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Research Article

Influence of poor Non Motorized Transport (NMT) Infrastructure leading towards declination in NMT users

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Abstract: The aim of this study is to redefine or suggesting the infrastructure for Non Motorized Transport (NMT) at congested intersection in Nagpur City, four congested intersection where selected for the study which is having high NMT contribution along with the Motorized Transport. The highest priority should go to the public transport, walking and non motorized vehicles that are accessible to almost everyone and have low impact. Developing countries with the advancement in automobile sectors it has been observed from the last past year's that the countries are getting dominated for using motorized vehicles as their major mode of transportation and avoiding the use of public transportation. Due to continuously increase in motorized transport environment witness adverse effects, increasing green house gases, sudden climate change and contributing towards pollution. It has been observed that due to inadequate non motorized infrastructure people or user tends to use motorized transportation. However often developing countries face challenge in the form of lack of pedestrian Infrastructure, nonexistent sidewalk, inadequate cycling Infrastructure. In terms of infrastructure, what differentiate advance cities are not highway or subway but quality of sidewalk and cycle ways. Traffic volume study is carried out at selected location by manual count method to determine the Level of Service (LOS) by Highway Capacity Manual (HCM 2010).

The motive of this study is to encourage the public to use the non motorized transportation and to review the impact of poor non motorized transport (NMT) infrastructure results into increased Motorized vehicle.

Keywords: Non Motorized Transport (NMT), Infrastructure, Pedestrian, Cyclists, Walking, Public Transport, Highway Capacity Manual, Level of Service (LOS), Sustainable transportation.

1. Introduction

Developing countries are getting dominated by use of motorized transportation due to lack of safe and maintained Non-motorized infrastructure. According to Ministry of Road Transport & Highway, Road accident report – 2018, in India there are 253 million registered vehicles and the number has been growing at a CAGR of 10.11 percent during 2007 to 2017. The table given below indicated the different accidents occurred in road, different fatalities and injuries due to collision – 2018.

Table 1. Road accidents, fatalities and injuries by type of collision – 2018 [1]

Collision Type	**No of accidents**	**Persons Killed**	**Persons injured**
Vehicle to Vehicle	2,53,253 (54.32)	78,766 (52.02)	2,56,919 (54.73)
Vehicle to Pedestrian	78,974 (16.91)	24,861 (14.96)	64,997 (13.85)
Vehicle to non-Motorized Vehicle	22,248 (4.76)	8,753 (5.78)	20,035 (4.27)
Vehicle to Animal	5,902 (1.26)	2,267 (1.50)	4,917 (1.05)
Others	1,06,667 (22.84)	38,975 (25.74)	1,22,550 (26.11)
Total	**4,67,044**	**151,417**	**4,69,418**
Note :figure in parenthesis is the percentage share in total			
Source : Ministry of Road Transport & Highway, Road accident report – 2018			

From 2017 to 2018 the number of pedestrian killed in road accidents has increased from 20,457 to 22,656 and about 10.75 percent in increase. Further, Pedestrians accounted for 14.62% and Cyclists contributed to another 2.4% of the Road Users killed in 2018, shown in fig.1.[1].

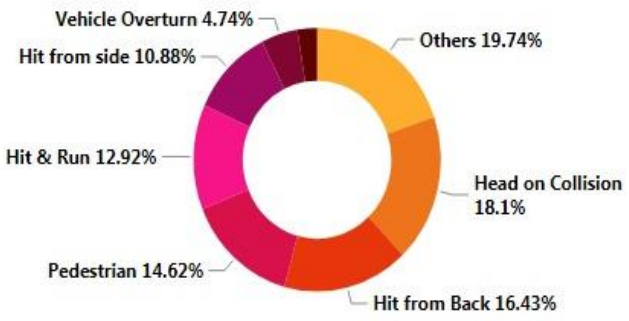


Fig.1. Accidents share by type of collision - 2018

Source: Ministry of Road Transport & Highway, Road accident report – 2018

Around 2515 pedestrian killed in road accidents in calendar year 2018 in the state of Maharashtra and 22656 in the country.

Total 11% of accidents occurred in Maharashtra among all state.

