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The Role of Height Perception in Administrative Building Façade Visual Sustainability

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Abstract-
One of the defining characteristics of modern structural engineering feat is height. Tall buildings have been continually listed to be aesthetically pleasing with great impact in defining the immediate built environment. The affirmation of this statement was tested on university administrative building facades to identify the relationship between building height as an aesthetic perception for visual sustainability. In testing the validity of building height in aesthetic preference for future application in architectural designing, ten administrative buildings were selected from southwest Nigerian universities through the stratified random sampling technique. Quantitative data were obtained from 577 respondents, which comprised of staff and students from the ten selected universities through a close-ended structured questionnaire. Selected building façade photographs were also attached to elicit a response from respondents. The study involved identification of height as an important building façade element and also examining respondents' perception of building façade height for visual sustainability. Data analysis was done using frequencies, percentages, mean ranking, and factor analysis. Building façade height was ranked third in terms of importance for visual sustainability, while buildings above four floors were observed to be most preferred by respondents. The findings of this study imply the need for planners and designers to ensure distinguishing the university administrative building as the tallest in relation to other campus building facades. This affirms the importance of height in the visual sustainability of this building typology and overall campus outlook.

Keywords: Aesthetics, Building Height, Façade, University Administrative building, Visual sustainability

1. Introduction

Reshaping the environment has been one of the defining characteristics of man. The natural environment is continually being adorned with fascinating human-made structures leveraging on advancement in engineering and architecture [1]. Tall buildings have assumed the position of high-level landmarks for the city and can create an iconic skyline. Al-Kodmany [2] asserts that the taller the building, the wider the area of influence. Height has continuously been one of the hallmarks of record-breaking structures the world over between 1900 and the present day. For instance, the World Trade Center in New York, USA; the Shark, London UK; Petronas Towers in Kuala Lumpur, Malaysia; CN Tower in Toronto Canada; Taipei 101 in Taipei, Taiwan, and the Burj Khalifa in Dubai, UAE, have all become prominent skyscrapers with aesthetically pleasing facades. These structures, among others, have become tourists' haven sustaining the visual quality of their immediate environment as a whole. A good percentage of tall buildings are administrative buildings. The built environment can be divided into different sectors with different administrative core [3], [4], [1]. For instance, the state secretariat houses the administrative functions of a state government and various office buildings for administrative functions of diverse organisations. The university campus, as a community on its own, has a central administration that controls the functioning of the entire system, known as the university senate building. The university senate building as the seat of authority in a campus is expected to be outstanding in its aesthetic quality. This, in effect,, will enhance the overall outlook of the campus [5], [6]. Building height as an aesthetic element has been known to be synonymous with some outstanding buildings, as earlier mentioned. In testing the acceptability of height as seen in the larger society, this study is aimed at identifying the relationship between building height and aesthetic perception in university administrative building for future application in architectural education on visual sustainability.

Height is a relative term that is always within the context of the immediate built environment and the location of the observer [7]. According to [8], height parameters for considering a building as high is subjective and can be considered in relation to the human scale, proportion, and height limit permitted by the city master plan of the respective city. Buildings above three floors tall can be considered as tall in relation to human scale and occupant safety, while it is considered high if it is taller than five floors. This is the maximum height allowed without an elevator for vertical movement in many countries [9]. According to [8], tall buildings have a great influence on their immediate environment in the aspect of the economy, infrastructure, microclimate, urban landscape, and the use of the urban space. In ensuring the visual sustainability of a tall building on the environment, [10] suggests that designers should ensure the composition of three distinct sections, namely: base, shaft, and top. The base is usually seen from the street level within the 40° cone of vision, and it anchors the tall building with the immediate environment. The shaft is the most prominent of a tall building, which extends upwards from the base and determines the level of interaction between the building and its environment. The top seldom affects the immediate environment, but dramatically influences the skyline of the city.

Sustainability has become a determining factor for a large number of ventures from the beginning of this century, which has changed into a key force influencing long-term possibilities and success [11], [12]. Sustainability in lexical terms means the maintenance of a process or state at the desired level over a while necessary. It is the achievement of the present needs of development without jeopardising the capability of the immediate and distant generation in meeting theirs socially, economically, and environmentally [13], [14]. In other words, sustainability focuses more on a long-term vision. Sustainability of the built environment encompasses all human-made structures, which include buildings and infrastructures such as transportation, waste management, and utility systems installed to serve the building space [11].

