A Review: Understanding Pedestrian Walking Behaviour in Different Location and Situations

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Abstract—Out of total trips made, the sharing of walking has significant as every trip begins and ends with walking. Every pedestrians behave in their own way in different situations and places which influence planning and design of pedestrian facilities. Historical trends of India suggests importance of studying the pedestrian behavior more scientifically. Common Pedestrian behavior like group formation, leader follower effect, queue formation and bottleneck conditions have considerable influence on pedestrian facility planning. As pedestrian mind sets differ from place to place. The pedestrian behavior has studied locally by various researchers. These studies has focused on various parameters of pedestrian movements in different situations and places which are of prime importance. These parameters includes pedestrian age, gender, pedestrian walking speed, density, pedestrian flow, space and speed-flow-density interrelationships. This paper emphasis on the current understandings of pedestrian walking behavior in different location and situations.

I. INTRODUCTION

Pedestrians are an important element of transportation system since every person’s trip begins and end in walking. However in spite of its importance, pedestrian needs are often not considered effectively in the design and planning of transportation system particularly in developing economies like India. India is the second largest populated country in the globe with more than 125 million population.

However, pedestrians behaviours in public locations in a normal situation and in mass gathering during events are considerably different. A mass gathering is when more than a specified number of persons at a specific location for a specific purpose gather for a defined period of time. Also, on any event mass gathering have an enormous potential to place a severe disaster on the crowd. Specially, on any event mixture of high crowd density, restricted points of access, poor crowd control, and lack of complete information of the areas and activities can lead to situations of disaster.

II. BACKGROUND STUDIES

An Pedestrian behaviour study is quite different as compared to the vehicular traffic. Pedestrian behaviour and it's characteristics like speed, flow, space, density and their relationships are studied by different researchers for various locations and specific conditions. The detailed compiled literature is presented as followings.

A. Pedestrian Physical Characteristics study

Natasha Singh et al. (2016) have study developed Human Ellipse of Indian Pedestrians. The research work has taken place at busy street of Delhi, India. The sample size of 747 has taken consisting of 132 females and 615 males. The data analysis has includes measurement of human body ellipse i.e. body depth and shoulder width by carrying out video-grapy survey on pedestrians. The analysis also includes, classifying the body dimensions according to gender and walking with/without baggage (handbag/backpack), along with the measurement of the step length of pedestrians which shall give out the area required for walking. These body dimensions obtained have compared with the standard body dimensions available worldwide. The research study has found variation in body dimensions from 26.07 to 52.14 cm for body depth and 42.35 to 67.76 cm for shoulder width.

B. Pedestrian Behavior and Characteristics Study on Religious Place:

Hardik Sukhadia et al. (2014) have carried out to understand the behavior of pedestrians with an existing pedestrian facilities on normal working day and on specific event day in CBD area of Vadodara. The research has to be done in CBD area of Vadodara. The data has been collected on event day of “Durgashtami” & “Dusheera-Navatri Festival” and also on one normal working day. The pedestrian flow parameters has determined by data extraction from video on one minute basis.
Also the relationships have been determined and empirical formula developed. The research has found that pedestrian walking speed decreases by 20% on event day than normal working day, the pedestrian overrun on main carriageway is up to 40% on event day and 20% on normal working day.

Chhaya Brahmbhatt et al. (2015) have determine pedestrian flow parameters i.e. speed, density, space, flow rate at Dakor. Also the pedestrian LOS has determined as per HCM 2000 and a thesis of Ms. Rima Sahani & P.K. Bhuyan on "Pedestrian LOS criteria for urban off street facilities".

Bharathy G and Karthigaipriya T. (2016) have found the pedestrian behavior and the significant factors affecting pedestrians walking behavior based on the data collection of 350 pedestrian sample from 7 different wards of Madurai CBD area and from collected data analysis. The design crossing speed has found to be 0.95 m/s for old age pedestrians and 1.12 m/s for adult pedestrians.

Indo-Dutch collaboration team under supervision of Ashish Verma (2016) have carried out an experimental research on Kumbh Mela to understand crowd dynamics and explore the modeling techniques that are available to enhance crowd safety to overcome the adverse effect in mass religious gatherings such as Kumbh Mela. The Data has been collected in Kumbh Mela Ujjain-2016 and currently the analysis process continue.

