

## QUANTITATIVE ANALYSIS OF PEDESTRIAN WALK-SPACE IN URBAN CITY CENTRE: A CASE STUDY OF JOS BUSINESS DISTRICT

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### ABSTRACT

*This paper provides a quantitative method of proportioning pedestrian walk-space in urban centres in relation to street ways and adjoining buildings. The major focus is on the behaviour of pedestrians as they move from one destination to the other within the urban setting. It also tries to provide answers to questions such as; "what is the proper relationship between buildings and circulation space, and how does one avoid congestion in public places". In an attempt to pinpoint symptoms of congestion, the amount of walk-space available to people at various level of concentration were examined. This paper suggests that, the design of sidewalk for pedestrians should consists of a pathway dimension in relation to the pedestrian flow rate and public urban spaces should accommodate pedestrian access and free movement sufficient to meet reasonably expected desired demand.*

### INTRODUCTION

Every individual within the built environment is a pedestrian, since walking forms part of every trip. Walking is a "green" mode of transportation that not only reduces motor traffic congestion, but also has low environmental impact, conserving energy without air and noise pollution, unlike the other means of transportation. No matter how and by what means people arrive in the city centre, they end up as pedestrians on its sidewalks. Vehicles can be diverted from the surface, transit capacity can be expanded, but for a city centre to function very well, it has to provide for good and easy pedestrian circulation. Hence, a workable urban centre is one that provides maximum comfort for those walking on foot. Thus, a workable city can be defined as "the built environment that supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journey throughout the network" (Southworth, 2005).

In recent times within the urban city centres, there is significant widening of roads because of increase in the numbers of vehicles at the expense of walking spaces. As a result, the pedestrian has been squeezed into left over spaces between the traffic and building walls. Planning for pedestrian movement has been badly neglected in most city centres. Little effort has been made towards pedestrian comfort and amenity. Also, due to real estate pressure and large scale redevelopment, Architects and Planners were frequently bent upon providing monumental urban spaces totally out of scale with potential pedestrian flow (Isaac, 2001). There is therefore, the need to encourage pedestrian movement which stand as the most accessible and affordable means to get exercise. In an attempt to analyse pedestrian behaviour and walk-space within the urban centre, the amount of space available to people at various level of concentration are examined. This study focused on space for the pedestrian circulation in the urban city centre and the analysis of pedestrian behaviour within the urban setting. In addition, proposed a standard for the design of pedestrian walk-space for city planning.



## NATURE OF PEDESTRIANS SPACE WITHIN THE URBAN CENTRE

The essential characteristic of any city as an art form is that, it demands participation; and it requires movement through its spaces. It must be experienced through movement to come alive in its unique sense (Halprin, 1972). These kinds of movement involved both vehicular and pedestrian movement. Urban centres especially the business districts experienced a more vibrant movement because of the streets becoming so full of activities such that, a pedestrian must adopt such a preventive attitude of watchful walking to avoid stepping on others or being knocked off ones feet.

There are many obstacles to pedestrian movement within the urban city centres, which, emanated from the way traffic is managed and the manner in which buildings are built and other accessories are located. Obstacles to safe, comfortable walking comes in many forms such as posts, litterbins, advertising features, and cars parked on whole or part of the pavement, planting features, and even broken paving. Hence, the pedestrian is faced with several hazards such as accidents, noise, and unpleasant fumes that may cause long term health problems.

The problem of pedestrian movement within the urban city centre may not be a result of high density but inadequate allocation of spaces for pedestrian use. Micro design qualities such as the landscape, path design or streetscape are important factors affecting pedestrian behaviour as part of urban form (Isaacs, 2001). Where pedestrian are not considered in the design of the urban form or environment, there would be a lose intimate scale and transparency thereby creating an environment without public life (Pushkarev and Zupan, 1978). Pedestrian walk-spaces therefore, should be designed both for their activities and their kinaesthetic characteristics.



**PLATES - showing pedestrian predicament along streets**

(a) Ahmadu Bello way Jos (b) Bauchi road Jos.



**PLATES - Showing pedestrian spaces been annihilated by on-street parking**

(c) Ahmadu Bello Way, Jos (d) Tafawa Balewa Way, Jos



## METHODOLOGY

Data for the study were collected from field survey of some selected streets within the Jos business district. Three streets (Ahmadu Bello Way, Tafawa Balewa Way and Bauchi road) were randomly selected for the study and results obtained from the data analysis are use for inferences. The data collected comprises data on pedestrians' trip at unit time, pedestrians' walk-space and distance travel by pedestrians in a unit time.

