Traffic & Pedestrian Studies of Selected Routes in Nagpur City

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Abstract
Traffic flow is one of the major issues that most of the metropolitan cities are facing in spite of measures being taken to ease and reduce it. Traffic congestion in the recent past years, has emerged as one of the main challenge for engineers, planners and policy makers in urban areas. Also it is a challenge to provide efficient road width, footpath width, and signal time for the increasing demand with the limited resources available. In this research traffic flow and pedestrian facilities of selected routes in Nagpur city has been studied. This research investigates those sections of the Nagpur city which are considered among the busiest roads.

Key words
Traffic Flow, Pedestrian Facilities, Traffic Signal, Footpath, Traffic Congestion.

Introduction
Nagpur, being a developing metro, has got a traffic density which is growing at a rapid pace. The increasing number of two wheelers, four wheelers along with the public transport and pedestrians poses a severe issue for the smooth and congestion-free movement of the traffic. It is seen that no effective traffic management has been carried out at the heavily crowded areas like Variety square, Law College Square, Shankar Nagar Square, Ravi Nagar Square, Lokmat Square, etc. Effective designs of flyovers have been constructed keeping in view the density of the flow of the traffic and the roads underneath it.

One of the major reasons is the complexity involved in modelling pedestrian behaviour. Complexity arises from multiple parameters which affect the pedestrian crossing behaviour and are very difficult to identify. At signalized intersections, pedestrian travel is extremely high with lesser amount of safety measures provided to them. At gross level one will analyze the fundamental flow parameters like speed, density of pedestrian motion and at microscopic level one may track the paths followed by individual pedestrians while moving respectively. From this it is clear that the pedestrian may create their own paths in their journey trip.

Coming to the pedestrian crosswalks there were several cross walks like zebra crossing are designed for a road, provide gainful work to assist the pedestrians to move from one side to the opposite aspect of road, and which plays a significant role in the mobility and safety mode of signalized intersections. In some other places like where the busy traffic takes place, pedestrian choose the mid blocks to cross the road. But there's no safety as compared to signalized intersections. Even several pedestrian crosswalks area required in these midblock sections when pedestrian has to walk too much distance to either ends of divider to cross the road.

A number of traffic and transportation surveys were conducted as a part of the study in order to assess the passenger and goods movement pattern, travel characteristics, pedestrian and parking characteristics and the available infrastructure facilities within the study area. The data collection activities included classified traffic volume counts, PCU, speed, footpath analysis, parking surveys, pedestrian surveys.

Objective of Work
- To study the traffic flow.
- Parking facilities
- Pedestrian facilities available.

Review of Literature
Sachin Dass et al (2006) have reported that with an increase in the motor vehicular traffic and the corresponding increase in the congestion increase in the road accidents. [12] The importance for improvement of the pedestrian facilities has assumed great significance.

Wen Dong and Alex Pentland (2008) have reported their results on the high resolution tracking data for hundreds to thousands of urban vehicles, [14] as well as the availability of digitized map data, provide urban planners unprecedented opportunities for better understanding urban motor vehicle transportation and for better exploiting the knowledge thereof.

Rajat Rastogi, et al, (2011), studied the Pedestrian Speeds at Midblock Crossings. Speed while crossing a road depends on various characteristics related to pedestrians, traffic, and physical features of the road. [10] A few of these characteristics are age, gender, pedestrian movement singly or in a group, traffic volume, size of the urban area, and width of the road.

Marisamynathan, Vedagiri Perumal (2014), [9] have analysed the crossing behaviour of pedestrians like crossing speed, compliance with signal, and pedestrian-vehicular interaction under mixed traffic conditions.
Rajko Horvat, Goran Kos, Marko Ševrović (2015), [11] studied the design elements of road infrastructure such as, Road type and number of traffic lanes, cross-sectional profile. A Scientifically model has been developed to explore the traffic flows to the exact of traffic flows in urban areas.

Tejas Rawal, V. Devadas (2015), have studied on the world wide recurring problem in road traffic congestion which was acutely faced by almost all major cities.[13]

**Study Area**

The study area is limited to three routes of Nagpur,

1. From Law college square to Shankar Nagar
2. From Lokmat square to Variety square
3. From Ravi nagar square to Ram Nagar square

**Methodology**

Traffic surveys and pedestrian studies were conducted. Pedestrian facilities were studied and all the data were analysed using Microsoft Excel.

