

Exploring the role of Environment-Behavior Studies (EBS) in Residential Architecture- From Literature Review to Field Study

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Abstract - Arguably, one of the most crucial purposes of designing buildings is to generate form that can satisfy the various needs (both functional needs and aesthetic/ artistic/ visual ones) of the occupants. Often building designers end up making assumption-based decisions about needs of people and the built-environment that can best fulfill these requirements, without arduous scientific decision-making process. Hence, many a times they don't serve the intended purposes. Further, the buildings so designed and constructed are not assessed to evaluate their actual performance. Thus sometimes professional training can create a wide gap between what most people think about the built environment with that of the architects. Researchers have shown that making design decisions based on the needs, preferences, perceptions, and values of the inhabitants can create more satisfying results. To holistically address this issue (of bridging the gap between what people want and what is being designed by architects), the field of Environment-Behavior Studies (EBS) has been formed by the integration of the fields of architecture, town-planning, urban-design; along with socio-cultural and behavioral sciences. It can be said that in the field of architecture, EBS includes the systematic inspection of relationships between the built-environment and human behavior and their application in the design process. The present research paper will discuss the evolution of the field of EBS and the methodology of its application in residential architecture through literature study; along with an attempt to highlight the usefulness of EBS in the realm of residential architecture towards attaining better user satisfaction.

Key Words: Environment-Behaviour Studies, Residential Architecture, Post Occupancy Evaluation, LIG Apartments in Kolkata, User Satisfaction

1. INTRODUCTION

Architects/ building designers design buildings for different users for different functions. The field test for any design is when the users come into the picture. Only when a designed environment (be it any building or a public square, or any other built environment), after its completion, begins to be occupied and used by the user group it was meant for, does the reality about its fitness for purpose, i.e. the degree to which it fits its behavioural, social, and cultural context, starts coming to the forefront.

So, while architects move on from one project to another, producing several designs throughout their professional life, they affect the lives of their users to varied extents. Yet, the whole design process (from conceiving to completion) often runs independent of direct user involvement.

In case of residential architecture, this has severe implications (more so as the number of users increases- for example, mass housing) as residences are the designed built environments where people spend considerable amount of time, and the experiences within their residential environments affect their experiences in other environments.

EBS or Environment-Behaviour Studies is a multi-disciplinary field that advocates a greater involvement of users and a more detailed consideration of user aspects in the design process.

The term 'environment-behaviour studies' corresponds to several others like 'environmental psychology', 'human-environment studies', 'human factors', 'behavioural architecture', 'social ecology' or just 'programming'. The applied facets of environment-behaviour studies are often called 'user needs' or 'social and behavioural factors'. The most inclusive term, however, is 'environment-behaviour studies' (EBS).

The present research paper will discuss the evolution of the field of EBS and the methodology of its application in residential architecture through literature study. The paper will further attempt to highlight the usefulness of including the findings from the EBS in the realm of residential architecture for better user satisfaction.

2. THE EMERGING GROUNDS OF EBS

Architects frequently make assumptions about human needs and while deciding about how the built-environment can best fulfil these requirements. These assumptions, in a lot of cases are not purposive, the decision-making process is not rigorous and scientific, and the performance of the resulting buildings is not evaluated to find out how well they actually worked.

According to the Dutch architect, Neils Prak [1], “The ‘common sense’ of the architect is not the common sense of the user, simply because one has been subjected to a professional training and the other has not. Let us, therefore, mistrust the intuition of architects and try to find out where people’s needs have been thwarted, by experimenting and theorizing. There is no intuitive shortcut to knowledge.”

Professional training leads to the creation of a gulf between how architects and most other people perceive the built environment, which may be dissimilar [2]. Therefore, making design decisions based on perceptions, preferences, needs, and values of the user could lead to the bridging of this gap.

To holistically address this issue of bridging the gap between what people want and what is being designed by architects, the field of Environment-Behaviour Studies (EBS) has been formed with the integration from the fields of architecture, town-planning, and urban-design along with inputs from socio-cultural and behavioral sciences on the other. It can be said that in the field of architecture, EBS include the systematic inspection of relationships between the built-environment and human behavior and their application in the design process.

The EBS is carried out through Post Occupancy Evaluation (POE) tools. Gary T. Moore [3] developed several diagrams to represent the range of EBS (Fig. 1) to show the relationship between the sub-fields involved.

