

Effective Traffic Management for Two major junctions of Pune city by Predictive analysis and Design of Simulation Model

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ABSTRACT: This paper deals with traffic volume studies to determine the volume of traffic moving on the roads and classification of roadway vehicles at a particular section during particular time. Volumes of a day or an hour can vary greatly depending on the different day of the week or different time period of a day. Traffic volume survey is determination of number, movement and classification of roadway vehicles at a given location.

Traffic volume is the most delicate information to implement transportation planning, design and to start new transportation modes. In this paper we have chosen simulation model as the problem of uncontrolled traffic is rising in the city. The management of traffic has become a necessity. The model and its analysis are helpful for prediction of the traffic volume at the end of five years at selected junctions in Pune city facing maximum traffic congestion.

KEYWORDS: Traffic volume, simulation model, major junctions, prediction, five years.

I. INTRODUCTION

Effective traffic management is the need of the hour as the vehicular population and the problem caused by traffic congestion are ever increasing. There is no system adopted for traffic management in our city; however no mechanism has been implemented for co-operation and co-ordination.

Several studies related to traffic density, volume, congestion problems were conducted. This covered traffic systems like bus rapid transit, non motorised transport and public transport.

Due to scarcity of resources and desire to streamline the arrangement, a simulation model has been put to use. We plan to design a simulation model that will help us predict the traffic situation as well as the traffic volume at a particular junction for future.

Through this simulation model we can apply the remedial measures such as changes in road dimension, alternative routes to avoid traffic congestion, construction of flyovers or subways.

Traffic volume studies are conducted to determine the volume of traffic moving on the roads and classifications of roadway vehicles at a particular section during a particular time. Volumes of a day or an hour can vary greatly, depending on the different day of the week or different time period of a day. Traffic Volume survey is the determination of the number, movement and classifications of roadway vehicles at a given location.

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II. RELATED WORK

i. Analysis of the Construction Traffic Management Information (International) -Linda Ming

With China's rapid development of information technology and widely used in the transportation industry, on transport had a profound impact. Therefore, only the information continue to promote the construction of traffic management with the help and application of modern information processing technology, our transportation industry to adapt to the traffic construction, production and management of all aspects of development needs, better serve the public.

With China's rapid economic development, transportation management and service highlights the growing problem is not high. To this end, an urgent need of information technology into the construction of traffic and transport management to the whole process, therefore, the need to strengthen traffic management the construction of information for the public to provide more information services to the transportation industry to enhance the management level.

ii. The traffic control department in the role of rural road construction (national) - Anonymous (Science Direct)

Speed up rural road construction is the transport sector in the new period of a glorious and arduous task. We must clearly understand the situation, unify the thinking up to the central strategic plan, give the whole transport sectors ability to overcome difficulties, do solid work, and earnestly to the work of rural road construction as the focus of the traffic good job in order to build a new socialist in rural areas to make new and greater contributions.

Rural road constructions is to promote the building of new socialist countryside important content is to speed up rural economic development, adjusting the agricultural structure, to protect the farmers an important foundation for sustained income growth conditions, but also improve the road transport network, an important component. Building a new socialist countryside, we must comprehensively accelerate the pace of rural road construction. In accordance with the requirements of building a socialist new countryside and further speed up the country road construction in rural areas is the transport sector in the new period of a glorious and arduous task. We must clearly understand the situation, unify the thinking up to the central strategic plan, give the whole transport sectors ability to overcome difficulties, do solid work, and earnestly to the work of rural road construction as the focus of the traffic good job in order to build a new socialist in rural areas to make new and greater contributions.

III. AIM & OBJECTIVES

The aim of the study is to design the simulation model for forecasting and solving issues related to traffic congestion by predicting the traffic volume in the future from the analysis of the current traffic volume.

To achieve this aim following objectives were set:

1. Identification of the traffic problem in a certain area (nal stop and mundhwa-keshavnagar junction).
2. Study of traffic volume and data collection.
3. Design of simulation model.
4. Recommendation of remedial measures

IV. METHODOLOGY

1. Problem identification based on current traffic congestion problems.
2. Selection of junctions, time periods, vehicle type.
3. Data collection by manual/counter method.
4. Analysis based on Monte Carlo Simulation method.
5. Prediction of increase in traffic volume for next 5 years based on results obtained.
6. Remedial measures suggested tackling traffic problem.

