

Sustainability and High-Rise Design for the Future

Importance of connectivity between vertical living and the natural environment

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Abstract: High-rise living had been universally accepted as a sustainable solution to the housing problem by the end of the 20th century. However, it invariably results in the separation of people from nature, a fact that is especially true of users occupying the upper floors of high-rise apartments. Consequently, such a lifestyle has long been associated with the poor mental and physical health of their users. Sustainable high-rise buildings are, therefore, not merely about responsiveness to environmental, technical and economic issues, but also about the improvement of high-rise dwellers' quality of living. Such concerns become even more important in the context of the high-rise's evolution as a holistically sustainable urban dwelling of the future, due to rising real estate prices in urban areas. It is a foregone conclusion, therefore, that the aforementioned negative influences would also occur in the Sri Lankan context, especially since high-rise living has yet to become entrenched in the collective conscious of her people as a viable lifestyle choice.

This paper demonstrates how the outdoor natural environment affects the mental wellbeing of high-rise dwellers. Responses of dwellers of three different high-rise apartments in Colombo, Sri Lanka, regarding their phenomenological experiences of how the outdoor natural environment affected their mental wellbeing, were collected and qualitatively analysed. The results show how the presence of visual connections to the natural environment contribute to the mental health and wellbeing of high-rise dwellers. These findings have relevance to the way user-friendly high-rise apartments would be designed in the foreseeable future.

Keywords— High-rise, natural environment, views

I. INTRODUCTION

The concept of vertical living evolved from low rise, mid-rise through high-rise to super high-rise, in order to cater to the demand for housing seen as a solution to the scarcity of land, rapid urbanization and population increase. High-rise living had, in this fashion, become universally accepted as a sustainable solution to the demand for urban housing by the end of the 20th century.

A. Health and Wellbeing of High-rise Dwellers

Many consequences of high-rise living have been identified through research (Gifford, 2007). Some are caused by the building form itself while others are mediated by non-architectural factors such as socioeconomic status, building location, child-care, gender and stage of life (Gifford, 2007, p.13). Vertical living, in fact, separates high-rise dwellers from the natural environment, especially those who occupy the upper floors of such buildings. This is one of the main issues that result in negative experiences for dwellers of high-rise apartments, affecting their mental and physical wellbeing in the process. Evan et al (2003, pp. 536-548), who conducted a critical review of the data on mental health and housing, show that six out of eight studies reported that dwellers of higher floors had poor mental health compared to those on lower floors. Panczak et al (2013), using the data obtained from 1.5 million people from the Swiss National Cohort, established a correlation between cardiovascular disease and life on upper floor levels. Furthermore, he discovered that people living on the eighth floor and above faced a substantial increase in the degree of social isolation, a fact that might have also had a negative impact on their mental health. These results highlight the fact that an existence above the ground confined to a building with a small footprint, whilst being separated from the natural environment, creates a sense of entrapment and isolation. This, in turn, could negatively affect the mental health of high-rise dwellers, impacting indirectly on their physical health as well.

It is foreseeable that high-rise apartments would eventually become the dwellings of the future due to urban land values continuing to be at a premium. This makes finding solutions to mitigate the negative impact of high-rise living in order to improve the quality of livability in high-rise apartments, a dire necessity. Only then would such a lifestyle attain to the holistic goals of sustainable living.

B. Psychological impact of outdoor natural environment on high-rise dwellers

Human vision is the most dominant of the five sensory apparatus that is used to collect information about the surrounding environment (Madina, 2014, pp.191-210). Olszewska-Guizzo et al (2018) conducted “the first experimental study to assess the effects of the combination of floor level and green cover within a window view on the brainwave oscillations of healthy individuals living in high-rise estates” (P.11). Their research proved that quality window views, while aiding in the interaction with the outdoor natural environment, are vitally important as it has the potential to mitigate the negative impact of height on the mental wellbeing of high-rise dwellers. Human beings have an inherent desire to connect with nature, a fact that has been scientifically proven (Schultz 202, p. 61). Ulrich (1984) cites instances of how hospital patients, who have enjoyed quality views of greenery in the environment, have speedily recuperated (pp.420-421). This phenomenon has been established through the biophilia hypothesis as formulated by O. A. Wilson (1984). Further, a research study on environmental psychology by Kuo et al (1998, pp. 28-59) proved that interaction with the natural environment had a positive impact on people’s mental wellbeing. Kaplan R and Kaplan S (1989) also affirmed through their Attention Restoration Theory (ART), that contact with the natural environment helps reduce mental stress and fatigue.

