IMPROVEMENT OF HIGHWAY CAPACITY DUE TO CYCLE TRACK IN URBAN AREA

A Thesis submitted in partial fulfillment of the requirement for the degree of

MASTER OF TECHNOLOGY

In
Transportation Engineering

By

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LUCKNOW
2019-2020

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CERTIFICATE

This is to certify that thesis entitled **"IMPROVEMENT OF HIGHAWAY CAPACITY DUE TO CYCLE TRACK IN URBAUN AREA"** which has been carried out by Mr. ARIF ANWAR, (Roll No- 1180465004) for partial fulfillment of requirement for the award of **MASTER OF TECHNOLOGY** (Transportation Engineering) of Babu Banarasi Das University, Lucknow, India, is a record of his work carried out by his under the guidance and supervision. The result embodied in this thesis has not submitted elsewhere for award of any other degree or diploma.

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DECLARATION

I hereby declare that the work which is being presented in the M.Tech thesis report entitled **"IMPROVEMENT OF HIGHWAY CAPACITY DUE TO CYCLE TRACK IN URBAN AREA"** in fulfillment of the requirements for the award of the **MASTER OF TECHNOLOGY** in **Transportation Engineering (Civil Engineering)** and submitted to the Department of Civil Engineering of Babu Banarasi Das University, Lucknow (India) is an authentic record of our own work carried out during the period from August 2018 to June 2020 under the guidance of **Prof. D.S Ray, Department of Civil Engineering**. The matter presented in this Thesis has not been submitted by me for the award of any other degree elsewhere.

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ABSTRACT

This paper tries to make study of the Improvement of highway capacity due to cycle track in urban area. As urban areas develop in our country and the world, some issue related to urbanization such as traffic congestion became a serious issue. Cycle tracks are exclusive bicycle facilities that are physically separated cyclists from motor vehicle lanes. Cycle tracks are important part of infrastructure proven to increase ridership and improvement in highway capacity. Increasing bicycling can improve the overall quality in the urban areas. A separate cycle track can increase the speed of remaining vehicles so that it can save time, fuel consumption, wear and tear, reduce pollution etc. It can also increase the transportation choices, reduce parking and traffic congestion. Replacing vehicle trips with bicycle trips can reduce the number of single occupancy vehicle, traffic and associated air pollution, and fuel consumption also.

In urban planning, cycle tracks are designed to encourage bicycling to an effort to relieve traffic congestion and reduce pollution, reducing bicycling fatalities and injuries by eliminating the need for cars and bicycles to jouney for the same road space and to reduce overall confusion and tension for all users of the road. Cycle track may be one-way or two-way, and may be at road level, at sidewalk level, or at an intermediate level..

I did survey work on Chinhat to Dewa section of Itaunja-Kumharwa-Kursi-Dewa-Chinhat road, Lucknow. I did two way classified traffic survey of the road and also calculate average speed of commercial vehicles, personal vehicles and two wheeler vehicles except cycle. We studied of speed of commercial vehicles, personal vehicles and two wheeler vehicles based on algorithm that there will be no cyclist on mixed traffic. Lastly we studied and comparison of fuel consumption as well as total cost saving due to separate cycle tracks..

Cycle tracks offer a high level of safety, because they physically separated the cyclist from automobile traffic. However it does not follow that cycle tracks are always the safest solution, that we should construct as many cycle tracks as possible, and that more cycle tracks automatically increase overall road safety. Accident data show that as the number of cyclists on

the road increases, the accident rate drops. Even more, as the number increases further, the overall accident rates for all traffic modes drop as well.

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INTRODUCTION

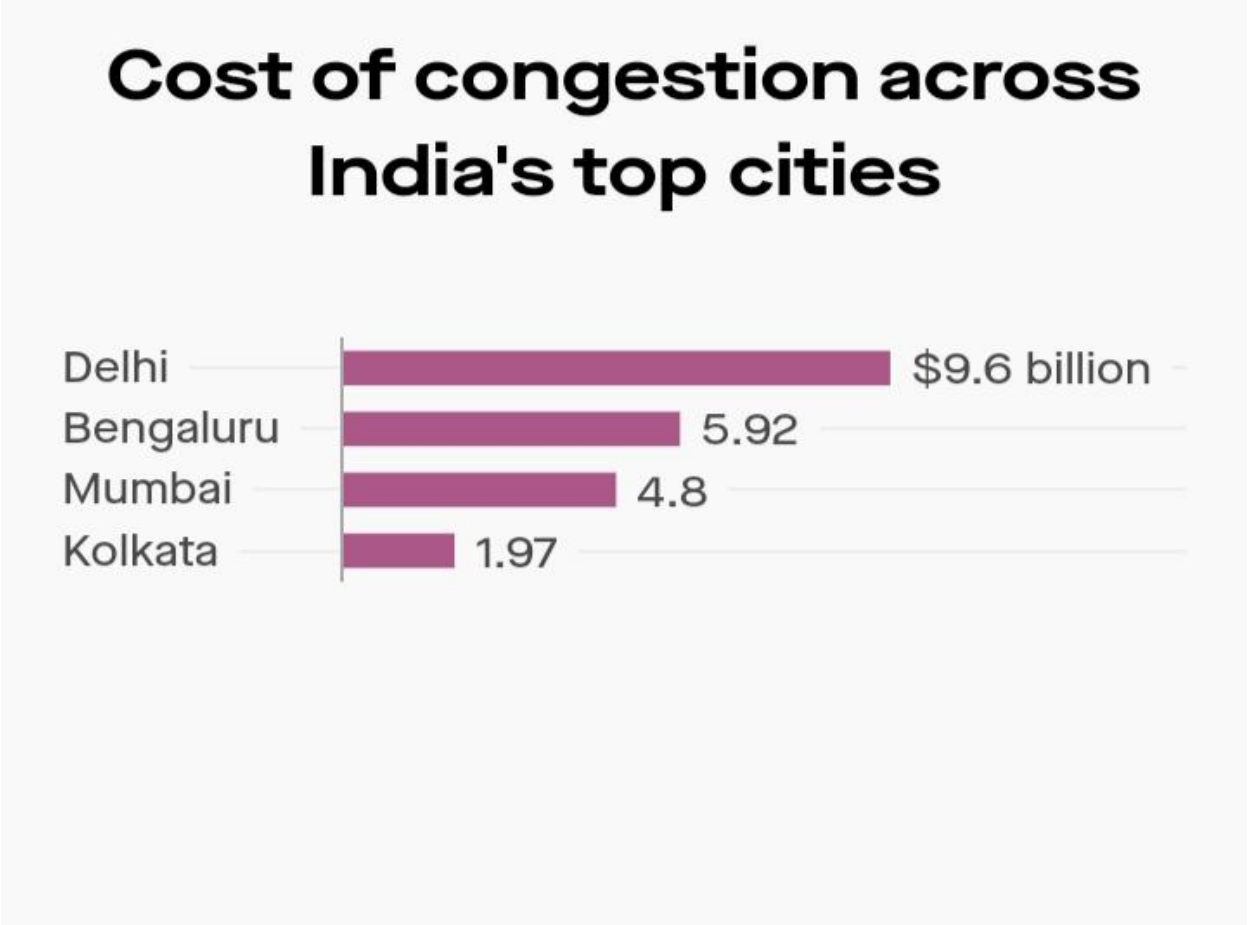
1.1 TRAFFIC JAMS

As the urban area develops in India, some issue related to urbanization such as traffic jams becomes serious issue. This problem becomes serious mostly due to inappropriate design of the urban landscape pattern. According to a survey India's biggest cities may be losing up to $22 billion annually due to traffic congestion and its burden is bearing by its commuters. Travelers in Delhi, Mumbai, Bengaluru and Kolkata spend 1.5 hours more on their daily commutes than other Asian cities during peak hours, on average. In these four Indian cities is estimated at 149% much higher than the Asian average of 67%, peak hour congestion during peak traffic to travel a given distance. On average, Indians bought almost 54,000 vehicles each day in 2018 as compared to 18,000 a day, a decade back. This number shows that Indian roads will continue to get more congested with each passing month as people will buy new cars, scooters, bikes as well as commercial vehicles like taxis and truck without necessarily junking older vehicles.

Traffic congestion is partially attributes to India's large population and high population density. While public transport in metro cities has been improving in last couple of years with an expanding metro network but this just has not enough. The reliance on cars is expected to increase more pressure to road network. The Mumbai congestion percentage is 65%, for Pune 59% and for Delhi it is 56%.

Source: Times of India

Fig. 1.1.1 Road congestion



Source: BCG- Unlocking cities: the impact of ridesharing across India

Fig. 1.1.2 Cost of congestion

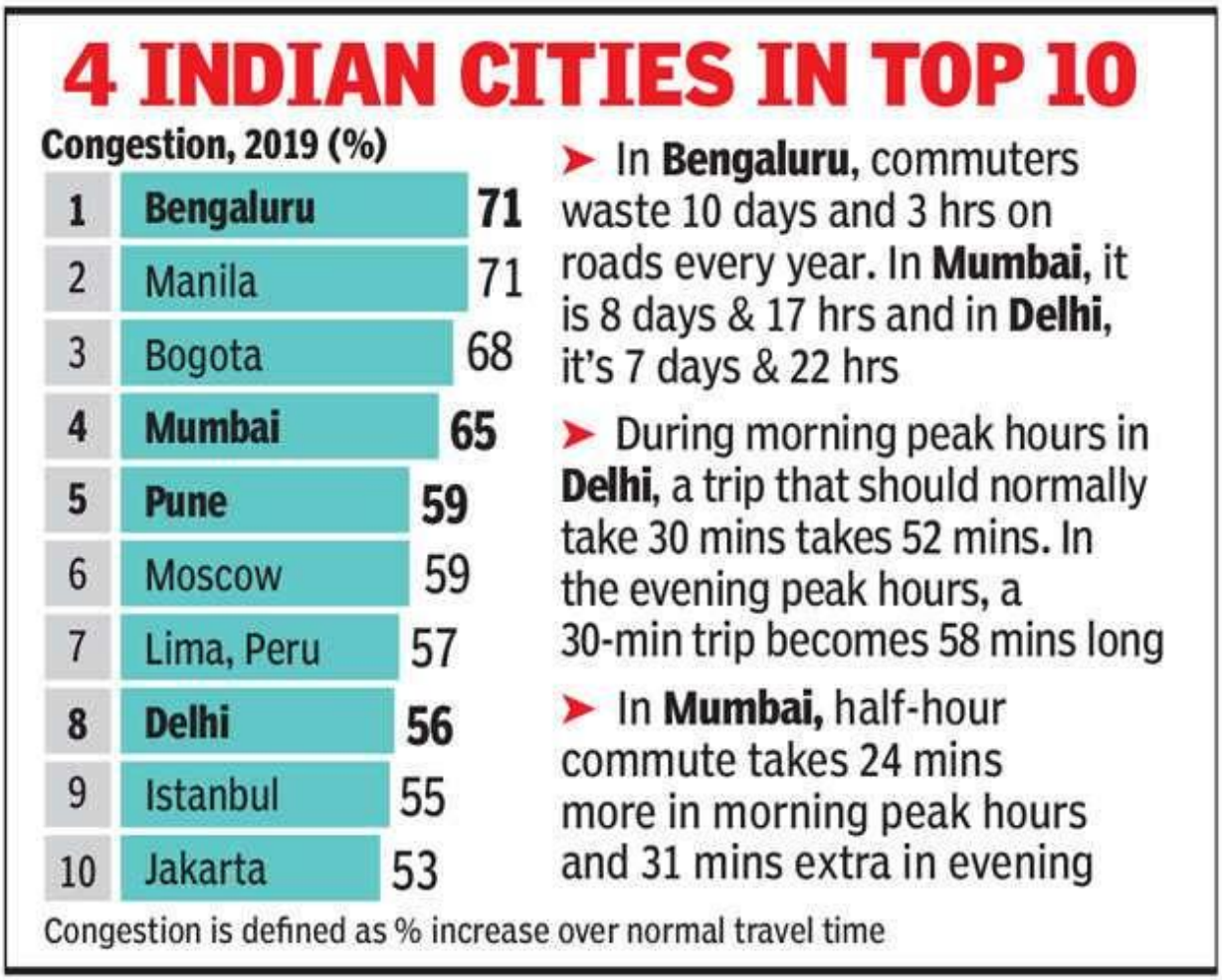
The cost of congestion was based on the basis of fuel consumptions and productivity loss, it includes the man hour and opportunity cost, pollution and accidents incurred on the yearly basis.

Indian travelers have struggled for years now. Transport demand has been increased by almost eight times since 1980s due to rapid economic development and increasing wealth among household and its led to higher vehicle ownership. This is higher than anywhere else in Asia, according to BCG.

Traffic jams is the one of the main reason for the noise and air pollution in the urban area.

Bengaluru has overtake Mumbai as the city with highest traffic congestion and become one of the top globally. According to a report released by a major global location technology

specialists, southern city drivers spent an average 71% extra time on the road due to congestion in 2019. In Mumbai, drivers spent 65% more time in traffic. Pune was included first time in the ninth edition of TomTom traffic index in 2019 and ranked fifth where drivers spent 59% extra time in traffic jams. In 2017, Indian cities included in global ranking first time. For commuters in Delhi, Mumbai and Bengaluru, the worst period was Friday evening (7-8 PM). Any travelers can save up to five hours annually for a 30 minutes travel by deferring the journey post 8 PM. According to report, Delhi commuters driving peak these peak spent an extra 190 hours or seven days and 22 hours in a traffic during 2019. In Bengaluru, the extra time spent on roads was 243 hours or 10 days and 3 hours. In Mumbai, the drivers wasted 8 days and 17 hours in traffic.

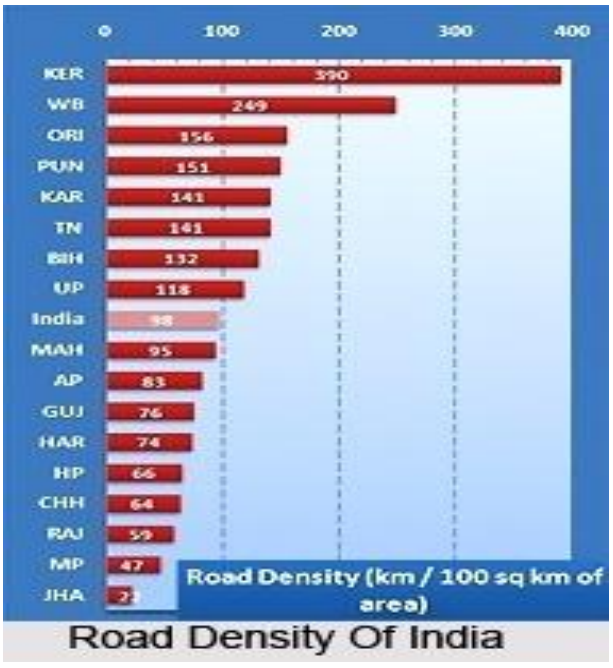


Source: Times of India

Fig. 1.1.3 Indian cities congestion

1.2 TRAFFIC DENSITY:

Traffic density is defined as the number of vehicles occupying a unit length of roadway at an instant in time. It can also defined as "the number of vehicles per hour passing any selecting point on a road or the number of vehicles per mile on a selected portion of road. Density is inversely proportional to the volume of the traffic. If density is less, speed will be more and traffic volume will be more too. And if the density is the greater, speed will be low and traffic volume will be less. According to 2011, road density for was 142.7 km per 100 sq.km. Road density of India increased from 104.2 km/100 sq. km in 2002 to 142.7 km per100 sq.km and it was growing at an average annual rate of 3.57%. The road network in India (including national highways etc) has grown by just about a third in the last decade whereas vehicles registration have increased by nearly three times. According to latest data by the ministry of Road Transport and Highways (data till 2016), there were 230 million vehicles are registered in India as on 31 March 2016. The total number of registered motor vehicles grew at a annually growth rate of 9.9% between the 2006 and 2016 decade. Vehicular population as on 2016 showed the highest share of two wheelers (73.5%), Cars, Jeeps, and taxis (13.1%) other vehicles (8.1%), goods vehicles (4.6%) and buses (0.8%).



