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Assessment of passive design features for human circulation safety in Commercial Centres of Federal Capital Territory, Abuja.

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Abstract

Human safety entails relative freedom from danger, threat of harm or injury caused deliberately or by accident. Consideration for safety encompasses every aspect of wellbeing from the beginning of an activity to its end. The aspect of human safety in buildings covers consideration for planning, design and construction from the preconstruction stages to the actual construction and throughout the life span of the building. This study examines passive design variables that are necessary to ensure effective human safety in commercial centres using Abuja as a case study. Research method used for this study is a descriptive survey method that elicits both qualitative and quantitative data. Eight shopping centre were randomly selected study area based on the nature of the design as majority of the shopping centre were of similar concept. The employed the use of observation checklist to evaluate the building in shopping centres. The study showed that all of the commercial centres used stairwell as a means of vertical circulation but did not go beyond textbook standard for safety regarding the height of the railings, and that 37% of the commercials went below the required standard of 900mm. This stems from the fact that considerations for passive safety were not properly implemented at the design stage of the commercial centres. In cases where these considerations were available, poor maintenance and upgrade practises had made the buildings unsafe. Enacting laws to ensure the compliance to necessary safety guidelines in buildings and periodical checks of the building by relevant bodies to ascertain the building safety level is recommended to enhance effective human safety in commercial centres.

Keywords: *building, commercial centres, human safety, maintenance, passive design.*

Introduction

Commercial centres are facilities where an array of commercial activities take place simultaneously and its origin can be traced back to the early 20th century America. Commercial centres attract a wide range of users having several needs and serve the purpose of bringing commercial activities close to the residential areas. It is a more organised modern market system having an array of functions such as office complexes, cinemas, departmental store and boutiques (Woodruff, 2009).

Human safety encompasses every aspect of life. The America business dictionary (2015) defined human safety as relative freedom from danger, risk or treat of harm, injury or loss to personnel and property whether caused deliberately or by accident. McManus (2011), assert that the first consideration in every human endeavour is safety of which design is a key component. In design and construction of buildings, safety is the primary frame work to be considered in ensuring workability of the building (Hayes, 2007). Human safety covers both the passive and active aspects of ensuring the well-being of building users from attacks or accident regardless of how small they might appear. Passive aspect of human safety in buildings includes considerations for planning, design and construction. It covers all aspects starting from the pre-construction stage through the actual construction and usage life span of the building (Hosken, 2008a). The aim of this study is to assess the nature of safety design variables in commercial complexes in order to determine if they adequate to serve the expected purpose.

The concept of safety is primary to the sustainability of all aspect of life (Wortman & Loftus, 1988). Sisiopaiku, & Akin, (2003) also reaffirmed the importance of adequate planning in terms of space usage, building form, building connectivity and placement of modalities to ensure a safe, sound and comfortable building environment. Commercial activities are enhanced when adequate and responsive modalities are in place to primarily safe guard the life of the users. Agbola (2009), identified the consequences of urbanization in F.C.T on commercial public facilities and concluded that there was need to ensure that varying safety considerations be put in place to cater for the basic safety needs of the people. According to Ago (2001), the rapid population increases in Abuja without the necessary infrastructure to carter for them has led to the increase in social vices

such as harm robbery and other anti-social activity that posed a threat to human safety in commercial areas. Studies carried out by Hoogendoorn (2004) have shown that the primary determinant for the level of human safety in a building is the type and intended use of the building. Hence for a commercial building where different category of people have access the need for safety becomes apparent. According to McManus (2011), falls are the most frequent type of accident on circulation path, it also reported that more than one hundred thousand injuries occur annually in commercial centres. Hence the need to place importance on the design of such space and also careful material specification.