C. Pedestrian Behavior Study on Sidewalks

Vasantha Wicramasinghe & Sunanda Dissanayake (2016) have developed an unbiased methodology to evaluate the most vital attributes influencing to avoid the sidewalk. The research found that width of sidewalk, availability of obstacles, opposing pedestrian flow rate, availability of safety rails are few of the sidewalk attributes which mainly influence the usage of carriageway, while using sidewalks. The availability of side rails is the least influencing attribute in use of sidewalks.

Arunabha Banerjee & Akhilesh Kumar Maurya (2017) have study pedestrian behavior on walkway and sidewalk facilities using quantitative method along with general pedestrian characteristics which affect walking speed such as age, gender and carrying of luggage or not for a commercial cum shopping area in Gantok, Sikkim. The study results show that pedestrian flow characteristics are highly affected by age, gender and presence of luggage.

D. Pedestrian behavior and flow characteristics study in different conditions

Rajat Rastogi et al. (2010) have researched on pedestrian flow characteristics in mixed traffic condition.

The data has collected at four locations in a medium-sized city of India, are analyzed for pedestrians flow characteristics under mixed traffic conditions. The data has presented in the form of mathematical and graphical relationships between speed and volume, speed and density, flow and area module, and flow and density. The free flow speed of pedestrians has observed to be 80 m/min which is higher than that reported for China and Singapore, but slightly lower than that in Germany. The speed of the pedestrian has found to be influenced by the age and gender also. Male pedestrian move faster than female pedestrians. Pedestrians in the age group of 10-15 years has the highest speed, 82 m/min. The speed has reduced by about 85% when pedestrians move with their baggage.

Jiten Shah et al. (2013) have carried out pedestrian flow behavior study at Vadodara railway station in state of Gujarat, India. For the research total 3411 numbers of pedestrian data was extracted by employing video-grapy. The data has been analyzed and speed, flow density, space etc characteristics found out. The flow models of speed-flow, speed-density and flow-density are developed to illustrate behavior of pedestrian stream on stairways of different dimensions. Also in addition to that higher walking speed has reported on downstairs than upstairs with reduction in speed with increase in pedestrian density.

Ankit Gupta et al. (2016) have study the effect of gradient on pedestrian flow characteristics under mixed flow conditions. The study has based on the survey of three locations from Central Business District (CBD) area of Dharamshala, with the help of video graphic survey during the peak hours. The pedestrian flow characteristics has extracted and also age, sex and baggage condition of pedestrians assessed with the help of captured videos. The relationships between speed-density, flow-density and flow-space have projected through graphs. The pedestrian flow models have developed and those compared with the models developed for plain topography regions. Also pedestrian Level of Service (LOS) has derived from standards laid down by Indian Road Congress (IRC).

III. FINDINGS FROM LITERATURE REVIEW

A. Research Gap

The research work on pedestrian walking behavior presented in this review paper covers nearly all the aspects of pedestrian walking behavior, pedestrian physical characteristics, pedestrian flow characteristics. However, there are still some research gaps founded as listed below:

- Less work have been done by considering pedestrians with disabilities.
• Impact of climatic conditions has not been fully understood.
• Pedestrian walking behaviour at bottlenecking situations has not been fully understood.
• Very less research has been found on Pedestrians Walking behaviour during religious mass gathering.

B. Summary

This paper summarizes the various studies that have been done on pedestrian's flow characteristics, physical characteristics and behavioral characteristics specifically focused on walking behavior of pedestrian in different locations and situations. It is observed that not much more studies have been carried out on religious places, specially on religious mass gatherings.

The analysis of pedestrian body structure has been studied and the results are compared with Indian & International standards. Also the effect of baggage on walking behavior is studied.

The pedestrian walking behavior study related to religious events and places have been found that the LOS has been decreases on event days compared to normal working days. Also a significant effect of luggage has been observed on walking behavior of pedestrians.

The research works on pedestrian sidewalk behavior, observed that the pedestrians choice to use sidewalks or not significantly influenced by sidewalk width, obstructions and opposite pedestrian flow. Also the age and gender affect the walking speed and choice of using sidewalks.

The research studies shows that on public terminals like railway stations the arrival and departure schedule of trains influences the LOS of pedestrian foot over bridge. The free flow speed of Indian pedestrians has been observe higher than Singapore and china but lower than Germany.

Also the studies shows that the male pedestrians walk faster than female pedestrians. The walking speed of pedestrian highly influenced by gradient of walkway, specifically in hilly areas.

REFERENCES