Improving pedestrian facilities in congested urban areas: a case study of Chennai city

B Subramanyam* and R Prasanna Kumar

1School of Civil Engineering, SASTRA University, Thanjavur – 613 401. India.
2Professor, Department of Civil Engineering, Malla Reddy Engineering College (Autonomous), Telangana, India

*Email: subramanyam@civil.sastra.edu and subramanyamjy@gmail.com

Abstract. Traffic congestion and lack of public pedestrian space are some problems faced by most urban metropolises. Conventionally walking has been a mode of transportation in Indian cities. The percentage of pedestrians may vary from 16 to 57 depending upon the city. Encounters between vehicular traffic and pedestrian traffic are at its rise currently. Rapid industrialization and urbanization in India has resulted in neglecting of pedestrian facilities. Consequently pedestrian are at greater risk for their safety more especially in the commercial zones of large cities. A change in perspective spotlight will create a sense of awareness that the pedestrian traffic is also vital as the vehicular traffic. Soothing the traffic would moderately cut the driving expediency but the pedestrians will get a much safer and peaceful route to their terminuses. Safety and comfort are the two pans of a balance while considering the pedestrian traffic. Considering these aspects, this study deals a study in improving pedestrian facilities by analysing the existing skeleton of the selected locations. The adequacy of facility is checked based on IRC latest guidelines and counteractive measures are postulated.

Keywords: pedestrian, vehicular traffic, Safety and comfort

1. Introduction

The major characteristics of Indian cities are very high densities and a variety of land use. Pedestrians and vehicles are the two main inhabitants of the urban roads. Earlier, there was much focus on the development of urban roads, focusing only on solving the issues faced by the vehicular traffic. The result of this is that nowadays vehicular traffic occupies a larger number of roads in cities, leading to a number of conflicts arising for pedestrians and other non-vehicular users. The most basic step to creating a safer city is by providing proper amenities to pedestrians. This research paper focuses on identifying the problems faced by the pedestrians in congested urban cities like Chennai. A management technique for the pedestrians is the skywalk. Therefore, the safety of pedestrians has become a very integral part of any transport planning. Many urban areas focus on development at a very small scale because of which results in congestion and leads to pedestrian-vehicular conflicts especially at Signalized Intersections. Two behavioural sides of pedestrians are of interest to planners, i.e. how pedestrians move relative to the others, their choice of route, and their decision whether to cross the road or not etc. and how pedestrian travel times are affected by the signal control measures.
2. Literature Review

The quality of service provided to the pedestrians is evaluated in terms of average delay to the pedestrians and also in terms of the comfort experienced by them. These are defined in terms of Level of Service (LoS) and is designated with letters A, B, C etc indicating poor quality of service in the descending order.

[1] Map the conditions at the site and comparing it with standards. Pedestrian’s proneness to accidents is the most considered factor in determining the dearth of facilities. Various road users include commuter, shopper, Disabled person and child. Differing priorities such as safety versus directness, based on different requirements are considered. Factors such as reliability, safety, greenery environment are the major contributors to a sustained skeleton. This is objectively measured but to an extensive scale. The existing features or the road furniture’s related to the pedestrians such as pedestrian facilities, Hazards to pedestrians were noted. The analysis provided remedial measure that ensures safety of the pedestrian. The template of the data collection, analysis of the existing condition, was generalized as a model for any situation that could predict the pedestrian proneness to accidents. [2] States that delay is the key feature for designing or improving the existing facilities. Various intersection requirements such as bus stop, signalized systems and regular bus service routes are necessary to find the delay. Data regarding opinion of the pedestrians, Road inventory data and data related to speed of vehicle and the pedestrian are the foremost components to be considered. This can be removed [3] carried out pedestrian traffic flow studies in two medium sized cities to assess the comfort and safety levels of pedestrians of these cities in Haryana. Various facilities are rated based on the analysis and the results are given in the form of percentages. Satisfaction and safety are given much importance. Lack of awareness and less importance to the pedestrians are the concerns that are to be taken care of.

[4] Propose a micro-simulation based approach for preparing footpath design guidelines integrating street vendors in these facilities. The micro-simulation model is calibrated and validated using data collected on selected locations in Bangalore city. The model was then used for two purposes: (a) to demonstrated strategies to improve LOS at the study locations in Bangalore with re-organized vendor spaces, (b) to develop general footpath design guidelines for different footpath widths and pedestrian flows. Offsets are provided in the footpaths to allocate separate threshold spaces to make the flow free from any obstructions. HCM guidelines are followed to match the data and suitable results are provided.