Most of the cities in India are still compact in their design with high population densities and mixed level use. Various intersections are working with the old infrastructure which needs serious improvement. As we have seen cyclist and pedestrian have the comparatively high contribution of traffic accidents. This is the output of increased in urbanization and increased in infrastructure development that has given the major priority to motorized vehicle over the NMT. National and Urban policies target their investment in heavy transport infrastructure, while the NMT sector was neglected. This is the reason behind deteriorating the LOS provided to the NMT users. Same is the situation with the Nagpur City in Maharashtra. A proper research is required to control the accident rate and to identify the cause behind the declination in NMT contribution, so the traffic volume count data for pedestrian has been collected by manual count method at four congested intersection to determine the LOS by HCM Method. Main objective of this research is to recognize the factor that declining the contribution of Non Motorized Transport in Nagpur City, to calculate the LOS by Highway Capacity Manual (HCM) method for four congested intersection and to suggest the improvised infrastructure for NMT for betterment of their safety and to reduce the accident rate.

2. Literature Review

A.C.Sarana, (1991) [2] The paper deals with the increase in transport demand according to the population growth and rapid increase in motorized vehicles. The researchers have collected wide range of data by considering factors such as growth of motor vehicles, importance of road system, heterogeneous nature of traffic, road safety, motor vehicle ownership levels, Socioeconomic aspects and mobility levels, Quality of transport service and majorly the importance of non Motorized modes. Growth of motor vehicles has significantly increased over the past few years and particularly there is 50 to 78 percent of two wheeler contribution in motorized traffic, despite continuous development of transportation system existing capacity fails to serve the increasing demand which results into the congestion on road heading to a decreased in productivity as well as the efficiency of city. Developed transportation system also requires proper maintenance; lack of maintenance affects the situation such as lowering of speed, increase in consumption of fuel, greater chances of accident, compromising the safety of Non Motorized Transport users which increases discomfort to riders. From the available accidental data, the road users killer or injured in road accidents are 50 to 80 percent of the total population are NMT users. For most of the city's infrastructure for NMT have been completely neglected. Therefore on the basis of studies the infrastructure for NMT needs to be planned and implemented to improve safety and environmental aspects.

Adriana Ortegon Sanchez, Daniel Oviedo Hernandez [3] The research has been carried out on the potential for model shift to NMT in developing country. Under the logic of avoid, shift, improve fostered by donor's and NGO's worldwide. Developing countries are investing on non motorized transportation facilities and policies for low carbon transportation which eventually decrease the emission of greenhouse gases. They have carried out the case study of the metropolitan area of Lima, Peru. Environmental impact of non motorized modes are close to zero carbon emissions and have flexibility in terms of route design and timetable timing the only drawback is they are not suitable for long distance, however mass transit modes are rigid in both their operations and the layout of the route but feasible for long distance travel. The researcher's major motto is to provide conditions for convenient, affordable and enjoyable door to door trips, decreasing monetary cost and time and improve the comfort. They have collected data that includes origin and destination survey from 2012 for the Lima city along with the geostatistical information of transport network, land use, non motorized infrastructure and socioeconomic figures.

Firstly they have identified the modes with potential for integration. The objective was to use Lima'a transportation system effectively to reduce greenhouse gas emissions hence they have focused of the integration of NMT modes with the mass transit system. So by increasing facilities or infrastructure for the NMT the existing mass transit can be effectively used and will lead to the reduction in the emission of greenhouse gases. Assessment of the capacity of the integration between mass transit and NMT allow a sensible estimate of additional ridership and connectivity.

M.R.Mat Yazida*, R.Ismailb, R.Atiqa [4] In this paper the author studied the use of non motorized for sustainable transportation in Malaysia. Non motorized transportation plays important role for sustainable living. In India we have developed transit system but they are not sustainable and not 100 percent efficient. The objective is to integrate the non motorized transportation system with the developed transit system to elevate the environmental awareness in the country and make the transit system 100 percent efficient which can be achieved by proper planning and implementation of infrastructure for non motorized transportation which not only increase the percentage of pedestrian and bicycle but also improve the efficiency of transit system which leads to reduction of greenhouse gases and improve the environment and out lifestyle.

B. Raghuram Kadali and P. Vedagiri [5] In this paper an investigational study of pedestrian LOS at the sidewalk, intersection and midblock crosswalk location is carried out along with the importance of pedestrian LOS at unprotected midblock crosswalk is explored. While evaluating the pedestrian LOS at the crosswalk and sidewalk pedestrian with disabilities needed to be considered. The review also shows the importance of land use conditions with pedestrian LOS. Simulation based pedestrian LOS studies should consider the different conditions such as varied pedestrian, vehicle flow, vehicle characteristics as well as the roadway geometry, which will help in determining the capacity of crosswalk.

Bibie Sara Salleh, Riza Atiq Abdullah O.K Rahmat and Amiruddin Ismail [6] The authors aim is to define the strategies for influencing the road users to shift from the motorized vehicles to non motorized vehicles because transportation system is getting dominated by motorized vehicles which are having negative impact on environment, road safety, traffic congestion, air pollution and climate change. Author suggests improving the facilities for the cyclists and pedestrians to encourage the road users to use non motorized transportation. For improving Non Motorized Transport condition improve comfort and convenience of Non Motorized Transport users by taking consideration of factors such as physical infrastructure, safety and security, promote Non Motorized Transport by implementing various programmers for transportation. Improve transport options by developing public transport, walking, cycling, restricting automobile travel etc.

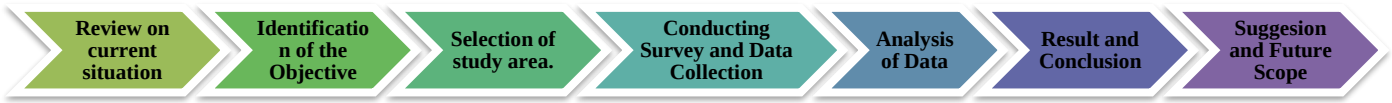
Integrating NMT with public transport will not only increase the efficiency of public transport but also elevate the contribution of NMT's. The author’s ultimate goal was to promote implementation of infrastructure for cycling and walking along with the integrating NMT with the public transport.

Meena Pawar, B.V. Khode [7] The research has studied the importance of non-motorized transportation in transit system. The main objective was to identify the factors which affect the non motorized transportation system of Nagpur City along with the calculation of BCI i.e. Bicycle Compatibility Index and LOS (Level of Services) for NMT and to suggest the measures for improvement of road condition by taking consideration of level of services. The author has identified the areas where there is high flow of Motorized as well as non-motorized traffic and conducted the survey and collected the data. The survey was based parameters such as safety, Visibility, convenience and crossing comfort. According to analysis 87 % of Non motorized vehicle users face problems and want separate infrastructure for safe travel.

3. Methodology

For the research work, the first step is to identify the non motorized concentrated zones covering the maximum users from the different part of the city the following are the four intersections were selected and surveyed; pedestrian volume count has been collected by manual count method. Selected intersection listed below-

- **Varity Square**
- **Bus Stand (Ganeshpeth)**



- **Central Avenue**
- **Sadar Kingsway**

A Flowchart of the methodology that was developed for the project.

To make sure that the intersection needs the improvement in NMT infrastructure, the Level of Service (LOS) needed to be determined, by using HCM's method for analyzing pedestrian LOS. This method is based on the measurement of pedestrian flow rate, sidewalk space, pathway which may be used by more than foot based traffic. There is Verity of pedestrian users walking at different speed, rely on their age, ability and environmental characteristics. Pedestrian interacts closely with the other modal users, as a output perceived safety and a environmental factors crucially influence pedestrian flow quality of service.

Quality of service depends upon various factors such as comfort (proximity; volume and speed of motor vehicle traffic; weather protection; pedestrian amenities; pathway surface), Convenience (intersection delays, walking distance, grades, pathway directness, way finding signage, sidewalk ramp and map), security, safety and e economics of the walk way system. As per the HCM an average of 5 to 9 ft2 of area is required by pedestrian for movement and if limited area is there it will restricts pedestrian speed and freedom of maneuver. So by considering various factors HCM method has developed the LOS.

Table 1. Pedestrian Level of service ranges as per HCM 2010 [8]

LOS	Average Space	Flow rate	Average Speed	Vol./Cap Ratio	Comments
A	>18.30	<0.03	>1.29	<0.21	Capability to follow the chosen pathway without altering movements.
B	>12.20- 18.30	>0.03- 0.04	>1.27- 1.29	0.21- 0.31	Commence a course to avoid accidental clashes
C	>7.32- 12.20	>0.04- 0.05	>1.22- 1.27	>0.31- 0.44	Regular requirement to change path to avoid clashes.
D	>4.6-7.32	>0.05- 0.08	>1.14- 1.22	>0.44- 0.55	Potential of speed to pass sluggish Pedestrians restricted
E	>2.43-4.6	>0.08- 0.12	>0.76- 1.14	>0.65- 1.00	Speed limited, very partial ability to pass sluggish pedestrians.
F	<2.43	variable	<0.76	variable	Speed brutally constrained, regular contact with other users

Source: Highway Capacity Manual (HCM) – 2010

For determination of LOS following factors needed to be understood –

Determination of effective walkway width

It is the effective width of the sidewalk which can be used effectively, in the presence of obstruction such as pot holes tress etc

$$we = wt - wo$$

Where,

we is Effective walkway width.

wt is the total walkway width at a given point along the walkway.

wo is the width of obstruction

Determination of pedestrian flow rate

The 60 min hourly time is used as an input for the analysis of rate of flow for pedestrian. According to the general method of analysis used in HCM, the hourly demand is generally converted to a 15-minute flow, so LOS relies on 15 minutes being extracted in one hour

$$V15 = VH/(4 * PHF)$$

$$Vp = V15/(15 * We * 60)$$

Where,

$V15$ is the pedestrian flow rate during peak 15 min., VH is the pedestrian demand during analysis hour., PHF is the peak hour factor.

Vp is the pedestrian flow per unit

Determination of average pedestrian space

Pedestrian space can be perceived in the field by measuring a sample area of the facility and determining the extreme number of pedestrians at a given time in that area. The pedestrian unit flow rate is related to pedestrian space and speed:

$$Ap = SP/Vp$$

Where,

Ap Is pedestrian space ($m2$ /p),

SP Is pedestrian speed (m/sec), and

Vp Is pedestrian flow per unit width (p/m/sec).

Survey and Data Collection

Before going to any conclusion it is very important to study the current situation so on selected for intersection i.e. Variety Square (Fig.2), Bus Stand (Ganeshpeth) (Fig.3), Central Avenue (Fig.4) and Sadar Kingsway (Fig.5). Location of study area in google map, shown in below-

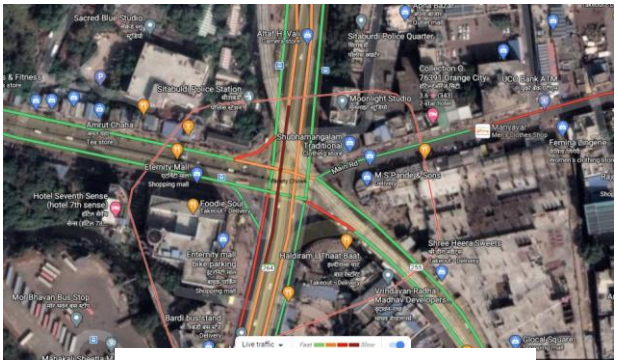


Fig. 2 Variety Square

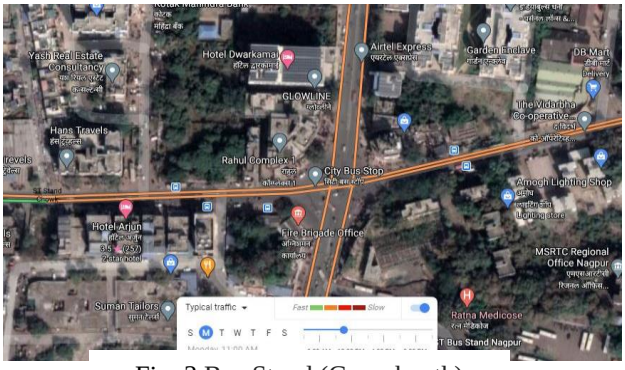


Fig. 3 Bus Stand (Ganeshpeth)

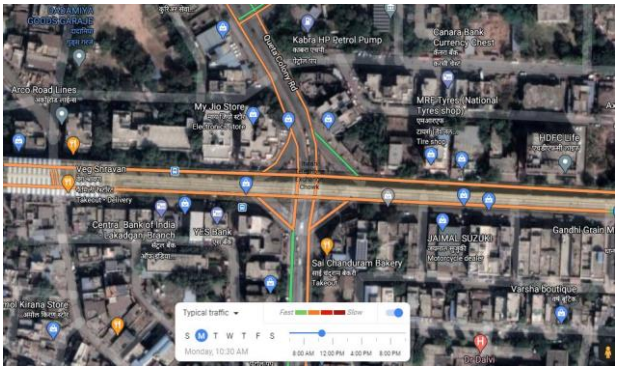


Fig. 4 Central Avenue

Fig. 5 Sadar Kingsway

Data C

Survey has been carried out with the manual count method.

This method is used to count the pedestrian flow through a junction, across road or along a road section/ footway manually using tally marking sheet or manual clicker.

The survey is conducted from 8am to 9pm which includes peak hours and on working days avoiding weekends.

Selected area for Study is -

Table 3. Pedestrian Count at Variety Square and Bus Stand (Ganeshpeth)

Time	Variety Square			Bus Stand		
	PH (Pedestrian/Hr)	Effective Width (m)	Average Speed (m/s)	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)
8:00-9:00	1348	2	1.3	1684	2	2.54
9:00-10:00	942	2	1.55	1178	2	1.51
10:00-11:00	831	2	1.7	1039	2	2.65
11:00-12:00	797	2	1.72	997	2	1.61
12:00-13:00	888	2	1.8	1110	2	1.83
13:00-14:00	641	2	1.83	802	2	1.76
14:00-15:00	683	2	1.53	854	2	1.67
15:00-16:00	518	2	1.71	647	2	1.49
16:00-17:00	585	2	1.76	732	2	1.72

17:00-18:00	991	2	1.38	1239	2	1.49
18:00-19:00	849	2	1.48	1061	2	1.55
19:00-20:00	653	2	1.67	816	2	1.46

Table 4. Pedestrian Count at Central Avenue and Sadar Kingsway

Time	**Central Avenue**			**Sadar Kingsway**		
	PH (Pedestrian/Hr)	**Effective Width (m)**	**Average Speed (m/s)**	**PH (Pedestrian/Hr)**	**Effective Width (m)**	**Average Speed (m/s)**
8:00-9:00	78	1.8	1.52	176	1.5	1.39
9:00-10:00	458	1.8	1.47	222	1.5	1.51
10:00-11:00	617	1.8	1.51	810	1.5	1.46
11:00-12:00	648	1.8	1.61	777	1.5	1.75
12:00-13:00	721	1.8	1.5	866	1.5	1.23
13:00-14:00	521	1.8	1.62	625	1.5	1.52
14:00-15:00	555	1.8	1.56	666	1.5	1.59
15:00-16:00	421	1.8	1.48	505	1.5	1.5
16:00-17:00	476	1.8	1.52	571	1.5	1.61
17:00-18:00	805	1.8	1.37	966	1.5	2.24
18:00-19:00	690	1.8	1.45	828	1.5	1.78
19:00-20:00	531	1.8	1.49	637	1.5	1.37

At this four selected study area the pedestrian count has been collected and identified that the pedestrian contribution is heavy which is leading to frequent traffic congestion and increase in accident rate and delay.

Calculation:

