Improving Airport Circulation: A Design Perspective

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Abstract- ***Movement from one point to the other and safety of passengers within the airport has become the talking point among users of air transportation, especially the ease of movement of passengers with their luggage around the airport premises has become an issue of serious concern around the world. A different approach to the design and construction of terminal buildings has been necessary as a result of this shift, which has been manifested in expanded retail and increased automation. Older terminal buildings, which typically do not permit the separation of departing and arriving passengers, seldom meet modern requirements. this study proposes a design mobility in relation to managing large traffic and enhancing safety measures.***

I. INTRODUCTION

An airport is, to us, a site where airplanes land and take off. According to Ernst and Peter Neufert (2003), an airport includes both the airfield, which may have one or more accompanying buildings, and heliports in addition to the civil airport that is well-known to tourists. They can be separated into two categories: public (available to all air travelers) and private (such as air freight terminals, corporate airports, aero-clubs, and air force bases).

Therefore, it can be said that an airport is a place for air transportation, where passengers and visitors can also relax, shop and tour round the airport facilities while waiting for their flight arriving passengers.

An airport's terminal separates the two areas, known as landside from airside. Runways, taxiways, aircraft aprons, lighting, commercial operations, flight instrumentation and navigational aids, ground and air traffic control facilities, cargo operations, and other related activities that support airport operations are all part of the intricate and integrated system of pavements that make up an airport's airside area (Ian Redhead, 2006). According to Kenneth Hutton (2006), the landside of an airport is the portion of the buildings and grounds that are open to both traveling and non-traveling people. Among other amenities listed in landsides are houses, public and employee parking lots, public roads and terminals, car rental agencies and ground transportation, hotel facilities, and commercial and industrial buildings.

Depending on their intended use and the kinds of aircraft that use them, airports vary in size and design. General aviation airports, military airports, and commercial airports are the three main categories of airports. One or two paved runways, typically measuring 3,000 to 4,600 meters (10,000 to 15,000 feet) in length, are found at military airports. Only military aircraft use these airports. Commercial airports are larger than general aviation airports, which serve small civilian aircraft. They are typically located in small towns or rural areas. One or two 900–1,500 m (3,000–5,000 ft) long runways are seen in general aviation airports. At general aviation airports, there are asphalt runways as well as grassy walkways. Depending on the airport's size, general aviation airports offer a wide range of amenities. Airlines utilize commercial airports. These airports could be tiny or huge. Larger aircraft can land at small commercial airports than general aviation ones since they have one or two 1,800–2,400 m (6,000–8,000 ft) long runways. The world's largest cities are served by sizable commercial airports. Typically, they feature two sets of parallel runways that are between 10,000 and 12,000 feet (3,000 and 3,700 meters) long. (CourseHero, 2019).

There are a lot of issues facing the airport these days. From the beginning of the journey until its conclusion, there is room for improvement in the areas of circulation related to air travel. There are issues with other people, places, things, and the connections between them in addition to the traveler and his belongings. One common matrix unites all of these

components: circulation. The study highlights the need to recognize the way which mass mobility and circulation at the airport has been planned especially in Nigeria, often disregarding the ease, comfort and safety that should be considered for proper access of the airport.

II. LITERATURE REVIEW

A. Airport

Primary airports are defined by the FAA as commercial service airports with more than 10,000 passengers boarding annually; secondary airports are airports used as a backup to a city's primary airport. The first classification is based on the type of tower in the airport. A non-towered airport follows recommended procedures during landing and take-off, but it is not uncontrolled. In contrast, a towered airport is a typical airport, navigated by a tower control. These kinds of airports usually have smaller size, resulting in limited interior space, including a big hall and probably related functional spaces. Additionally, the number of users is limited and they do not require a complicated circulation. Sometimes, discounted fares are available from these alternative airports. As a result, having a robust circulation system is essential to having an efficient passenger flow.

Regarding the secondary airport, traffic flow should be such that travellers using transit can easily access their assigned route.

Airports are further classified according to their major and secondary roles:

Here are some further subcategories:
Three types of hubs: large/main, medium, and small.
Typically, hubs serve as a point of transfer for travellers to get to their intended locations. The areas of airports where travellers migrate to get to their planes are called hubs.

While some airports employ many hubs, others may only use one. Or Non-commercial, and Commercial.

B. Circulation and Flow Challenges

Movement refers to the route that a person takes to go to a certain location; this route needs to be specifically designed in terms of the relationships between spaces and their uses, eliminating cross-flow, and having the right width, length, slope, illumination, etc. Even while many people still think it's a suitable method, the finger circulation mechanism from the terminal to the plane and back may soon prove untenable in handling these quantities. Passengers are now having to walk great distances while carrying bags and are exposed to the elements due to parking issues. Previously, the open parking area next to the terminal building was sufficient. There is a need to reevaluate the current methods for managing the increased numbers of cars, passengers, luggage, planes, services, and workers' elements. (Creighton, 1963).

