Application of Crowd Control Strategies in Proposed Ultra-Modern Train Station, Osogbo, Osun State, Nigeria

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ABSTRACT

Train stations are busy public spaces that often experience high levels of foot traffic, making them prone to crowding and congestion. This can lead to safety issues and can also disrupt the smooth functioning of the transportation system. Different crowd control design strategies can be used in train stations to address these problems. These tactics seek to control the flow of traffic through the station and guarantee that all users may use it safely and effectively. The aim of this study is to design a train station by incorporating crowd control design strategies. The evaluation of literature, the study of existing train stations, and a thorough examination and analysis of findings were the methods used in the collection, collation, and organization of information for this research thesis. This helped to identify issues that were specific to train station typology. Train stations were exclusively built to provide a halt for pick-up and drop-off situations for passengers, with little to no attention paid to the supply of crowd control techniques. The study has revealed that the provision of spatial crowd control features is given little consideration in most of the train terminals assessed. The use of physical barriers, such as barricades or ropes, to manage the flow of people and avoid congestion in specific areas is suggested as a typical crowd control approach in railway stations. In areas where trains are coming or departing or where lines are likely to form, this can be very helpful. Other tactics include using navigation systems and signage to direct people through the station and mark important locations like the ticketing and boarding gates. The management of lineups is another important component of crowd control in train stations. To avoid having customers wait in line, this can entail using queue management technologies like ticket vending machines or self-service kiosks. By regulating the flow of people and managing queues, train stations can be more enjoyable and convenient places for all users.

Keywords: Crowd control, Circulation, Overcrowding, Passengers, Train station, Way finding

INTRODUCTION

Background of the Study

Millions of people use train stations, which are intricate transportation hubs, as their entryway each day. One of the most important aspects of train station design and operation is making sure that passengers can move about these areas effectively and safely. (Roman, et al., 2022). Effective circulation strategies aim to optimize the flow of people through the station, minimizing bottlenecks and congestion while maximizing accessibility and safety. These strategies might involve using navigation, signage, designing circulation patterned areas, wayfinding tools, and putting crowd control procedures into action. (Zhe , Limin, & Young, 2017).

The study examined the numerous elements that affect how users of the train station move about when using the facility and the methods that can be applied to enhance this circulation. Focus is on the station's architecture design and layouts, how technology and digital signage is used, how crowd control and security ensure that passengers can travel around the facility safely and efficiently, and how these factors all work together. (Flurin, 2016).

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Statement of Design Problem

There has been a need to proffer solution to the undeniable problem of overcrowding peculiar to this building type. Train stations are facilities that usually have a lot of people coming into and exiting. The challenge lies in addressing the complex dynamics of crowd behavior, optimizing station layout and infrastructure, and integrating technological solutions to mitigate congestion and potential hazards,

In recent times the need for crowd control design strategies in train station centers around developing effective and efficient measures to manage commuters flow and movement, ensure safety, and overall user experience within the station premises during peak travel times and special events.

Aim and Objectives of the Study

Aim of the Study

The aim of this study is to design a train station for the commuters of Osogbo with an emphasis on crowd control design strategies.

Objectives of the Study

To determine the Architectural design characteristics of a train station that enhances Crowd control through efficient circulation.

Justification for the Study

Train stations in Nigeria are facing many challenges and most of the efforts of the federal government and state government on Nigerian railways are targeted towards running more trains to cater to increasing demands, but improving the station's environment to cater that much demand is met. Four train stations have been highlighted for an upgrade in the southwest zone, and on the list is the train station in Osogbo, Osun state. The Station facilities are obsolete and need to be upgraded as well as land side connectivity is absent in most of the railway stations. The federal government in partnership with the state government has highlighted that passenger services provided by Nigerian railways are low to medium level of service, security, and comfort with poor facilities as well as poor upkeep of stations and recommends redeveloping stations for smooth flow and comfortable experience of commuters as also to ensure clean and conducive environment.

