

Pedestrian Speed-Flow Relationship for Mehsana City

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Abstract— The proper estimation of pedestrian speed-flow-density relationships is of vital importance, because such Relationships play an important role in developing useful tools for analyzing and improving pedestrian facilities in Terms of efficiency and safety. Data collected at Mehsana city at five different routes are analyzed to study the influencing factors and their effect on pedestrian walking speed. The results are compared in five routes of Mehsana city with respect to age and gender of pedestrians, cell phone usage, baggage and accompaniment. Further analysis was conducted on the mean walking speed of pedestrians with regard to several factors. Gender, age, and the group size were found to significantly influence the pedestrian mean walking speed.

Keywords: Pedestrian characteristics, Speed Flow, T-test, F-test

I. INTRODUCTION

The freedom with which a person can walk is a useful guide to the civilized quality of an urban area. The transport need of most people cannot be satisfied by motorized vehicles alone. Most people in developing countries cannot afford owning or using a motor vehicle and their normal means of transport is therefore, their own feet. High densities, mixed land use patterns, short trip distances and high share of walking are major characteristics of Indian cities. Narrow and inadequate footways coupled with the problems due to street hawkers push the pedestrians on to the roadway. As a result, there is no scope for ensuring safe and convenient pedestrian movements. Many of the Indian towns and cities are not Friendly to the pedestrian movements. The complexity of the transportation network of the Indian cities is such that it cannot be compare with any western city for developing a model using the same parameters. So the local pedestrian characteristics have to be observed to understand the pedestrian behavior and their perception to different scenarios.

II. AIM AND OBJECTIVE

The purpose of this study is to observe the pedestrian behavior to improve the quality of pedestrian movement in urban area.

1. To identify the existing pedestrian behavior.
2. To develop a data collection system for pedestrian studies.
3. To examine the pedestrian flow characteristics.
4. To develop mathematical models for pedestrian flow base on various pedestrian & road characteristics.
5. Empirically measure the factors that contribute to pedestrian congestion on the sidewalks

III. PEDESTRIAN FLOW CHARACTERISTIC

In many ways pedestrian flow are similar to those used for vehicular flow because it can be described in terms of

familiar variables such as speed, volume, rate of flow and density. Other measures related specifically to pedestrian flow include the ability to cross a pedestrian traffic stream, to walk in the reverse direction of a major pedestrian flow, to maneuver generally without conflicts and changes in walking speed, and the delay experienced by pedestrians at signalized and unsignalized intersections.

IV. SPEED-FLOW RELATIONSHIPS

The relationship between pedestrian speed and flow, similar to vehicle flow, shows that when there are few pedestrians on a walkway (i.e., low flow levels); there is space available to choose higher walking speeds. As flow increases, speeds decline because of closer interactions among pedestrians. When a critical level of crowding occurs, movement becomes more difficult, and both flow and speed decline. Confirms the relationships of walking speed and available space, and suggests some points of demarcation for developing LOS criteria. The outer range of observations indicates that at an average space of less than 1.5 m²/p, even the slowest pedestrians cannot achieve their desired walking speeds. Faster pedestrians, who walk at speeds of up to 1.8 m/s, are not able to achieve that speed unless average space is 4.0 m²/p or more.

V. PEDESTRIAN WALKING SPEED

Pedestrian walking speed is highly dependent on the proportion of elderly pedestrians (65 year old or more) in the walking population. If 0 to 20 per cent of pedestrians are elderly, the average walking speed is 1.2 m/s on walkways.

VI. STUDY AREA

Area takes in Mehsana city to determine the pedestrians speed/flow relationship in the entire survey roads. Pedestrian's side walk survey was conducted in five roads of mehsana city. 1. Gayatri mandir to nagalpur station (right side) having distance 543m 2. Nagalpur to swaminarayan mandir (left side) having distance 580m 3. Modhera crosses roads to Gayatri mandir (right side) having distance 447m 4. Swaminarayan mandir to Modhera crosses road (left side) having distance 615m 5. Modhera crosses roads to B.K. Cinema having distance 687m.

VII. SURVEYS AND DATA COLLECTION

Pedestrian walking speed survey was conducting in five road of Mehsana city. Data collected by manually. We are taking pedestrian's average walking speed and compare with different groups like age, gender, group size etc and identify its characteristics.