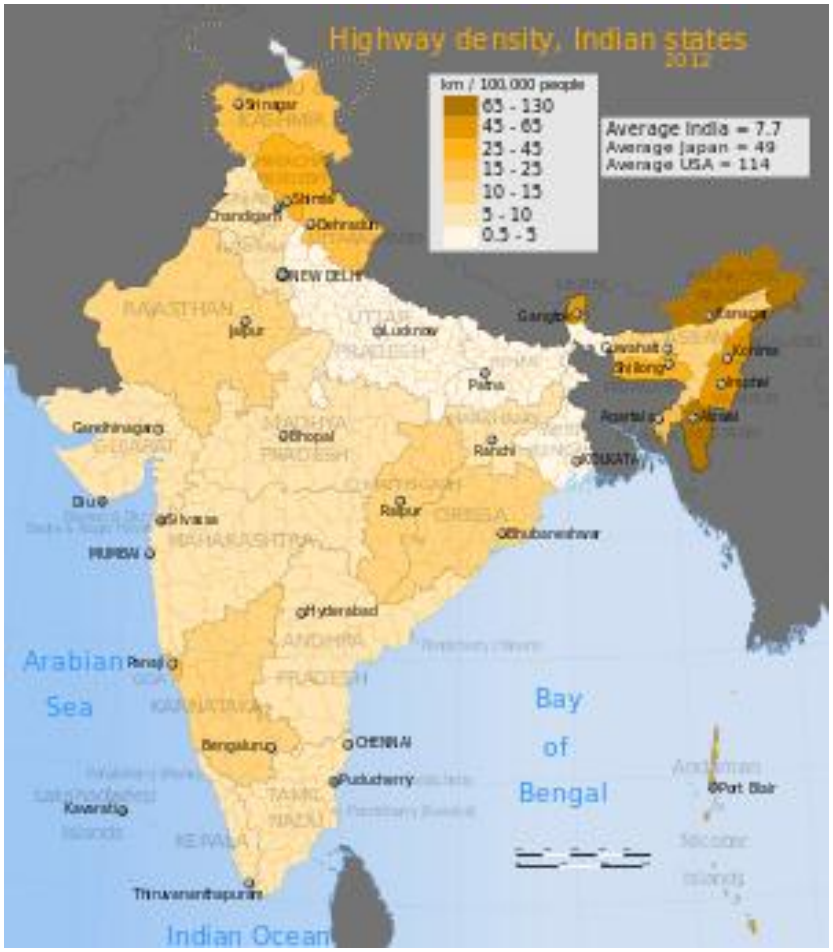
Source: India net zone

Fig. 1.2.1 Road density in India

Bengaluru has worst traffic in the world. Average Bengaluru drivers waste in traffic 10 days and 3 hours every year. In Mumbai, it is 8 days and 17 hours and in Delhi it is 7 days and 22 hours.

India's financial capital Mumbai is the most car congested city in India. The density of private car increased by 18 per cent in just two years. In Mumbai, there are 510 car per km, the car density of the city is about five times than Delhi which has 108 cars per km according to Times of India. The reason of Mumbai's high car density may be attribute to lack of road space with just 2,000 km of roads than 28,999 km roads in Delhi.

Kerala has the highest road density with road network of 5,268 km per 1,000 sq km followed by Tripura with a road density of 3,026 km per 1,000 sq km according to Times of India report. Jammu and Kashmir has lowest road density in country with only 164 km per 1,000 sq km.



Source: Wikipedia

Fig. 1.2.2 Highway density of Indian States

1.3 CYCLE TRACK:

This paper tries to make study of the Improvement of highway capacity due to cycle track in urban area. Cycle tracks are exclusive bicycle facilities that are physically separated from motor vehicle lanes and sidewalks in urban areas.

To make cycling safer and more attractive, much more needs to be done than only providing cycle tracks and cycle lanes. In case of Lucknow and other Indian cities, there are many aspects of the road planning and design that discourage cycling and make it less safe. Planning and design make cycling more attractive and safer.

Cycle tracks offer a high level of safety in urban area, because they physically separated the cyclist from other traffic. Although it does not follow that cycle tracks are always the safest solution, that we should create as many cycle tracks as possible, and that more cycle tracks automatically increase overall road safety. Accident statics show that as the number of cyclists on the road increase, the accident rate drops. Even more, as the number increases further, the overall accident rates for all traffic modes drop as well.

There are many factors that influence a person's choice to bicycle. These factors can be categorized as 1) Environmental 2) Subjective and 3) Demographic. Environmental factors include Climate, topography, land use and Infrastructure. Infrastructure includes the bicycle facility network (Lanes, paths, shared roads etc). Bicycle parking and support facilities, as well as the infrastructure provided for other competing modes.

One of the factors that has contributed making cycling a success in the world's most cycling friendly cities (i.e. Netherlands and Denmark) is the development of car free city centre. Many studies says in Northern Europe that there is reduction of 4% in crashes due to construction of cycle track. With rates of obesity, heart disease, and related health problem s increasing in the India, policy makers, health professionals and urban planner should looking for ways to increase physical activity. For this purpose cycling is the best option.

Source: Ecoldeaz

Fig. 1.3.1 Cycle track

In urban areas, the cycle tracks are designed to encourage bicycling. Bicycling reduce pollution, motor vehicles congestion etc. Cycle tracks may be one way or two-way. It may be at road level or may at intermediate level. The main objective of cycle tracks is separation from motor traffic.

Then chief minister of UP, Mr. Akhilesh Yadav, visited Amsterdam in 2014and observed that cycling was a common mode of transportation of the people of Amsterdam and Netherlands. After returning from there, he instructed the officials in Uttar Pradesh to plan cycling corridors for the purpose of greener approach to transportation. The first cycle in Lucknow was inaugurated at Kalidas Marg by then chief minister on 1st March 2015.

Source: Hindustan Times

Fig. 1.3.2 Cycle track

Cycling is the low cost and easiest form of transportation which can be used to reduce traffic congestion, air pollution and as eco friendly. For developing countries like India, which is also a low income country, cycling offers a good option to use when it difficult to use motor vehicles. Cycling is amongst the most sustainable medium of traveling, which has zero dependence on fossil fuels and zero emission unlike the motor vehicles. Cycling offers so many positives like health improvements, congestion reduction, reducing air pollution, and minimizing energy use. One of the most aspect of cycling in the developing country like India that it presents the most affordable and efficient means of travels for low income households who cannot afford motorizes vehicles.

1.3.1 The following design principles are recommended for the cycle tracks:

- Separate the cycle tracks physically from main road, by creating a wall partition or physical partition or simply raising the cycle track on high as compare to main road.
- For two-way cycle track, consider centre line marking.
- Preferably use closed surface paving by asphalt or concrete.
- A minimum width for one-way cycle track is recommended is 2m.

1.3.2 BENEFITS OF CYCLING:

- Highest safety and comfort
- Strong incentive to cycling
- Reduce traffic congestion
- Reduce pollution
- Health benefits
- Cycling is very cheap as compare to motor vehicles

1.3.3 DISADVATAGES OF CYCLING

- Time taking
- Can not ride for a long distance
- You are subject to the weather, hot, cold, rainy or windy

1.3.4 DESIGN OF CYCLE TRACK:

Separate cycle tracks can be provided when the peak hour cycle traffic is 400 or more than 400 on that route with traffic of 100 motor vehicles or more motor vehicles.

1.3.4.1 CAPACITY:

As a general rule the capacities of cycle tracks may be gives as following:

Width of cycle track	Capacity in number of cycle per day	
	One way traffic	two way traffic
Two lanes	2000-5000	500-2000
Three lanes	Over 5000	2000-5000
Four lanes	-	over 5000

Table 1.3.4.1.1 Capacity of cycle track

1.3.4.2 GRADIENTS:

The length of grades should not exceed the following:

Gradient	Maximum Length	
	(Metres)	(ft)
1 in 30	90	295
1 in 35	125	410
1 in 40	160	500
1 in 45	200	656
1 in 50	250	820
1 in 55	300	984
1 in 60	360	1,181
1 in 65	425	1,394
1 in 70	500	1,640

Table 1.3.4.1.2 Length of grades

The value of maximum length may be obtained from the formula approximately

$Y=X^2/10$

Where Y= the maximum length in metre

X= the reciprocal of gradient

1.3.4.3 SIGHT DISTANCE:

It is desirable that a cyclist should have a clear view of minimum 25 metres or 82 feet. In case of if cycle tracks at gradients of 1 in 40, cyclists should have a clear view of minimum 60 metres or 197 feet.

1.3.4.4 LANE WIDTH:

The width of a cycle at the handle bar which is the widest portion, ranges from 45cm (1ft 6 inch) to 50 cm (1 ft 9 inch). Generally for cyclists, it is not possible to drive in a perfectly straight path. Therefore, allowing for a clearance of 25 cm (9 inch) on either side. The total width of pavement required for the movement of one cycle is one metre (3 ft 3 inch).

1.3.4.5 WIDTH OF PAVEMENT:

The width (minimum) of pavement for a cycle track should not be less than 2 lanes which mean 2 metres (6ft 6 inch). If overtaking is provided for, the width should be made 3 metre minimum (9 ft 9 inch). Each additional lane where required should be 1 metre (3 ft 3 inch) wide.

1.4 PROBLEMS DUE TO TRAFFIC CONGESTION:

1.4.1 POLLUTION

Traffic congestion increase vehicles emissions and degrades ambient air quality. According to a recent study, there are excess morbidity and mortality for drivers, travelers and persons living near major roadways. Traffic on roads has been significantly increased in the India and elsewhere in last 15-20 years. In many areas, vehicles emission have become the major source

of air pollution, including carbon monoxide (CO), carbon dioxide ($CO_{2),}$ or hydrocarbons (HCs), nitrogen oxide (NO_x), and particular matter (PM). Road transport cause a significant portion of air pollution in big cities and towns. Traffic fumes contain harmful chemicals that pollute the whole atmosphere. It (Road traffic) emissions produce greenhouse gases that is a major reason for the global warming. Local administration can reduce pollution by using their traffic control powers. They can make traffic regulation orders to reduce traffic congestion and improve the condition of air quality.

1.4.1.1 Causes and effects of pollution:

Environmental pollution is currently the biggest problem facing the world today. The burning of fossil fuels for the purpose of transportation produces both primary and secondary pollution and it is one of the biggest sources of air pollution. Air pollution in India is a serious issue for the health. Out of 30 most polluted cities in the world, 21 were in India in 2019. As per a report based in 2016, at least 140 million people in India breathe air that is 10 times or more over the WHO safe limit. Out of 20 cities in the world, 13 cities with the highest annual levels of air pollution are in India. 27% of total pollution is caused by the vehicles and mostly due to traffic congestion. Air pollution is the reason for the premature deaths of 2 million people in India every year.

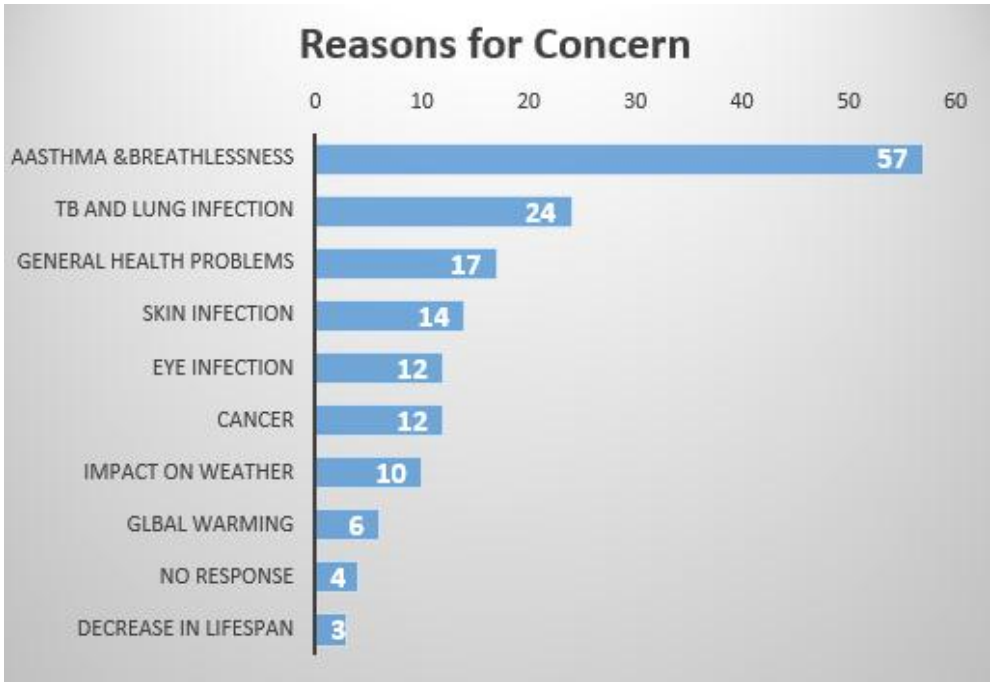


Fig. 1.4.1.1.1 Dieses caused due to air pollution

Top cities in India with the highest level of PM 2.5

Cities	PM2.5 Levels
Delhi	153
Patna	149
Gwalior	144
Raipur	134
Ahmadabad	100
Lucknow	**96**
Firozabad	96
Kanpur	93
Amritsar	92
Ludhiana	91
Allahabad	88

Table 1.4.1.1.1 Pollution level in cities

One of the important reasons of air pollution is **TRAFFIC CONGESTION.** It is severe in India's cities and towns. Traffic congestion is caused by many reasons but some important reasons are increase in number of vehicles, a lack of intra city divided lane highways and intra city expressways network etc

Traffic congestion reduce the average traffic speed of vehicles. At low speed, according to scientific study data vehicles burn fuel inefficiently and pollute more per trip. A study in USA found that for the same trip, cars consumed more fuel and polluted more if the traffic is congested as compare to when traffic flows freely. An average speed between 20 and 40 km per hour, the cars polluted twice as much as when speed is 55 to 70 km per hour.

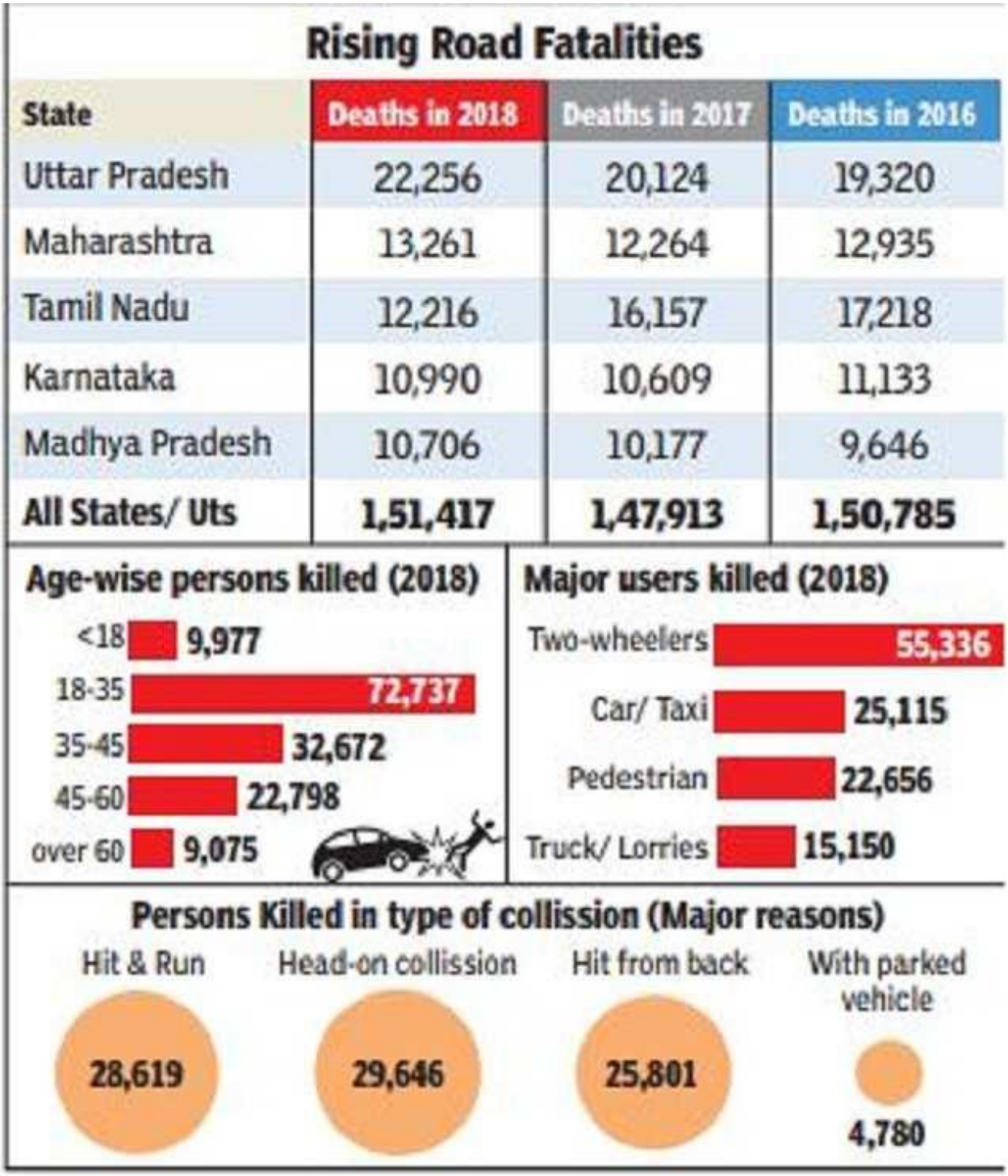
Traffic congestion in Lucknow and other Indian cities is extreme. The average speed in many Indian cities is less than 20km per hour in peak hour. Vehicles also consume a lot more carbon footprint fuel per trip than they would if the traffic congestion is less.