3. Data collection

The study location for the present work chosen was Chennai. The locations which had conflict between both vehicles and pedestrian were identified. Eleven locations were chosen on the basic of conflict between vehicular traffic and pedestrian traffic. From the observation it was found that 8am to 10am was the peak period for the pedestrians in the morning and 6pm to 8pm was the peak period in the evening. Pedestrian volume count was made for every 15minutes interval during the peak identified peak period. Geometric details of the study locations such as Footpath width, kerb height etc were collected and presented in table 1. Other details such as type of footpath surface, obstruction, electrical poles, location of trees, encroachment, subway, Foot over Bridge etc. were also observed. The volume count includes the pedestrian movement in both the directions of the pathway. The pedestrian traffic volume data were collected at morning and evening peak hours. The pedestrian traffic volume data were presented in table 2 and table 3.
### Table 1. Geometric Details of Identified study locations

| S. No | Locations                        | Width(m) | Footpath Surface |
|-------|----------------------------------|----------|-----------------|
| 1     | Olympia tech park                | 2.5      | Raised          |
| 2     | Race course guindy               | 1        | Raised          |
| 3     | Purasiwalkam high road 1         | 1.2-1.8  | Raised          |
| 4     | Purasiwalkam high road 2         | 1.2-1.8  | Raised          |
| 5     | Central                          | NIL      | Not raised      |
| 6     | Kodambakkam (meenakshi college)  | NIL      | Not raised      |
| 7     | Koyambedu bus stand              | 2.5-4    | Raised          |
| 8     | T.nagar                          | 0.6-1.2  | Raised          |
| 9     | Mgr statue                       | NIL      | Not raised      |
| 10    | Beach railway station            | NIL      | Not raised      |
| 11    | Light house                      | 1.3      | Raised          |

### Table 2. Pedestrian Traffic volumes during morning peak hour

| Location                  | 8.00-8.15 | 8.16-8.30 | 8.31-8.45 | 8.46-9.00 | 9.01-9.15 | 9.16-9.30 | 9.31-9.45 | 9.46-10.00 |
|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Olympia tech park         | 298        | 350        | 368        | 384        | 414        | 438        | 446        | 430        |
| Race course guindy        | 570        | 584        | 620        | 660        | 740        | 712        | 680        | 672        |
| Purasiwalkam high road 1  | 502        | 512        | 560        | 552        | 590        | 620        | 642        | 658        |
| Purasiwalkam high road 2  | 456        | 486        | 520        | 470        | 440        | 428        | 460        | 530        |
| Central                   | 3100       | 2988       | 2882       | 2852       | 2845       | 2951       | 2892       | 2974       |
| Kodambakkam (meenakshi college) | 424 | 484        | 521        | 541        | 512        | 486        | 476        | 497        |
| Koyambedu bus stand       | 542        | 524        | 502        | 492        | 482        | 508        | 524        | 574        |
| T.Nagar                   | 0          | 298        | 265        | 304        | 385        | 348        | 396        | 428        |
| MGR statue                | -          | -          | -          | -          | -          | -          | -          | -          |
| Beach railway station     | 152        | 162        | 172        | 165        | 210        | 260        | 284        | 292        |
4. Data analysis

4.1 Peak hour factor

This parameter helps us to understand the variation of traffic volume with in the peak hour. To account for these variations in the peak hour traffic engineers usually calculate peak hour factor to identify the critical volume.

PHF is calculated using the following equation.

\[
PHF = \frac{\text{Hourly volume}}{\text{Peak rate of flow within the hour}}
\]

(1)

If 15-minute periods are used, the PHF is computed as:

\[
PHF = \frac{V}{(4 \times V_{15})}
\]

Where,

- \( V = \) peak-hour volume (vph)
- \( V_{15} = \) volume during the peak 15 minutes of flow (ped/15 minutes)

Table 3. Pedestrian Traffic volumes during evening peak hour

| Locations                          | 6.00-6.15 | 6.16-6.30 | 6.31-6.45 | 6.46-7.00 | 7.01-7.15 | 7.16-7.30 | 7.31-7.45 | 7.46-8.00 |
|------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Olympia tech park                  | 450       | 480       | 442       | 468       | 520       | 490       | 512       | 532       |
| Race course guindy                 | 624       | 676       | 686       | 692       | 668       | 720       | 742       | 786       |
| Purasiwalkam high road 1           | 674       | 682       | 725       | 714       | 734       | 762       | 742       | 692       |
| Purasiwalkam high road 2           | 570       | 524       | 598       | 542       | 620       | 624       | 618       | 590       |
| Central                            | 3452      | 3354      | 3426      | 3374      | 3452      | 3512      | 3596      | 3698      |
| Kodambakkam                        | 514       | 520       | 489       | 496       | 467       | 472       | 452       | 483       |
| Koyambedu bus stand                | 542       | 596       | 572       | 569       | 620       | 604       | 629       | 672       |
| T.nagar                            | 560       | 512       | 579       | 620       | 614       | 630       | 642       | 615       |
| Mgr statue                         | 120       | 145       | 198       | 212       | 254       | 241       | 225       | 214       |
| Beach railway station              | 220       | 254       | 264       | 256       | 248       | 273       | 289       | 278       |
| Light house                        | 189       | 186       | 168       | 196       | 215       | 226       | 210       | 242       |
Greater variation in traffic volume within the peak hour is indicated by lower values of PHF and vice versa. The values of the Peak Hour Factor obtained in all the study locations range between 0.9 to 1.0. It signifies that there is not much variation in the flow rate. Subsequently to understand the fluctuation in pedestrian traffic volume within the peak period, Peak Hour Factors (PHF) for all the study locations were determined and presented in Table 4. Speed is an important variable in assessing the delay to the Pedestrians which is essential in arriving at appropriate Level of Service (LOS), based on the quality of service offered by the facility to the users. Hence speed data was collected from all the study locations and presented in Table 5. The LOS calculations were presented in Table 6.