A. Age

Pedestrians are divided into four different group based on their age as children (0 to 15), younger adult (15 to 30), older adult (30 to 60), and elderly (above 60).

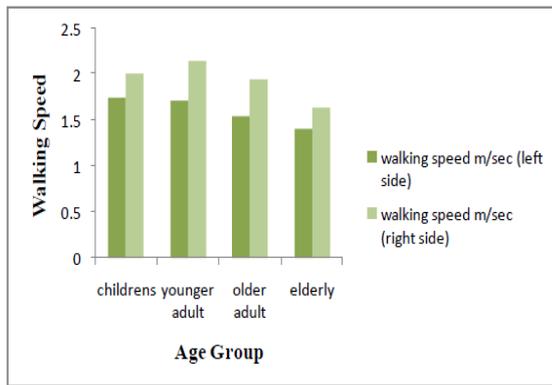


Fig. 1: Graph of effect of age on walking speed

Pedestrian's side walk speed survey conducted on state highway 41. As we collected data get the graph of speed v/s age group. Younger adults are 9.5% faster than other age groups. Elder persons are 17.6% slower than other groups.

B. Gender

Pedestrians walking speed survey was conducted in five routes and data collected based on gender. It is divided into two groups - male and female.

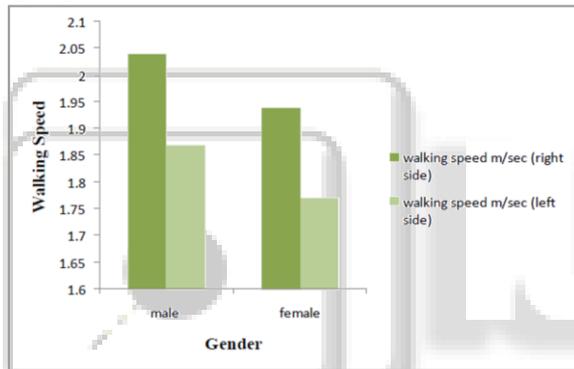


Fig. 2: Graph of effect of gender on walking speed

The survey was conducted on the gender basis. It was found that the average walking speed of male pedestrian is more than that of female pedestrians. Also the survey result shows that the pedestrian speed on the right side more as compared to left side.

C. Group Size

Pedestrians walking speed survey was conducted in five route and data collected also base on group size. It is divided into 6 groups are single, 2persons, 3persons, 4 persons, 5 persons, 6 persons. It may be more than 6persons group but in our data collection we get till 6 persons.

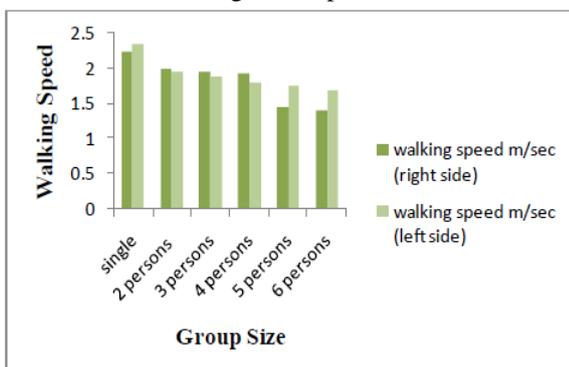


Fig. 3: Graph of effect of group size on walking speed

The walking speeds of different group size in Mehsana city are compared. It is found that group of larger size tend to walk slower as the size of group increase, the walking speed decrease significantly. F-test results also indicate that there is significant difference in the walking speed of smaller group size 2 and larger group like group size 5 and >5.

D. Effect of Baggage and Cell phone

Pedestrian walking speed survey was conducted in five routes and data collected. It is divided into two groups. Pedestrian's using cell phone and without using cell phone during the walking.

Table 1. Results of F test on effect of age size

Source of Variation	Sum of square	D.F	Mean Square	F
Between	0.1927	3	6.4218E-02	0.9014
Error	1.140	16	7.1240E-02	
Total	1.332	19		

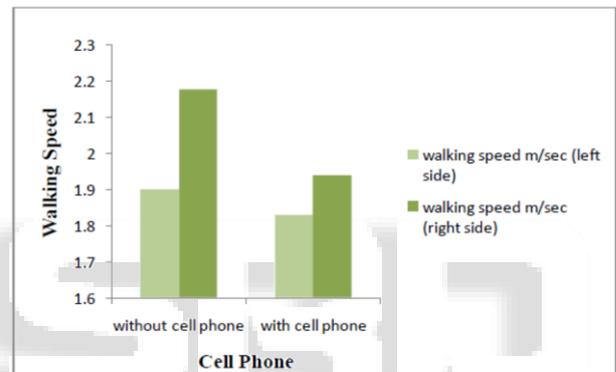


Fig. 4: Graph of effect of cell phone in walking speed]

E. Baggage

Pedestrians walking speed survey was conducted in five route and data collected. It is also again divided into two groups. Pedestrian's carrying baggage and without carrying baggage.