Air pollution in India is estimated to cause about 70,000 deaths per year.

1.4.2 TRAFFIC ACCIDENTS:

Traffic congestion is a major source of deaths, injuries and vehicles damage every year. The National Crime Records bureau (NCRB), 2016 reports said that there were 464,674 traffic collisions in 2015 which caused 148,707 deaths in India. In 2018, the number of persons killed in road accidents touched all time high over to 1.51 lakh in India. Uttar Pradesh records maximum road deaths followed by Maharashtra and Tamil Nadu, according to latest road accident report.

The number of 467,707 accidents and more than 1.51 lakh deaths in India in 2018 means an average of 1,280 accidents and 415 deaths every day and about 53 accidents and 17 deaths every hour. According to report share of two wheelers involved in fatal accidents was maximum at 31.4% followed by car and jeeps.



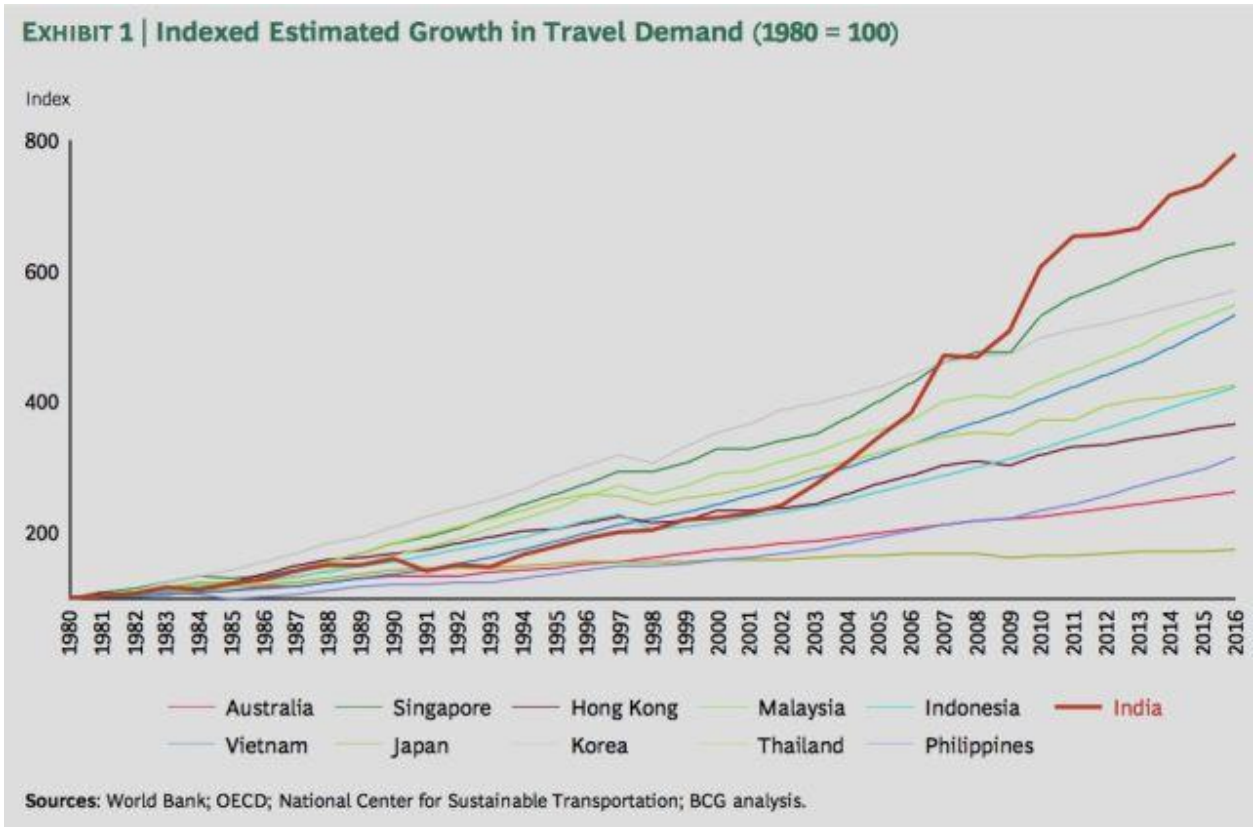
Credit: Times of India

Fig. 1.4.2.1 Roads deaths in India

1.4.3 TIME CONSUMING:

According to a report, travelers in metro cities like Delhi, Mumbai, Kolkata, Bengaluru spend 1.5 hours more on daily basis than other cities in Asia. The main reason for traffic congestion in India is lack of urban planning. The slow vehicle such as cycle and rest of vehicles travels on the same road. Therefore speed of automobile vehicles decreases and becomes congestion. If we plan a separate cycle track then it must be good for traffic. Traffic congestion is costly too. The cost of traffic congestion is calculated on the basis of fuel consumption, and productivity loss which is man hours, pollution and accidents on annual basis. India cities may be loosing up to $22 billion annually due to congestion.

Transport demand in India has increased by almost 6 times since 2000 due to economic development, increasing wealth. Increasing wealth among households is the main reason behind vehicle ownership. This is higher in Asia pacific region.



Source: Scroll.in

Fig. 1.4.3.1 Growth in travel demand

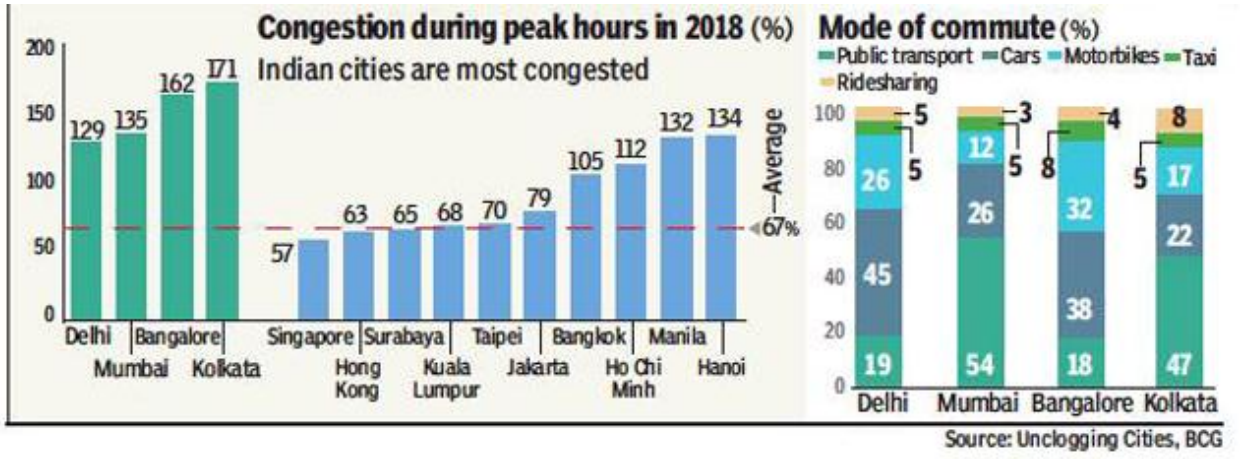
1.4.4 ECONOMICAL LOSS:

In Indian cities, the traffic congestion is visibly rise. This has a detrimental effect on economy apart from other factors like air pollution, fuel wastage, health issues and quality of life.

A brief overview of traffic congestion statistics in some developed countries.

- In United Kingdom, the annual congestion cost will reach 33.4 billion US$ by 2030. It will rise by 50% from the 2014 levels of 20 billion US$.
- In United States, the annual cost projected to increase to 186 billion US$ by 2030. In 2014, it was 124 billion US$.
- In Australia, the annual congestion cost will increase to AUD 7.8 billion as compared to 3.5 billion in 2005 for Sydney. In Melbourne it will increase from AUD 3.0 billion in 2005 to AUD 6.1 billion in 2020.

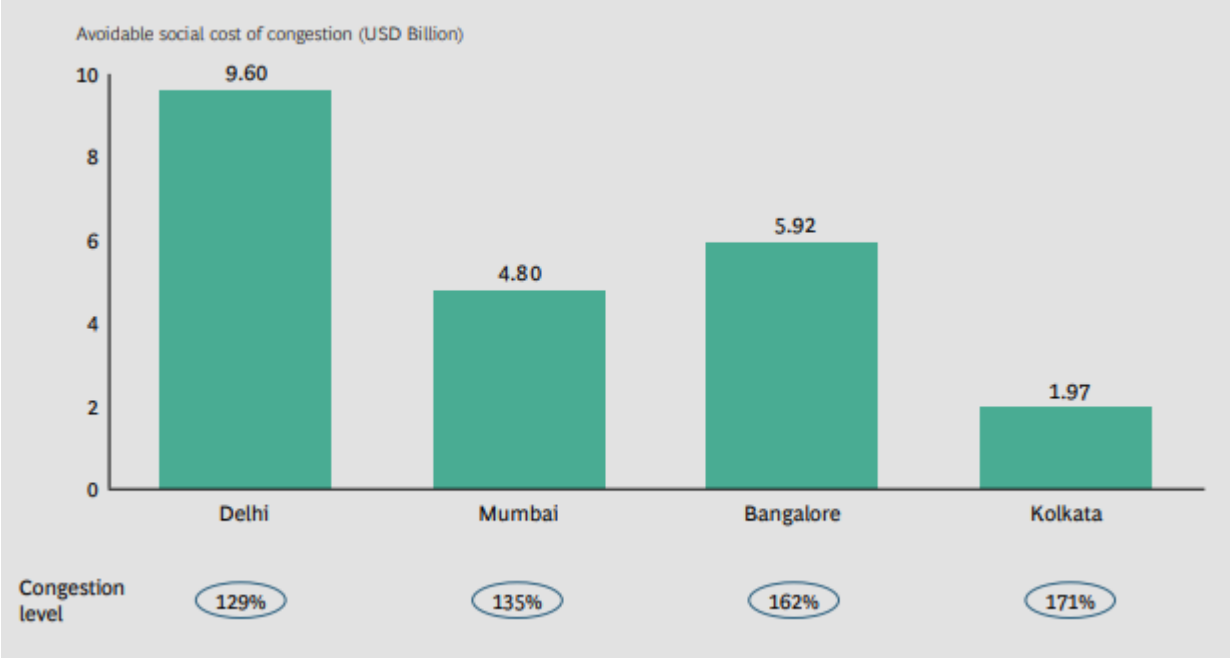
If we talk about India, only in capital city Delhi, the projected traffic congestion costs will come around 14,658 US$ by 2030. The vehicular population is projected to rise by 10 million by 2020 in New Delhi, which will increase in congestion. At least about 300,000 US$ worth of fuel was wasted every day in New Delhi in 1998. This number jumped to about 1.6 million US$ per day of 2010.



Source: Times of India

Fig. 1.4.4.1 Congestion during peak hours

Traffic congestion in Delhi, Kolkata, Bengaluru and Mumbain combined costs the economy of Rs. 1.5 lakh cr annually according to a study conducted by global consultancy firm. According to this study, Kolkata is the worst amongst four cities followed by Bengaluru. In this survey, peak hours were 7-9 AM and 6-8 PM during which travelers spent one and half hour extra time to travel a given distance as compared to non-peak hours.



Source: The Financial Express

Fig. 1.4.4.2 Congestion level

Traffic congestion in this four metro cities cost more than the entire rail budge, which is 1.48 lakh cr. The traffic congestion in Delhi costs about $10 billion which is about 10% of GDP. The Mumbai congestion costs $4.5 billion. Bengaluru costs $5.92 billion while Kolkata costs lowest with $1.97 billion.

CHAPTER-2

LITERATURE REVIEW

1. Jensen (2007)[9]

compares bicycle tracks and lanes a before and after study. The construction of bicycle tracks resulted in a 20 percent increase in bicycle traffic and a decrease of 10 percent in motor vehicle traffic on those roads where bicycle tracks have been constructed. The making of bicycle lanes resulted in a 5 percent increase in bicycle traffic and a decrease of 1 percent in motor vehicle traffic on those roads where bicycles lanes have been marked.

2. Dill and Gliebein (2008)[5]

in their research understand and measures bicycle behavior. In their study they found that the bicycle trips were 13.4 minutes longer than the estimated auto travel time. The medium difference was 9.5 minutes.

About half of the trips occurred during morning and evening peak travel times (6-9 AM and 4-7 PM) with about one third occurring between those time periods. Therefore, less than 20% of the trips occurred in the late evening and early morning.

3. Fraser and Lock (2010)[15]

The objective was to consider the effect of all interventions or physical factors on cycling in any population group, including cycle path or route. This review provides evidence for the positive association between certain built environment factors and cycling.

Policies promoting cycle lane construction appears promising in helping to reduce physical inactivity and the transport component of greenhouse gas emission.

4. Lusk, Furth, Willett and team (2011)[3]

had studied six cycle tracks in Montreal that are two way on the one side of the street. Each cycle track was compared with one or two reference streets without bicycle facilities that were consider alternative bicycling route. All six cycle tracks were two-way on one side of the street and separated from traffic by raised medians, parking lanes, or delineator posts. There were 8.5 injuries and 10.5 crashes per million bicycle-km.

5. Morency, Luis and team (2013)[14]

researched on crash rates on cycle tracks in the United States. They studied state adopted bicycle guidelines to determine whether cycle tracks (physically separated) were recommended, whether they were built and their crash rate.

For the 19 US cycle tracks they examined, the overall crash rate was 2.3% per 1 million bicycle kilometer.

6. Hull and O'Holleran (2013)[4]

has used a detailed template to benchmark the level of service provided to cyclist in six European cities. The methodology has been tested using an experienced and a novice cyclist to capture their perceptions of the design of the cycle infrastructure in these cities. The research paper identified one of the barriers to encouraging more cycling is the potential/ inexperienced cyclists perception of the safety, comfort, and continuity of the cycling network in the city.

7. Kristinsdottir (2015)

had studied attitudes towards cycling in general. According to his study "travel behavior surveys all over the world indicate that access to transportation is most important factor influencing mode choice. In this research when asked from people about the benefits of cycling, the most common answer were that is save money on both on soil/gasoline and on owning and managing a car

8. Greibe and Thomas (2016)[8]

Study is based on empirical data collected through video recordings at 8 different locations in Denmark. Two synchronised cameras covering the observational area on the cycle track are used for the video recording. The main objective of this study is to examine how widths of one-way cycle tracks in urban areas influence the behavior, flow and capacity of bicycle traffic. Traffic safety has not been a part of the project but is of course a direct offshoot of the subject.

9. Ekblad, Svensson and Koglin (2016)[1]

Studied concerning how different factors associated with bicycle planning influence then propensity to choose the cycle for transportation.

It has been shown in research that the organization of transport and urban planning can have a positive or negative impact on planning on cycle.