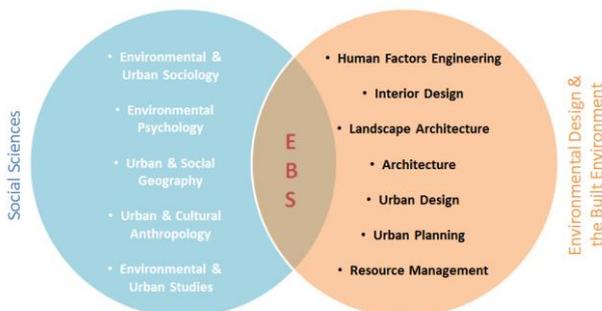


Fig -1: Emergence of EBS by including multiple domains. [3]

3. MODES OF INQUIRY IN EBS AND ITS PLACE IN THE DESIGN PROCESS

3.1 EBS in the Design Process

EBS research forms a part of the cyclic process of the professions of the built environment, involving- policies that govern planning, architectural design and construction of built environments; the users; collection of information

about user experiences and user reviews through post occupancy evaluations (POE); EBS research based on the information collected through POE; and using the research findings as guidelines for framing and modifying policies for planning, design and construction.

Narrowing down to the specific place of environment-behaviour in the design process, the model given by John Zeisel [4] can be mentioned here, according to which, the information and ideas of EBS should be applied and integrated in all stages of design process starting with the development of ideas and concepts till the execution and delivery of the building projects and further in examining the people’s reaction to the buildings or the completed projects. This model was further developed and used by Gary T. Moore [3] in his work in this field.

3.2 POE as a mode of inquiry in EBS

POE is one of the major modes of inquiry in Environment-Behaviour research. POEs have been considered as an indispensable tool in producing user-responsive and sustainable built environments by many researchers and building-designers. The findings from POEs of existing buildings, when incorporated into future projects would also lead to greater user satisfaction.

While extensive literature is already available on the theories, advantages and application of POE, the focus of this paper is to gain an understanding about the current approaches and procedures in POEs in context to residential architecture. Some existing studies like that by Meir et al [5] have tabulated around 100 previously published POE studies. After reviewing the earlier published works, some selective application-oriented POE studies, published till the recent past, are chronologically listed in Table 1. However, it is needless to say that this is not an exhaustive list of the same.

The listed studies indicate that POEs can be used to evaluate various aspects of performance and functioning of occupied buildings such as subjective responses about space uses, indoor air quality (IAQ), thermal comfort, indoor lighting and acoustic condition, etc. to bring out satisfaction level and expectations of users. POEs use an array of various instruments for measuring, monitoring and recording to do the quantitative analysis, and also various other techniques of data collection such as walk-throughs, collecting maps and drawings, observations, interviews, questionnaire surveys, to do the statistical and qualitative analysis.

Table -1: Chronological overview of some previously published residential POE studies

| Sl. No. | Name of Researcher (s) | Scope | Evaluated Dimensions | Adopted Methods |
|---------|--|--|---|---|
| 1 | Meir (1990) [6] | Residential-symmetrical building discrepancies evaluation | Indoor/outdoor temperatures | Monitoring |
| 2 | Adedokun Jagun et al (1990) [7] | Residential | Residential Satisfaction | Interview, consisting of questions related to personal characteristics, physical environmental factors, and residential satisfaction variables, with a sample size of 1018 Black adults |
| 3 | Etzion et al (1993) [8] | Residential, office, educational - Student accommodation, | Indoor temperatures, thermal performance | Monitoring |
| 4 | Etzion (1994) [9] | Residential- single family detached house | Indoor temperatures, thermal performance | Monitoring |
| 5 | Meir et al (1995) [10] | Residential courtyards | Temperatures, shading simulations | Monitoring, CAD shading simulation/ visualization |
| 6 | Pearlmutter and Meir (1995) [11] | Houses with heavy and light construction | Indoor temperatures, relative humidity (RH), mean radiant temperature (MRT) | Monitoring |
| 7 | Nur Esin Altas and Ahsen Ozsoy (1997) [12] | Apartments with different spatial and physical attributes, which have been used for 16-20 years in Turkey | Evaluation of space adaptability and flexibility | Survey and evaluation through several statistical analyses and spatial analyses |
| 8 | Pearlmuuter and Meir (1998) [13] | Residential- 1 heavy, 2 lightweight housing units | Indoor temperatures, RH, MRT, and building energy consumption | Seasonal monitoring and building thermal modeling |
| 9 | Meir (1998) [14] | Residential- 1 single family detached house | Indoor temperatures, RH, MRT, building energy and water consumption | Monitoring |
| 10 | M. Bonaiuto et al. (1999) [15] | Residential neighborhood- 20 different neighborhood in the city of Rome, used on a sample of 497 inhabitants | Measuring residential satisfaction | Multidimensional questionnaire survey To measure perceived residential environmental quality (PREQ) and a unidimensional scale to measure neighborhood attachment |
| 11 | Etzion et al (2000a, 2000b, 2001) | Residential neighborhood | Adapting building to climate change | Survey, walk-through, and GIS |