In order to determine the amount of space needed by each pedestrian, a pedestrian travel demand survey was carried out in three different weekdays and an average for each time limit was computed and presented in table 2. The pedestrian trip was determined by recording the number of pedestrians passing through a pedestrian walk-space in a minute within a specified period. The pedestrian walk-space needed is thus determined from the relationship between the pedestrian flow rate, and speed of movement as shown below:

1. The average number of trips at a unit time gives the traffic flow rate. That is,

$$\text{Pedestrian flow rate} = \frac{\text{Average No. of Trip}}{\text{Time}} = A$$

2. Speed of pedestrian movement;

$$\text{Speed} = \frac{\text{Distance Cover Per Pedestrian}}{\text{Time}} = B$$

3. The relationship between pedestrian flow rate and speed gives the average distance needed by each pedestrian.

$$\text{Average Width of Pedestrian Space} = \frac{\text{Speed}}{\text{Flow rate}} = \frac{B}{A} = C$$

4. The pedestrian space required by one person at a particular flow rate and speed is given as;

$$\text{Pedestrian Space} = \text{Average Width of Pedestrian Space} \times \text{Width of Path}$$

1. The width of path that would allow pedestrians to pass each other in comfort is 1.8m (Neufert 1990). Therefore, the space required by each pedestrian is the multiple of 1.8m by the average distance. Thus,

$$\begin{aligned} \text{Pedestrian Space} &= \text{Average Width of Pedestrian Space} \times 1.8 \\ &= C \times 1.8m = D \end{aligned}$$

The values of A, B, C, and D at different time intervals are shown in Table 2.

## RESULTS AND DISCUSSION

The summary of the estimated pedestrians' walk-space along the three streets under study within the Jos business district is presented in Table 2, while Table 1 shows the standard pedestrian walk-space for different level of movement and circulation on which comparison is made to determine the level of pedestrians constraints and congestion.

Based on the above analysis and comparison of Table 1 and Table 2, circulation in between pedestrian without disturbance is only possible between 0600hr to 0800hr and 2000hr to 2200hr along all the three roads. Between the hours of 1000hr and 1200hr, pedestrian movement is possible but with disturbance or without comfort. Proper circulation and movement is only possible as a group. The pedestrian space available for the peak period (from 1300hr to 1800hr) from Table 2 is 0.34m<sup>2</sup> for Ahmadu Bello way and 0.32m<sup>2</sup> for both Tafawa Balewa way and Bauchi road, which is a constraint to pedestrian free flow as compared with Table 1. A pedestrian walk-space of 0.30m<sup>2</sup> to 0.9m<sup>2</sup> creates a problem of disturbance between pedestrians as they move along their path. Circulation is mostly



restricted and pedestrian flow is only possible in one direction as a group.

Since people need enough space to perform whatever physical tasks they are doing without interference from objects and other people, meeting such obstacles or making a turn to avoid it is an indication of constraint or congestion. Therefore, from the above analysis of pedestrian walk-space, Ahmadu Bello Way, Tafawa Balewa way and Bauchi road can be considered as being a constraint to pedestrian free-flow especially at peak period of between 1300hr and 1800hr.

**Table 1. Standard Space Requirement for Pedestrians in Cities**

Quality	Space (m)	Area per Person(m <sup>2</sup> )	Description
Unimpeded	Over 1.2	Over 1.2	Circulation in-between pedestrian is possible without disturbance.
Impeded	1 – 1.2	0.9 – 1.2	Circulation in-between pedestrian is somewhat restricted.
Constrained	0.6 – 0.9	0.7 – 0.9	Walk in -between pedestrian is possible only by disturbing them.
		0.3 – 0.7	Circulation through the group is severely restricted and forward movement is only possible as a group.
Congested	Under 0.6	0.2 – 0.3	Contact with others is unavoidable, circulation is impossible.
Tamed	0	Under 0.2	No movement is possible

**Table 2 - Estimated Pedestrian Walk-space along Ahmadu Bello way, Jos.**

Time	A			B			C			D		
	Pedestrian flow rate			Speed of Movement			Average Width of pedestrian Space			Total Pedestrians Space Available		
	ABW	TBW	BR	ABW	TBW	BR	ABW	TBW	BR	ABW	TBW	BR
0600HR - 0800HR	6	8	9	12.25	11.00	10.5	2.04	1.38	1.17	3.67	2.48	2.11
1000HR - 1200HR	18	16	18	8.50	7.50	9.00	0.47	0.47	0.50	0.85	0.85	0.90
1300HR - 1800HR	32	28	31	6.00	5.00	5.50	0.19	0.18	0.18	0.34	0.32	0.32
2000HR - 2200HR	3.00	2.00	5.00	15.00	14.50	12.00	5.00	7.25	2.40	9.00	13.05	4.32

ABW -Ahmadu Bello Way      TBW - Tafawa Balewa Way      BR -Bauchi Road

Source : Field Survey

**CONCLUSION**

The freedom with which a person can walk about and look around is a very useful guide to achieving a better quality of an urban space. Pedestrians overall, are not merely interested in walking. They want to get to their destination and would not take it kindly with planners who simply push them up to building facilities without considering their maximum comfort as they walk. For this reason, the hope of the pedestrians must lie in trespassing on street space at present, reserved for vehicular traffic and converting it to pedestrian use.