10. Prasanna Desai (2017)

Provide information about the kind of cycle infrastructure that is needed at each road of the road network in the city of Pune.

There are number of key success factors that need to be applied to increase the success of cycling infrastructure in Pune.

Continuity: Detailed design need to be include dealing with trees, lamp posts, bus stops and pinch points.

Footpath width: Not only cycle track need to be wide enough, footpaths need to be designed for the existing actual use and flow of pedestrians to avoid that cyclists walk on the cycle track. If footpaths are full of obstacles pedestrians will walk on the cycle track.

Maintenance: Many cycle tracks in Pune have not been maintained. It is essential that the PMC reserve an annual budget for the maintenance of cycling infrastructure in the city. This budget should increase when the total length of cycling infrastructure increases.

CONCLUSION OF LITERATURE REVUEW:

- A separate cycle track can increase the speed of the remaining vehicles.
- Reduce parking and roadway congestion.
- Replacing vehicles trips with bicycle can reduce the number of single occupancy vehicles, traffic and associate air pollution fuel consumption.
- The construction of bicycle tracks can resulted in a 20 percent increase in bicycle traffic and decrease of 10 percent in motor vehicles on the road.
- Roads with cycle tracks are safer.
- Bicycling can promising in helping to reduce physical inactivity.

CHAPTER-3

METHODOLOGY

3.1 Two way classified survey:

Since the approach to this research is more or less based on the survey so I had to find a road in Lucknow having a number of cycle traffic. Main criteria adopted for selection of road was, more number of cycle traffic. In Lucknow city maximum cycle users are labourers So I selected a road where more labourers are travels namely Itaunja-Mohana-Kumhrawa-Kursi-Deva-Chinhat Road, which is a main district road and their road classification is MDR 88C. I did my survey work on Chinhat to Deva section of this road. I have done following work on this road on 15-16 February 2020 from 8:00- 08:00 hours for 24 hrs.

- Two way classified traffic survey of the road
- Calculation of average speed of commercial vehicles, personal vehicles and two wheelers vehicles except cycle in mixed traffic
- Calculation of average speed of commercial vehicles, personal vehicles and two vehicles with cycle in mixed traffic.
- Study of congestion of vehicles
- Study and comparison of fuel consumption for per hour as well as total cost saving due to separate cycle track.

The results of two-way classified traffic are as follow

Vehicles	No. of vehicles
Cars, Jeeps, Vans, Three wheelers etc	16,443
Buses	393
Trucks	741
Motor cycle/ Scooter	14,456
Animal driven vehicles	02
Cycles	5,863
Others (Tractors)	241

Table 3.1.1 Two-way classified survey

3.2 Average speed difference between peak hours and non-peak hours:

For average speed difference I had to choose peak hours for cycle traffic and non-peak hours for cycle traffic and I had to see that how much motor vehicles speed can increases due to no cyclists in mixed traffic. For this I had made two points at 10km difference. One person stood at 0 km point and other person was at after 10 km point. As soon as a vehicle passes through o km point, the person used to note the vehicle registration number and time of crossing the point and tell other person on phone that the vehicle number xxxx had crossed at this point and please note their exit time on that point. For example a car with registration number UP32 S XXXX passes through at 0 km point at 8:10 hours and the same car exit at 10km point at 8:24 hours it means that car took 14 minutes to cover that 10 km distance. I have data of about 50 cars at peak hour and same number of car at non-peak hour. I have checked speed difference of four wheelers, two wheelers, buses, trucks and tractors.

The average speed difference between peak hours and non-peak hours are as follows.

Vehicles	Average speed difference
Car, Jeeps, vans etc.	2 m 20 sec
Buses	50 sec
Trucks	35 sec
Two wheelers	13 sec
Tractors	34 sec

Table 3.2.1 Average speed difference

CHAPTER-4
DATA COLLECTION

I did all my survey work on Chihat to Deva section of Itaunja-Mahona-Kumhrawa-Kursi-Deva Chinaht road (MDR 88C), which length is 47 km. It's a main district road with 2 numbers of lanes. The survey has been done for to give practical relation in the research work and this purpose the first thing I did is two way classified survey of the road for 24 hours. Calculate the average speed of commercial vehicles, personal vehicles as well as two wheelers vehicles except cycle in mixed traffic. Study of average speed of commercial vehicles, personal vehicles and two wheelers vehicles based on algorithm that there is no cyclist in mixed traffic.

4.1 Two way survey Result:- (for 24 hrs)

Type of vehicles	No. of vehicles
Cars/ Jeeps/ Vans/ Three wheelers etc	16,443
Buses	393
Trucks	741
Motor cycle/ Scooter	14,456
Animal Drawn vehicles	2
Cycles	5,863
Others (Tractors)	241

Table 4.1.1 Two-way survey

4.2 Average speed difference (Peak hour Vs Non Peak hour) for 10 KM:

vehicles	Peak hour time (minutes)	Non- Peak hour time (Minutes)	Differences
Four Wheelers	13.21	12.1	1.20 m
Pickup	14.55	14.00	55 sec
Bus	16.5	15.4	50 Sec
Trucks	17.00	16.25	35 Sec
Two wheelers	12.41	12.28	13 Sec
Three Wheelers	19.37	17.28	2 m 9 Sec
Tractors	17.5	17.16	34 Sec

Table 4.2.1 Average speed difference for 10 km

4.2.1 Average Time difference (Peak hour vs Non peak hour) for 100 Km

Vehicles	Peak hour time (m)	Non peak hour time (m)	Difference (m)
Four Wheeler	133.5	121.5	13
Pickup	149	140	9
Bus	168	156	8
Trucks	170	164	6
Two Wheeler	127	124	3
Three Wheeler	196	175	21
Tractors	178	172	6

Table 4.2.2 Average speed difference for 100 km

4.3 WAER AND TEAR COST WITH NO CONGESTION ANNUALLY:

Vehicles	Cost for 1 vehicles (Rs)	Total no. of vehicles	Total cost
Four wheelers	900	16,443	900*16,443=14,798,700
Buses	12,000	393	12000*393= 4,716,000
Trucks	14,000	741	14,00*741=10,374,000
Two wheelers	500	14,456	500*14,456=7,228,000
Tractors	3,000	241	3,000*241=723,000
		TOTAL	**Rs. 37,839,7000**

Table 4.3.1 Wear and tear cost with no congestion

4.4 WEAR AND TEAR COST WITH CONGESTUION ANNUALLY:

Vehicles	Cost for 1 vehicle (Rs)	Total no. of vehicles in 24 hrs	Total cost (Rs)
Four wheelers	2,000	16,443	16,443*2,000= 32,886,000
Bus	25,000	393	393&*25,000= 9,825,000
Trucks	30,000	741	741*30,000=22,230,000
Two wheelers	1,000	14,456	14,456*1,000= 14,456,000
Tractors	7,000	241	7,000*241= 1,687,000
		Total	**Rs. 81,084,000**

Table 4.4.1 Wear and tear cost with congestion

CHAPTER-5
DATA ANALYSIS

5.1 Average speed in peak hour (With cycle in mixed traffic) and non-peak hour (Cycle is not in mixed traffic) for 1 hour.

Vehicle	Average Speed in peak hr	Average Speed in non-peak hr	Difference
Four Wheelers	47km/hr	50km/hr	3km/hr
Bus	36.5km/hr	38.5km/hr	2km/hr
Trucks	35.5km/hr	37km/hr	1.5km/hr
Two wheelers	48km/hr	49km/hr	1km/hr
Tractors	34km/hr	35km/hr	1km/hr

Table 5.1.1 Average speed difference for 1 hr

After calculating the average speed of every type of vehicles, now we can calculate the how less the fuel consumption in traffic in which there are no cyclists on the road.

- The mileage of **four wheelers** for peak hour is 14km/L and for covering distance of 47km in 1 hr it will take 3.35L fuel and it will cost Rs 261 @ 78 rupees per litre in Lucknow. For non-peak the mileage is 16km/L and for covering distance of 50 km distance in 1km it will take 3.125L fuel and it will cost Rs 243. **So in 1 hr journey we can save Rs 18.**

- For **bus**, mileage is 5km/L for peak hour journey and for covering distance of 36.5km in 1 hour, will take 7.3L diesel and it will cost Rs 496 @68 per litre. For non-peak journey, the mileage is 6km/L and it will take 6.4L diesel and will cost Rs 435 for covering distance of 38.5km in 1 hour**. It will save Rs 61 in 1 hour journey**.

- For **trucks,** mileage is 4km/L for peak hour journey and in 1 hour span it will cover 35.5km and it will take 8.8L diesel and it will cost Rs 598 @68 per litre. For non-peak hour journey, the mileage is 5km/L and it will cover 37km in hour and will take 7.4L diesel and its cost will be Rs 503. **So in one hour journey of trucks will save Rs 95**.

- For **two wheelers,** mileage is 57km/L for peak hour journey and it will cover 48km in 1 hour and it will take 0.84 L petrol for Rs 65 @78 per litre. The mileage is 59km/L for non peak hour journey and it will cover 49km journey in 1 hour span and it will cost Rs. 64**. It will save Re. 1 for one hour journey**.
- Tractors cover the 34km distance in one hour and it will cost Rs 385. For non-peak hour journey, mileage is 8km/L and it will take 4.375L diesel and it will cost Rs 297.5 and **it will save Rs 87.5 for one hour journey.**

5.1.1 FUEL CONSUMPTION COST FOR 1 HOUR (FOR 1 VEHICLE)

Vehicles	Cost for peak hour (Rs)	Cost for non-peak hour (Rs)	Savings (Rs)
Four wheeler	261	243	18
Bus	496	435	61
Truck	598	503	95
Two wheeler	65	64	1
Tractor	385	297.5	87.5

Table 5.1.1.1 Fuel consumption cost for 1 hr

5.1.2 FUEL CONSUMPTION SAVINGS FOR 1 DAY

Vehicles	No. of vehicles in 24 hrs	Saving in 1 hr (Rs)	Total savings (Rs)
Four wheelers	16,443	18	18*16443= 295,974
Bus	393	61	61*393= 23,973
Truck	741	95	95*741= 70,395
Two wheelers	14,456	1	1*14,456= 14,456
Tractors	241	87.5	87.5*241= 21,087.5
		Total savings	Rs. 425,885.5

Table 5.1.2.1 Fuel consumption saving for 1 day

The total saving by fuel consumption for one day for all type of vehicles is Rs 425,885.5 by this calculation we can calculate total saving by fuel consumption for one year and that is 365*425,885= Rs 155,448,207.5. Assumed 1% of total fuel consumption due to that road and that is equal to Rs. 1,554,482.

5.2 SAVING FROM ACCIDENT:

Due to traffic congestion, according to police records there were total 53 accidents happened on this particular road in last year i.e. 2019. In this, some were minor accidents and some were major and there were 4 two wheelers, 5 four wheelers, 2 buses, 3 trucks and 3 tractors was damaged and total 2 people died in road accident on this particular road.

5.2.1 Two wheelers:

For repairing cost of the vehicles three garages were visited and data were collected as there is different cost for different type of accident. They show their records and when checked the cost

of repairing of 5 different two wheelers was Rs 16000, Rs 13000, Rs 15,500 Rs 14000 and Rs 13,500 respectively. The average cost of 5 two wheelers which is damaged by accident was Rs 14,400. I visited another garage and there repairing cost was Rs 15000, Rs 17,500, Rs 12000, Rs 14,500 and 13,500 respectively. And there average cost was Rs 14,500. I visited another garage and their records shows that their repairing cost was Rs 13000, Rs 15000, Rs 12,500, Rs 14000 and Rs 12000 and their average was Rs 13,300. The total average cost of two wheelers damaged vehicles by accident according to three garages I visited was Rs. 14,066.

Now the average cost of three different repairing centre was Rs. 14,322

5.2.2 Four wheelers:

For four vehicles repairing three different repairing centre were visited and at first centre, according to their data the cost of repairing of four wheelers damaged due to accident was Rs. 65000, Rs. 57000, Rs. 72000, Rs. 64000 and Rs. 75000 respectively for 5 vehicles and their repairing cost average was Rs. 66,600. At other repairing centre the cost of repairing for 5 vehicles was Rs 74000, Rs. 70000, Rs. 65000, Rs. 69000, and Rs. 78000 and average of 5 vehicles was Rs 71,200. At third centre, the cost of repairing was Rs 72000, Rs 80000, Rs 65000, Rs 70000 and Rs 76000. The average cost for 5 vehicles was Rs 72,600. The average of three repairing centre was Rs. 70,133.

The average repairing cost for three different garage was Rs. 70,133

5.2.3 Buses:

For bus repairing cost one repairing centre were visited and data were collected repairing cost of bus which is damaged in road accident and got the cost of repairing for 4 buses and that was Rs. 120,000, Rs. 135,000, Rs. 115,000 and 145,000 respectively. **The average cost of bus repairing was Rs. 128,750.**

5.2.4 Trucks:

For trucks repairing cost repairing centre was visited and data shows repairing cost of trucks damaged in road accident. They have data of 6 recent trucks which shows the cost of repairing was Rs. 160,000 Rs. 153,000 Rs. 137,000, Rs. 150,000, Rs 165,000 and Rs. 142,000.

The average repairing cost of 6 trucks is Rs. 151,000.

5.2.5 Tractors:

For tractors repairing cost, visited two repairing centre and according to first centre visited, the data collected shows cost of tractors repairing was Rs. 55,000, Rs. 62,000, Rs 65,000, Rs 52,000 and Rs 70,500 for 5 tractors. The average cost for 5 tractors was Rs. 60,900. At second centre I visit, their records show the cost of repairing of 5 tractors was Rs. 48,000, Rs 54,000, Rs 60,000, Rs 58,000 and Rs 63,000. The average cost was Rs. 56,600.

The average cost of both repairing centre was Rs. 58,750.

Vehicles	No. of vehicles damaged by accident in 2019	Average repairing cost for 1 vehicle (Rs)	Repairing cost for total damaged vehicles as per data (Rs)
Two wheelers	4	14,322	4*14,322= 57,288
Four wheelers	5	70,133	5*70,133= 350,665
Buses	2	128,750	2*128,750= 257,500
Trucks	3	151,000	3*151,000= 453,000
Tractors	3	56,600	3*56,600= 169,800
		Total saving	**Rs. 1,288,253**

Table 5.2.1 Saving from accidents

There are 2 people died in 2019 in accident due to traffic congestion and one person loss is estimated Rs. 1,000,000 then it will be Rs. 1,288,253+ 2,000,000= **Rs. 3,288,253 saving if there was no cycle in mixed traffic**

5.3 COSTS DUE TO AIR POLLUTION:

According to a study by the Centre of Environmental and Energy Development (CEED), Lucknow has recorded the second highest number of premature deaths due to air pollution. The study revealed that an estimated 4,127 people has been died annually in the city due dieses caused by air pollution. We can assume a total 2 people has been died due to air pollution at Itaunja-Mahona-Kumhrawa-Kursi-Deva-Chinahat Road annually. Is is estimated Rs. 10 lakh for one person loss.

Doctors at KGMU maintained that the number of patients with problems due to air pollution had jumped by 30%. Now the patient number is 325 per day. Assume that total number of patients annually suffering health issues due to that road is 182. It is estimated Rs. 40,000 for treatment for one patient suffering health issues due to air pollution and Rs. 1,000,000 estimated for one person loss.