As pointed out earlier, high-rise living is still a novel concept for Sri Lankans and its negative influences, discussed above, would very likely prevail in local high rise apartments as well. It would be timely, therefore, to seek solutions for the negative impact of vertical living on dwellers living in high-rise apartments, for the purpose of minimising these issues at the very inception of the high-rise industry in Sri Lanka. The engenderment of a salubrious urban landscape in Sri Lanka along with the improvement in the quality of life of high-rise dwellers would be the result of such an endeavour.

C. Research Questions.

The initial questions for which answers are sought through this study may be posed as follows.

Q1. What is the experience of living above ground level in Sri Lankan high-rise apartments?

Q2. What are the negative issues impacting occupants due to building height in such settings?

Q3. What are the cues that help reduce the negative impact of building height?

Q4. How could the negative impact on occupants due to the height of high-rise apartments be minimised, in order to enhance the liveability of occupants?

The aim and objectives of the research are as follows.

- Ascertain whether living above the ground would impact negatively on the livability of users occupying the upper levels of local high-rise apartments.
- Determine what attributes of high-rises create negative impacts on users occupying the upper levels of local high-rise apartments.
- Recommend solutions to minimise the negative impact of building height on occupants of local high-rise apartments, in order to enhance their liveability.

This, in turn, would ensure the wellbeing of future urban communities through the upliftment of living standards in user-friendly high-rise apartments in Sri Lanka, while contributing in the final analysis to the growth of the sustainable global city of the future.

II. METHODOLOGY

This study seeks to understand the phenomenological experiences and concerns of high-rise apartment dwellers in order to determine how the natural environment affects their overall wellbeing. Consequently, this study had recourse to a qualitative research approach since the research data comprised human experience, i.e., how the natural environment relates to the occupants of the various floor levels. Condensation of the horizontalised responses was conducted by grouping words with similar meanings and identification of similar words used repeatedly, to yield sub-codes, codes and finally, themes (Moustakas, 1994, p. 123). Responses to close-ended questions were further analysed in order to determine the respondents’ concerns and experiences within the given frame work.

A multiple case study strategy was used to collect data for this research. Three different types of high-rise apartments with over 30 floors were selected from three different urban contexts in Colombo, Sri Lanka, for the purpose of conducting the study. The reason for making such a selection was to provide an urban cross-sectional view of how occupants perceive the building height of their apartments along with the contextual cues that could help trigger their responses. It was assumed that this would provide insights, among other things, on how the setting influences the experience of building height, through a comparative analysis based on the themes identified during the literature review. All in all, the findings were expected to be generalisable to the population of high and middle income inmates of high-rise apartments in Colombo.

The management committees of the selected high-rise apartments requested that the names of apartments and their occupants be withheld in order to maintain their privacy and security. The income demographic was not considered in the selection of case studies, since it becomes irrelevant when apartment height is considered. This decision was made because the segregation of dwellers from the natural environment becomes evident with increase in apartment height, which is the problem that needs resolution. However, only very few apartments in Sri Lanka have more than 50 floors. Considering their availability and

accessibility, therefore, this research was limited to high-rise apartments with more than 30 floors.

Sixty five questions were formulated inclusive of both open-ended and closed-ended questions. In order to evaluate participants' experiences, questions were structured to facilitate understanding of how the natural environment impacts on high-rise apartment dwellers. The Google Form was used to prepare a questionnaire and it was distributed among high-rise occupants via email, through the mediation of the management committees of each apartment building. The same questionnaire was distributed among occupants of all three apartment types, in order to determine whether they would have different responses to their respective contexts. Participants chose not to respond to the verbal questionnaire and agreed to fill the online questionnaire instead.

A total of fifty four responses were obtained from the occupants of the aforementioned three high-rise apartments. The contextual profiles of the selected case studies are as follows.