Moreover, Ketchum Morris notes that frequency is another issue with the airport's circulation. There hasn't been much work done to remedy this issue. Most airports constructed up to this point have ignored it. However, the frequency issue would worsen with the arrival of the large capacity jet. An hour before the flight leaves, people start to arrive at departure lounges, as indicated in table (I), creating a "trickle-down" flow of travelers that enables passenger handling facilities to handle high loads. With the departing passenger, this is not the case. Up to 210 passengers can be let from the aircraft at once. The "flood" that results from this surge affects the passenger and baggage handling facilities, frequently leading to needless waits for cars and bags or other forms of transit. (K. Morris. 1967).

PASSENGER FLOW TO DEPARTURE LOUNGE	
Passenger Flow to Departure Lounge	Percentage of Passenger Per Flight (%)
60	0
55	2
50	5
45	11
40	19
35	29
30	42
25	57
20	72
15	85
10	96
5	99
0	100

TABLE 2.1.: Indicating Passenger Arrivals at Departure Lounges

- According to Demerjian, D., one of the most stressful aspects of a passenger's journey is getting from the airport entrance to the aircraft departure gate. The greatest traffic on airport roads is caused by scheduled arrival and departure times during peak hours. For instance, drivers who are trying to pick up passengers frequently don't know when an aircraft is going to arrive. When cars arrive at the curb before the people being picked up arrive, police or other traffic enforcement officers usually make them move, which adds to the already heavy traffic on the roads and results in other issues such as:
- There is more parking on the shoulders of the access routes as a result of drivers waiting before pulling back to the curbside.
- Operational effects on traffic as drivers travel slower than the flow of traffic to lengthen their travel time back to the curb;
- Potentially unsafe driving maneuvers resulting from drivers trying to access impromptu parking areas or being unsure of the return path to the terminal; and • Increased vehicle emissions (Demerjian, 2008).

C. Solutions To Circulation And Flow Challenges

Physical enhancements and technology-based operational enhancements are not the same as the latest developments to increase on-airport ground access. Airport managers are accommodating drivers who need places to wait for their parties to arrive in designated short-term parking lots, often called cell phone lots. In addition to being usually free of charge, these lots sometimes feature large flight information displays that alert vehicles when a plane has arrived. Additional developments intended to improve vehicle flow across airport highway networks comprise:

- Peak-hour pricing discounts that lower or eliminate parking fees, encouraging drivers to park their vehicles rather than circle on airport roadways;
- Automated vehicle identification (AVI), which can help track the number of commercial vehicle trips through the terminal core; and • Low-frequency advisory radio and variable message systems on overhead signage to notify travelers of bottlenecks as stated by Avery (2004).

Although the design of modern airport terminals differs greatly from that of the past, there are still numerous commonalities. The use of technology to improve the efficiency and customer friendliness of the buildings and procedures is one of the most obvious distinctions. The following cutting-edge concepts and emerging trends were identified through an examination of case studies and press releases about new terminal projects:

- The size of the facility and the number of employees needed can be decreased as passenger processing speeds rise and customer satisfaction rises.
- Large-scale expenditures in public transit, notably rail lines, are being considered by numerous airport operators and the local communities. The primary objective is to offer a cost-effective service that facilitates seamless access between the inter-modal facilities and the terminal.
- Travelers want additional options when it comes to check-in so they may avoid pointless lines or interactions with agents. Due to the limited alternatives offered by traditional ticketing/check-in arrangements, the focus has turned to automated self-service operations in a number of locations both on and off the airport.
- To increase flexibility, the terminal building's shell could be structurally independent from the interior core facilities. Since it is impossible to predict passenger and airline needs more than five or ten years in advance, this separation would minimize the cost of making adjustments to meet changing airport user needs.
- There might be fewer at-grade crossings if the terminal's curb-side roadways were moved into the parking garage. The parking garage is currently used for other customary terminal operations, including as rental car pickup and drop-off, baggage claim, and check-in.
- Large public areas, easy navigation, and natural light all contribute to improved way-finding, giving travelers a greater view of the terminal and a better sense of their surroundings.
- A wider range of services are offered at the airport by hotels and business centers integrated within or next to the terminal buildings. These establishments draw clients who aren't just interested in flying.

- Restoring emphasis on the baggage claim or arrivals hall as the travelers' initial impression of the airport and surrounding region would lead to more open spaces and improved wayfinding in the terminal, close-in parking, and ground transit.
- Transit options, such as ground transportation centers, are used to segment terminal roadways rather than arrivals and departures.
- Passengers are transported between terminals, as well as to regional transit, centralized vehicle rental agencies, and remote parking, using non-secure people-movers. In certain places, travelers can check in for their flights and retrieve their luggage from the far-off sites.