| Sl. No. | Name of Researcher (s) | Scope | Evaluated Dimensions | Adopted Methods |
|---------|--|---|--|---|
| | [16-18] | | | |
| 12 | Marino Bonaiuto et al (2002) [19] | 7 Urban neighborhood, 312 residents | Perceived environmental qualities of urban neighborhood and neighborhood attachment | Self-reported questionnaire, principal component analysis (PCA) for data analysis |
| 13 | Kowaltowski et al (2004) [20] | Residential and public space | Space use, thermal control and occupants satisfaction | Questionnaire survey with selected representatives |
| 14 | Stevenson (2004) [21] | Houses-14 nos. | Space use, thermal control, building energy consumption and occupants satisfaction | Interviews with tenants, and building energy meter data |
| 15 | Hyun-Jeong Lee and Kathaleen Parrott (2004) [22] | Residential- 169 graduate student respondents of Virginia Tech, USA | Relationship between residents' cultural background and housing satisfaction among graduate students living in apartment communities | Online questionnaire survey involving 22 housing parameters including layout, interiors and user satisfaction |
| 16 | Vainer and Meir (2005) [23] | 79 single-family detached houses, solar neighborhood | Occupants satisfaction, building energy performance | Questionnaire, interviews, survey, spatial and visual analysis |
| 17 | Genjo and Hasegawa (2006) [24] | Residential | Thermal comfort, energy consumption | Questionnaire |
| 18 | Kenda (2006) [25] | Residential, Clinic | User satisfaction, ventilation | Monitoring |
| 19 | CABE (Chartered Association of Building Engineers) (2007) [26] | Residential | User satisfaction | Survey to find residents views |
| 20 | Xiong (2007) [27] | Residential- 40 sampling sites | User satisfaction, thermal control | Interviews, measurements, simulations |
| 21 | Ge Jian et al (2007) [28] | Residential | Occupants preference and satisfaction, attributes and selection factors of houses | Questionnaire surveys |
| 22 | C. C. M. Adriaanse (2007) [29] | Residential | User satisfaction in housing environments | Questionnaire survey with residents |
| 23 | Coulter et al (2008) [30] | Residential houses | Energy efficiency, owner satisfaction | Monitoring and questionnaires |
| 24 | Nordberg | One house with no | Indoor thermal | On site measurements |

