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ASSESSMENT OF CROWD CONTROL DESIGN STRATEGIES FOR POST COVID CONFERENCE CENTRE IN MINNA, NIGERIA

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ABSTRACT

COVID-19 virus created a new challenge to all the major industries around the world, being an air burn disease coming together of a large group of people can increase the risk of spread of COVID-19. This has brought about the need for building experts to come up with a way to minimize the spread of the disease in large spaces such as a conference centre. This paper seeks to minimize the spread of COVID-19 virus using building itself. The goal of this paper hence, is to identify the processes in the use of a conference centre, areas where the spread is eminent and then provide the necessary building design strategies to minimise the spread of the disease. In order to archive this, major areas such as the meeting areas, as well as crowded areas, walk ways and rest rooms would be looked into. A quantitative research method was used where questionnaires was disturbed and a sample size was taken from Minna, Nigeria. The data collected was analysed using descriptive statistical tool. It was discovered that public building that are existing have not been able to find a solution to the spread of the disease, although temporary solutions were provided which is not as effective to reduce the spread. The use of face masks and placement of basins to wash at strategic points was adopted. The implementation of layered approach for indoor spaces, proper ventilation of large spaces as well as air condition spaces is recommendeds. In conclusion, the size of a building does not matter when it comes the reduction of COVID-19, what matters is the how ventilated the space is.

Keywords: COVID-19, Architecture, Conference centre

INTRODUCTION

Crowds consists of companions clusters (Kenny, *et all*, 2001), hence, they do not all assume the same sense of anonymity, even if they do act the same it does not last for long. The reason for crowd control is firstly to ensure the safety of the crowd at an event, hence with crowd control everyone in the event have the right to enjoy themselves. In crowds individuals act and behave in a manner that they will not when on their on own on the streets, which could lead to mayham. Poor crowd manageement

can cause damages to properties and as far as loss of life. With crowd control there is better organisation. With a lot of people moving on pedestrians as well as in vehicles crowd control becomes mandatory.

Architecture has advanced towards building spaces that withstand pressure as well. Importantly in the design of large spaces tht can contain crowd in providing unique approaches in long-term and short-term solutions and actions for a better developed evnironment, as well as updated existing buildings. This kind of building design needs to be supported with other elements such as, well planned layout based on the function of the building sapce design, circulation, and behaviour of the users to be able to assist users in the situation where there are extreme events.

COVID-19 has during the course of a year killed over three thousand people in Nigeria alone (NCDC, 2022).it is difficult to conclude that the building industry is not affected by this development, in fact it plays a major role in the reduction and spread of this disease. This paper seeks to minimize the spread of COVID-19 virus using building itself. The goal of this paper hence, is to identify the processes in the use of a conference centre, areas where the spread is eminent and then provide the necessary building design strategies to minimise the spread of the disease.

EVOLUTION OF THE ECCLESIASTIC ARCHITECTURE

Just as every great organization or movement, the church started from somewhere. History shows that believers as popularly known create spaces of worship in a way that help propel the worship experience expressing their double characters, that is preaching the gospel as well as catering for the needs of the converts. Here is a brief background of the Christin church, a place where worship is endowed with symbolism. These needs have raised questions each worshipper should ask such as, how does a building affect the worship? How does the designer understand these processes? These questions have created a historical trial in ecclesiastical architecture.

THE HOUSE CHURCH

For every movement that starts there is always level resistance posed at it in order to see its end, for the case of Christianity it from the Roman empire. Christianity is seen as a fellowship of people to worship, pray, sing and share their need especially for the early church which started after Jesus had ascended to heaven (Fellowship, 2020)

BASILICA CHURCH

Originally the term referred to a style of building. Early Christians, when they could worship in the open, did not wish to have churches that resembled pagan temples. Instead they adapted the large Roman building which was a Hall of Justice. This building was called by the Greek word "basilica," which means "the house of a king." The ancient Roman floor plan of the basilica usually had three or five naves that were separated by columns. At the far end there was a raised platform for the judge's bench. Many columns and arches were standard features of the classical basilica.

The church is a historical center of the growth of the Catholic faith.

1. The church is outstanding for its architectural design and embellishments which render it a fine specimen of art.
2. The church is a center of pilgrimage of special ministry, as to a definite ethnic group.