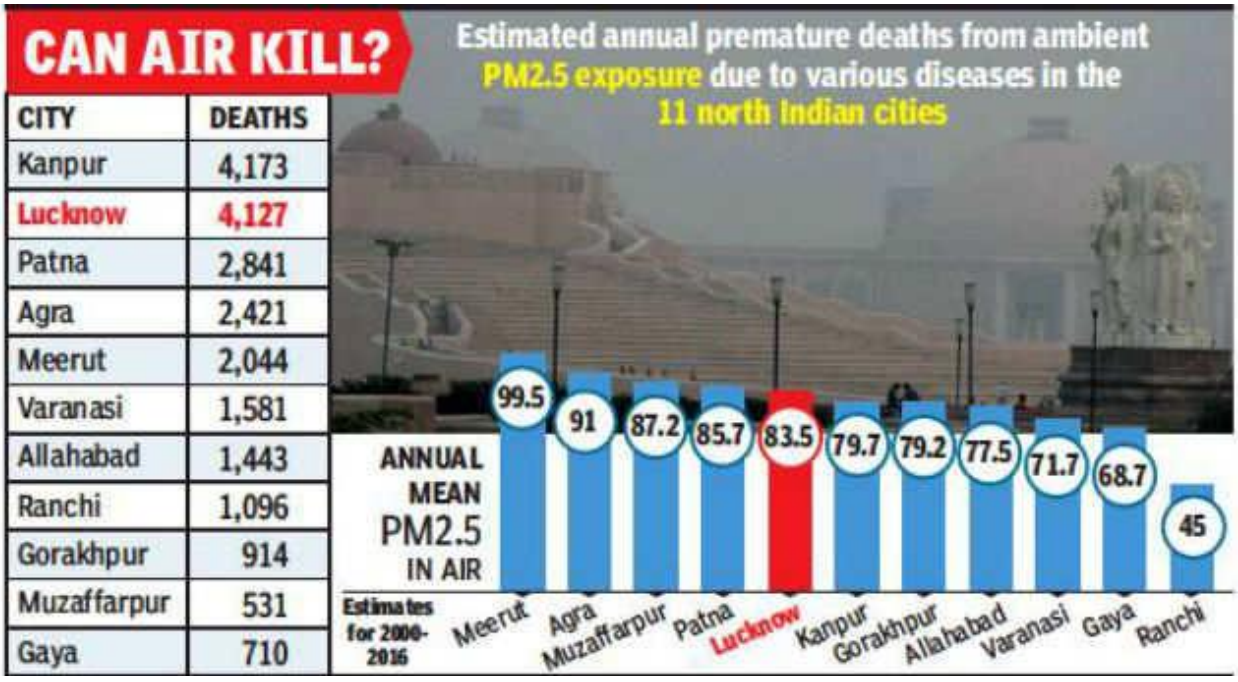


Fig. 5.3.1 Estimated deaths due to air pollution

Caused	No. of person (Yearly)	One person cost (Rs)	Total cost (Rs) (Yearly)
Died	2	1,000,000	2,000,000
Illness	182	40,000	7,280,000
		Total	**Rs. 9,280,000**

Table 5.3.1 Cost due to Air pollution

Two garages were visited and data were collected as garage owner said that 1% of total vehicles repairs for tear and wear.

5.4 WEAR AND TEAR COST:

5.4.1 WITH NO CONGESTION:

Vehicles	Total No. of vehicles consider as 100%	Repairing 1% of total no. of vehicles	Average cost for 1 vehicle (Rs)	Total cost (Rs)
Four wheelers	16,443	164	900	900*164= 147,600
Buses	393	4	12,000	12,000*4= 48,000
Trucks	741	8	14,000	14,000*8= 112,000
Two wheelers	14,456	144	500	144*500= 72,000
Tractors	241	3	3000	3000*3= 9,000
			TOTAL	**Rs. 388,600**

Table 5.4.1.1 Wear and tear cost with no congestion

5.4.2 WITH CONGESTION:

Vehicles	Total No. of vehicles consider as 100%	Repairing 1% of total vehicles	Average cost for 1vehicle	Total cost
Four wheelers	16,443	164	2000	2000*164= 328,000
Buses	393	4	25,000	25,000*4= 100,000
Trucks	741	8	30,000	30,000*8= 240,000
Two wheelers	14,456	144	1,000	1,000*144= 144,000
Tractors	241	3	7,000	7,000*3= 21,000
			TOTAL	**Rs. 829,000**

Table 5.4.2.1 Wear and tear cost with congestion

NET WEAR AND TEAR COST DUE TO CONGESTION:

Rs. 829,000- Rs.388,600= Rs. 440,400

5.5 COSTS DUE TO TIME:

Rs. 9,000 average monthly income estimated of a person working 8 hours daily.

5.5.1 COSTS DUE TO TIME FOR 1 VEHICLE FOR 1 MONTH

Vehicles	Extra time taking in 1 hr due to congestion (m)	Average income for 1 minute (Rs.)	Total cost due to time consuming in 1 hr(Rs)	Total cost due to time consuming in 24 hrs (Rs	Total cost due to time consuming in 1 month (Rs) for 1 vehicle
Four wheelers	3.6	0.625	3.6*0.625= 2.25	2.25*24= 54	1,620
Buses	3	0.625	3*0.625= 1.875	1.875*24= 45	1,350
Trucks	2.5	0.625	2.5*0.625= 1.56	1.56*24= 37	1,110
Two wheelers	1.5	0.625	1.5*0.625= 1	1*24= 24	675
Tractors	2	0.625	2*0.625= 1.25	1.25*24= 30	900
			TOTAL		Rs. 5,655

Table 5.5.1.1 Cost due to time

5.5.2 COST DUE TO TIME CONSUMING YEARLY:

Vehicles	Total no. of vehicles	Cost for one vehicle	Cost for all vehicles
Four wheelers	16,443	1,620	1,620*16,443= 26,637,660
Buses	393	1,350	1,350*393= 530,550
Trucks	741	1,110	1,110*741= 822,510
Two wheelers	14,456	675	675*14,456= 9,757,800
Tractors	241	900	900*241= 216,900
		TOTAL	**Rs. 37,965,420**

Table 5.5.1.2 Cost due to time monthly

5.6 CYCLE TRACK CONSTRUCTION COST:

Let assume if we are estimating the cost of construction of one kilometer long and 2 metres wide cycle track. This track has 15 cm base of cm size stone boulders.

Description	No	Length	Width	Height	Quantity	Remarks
Sub grade preparation and dressing	1	1000 m	2.3 m		2000 m^2	2.00= 1.7+0.15+0.15
Sub base materials (WBM grade3)	1	1000 m	2.10m	0.10	210 m^3	0.10= 0.05+0.05
Base layer material (PQC)	1	1000 m	2.00 m	0.10	200 m^3	0.10= 0.05+0.05

Description	Quantity	Unit	Rate	Amount (Rs)
Sub grade preparations and dressing	2000	m^2	20	20*2000= 40,000
Sub base material (WBM grade3)	210	m^3	1656	210*1656= 347,760
Base layer material (PQC)	200	m^3	6500	200*6500= 1,300,000
Total amount				**Rs. 1,687,760**

Fig. 5.6.1 Cycle track cost estimation

Total cost estimated for 1 km construction of cycle track = 1,678,760

Estimated cost of construction of cycle track for 10 km= 10*1,678,760= 16,877,600

5.7 TOTAL SAVING

5.7.1 TOTAL COST SAVING DUE TO DIFFERENT REASONS:

Factors	Savings (Rs)
Fuel consumption	1,554,482
Accidents	3,288,253
Pollution	9,280,000
Wear and tear	440,400
Time	37,965,420
Total	**Rs. 52,528,555**

Table 5.7.1.1 total saving

Estimated cost of cycle track for 10 km in one side= Rs 16,877,600

Estimated cost of cycle track for 10 km in both sides= 2*16,877,600= 33,775,200

NET PROFIT DUE TO CYCLE TRACK= 52,528,555- 33,775,200= Rs. 18,753,355

CHAPTER- 6

CONCLUSION

In the present world, the congestion of the traffic is increasing and therefore there are a lot of scopes for research in this field since with growing congestion it requires for improvements. This paper is not concerned with any designing aspect of cycle track, only estimated cycle track cost. India and the world are suffering with major traffic congestion mainly in urban areas. Traffic congestion had led to greater loss to country economy. With increasing people, the use of vehicles also increasing, be it via public transport or personal transport modes. The construction of cycle track in urban areas benefits in so many way. It increases motor vehicles average speed, it saves time for automobiles commuters, it reduces pollution, reducing wear and tear etc.

It is the first step towards the Improvement of highway capacity due to cycle track in urban area. It is seen from the survey that if a cycle track construct on a highway, it can increase the average speed of four wheelers for 3 km per hour in Lucknow. According to survey it can increase the average speed of buses for 2 km per hour and trucks for 1.5 km per hour.

It is seen from the survey that for covering of 10 km distance with cycle in mixed traffic and cycle is not in mixed traffic, four wheelers, buses, trucks, two wheelers and tractors takes 2 m 20 sec, 50 sec, 35 sec, 13 sec, 34 sec more average time with cycle in mixed traffic as compared to there is no cyclists in mixed.

India is going to face a lot of problems due to traffic congestion in future. The officials and government should try to avoid this problem to measure some steps and constructing cycle tracks in urban areas is one the solution. It is also good for health and it can any income group if they feel safe to ride bicycle and other hand it is beneficial for motor vehicles and traffic congestion.

Traffic congestion is frustrating in so many ways according to this study. According to this research the wear and tear cost also increases due to congestion of traffic, leading to more frequent replacement and repair as compared to those roads where traffic congestion in

negligible. Therefore the cycle track option should be adopted at least on those roads where traffic congestion is regular.

Total expenditure for the construction of 10 km of cycle track on both sides of the road is Rs. 33,775,200 and total benefit from various factors due to cycle track is Rs. 52,528,555 per year. Net profit due to cycle track is 18,753,355 per year.

CHAPTER-7

FUTURE SCOPE

Based on this study and findings, it is believed that the better analysis can be done on those roads where there traffic capacity is more and can derive an arithmetic formula.

- The relation between the increasing in average speed of vehicles due to no cycle in mixed traffic could be done with more traffic capacity.

- The average speed difference between cyclists in mixed traffic and no cyclists in mixed traffic could be done for far distance for more accurate result.

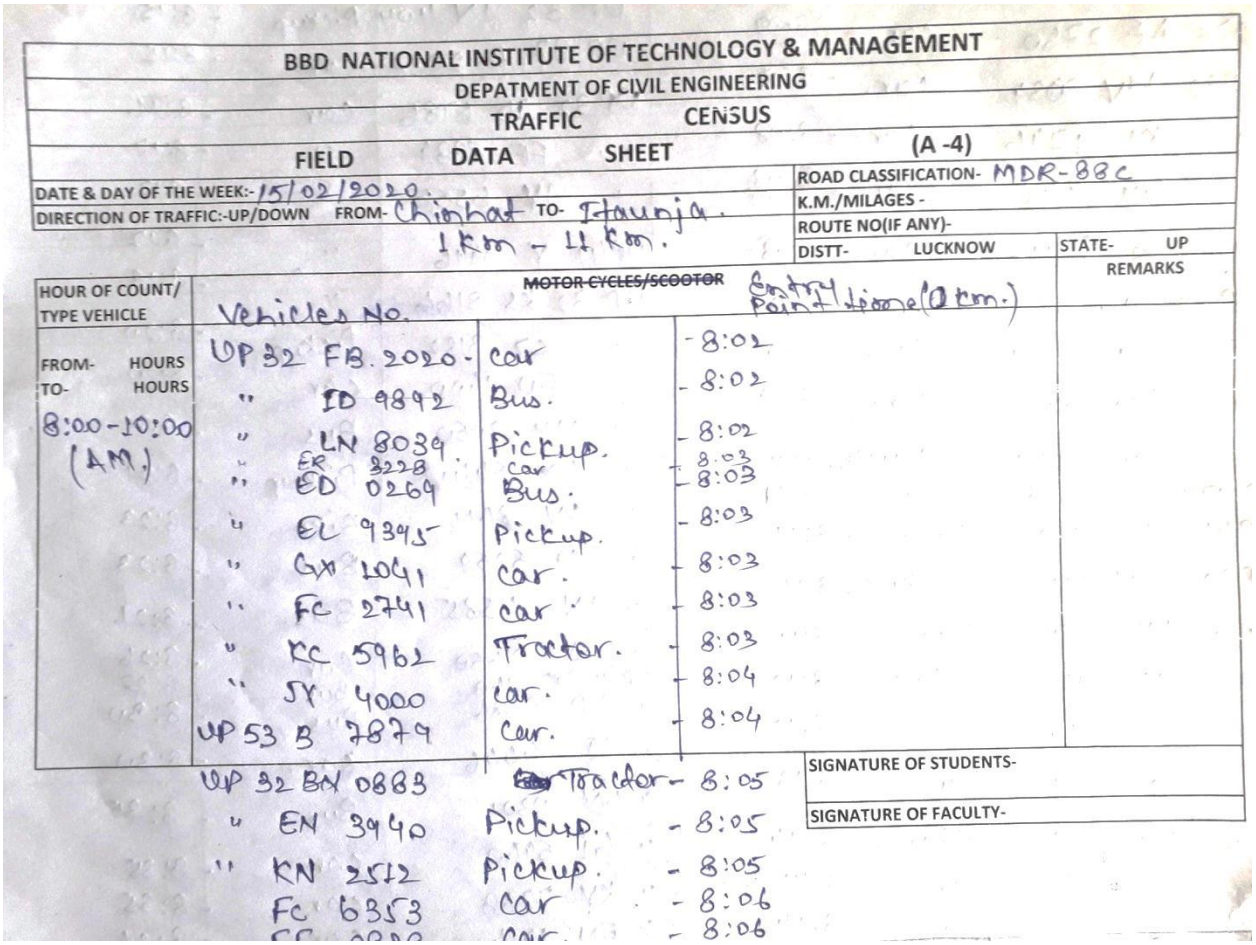
- The exact pollution emission due to traffic congestion on a specific road could be calculated.

- A deeper study can be adopted for deriving an arithmetic formula.

- The result has been made from less number of data due global pandemic COVID19, hence for further research purposes, more data can be used.

CHAPTER-8

FIGURES OF SURVEY RESULTS:



BBD NATIONAL INSTITUTE OF TECHNOLOGY & MANAGEMENT
DEPATMENT OF CIVIL ENGINEERING
TRAFFIC CENSUS
FIELD DATA SHEET (A -4)

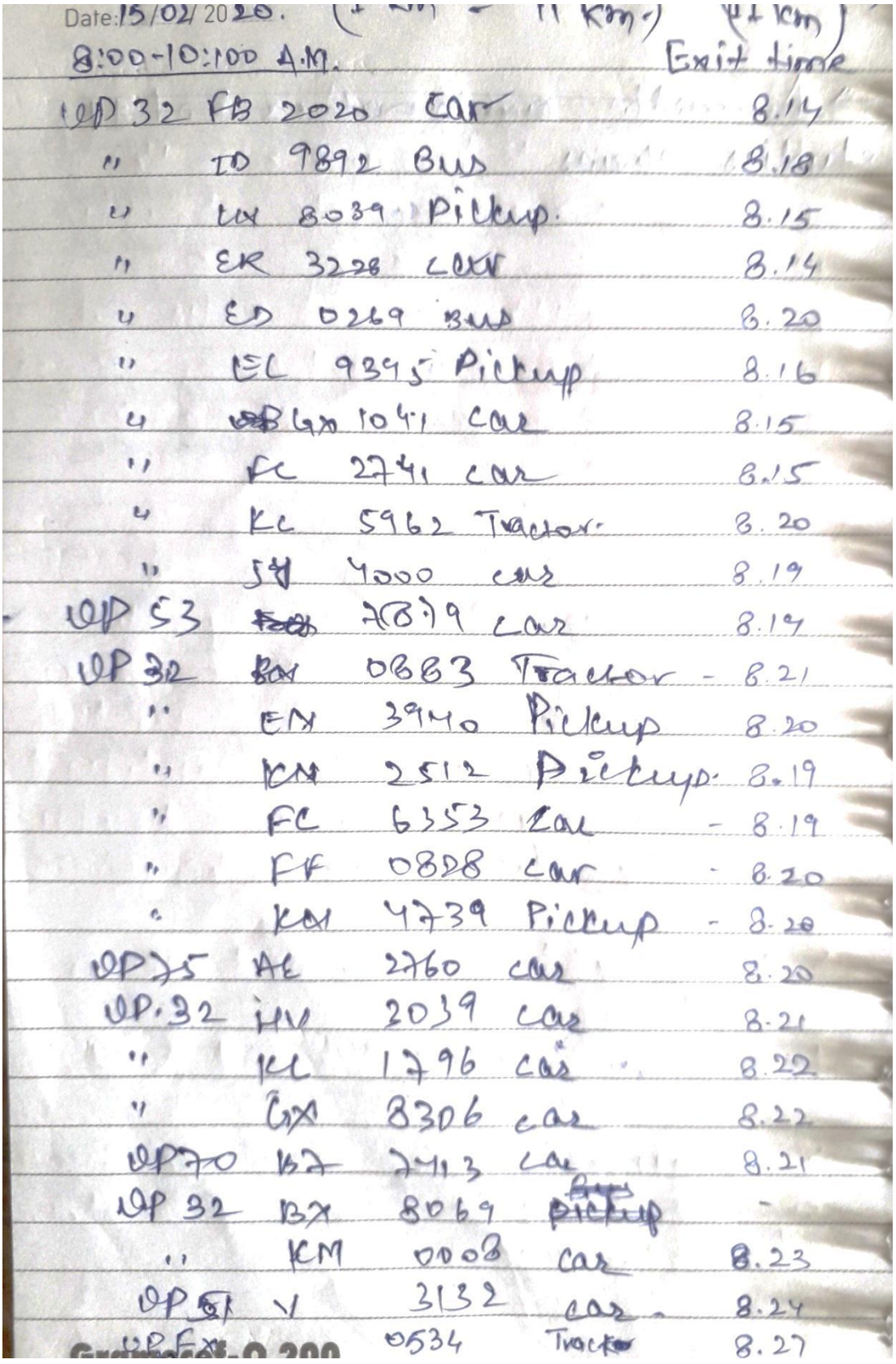
DATE & DAY OF THE WEEK:- 15/02/2020.
DIRECTION OF TRAFFIC:-UP/DOWN FROM- Chinhat TO- Itaunja.
1 Km - 11 Km.