The requirement for safety in buildings entails modalities that are put in place to ensure maximum comfort and wellbeing of building users (Ficks, 2000). The entire considerations for safety must be suitable for all users at all times even when they are not shopping, it also implied that the safety of all age categories of the users should also be factored into the building development. Safety at the entrance point of commercial centres is a very important part of its planning, design and construction (United State Centre for Excellence in Design, 2010). ADA Standards (2010), showed that it is suitable to place entrances of public buildings in such a way that it gives more benefits to pedestrian over vehicle in the formatting of its size and partitioning. In terms of safety on circulation path, Saffron, Tricia and Lucia (2011) illustrated the moving behaviours of pedestrian and how it is affected by gender through blood while Kockelman, (2001), examined congestions in traffic within spaces and the human safety issues. Mehta (2007), illustrated the influence of varying personalities and culture on their walking behaviour on circulation path. According to several researches (Jane & Loretta, 2013; Wekerle and Whiteman, 1995; Sepideh, Sepideh and Homa, 2011) to ensure safety on circulation path the following must be considered; User diversity, Street activities, Lighting of circulation path and Presence of security device and personnel. Internal walkways and corridor are very important factors when looking at safety of building users (Hoogendoorn, 2004a; Saffron, 2011). The configuration of the walkway in terms of its materials composition and sizes, should be such that there is reduction of obstruction (Tibbalds, 2001). Sepideh, *et al*, (2011), further stated that the size of the walkway should be directly proportional to the expected volume of users on the walkway

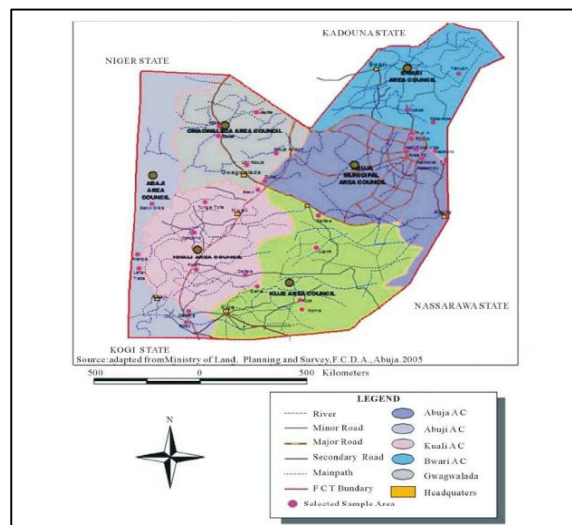


Figure 1: Abuja showing the Six Area Councils in the Capital Territory.
Source: Adapted from Ministry of Land, Planning and Survey, F.C.D.A, Abuja, (2005)

Study Area

Abuja which is the Federal Capital Territory of Nigeria is located in the North Central region of Nigeria between longitude $6^{\circ}.45''$ and $7^{\circ}.39''$ E and latitude $8^{\circ}.25''$ and $9^{\circ}.20''$ N with a land mass of approximately $7,315\text{km}^2$ and a total area of $29,484\text{sqm}$ within savannah region with moderate climatic conditions. The map of Abuja in figure 1 which shows that the capital territory is made up of six (6) local councils, comprising the city of Abuja and five (5) Area Councils as it is referred to. It shares borders with Niger State to the west, Nasarawa State to the east, Kogi State to the south and Kaduna state to the north. These States have had significant influence on the development of the FCT. The population of Abuja was put at 1,405,201 in 2006 based on data from National Population Commission (NPC, 2006). This figure has drastically gone up considering the level of

migration from the surrounding States given the volume of construction works and job opportunities associated with the FCT.

Materials and Methods

The study is a descriptive survey which sought to obtain qualitative data on the shopping centres and also the users. A mixed method approach was employed in this study which is considered appropriate for this type of study. The quantitative aspect of the data has to do with the number of quantifiable elements of the building. A purposive sampling method was employed in selecting eight shopping centres from the high commercial areas and the low commercial areas of FCT, Abuja. The selected shopping centres are presented in Table 1.0. The nature of the design of shopping centre also formed a basis for selecting a shopping centre. An observation checklist was used to measure the study elements in the buildings while an interview guide was used to obtain data from the users of the shopping centres. The variables studied in the shopping centres include, door configurations, walkways, handrails and circulation means. These variables are considered important to the study because they affect the users. The data obtained was analysed using the descriptive tool such as cross-tabulation and frequency from SPSS software. The data obtained were transferred to Microsoft Excel from where the tables were developed. Pictures were presented to show the visual aspect of some of the data and explain the existing conditions in some of the shopping centres. The results and discussions are presented under specific subheading with the appropriate tables and plates.