Analysis for determination of Pedestrian Level of Service

Table 5. Calculation of Volume/Capacity Ratio for Variety Square

Time	**PH (Pedestrian/Hr)**	**Effective Width (m)**	**Average Speed (m/s)**	**P15 (Pedestrian/15 Min)**	**Capacity (ped/hr) IRC-103**	**Flow Rate (ped/sec/m)**	**Average Space (sq.m/ped)**	**Vol/ Cap Ratio**
8:00-9:00	1348	2	1.3	337	1800	0.187	6.946	0.749
9:00-10:00	942	2	1.55	236	1800	0.131	11.844	0.523
10:00-11:00	831	2	1.7	208	1800	0.115	14.729	0.462
11:00-12:00	797	2	1.72	199	1800	0.111	15.534	0.443
12:00-13:00	888	2	1.8	222	1800	0.123	14.595	0.493
13:00-14:00	641	2	1.83	160	1800	0.089	20.539	0.356
14:00-15:00	683	2	1.53	171	1800	0.095	16.121	0.380
15:00-16:00	518	2	1.71	129	1800	0.072	23.776	0.288
16:00-17:00	585	2	1.76	146	1800	0.081	21.645	0.325
17:00-18:00	991	2	1.38	248	1800	0.138	10.025	0.551
18:00-19:00	849	2	1.48	212	1800	0.118	12.554	0.472
19:00-20:00	653	2	1.67	163	1800	0.091	18.412	0.363

Table 6. Calculation of Volume/Capacity Ratio for Bus Stand (Ganeshpeth)

Time	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)	P15 (Pedestrian/ 15 Min)	Capacity (ped/hr) IRC-103	Flow Rate (ped/sec/m)	Average Space (sq.m/ped)	Vol/ Cap Ratio
8:00-9:00	1684	2	2.54	421	1800	0.234	10.857	0.936
9:00-10:00	1178	2	1.51	294	1800	0.164	9.231	0.654
10:00-11:00	1039	2	2.65	260	1800	0.144	18.368	0.577
11:00-12:00	997	2	1.61	249	1800	0.138	11.633	0.554
12:00-13:00	1110	2	1.83	277	1800	0.154	11.871	0.617
13:00-14:00	802	2	1.76	200	1800	0.111	15.803	0.445
14:00-15:00	854	2	1.67	214	1800	0.119	14.077	0.475
15:00-16:00	647	2	1.49	162	1800	0.090	16.574	0.360
16:00-17:00	732	2	1.72	183	1800	0.102	16.923	0.407
17:00-18:00	1239	2	1.49	310	1800	0.172	8.659	0.688
18:00-19:00	1061	2	1.55	265	1800	0.147	10.518	0.589
19:00-20:00	816	2	1.46	204	1800	0.113	12.877	0.454

Table 7. Calculation of Volume/Capacity Ratio for Central Avenue

Time	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)	P15 (Pedestrian/ 15 Min)	Capacity (ped/hr) IRC-103	Flow Rate (ped/sec/m)	Average Space (sq.m/ped)	Vol/ Cap Ratio
8:00-9:00	78	1.8	1.52	19	1350	0.012	126.315	0.058
9:00-10:00	458	1.8	1.47	115	1350	0.071	20.783	0.340
10:00-11:00	617	1.8	1.51	154	1350	0.095	15.859	0.457
11:00-12:00	648	1.8	1.61	162	1350	0.100	16.107	0.480
12:00-13:00	721	1.8	1.5	180	1350	0.111	13.473	0.534
13:00-14:00	521	1.8	1.62	130	1350	0.080	20.141	0.386
14:00-15:00	555	1.8	1.56	139	1350	0.086	18.208	0.411
15:00-16:00	421	1.8	1.48	105	1350	0.065	22.795	0.312
16:00-17:00	476	1.8	1.52	119	1350	0.073	20.707	0.352
17:00-18:00	805	1.8	1.37	201	1350	0.124	11.024	0.597
18:00-19:00	690	1.8	1.45	172	1350	0.106	13.624	0.511
19:00-20:00	531	1.8	1.49	133	1350	0.082	18.196	0.393

Table 8. Calculation of Volume/Capacity Ratio for Sadar Kingsway

Time	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)	P15 (Pedestrian/ 15 Min)	Capacity (ped/hr) IRC-103	Flow Rate (ped/sec/m)	Average Space (sq.m/ped)	Vol/ Cap Ratio