Geographical Scope of the Study

The geographical scope covered by this research includes the capital of Osun state, Osogbo. The map below shows the amenities of Osogbo and other major landmarks close to the selected site.

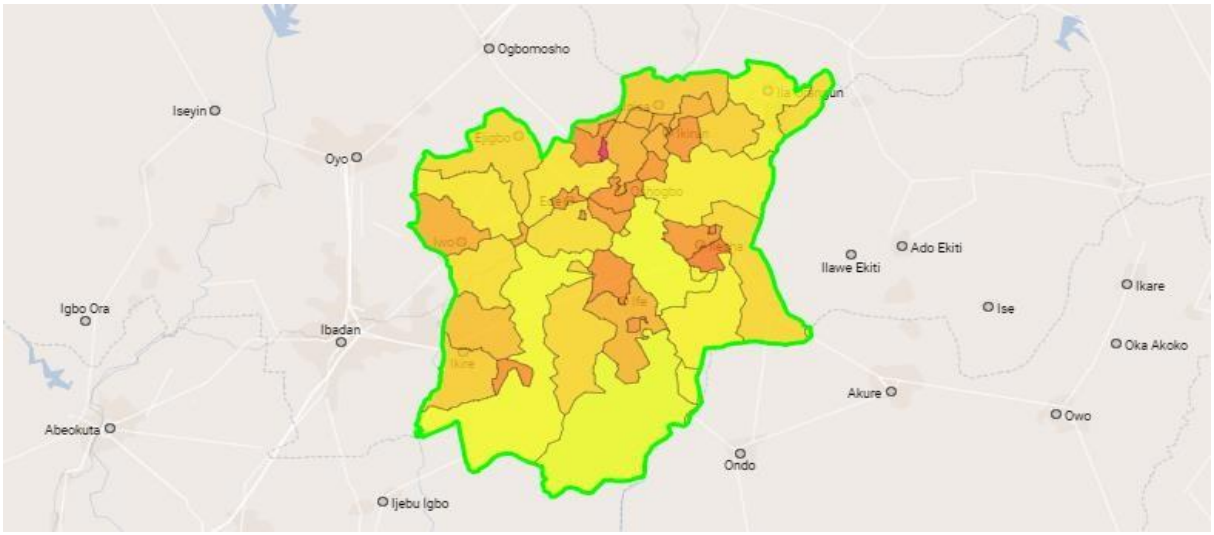

Figure 1.1: Map of Osogbo, Osun State (Source; Google Map)

The project is limited to redesigning the train station in Osogbo, Osun State with modern day facilities for smooth flow and comfortable experience for commuters and also to ensure a clean and conducive environment for end users.

LITERATURE REVIEW

History of Transportation

Technological advancements have largely defined transportation history. People have been able to explore, travel more territories, and spread their influence over larger and more expansive areas. As discoveries and technologies were applied to the challenges of transportation, travel time dramatically decreased, while the ability to transport heavier and larger goods increased. In the pre-Modern era, international trade was the driving force behind global transportation advancements (Aqib, Johannes, Giang, Florence, & Roberto, 2018). "From 1500 onwards, there was a single global world economy with global labor division and international trade." Textiles, jewelry, spices, slaves, and luxury commodities would spread across Afro-Eurasia and, later, the New World via overland and maritime trade routes. The wheel's origin is unknown, but once invented, knowledge of the wheel spread quickly throughout the Mediterranean and Asian worlds. Wheeled vehicles made it much easier to transport goods. The first known examples of wheels are from Mesopotamia and date from 3500 to 3000 BC (Alexander, 2003). The first wheeled vehicle was a cart or wagon pulled by humans or animals. Animal-drawn carts are still used in many countries today, primarily to transport freight but also to transport people. A quicker form of the cart, the horse-drawn chariot, became a crucial tool of combat since it could easily overwhelm opposing soldiers. (Henry, 2018).