Table 1.0: Surveyed Commercial Centre’s Selected for Study

S/N	Name of Commercial Centre	Location	Type of Commercial Centre
1	Sky memorial commercial centre	Wuse zone 6	Shopping plaza
2	Shoprite commercial centre	Central District	Business Shopping mall
3	Ceddi commercial plaza	Central District	Business Shopping plaza
4	Metro commercial centre	Opposite war college Central Business District	Shopping plaza
5	Area 1 commercial centre,	Area1 Garki Abuja.	Commercial hub
6	Nyanya Commercial Centre,	Nyanya	Commercial hub
7	Next Commercial Centre	Jayi .	Shopping mall
8	Bannex commercial centre,	Wuse II	Neighbourhood Centre

Results and Discussion

The results obtained from the research are discussed based on the observations made and highlights the analysis of passive design variables adopted for effective human safety in commercial centres in FCT, Abuja.

Door Configuration

The analysis of a door gives a detail of its constituent materials, effective size in terms of height and width, the methodologies for its placement and its radius and direction of opening which play an impact in ensuring effectiveness of safety means of users in the building. Varying standards of doors exist which can be made from wood, glass, plastics and metal. The standard sizes of doors range from 750mm and above depending on the intended use. It is important that the door configuration and setting conforms to the needs of the intended users. For instance, it is not proper for a door to open up into walkways as seen in Figure 1 because it caused obstruction of movement and increases the rate of accident chances. The materials used for making the door must be smooth with finished edges to avoid injuries to users.

Table 2.0 shows the sizes and opening of doors in the 8 selected commercial Centres. In all commercial centres 750mm door and 900mm doors were common; 1500mm doors and 2000mm doors and above both have 37.5% present in the selected commercial centres; the openings of the door in commercial centres is very essential in ensuring adequate safety of users. Doors opening onto the walkways take up space required for movement and also cause distraction which could lead to accidents especially at peak periods. In this case,

the size of doors should be relative to the function it intends to provide. For instance, space where huge traffic is expected should have doors with wider sizes compared to spaces where traffic is considered minimal; these should also be reflected in spaces where the items being sold are of large individual sizes examples show rooms and spaces which involves lots of users also cinemas, multipurpose halls and auditoriums.

It was observed that none of the shopping centres had the 1200mm door option installed. It could be concluded from Table 2.0 that Shoprite and Ceddi commercial complexes offered the best form of safety in terms of configuration of doors as they had larger doors which allowed users easy access. The larger the door sizes the easier at which they could be designed to swing two ways without affecting the flow of traffic. In terms of locating the doors it was observed in Shoprite that there was a recess for the doors hence it did not obstruct users on the corridor. This method of locating the doors is considered the best option when designing for safety of the users in commercial buildings which is in agreement with Jane & Loretta (2013) and Tibbalds (2001).

Table 2.0: Configuration of entry doors

S/No	Commercial Centres	750m m	900m m	1200m m	1500m m	2000m m & above	Opening	
							Appropriate	Not appropriate
1	Sky memorial commercial centre	✓	✓	X	X	X		X
2	Shoprite commercial centre	✓	✓	X	✓	✓	✓	
3	Ceddi commercial plaza	✓	✓	X	✓	✓	✓	
4	Metro commercial centre	✓	✓	X	✓	X	✓	
5	Area 1 commercial centre	✓	✓	X	X	X		X
6	Nyanya Commercial Centre	✓	✓	X	X	X		X
7	Next Commercial Centre	✓	✓	X	X	✓	✓	
8	Bannex commercial centre	✓	✓	X	X	X		X
Total		100%	100%	0%	37.5%	37.5%	50%	50%