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(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 3, March 2017

V. DATA COLLECTION

For the predictive analysis we needed the current traffic volume. Out of the many methods available for finding the current traffic volume we selected the manual method. Considering the generalized traffic scenario at both the junctions, for collection of this traffic volume we selected the time slots of one hour in the peak hours in the morning and evening and one hour in the slack hours in the afternoon. We recorded the traffic by taking video recording.

a) NAL STOP

This junction connects prime commercial areas such as Deccan and Shivajinagar. It also connects prime residential areas like Kothrud, Karvenagar and Warje. These areas have large number of schools and colleges and are considered the heart of the city. Thus we observe crowded roads having mixed traffic conditions.

TABLE 1
Nal stop readings – 9-10am

| Road direction | Sr. No. | 2 wheeler | 3 wheeler | 4 wheeler | heavy | |
|-----------------------|---------|-------------|------------|-------------|------------|-------------|
| Towards Deccan | 1 | 2172 | 280 | 756 | 72 | |
| Towards Kothrud | 2 | 1028 | 340 | 456 | 132 | |
| Towards Mhatre bridge | 3 | 2316 | 186 | 588 | 36 | |
| | | 5516 | 806 | 1800 | 240 | 8362 |

Table 1 describes readings for time 9-10am for 2, 3, 4 wheeler and heavy vehicles at Nalstop towards Deccan, Kothrud & Mhatre bridge.

TABLE 2
Nalstop readings – 2-3pm

| Road direction | Sr.No | 2 wheeler | 3 wheeler | 4 wheeler | heavy | |
|-----------------------|-------|-------------|------------|-------------|------------|-------------|
| Towards Deccan | 1 | 1184 | 288 | 536 | 100 | |
| Towards Kothrud | 2 | 1624 | 356 | 672 | 108 | |
| Towards Mhatre bridge | 3 | 1902 | 240 | 534 | 66 | |
| | | 4710 | 884 | 1742 | 274 | 7610 |

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(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 3, March 2017

Table 2 describes readings for time 2-3pm for 2, 3, 4 wheeler and heavy vehicles at Nalstop towards Deccan, Kothrud & Mhatre bridge.

TABLE 3
Nal stop readings – 7-8 pm

| Road direction | Sr.no | 2 wheeler | 3 wheeler | 4 wheeler | heavy | |
|-----------------------|-------|-------------|-------------|-------------|------------|-------------|
| Towards Deccan | 1 | 1920 | 432 | 858 | 120 | |
| Towards Kothrud | 2 | 2234 | 376 | 875 | 112 | |
| Towards Mhatre bridge | 3 | 1452 | 225 | 658 | 62 | |
| | | 5606 | 1033 | 2391 | 294 | 9324 |

Table 3 describes readings for time 7-8pm for 2, 3, 4 wheeler and heavy vehicles at Nalstop towards Deccan, Kothrud & Mhatre bridge.

From the above data we get to know about the current overall traffic scenario at Nal Stop. From the analysis of this data we can clearly see that the two wheeler traffic is the maximum compared to the other three vehicle types.

b) KESHAVNAGAR – MUNDHWA JUNCTION

The area connected by this junction has largely developed over the past few years due to many corporate companies having their large campuses and also development of residential and commercial places like Magarpatta City, Amanora Park Town, Seasons Mall and many other famous hotel chains.

TABLE 4
Mundhwa readings – 9-10am

| Road direction | Sr no. | 2 wheeler | 3 wheeler | 4 wheeler | heavy | |
|-----------------------|--------|-------------|------------|-------------|------------|-------------|
| towards nagar road | 1 | 1052 | 210 | 845 | 108 | |
| towards seasons | 2 | 1952 | 198 | 863 | 114 | |
| towards keshavnagar | 3 | 757 | 157 | 923 | 49 | |
| towards passport off. | 4 | 1423 | 212 | 821 | 98 | |
| | | 5184 | 777 | 3452 | 369 | 9782 |

Table 4 describes readings for time 9-10am for 2, 3, 4 wheeler and heavy vehicles at Mundhwa towards Nagar road, Seasons, Keshavnagar & Passport office.