THE MONASTERY CHURCH

In 313 CE, Constantine the Great (272 – 337 CE) ended the sporadic-yet-terrifying Christian persecutions under the Roman Empire with his "Edict of Milan," and brought the Christian church under imperial protection. Not surprisingly, public social activities and normative culture changed, quite dramatically and favorably, for the early Christians. Previously, early Christians faced dangers from outside of the faith and often had to "worship underground," in order to avoid both physical dangers and social oppression from various Pagan and Jewish factions in the first three centuries of the faith. However, after Constantine's imperial endorsement and favouritism for Christian leaders and the laity, a new cultural permissiveness and secularism arose within the faith; and pious believers began to worry more about inner church immorality, abuse, and vice.

GOTHIC AND ROMANESQUE CHURCH ARCHITECTURE

The name gives it away–Romanesque architecture is based on Roman architectural elements. It is the rounded Roman arch that is the literal basis for structures built in this style.

All through the regions that were part of the ancient Roman Empire are ruins of Roman aqueducts and buildings, most of them exhibiting arches as part of the architecture. (You may make the etymological leap that the two words are related, but the Oxford English Dictionary shows arch as coming from Latin arcus, which defines the shape, while arch-as in architect, archbishop and archenemy-comes from Greek arkhos, meaning chief. Tekton means builder.)

Gothic Architecture

Forget the association of the word "Gothic" to haunted houses, dark music, or ghostly pale people wearing black nail polish. The original Gothic style was actually developed to bring sunshine into people's lives and especially into their churches. To get past the accrued definitions of the centuries, it's best to go back to the very start of the word Gothic, and to the style that bears the name.

RENAISSANCE CHURCH

Renaissance architecture, style of architecture, reflecting the rebirth of Classical culture, that originated in Florence in the early 15th century and spread throughout Europe, replacing the medieval Gothic style. There was a revival of ancient Roman forms, including the column and round arch, the tunnel vault, and the dome. The basic design element was the order. Knowledge of Classical architecture came from the ruins of ancient buildings and the writings of Vitruvius.

MODERN OR CONTEMPORARY CHURCH ARCHITECTURE

The modern and contemporary church buildings are upshots of the modernist and postmodern architecture. The modern church style employs an architectural form hinged on a basic shape, with facades consisting of reinforced concrete material ornamented for aesthetic purpose. The entire outlook of the church carries the basic features of a quintessential church structure existing at that time. the post-modernist idea on the design of a church structure on the other hand employs the use of visually light materials such as the glass facades, contemporary façade finishes such as titanium etc.

CROWD CONTROL

HISTORICAL BACKGROUND AND HAPPENINGS ON CROED CONTROL

Crowd disasters have been quite a common occurrence in different parts of the world. below are a few accounts of crowd disasters that have occurred in a descending order of occurrence. In the year 2017, eight people were killed and 60 seriously injured in a stadium crush in DembaDiop stadium in Senegal. (Al Jazeera, 2017). In 2016, at least 52 people were killed during a thanksgiving festival in Ethiopia from human stampede (BBC news, 2016). In the year 2015, no fewer than 19 people died after a stampede that occurred in a football match in Cairo Egypt. (Maher H, 2015) In the year 2014, Tragedy occurred when about 16 to 24 recruits were killed and more than 119 were injured at several stadiums and other centres across the country of Nigeria.

CROWD CONTROL AND ITS CONCEPTS

The term "crowd control" literally means measures put in place to keep crowd orderly. This definition however does not specify the approach or method adopted in the quest to keep crowd orderly, whether actively or passively. Passive crowd control design is the integration of architectural elements features and principle to control crowd in both normal and extreme (emergency) conditions (Winter, 2012). This definition highlights two distinct situations that warrants passive crowd control design measures: normal and emergency conditions. Crowd control during normal conditions are meant to incorporate features required for crowd comfort, restriction of crowd from unwanted positions, ease in circulation, while emergency conditions focuses on features responsible for crowd evacuation within the shortest possible time. According to Maslow"s hierarchy of needs, safety and security constitute the second