Key ✓ =Yes x =No

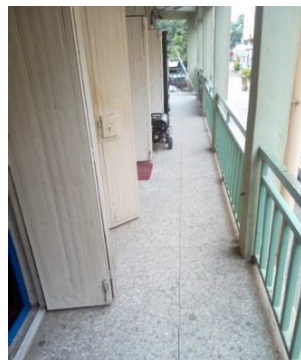


Fig 2: Secondary walkway, Sky memorial commercial centre, FCT, Abuja

Means of Circulation

The means of circulation is also very essential when considering human safety as many of the shopping centres had basically stairs and interior corridors as shown in Table 3.0. Other electromechanical means of interior circulation include: - escalator, lift and paternosters were not commonly used as many of the shopping centres were either two or three storey buildings. The location of the Stairwell, escalators and lift system should be of great importance to the architect and building users so as to ensure easy visibility for safety agrees with Sarka, (1993). In all the commercial buildings studied two types of interior circulation were observed namely:

- i. **Horizontal Circulation:** Horizontal circulation which is a movement within a platform on the same level which is carried out on corridors and walkways.
- ii. **Vertical Circulation:** Vertical circulation which comprises of movement from one level of height to the other, example the movement from ground floor to first floor is considered vertical circulation. This can be carried out using staircase, escalator and lifts. Figure 3 and Figure 4 shows different means of interior circulation with the use of corridors and staircase which is adequate and effective for safety.

The means of staircases, which has a 100% usage, as such concentration for safety must be place on staircase area. Three facility representing 37.5% of the eight facility visited had lift system while only one facility representing 12.5% had escalator. Figures 3 and 4 shows the horizontal and the vertical means of interior circulation. The nature of the design of the stairwell is quite important in terms of none use of spiral staircase and the thread of the steps being greater 300mm. The steps should be such that they are non-slippery material surface, however majority of the shopping centre studied used slippery tiles which they considered aesthetically pleasing even though it posed a risk to the users which negates Sepideh, Payami & Homa (2011). The use of terrazzo in Bannex and Sky memorial commercial centre even though not too aesthetically pleasing was considered safer for users because the risk of falling was greatly reduced.

Table 3.0: Means of internal circulation

S/No.	Names of Commercial Centres	Staircase	Lift	Escalator	Paternoster
1	Sky memorial commercial centre	✓	X	X	X
2	Shoprite commercial centre	✓	✓	✓	X
3	Ceddi commercial plaza	✓	✓	X	X
4	Metro commercial centre	✓	✓	X	X
5	Area 1 commercial centre	✓	X	X	X
6	Nyanya Commercial Centre	✓	X	X	X
7	Next Commercial Centre	✓	X	X	X
8	Bannex commercial centre	✓	X	X	X
	Total	100%	37.5%	12.5%	0%

Key ✓ =Yes x =No



Fig 3: Interior corridor, metro commercial Plaza, FCT, Abuja.



Fig 4: Stairwell, metro commercial plaza, FCT Abuja

Size and Configuration of Walkways

From Table 4.0 the configurations of walkways in the selected commercial centres it is observed that 37.5% of the commercial centres have visible primary walkways, 62.5% have secondary walkways and 87.5% have tertiary walkways. Walkways in the commercial centres have no top or side covers, materials used for the walkways ranges from mass concrete walkways (25%) and interlocking tile (75%). The platform for movement in building both internally and externally has a direct reflection on the level of safety of building users because different users have different needs and requirements. The sizes in this case implies that the platform for movement must comprises of enough space to ensure free to and fro movement for pedestrians both in same direction and opposite direction. The configuration of the walkways also consists of materials used for the construction of the walkway and are generally classified into primary walkway, secondary and tertiary walkway, this classification is based on sizes of the walkway. It encompasses the various treatment of side and top cover and the orientation and the connection of the walkways relative to one another. Primary walkways should connect to secondary walkways and secondary walkways to tertiary walkways and vice versa. Adequate direction and guardians must be given for the use of these facilities, this will help to ensure easy evacuation which was adequate in some of the selected commercial centre's visited and shown in figures 5 and 6.

A concise combination of the various categories of walkways improves the safety of the building and it could be observed that the Shoprite and Ceddi commercial centres adopted this design concept adequately. The choice of floor finish also ensured that cleaning was easy by means of regular mopping also ensured safety for the users as any form of water or stain was cleaned immediately. The size of the walkways was also quite adequate as this allowed users to be able to carry their items without bumping into other users which is supported by Morrall, Ratnayaka, and Seneviratne, (1991). The use of trolleys for shopping also was key to choice of floor finish, it is safe to conclude that for shopping centres to be safe there is need to consider the shopping aids which could inform their perception of safety. The larger the shopping centre the better to have a wider walk way for the users to navigate within and outside the commercial centre.