TABLE 5

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 3, March 2017

Mundhwa readings – 2-3pm

| Road direction | Sr no. | 2 wheeler | 3 wheeler | 4 wheeler | heavy | |
|-----------------------|--------|-------------|------------|-------------|------------|-------------|
| Towards nagar road | 1 | 639 | 103 | 430 | 53 | |
| Towards seasons | 2 | 986 | 91 | 523 | 49 | |
| Towards keshawnagar | 3 | 452 | 67 | 578 | 43 | |
| Towards passport off. | 4 | 782 | 107 | 334 | 19 | |
| | | 2859 | 468 | 1865 | 164 | 5356 |

Table 5 describes readings for time 2-3pm for 2, 3, 4 wheeler and heavy vehicles at Mundhwa towards Nagar road, Seasons, Keshavnagar & Passport office.

TABLE 6
Mundhwa readings – 7-8 pm

| Road direction | Sr. no. | 2 wheeler | 3 wheeler | 4 wheeler | Heavy | |
|-----------------------|---------|-------------|------------|-------------|------------|--------------|
| towards nagar road | 1 | 1120 | 202 | 861 | 111 | |
| towards seasons | 2 | 2051 | 201 | 884 | 117 | |
| towards keshawnagar | 3 | 921 | 221 | 924 | 101 | |
| towards passport off. | 4 | 1578 | 163 | 817 | 54 | |
| | | 5670 | 787 | 3486 | 483 | 10426 |

Table 6 describes readings for time 7-8pm for 2, 3, 4 wheeler and heavy vehicles at Mundhwa towards Nagar road, Seasons, Keshavnagar & Passport office.

This suggests that the two wheeler based traffic is the maximum. But as compared to the other areas of the city, the 4 wheeler based traffic is greater as the connecting areas have large commercial and corporate zones.

VI. ANALYSIS

Analysis of data collected was divided in 2 cases:

1. Case A: Keeping direction and time constant (vehicular type analysis)

NAL STOP JUNCTION

Time : 9-10am

Vehicle type: Two wheeler

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 3, March 2017

Table 7

| Direction | 2 wheeler | cum. Freq | range | year | random nos | freq |
|---------------|-------------|-----------|-----------|------|------------|--------------|
| Deccan | 2172 | 2172 | 0-2171 | 1 | 451 | 2172 |
| Kothrud | 1028 | 3200 | 2172-3199 | 2 | 1156 | 2172 |
| mhatre bridge | 2316 | 5516 | 3200-5516 | 3 | 2791 | 1028 |
| | 5516 | | | 4 | 4672 | 2316 |
| | | | | 5 | 5353 | 2316 |
| | | | | | | 10004 |

Table 7 gives analysis of data by simulation for 2 wheeler at Nalstop junction towards deccan, kothrud and Mhatre bridge for time 9-10am.

Vehicle type: Three wheeler

Table 8

| Direction | 3 wheeler | cum. Freq | range | Year | random nos | freq |
|---------------|------------|-----------|---------|------|------------|-------------|
| Deccan | 280 | 280 | 0-279 | 1 | 101 | 280 |
| kothrud | 340 | 620 | 280-619 | 2 | 304 | 340 |
| mhatre bridge | 186 | 806 | 620-806 | 3 | 413 | 340 |
| | 806 | | | 4 | 599 | 340 |
| | | | | 5 | 734 | 186 |
| | | | | | | 1486 |

Table 8 gives analysis of data by simulation for 3 wheeler at Nalstop junction towards deccan, kothrud and Mhatre bridge for time 9-10am.

Vehicle type: 4 wheeler

Table 9

| Direction | 4 wheeler | CF | range | Year | RN | freq |
|---------------|-------------|------|-----------|------|------|-------------|
| Deccan | 756 | 756 | 0-755 | 1 | 356 | 756 |
| Kothrud | 456 | 1212 | 756-1211 | 2 | 609 | 756 |
| mhatre bridge | 588 | 1800 | 1212-1800 | 3 | 904 | 456 |
| | 1800 | | | 4 | 1270 | 588 |
| | | | | 5 | 1696 | 588 |
| | | | | | | 3144 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 3, March 2017

Table 9 gives analysis of data by simulation for 4 wheeler at Nalstop junction towards deccan, kothrud and Mhatre bridge for time 9-10am.