CROWD DYNAMICS

Crowd dynamics is the study of the movement of people: how, when and where crowds are formed and how they move. The behavior of people may be affected by the conditions of their immediate environment as a result of interactions with the space and the behavior of the other people. There may be spreading over the space in large environments and compression of groups of people in small spaces. The density of the surrounding crowd affects the speed of each person and individual behaviors due to personal characteristics and their response to environment can be included to modify the locomotion (Loet al., 2002). Moreover, the behavior of crowds show different characteristics compared to individual behaviors and the behavior of people during disasters differs from that of normal conditions. People do not like interruptions and interference with their activities and lives, so they would follow routines and see warning s as an "exercise" ignoring the signs in order to continue with their normal behavior when they face d with a disaster (Boer and Skjong, 2001)

CROWD DENSITY

Crowd density is the level of concentration of people in a given space it can be mathematically said to mean the number of people per unit area of a space. Crowd density is a vital factor in circulation crowd as well as emergency evacuation of crowd during extreme conditions. Standards have been put in place as to the maximum number of people required in a space. According to events management book, the standard crowd density for a seating crowd is 1person per square meter (1 per/sqm).

CROWD MANAGEMENT

Crowd management is the process of controlling the behaviors of large groups of people for their safety and security. It involves planning, organization, guidance and evaluation activities (Sagun et al.,2008). Crowd safety and security in public areas are primarily the organizer's or operator's responsibility. A health and safety management system is required to monitor and control potential crowding risks in public areas. The four interacting elements that need to be put into consideration to minimize injuries and death during crowd situations are defined as: time, space, information and energy by Fruin(1984).

BASIC CROWD CONTROL DESIGN MEASURES IN LARGE CAPACITY BUILDINGS

As afore said, safety of crowd in large capacity buildings is of high importance. The requirements for crowd safety in large capacity buildings conflict with those required for security, as the initial seeks to increase modalities for ease in movement while the latter seeks to restrain and monitor movement (Billingtonet al., 2002). Thus proper synergy between security and safety has to be achieved to ensure a logical balance. According to Daolianget al.,2006 and Helbing et al., 2002 the three most important factors that can cause reduction of evacuation time in large capacity buildings are the placement and width of exits and the placement of environmental objects.

Sagunet al. (2008) enumerated the design variables to consider when addressing the issue of passive crowd control.

1. Size and capacity of the building.
2. Characteristics of entrance to the building
3. Building layout.
4. Number of routes and doors.
5. Dimension of the routes and doors

RESEARCH METHODOLOGY

Descriptive survey method was used on the selected church buildings in Abuja. Owing to the fact that the variables for evaluating passive control design measures are physically measurable variables, observation schedule was used which also involved the physical measurement of linear variables (length, breadth, depth). A total of 10 samples were selected from a study population of 447 churches using stratified purposeful sampling method which according to Palinkas (2013) will provide variation in the sample selected bringing to bear some specific features the researcher wishes to observe in the selected population sample. In this vein the criterion for selection of samples is the seating capacity of the churches, choosing a minimum

requirement of 1000 seating capacity for the selection of samples. This was to afford the researcher a wide range of passive crowd control design features required to be evaluated. It is also noteworthy that no 2 churches were selected from the same denomination as this stratified sampling technique afforded the researcher a variety of design typologies as are obtained from the different samples selected.

Name of churches

1 National Ecumenical Centre,Central Area, Abuja
2 Champion"s Royal Assembly, Chikakore, Abuja
3 Holy Trinity Catholic Church Maitama Abuja
4 Living faith church Dutse, Abuja 5 Redeemed Christian Church of God Kubwa, Abuja
6 ECWA Blantire, Wuse, Abuja
7 St Bartholomew Anglican cathederal, kubwa, Abuja
8 Common Wealth of Zion Assembly, Guzapei Hills Abuja
9 First Baptist Church Garki Abuja
10 Dunamis International Gospel Centre, Area 1, Abuja

RESULT AND DISCUSSION

Capacity of Church Building

Capacity of the space has a strong influence on the crowding (Fruin, 1984) and bottlenecks because as (Casburn,L *et al*, 2005) stated that people spread out when there is enough space to avoid collisions and they bunch up without intersecting at bottlenecks. The capacity of an enclosed space is the first factor to consider when designing for crowd control.