Fig 5: Interior walkway, Shoprite commercial Centre, FCT, Abuja.



Fig 6: Interior walkway, Ceddi commercial Plaza, FCT, Abuja

Table 4.0: Configuration of walkways

S/No	Names of Commercial Centres	Walkways Configuration			Height (2mm)	Top Cover	Side Cover	Floor Material	Roofing material
		Width Primary walkways / corridor (2.4mm)	Secondary walkways / corridor (1.5mm)	Tertiary walkways / corridor (2.4mm)					
1	Sky memorial commercial centre	X	X	✓	✓	x	x	Mass Concrete	X
2	Shoprite commercial centre	X	X	X	X	x	x	Interlocking Tiles	X
3	Ceddi commercial plaza	✓	✓	✓	X	x	x	Interlocking Tiles	X
4	Metro commercial centre	✓	✓	✓	✓	x	x	Interlocking Tiles	X
5	Area 1 commercial centre	✓	✓	✓	X	x	x	Interlocking Tiles	X
6	Nyanya Commercial Centre	X	✓	✓	X	x	x	Mass Concrete	X
7	Next Commercial Centre	X	✓	✓	X	x	x	Interlocking Tiles	X
8	Bannex commercial centre	X	X	✓	X	x	x	Mass Concrete	X
	Total	37.5%	62.5%	87.5%	25%	0%	0%		0%

Key ✓ =Yes x =No

Configuration of Handrails

An examination of Table 5.0 shows the configuration of handrails in commercial Centres visited. Handrails of 900mm finely finished were more prominent in use having 62.5% usage followed by 800mm finely finished handrails with 37.5% usage. The presence of handrails is essential in public buildings as it can be used to act as a barricade and a support mechanism for building users safety. Handrails can be made from materials such as metal, glass, wood and steel and it ranges in different sizes from 750mm and above depending on the intended use. These is essentially visible for buildings that are above one floor, the size and shape of the handrails could be used as indicators for varying uses. Handrails of 1000mm and above having rough exterior finishes may indicate that building users are not expected to touch or line on them.

The Height of the railings and the material used greatly affect safety of the users particularly children who often seek to play within shopping areas. The perception of safety during shopping by parents is greatly improved if they see that building does not encourage their children to try sliding on the railings. The use of resistant glass as balustrade is also of importance as this would ensure that should there be a mishap on the stairs or balcony the risk of glass breaking and affecting the user is minimised. Standards usually stipulates a minimum of 900mm for railing therefore the three shopping centres that used 750mm are considered too safe

for all users. The use of railings of higher height as higher floors would reduce the risk of falling over in any case of mishap. It is concluded on the issue of railing heights that the other shopping centres were working within the minimum acceptable standard which often does not account for the safety of all user which negates the assertion that shopping buildings should be safe according to Ficks (2000).

Table 5.0: configuration of handrails

S/No.	Names of Commercial Centres	Sizes of handrails			
		750mm	800mm	900mm	1000mm
1	Sky memorial commercial centre	X	✓	x	X
2	Shoprite commercial centre	X	X	✓	X
3	Ceddi commercial plaza	X	X	✓	X
4	Metro commercial centre	X	X	✓	X
5	Area 1 commercial centre	X	✓	x	X
6	Nyanya Commercial Centre	X	✓	x	X
7	Next Commercial Centre	X	X	✓	X
8	Bannex commercial centre	X	X	✓	X
Total		0%	37.5%	62.5%	0%

Key ✓ =Yes x =No

Configuration of windows

The various type of window that exist include: - casement window, sliding window, projected window and louvers. Figures 7 and 8 show how the configuration of window are being used as safety elements for both interior and exterior of commercial buildings as well as lightening and ventilation. From Table 6.0 it is observed that a single building can use combination of different types of window however casement window was used

Centre was estimated at 37.5%; projecting windows were also used in one at of the 8 commercial Centre visited. Casement window are very good in admitting ventilation and natural lighting into the building.