Vehicle type: Heavy
Table 10

| Direction | heavy | CF | range |
|---------------|------------|-----|---------|
| Deccan | 72 | 72 | 0-71 |
| Kothrud | 132 | 204 | 72-203 |
| mhatre bridge | 36 | 240 | 204-240 |
| | 240 | | |

| year | RN | freq |
|------|-----|------------|
| 1 | 29 | 72 |
| 2 | 45 | 72 |
| 3 | 97 | 132 |
| 4 | 169 | 132 |
| 5 | 235 | 36 |
| | | 444 |

Table 10 gives analysis of data by simulation for heavy vehicles at Nalstop junction towards deccan, kothrud and Mhatre bridge for time 9-10am.

2. Case B : Vehicle and duration constant:

NAL STOP JUNCTION

Towards deccan

Time: 9-10am

Table 11

| vehicle type | towards deccan | CF | range |
|--------------|----------------|------|-----------|
| 2 wheeler | 2172 | 2172 | 0-2171 |
| 3 wheeler | 280 | 2452 | 2172-2451 |
| 4 wheeler | 756 | 3208 | 2452-3207 |
| Heavy | 72 | 3280 | 3208-3280 |
| | 3280 | | |

| year | RN | freq |
|------|------|-------------|
| 1 | 1014 | 2172 |
| 2 | 1736 | 2172 |
| 3 | 2463 | 756 |
| 4 | 2902 | 756 |
| 5 | 3127 | 756 |
| | | 6612 |

Table 11 gives analysis of data by simulation for heavy vehicles at Nalstop junction towards deccan for time 9-10am keeping vehicle and duration constant.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 3, March 2017

Time: 2-3pm

Table 12

| vehicle type | towards deccan | CF | range |
|--------------|----------------|------|-----------|
| 2 wheeler | 1184 | 1184 | 0-1183 |
| 3 wheeler | 288 | 1472 | 1184-1471 |
| 4 wheeler | 536 | 2008 | 1472-2007 |
| Heavy | 100 | 2108 | 2008-2108 |
| | 2108 | | |

| year | RN | freq |
|------|------|-------------|
| 1 | 966 | 1184 |
| 2 | 1270 | 288 |
| 3 | 1542 | 536 |
| 4 | 1754 | 536 |
| 5 | 2008 | 100 |
| | | 2644 |

Table 12 gives analysis of data by simulation for heavy vehicles at Nalstop junction towards deccan for time 2-3pm keeping vehicle and duration constant.

Time: 7-8pm

Table 13

| vehicle type | towards deccan | CF | range |
|--------------|----------------|------|-----------|
| 2 wheeler | 1920 | 1920 | 0-1919 |
| 3 wheeler | 432 | 2352 | 1920-2351 |
| 4 wheeler | 858 | 3210 | 2352-3209 |
| Heavy | 120 | 3330 | 3210-3330 |
| | 3330 | | |

| year | RN | freq |
|------|------|-------------|
| 1 | 1014 | 1920 |
| 2 | 1432 | 1920 |
| 3 | 2008 | 432 |
| 4 | 2556 | 858 |
| 5 | 3073 | 858 |
| | | 5988 |

Table 13 gives analysis of data by simulation for heavy vehicles at Nalstop junction towards deccan for time 7-8pm keeping vehicle and duration constant.

Similar calculations were done for case A and B for other junctions and time periods.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 3, March 2017

VII. RESULTS & OUTCOME

Case A : Keeping direction and time constant

OUTCOME: Which type of vehicle is causing max. traffic.

