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Influence of affluence on sustainable housing: a contextual study of Mysore, India

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Abstract Summary*: This inter-disciplinary research draws understanding from the social-cultural and economic studies to define the values and aspirations of the middle class demographic and its implications on the sustainable housing. Shared spaces have traditionally played a key role in passive cooling strategies and the maintenance of socially sustainable communities. Changes in social conditions, practices and lifestyle can be traced by the way they identify, demarcate and celebrate their boundaries. This research points to the importance of the external boundary of the site and the edge of buildings in terms of aligning meaningful sustainable design strategies with the concerns and aspirations of the emergent middle-class. Generating 3D models and applying an environmental design method, possible options for these external boundary conditions are tested, which are validated by the stakeholders during the fieldwork. This research provides new-insight into the way sustainability can be understood with qualitative values that are complemented by quantitative measurements.*

Sustainable Housing, Indian Middleclass, Developing countries, 3D Model simulation

Background study

It is important to understand housing as social and cultural phenomena that can allow insights in the effective formulation of localised and relevant low carbon housing strategies. Although strategies such as converge and contract [1] seek to accommodate developing countries' valid aspirations to achieve higher levels of prosperity, there is still an imperative to reduce carbon emissions within India. Whilst a low carbon society for developed nations can be defined as "inventing low carbon technology and reducing carbon dioxide emission by the middle of 20th century" [2]; for developing nations, achievement of low carbon communities must go hand in hand with achieving wider development goals. Further, while acknowledging the role of technology, emphasis has to be given to the importance of lifestyle and social change [2]. The complex and multifaceted society of India is interwoven with caste, religion and regional disparities, where newfound economic status and affluence in middle-class segments has a critical impact in the process of sustainable development.

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The residential sector in the construction industry accounts for 22% of global energy consumption [3]. In case of India, about 17% of emissions originate from construction activities of which 60% can be attributed to the housing sector [4]. In India with new build reflecting greater income and mobility amongst the population, it would be simplistic to characterise a growing middle class as being exclusively materialistic where social and cultural conditions unique to India have the opportunity to marry prosperity, property and low environmental impact.

The provision of housing in India has traditionally been less related to income and wealth. It is proposed to explore this theme through the example of the city of Mysore, India. It is a useful exemplar in that it has a history that directly influenced environmental response in the built environment [5]. Shared facilities (including party walls), the efficient use of semi-open outdoor spaces for much of the day, and the effective use of multi-purpose areas all facilitated a compact building footprint. Using locally available material within a climatically responsive layout and construction would today be regarded as a good example of efficient sustainable development [6]. Plot ratios are dense compared to more diffuse contemporary layouts with less environmental impact because of a more efficient land use. Comparisons in Mysore of typical Agrahara settlements with contemporary middle-income settlements indicate an increased dwelling footprint. Cartographic measurements of representative land parcels indicate that for a contemporary dwelling, 50% more plot area is required compared to more traditional Agrahara typologies [7, 8].

It is suggested that the Jagali neighbourhood embodies a sense of the communal that reflects the values of the Nehru consensus middle class. Modern typologies mirror the ascendance of the individual over community where often, competing needs for privacy and display produce buildings that are inefficient in their use of land and building materials, with little consideration given to passive methods of environmental mediation.

Methodology: Models and simulation analysis

This paper draws observations and conclusions of the earlier research and fieldwork to identify the needs and wants of middle class homeowners [7, 9-11]. Structured interviews and surveys clearly indicated the concerns for security and notions of protecting one’s boundary, coupled with the need for privacy, and the use of form and façade to provide visual cues in expressing wealth and aspiration [7, 8]. The understanding of the fieldwork is triangulated with literature studies and the outcomes related to boundary conditions are used to produce different computer models, representing alternatives for major elements, a sustainability agenda and middle class aspirations. Feedback from architect, builder, and homeowner is used to define these models that are then related to sustainable values.