History of Train Stations

Train stations have played a significant role in the development of transportation and have shaped the way societies have evolved and interacted with each other. The history of train stations is a complex and multifaceted one, reflecting the changing needs and demands of society and the impact of technological and social developments. The earliest known train stations were built in the 18th and 19th centuries, as the use of railroads and steam locomotives for transportation grew (Barker, 2003). Train stations served as hubs for the rail network and as a place for passengers to board and disembark trains (Barker, 2003).

Figure 2.1: The Liverpool Street Station Building Manchester by John R. Harris

The history of train stations in Nigeria

This can be traced back to the colonial era when the British government established a railway network in the country to facilitate the transportation of goods and people. The first railway line in Nigeria was built in 1896, connecting Lagos to the port of Abeokuta Okonkwo, C. (2012). This line was later extended to Ibadan in 1901

and to the northern part of the country in 1912. During the colonial period, train stations were mainly built to serve the needs of the British government and the colonial economy. Many of these stations were located in major cities and towns and were often designed to reflect the architectural style of the British colonial era. As seen in Figure 2.2: After Nigeria gained independence in 1960, the railway system in the country fell into decline. Many of the train stations were left in disrepair, and the trains themselves were not well-maintained. This led to a decline in the number of passengers using the trains, as well as a reduction in the amount of freight being transported by rail (Chukwrah, Okeke, Isimah, & Igwe, 2022). In the 1980s and 1990s, the Nigerian government began to invest in the modernization of the railway system. This included the construction of new train stations, as well as the renovation of existing ones. However, despite these efforts, the railway system in Nigeria remained in a state of disrepair, with many of the train stations still not well-maintained. Adegoke, O. (2018).

Figure 2.2 Showing steam locomotive train at Offa Station moving from Ibadan to Jebba. (Source: Historical railway images, 2018).

Effective Wayfinding in the Train Station

Effective wayfinding is also crucial in the design of hub train stations. This includes clear signage and information systems, as well as an intuitive layout that makes it easy for passengers to navigate the station (Anthony & Frank, 2020). A study by the Norwegian University of Science and Technology (NTNU) found that good wayfinding can improve the overall passenger experience and reduce travel time (Anna, Tristan, Sandrra, Prasad, & Kerrie, 2014).

Capacity of the Train Station

Capacity is another important architectural consideration for hub train stations. This includes designing the station to accommodate the high passenger volume, as well as providing enough space for services and amenities. A study by Politecnico di Milano found that, to manage the high passenger volume, hub train stations need to be designed with sufficient capacity for circulation, access, and egress, as well as for services and amenities (Borri, 2013).

Sustainability in the Train Station

Sustainability is also a key architectural consideration for hub train stations. This includes designing the station to be energy-efficient and using materials and technologies that are environmentally friendly. A study by the

Technical University of Denmark (DTU) found that, by incorporating sustainable design principles, hub train stations can reduce their environmental impact and improve overall energy efficiency (Christensen, 2016). In conclusion, the literature on architectural considerations of hub train stations has highlighted the importance of accessibility, wayfinding, capacity, and sustainability.

Types and Classification of Crowds

There are two kinds of crowds: the passive crowd (also known as the audience) and the active crowd (also known as the mob) A passive crowd, often known as an audience, is a type of crowd that has been institutionalized. Face-to-face and shoulder-to-shoulder contact is also possible. However, there is no close contact or movement as in a throng. The goal here is for people to desire to listen to a specific lecture. The kind of touch between an audience and a crowd may be the same, but in the case of an action crowd, the contact is more intense. A dynamic audience, on the other hand, lacks this. A musical function gathering is a passive mob. This passive crowd, however, has the potential to transform into an active crowd or mob at any time. When the hall is quite small and a large number of people arrive to see the musical, there is enough disruption due to a lack of space that it evolves into a mob in which People begin throwing chairs and tables at other audiences, causing complete chaos and a wide range of emotional reactions. A mob or an active crowd, on the other hand, might transform into an audience or a passive crowd when someone, possibly the leader, comes up to soothe the members or explains the reason and goal for which the crowd has gathered. As a result, there is constantly a transition from audience behavior to mob behavior and back again.