For an unimpeded movement along the streets within the Jos business district to be achieved, the walkway space that would be required per pedestrian should have a width of not less than 1.8m



that will also give a comfortable walk-space area of not less than  $1.2\text{m}^2$ . This will make circulation between pedestrian possible without any disturbance, In addition, walkway should be inclusive of sidewalk and pedestrian space. The design for pedestrian movement at a slow speed should relate the environment to the person in constant motion with a varied viewpoint and a constant changing position.

Finally, the design of a comfortable pedestrian walk-space is based on the amount of pedestrians and the space area in square metre required by each within the setting. Making any provision that is short of the above makes the pedestrian neurotic. Knowing how much space a pedestrian needs to be comfortable, walkways can be dimensioned in relation to the traffic that is anticipated within an area. Therefore, the amount of each pedestrian space needed within the city centre can be deduced from the rate of pedestrian flow and the speed.

## RECOMMENDATION

Achieving a free flow pedestrian environment around the streets within the Jos business district is not going to be easy since the area is built-up with the pattern already established. However, there is the need to assess the current conditions and then develop a policy and plan for creating a total pedestrian walk-space within the area. Sidewalks are to be constructed along the roads, which should consist of a pathway dimension in relation to the pedestrian flow rate as calculated above. There should be auxiliary space provided for standing and sitting to avoid pedestrian congestion because of stopping to chat along pedestrian flow line. Sidewalks widening especially at intersection could result into a free-flow pedestrian traffic.

The design of an urban space for pedestrian circulation/movement should be that of safety rather than aesthetics. Business district can be converted into an entire pedestrian zone by closing it to vehicles other than delivery vans by the provision of off-street parking that can be easily accessible from the district. As this is done, the pedestrian can be free from noise and fumes created by vehicular traffic. The introduction or the use of off-street parking is capable of decongesting on street parking thereby creating more spaces for pedestrian movement.

In conclusion, public urban spaces should be designed to accommodate pedestrian access and circulation sufficient to meet reasonably expected desired demand. All arterial and principal streets of any classification within the city centres should have continuous functional sidewalks along both sides. Measures should be taken to offset negative impact upon pedestrian travel, exposure and safety.

## REFERENCES

- Funihashi, K. (1985).** *A Study of Pedestrian Path Choice*. A Working Paper, Centre For Architecture and Urban Planning Research, the School of Architecture and Urban Planning University of Wisconsin, Milwaukee, Wis.
- Hall, T.E. (1966).** *The Hidden Dimension*. New York Doubleday.
- Halprin, Lawrence (1972).** *Cities*. The MIT Press, Cambridge Massachusetts, London England.
- Isaacs, R (2001).** The Subjective Duration of Time in the Experience of Urban Spaces. *Journal of Urban design* 6(2).
- Southworth M. (2005).** Designing the Workable City. *Journal of Urban Planning and Development*. ASCE December 2005



**Neufert, E. (1990).** *Architects' Data*. Second (International) English Edition: BSP Professional books.

**Pushkarev, B and Zupan, M. J. (1978).** *Urban Space for Pedestrian; A Report of the Regional Plan Association: The MIT Press Cambridge, Massachusetts and London, England.*

#### ABSTRACT

The paper presents a study of the urban space for pedestrian in the city of Lagos, Nigeria. It examines the physical environment and the social and cultural factors that influence pedestrian movement. The study is based on a survey of pedestrian routes and the use of public spaces. The results show that pedestrian movement is concentrated in certain areas of the city, particularly in the central business district and the waterfront. The study also identifies the factors that encourage or discourage pedestrian movement, such as the availability of public spaces, the quality of the urban environment, and the social and cultural norms of the city.

#### INTRODUCTION

The dominant feature in the debate in recent years on sustainable development is the development of sustainability in almost all sectors of human development. However, most sectors particularly in Africa are still not given the appropriate emphasis. For instance, pedestrian movement for human habitation and for other various activities are developed with very little attention. This is especially in the design concepts. Most of the results of the built environment are designed with a quantity building which is costly to build and maintain and which does not take into account the needs of the occupants. (Michael 1997) identifies some of the major reasons why buildings are not sustainable. Amongst these problems is the design of vertical and horizontal spaces for architecture and planning.

This is a critical question at this point is what makes a building sustainable? According to (Gosling 2005) sustainable buildings are those that through their design, siting, orientation, construction and operation are highly energy efficient, have low operating costs, are better for the environment, promote health and well-being for the users and occupants with maximum results. To achieve sustainability in architecture, building materials for construction must be made from locally sourced renewable natural resources without wrongly affecting the environment or the fabric. Again, the concept of energy efficiency and methods of construction of traditional buildings have been used as a model for sustainable buildings. It is important to note that the design of sustainable buildings should be considered for a long period of time and not just for the short term. While the focus is on the construction of sustainable design and other energy efficiency measures, it is also important to consider the various building components such as the exterior design, window design, and the use of materials, which affect the building's energy performance. In simple terms, sustainability is the application of methods and techniques which form a holistic approach to the design of a building, system and the natural environment. The design of a building should be based on the following principles: