

PEDESTRIAN SPEED ANALYSIS ON RELIGIOUS EVENT

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Abstract : The present study has been performed to understand the variation in speed of pedestrian devotees during specific religious event. For the study "BAPS Shri Swaminarayan Mandir, Bharuch" has been selected as study area. The data has been collected on Guru Purnima by using video recording of 60 minutes. Total 1427 no of pedestrian from different category has been observed on the event day. The pedestrians has been categorized gender wise in four different categories namely Children 5-18years, Youngster 18-35 years, Mid-Age 35-60 years and Senior Citizen 60 years and above.

Index Terms - Pedestrian, Devotees, Religious Event, Pedestrian Speed

I. INTRODUCTION

Pedestrians are an essential element of transportation system since every person's trip starts and end in walking. India is the second largest populated country in the world with over 125 million population. In addition to that India having multiple religious people. As a rough idea more than 6 religions has been followed by different devotees in India. So, every year devotees travel to respective different religious places worship their almighty. Also various religious events has been organized by respective religious places during entire year. On few specific events, this gathering used to be very large and needs special attention with respect to pedestrian facilities. However, pedestrians behavior in public locations in a usual situation and in crowd for the period of religious festivals are considerably different. Figure 1.1 and 1.2 below shows the difference in pedestrian walking behavior in public locations and in a usual situations.



Figure 1.1 Pedestrian Walking Behavior in Religious Mass Gathering (Source: Google Image)



Figure 1.2 Pedestrian Walking Behavior in public locations and in a usual situations (Source: Google Image)

From all the temples around India, "BAPS Shri Swaminarayan Mandir, Bharuch" is one of the busiest temple when it comes to devotees visit. So for the present study "Pedestrian Speed Analysis on Religious Event" the "BAPS Shri Swaminarayan Mandir, Bharuch" is selected as study area. At BAPS Shri Swaminarayan Mandir, Bharuch there are more than 10 major festivals celebrated where large no of pedestrian devotees visits. At BAPS Shri Swaminarayan Mandir, Bharuch to control the devotees flood on specific events is kind of a headache. so it is evident that scientifically designed pedestrian walking facilities are essential for devotees.

II. AIM OF STUDY

Examine the impact of religious events on walking speed of pedestrian devotees.

III. OBJECTIVES OF STUDY

- Identify the offered pedestrian facilities for pedestrian devotees.
- Identify the speed of various category pedestrians during religious event.
- Investigate the dominating pedestrian category which affects maximum to other category pedestrian's speed.

IV. LITERATURE REVIEW

Pedestrian behavior study is quite different as compared to the vehicular traffic. Pedestrian behavior 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 in table 4.1 below.

Table 4.1 Review of Pedestrian Researches

Sr. No.	Paper Title	Author	Journal and Publication Year	Remarks
1	The effect of events on pedestrian behavior and it's compression with normal walking behavior in CBD area in Indian Context.	<ul style="list-style-type: none"> • Hardik Sukhadia • Sanjay Dave • Jiten Shah 	Elsevier - 2014	<ul style="list-style-type: none"> • Conducted at CBD area of Vadodara • Data collected on Durgashtami, Dushera and One normal working day • Decrease in walking speed on event day by 20% than working day. • LOS Decreases on event day than normal day
2	Measurement of Pedestrian Flow Parameters – A Case Study of Dakor.	<ul style="list-style-type: none"> • Chhaya Brahmhatt • L. B. Zala • Mukti Advani 	IRJET - 2014	<ul style="list-style-type: none"> • Conducted at Dakor temple • Data collected on Outside street on normal working day. • Pedestrian flow parameters speed, space, density, flow rate determined. • Determined LOS as per HCM 2000 & from Thesis of Rima Sahani.
3	Pedestrian characteristics & behavior on surrounding temple area Madurai	<ul style="list-style-type: none"> • Bharathy G. & Karthigaipriya T. 	IJMETMR - 2017	<ul style="list-style-type: none"> • Conducted at CBD area of Madurai Temple • 7 wards 350 pedestrian samples • Crossing speed found for <ul style="list-style-type: none"> • - old age – 0.95 m/s • - Adults – 1.12 m/s
4	Pedestrian crossing decision making : A situational & behavioural approach	<ul style="list-style-type: none"> • Brigitte Cambon de Lavalette • Charles Tijus • Sebastian Poitrenaud • Jean – Paul Thouez 	Elsevier - 2009	<ul style="list-style-type: none"> • Montreal City • 19 sites and more than 4000 samples • Seeking better match b/w regulatory system and the user of the system. • Describe level of violation in pedestrian crossing behavior.
5	Study of pedestrian behaviour on walkway and sidewalk facilities for a commercial area in Gangtok, Sikkim	<ul style="list-style-type: none"> • Arunabha Banerjee • Akhilesh Kumar Maurya 	Research Gate - 2016	<ul style="list-style-type: none"> • Commercial and shopping area of Gangtok Sikkim. • Speed, flow and density estimation • Influence of age, gender and presence of luggage on pedestrian speed, flow and density.

V. METHODOLOGY

Initially the problem will be identified such as difficulty in managing pedestrian devotees mass on any religious event at respective religious places, then objectives would be set as per the requirement that minimize the problems and lastly data will be collected on event day "Guru Purnima" and then it will be analyzed. Lastly on the basis of data analysis and its results the suggestions will be concluded to minimize the impact of the problem. The figure 5.1 below shows the flow chart of methodology that has been followed for the present study.

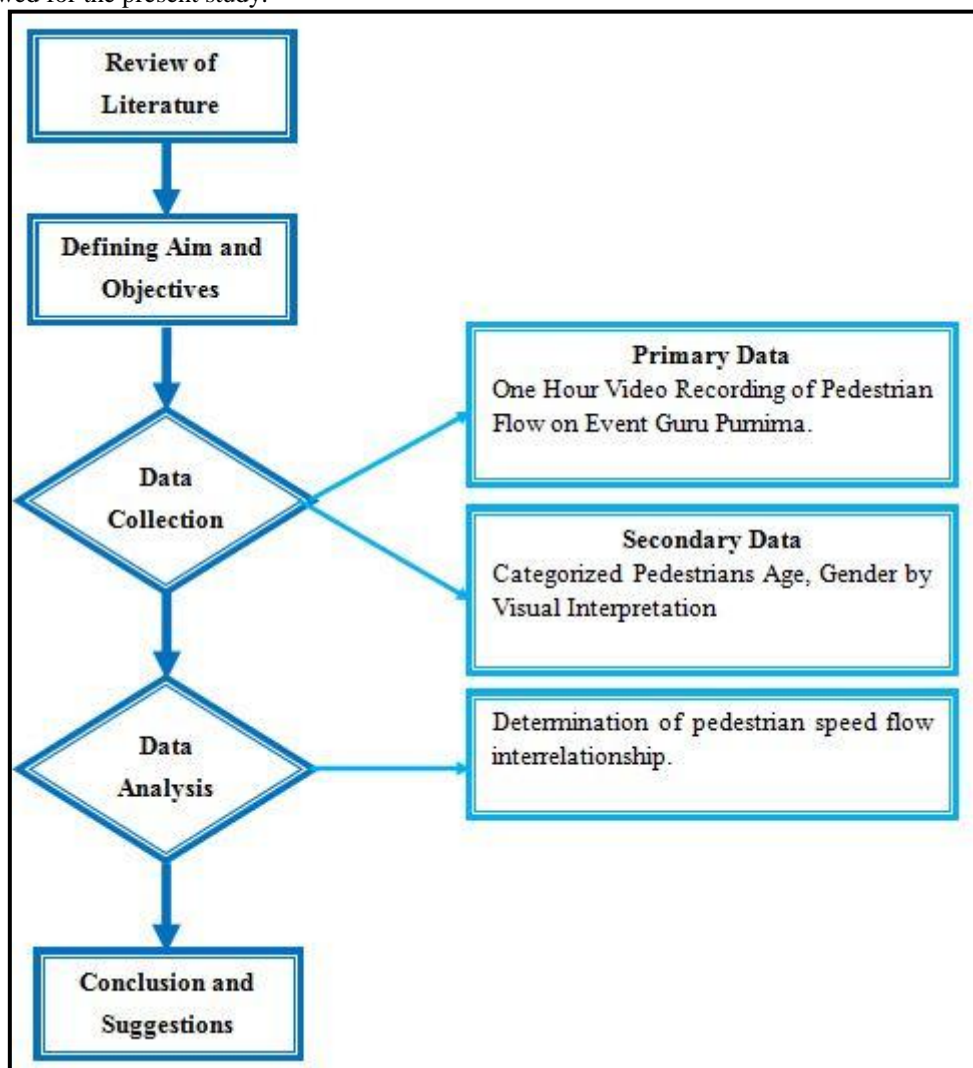


Figure 5.1 Study Methodology

VI. STUDY AREA

For the present study "Variation in Pedestrian Flow During Religious Event" BAPS Shri Swaminarayan Temple, Zadeshwar, Bharuch has been selected as study area. The Fig. 5.1 below shows the location of temple.

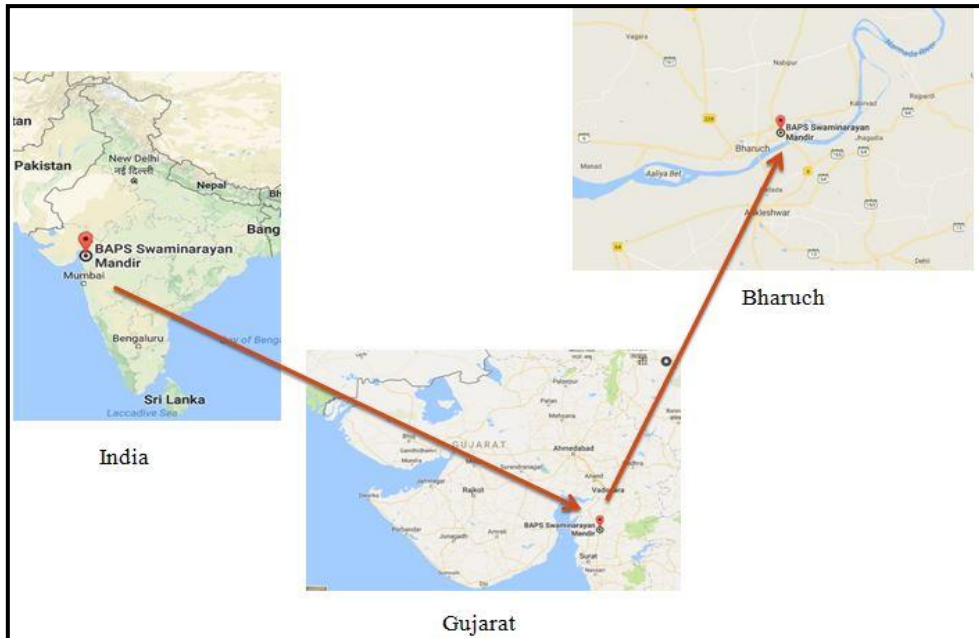


Figure 6.1 Study Area Location

VII. DATA COLLECTION

The pedestrian flow data has been observed on event day of "Guru Purnima" to be celebrated at study location with maximum number of visits by pedestrian devotees. Pedestrian flow has been observed at the entry gate of temple inside the temple premises on 30 feet long (10m) walk way. The trap length to be considered is 6m. The observation location is clearly shown in fig. 8.1.



Figure 8.1 Observation Location

VIII. RESULTS AND DISCUSSION

The pedestrian volume count has been done per one minute basis. Firstly the Pedestrians are categorized in children, Adult Youngsters, Adult Mid-Age and Senior Citizens. The pedestrians passing the trap entry and exit point counted as per the motioned category. Table 8.1 shows the pedestrian flow per minute according to gender and different categories.

Table 8.1 Pedestrian Volume Count

Time		Number of Pedestrians								Total No. of Pedestrians per Minute
		Male				Female				
		Children	Youngsters	Mid - Age	Senior Citizen	Children	Youngsters	Mid - Age	Senior Citizen	
12:30	12:31	3	5	7	3	4	2	4	6	34
12:31	12:32	2	6	4	2	3	2	2	4	25
12:32	12:33	4	4	3	4	2	3	5	6	31
12:33	12:34	3	2	5	3	4	3	6	3	29
12:34	12:35	2	5	4	4	5	0	7	4	31
12:35	12:36	1	3	3	2	3	4	4	2	22
12:36	12:37	3	4	0	1	4	4	2	3	21
12:37	12:38	2	6	1	4	3	3	3	2	24
12:38	12:39	4	8	8	3	0	0	4	2	29
12:39	12:40	2	2	2	5	2	2	3	5	23
12:40	12:41	1	1	4	4	4	1	5	4	24
12:41	12:42	0	3	3	2	3	0	7	5	23
12:42	12:43	3	5	6	2	2	1	5	3	27
12:43	12:44	1	6	4	2	4	2	3	0	22
12:44	12:45	2	4	2	3	5	1	4	5	26
12:45	12:46	3	3	4	2	4	3	2	3	24
12:46	12:47	4	4	3	0	3	0	4	5	23
12:47	12:48	3	7	6	3	2	3	0	3	27
12:48	12:49	2	2	4	2	0	1	4	5	20
12:49	12:50	4	3	2	0	4	3	3	2	21
12:50	12:51	2	4	3	3	3	0	2	5	22
12:51	12:52	5	6	4	4	2	3	4	4	32
12:52	12:53	3	2	6	2	4	0	6	4	27
12:53	12:54	4	5	7	3	3	0	7	5	34
12:54	12:55	2	4	5	2	2	0	3	3	21
12:55	12:56	0	3	6	4	4	2	4	4	27
12:56	12:57	1	6	3	3	0	0	6	4	23
12:57	12:58	3	4	4	2	5	3	5	3	29
12:58	12:59	4	5	2	3	3	4	3	2	26
12:59	13:00	2	3	3	6	4	3	5	3	29
13:00	13:01	2	5	4	2	3	4	4	3	27
13:01	13:02	3	4	3	3	1	3	2	2	21
13:02	13:03	1	3	1	4	2	4	3	4	22
13:03	13:04	2	5	2	1	5	5	4	3	27
13:04	13:05	3	1	6	2	4	3	6	5	30
13:05	13:06	5	4	4	4	3	6	2	2	30
13:06	13:07	4	6	2	2	2	7	4	4	31
13:07	13:08	2	5	0	3	4	4	2	1	21
13:08	13:09	3	3	1	1	3	3	3	0	17
13:09	13:10	1	4	3	4	2	5	4	3	26
13:10	13:11	2	2	4	2	4	2	2	0	18
13:11	13:12	0	1	2	6	1	4	3	2	19
13:12	13:13	0	3	6	0	2	6	4	4	25
13:13	13:14	0	5	2	0	3	0	2	0	12
13:14	13:15	2	0	5	1	4	2	2	3	19
13:15	13:16	3	2	7	3	3	0	3	2	23
13:16	13:17	0	5	2	0	4	3	3	0	17
13:17	13:18	1	0	1	1	1	4	4	1	13
13:18	13:19	0	4	0	2	4	6	2	5	23
13:19	13:20	2	5	3	3	2	2	0	3	20
13:20	13:21	4	0	5	4	3	3	0	5	24
13:21	13:22	3	3	4	0	4	4	2	4	24
13:22	13:23	2	2	2	2	4	2	3	2	19
13:23	13:24	0	4	3	3	3	3	4	3	23
13:24	13:25	1	3	1	4	2	0	2	4	17
13:25	13:26	3	2	4	1	4	1	3	0	18

13:26	13:27	2	2	3	2	1	3	4	3	20
13:27	13:28	2	3	5	4	3	4	2	1	24
13:28	13:29	4	2	1	3	1	2	3	3	19
13:29	13:30	2	3	4	2	3	2	4	2	22

The graphical representation of above mentioned per minute pedestrian volume change is as shown below figure 8.2.