8:00-9:00	176	1.5	1.39	44	800	0.033	42.661	0.220
9:00-10:00	222	1.5	1.51	55	800	0.041	36.741	0.277
10:00-11:00	810	1.5	1.46	203	800	0.150	9.731	1.013
11:00-12:00	777	1.5	1.75	194	800	0.144	12.158	0.972
12:00-13:00	866	1.5	1.23	216	800	0.160	7.672	1.082
13:00-14:00	625	1.5	1.52	156	800	0.116	13.123	0.782
14:00-15:00	666	1.5	1.59	167	800	0.123	12.887	0.833
15:00-16:00	505	1.5	1.5	126	800	0.093	16.043	0.631
16:00-17:00	571	1.5	1.61	143	800	0.106	15.231	0.714
17:00-18:00	966	1.5	2.24	242	800	0.179	12.517	1.208
18:00-19:00	828	1.5	1.78	207	800	0.153	11.615	1.034
19:00-20:00	637	1.5	1.37	159	800	0.118	11.619	0.796

4. Result:

Table 9. Pedestrian Level of Service (Average)

Location	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)	P15 (Pedestrian/ 15 Min)	Capacity (ped/hr) IRC-103	Flow Rate (ped/sec/m)	Average Space (sq.m/ped)	Vol/ Cap Ratio	PLOS
Variety Square	**811**	**2.0**	**1.619**	**203**	**1800**	**0.113**	**15.560**	**0.450**	**D**
Bus Stand	**1013**	**2.0**	**1.773**	**253**	**1800**	**0.141**	**13.116**	**0.563**	**D**
Central Avenue	**543**	**1.8**	**1.508**	**136**	**1350**	**0.084**	**26.436**	**0.403**	**D**
Sadar Kingsway	**637**	**1.5**	**1.579**	**159**	**800**	**0.118**	**16.833**	**0.797**	**E**

Table 10. Pedestrian Level of Service at Peak Hours

Location	PH (Pedestrian/ Hr)	Effective Width (m)	Average Speed (m/s)	P15 (Pedestrian/ 15 Min)	Capacity (ped/hr) IRC-103	Flow Rate (ped/sec/m)	Average Space (sq.m/ped)	Vol/ Cap Ratio	PLOS

Variety Square	**992**	**2.0**	**1.482**	**248**	**1800**	**0.138**	**11.220**	**0.551**	**E**
Bus Stand	**1187**	**2.0**	**1.883**	**297**	**1800**	**0.165**	**11.591**	**0.659**	**E**
Central Avenue	**657**	**1.8**	**1.485**	**164**	**1350**	**0.101**	**15.145**	**0.486**	**D**
Sadar Kingsway	**849**	**1.5**	**1.692**	**212**	**800**	**0.157**	**10.738**	**1.062**	**F**

Level of Service for study area has been calculated and found out to be "D" for Variety Square for average pedestrian count and "E" at Peak hours, for Bus Stand (Ganeshpeth) "D" at average and E at peak hours, for Central Avenue its "D" at average and at peak hours and for Sadar Kingsway "E" for average pedestrian count and for peak hours it's found out to be "F".

5. Conclusion

The share of NMT is declining and consumers are getting discouraged to use the mode, there is a serious need in development of NMTs as a sustainable transportation system. By determining the LOS it is clear that the area which has been studied needs serious attention towards the NMT infrastructure. The challenged faced in development are: the urban structure, Safety, People's mentality and lifestyle, Planning and design fault, Inconvenient Public Transport and Quality Infrastructure of NMT. Objectives

While planning the NMT should be safety and mobility for all road users and avoid conflicts by providing satisfactory and sufficient facilities. Currently in India our Practices for Non- Motorized Transportation is very poor and the roads are not very bicycle/ Pedestrian Friendly, People are losing out the most essential asset the public has got that is their public space is reduced and the evidences are from developing countries were more and more spaces are reducing exponentially and going to Road Networks, Physical Infrastructures, but most importantly the Motorized vehicles are taking a lot of our cities

The quality of non motorized transportation is decreasing day by day. Due to inadequate non motorized transport infrastructure many users don't feel safe to use the facility. While developing or designing the route or road network for city proper attention should be given to the designing of non motorized infrastructure. Rate of accident of non motorized transport users are increasing, which discourage the users to go for non motorized transport. Integration of non motorized transport with mass transit or existing public transport will not only promote the use of non motorized transportation but also increase the efficiency of public transport. So to achieve sustainable transportation, non motorized transportation should be promoted and improvised infrastructure for users should be provided which will encourage more people to use it. Use of non motorized transportation system will improve the quality of environment; control the emission of greenhouse gases which leads to healthier and safe lifestyle.

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