Visual sustainability, according to [15], is defined as the process of sustaining people and enriching their daily life through the visual connection they hold unique to their surroundings. It is hinged on the visual sense, which gives up-to-date knowledge of our spatial surroundings and identifying all objects to our consciousness [16]. Visual quality studies in enhancing visual sustainability are one of the essential aspects of determining user experience. It also plays a critical role in prequalifying a building as a piece of architecture. Also, it determines the level of appreciation by the users and the design professionals.

Campus architecture is highly dynamic, and just as education around the world continues to evolve and innovate, architects are going back to the books to marry design and academia [17]. Several campus buildings have become a masterpiece with a show of architecture dictating and defining the academic excellence of the universities. In a bid to achieve this harmony between design and academia, one of the critical structures in the university campus is the senate building, which is categorised as a public building. The senate building is an administrative building or an office building with the inherent function of administration in an academic environment [5]. Given the strategic nature of the senate building, diverse universities are seen to give it, especially the façade, an outstanding identity in relation to other buildings on campus. In describing an office building, [4] listed it as a member of the outstanding icons of the twentieth century. Office buildings are increasingly built to overshadow the skylines of cities in all continents as an index of socio-economic activity, financial and technological progress.

Conway [4] suggested that office buildings are expected to be a product of a comprehensive design approach centred on meeting a set of objectives. This includes being technologically-advanced and flexible working environments that are safe, comfortable, healthy, durable, aesthetically-pleasing, accessible, functionality, and cost-effectiveness. Other considerations are security and sustainability. Conway [4] also emphasised that the first impression program must be considered in office buildings as championed by the United States of American government for all public buildings. This is more than just an aesthetic agenda; first Impressions strengthens an asset, makes the office building more profitable, and improves users' satisfaction. According to [3], not all office buildings are equal, which is why a comprehensive classification system exists to categorise them by age, amenities, general infrastructure, and aesthetics. Class A is described as high-quality office buildings with high aesthetic appeal, outstanding height (many high-rises), high ceilings, and sizeable central lobby in interior space. Class B office buildings have heights less than four stories tall and are older buildings. A building initially rated as' A' can be downgraded to' B' after 10years or when signs of wear and tears become apparent. Class C office buildings are more than 20years old and command lesser market value.

2. Experimental Methods

The methodology involved the sample size of ten universities in southwest Nigeria from a sample frame of thirty-four universities [18] using the proportionate sampling technique. The sample size consists of 2 federal, three state, and five privately-owned universities. The building heights of ten senate buildings from the selected ten universities were considered for users' perception. The facades were presented to respondents in high quality, A5 (14.8x21cm) sized, still photographs. The fourteen architectural façade elements were gotten from the review of Broudy Aesthetic Model [19] and observation of the ten selected university senate building façade photographs by ten professional architects from Caleb University, Imota, Lagos State. Quantitative data were collected using a close-ended questionnaire and based on the 5 Likert-type scale rating of not attractive, less attractive, unattractive, attractive, or very attractive. Data analyses were done using a simple univariate method of analysis, which involves frequencies, percentages, and mean ranking. The stratified random sampling was adopted in distributing 788 questionnaires to staff and students of ten selected universities in southwest Nigeria. The sample size of 788 was arrived at by applying the Yemane formula. However, 577 retrieved questionnaire found valid were analysed using the SPSS version 20.

3. Results and discussion

A summary of the content analysis of the ten selected university senate building façade images and height is presented in Table 1.

Table 1: Summary of Selected Senate building Facade

University and Location	Year of Establishment	Senate Building Image	Year of Completion	Height
Augustine University Ilara-Epe, Epe, Lagos State	1948		2-Storey	2014
Ladoke Akintola University Ogbomosho, Oyo state	1990		4-Storey	2008
Fountain University Oke Osun, Osogbo, Osun State	2007		3-Storey	2011
Adeleke University Ede, Osun State	2011		4-Storey	Not Available
Elizade University Ilara-Mokin, Ondo State.	2012		4-Storey	Not Available
Tai Solarin University of Education Ijagun Road, Ijebu Ode, Ogun state	2005		4-Storey	2013
University of Ibadan Agbowo, Ibadan north, Ibadan, Oyo State	1948		4-Storey	1967 (Vertical increase, 2017)
Adekunle Ajasin University, Akungba Akoko, Ondo State	1999		6-Storey	2014
Covenant University Ota, Ogun state	2002		8-Storey	2013