| Sl. No. | Name of Researcher (s) | Scope | Evaluated Dimensions | Adopted Methods |
|---------|--|--|--|---|
| | (2008) [31] | conventional heating | comfort | |
| 25 | Dolapo Amole (2008) [32] | Residential-Students' housing | Residential satisfaction and factors which affect user satisfaction in Nigeria | Questionnaire survey, statistical analysis of data |
| 26 | M.A. Mohit et al. (2010) [33] | 102 hoses selected through stratified random sampling | Residential satisfaction in public low-cost housing | Questionnaire survey with residents including 45 variables |
| 27 | Adetokunbo Oluwole Ilesanmi (2010) [34] | Low income and medium income public housing in Lagos, Nigeria | Survey of residents' satisfaction | Questionnaire survey carried out with a systematic sample size from the occupants |
| 28 | A.M.M. Haque Mridha and G.T. Moore (2011) [35] | Residential neighborhood in Dhaka | Focus has been placed on quality of urban life (QOUL) | Structured questionnaire |
| 29 | Sylvia J. T. Jansen (2012) [36] | Residential | Users' perception about residential qualities | Interviews over telephone based on questionnaires, with tenants and house-owners |
| 30 | M.A. Mohit and M. Azim (2012) [37] | Residential units in public housing | User satisfaction in housing environments including physical and social environments | Questionnaire survey, and data analysis using statistical methods like cross-tabulation, correlation and regression analysis of variables |
| 31 | Muhammad Hilmy Muslim et al (2013) [38] | Seven groups of neighborhoods in the city of Shah Alam, Malaysia | Residential satisfaction among students living off-campus | Questionnaire survey done with non-resident students |
| 32 | Carlotta Balestra, Joyce Sultan (2013) [39] | Residential units and neighborhood | Occupants' satisfaction and factors which affect user satisfaction | Household surveys with questionnaires |
| 33 | Yasemin Afacan & Halime Demirkan (2015) [40] | Apartments, row and detached houses | Effect of sustainable design elements on users' satisfaction levels and indoor environmental quality (IEQ) | Field survey with participants using self-assessment questionnaire and interview |
| 34 | Teck Hong Tan (2015) [41] | Gated Residences in Malaysia | Residential satisfaction of homeowners with their gated residences | Data collected through self-administered surveys, and analyzed by regression method |
| 35 | Vini Nathan (2015) [42] | Houses under 'sites and services' scheme in Mogappair, Tamil Nadu, India | Residential Satisfaction of occupants | Survey, in depth interviews, followed by data analysis using statistical techniques like ANOVA, etc. |
| 36 | Muyiwa Lawrence | Students' housing | Functional, aesthetic, structural | Data collection through survey method, analysis using descriptive and |

| Sl. No. | Name of Researcher (s) | Scope | Evaluated Dimensions | Adopted Methods |
|---------|-------------------------|-------|--|------------------------|
| | Akinluyi (ICONARP) [43] | | and satisfaction in students' housing, with a view to providing policy interventions for the designers of halls of residences for Universities | inferential statistics |

4. DISCUSSION

The above table listed out some of the researches conducted in the field of 'Environment-Behaviour Studies' in residential architecture. On the basis of this literature study a field study was conducted by the authors in Kolkata to ascertain the residential satisfaction in low-income-group (LIG) apartments (designed and constructed by the West Bengal Housing Board- WBHB).

4.1 Inferences from the Literature Review

These literatures show that in the recent years residential satisfaction has started to become an important area of study in developing countries of the east like India (and neighbouring ones like Bangladesh). Up until now, residential satisfaction was an important area of consideration only in developed countries of the west. That scenario is changing now as more and more studies are being conducted to gain a deeper understanding of housing satisfaction requirements.

Keeping in mind the end goal to survey the level of residential satisfaction in LIG public housings of Kolkata, the criteria utilized in the study are particular to the context of Kolkata, yet are in view of or adjusted from the fundamental definitions and ideas of residential satisfaction that are globally accepted, and have been based on lessons learned from similar studies in other countries or contexts.

The parameters chosen for the present field study included the responding households' attributes, physical, social and design attributes of the dwellings, and the respondents' attitudes and opinions towards these attributes. Following are these parameters:

Table -2: List of parameters chosen to evaluate residential satisfaction based on literature study. (Source: Author)

| | |
|--|---|
| Responding Household Attributes | Monthly household income; Ownership status (Owner/Tenant); Household size; Period of stay; Floor level |
| Dwelling Attributes | Modification and alteration to flat's physical attributes; Surroundings, Amenities, Public facilities & Common areas; Floor Preference; Neighbours; Safety & Security; Noise; Privacy; Unit internal attributes; Vastu; Materials of Construction & External Appearance; Residents' History, Buying Motivation, Future Intentions |

4.2 Findings from Field Study in Kolkata

Two LIG housing complexes in Kolkata were selected for the field survey:

- **Eastern Nook** at New Town
 - Completed in year 2008, Eastern Nook comprises of 80 LIG units in 5 four-storey blocks.
- **Monihar** at E.M. Bypass
 - Completed in year 2000, Monihar comprises of 144 LIG units in 9 four-storey blocks.

The study was conducted with a sample size of 25% of total number of apartment units from each housing complex. The data was collected using a multi-method fieldwork, which involved questionnaires, interviews and observations to find out user preferences, user satisfaction, as well as any modification in space uses/ design.