Table1. *Capacity of Church Building*

s/n	Name of church	1000-2500	2501-5000	5001-10000	10001-20000	Above 20,000
1	National Ecumenical Centre Abuja		•			
2	Champion's Royal Assembly, Chikakore, Abuja					•
3	Holy Trinity Catholic Church Maitama Abuja		•			
4	Living faith church dutse, abuja		•			

5	Redeemed Christian Church of God Kubwa Province	•				
6	ECWA Blantire, Wuse	•				
7	St Bartholomew Anglican cathederal, kubwa		•			
8	COZA Guzapei Hills Abuja		•			
9	First Baptist Church Garki Abuja	•				
10	Dunamis International Gospel Centre, Area 1, Abuja		•			
	Percentage (%)	30%	60%			10%

Number of Seats Per Seat Clusters

Large capacity auditoriums arrange their settings in smaller clusters with aisles between them for circulation. The smaller the capacity of such seating clusters, the more circulation spaces are created and the less congestion is likely to be experienced

Table2. *Number of Seats Per Seat Clusters*

s/n	Name of church	Below-25	25-50	51-75	76-100	Above 100
1	National Ecumenical Centre Abuja	•				
2	Champion's Royal Assembly, Chikakore, Abuja		•			
3	Holy Trinity Catholic Church Maitama Abuja			•		
4	Living faith church dutse, abuja			•		
5	Redeemed Christian Church of God Kubwa Province				•	
6	ECWA Blantire, Wuse			•		
7	St Bartholomew Anglican cathederal, kubwa		•			
8	COZA Guzapei Hills Abuja				•	
9	First Baptist Church Garki Abuja				•	
10	Dunamis International Gospel Centre, Area 1, Abuja					•
	Percentage (%)	10%	20%	30%	30%	10%

Average Crowd Density Per Seating Cluster

Crowd density shows the extent of concentration of a population per space. This is a derivative of dividing the number of seats in a cluster by the floor area of that cluster. According to Emergency Planning College Handbook, standard Crowd density for people seating is 1 person per square. meters. 47 people per 10 square meters for people standing and 10-15 persons per 10 square meters for easy circulation of people. This is also regarded as critical mass. A value which if exceeded, poses a potential threat to the safety of the occupants of that given space.

Table3. *Number of Seats Per Seat Clusters*

s/n	Name of church	1 head & below per m^2	3 heads per $2m^2$	2 heads per m^2	3 heads per m^2
1	National Ecumenical Centre Abuja			•	
2	Champion's Royal Assembly, Chikakore, Abuja			•	
3	Holy Trinity Catholic Church Maitama Abuja				•
4	Living faith church Dutse, Abuja			•	
5	Redeemed Christian Church of God Kubwa Province		•		
6	ECWA Blantire, Wuse			•	
7	St Bartholomew Anglican cathederal, Kubwa				•
8	COZA Guzapei Hills Abuja			•	
9	First Baptist Church Garki Abuja				•
10	Dunamis International Gospel Centre, Area 1, Abuja			•	
	Percentage (%)		10%	60%	30%

Emergency Evacuation Rate of Auditorium Per Time.

This analysis is an extrapolation of the obtained data (entrance/exit and capacity of the auditorium.) to derive the emergency evacuation rate of the building per unit time.

Table4. *Emergency Evacuation Rate of auditorium Per Time.*

s/n	Name of church	Capacity of church auditorium	Available exit width	Number of doors provided	Total entrance/ exit width(m)	Carrying capacity of entrance/exit (no of persons per unit time)	Ratio of capacity of church to capacity of entrance per unit time
1	National Ecumenical Centre Abuja	8000	1800(8),1500(12)	20	32.4	40, (16,24)	1:200
2	Champion's Royal Assembly, Chikakore, Abuja	80000	1500(12),1100(6)	18	24.6	30, (24,6)	1:2667
3	Holy Trinity Catholic Church Maitama Abuja	3000	1500	12	18.0	24	1:125
4	Living faith church Dutse, Abuja	2000	1800	6	10.8	12	1:167
5	Redeemed Christian Church of God Kubwa Province	1200	1800	4	7.2	8	1:150
6	ECWA Blantire, Wuse	2000	1800	6	10.8	12	1:167
7	St Bartholomew Anglican cathederal, Kubwa	1500	1800	5	9.0	10	1:150
8	COZA ,Guzapei Hills Abuja	2000	1500	4	6.0	6	1:333
9	First Baptist Church Garki Abuja	1500	1500	3	4.5	6	1:250
10	Dunamis International	1800	1200(7), 900(2)	9	10.8	9	1:200