Table 14

| Road | 2 wheeler | | 3 wheeler | | 4 wheeler | | heavy | |
|---------------------|-----------|---------|-----------|---------|-----------|---------|---------|---------|
| | 2015-16 | 2020-21 | 2015-16 | 2020-21 | 2015-16 | 2020-21 | 2015-16 | 2020-21 |
| Nal stop | | | | | | | | |
| time 9-10 | 5516 | 10004 | 806 | 1486 | 1800 | 3144 | 240 | 444 |
| time 2-3 | 4710 | 8954 | 884 | 1596 | 1742 | 3086 | 274 | 524 |
| time 7-8 | 5606 | 9292 | 1055 | 1992 | 2391 | 4124 | 294 | 518 |
| Mundhwa-keshavnagar | | | | | | | | |
| time 9-10 | 5184 | 7136 | 777 | 989 | 3452 | 4351 | 369 | 467 |
| time 2-3 | 2859 | 3988 | 468 | 487 | 1865 | 2498 | 164 | 213 |
| time 7-8 | 5670 | 7522 | 787 | 950 | 3486 | 4326 | 483 | 500 |

Table 14 shows results for maximum traffic by simulation for 2 wheeler, 3 wheeler, 4 wheeler and heavy vehicles for nalstop and mundhwa junction for time 9-10am, 2-3pm, and 7-8pm by keeping direction and time constant. It can be seen that maximum traffic is predicted for 2 wheeler at 9-10am at Nalstop and Mundhwa junction.

2. CASE B: Keeping vehicle type and duration and direction constant

Table 15

| Road | time: 9-10am | | time: 2-3pm | | Time: 7-8pm | |
|-----------------------|--------------|-------------|-------------|--------------|--------------|--------------|
| | 2015-16 | 2015-16 | 2015-16 | 2015-16 | 2015-16 | 2015-16 |
| nal stop | | | | | | |
| Towards deccan | 3280 | 2108 | 2108 | 2108 | 3330 | 3330 |
| towards kothrud | 1956 | 2760 | 2760 | 2760 | 3597 | 3597 |
| Towards mhatre bridge | 3126 | 2742 | 2742 | 2742 | 2397 | 2397 |
| | 8362 | 7610 | 7610 | 7610 | 9324 | 9324 |
| mundhwa-keshavnagar | | | | | | |
| Towards nagar road | 2215 | 1225 | 1225 | 1225 | 2294 | 2294 |
| Towards seasons | 3127 | 1649 | 1649 | 1649 | 3253 | 3253 |
| Towards keshavnagar | 1886 | 1140 | 1140 | 1140 | 2167 | 2167 |
| Towards passport off. | 2554 | 1242 | 1242 | 1242 | 2612 | 2612 |
| | 9782 | 9782 | 9782 | 17728 | 10326 | 10326 |

Table 15 shows results for maximum traffic by simulation for time 9-10am, 2-3pm, 7-8pm for nalstop junction towards deccan, kothrud and mhatre bridge and for munhwa-keshavnagar junction towards nagar road, seasons, keshavnagar and passport office.

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Vol. 6, Issue 3, March 2017

VIII. CONCLUSION

From the analysis of the current traffic condition, and depending on the data we predicted the traffic volume data after a five year period. The irrational rise in the traffic volume data is studied and depending on the data remedial measures are suggested. The irregular rise in vehicular traffic is shown with the help of bar graphs. From the simulation data we can see that the traffic volume has almost doubled in the predicted time period (5 years). The same simulation model can be used to predict the traffic volume for even 10 or greater number of years. But, as there is so much traffic rise in just five years recommendations are made on the predictive analysis of five years. The remedial measures suggested can be included in the development plans by the Municipal Corporation or local governing authorities to avoid the traffic congestion problems in future.

Remedial measures that can be implemented are:

1. Road widening can be done where there is enough space available.
2. Delhi pattern can be followed i.e. vehicles having odd number in the unit place of the number plate are allowed on odd days and vehicles having even number on even days. It is more of complicated remedy having much criticism but if followed perfectly it is a good solution.
3. Reductions of existing elements, for e.g. bus stops on critical turns can be shifted to some other location and can be avoided near to junctions.
4. Provision of grade separation and flyovers.
5. Diversion of traffic can be done wherever parallel road options are available.
6. Change of pattern of vehicular flow, provision of one ways.
7. Use of smart traffic control and signalling systems by use of traffic volume sensor.

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