Type1: high-rise apartment without any other high-rises in the vicinity

Type2: high-rise apartment with roof garden at level 05 (podium level) and without any other high-rises in the vicinity

Type3: high-rise apartment with other high-rises in the vicinity

The foregoing contextual variances, as mentioned previously, ensure that the findings would be generalisable to the population of high and middle income inmates of local high-rise apartments. Participants' experiences were evaluated with regard to their interaction with the natural environment from the floor level they occupied. However, they could vary due to various demographic factors such as age group, gender and sociocultural biases. The target group for the research has also been restricted to the 36 to 65 demographic, based on the assumption that this particular group would have the maturity and education to clearly articulate their experiences. Gender was not considered due to limited participant availability. All of the participants were literate and willing to participate in this study. Consequently, they were expected to clearly understand the questions and also have the ability to respond to them with clarity.

III. RESULTS AND DISCUSSION

The breakdown of fifty four participant responses with regard to the case studies are as follows.

Table 1. Overall responses

Case study	Responses received
Type 1	18
Type 2	19
Type 3	17
Total responses	54

The condominium management committee carefully regulated outsiders' contact with participants in order to ensure their privacy and safety, especially on account of the then ongoing Covid-19 pandemic. Given the foregoing circumstances, the researcher was unable to engage with the participants directly, hence information pertaining to the actual number of occupants among whom the questionnaire was circulated is not available. All the responses were from the 36-65 age group and are summarised as follows.

Table 2. Age group break down

Responses (n=54)	Age group
33.3%	36-45
40.7%	46-55
25.9%	56-65

It was further assumed that the admixture of non-Sri Lankans and former expatriate Sri Lankans, who have had previous experience of living in high-rise apartments, created a representative cross section of the population as participants for the research.

Table 3. Nationalities of participants

Responses (n=54)	Nationality
51.9%	Sri Lankan
27.8%	Sri Lankan former expatriate
14.8%	Non-Sri Lankan
5.5%	Non-Sri Lankan longtime resident (more than 10 years)

Table 4. Overall response regarding experience of living in high-rise apartments

Responses (n=54)	
55.6%	First time experience of living in a high-rise apartment
44.4%	Prior experience living in high-rise apartment

It was also assumed that participants with first time experience of living in high-rise apartments, would feel the difference between a high-rise apartment and other housing types more acutely. This would be on account of the novelty of their experience of vertical living. On the other hand, a person with prior experience of living in high-rise apartments for a long period of time would, very likely, get habituated to living in that environment. Hence, it would be important to consider the experiences of both these demographic categories in order to obtain a broader picture of dwellers experiences and concerns relevant to the three case studies of this research.

A. Participants' responses to the natural environment.

Participants prefer to see the natural environment when they look outside, a fact which has been proven by the responses of 83.3% (n=54) of the participants, which constitutes a majority. This was found to be especially true of those participants occupying level 20 and above.

B. Participants' responses with regard to their behaviour pattern.

Table 5. Overall response regarding manner of spending the day off

Responses (n=54)	Participants responses
57.4%	Spend day off outside apartment
42.6%	Spend day off inside apartment

According to the overall responses, 57.4% of the participants (n=54) prefer to spend their day off away from their apartments. Further analysis of the reasons given shows that the majority of these participants spend their days off away from the apartments, because they feel a sense of entrapment and monotony generated by the building height, lack of quality views, and lack of a natural environment.

Only 42.6% (n=54) showed a desire to spend their day off inside their apartments. Majority of these participants, who belonged to case study 2, level 5 to level 10, reported that they were happy and enjoyed the environment of their apartments because of the accessibility to quality views and greenery.

C. Participants' responses when looking outside the apartment.

Table 6. Overall response when seeing greenery-i

"Participants when seeing greenery at eye level"	
Responses (n=54)	Participants responses
87%	Excited and happy
11.1%	Normal

Furthermore, 87% (n=54) of participants were excited and happy to see greenery at eye level. It becomes apparent, therefore, that having views of greenery while living in high-rise apartments, benefits the residents.

The participants from all three case studies, who occupied level 5, were neutral in their attitude towards not seeing much greenery, since they live within easy access of the ground level.

Table 7. Overall response when seeing greenery-ii

"Oblivious to the fact of living above the ground when seeing greenery in close proximity."	
Responses (n=54)	Participants responses
59.3%	Strongly agreed
24.1%	Simply agreed

From the overall participants, 59.3% (n=54) strongly agreed that they were oblivious to the fact of living above the ground when seeing greenery in close proximity, with 24.1% (n=54) simply agreeing.

This proves that a majority of the respondents prefer to see a green environment in close proximity to their dwelling place, which creates a sense of well-being and freedom in the respondents as mentioned in the summary. This fact also illustrates how participants benefited from views of greenery which, in close proximity, caused them to be oblivious to living above the ground.