Gospel Centre,
Area I, Abuja

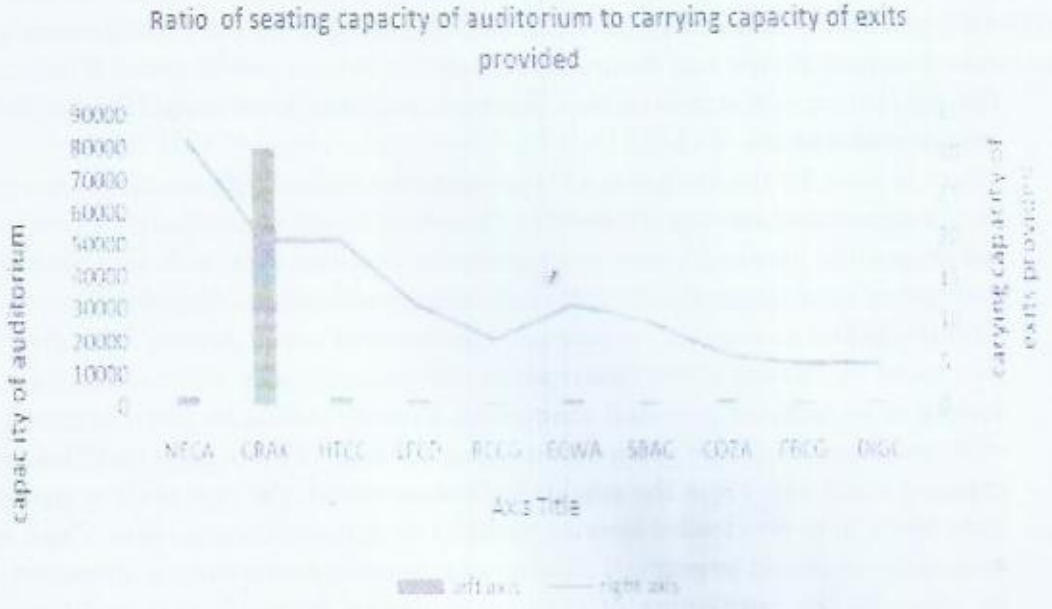

Figure1. Chart showing the ratio of seating capacity of church auditorium to the carrying capacity of exits provided

Results of this analysis shows the ratio of capacity of the church auditorium to the carrying capacity of the accesses (entrance and exit doors) provided.ie for the national Christian centre, for the first person exiting the building during emergency evacuation, there is a potential queue of 200 people waiting to use the same exit if assumptions for even distribution of persons per exits are made. This gives a projection of what is likely to occur during emergency evacuation the church auditoria evaluated in their full capacity.

Fig 1 comparatively illustrates the ratio of the church capacity to the total carrying capacity of the exits provided per time. Presence of Obstructions at movement path The presence of elements that constitute obstructions at movement path is an inhibitor to the optimum circulation and emergency evacuation of crowd. Winter (2012) opined that placing a column at the exit point of building is a counter intuitive measure that could increase the perceived danger of an individual, which could lead to more danger than if there was no column at all.

CONCLUSION AND RECOMMENDATION

In adequately solving the problem of crowd control in large capacity public buildings, integrated approach needs to adopted. The evaluation conducted in this research was mainly on the existing features and parameters used in the design of the church auditoriums so assessed. The variables appraised were such influencing passive crowd control design and design for emergency evacuation of crowd. Findings from the evaluation conducted in this research provides a rationale for the following recommendations:

There is need for the designers of large capacity spaces to do an adequate appraisal on the capacity of seating clusters the church auditorium as this is a key factor that influences the level of crowd congestion in the aisles as well as the success of emergency evacuation of crowd during extreme situations. Also, for effective crowd circulation and emergency evacuation, the required crowd density for a given space has to be calculated while determining the capacity of a church auditorium and known so as to avoid potential congestion. Priority should be given to crowd safety over space maximization when determining the type of seats to be specified for large capacity buildings. From the researcher's observation, the pew seating type are the ones likely to be overloaded because there is no demarcation on them. Thus, seating arrangement should be properly monitored to prevent overcrowding. Attention should be given to the positioning of permanent design elements that could constitute movement obstruction of people especially during emergency evacuation of crowd. Findings from this research revealed that the major source of movement obstruction is from the positioning of the structural columns supporting the suspended gallery floors with respect to the circulation aisles. Thus, there have to be a synergy between structural design and interior design/furniture specification and arrangement.

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