University of Lagos, Akoka, Lagos state	1962		14- Storey	1985

3.1 Identification of Architectural Facade Elements by Respondents

In the identification of relevant architectural façade elements, fourteen elements, as presented in Table 2, were considered. This study used a five-point Likert scale to enable distinction between the numeric values generated, and these elements were rated in relation to their importance in assessing the visual quality of university senate building façade as: not at all, a little, undecided or not sure, to some extent and to a large extent. A questionnaire was administered in line with the listed attributes and refined to reduce the respondents' time. Each of the fourteen elements was scored in-situ using the sensory elements evaluation form. It is evident from Table 2 that the least scored architectural façade elements identified by respondents are railings (3.15), services (3.31), and terraces (3.33). Architectural façade elements considered most relevant by respondents are building shape (4.27), façade colour (4.18), and building height (4.16). The respondents also rated foreground (4.01) and fenestration (4.00) as important architectural façade elements. The mean scores and subsequent ranking implies that the respondents considered building shape, façade colour, and building height as the most important elements in assessing the university senate building façade in the study area.

Table 2: Descriptive Statistics of Architectural Element Identification

Factors	Mean	Std. Deviation	Rank
Building Shape	4.27	0.90	1
Façade Colour	4.18	0.99	2
Building Height	4.16	1.00	3
Foreground	4.01	1.08	4
Fenestrations	4.00	1.00	5
Texture	3.83	1.12	6
Entrance Design	3.79	1.14	7
Columns	3.65	1.05	8
Roof shape or Parapet wall at roof level	3.63	1.12	9
Screen Walls	3.50	1.11	10
Inscriptions	3.38	1.16	11
Terraces/Balconies	3.33	1.14	12
Services (Ducts, outdoor AC units, pipes)	3.31	1.27	13
Railings	3.15	1.18	14

Further to the identification of architectural elements presented in Table 3, the dimensional reduction of the 14 elements to the key elements was considered, and a principal component analysis was carried out. A correlation matrix was first carried out on the 14 façade elements,

and most of the correlations were observed to be above 0.3, which is a good indication that the expected result will be obtained. The Kaiser-Meyer-Olkin Measure (KMO) indicates a value of 0.864, which is acceptable as it is greater than 0.6. The Bartlett's test of sphericity with an associated p-value of 0.000 was also considered. Factor extraction was done using the Varimax Rotation method with Kaiser Normalization was used to identify the dimensions to best represent the set of variables used in identifying the architectural elements.
Using the Factor Analysis extraction method, three main dimensions were extracted, as shown in Table 3. Table 5 shows that the total variance accounted for by the four dimensions that have an eigenvalue of 1 and approximately 55%. The loadings considered significant were readings above 0.5.

Table 3: Total Variance of Components of Factors of Architectural Elements

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.971	35.507	35.507	3.313	23.666	23.666
2	1.621	11.579	47.086	2.906	20.758	44.424
3	1.116	7.969	55.055	1.488	10.630	55.055
4	.933	6.662	61.717			
5	.820	5.857	67.574			
6	.747	5.333	72.907			
7	.650	4.645	77.551			
8	.605	4.322	81.873			
9	.551	3.933	85.807			
10	.515	3.678	89.484			
11	.419	2.991	92.475			
12	.381	2.722	95.197			
13	.354	2.527	97.725			
14	.319	2.275	100.000			
Extraction Method: Principal Component Analysis.						

Table 4 presents three dimensions which summarise the identified elements (variables) by respondents. They were named: Primary aesthetic elements, secondary aesthetic elements, and comfort elements.

Table 4: Presentation of Result of Factor Analysis

Identification of Architectural Elements on Senate Building Façade	Factor Loadings	Eigen Value	% of Variance	Cum' %
Dimension 1: Primary Aesthetic Elements		3.313	23.666	23.666
Building Shape	.761			
Facade Colour	.725			
Building Height	.662			
Foreground (Landscape)	.610			
Fenestration (Doors And Windows)	.591			
Texture	.566			
Roof Shape	.540			
Entrance Canopy/Design	.530			
Dimension 2: Secondary Aesthetic Elements		2.906	20.758	44.424

Roof Shape	.508			
Terrace/Balconies	.808			
Railings	.794			
Screen Walls	.629			
Columns	.629			
Dimension 3: Comfort Elements		1.488	10.630	55.055
Fenestration (Doors And Windows)	.528			
Services (Ducts, Outdoor AC Units, Pipes)	.778			
Inscription	.541			

The primary aesthetic elements have eight out of the 14 variables loading on it. This dimension accounts for about 23.6% of Variance in the 14 variables included in the analysis; hence it is the dimension with the highest contribution to the aesthetic perception of the university administrative building in southwest Nigeria. Building height is the third factor loading on this dimension. The second dimension, secondary aesthetic elements, has five elements out of the 14 elements loading on it. They account for about 20.7% of Variance in the 14 variables, and it is the second most important dimension contributing to the aesthetic perception of the university administrative building in southwest Nigeria. The third dimension: comfort elements, which are three in number account for about 10.6% of Variance in the 14 variables.