ROAD CLASSIFICATION- MDR-88C
K.M./MILAGES -
ROUTE NO(IF ANY)-
DISTT- LUCKNOW STATE- UP

HOUR OF COUNT/ TYPE VEHICLE	MOTOR CYCLES/SCOOTOR Vehicles No.		Entry Point / Home (0 km.)	REMARKS
FROM- HOURS TO- HOURS				
8:00-10:00 (AM.)	UP 32 FB. 2020	car	- 8:01	
	" ID 9892	Bus.	- 8:02	
	" LN 8039	Pickup.	- 8:02	
	" ER 3228	car	- 8:03	
	" ED 0264	Bus.	- 8:03	
	" EL 9395	Pickup.	- 8:03	
	" GX 1041	car.	- 8:03	
	" FC 2741	car.	- 8:03	
	" KC 5962	Tractor.	- 8:03	
	" SY 4000	car.	- 8:04	
	UP 53 B 7879	Car.	- 8:04	
	UP 32 BN 0883	Tractor	- 8:05	
	" EN 3940	Pickup.	- 8:05	
	" KN 2512	Pickup.	- 8:05	
	Fc 6353	car	- 8:06	
	[illegible]	Car.	- 8:06	

SIGNATURE OF STUDENTS-
SIGNATURE OF FACULTY-

Fig. 14 Entry point at 0 km point (Peak hour)

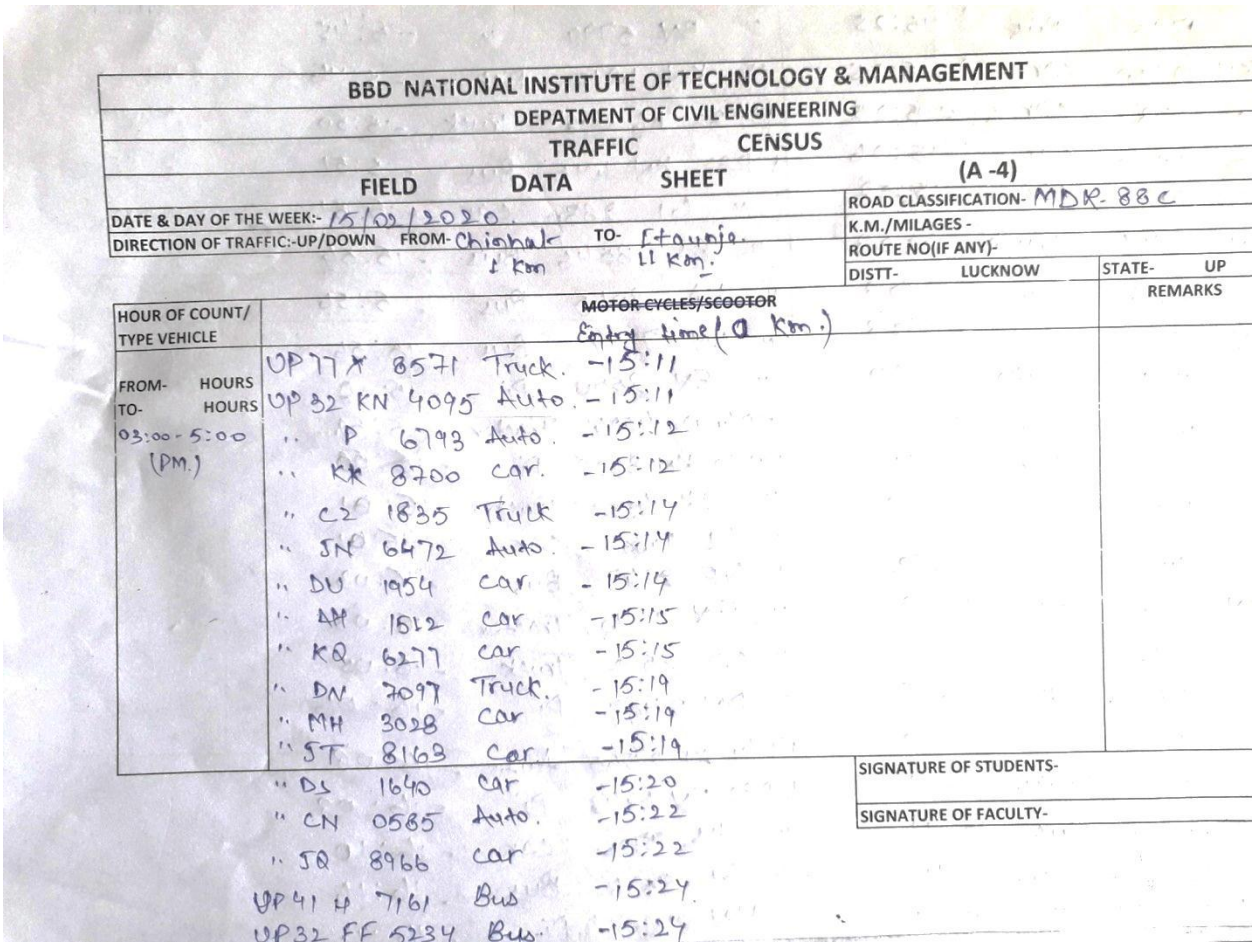


Date: 15/02/2020. (+ 1 km = 11 km) (1 km)

8:00-10:100 A.M. Exit time

UP 32	FB	2020	Car	8.14
"	TD	9892	Bus	8.18
"	LW	8039	Pickup.	8.15
"	ER	3228	Car	8.14
"	ED	0269	Bus	8.20
"	EL	9345	Pickup	8.16
"	GX	1041	Car	8.15
"	FC	2741	car	8.15
"	KC	5962	Tractor.	8.20
"	SY	4000	car	8.19
UP 53	[illegible]	7819	car	8.19
UP 32	BM	0883	Tractor	- 8.21
"	EN	3940	Pickup	8.20
"	KM	2512	Pickup.	8.19
"	FC	6353	Car	- 8.19
"	FF	0808	car	- 8.20
"	KM	4739	Pickup	- 8.20
UP 75	AE	2760	car	8.20
UP. 32	HH	2039	car	8.21
"	KC	1796	car	8.22
"	GX	8306	car	8.22
UP 70	BZ	7413	Car	8.21
UP 32	BX	8069	Pickup	-
"	KM	0008	car	8.23
UP [illegible]	V	3132	car	8.24
[illegible]		0534	Tractor	8.27

Fig.15 Exit point at 10 km point (Peak hour)



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DEPATMENT OF CIVIL ENGINEERING

TRAFFIC CENSUS

FIELD DATA SHEET (A -4)

DATE & DAY OF THE WEEK:- 15/02/2020

DIRECTION OF TRAFFIC:-UP/DOWN FROM- Chinhat 1 Km TO- Ftaunja. 11 Km.

ROAD CLASSIFICATION- MDR-88C

K.M./MILAGES -

ROUTE NO(IF ANY)-

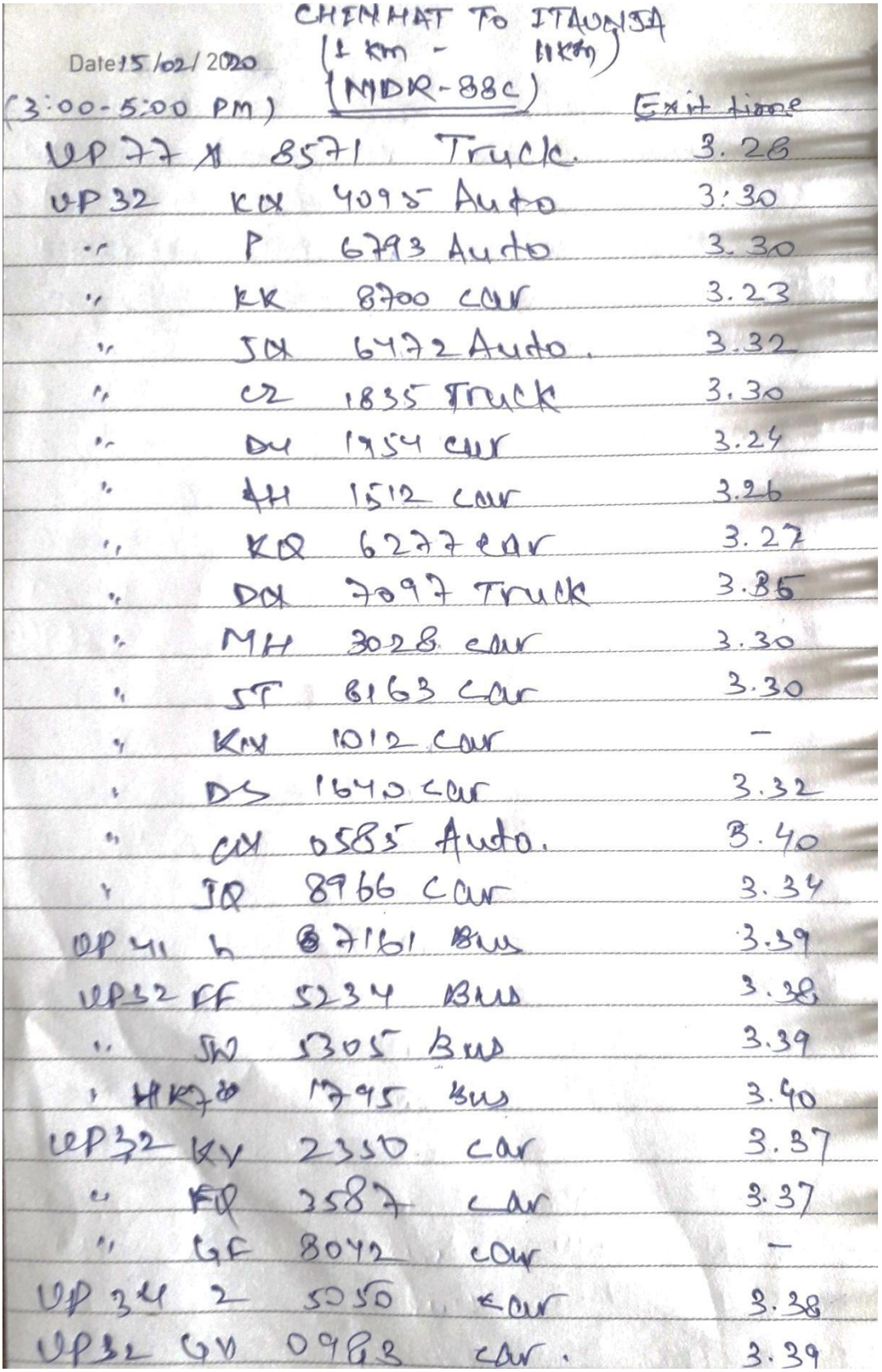
DISTT- LUCKNOW STATE- UP

HOUR OF COUNT/ TYPE VEHICLE	MOTOR CYCLES/SCOOTOR Entry time (0 Km.)	REMARKS
FROM- HOURS TO- HOURS 03:00 - 5:00 (PM.)	UP77 X 8571 Truck. -15:11	
	UP32 KN 4095 Auto. -15:11	
	" P 6793 Auto. -15:12	
	" KK 8700 car. -15:12	
	" C2 1835 Truck -15:14	
	" JN 6472 Auto. -15:14	
	" DU 1954 car -15:14	
	" AM 1812 car -15:15	
	" KQ 6277 car -15:15	
	" DN 7097 Truck. -15:19	
	" MH 3028 car -15:19	
	" ST 8163 car -15:19	
	" DS 1640 car -15:20	
	" CN 0585 Auto. -15:22	
	" SQ 8966 car -15:22	
	UP41 H 7161 Bus -15:24	
	UP32 FF 5234 Bus -15:24	

SIGNATURE OF STUDENTS-

SIGNATURE OF FACULTY-

Fig.16 Entry point at 0 km (Non peak hour)

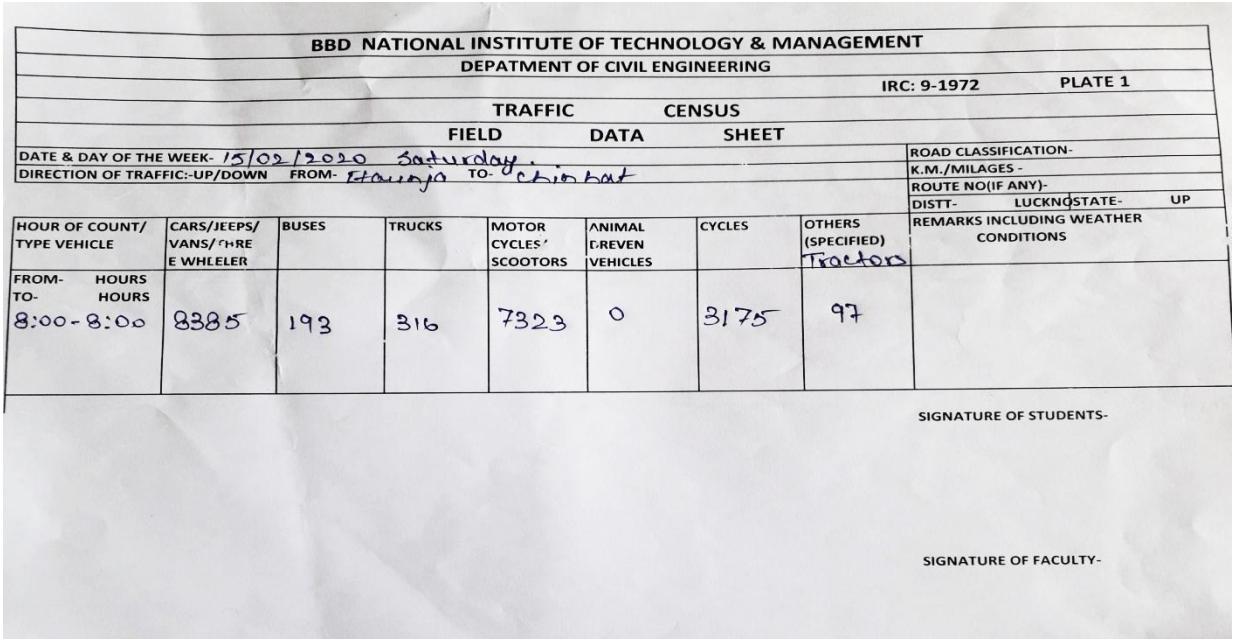


CHEMHAT TO ITAUNJA (1 km - 11 km) (NHDR-88C)

Date: 15/02/2020 (3:00-5:00 PM)

				Exit time
UP 77	N	8571	Truck.	3.28
UP 32	KN	4095	Auto	3:30
"	P	6793	Auto	3.30
"	KK	8700	car	3.23
"	JN	6472	Auto.	3.32
"	CZ	1835	Truck	3.30
"	DU	1954	car	3.24
"	AH	1512	car	3.26
"	KQ	6277	car	3.27
"	DN	7097	Truck	3.35
"	MH	3028	car	3.30
"	ST	8163	car	3.30
"	KN	1012	car	-
"	DS	1640	car	3.32
"	CN	0585	Auto.	3.40
"	JQ	8966	car	3.34
UP 41	H	7161	Bus	3.39
UP 32	FF	5234	Bus	3.38
"	SN	5305	Bus	3.39
"	HK	1795	Bus	3.40
UP 32	KV	2350	car	3.37
"	FQ	3587	car	3.37
"	GF	8042	car	-
UP 34	Z	5050	car	3.38
UP 32	GN	0983	car.	3.39

Fig.17 Exit time at 10 km (non peak hour)



BBD NATIONAL INSTITUTE OF TECHNOLOGY & MANAGEMENT

DEPATMENT OF CIVIL ENGINEERING

IRC: 9-1972 PLATE 1

TRAFFIC CENSUS

FIELD DATA SHEET

DATE & DAY OF THE WEEK- 15/02/2020 Saturday.