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The fieldwork was combined with intensive literature reviews of both contemporary Indian building typologies [12-15] and research on boundary, threshold and border that help explain contemporary preoccupations with security and defensible space [16-20]. From this a series of four test models were generated for study in respect to both predictive quantitative performance and as a basis for revisiting the fieldwork. The models were organised to test housing market stakeholders' responses to a range of sustainable criteria. At one extent a traditional bioclimatic solution that reflects past models of communal living and at the other extent, a model representative of current private sector middle class housing were constructed. A further two models between these extremes were designed primarily to get a finer understanding of the exact levels of privacy and social interaction that might be embraced by potential stakeholders (Figure 1).

The focus of this research is to access the implication of varied boundary condition in terms of change in energy consumption and resultant carbon emission. For the simulation purpose, only these boundary conditions of different typologies are altered while providing input in Integrated Environmental Solutions (IES). The models were generated with similar configuration in terms of built up area, number of rooms, size of the plot and provision for minimum light and ventilation. To focus the research more on the boundary conditions, all other components such as constructional systems and spatial planning were kept as constants. An advanced simulation package, IES, was used in this research. IES uses climatic data and supports a range of analytical tools for lighting, thermal comfort and resultant energy consumption and carbon emission. To predict energy consumption and carbon emissions, longitude and latitude were specified for Mysore using climate data from Bangalore, the nearest city to the study area.

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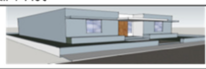
		Model 1	Model 2	Model 3	Model 4
	Typologies	Jagali Typology	Jagali + Plot	Plot + Gate	Plot + High Gate
					
Description	Boundary condition	A traditional bioclimatic solution that reflects past models of communal living	A representative model of a combination of traditional and current middle class housing. Demarcation of boundary with very low wall. Combination of Jagali and plot system.	A representative model of current private sector middle class housing	a representative model of aspirations and high end / upper middle class housing
	Physical	Sharing party wall either in a row or arranged around the open space	The plot is defined more as a very low hedge to retain the permeability of the Jagali typology	About four feet high compound. Clear definition of one's territory	Very high compound. Min 6 feet high. Totally cut off from the external world.
	Spatial	Use of semi-open space for most of the time	Opportunity to use open space for informal activity	Clear demarcation of territory. Presently, the space is not used for much of the activities.	Well defined barrier segregating the inside and outside. Open space and landscape areas for personal consumption.
	Visual	House and central open space are visually connected. Kids can play and people can use the Jagali for informal gatherings/activities	Developed more to suit the prevailing plot typology. Scope for interaction among neighbours.	There is a visual connection if not physical. Owners have the option to interact with the neighbours.	Insulated and visually cut off from the street and neighbours.
Qualitative	Communal / Social	Community oriented. Common open space and other than the rear utility area, there is no individual house open space	Scope to use open space for most of the day	Scope for informal interaction with the neighbours and street. Not much importance for the exterior open spaces and community activities	Totally cut off from the neighbours. Introverted, independent and more importance for privacy. Independent of neighbours and not involved in community activities.
	Economics / reflection	More emphasis on culture than economics (Rangoli). More functional	More functional	Combination of function and appearance. Skin and compound used for demonstration of one's aspiration.	Skin and compound used for demonstration of one's aspirations
	Security	Social security, compact community and known neighbours	More importance attributed to social security	Compound used as a psychological barrier, main door with steel shutter	Compound itself acts as first level of defence. Totally grill and very high individual security.
Quantitative	land foot print	13 Smt / person	27 Smt / Person	27 Smt / Person	43 Smt / Person
	Embodied energy	Use of least embodied energy and lifecycle energy	Less embodied energy		Use of very high embodied energy and lifecycle energy
	Embodied energy	0.47 MWh / SQM	0.57 MWh / SQM	0.68 MWh / SQM	0.78 MWh / SQM
	carbon emission	0.24 t CO2 / SQM	0.29 t CO2 / SQM	0.33 t CO2 / SQM	0.40 t CO2 / SQM
	Openings	Very small, just enough light inside.	Narrow openings, enough light for the interiors	Wide openings, no relation to direction and requirements	Very wide openings. Spanning most of the wall
	Climate responsive features	Climate responsive, roof, wall, construction and materials were reflective of local climate	Jagali area is shaded and could be used for most of the day	Design is independent of climate	Highly insensitive to the climatic condition.
	source of material	Use of locally sourced materials	Emphasis on use of locally sourced materials	Combination of local and imported materials.	Use of imported materials
	Security	No/least number of materials used for security other than the regular wooden door	Steel door as additional security to the main and rear doors	Steel grill for the portico area	Entire or most of the plot is covered by a grill
Summary		Most sustainable typology	Some of the features are sustainable	Some of the features are unsustainable	Least sustainable typology