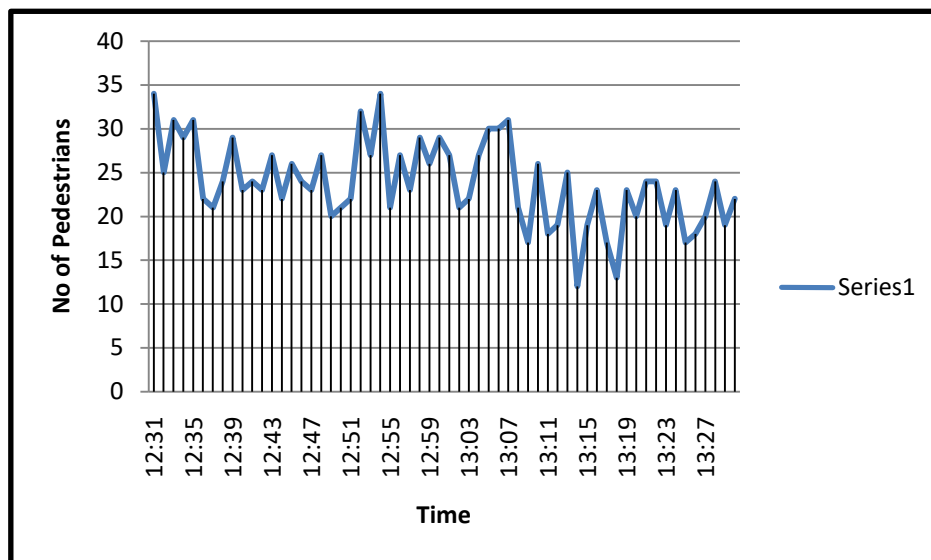


Figure 8.2 Per Minute Variation in Pedestrian Flow

For pedestrian speed measurement total 8 number of samples has been taken at every one minute. If any category pedestrian sample is not present in any particular minute than that sample is being neglected. The pedestrian speed calculated by the formulae pedestrian speed = (Trap length 6 m) / (Total time taken by pedestrian to cross trap length). The table 8.2 below shows the Average speed of pedestrians per minute.

Table 8.2 Pedestrian Speed Count

Time		Total No. of Pedestrians per Minute	Average Time Taken by Pedestrians in Sec	Average Speed
12:30	12:31	34	15	0.52
12:31	12:32	25	12	0.65
12:32	12:33	31	15	0.54
12:33	12:34	29	13	0.6
12:34	12:35	31	15	0.55
12:35	12:36	22	12	0.67
12:36	12:37	21	13	0.63
12:37	12:38	24	12	0.68
12:38	12:39	29	14	0.59
12:39	12:40	23	12	0.66
12:40	12:41	24	12	0.67
12:41	12:42	23	11	0.71
12:42	12:43	27	13	0.63
12:43	12:44	22	11	0.72
12:44	12:45	26	12	0.66
12:45	12:46	24	11	0.7
12:46	12:47	23	11	0.74
12:47	12:48	27	13	0.61
12:48	12:49	20	11	0.76
12:49	12:50	21	11	0.7