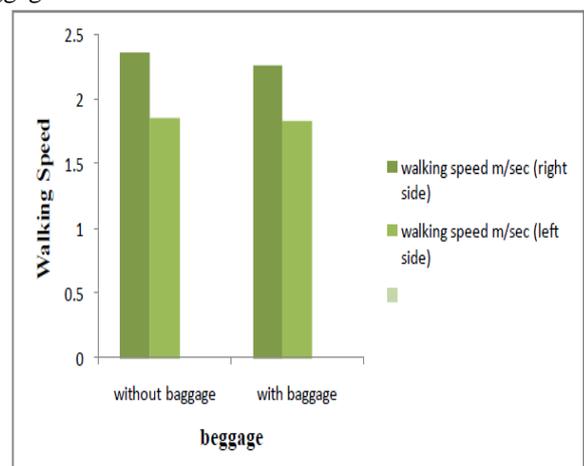


Fig. 5: Graph of effect of baggage on walking speed

Sites are chosen to have sizable percentage of pedestrians carrying baggage and using cell phone while walking in different age groups in the whole sample data. Pedestrians carrying baggage were identified from whole sample and walking speed was computed. Similarly the

speed of pedestrians using cell phone was found. It was observed on all five survey roads without using cell phone and carrying baggage faster than using cell phone and carrying baggage.

VIII. HYPOTHESIS TESTING

Pedestrians walking speed survey was conducted and data analyzed should be checked for the assumption for their validity. The hypothesis was checked using F-test and T-test, using ANOVA. F test is conducted for more than 3 groups and t-test conduct for less than 3 groups. So f-test was conducted for effect of age and group size and t-test was conducted for effect of gender, cell phone and baggage respectively.

The probability of this result, assuming the null hypothesis, is 0.462 That means our analysis and hypothesis readings observed walking speed are true for different age group.

Table 2. Results of F test on effect of group size

Source of Variation	Sum of square	D.F	Mean Square	F
Between	0.4096	5	8.1919E-02	1.03
Error	1.586	20	7.9311E-02	
Total	1.996	25		

The probability of this result, assuming the null hypothesis, is 0.425 That means our analysis and hypothesis readings observed walking speed are true for different group size.

A. T test for effect of gender

The probability of this result, assuming the null hypothesis, is 0.66 That means our analysis and hypothesis reading observed walking speed are true, male pedestrians are faster than female pedestrians.

B. T test of effect of cell phone

The probability of this result, assuming the null hypothesis, is 0.83 That means our analysis and hypothesis readings observed walking speed are true without cell phone using pedestrians faster than cell phone using pedestrians.

C. T test of effect of Baggage

The probability of this result, assuming the null hypothesis, is 0.59 That means our analysis and hypothesis readings observed walking speed are true, without carrying baggage pedestrians can walk faster than carrying baggage pedestrians.

IX. CONCLUSIONS

Pedestrians in Mehsana have different walking speeds. The present study supports that pedestrian speed is greatly influenced by pedestrian characteristics. It is also found that difference in the walking speeds of this route pedestrians are as high as 12% for younger adults and it reduces to 3% for elderly pedestrians.

There is a significant difference in the walking speed of pedestrian when they move in group. Group of children walk faster than older adult groups indicating that group behavior is different from the individual pedestrian behavior as the size of group increases, the walking speed decreases in all five routes when pedestrian move in a group of size greater than five, they tend to walk slow disregarding

the needs of pedestrians in opposite direction or pedestrian following them.

The significant difference is observed in the walking speed of pedestrian carrying baggage and pedestrians without baggage in different route are observed same. T-test results indicate that there is no significant difference in speed of pedestrian using cell phones and those without cell phones.

A better understanding of these factors will result in better pedestrian behaviors perception which is vital for developing a good and efficient pedestrian network for a city.

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