Figure 1. Analysis of different model typologies

The focus of this research is to access the implication of varied boundary condition in terms of change in energy consumption and resultant carbon emission. For the simulation purpose, only these boundary conditions of different typologies are altered while providing input in IES. The models were generated with similar configuration in terms of built up area, number of rooms, size of the plot and provision for minimum light and ventilation. To focus the research more on the boundary conditions, all other components such as constructional systems and spatial planning were kept as constants.

IES allows altering the input of each typology while retaining some of the features as constant across all typologies. Further, it allows comparison of specific parameter across typologies during output. For instance we can run the models to simulate only the conductive heat gain, where the internal temperature rise is due only to heat gain by conduction. Similarly, the energy consumption due to cooling load, resultant of bringing down the internal temperature to set comfort condition is assessed (Figure 2 and 3).

A key finding is one of increased energy consumption in the high compound typology (model 4) representing the aspirational model. It uses nearly 65% more energy than model 1 (the Jagali typology). Similarly, there are differences in the performance of other models; for

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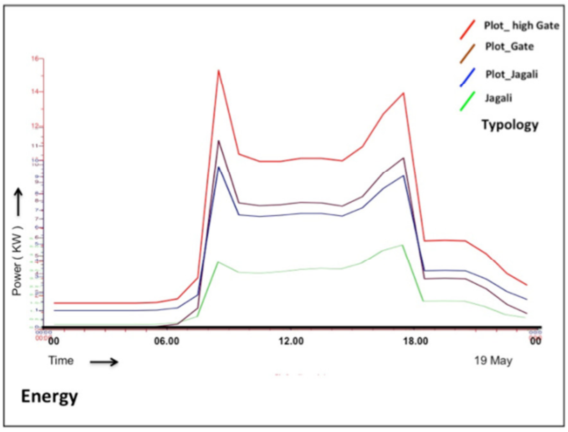
instance, in the case of energy consumption, the high compound typology (model 4) requires nearly 300% of more cooling load compared to a Jagali house typology (model 1). And even this will increase the conduction gain by nearly 90%. The simulation output demonstrates that changed boundary conditions have implications for energy consumption and resultant carbon emission. They also validate the hypothesis while developing models that explore different boundary conditions. It also clearly points to a direct relation between peoples' changed preferences and aspirations and their implications for energy consumption and carbon emission. The outcome clearly indicates higher conduction gain, cooling load, energy consumption and resultant carbon emission in plot and high gate typologies and consistently lowest energy consumption and carbon emission in the Jagali typology.



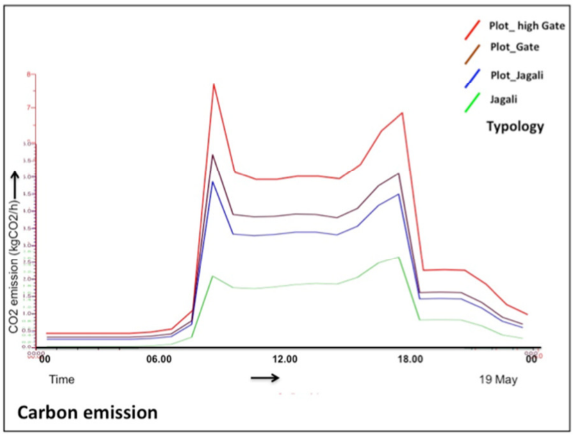


Figure 2. IES simulation: Energy consumption

Figure 3. IES simulation: Carbon emission

Fieldwork

The main objective of achieving sustainable strategies within the existing middle class paradigm is achieved by contextualising the broad term of sustainability to Mysore condition on one hand and reflecting the acceptability of middle class homeowners' preferences and acceptability on the other. The models prepared and simulations carried out reflect the local sustainability agenda and different levels of sustainability with specific reference to boundary condition. Further fieldwork looked the aspirations of the middle class people and their willingness to align towards more sustainable features. The models were tested with homeowners by semi-structured interview and with key stakeholders in the design and procurement process. To analyse the issues reflected in transition spaces, elements representing middle class aspirations and the sustainability agenda were identified, namely: Volume, Entrance, Opening, Security, Interaction and Skin [9, 11].

