramine a base line methodology for the objective evaluation of functional efficiencies in different building program. The methodological contribution of this research is useful as it relies on an objective evolution, based on space syntax tools and techniques, and not on subjective evaluations.

## Acknowledgements

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