Classification of Crowd

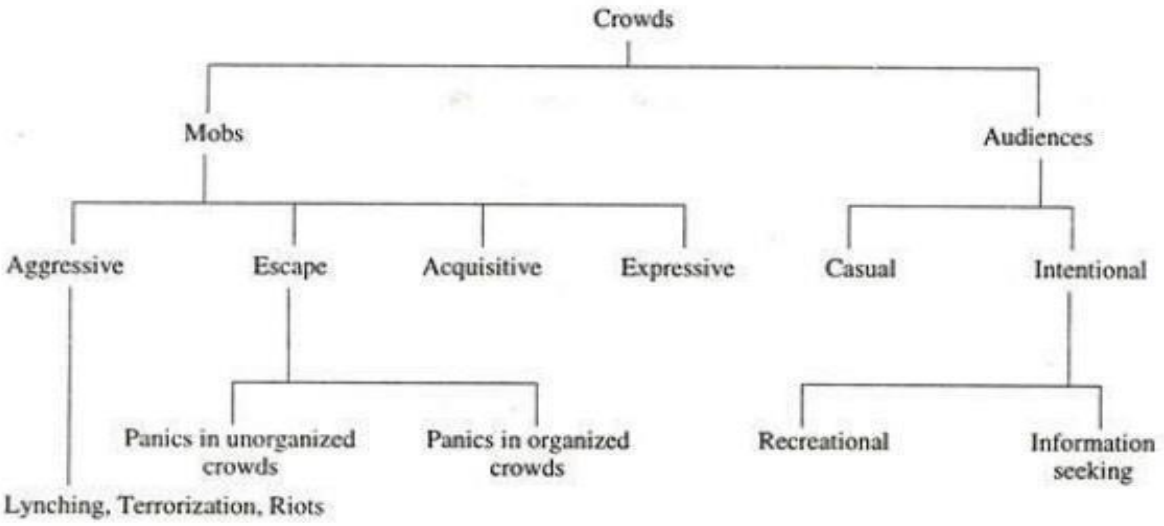

Figure 2.3: Chart on the Classification of Crowd (source; google)

Overcrowding

A crowd is defined as a group of people who are all focused on the same thing, with a simple and powerful reaction that is followed by strong emotional responses. A crowd is defined as a group of people in a market, on the street, in front of a movie theatre, wedding ceremony, or conference venue. Overcrowding occurs when more people are crammed into a specific space than is considered safe and healthy. Current contexts as well as local cultural norms influence perspectives on safety and health. Overcrowding in the home, public spaces, or public transportation can occur either temporarily or regularly. Overcrowding in the home can be especially concerning because it is a person's haven.

Entrance and Exits in the Train Station

To encourage orderly queuing and movement through entrances and exits, a combination of barriers and effective stewarding can be used. It is best to avoid placing ticket sales and pickup locations, temporary structures, attractions, facilities, and primary information sources near entrances and exits.

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Entrances for Passengers of the Train Station

The standard used in entry and exit for design can also be used indoor design. A free swinging door has a maximum capacity of approximately 60 people per minute. This capacity, however, comes at the expense of frequent traffic disruptions and queueing at the entrance section. In a congested area with occasional traffic disruptions, a standard of 40 people per minute would be appropriate. A standard of 20 people per minute should be used where free-flowing traffic is desired.

RESEARCH METHODOLOGY

Data Type and Sources

Primary and secondary data sources were analyzed to form the basis for the data used in the study. A visual survey with the aid of pictures and well-designed viewing schedules was used as the source of primary data during the interviewing process. The nature of a train station building is duly noted and the control strategies set aside for the visiting crowd are also noted. Secondary data were collected individually, they were be gotten from sites, journals,and publications.

Population of the Study

The population of this study will entail different train station buildings both at home and abroad to determine the design strategies that were adopted in controlling the expected crowd. Also, a certain Demographical percentage has been taken as a sample size to help project the total design amount/scope for the project.

Sampling Method and Technique

A simple random sampling technique was adopted during this study. 10 samples were randomly selected. The train station buildings were purposely selected while the observation schedule was used simultaneously for the five (5) selected samples. The sample sizes and locations are illustrated below as shown in table 3.1.

Sample Size and Location

S/N	Sample Size	Location
1.	Idu Train Station	Abuja, Federal Capital Territory
2.	Wole Soyinka Train Station	Abeokuta, Ogun State
3.	Mobolaji Johnson Train Station	Ebute Metta, Lagos State
4.	Chief Obafemi Awolowo Train Station	Moniya Ibadan. Oyo State
5.	London Euston Train Station	Euston Rd, London, United Kingdom

DATA PRESENTATION AND DISCUSSION

A well-designed train station must incorporate measures to prevent accidents, mitigates risk, and respond effectively to emergencies. This includes considerations such as clear signage, effective wayfinding systems, properly lit areas, and efficient emergency evacuation routes. The first goal of this research is to determine the type of train station building and this was gotten through literature and other variables concerning the nature of train station designs.

Presence of Decals and Stanchions

Major crowd management strategies include the employment of decals and stanchions in train station layouts, which are used to manage both passenger line-ups and crowd flow within the station. As shown in table 4.1, from the cases observed, the provision of decals, stanchions, barricades, retractable belts are necessary for effective crowd control and reducing congestion of commuters. Around the station, decals are used to designate areas or display directions as shown in figure 4.4 and figure 4.5. They also aid in crowd control because people can walk around freely by following the decals' instructions.

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Table 4.1 Cross Tabulation of the Train station studied and provision of the necessary crowd control strategies.

Case Processing Summary

	Valid		Missing		Total N	Percent
	N	Percent	N	Percent		
Name of Building * Are Rails Available	5	100.0%	0	0.0%	5	100.0 %
Name of Building * Are Stanchions Available	5	100.0%	0	0.0%	5	100.0 %
Name of Building * Are Barricades Available	5	100.0%	0	0.0%	5	100.0 %
Name of Building * Are Decals Painted on the Ground	5	100.0%	0	0.0%	5	100.0 %
Name of Building * Are Retractable Belt Systems Available	5	100.0%	0	0.0%	5	100.0 %
Name of Building * Are Muultiole Booths Available	5	100.0%	0	0.0%	5	100.0 %

Source: Author Field Work, (2023)

Figure 4.4: Image showing the provision of Rails in Mobolaji Johnson Train Station.

Figure 4.5: Image showing the provision of Retractable belts in Mobolaji Johnson Train Station.

Presence of Multiple Ticket Booths

In a situation where there is increasing connectivity and growing commuter demand, efficient ticketing systems are crucial to ensure seamless travel experiences for passengers, the significance of having multiple ticket booths is important in the design of a train station. Multiple booths prevent long queues and frustrated

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commuters. As shown in figure 4.6 from a case studied, by having multiple ticket booths in the station, we spread the crowd in different groups when purchasing the tickets thereby making it faster for everyone.

Figure 4.6: Image showing Multiple booths in Mobolaji Johnson Train Station.

Size of Arrival and Departure Hall

The size of both the arrival and department areas are necessary considerations when designing the train station in other to be able to provide the necessary spatial occupancy of the expected crowd coming into and going out of the facility. From Fig 4.7 we can see from the cases studied 60% rated medium size for the size of the arrival hall and 40% rated large for the size of the arrival hall.