III. DESIGN FRAME WORK

A. Level Of Organisaton

Level of organisation helps in separating movement between departure passengers and arrival passengers. It shows how best passenger traffic can be managed. David Littlefield (2008) identified four levels of organisation. These include;

1. Arrivals and departures concurrently on a single level: This is appropriate for small-scale operations where it is not justified to convey passengers from the terminal to the aircraft on the first level using telescopic loading bridges. This kind of level is depicted in Fig. VI below.

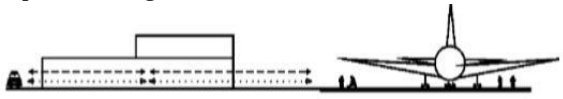

Figure 2.6. Side-by-side arrivals and departures on a single level

2. Side-by-side arrivals and departures on two levels: All arrivals really occur at ground level; therefore, this eliminates the need for elevated roadways. Departing passengers can reach the boarding level with the help of elevators and escalators.

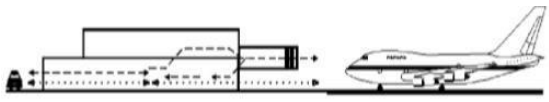

Fig. 2.7 Side-by-side arrivals and departures on two levels

3. Vertical stacking of arrivals and departures: Most large terminals now adopt this configuration. Departure facilities are invariably at the high level with the baggage handling and arrivals facilities below. It is convenient and economic for both passengers and baggage movement: departing passengers arrive at an elevated forecourt and move either on the level or down a ramp to the aircraft loading point. Arriving passengers also move downwards to baggage reclaims and land-side facilities.

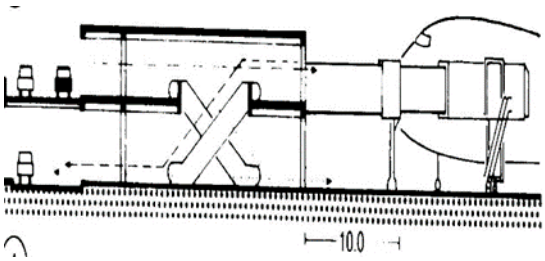

Figure 2.8 vertical stacking of arrivals and departures

4. Vertical segregation: is the most effective way to handle large passenger quantities, especially on long-haul flights with wide-bodied aircraft. While vertical or horizontal segregation is possible, it has been discovered that departure routes at a high altitude with downward circulation to the aircraft and arriving passenger routes below are the most practical.

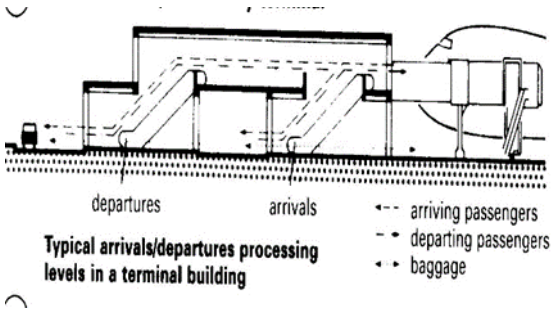

Figure 2.9. Vertical segregation

B. Factors Contribute Towards A Good Terminal Building Design

1. Passenger Flow: Reduce disruptions by separating screened passengers.
2. Walking Distance: An important quantitative factor that takes into account the psychology of users and the proportions of buildings to human scale. Walking distances can be assisted or unassisted. Industry standards for walking distances are as follows:

1. IATA: < 300 m unassisted; ADP: < 300 m unassisted; < 900 m use travellators;
2. BAA: < 250 m unassisted; < 650 m use moving sidewalks. 3. Level of Service for Passengers: Capacity is a function of Level of Service - Depending on the level of service intended, a facility can operate at different levels of congestion and delay. Table 2.8. IATA Level of Service Space Standards for Airport Passenger Terminals (sq.m per occupant).

	A	B	C	D	E	F
Check-in queue area	1.8	1.6	1.4	1.2	1.0	-
Wait/circulate	2.7	2.3	1.9	1.5	1.0	-
Hold room	1.4	1.2	1.0	0.8	0.6	-
Bag claim area (excluding claim device)	2.0	1.8	1.6	1.4	1.2	-
Government inspection		1.4	1.2	1.0	0.8	0.6

CONCLUSION

An rising number of individuals are now able to travel by air each year because to airline competition created by deregulation and subsequent improvements in the aviation industry (IATA, 2012). According to Air Transport Group (2012), there is a high likelihood of this trend continuing, with projections indicating a threefold increase in passenger numbers in the Asia-Pacific region alone. The passenger terminal at the airport is designed to handle future expansion in passenger traffic. It also features efficient flow and circulation, which will end the lengthy delays that passengers would otherwise suffer.

To address the issue of efficiency in passenger movement, Arriving and departing passengers should be giving the least level of organisation of one level to avoid passenger cross flow. Passengers should be made to access their luggage with ease.

In conclusion improving airport circulation from a design perspective is crucial for a smooth operation of an airport, by understanding the design frame work can enhance the travel experience and ensure efficient circulation

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