Window also known as fenestration act as a key element in buildings to facilitate ventilation and lightening. Windows are usually made with the combination of glass, wood, plastic, and metal, this is basically influenced by the intended use of the window. However, precaution should be put in place so that windows do not project into walkways so as to avoid distraction and possible accident from occurring. The louvers which is the oldest type of window were not used in any of the commercial centres visited; however, projecting window are advice for use for high level windows. Sliding windows are more preferable for use in commercial centres; these is because the window slide on a stationary point that has low tendency to obstruct movement on the walkways. Figures 7 and 8 showing the use of casement windows respectively.

The issue of safety as it affect windows is to ensure that people could not be viewed from the exterior of the building thereby ensuring their safety when the leave the building. However this is a major challenge as use of windows and clear glass has focussed on achieving aesthetic value. None of the commercial centres used windows as a secondary means of lighting a space which could have allowed for achievement of safety for user. The nature of the windows are such that they are not shock resistant hence many would shatter if impacted from outside, this probably explains why the shopping areas are away from them. The location of the parking lots close to the building could really affect the safety of the users of the building should there be mechanical failure.

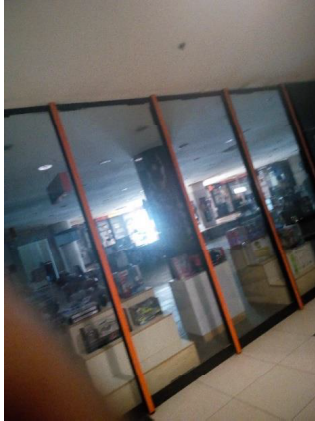


Fig.7: Window configuration at interior, ShopRite Commercial Centre, FCT, Abuja. Source: Field work,2016



Fig. 8: Window configuration at external, Ceddi Commercial plaza, FCT, Abuja.

Table 6.0: Configuration of windows

S/No.	Names of Commercial Centres	Window Configuration			
		Louvre	Casement	Sliding	Projection
1	Sky memorial commercial Centre	X	✓	✓	X
2	Shoprite commercial Centre	X	✓	X	X
3	Ceddi commercial plaza	X	✓	X	X
4	Metro commercial Centre	X	✓	X	✓
5	Area 1 commercial Centre,	X	✓	✓	X
6	Nyanya Commercial Centre,	X	✓	✓	X
7	Next Commercial Centre	X	✓	X	X
8	Bannex commercial Centre,	X	✓	x	X
Total		0%	100%	37.5%	12.5%

Key ✓ =Yes x =No

Conclusion

A proper application of passive design variables can influence the safety of users as it affects circulation in a building from the planning, design and implementation phase and throughout the life span of the building is important. The research examined five (5) passive design variables for effective human safety in commercial centres in FCT, Abuja. The study showed that all of the commercial centres used stairwell as a means of vertical circulation but did not go beyond textbook standard for safety regarding the height of the railings. The sizes and configuration of circulation along interior corridors were less suitable for dual movement in opposite direction and door openings were poorly placed causing obstruction to circulation path especially those that are government owned and thus commercial centres within this frame work is detrimental to the well-being of the users. This could cause real treat to building users in the course for evacuation of an emergency at peak period and thus will require the attention of building construction team for a proper periodical supervision and specifications to be adhered to throughout the planning, design and implementation stage in order to avoid variation during construction. The study concludes that Shoprite and Ceddi commercial centres were the

better suited in terms of passive safety for human circulation, while there was need for improvement with other commercial centres.

Recommendation

It is recommended that the minimum requirements for safety of users with regards to circulation in commercial centres should not be operated at the minimum standard level rather attempt should be made by the architects and regulators to ensure that all social behaviours capable of causing accidents within the building are factored in at the design stage and solved. The use of single swing doors at the entrance and exits of the shops should be discouraged regardless of the size of the door. The external corridors of the shopping centres should not be less than 1800mm this is to accommodate different category of users and also ensure that people could pass each other undisturbed. The use of glazing in the building should be such that it accommodate the need for safety aside from aesthetics needs.

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