The collected data was analysed both qualitatively (analysis of observations, photographs and drawings); as well as quantitatively (descriptive statistics, chi-square tests).



Fig -2: The two LIG housing complexes where the study was conducted- Eastern Nook (a) and Monihar (b).

The findings, as comparatively analysed with those from previous studies undertaken by other researchers, can be summarised through the following points.

- Residential satisfaction is a complex construct;
- Satisfaction surveys could lead to the accumulation of valued information on residential choices;
- The residents were reported to experience more satisfaction with the facilities and amenities associated with the housings than the residential units;
- Satisfaction was found to fluctuate based upon floor level or height;
- Residents were found to change the physical characteristics of their residences to increase the adaptability and flexibility of the spaces;
- The residents were reported to experience more satisfaction with the distance of housing from the city over other aspects in low-cost housings;
- Tenure status (owner / tenant) was found to be a key predictor of residential satisfaction;
- Period of stay was found to be an important factor in evaluating residential satisfaction;
- Age was found to be a predictor of residential satisfaction.

5. CONCLUSIONS

The present study threw light on to some issues specifically with respect to the LIG housing scenario in Kolkata. A discussion on these and some suggested strategies that could help address the identified issues, are as follows.

- Firstly, clubbing HIG, MIG and LIG housings into single estates is also a very common practice in the Kolkata housing scenario. In fact, the housing regulations make it mandatory to provide 50% of the dwellings units constructed for the LIG and MIG sections. Although the regulation was undoubtedly framed with the best of intentions, the present study revealed the dark side of such scenarios where this regulation has been implemented, by throwing light on the severe conflicts between the LIG, MIG, and HIG residents of Eastern Nook, Eastern Grove and Eastern High.
- Secondly, considering that the WBHB flats are allocated through a lottery process and the applicants do not have provisions to choose their preferred floor, special needs of the elderly and the specially-abled need to be considered by the WBHB while designing and handing-over housing projects in the future.
- While the kitchen and toilet sizes were satisfactory for majority of the respondents the drawing rooms and bedrooms received very negative feedback. It was a positive step by the government to increase the standard LIG flat built-up area from 37.16 sq. m. to a maximum of 65.03 sq. m. through a revision in 2015. However, currently the WBHB's housing designs, as the present study revealed, are repetitive, and only few changes are made from one housing to another. With a specific end goal to guarantee that housing designs manifest the socio-social aspects of the user groups, there is a requirement for change in the design principles. A change in practices- from putative to precise and from mass-production to mass-customisation is necessary in the field of housing design, making the end-users and their socio-cultural characteristics one of the main considerations of the process. On the other hand, sensitisation of the users too about the basics of the built-environments surrounding them, so as to enable them to be informed decision-makers, and to be more involved in matters pertaining to their residences is the other important flip-side.
- Expanding the provided flats through extension is a common practice in many WBHB projects. Such practices under the current system of design, have been deemed as detrimental to the residents'

wellbeing by experts as it reduces the amount of open spaces available to the residents, reduces the gap between the blocks to such levels that a healthy amount of natural light and ventilation is no longer available even at the dwellings on the top floors. They feel that extensions should not be done as it changes the very layout which was a result of a multitude of considerations like climate, wind direction, green percentage, and many more. Thus, such practice should be addressed through studies and research, keeping in view both the residents' changing need for space, and their health in the long run.

- The various modifications done by the residents, no matter how much their income is, also point at the need and importance of open-endedness in design. Open-endedness could lead to higher satisfaction among residents and also reduced wastage of materials.
- In spite of having their uses, building codes are often rigid, and their regulations often do not take the context into account. Housing itself being a very complex activity, constant and active participation of the various concerned authorities, adjusting the rules, regulations and guidelines to eliminate misconceptions, and to suit the ever-changing circumstances giving rise to new conditions is indispensable.

Shelter is a basic necessity for human beings and thus the significance of EBS in the residential realm becomes even more prominent. Environment behaviour research could greatly facilitate the design of places for people, if the whole process of conceptualizing, discussion detailing and executing architectural design could be perceived as a process embedded with the values and concepts of EBS.

However, the outcomes of several previous studies in the field, as well as the field-study conducted by the author lead to the observation that the creation of more user-responsive built environments is a two-way process, which requires not only a more detailed consideration of user aspects on the part of designers, but also the presence of basic knowledge of built environments among the users.

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