Table 8. Overall response to sense of entrapment

Case Study 1, 2 and 3: participants' responses		
"I feel trapped when I look outside".		
Case study	Responses	Floor Level occupied by participants
Type 1	agreed and strongly agreed	Level 5 to level 25
	strongly disagreed	Level 25 and above
Type 2	strongly disagreed	Level 5 to 10
	strongly disagreed	Level 15 and above
Type 3	Agreed	Level 5
	Strongly agreed	Level 10 to level 40

In case study type 1, those living below level 25 responded with "agree" and "strongly agree" to the statement "I feel trapped when I look outside". However, participants who occupied level 25 and above strongly disagreed with this comment.

All respondents who occupied the first 10 floors in case study 2, strongly disagreed with the above statement, meaning that they did not feel trapped when looking outside the apartment. However, participants of level 15 and above also did not feel a sense of entrapment when looking outside the apartment, due to the presence of quality views in the building's environment.

In case study 3, all respondents from level 5 to level 40 stated that they feel trapped when looking outside the apartment. Participants occupying level 10 to level 40 responded with "strongly agree" and "agree", due to the building context with tall buildings in close proximity.

Table 9. Overall response when seeing the horizon

Case Study 1, 2 and 3: participants' responses		
"I forget that we live above the ground when seeing the horizon".		
Case study	Responses	Participants responses relevant to the occupied floors
Type 1	agreed and strongly agreed	Level 15 to level 20 all participants
Type 2	strongly disagreed	Level 10 and those below
	neutral	Level 15
	strongly agreed	Level 20 and above
Type 3	disagreed	Level 10
	strongly disagreed	Level 15 to 40

Case study type 1: from level 15 to level 20 all participants agreed and strongly agreed that they forgot the fact that they were living above the ground when they see the horizon.

Case study type 2: Participants who occupied level 10 and those below strongly disagreed and occupants above level 20 strongly agreed with this statement. However, occupants of level 15 responded with "neutral". Because of the effect

of the roof garden located at the level 5 gives positive impact on dwellers up to level 15.

Case study type 3: Occupants from level 15 to 40 strongly disagreed with this comment and occupants of level 10 disagreed due to the presence of vertical sprawl, which creates a feeling of congestion and entrapment.

D. How outside greenery impacts on the participants.

In all three case studies, participants living up to level 15 enjoy looking at the greenery outside. This enables them to feel that the ground is close to them, which reduces the perception of building height.

IV. CONCLUSION.

This study shows that outside greenery and the natural environment impact positively on the dwellers who occupy high-rise apartments. The findings also suggest that a high-rise's connectivity to greenery and the natural environment, could also help mitigate the sense of entrapment and isolation that affects the overall wellbeing of high-rise dwellers. The study also goes on to show that outdoor trees, which create a green ground cover, reduce the perception of building height. Conversely, it also confirms that level 20 and floors above this level, would not be affected by outside greenery, since the ground level green cover would be too far below to have any impact on the perceptions of high-rise dwellers. However, at this height quality views of the distant natural environment and horizon could contribute towards mitigating dwellers' feelings of entrapment and isolation.

It is imperative, therefore, that urban designers and architects take cognizance of a city's landscape, especially with regard to the settings of high-rise apartments, to enable perspectival window views of the city's urban fabric from such apartments. Such devices conduce to the engenderment of sustainable built environments through the prevention of sensory deprivation due to a lack of greenery.

Theories pertaining to the spatial organisation and landscaping of the urban fabric around high-rises are already part of a global urban design discourse (Larcombe, Lea et al 2019). However, the Sri Lankan government and its regulating bodies are still lagging behind in this regard. A global architectural trend is to design high-rise apartments covered in trees and other plants. The key here is to determine whether this tendency is just for aesthetic purposes or the provision of additional benefits for human well-being.

"Human survival is directly tied to our relationship with the natural environment. The achievement of a sustainable lifestyle depends on establishing a balance between the consumption of individuals and the capacity of the natural environment for renewal. However, we often act as if we are separate from nature and that we can survive without it. Indeed, "built environments serve as barriers between individuals and the natural environment in which they live" (Schultz, 2002, P. 61). In this regard, the evolution of user-

friendly high-rises with connectivity to the natural environment would be a key factor in the genesis of urban communities of the future.

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