DIRECTION OF TRAFFIC:-UP/DOWN FROM- Itaunja TO- Chinhat

ROAD CLASSIFICATION-

K.M./MILAGES -

ROUTE NO(IF ANY)-

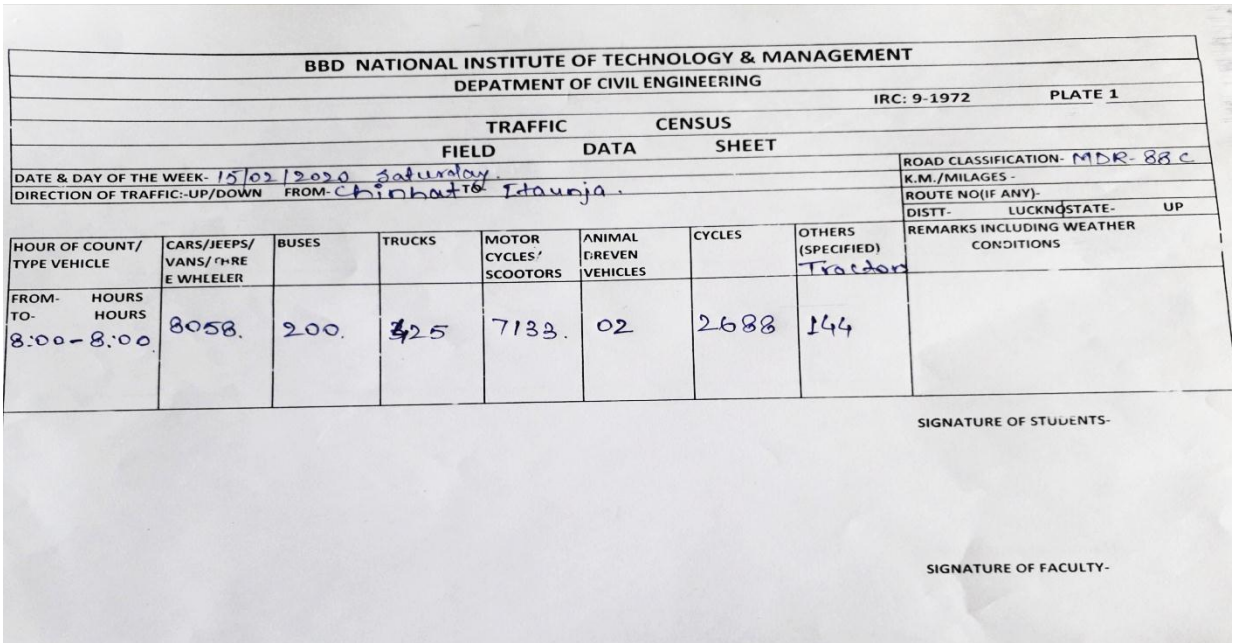
DISTT- LUCKNOSTATE- UP

HOUR OF COUNT/ TYPE VEHICLE	CARS/JEEPS/ VANS/THRE E WHEELER	BUSES	TRUCKS	MOTOR CYCLES/ SCOOTORS	ANIMAL DREVEN VEHICLES	CYCLES	OTHERS (SPECIFIED) Tractors	REMARKS INCLUDING WEATHER CONDITIONS
FROM- HOURS TO- HOURS 8:00-8:00	8385	193	316	7323	0	3175	97	

SIGNATURE OF STUDENTS-

SIGNATURE OF FACULTY-

Fig.18 Total no. of vehicles from one side



BBD NATIONAL INSTITUTE OF TECHNOLOGY & MANAGEMENT

DEPATMENT OF CIVIL ENGINEERING

IRC: 9-1972 PLATE 1

TRAFFIC CENSUS

FIELD DATA SHEET

DATE & DAY OF THE WEEK- 15/02/2020 Saturday.

DIRECTION OF TRAFFIC:-UP/DOWN FROM- Chinhat TO Itaunja.

ROAD CLASSIFICATION- MDR-88 C

K.M./MILAGES -

ROUTE NO(IF ANY)-

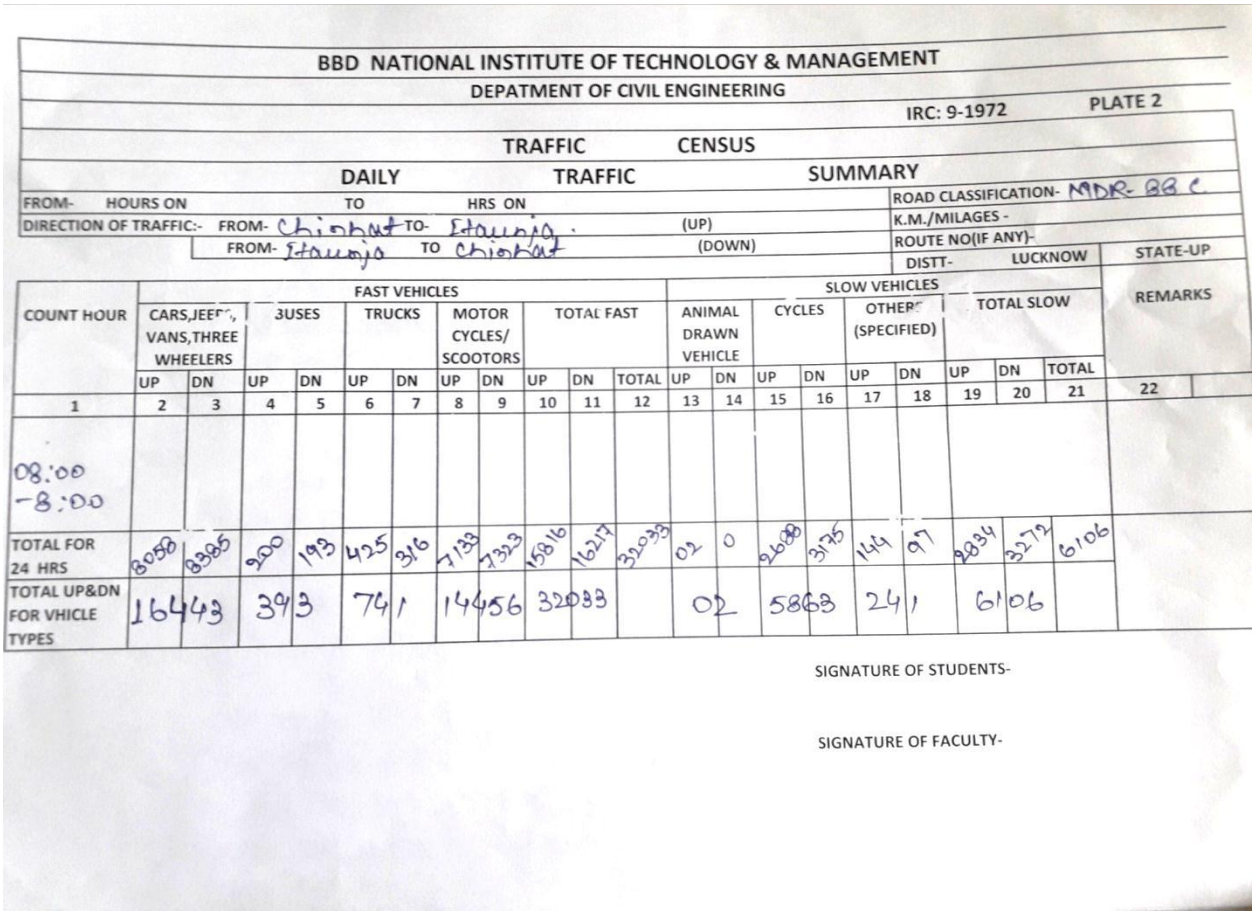
DISTT- LUCKNOSTATE- UP

HOUR OF COUNT/ TYPE VEHICLE	CARS/JEEPS/ VANS/THRE E WHEELER	BUSES	TRUCKS	MOTOR CYCLES/ SCOOTORS	ANIMAL DREVEN VEHICLES	CYCLES	OTHERS (SPECIFIED) Tractors	REMARKS INCLUDING WEATHER CONDITIONS
FROM- HOURS TO- HOURS 8:00-8:00	8058.	200.	325	7133.	02	2688	144	

SIGNATURE OF STUDENTS-

SIGNATURE OF FACULTY-

Fig.19 Total no. of vehicles from another side



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DEPATMENT OF CIVIL ENGINEERING

IRC: 9-1972 PLATE 2

TRAFFIC CENSUS

DAILY TRAFFIC SUMMARY

FROM- HOURS ON TO HRS ON

ROAD CLASSIFICATION- MDR- DD C.

DIRECTION OF TRAFFIC:- FROM- Chiorhat TO- Itanagar. (UP)

FROM- Itanagar TO Chiorhat (DOWN)

K.M./MILAGES -

ROUTE NO(IF ANY)-

DISTT- LUCKNOW STATE-UP

COUNT HOUR	FAST VEHICLES											SLOW VEHICLES									REMARKS
	CARS,JEEP, VANS,THREE WHEELERS		3USES		TRUCKS		MOTOR CYCLES/ SCOOTORS		TOTAL FAST			ANIMAL DRAWN VEHICLE		CYCLES		OTHERS (SPECIFIED)		TOTAL SLOW			
	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	TOTAL	UP	DN	UP	DN	UP	DN	UP	DN	TOTAL	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
08:00 -8:00																					
TOTAL FOR 24 HRS	8058	8385	200	193	425	316	7133	7323	15816	16217	32033	02	0	2600	3175	144	97	2834	3272	6106	
TOTAL UP&DN FOR VHICLE TYPES	16443		393		741		14456		32033			02		5863		241		6106			

SIGNATURE OF STUDENTS-

SIGNATURE OF FACULTY-

Fig.20 Total no. of vehicles from both sides

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Research Article Volume 10 Issue No.2

A Review of Literature on Improvement of Highway Capacity Due to Cycle Track in Urban Area

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Abstract:
The main purpose of this paper is to calculate improvement of highway capacity due to cycle track in urban area. We will do two-way classified traffic survey of the road and also calculate average speed of commercial vehicles, personal vehicles and two wheeler vehicles I mixed traffic and without cycle traffic. We will study and comparison of fuel consumption as well as total cost saving due to separate cycle track.

I. INTRODUCTION

This paper tries to make study of the Improvement of highway capacity due to cycle track in urban area. Cycle tracks are exclusive bicycle facilities that are physically separated from motor vehicle lanes and sidewalks. Cycle tracks are an integral piece of infrastructure proven to increase ridership. Increasing bicycling can improve the overall quality in the city. A separate cycle track can increase the speed of remaining vehicles so that it can save time, fuel consumption, wear and tear etc. It can also increase the transportation choices, reduce parking and roadway congestion. Replacing vehicle trips with bicycle trips can reduce the number of single occupancy vehicle, traffic and associated air pollution, and fuel consumption also. We will do survey work on Chinhat to Dewa section of Itaunja-Kumharwa-Kursi-Dewa-Chinhat road, Lucknow. We will do two way classified traffic survey of the road and also calculate average speed of commercial vehicles, personal vehicles and two wheeler vehicles except cycle. We will study of speed of commercial vehicles, personal vehicles and two wheeler vehicles based on algorithm that there will be no cyclist on mixed traffic. Lastly we will study and comparison of fuel consumption as well as total cost saving due to separate cycle track.

II. LITERATURE REVIEW

1. Jensen (2007) compares bicycle tracks and lanes a before and after study. The construction of bicycle tracks resulted in a 20 percent increase in bicycle traffic and a decrease of 10 percent in motor vehicle traffic on those roads where bicycle tracks have been constructed. The making of bicycle lanes resulted in a 5 percent increase in bicycle traffic and a decrease of 1 percent in motor vehicle traffic on those roads where bicycles lanes have been marked.

2. Dill and Gliebein (2008) in their research understand and measures bicycle behavior. In their study they found that the bicycle trips were 13.4 minutes longer than the estimated auto travel time. The medium difference was 9.5 minutes. About half of the trips occurred during morning and evening peak travel times (6-9 AM and 4-7 PM) with about one third occurring between those time periods. Therefore, less than 20% of the trips occurred in the late evening and early morning.

3. Fraser and Lock (2010) the objective was to consider the effect of all interventions or physical factors on cycling in any population group, including cycle path or route. This review provides evidence for the positive association between certain built environment factors and cycling. Policies promoting cycle lane construction appears promising in helping to reduce physical inactivity and the transport component of greenhouse gas emission.

4. Lusk, Furth, Willett and team (2011) had studied six cycle tracks in Montreal that are two way on the one side of the street. Each cycle track was compared with one or two reference streets without bicycle facilities that were consider alternative bicycling route. All six cycle tracks were two-way on one side of the street and separated from traffic by raised medians, parking lanes, or delineator posts. There were 8.5 injuries and 10.5 crashes per million bicycle-km.

5. Morency, Luis and team (2013) researched on crash rates on cycle tracks in the United States. They studied state adopted bicycle guidelines to determine whether cycle tracks (physically separated) were recommended, whether they were built and their crash rate. For the 19 US cycle tracks they examined, the overall crash rate was 2.3% per 1 million bicycle kilometer.

6. Hull and O'Holleran (2013) has used a detailed template to benchmark the level of service provided to cyclist in six European cities. The methodology has been tested using an experienced and a novice cyclist to capture their perceptions of the design of the cycle infrastructure in these cities. The research paper identified one of the barriers to encouraging more cycling is the potential/ inexperienced cyclists perception of the safety, comfort, and continuity of the cycling network in the city.

7. Kristinsdottir (2015) had studied attitudes towards cycling in general. According to his study "travel behavior surveys all over

the world indicate that access to transportation is most important factor influencing mode choice. In this research when asked from people about the benefits of cycling, the most common answer were that is save money on both on soil/gasoline and on owning and managing a car.

8. Greibe and Thomas (2016) Study is based on empirical data collected through video recordings at 8 different locations in Denmark. Two synchronised cameras covering the observational area on the cycle track are used for the video recording. The main objective of this study is to examine how widths of one-way cycle tracks in urban areas influence the behavior, flow and capacity of bicycle traffic. Traffic safety has not been a part of the project but is of course a direct offshoot of the subject.

9. Ekblad, Svensson and Koglin (2016) studied concerning how different factors associated with bicycle planning influence then propensity to choose the cycle for transportation. It has been shown in research that the organization of transport and urban planning can have a positive or negative impact on planning on cycle.

10. Prasanna Desai (2017) provides information about the kind of cycle infrastructure that is needed at each road of the road network in the city of Pune. There are number of key success factors that need to be applied to increase the success of cycling infrastructure in Pune.

Continuity: Detailed design need to be include dealing with trees, lamp posts, bus stops and pinch points.

Footpath width: Not only cycle track need to be wide enough, footpaths need to be designed for the existing actual use and flow of pedestrians to avoid that cyclists walk on the cycle track. If footpaths are full of obstacles pedestrians will walk on the cycle track.

Maintenance: Many cycle tracks in Pune have not been maintained. It is essential that the PMC reserve an annual budget for the maintenance of cycling infrastructure in the city. This budget should increase when the total length of cycling infrastructure increases.