### Table 4. Peak hour factors at different study locations

| Location                      | Peak Hour Volume (M) | Peak Hour Volume I (M) | Peak 15 mins Volume (M) | Peak 15 mins Volume I (M) | Peak Hour Factor (M) | Peak Hour Factor I |
|-------------------------------|----------------------|------------------------|-------------------------|--------------------------|----------------------|------------------|
| Olympia tech park             | 1728                 | 2054                   | 446                     | 532                      | 0.96                 | 0.96             |
| Race course guindy            | 2804                 | 2916                   | 740                     | 786                      | 0.94                 | 0.927            |
| Purasiwalkam high road 1      | 2510                 | 2953                   | 658                     | 762                      | 0.953                | 0.96             |
| Purasiwalkam high road 2      | 1932                 | 2452                   | 486                     | 624                      | 0.99                 | 0.98             |
| Central                       | 11822                | 14258                  | 3100                    | 3698                     | 0.95                 | 0.963            |
| Kodambakkam                   | 2060                 | 2376                   | 541                     | 496                      | 0.95                 | 1.19             |
| Koyambedu bus stand           | 2088                 | 2525                   | 574                     | 672                      | 0.91                 | 0.93             |
| T.Nagar                       | 1557                 | 2501                   | 428                     | 642                      | 0.9                   | 0.97             |
| MGR statue                    | -                    | 934                    | -                       | 254                      | -                    | 0.919            |
| Beach railway station         | 1046                 | 1088                   | 292                     | 289                      | 0.89                 | 0.941            |

### Table 5. Observed Pedestrian speeds at study locations

| Location                      | Men (m/s) | Women (m/s) | Avg speed (m/s) | Width (m) | Los |
|-------------------------------|-----------|-------------|-----------------|-----------|-----|
| Olympia tech park             | 298       | 350         | 368             | 384       | 414 |
| Race course guindy            | 570       | 584         | 620             | 660       | 740 |
| Purasiwalkam high road 1      | 502       | 512         | 560             | 552       | 590 |
| Purasiwalkam high road 2      | 456       | 486         | 520             | 470       | 440 |
| Central                       | 3100      | 2988        | 2882            | 2852      | 2845|
| Kodambakkam                   | 424       | 484         | 521             | 541       | 512 |
| Koyambedu bus stand           | 542       | 524         | 502             | 492       | 482 |
| T.Nagar                       | 0         | 298         | 265             | 304       | 385 |
| MGR statue                    | -         | -           | -               | -         | -   |
| Beach railway station         | 152       | 162         | 172             | 165       | 210 |

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Table 6. Pedestrian delay at study locations

| Location                        | Length (m) | Avg. speed (min) | Actual speed (min) | Delay (min) |
|---------------------------------|------------|------------------|--------------------|-------------|
| Race course guindy              | 560        | 6.43             | 8.14               | 1.31        |
| Purasiwalkam high road 1        | 435        | 5.09             | 6.11               | 1.02        |
| Purasiwalkam high road 2        | 267        | 3.12             | 3.45               | 0.33        |
| Kodambakkam                     | 552        | 6.51             | 7.43               | 0.52        |
| T.nagar                         | 421        | 5.50             | 7.36               | 1.46        |
| Beach railway station           | 620        | 7.43             | 9.32               | 1.49        |

5. Conclusion

From the analysis of data collected at various study locations and based on the Level of Service calculations suggestions for improvement of pedestrian facilities were made.

- Instalment of rumble strips
- construction of pedestrian islands
- installment of pedestrians sensors in crosswalks
- installation of more perspicuous traffic signs and signals
- removal of trees and utility poles

Scope of future work: more advanced data collection techniques to collect robust data and soft tools need to be utilized in the analysis for understanding the intricacies of pedestrian characteristics and improve them to meet the demands of the present cities.

References

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