**Results and Discussion**

Traffic volume data has been collected in all the routes of study area presented in the Figure 2, Figure 3, Table 1 and Table 2. Peak hour traffic volume is collected in the morning from 10 a.m. to 12 noon and in the evening from 4 p.m. to 6 p.m. Similarly Non peak hour traffic volume is collected from 1 p.m. to 4 p.m. Similarly total pedestrians using or not using footpath was also collected during the same peak and non-peak hours. Total footpath area and obstruction in footpath area was also studied, the data of the same is shown in Figure 4, Figure 5, Table 3 and Table 4. The obstruction area of footpath varies from 10% to 60%. Due to which the pedestrians are forced to use road which is meant for vehicles. This directly affects the speed of vehicles. The average speeds of two and four wheelers have fallen respectively to 25 KMPH and 22 KMPH. Also it observed that pedestrians not using footpath is almost ranges from 80% to 90%. This may be due to encroachment of footpath by roadside vendors and obstructions in footpath.
Route from Lokmat square to Variety square

| Route       | Two Wheelers | Three Wheelers | Four Wheelers | Cycles | Trucks & Buses | Total Volume (in vehicles) | Total Volume (in PCU's) |
|-------------|--------------|----------------|---------------|--------|----------------|---------------------------|-------------------------|
| LS TO PS    | 3276         | 748            | 1148          | 126    | 110            | 5408                      | 2697                    |
| 10 TO 12    | 3420         | 940            | 1023          | 145    | 198            | 5726                      | 2981                    |
| PS TO LS    | 3854         | 764            | 1040          | 98     | 102            | 5858                      | 2861                    |
| 4 TO 6      | 3792         | 846            | 1326          | 114    | 116            | 6194                      | 3081                    |
| LS TO PS    | 2456         | 561            | 861           | 94     | 82             | 4054                      | 2022                    |
| 1 TO 4      | 2565         | 705            | 767           | 108    | 148            | 4293                      | 2235                    |

Figure 2: Sample Graph showing total Vehicles Plying (PCU’s)

Figure 3: Sample Graph showing Vehicles Plying

Figure 4: Sample Graph showing Utilization of Footpath by Pedestrians

Figure 5: Sample Graph showing Availability and Obstruction Area of Footpath
### Table 1: Traffic Volume in the Route from Lokmat Square to Variety Square

| Route from Ravi Nagar square to Ram Nagar square | Two Wheelers | Three wheelers | Four Wheelers | Cycles | Trucks & Buses | Total Volume (in vehicles) | Total Volume (in PCU's) |
|-------------------------------------------------|--------------|----------------|---------------|--------|---------------|--------------------------|------------------------|
| RS TO LITR 10 TO 14                             | 1489         | 229            | 728           | 32     | 42            | 2520                     | 1204                   |
| LITR TO RS 10 TO 14                             | 1372         | 214            | 718           | 28     | 36            | 2368                     | 1133                   |
| RS TO LITR 10 TO 14                             | 1836         | 258            | 840           | 36     | 48            | 3018                     | 1427                   |
| LITR TO RS 4 TO 10                              | 1921         | 261            | 872           | 39     | 54            | 3147                     | 1485                   |
| RS TO LITR 10 TO 1                                 | 1377        | 193            | 630           | 27     | 36            | 2263                     | 1069                   |
| LITR TO RS 1 to 4                                | 1442         | 214            | 520           | 22     | 38            | 2236                     | 1061                   |
| LITR TO RNS 10                                   | 1612         | 248            | 847           | 36    | 49            | 2792                     | 1337                   |
| RNS TO LITR 10                                   | 1479         | 297            | 812           | 36    | 51            | 2675                     | 1321                   |
| LITR TO RNS 4                                   | 1975         | 315            | 978           | 42    | 54            | 3364                     | 1612                   |
| RNS TO LITR 4                                   | 2079         | 342            | 907           | 41    | 63            | 3432                     | 1653                   |
| LITR TO RNS 1 to 4                               | 1487         | 214            | 689           | 31    | 39            | 2460                     | 1165                   |
| RNS TO LITR 1 to 4                               | 1587         | 247            | 589           | 27    | 48            | 2498                     | 1195                   |