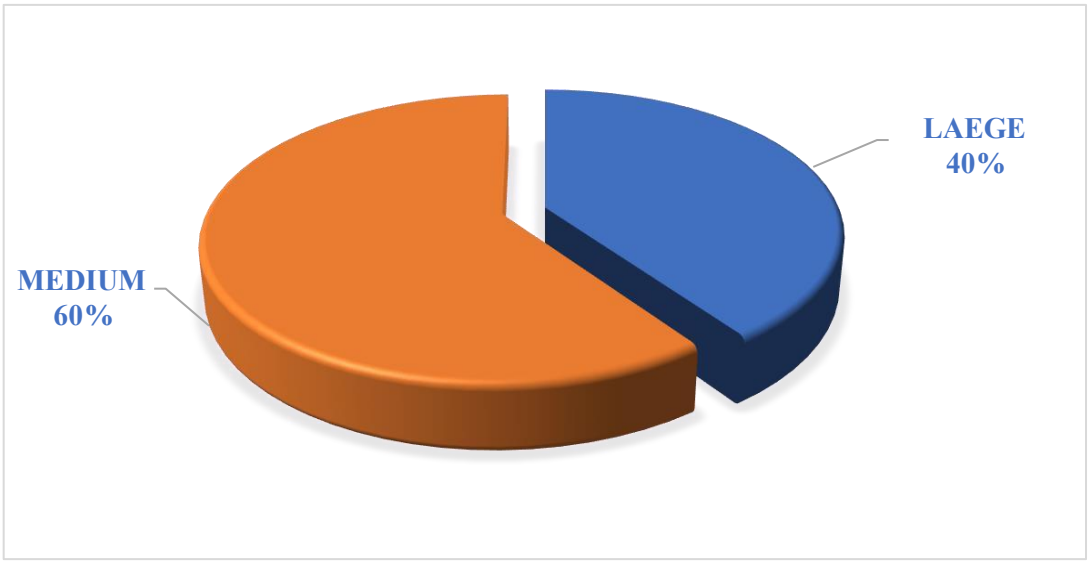

Figure 4.7: Chart showing the percentage of Arrival and Departure hall of Train stations studied

Provision of Separate Arrival and Departure Course

Separate arrival and departure zones in a station make it easier to control commuter access and exit because it is obvious where a passenger is supposed to be upon arrival at a train station and where he or she is supposed to be when leaving the terminal building. The movement of vehicles entering and leaving the station to drop

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off or pick up users without creating excessive traffic at the point they meet is another situation where separating the arrival and departure courses is appropriate on the ground.

Number of Entrances and Exits

The number of entrances and exits is a necessary consideration when designing a train station because it determines the gravity at which users will be able to access and exit the building easily. It is important in ensuring efficient and safe passenger flow. Although the precise number of entrances and exits may vary based on the station's size and design, several criteria play a role in choosing the right number of entrances. Such as the total capacity of the train station. As seen in the plates, Figure 4.8, Figure 4.9, and Figure 4.10 below the entrances and exits ways provided by some of the cases studied.

Figure 4.8: Entrance of Obafemi Awolowo Train Station

Multiple Ticketing Booths

The need for multiple ticketing booths is needed in a train station to be able to effectively and efficiently manage the troops and influx of users that come into the train station. Some of the importance of multiple booths in a train station is that it provides less waiting time for commuters, and enhances crowd distribution in the facility. The application of multiple ticketing booths is as seen in Figure 4.11 from a case studied.

Crowd Control Measures in Train Station Designs

Crowd control is a top priority in train stations since they are bustling centers where people from many different backgrounds converge. Effective strategies can be incorporated into train station designs to reduce traffic, shorten wait times, and improve the overall passenger experience. Every stage of the journey, from entry to exit, calls for rigorous planning and considerate execution. The second objective of this study is to identify the many approaches that can be used to manage the crowd in a train station facility.

Maximum Capacity of The Train Station

The capacity of a train station is a major factor used in determining the crowd control measures to be adopted in the designing of the train station; Hence, in determining the crowd control measures of the station the

capacity to be designed for at its busiest day must be considered. As shown in Table 4.3, the train station studied have a population of 1000-2000 commuters while the others have about 5000 and more commuters at its busiest days; hence crowd control measures will be put into consideration. From the case studied 60% has 10002000 commuters while 40% of the train station are about 5000-more. This category requires measures such as stanchions and decals majorly in controlling the crowd that comes in daily. Controlling the crowd with measures such as; decals, stanchions, labels, proper zoning of spaces, and security stands.