To elicit preferences and log the choices of people, architects and builders, a 'multi sorting task' methodology was followed. As Groat [21] has argued, it is possible for the participants either to sort representations of buildings they had experienced directly or pictures that

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functioned as simulations of the real environments. The models are deconstructed to highlight the element investigated and the complete 3D study models are not shown to the participants to avoid distraction. This technique is very helpful in this type of study as respondents are asked to place the cards from most acceptable to least acceptable. This multi sorting process was validated through a semi-structured interview. Apart from noting their preferences, the process was recorded and interviewees were informally questioned as to their decisions.

Fieldwork analysis, Discussion

The outcome of this fieldwork addresses issues including social and cultural values and perception of key stakeholders towards middle-income sustainable housing. The study can be broadly addressed at two levels; firstly, it deconstructs how various stakeholders perceive boundary and threshold in housing. The interview and survey assesses the choices and preference of a particular topology based on issues like, security, material, interaction etc. their choice of most preferred and least preferred are further triangulated with the discussion during the process about the rationale behind their choices and why they think their choice is appropriate.

At second level, the study analyses how the peoples' perception changes with awareness. The house owners are asked first to prioritise their preferences. Later after being given information on issues relating to climate change and sustainable housing, they are asked to again place their preferences. Feedback from stakeholders; architects, builders, contractors and home owners are analysed for each element identified namely; Volume, Entrance, Opening, Security, Interaction and Materials. Though there is a clear departure from the sustainable boundary condition, the outcome clearly reflects varied preferences among different elements identified. To summaries the field work results; two representative outcomes, Volume and Opening, are discussed below.

Volume: In the case of different Volume options, stakeholders strongly feel that the prevailing plot typology is most desirable followed by high gate typology preferred by more than 65% of homeowners. The most sustainable, Jagali typology is the least preferred option. Their strong preferences are evident while analysing their preferences after providing the information regarding sustainable concerns. Homeowners' revised preferences clearly reflect marginal decrease in the high gate typology, which is reflective of many unsustainable features and less than 10 % increase in the preferences for Jagali typology. Similar trend can be observed among other elements like, Entrance, and Security.

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Opening: In the case of different opening options, stakeholders are divided among the wide, small and inward openings. Less than 10% of homeowners prefer opening towards shared areas. According to one architect, changed social network and priorities makes this a least feasible typology (respondent no.76, interviewed on 09 March 2011). The concern and acceptability of the homeowners are evident, while their preference for the wide openings are reduced to less than 5%, their preference for small opening is increased by 20%. Similar trends can be found in case of Material choices as well.

Choices and preferences clearly represent the area in which we can expect people to support and adapt to sustainable features. The feedback can be classified in to three types. First the elements which people are ready to change their preferences for the cause of sustainability, in this we can easily find the materials, skin and openings as two aspects which people are ready to align towards a sustainable agenda. There are certain elements for which they do not have very strong preferences and to some extent are ready to align themselves. In this case people might consider some adjustment but are not ready to forthrightly support a sustainability agenda. However when it comes to issues like security; people are not ready to compromise and would not be interested in sustainability issues and would not compromise on their perception of what is safe and secured for them.

This study has been very useful in disentangling one area, the boundary condition and look at each element separately so as to identify people's choices and preferences resulting in the housing typology and hence resultant sustainable concerns rather than broadly summing up the boundary conditions as unsustainable in present context.

This study is also helpful in identifying the areas and elements where it is easier to achieve higher sustainable goals compared to areas where there will be higher resistance to change. Revising the model to suit both peoples' choices and sustainable agenda further tests this. Peoples' choices and preferences, collected by social methods, are fed into the IES simulation model to analyse the difference in the process of sustainable housing. To test this one model is altered to have optimum size windows which people would be ready to align with to achieve more sustainable housing.