### Table 2: Traffic Volume in the Route from Ravi Nagar Square to Ram Nagar Square

| Route From Lokmat Square To Variety Square | Pedestrian Using Footpath | Pedestrian Not Using Footpath | Route From Ravi Nagar Square To Ram Nagar Square | Pedestrian Using Footpath | Pedestrian Not Using Footpath |
|-------------------------------------------|---------------------------|-------------------------------|-----------------------------------------------|----------------------------|-------------------------------|
| LS TO PS 10 TO 12                         | 20                         | 1110                          | RS TO LITR 10                                 | 12                         | 248                           |
| PS TO LS 10 TO 12                         | 23                         | 1117                          | LITR TO RS 10                                 | 15                         | 236                           |
| LS TO PS 4 TO 6                           | 28                         | 916                           | RS TO LITR 4 TO 4                              | 24                         | 239                           |
| PS TO LS 4 TO 6                           | 27                         | 804                           | LITR TO RS 4 TO 4                              | 23                         | 243                           |
| LS TO PS 1 to 4                           | 15                         | 832                           | RS TO LITR 1 to 4                              | 10                         | 170                           |
| PS TO LS 1 to 4                           | 17                         | 838                           | LITR TO RS 1 to 4                              | 12                         | 178                           |
| PS TO JRS 10 TO 12                        | 28                         | 897                           | LITR TO RNS 10                                 | 18                         | 287                           |
| JRS TO PS 10 TO 12                        | 19                         | 742                           | RNS TO LITR 10                                 | 21                         | 264                           |
| PS TO JRS 4 TO 6                          | 31                         | 819                           | LITR TO RNS 4                                 | 25                         | 289                           |
| JRS TO PS 4 TO 6                          | 39                         | 925                           | RNS TO LITR 4                                 | 27                         | 281                           |
| PS TO JRS 1 to 4                          | 21                         | 672                           | LITR TO RNS 1                                 | 16                         | 199                           |
| JRS TO PS 1 to 4                          | 14                         | 556                           | RNS TO LITR 1 to 4                             | 19                         | 197                           |
| JRS TO VS 10 TO 12                        | 1200                       | 2198                          |                                               |                            |                               |
| VS TO JRS 10 TO 6                         | 1324                       | 2028                          |                                               |                            |                               |
| JRS TO VS 4 TO 6                          | 1500                       | 2134                          |                                               |                            |                               |
| VS TO JRS 4 TO 6                          | 1489                       | 2236                          |                                               |                            |                               |
| JRS TO VS 1 to 4                          | 900                        | 1648                          |                                               |                            |                               |
| VS TO JRS 1 to 4                          | 993                        | 1521                          |                                               |                            |                               |

### Table 3: Pedestrian Using or Not Using Footpath in the two routes
| Route From Lokmat Square To Variety Square | Total Footpath Area (Sq.m) | Obstruction area (Sq.m) | Available area for pedestrians (Sq.m) | Route From Ravi Nagar Square To Ramnagar Square | Total Footpath Area (Sq.m) | Obstruction area (Sq.m) | Available area for pedestrians (Sq.m) |
|------------------------------------------|----------------------------|------------------------|-------------------------------------|-----------------------------------------------|----------------------------|------------------------|-------------------------------------|
| LS TO PS                                 | 790.24                     | 341                    | 449.24                              | RS TO LITR                                    | 693                        | 338                    | 355                                |
| PS TO LS                                 | 788.44                     | 441.86                 | 346.58                              | LITR TO RS                                    | 745.5                      | 323.4                  | 422.1                              |
| PS TO JRS                                | 493.06                     | 88.34                  | 404.72                              | LITR TO RNS                                    | 670                        | 120                    | 550                                |
| JRS TO PS                                | 507.32                     | 252.87                 | 254.45                              | RNS TO LITR                                    | 790.24                     | 341                    | 449.24                             |
| JRS TO VS                                | 535.35                     | 200.82                 | 334.53                              |                                               |                            |                        |                                     |
| VS TO JRS                                | 507.22                     | 266.7                  | 240.52                              |                                               |                            |                        |                                     |

Table 4: Total Footpath Area Obstruction due to Encroachments and Other Factors in the Two Routes

Conclusion

- It has been observed that out of the three road routes, maximum traffic is from Variety Square to Jhansi Rani Square. This is because it is considered as the most crowded area in Nagpur city.
- Since this region is a Central Business Area (CBA), here traffic count is higher as compared to the remaining two stretches.
- The pedestrian count is maximum on Variety Square to Jhansi Rani Square stretch. Due to encroachments, the complete footpath stretch is not available to the pedestrians. There are also various obstructions on the foot path which made pedestrians to step up and step down of footpath.
- On all the three routes it has observed that the footpath tiles were broken on many places, and at some points, the length of broken footpath is greater than 20 meters.
- Trees, electric poles, telephone DP boxes, shopkeepers’ encroachments, removal of paver tiles/blocks and various openings were present in between the footpath which becomes the obstructions while walking through it.
- It has been observed that percentage area availability of footpath for the pedestrians is very less. So pedestrians have been forced to use road in place of footpath.
- On all the three routes, it was observed that vehicles were parked in no parking zone and also in haphazard ways. Also the pedestrians were using road due to encroachment of footpaths and obstructions on the footpaths. These are the reasons which resulted in decreased average speed of the vehicles plying on the road.
- Routine maintenance of the footpath with strict removal of encroachment will lead to smooth movement of the pedestrians.
- Pedestrians are encouraged to use footpaths and they are strictly warned not to use the road, which will result in full availability of width of road for vehicles and smooth traffic flow of vehicles.
- Strict and structural parking area will enhance the speed of vehicles.

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