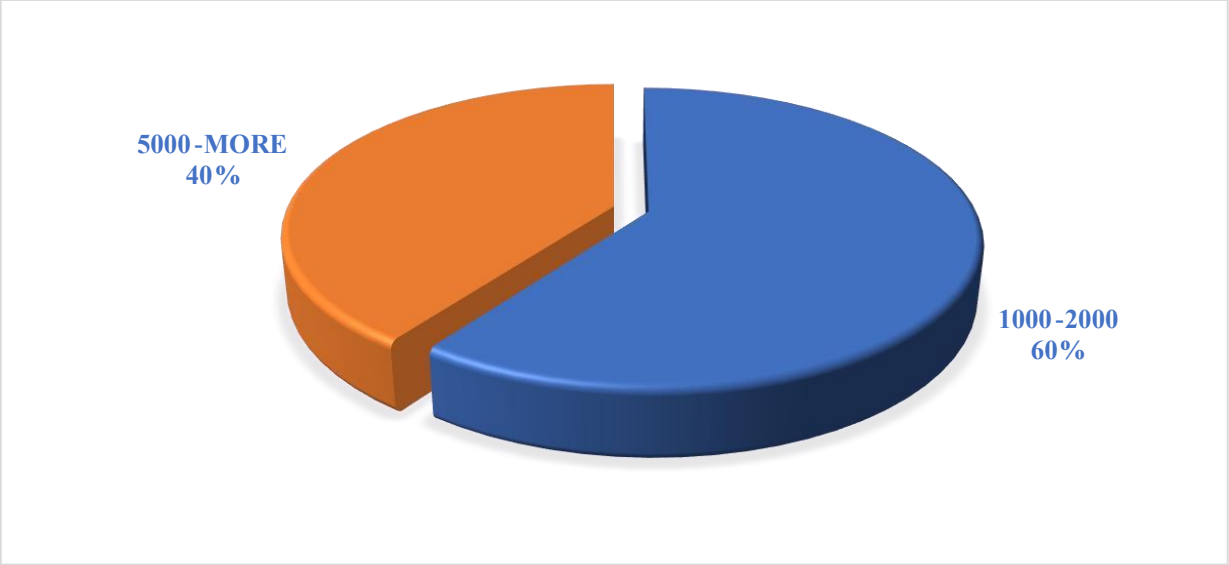

Figure 4.3: Chart showing the percentage of Maximum capacity for Train station studied

CONCLUSION

In public spaces, it's crucial to understand the value of crowd control. Train stations serve as gathering places for passengers to board and exit trains as well as the starting and finishing sites of train routes. Overcrowding is a typical issue with station layouts in general, since it results from a big flood of people entering the station to board trains, which causes congestion and traffic for commuters and necessitates the use of crowd control strategies to reduce traffic in the station. This is necessary in other to create an environment that is safe for every user of the station. The current issue of public building overcrowding being overlooked throughout design procedures needs to be adequately addressed. Although the understanding and need for crowd control at train stations are still unknown, global trends in architecture have demonstrated and implied the desire and relevance of achieving crowd control measures of final building users.

RECOMMENDATIONS

Architects and professionals in the built environment should always keep in mind that effective crowd control measures require meticulous planning and a comprehensive strategy that takes commuters experience, safety, and operational efficiency into account. Crowd control measures can be carried out by;

Real-time Monitoring and implementation of advanced surveillance for tracking inorder to monitor crowd movement and identify congested areas in real time and there-by Utilize systematic driven analytic tools to predict potential issues and proactively address them

Communication Channels including public address systems, and digital displays to keep passengers informed about crowd conditions, delays and safety instructions. Are essential. Antidote for passengers' instability and overcrowding.

Queue Management can be successfully realised by designating separate lines for boarding, security checks, and ticketing. Use of concrete barriers, stanchions, or floor markers to keep lines moving smoothly will prevent crowding.

Data Driven Insights Collection and analysis for passenger data to understand peak travel times, seasonal trends and special events be necessary for scheduling adjustments and crowd control strategies.

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