3.2 Assessment of building Height

The assessment of the building height by respondents was based on the 5 Likert-type scale rating of not interesting, less interesting, un-decided, interesting, or very interesting. These ratings are presented in Table 5 shows the percentages of each rating and mean score for the assessment of building façade images 1 to 10. Also indicated for easy reconciliation is the number of floors for each of the selected university senate building images and final perception ranking.

Table 5: Assessment of the Building Height

Images	Not Interesting	Less Interesting	Un-Decided	Interesting	Very Interesting	Mean Score	Number of Floors	Rank
Image 9	0.5	2.6	3.3	28.6	65	4.55	Seven	1st
Image 10	1.9	2.4	4.3	31.7	59.6	4.45	Fourteen	2nd
Image 8	0.7	2.8	5.4	39.5	51.6	4.39	Six	3rd
Image 4	2.4	6.4	6.6	56	28.6	4.02	Four	4th
Image 6	1.6	7.8	8.8	56.2	25.6	3.97	Four	5th
Image 7	2.1	11.3	10.9	42.6	33.1	3.93	Four	6th
Image 2	3.5	14.6	15.6	56.5	9.9	3.55	Four	7th
Image 5	5.9	18.7	14	45.1	16.3	3.47	Four	8th
Image 3	4.9	17.9	17.5	53.7	6.1	3.38	Three	9th
Image 1	17	46.3	13.3	15.9	7.5	**2.51**	Two	10th

The study presented in Table 5 revealed that images 9, 10, and 8 have the highest mean scores of 4.55, 4.45, and 4.39, respectively, with the corresponding heights of seven floors, fourteen floors, and six floors. The lowest mean scores as regards height assessment, which were considered as not interesting, include images 1, 3, and 5 with mean scores of 2.51, 3.38, and 3.47, respectively. Image 1 has a height of two floors, image 3 has a height of three floors, and image 5 has a height of four floors. The result presented shows higher mean scores for assessment of taller buildings. Image 9, with the highest mean score, has the highest percentage of respondents assessing it as very interesting at 65%. Next are images 10 and 8, with approximately 60% and 52% respondent rating them as very interesting. However, image 1 with the lowest mean score and least ranked has the highest percentage of respondents at 17% and 46%, assessing it as not interesting and less interesting, respectively. This suggests that buildings, above four floors, were considered to be most interesting by respondents. The most interesting buildings can be termed as high buildings as stated by [8] as they are above the recommended five floors, and this affirms the assertion by [2] that the taller the building, the wider the influence. [10] suggests three distinct sections (that is base, shaft, and top) should be considered in designing a tall building. This is evident in the two top-rated administrative buildings having these three distinct parts, with the base and shaft being within 40o cone of vision. Aesthetic preference of tall buildings can be termed as an increase in demand. An increase in demand can bring about an increase in value as posited by [3] and subsequent classification as 'A-class' office building premised on outstanding aesthetic appeal and outstanding height. The study confirms [4] assertion of administrative building height preference defining the immediate campus visual sustainability just as seen in iconic high-rise buildings are defining the environment the world over.

4. Conclusions

This study has bared the concept of tall buildings and their importance in defining the outlook of the built environment as seen in the larger society and its consequent effect also within the university campus environment. The university senate building, which is the administrative core of the entire campus, can be distinguished by the uniqueness of its height difference. The study also revealed respondents' preference for building shape and colour alongside the height as significant factors. The visual preference of height, which is mainly within the context of its immediate environment, demands that the administrative building should best be above four floors in height and preferable, the tallest building within the campus to typify its dominance over other campus buildings. Height definition for different university campus buildings is very important, and a defined training on height as an aesthetic element will also help in the achievement of the desired sustainability goal. For the continual acceptance of the university administrative building in the face of the ever-evolving campus architecture by the future generation, flexible design concepts should be adopted in designing its verticality. A further study on building shape and façade colour in relation to aesthetic perception of this building typology will be an excellent addition to the body of knowledge in the built environment.

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