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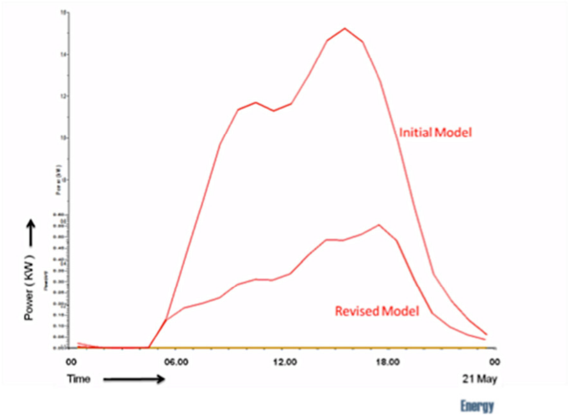

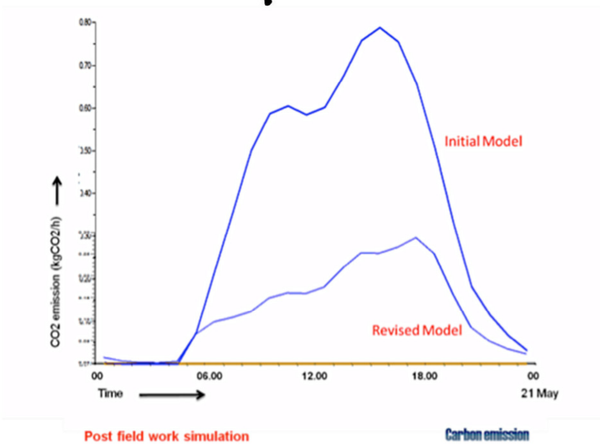

Figure 4. Post-field work: Energy consumption

Figure 5. Post-field work: Carbon emission

The new IES simulation chart clearly shows a drop in the energy consumption of 40% (Figure 4). The changed window parameter has also reduced the carbon emission by 40% (Figure 5). The results clearly show that, by changing the elements which people are ready to alter, we can reduce carbon emission by a fifth. This is significant because it is useful to know where we can really target and reduce emissions.

Conclusion

This research demonstrates that homeowner’s attitude towards housing elements depends on the specific issue and individual perceptions. Furthermore, their preferences will not only depend on the individual, but are also influenced by the building elements. For instance, middle class homeowners strongly prefer the high gate plot typology and would not like the ‘Jagali’ typology. The post-fieldwork analysis clearly demonstrates that in spite of a clear move away from sustainable living, the values of people can be recognised as being more than 40% ready to change their life style to align themselves towards more sustainable housing.

Researchers have proved that the homeowners of naturally ventilated buildings will accept and feel comfortable in a wide range of weather conditions [22]. The weather condition of Mysore facilitates passive ventilation and cooling strategies for most of the year except during the extreme summer of April and May. This research points to the limits of adaptive comfort as homeowners’ affluence and aspirations have made them more sensitive to temperature variations and energy intensive mechanical devices accessible to manage their micro-climate. Improvements in the standard of living, a sensitivity and desire to achieve desired comfort conditions in the internal spaces have encouraged middle class owners to invest in these mechanical devices. Furthermore, the interview feedback suggests that most of these mechanical devices are installed to display homeowners’ wealth.

The study using survey field work and model simulations has highlighted the relatively recent shift in attitudes and cultural values relating to housing; from an inherently sustainable approach which valued shared spaces, local materials and communal activities, to one which reflects a move towards a twentieth century western approach; of individualism, nuclear families and consumer driven values. The study also clearly demonstrates that there are elements like materials and openings, which people are willing to align themselves with and that there are elements like security, which they would not compromise. Their immediate concerns would be of greater importance than the greater issues of carbon emission and sustainable housing.

India has identified Housing as one of the eight national missions to reduce carbon emission as part of its commitment to reduce the vulnerability of the people to the impacts of climate change [23], this bottom-up approach to identify the sustainable strategies acknowledging people's needs and aspirations should be a useful contribution to achieving carbon reduction and sustainable housing.

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