12:50	12:51	22	12	0.69
12:51	12:52	32	14	0.56
12:52	12:53	27	13	0.61
12:53	12:54	34	16	0.51
12:54	12:55	21	11	0.73
12:55	12:56	27	13	0.62
12:56	12:57	23	12	0.69
12:57	12:58	29	14	0.57
12:58	12:59	26	13	0.62
12:59	13:00	29	15	0.55
13:00	13:01	27	13	0.64
13:01	13:02	21	12	0.67
13:02	13:03	22	12	0.66
13:03	13:04	27	12	0.68
13:04	13:05	30	13	0.61
13:05	13:06	30	9	0.9
13:06	13:07	31	14	0.58
13:07	13:08	21	11	0.71
13:08	13:09	17	11	0.74
13:09	13:10	26	13	0.63
13:10	13:11	18	11	0.76
13:11	13:12	19	10	0.78
13:12	13:13	25	12	0.67
13:13	13:14	12	9	0.85
13:14	13:15	19	10	0.79
13:15	13:16	23	11	0.71
13:16	13:17	17	10	0.78
13:17	13:18	13	10	0.81
13:18	13:19	23	12	0.69
13:19	13:20	20	11	0.73
13:20	13:21	24	12	0.67
13:21	13:22	24	12	0.69
13:22	13:23	19	10	0.78
13:23	13:24	23	11	0.72
13:24	13:25	17	10	0.79
13:25	13:26	18	10	0.81
13:26	13:27	20	10	0.79
13:27	13:28	24	11	0.7
13:28	13:29	19	10	0.81
13:29	13:30	22	11	0.74

To know the relationship between change in flow to change in volume regression analysis has been done. The graphical representation of interrelationship between change in flow to change in volume shown in figure 8.3 below.

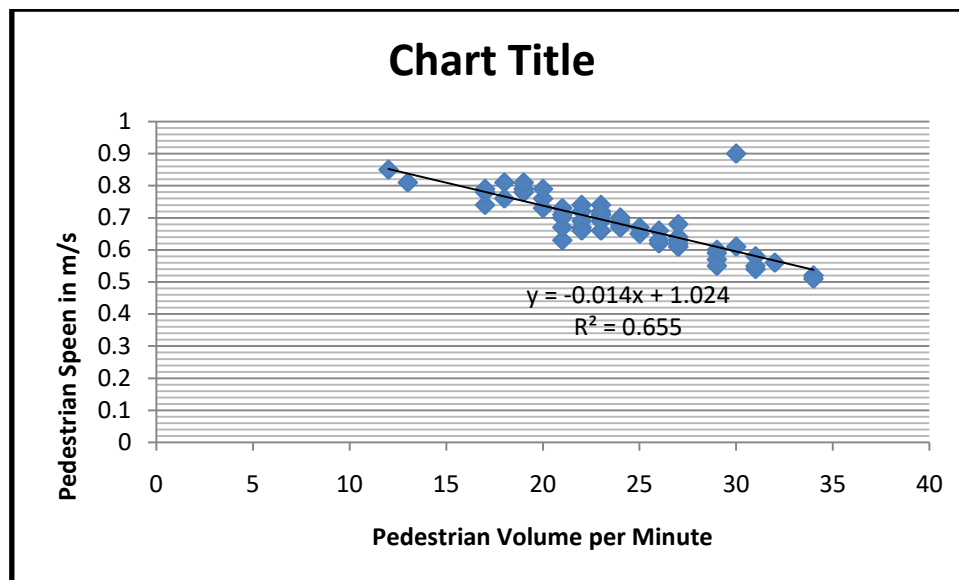


Figure 8.3 Relation Between Speed and Flow.

From above figure 8.3 the relation between speed and flow is linear. Also from regression analysis it shows that 65% of variation in pedestrian speed may be explained by variation in total pedestrian flow..

IX. CONCLUSION

From the present study the speed flow relationship obtained is linear. Also from regression analysis by considering speed as dependent variable and flow as independent variable R^2 value shows that 65% of variation in pedestrian speed may be explained by variation in total pedestrian flow. Also from volume count the youngsters and mid age pedestrians are dominating the flow so here also the speed of youngster and mid age pedestrians may be affected by presence of major percentage of senior citizen.

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