III. CONCLUSION

- A separate cycle track can increase the speed of remaining vehicles
- Reduce parking and roadway congestion
- Replacing vehicle trips with bicycle trips can reduce the number of single occupancy vehicle, traffic and associated air pollution, and fuel consumption.
- The construction of bicycles tracks resulted in a 20 percent increase in bicycle/ mopped traffic mileage and decrease of 10 percent in motor vehicle traffic mileage on those roads.
- Roads are cycle tracks and parking permitted are safer compared to roads with parking bans.
- Cycle tracks constructions appear promising in helping to reduce physical inactivity.
- The construction of cycle tracks in urban area, provides the necessary space for bicycle traffic and decrease perceived risk among cyclists

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Improvement of highway capacity due to cycle track in urban area

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ABSTRACT

This paper tries to make study of the Improvement of highway capacity due to cycle track in urban area. As urban areas develop in our country and the world, some issue related to urbanization such as traffic congestion became a serious issue. Cycle tracks are exclusive bicycle facilities that are physically separated cyclists from motor vehicle lanes. Cycle tracks are important part of infrastructure proven to increase ridership and improvement in highway capacity. Increasing bicycling can improve the overall quality in the urban areas. A separate cycle track can increase the speed of remaining vehicles so that it can save time, fuel consumption, wear and tear, reduce pollution etc. It can also increase the transportation choices, reduce parking and traffic congestion. In urban planning, cycle tracks are designed to encourage bicycling to an effort to relieve traffic congestion and reduce pollution, reducing bicycling fatalities and injuries by eliminating the need for cars and bicycles to journey for the same road space and to reduce overall confusion and tension for all users of the road. Cycle track may be one-way or two-way, and may be at road level, at sidewalk level, or at an intermediate level. I tried to find improvement of highway capacity if we construct cycle track in urban area. For this I did survey work on Chinhat to Dewa section of Itaunja-Mahona-Kumhrawa-Kursi-Dewa-Chinhat road, Lucknow. I did two way classified traffic survey of the road and also calculate average speed of commercial vehicles, personal vehicles and two wheeler vehicles except cycle. We studied of speed of commercial vehicles, personal vehicles and two wheeler vehicles based on algorithm that there will be no cyclist on mixed traffic. Lastly we studied and comparison of fuel consumption, wear and tear cost, air pollution cost, accident cost etc and as well as total cost saving due to separate cycle tracks.

Keywords— *Cycle Track, Traffic Congestion, Urbanization, Traffic Jams, Bicycling.*

1. INTRODUCTION

As the urban area develops in India, some issue related to urbanization such as traffic congestion becomes serious issue. This problem becomes serious mostly due to inappropriate design of the urban landscape pattern. According to a survey India's biggest cities may be losing up to $22 billion annually due to traffic congestion and its burden is bearing by its commuters. The cost of congestion was based on the basis of fuel consumptions and productivity loss, it includes the man hour and opportunity cost, pollution and accidents incurred on the yearly basis. On average, Indians bought almost 54,000 vehicles each day in 2018 as compared to 18,000 a day, a decade back. This number shows that Indian roads will continue to get more congested with each passing month as people will buy new cars, scooters, bikes as well as commercial vehicles like taxis and truck without necessarily junking older vehicles. Traffic congestion is partially attributes to India's large population and high population density. The cost of congestion was based on the basis of fuel consumptions and productivity loss, it includes the man hour and opportunity cost, pollution and accidents incurred on the yearly basis.

To make cycling safer and more attractive, much more needs to be done than only providing cycle tracks and cycle lanes. In case of Lucknow and other Indian cities, there are many aspects of the road planning and design that discourage cycling and make it less safe. Planning and design make cycling more attractive and safer. Construction of separate cycle tracks makes roads less congested so it can increase the speed of motor vehicles on the road. It can save fuel consumption, time of the commuters, there will be less emission of air pollution, accidents reduce due to less congestion. The main reason for traffic congestion in India is lack of urban planning. The slow vehicle such as cycle and rest of vehicles travels on the same road. Therefore speed of automobile vehicles decreases and becomes congestion. If we plan a separate cycle track then it must be good for traffic.

2. LITERATURE REVIEW

Jensen (2007)[9]: Compares bicycle tracks and lanes before and after study. The construction of bicycle tracks resulted in a 20 percent increase in bicycle traffic and a decrease of 10 percent in motor vehicle traffic on those roads where bicycle tracks have been constructed. The making of bicycle lanes resulted in a 5 percent increase in bicycle traffic and a decrease of 1 percent in motor vehicle traffic on those roads where bicycles lanes have been marked.

Dill and Gliebein (2008)[5]: In their research understand and measures bicycle behavior. In their study they found that the bicycle trips were 13.4 minutes longer than the estimated auto travel time. The medium difference was 9.5 minutes.
About half of the trips occurred during morning and evening peak travel times (6-9 AM and 4-7 PM) with about one third occurring between those time periods. Therefore, less than 20% of the trips occurred in the late evening and early morning.

Fraser and Lock (2010)[15]: The objective was to consider the effect of all interventions or physical factors on cycling in any population group, including cycle path or route. This review provides evidence for the positive association between certain built environment factors and cycling. Policies promoting cycle lane construction appears promising in helping to reduce physical inactivity and the transport component of greenhouse gas emission.

Lusk, Furth, Willett and team (2011)[3]: Had studied six cycle tracks in Montreal that are two way on the one side of the street. Each cycle track was compared with one or two reference streets without bicycle facilities that were consider alternative bicycling route. All six cycle tracks were two-way on one side of the street and separated from traffic by raised medians, parking lanes, or delineator posts. There were 8.5 injuries and 10.5 crashes per million bicycle-km.

Morency, Luis and team (2013)[14]: Researched on crash rates on cycle tracks in the United States. They studied state adopted bicycle guidelines to determine whether cycle tracks (physically separated) were recommended, whether they were built and their crash rate. For the 19 US cycle tracks they examined, the overall crash rate was 2.3% per 1 million bicycle kilometer.

Hull and O'Holleran (2013)[4]: Has used a detailed template to benchmark the level of service provided to cyclist in six European cities. The methodology has been tested using an experienced and a novice cyclist to capture their perceptions of the design of the cycle infrastructure in these cities. The research paper identified one of the barriers to encouraging more cycling is the potential/ inexperienced cyclists perception of the safety, comfort, and continuity of the cycling network in the city.

Kristinsdottir (2015): Had study attitudes towards cycling in general. According to his study "travel behavior surveys all over the world indicate that access to transportation is most important factor influencing mode choice. In this research when asked from people about the benefits of cycling, the most common answer were that is save money on both on soil/gasoline and on owning and managing a car.

Greibe and Thomas (2016)[8]: Study is based on empirical data collected through video recordings at 8 different locations in Denmark. Two synchronised cameras covering the observational area on the cycle track are used for the video recording. The main objective of this study is to examine how widths of one-way cycle tracks in urban areas influence the behavior, flow and capacity of bicycle traffic. Traffic safety has not been a part of the project but is of course a direct offshoot of the subject.

Ekblad, Svensson and Koglin (2016)[1]: Studied concerning how different factors associated with bicycle planning influence then propensity to choose the cycle for transportation. It has been shown in research that the organization of transport and urban planning can have a positive or negative impact on planning on cycle.

Prasanna Desai (2017): Provide information about the kind of cycle infrastructure that is needed at each road of the road network in the city of Pune. There are number of key success factors that need to be applied to increase the success of cycling infrastructure in Pune.

- **Continuity:** Detailed design need to be include dealing with trees, lamp posts, bus stops and pinch points.
- **Footpath width:** Not only cycle track need to be wide enough, footpaths need to be designed for the existing actual use and flow of pedestrians to avoid that cyclists walk on the cycle track. If footpaths are full of obstacles pedestrians will walk on the cycle track.
- **Maintenance: Many** cycle tracks in Pune have not been maintained. It is essential that the PMC reserve an annual budget for the maintenance of cycling infrastructure in the city. This budget should increase when the total length of cycling infrastructure increases.

3. DATA COLLECTION

I did all my survey work on Chihat to Deva section of Itaunja Mahona Kumhrawa Kursi deva Chinaht road (MDR 88C), which length is 47 km. It is a main district road with 2 numbers of lanes. The survey has been done for to give practical relation in the research work and this purpose the first thing I did is two way classified survey of the road for 24 hours. Calculate the average speed of commercial vehicles, personal vehicles as well as two wheelers vehicles except cycle in mixed traffic. Study of average speed of commercial vehicles, personal vehicles and two wheelers vehicles based on algorithm that there is no cyclist in mixed traffic.

3.1 Two-way classified traffic survey result

Table 1: Two way classified survey result

Types of Vehicles	No. of vehicles
Cars/ Jeeps/ Vans/ Three wheelers etc.	16,443
Buses	393
Trucks	741
Motor cycle/ Scooter	14,456
Animal Drawn vehicles	2
Cycles	5,863
Others (Tractors)	211

3.2 Average speed difference (Peak hour Vs Non Peak hour) for 10 KM

Table 2: Average speed difference (Peak hour Vs Non Peak hour) for 10 KM

Vehicles	Peak hour time (minutes)	Non- Peak hour time (Minutes)	Differences
Four Wheelers	13.21	12.1	1.20 m
Pickup	14.55	14.00	55 sec
Bus	16.5	15.4	50 Sec
Trucks	17.00	16.25	35 Sec
Two wheelers	12.41	12.28	13 Sec
Three Wheelers	19.37	17.28	2 m 9 Sec
Tractors	17.5	17.16	34 Sec

4. RESULTS

4.1 Average speed in peak hour (With cycle in mixed traffic) and non-peak hour (cycle is not in mixed traffic) for 1 hour

Table 3: Average speed difference

Vehicles	Average Speed in peak hr	Average Speed in non-peak hr	Differences
Four Wheelers	47km/hr	50km/hr	3km/hr
Bus	36.5km/hr	38.5km/hr	2km/hr
Trucks	35.5km/hr	37km/hr	1.5km/hr
Two wheelers	48km/hr	49km/hr	1km/hr
Tractors	34km/hr	35km/hr	1km/hr

After calculating the average speed of different types of vehicles, now calculated the fuel consumption for 1 hour for 1 vehicle in peak hour and non-peak hour.

4.2 Fuel Consumption Cost for 1 Hour (for 1 vehicle)

Table 4: Fuel consumption cost for 1 hr

Vehicles	Cost for peak hour (Rs)	Cost for non-peak hour (Rs)	Savings (Rs)
Four wheeler	261	243	18
Bus	496	435	61
Truck	598	503	95
Two wheeler	65	64	1
Tractor	385	297.5	87.5

4.3 Fuel Consumption Savings for 1 day

Table 5: Fuel consumption cost for 1 day

Vehicles	No. of vehicles in 24 hrs	Saving in 1 hr (Rs)	Total Savings (Rs)
Four wheelers	16443	18	18*16443= 295,974
Bus	393	61	61*393= 23,973
Truck	741	95	95*741= 70,395
Two wheelers	14,456	1	1*14,456= 14,456
Tractors	241	87.5	87.5*241= 21,087.5
		Total savings	**Rs. 425,885.5**

The total saving by fuel consumption for one day for all type of vehicles is Rs 425,885.5 by this calculation we can calculate total saving by fuel consumption for one year and that is 365*425,885= Rs 155,448,207.5. Assumed 1% of total fuel consumption due to that road and that is equal to Rs. 1,554,482.

4.4 Saving From Accident

Due to traffic congestion, according to police records there were total 53 accidents happened on this particular road in last year i.e. 2019. In this, some were minor accidents and some were major and there were 4 two wheelers, 5 four wheelers, 2 buses, 3 trucks and 3 tractors was damaged and total 2 people died in road accident on this particular road. For repairing cost, some garages were visited and data were collected for different vehicles and according to data, the average cost for repairing vehicles are, for two wheelers; Rs. 14,322, for four wheelers; Rs. 70,133, for buses Rs. 128,750, for trucks; Rs. 151,000 and for tractors; Rs. 58,750. One person loss is estimated as Rs. 1,000,000.

Table 6: Total repairing cost for vehicle

Vehicles	No. of vehicles damaged by accident in 2019	Average repairing cost for 1 vehicle (Rs)	Repairing cost for total damaged vehicles as per data (Rs)
Two wheelers	4	14,322	4*14,322= 57,288
Four wheelers	5	70,133	5*70,133= 350,665
Buses	2	128,750	2*128,750= 257,500
Trucks	3	151,000	3*151,000= 453,000
Tractors	3	56,600	3*56,600= 169,800
		Total saving	**Rs. 1,288,253**

There are 2 people died in 2019 in accident due to traffic congestion and one person loss is estimated Rs. 1,000,000 then total cost due to accident is Rs. 1,288,253+ 2,000,000= Rs. 3,288,253. It would be saved if there were no congestion on the road.

4.5 Costs due to air pollution

The study revealed that an estimated 4,127 people has been died annually in the city due dieses caused by air pollution. We can assume a total 2 people has been died due to air pollution at Itaunja-Mahona-Kumhrawa- Kursi-Deva-Chinahat road annually. It is estimated Rs. 10 lakh for one-person loss. Doctors at KGMU maintained that the number of patients with problems due to air pollution had jumped by 30%. Now the patient number is 325 per day. Assume that total number of patient annually suffering health issues due to that road is 182. Estimated Rs. 40,000 for treatment for one patient suffering health issues due to air pollution.

Table 7: Cost due to air pollution

Caused	No. of person (Yearly)	One person cost (Rs)	Total cost (Rs) (Yearly)
Died	2	1,000,000	2,000,000
Illness	182	40,000	7,280,000
		Total	**Rs. 9,280,000**

4.6 Tear and Wear Cost

The total tear and wear cost is calculated as Rs. 388,600 with there were no congestion on the road and Rs. 829,000 with there were congestion on the road. The value of tear and wear cost due to congestion is Rs. 829,000- Rs. 388,600= Rs. 440,600

4.7 Costs Due TO Time

Rs. 9,000 average monthly income estimated of a person working 8 hours daily. After analysis of data it come Rs. 1,620 for all four wheelers for 1 day. For buses it come Rs. 1,350, for trucks Rs. 1,110, for two wheelers Rs. 675 and for tractors Rs. 900. Total cost for one day is Rs. 5,655. For one year for all vehicles the cost due to time is Rs. 37,965,420.

4.8 Cycle Track Construction Cost

Let assume if we are estimating the cost of construction of one kilometer long and 2 meters wide cycle track. This track has 15 cm base of cm size stone boulders

Total cost estimated for 1 km construction of cycle track = 1,678,760
Estimated cost of construction of cycle track for 10 km= 10*1,678,760= 16,877,600

4.9 Total Cost Saving Due To Different Reasons

Table 8: Total savings

Factors	Savings (Rs)
Fuel consumption	1,554,482
Accidents	3,288,253
Wear and tear	440,400
Time	37,965,420
Total	**Rs. 43,248,555**

Estimated cost of cycle track for 10 km in one side= Rs. 16,877,600
Estimated cost of cycle track for 10 km for both sides= 2*16,877,600= Rs. 33,775,200
Net Profit Due To Cycle Track= 43,248,555- 33,775,200= Rs. 9,473,355

5. CONCLUSION

In the present world, the congestion of the traffic is increasing and therefore there are a lot of scopes for research in this field since with growing congestion it requires for improvements. This paper is not concerned with any designing aspect of cycle track, only estimated cycle track cost. India and the world are suffering with major traffic congestion mainly in urban areas. Traffic congestion had led to greater loss to country economy. With increasing people, the use of vehicles also increasing, be it via public transport or personal transport modes. The construction of cycle track in urban areas benefits in so many ways. It increases motor vehicles average speed, it saves time for automobiles commuters, it reduces pollution, reducing wear and tear etc.

It is the first step towards the Improvement of highway capacity due to cycle track in urban area. It is seen from the survey that if a cycle track construct on a highway, it can increase the average speed of four wheelers for 3 km per hour in Lucknow. According to survey it can increase the average speed of buses for 2 km per hour and trucks for 1.5 km per hour. It is seen from the survey that for covering of 10 km distance with cycle in mixed traffic and cycle is not in mixed traffic, four wheelers, buses, trucks, two wheelers and tractors takes 2 m 20 sec, 50 sec, 35 sec, 13 sec, 34 sec more average time with cycle in mixed traffic as compared to there is no cyclists in mixed.

India is going to face a lot of problems due to traffic congestion in future. The officials and government should try to avoid this problem to measure some steps and constructing cycle tracks in urban areas is one the solution. It is also good for health and it can any income group if they feel safe to ride bicycle and other hand it is beneficial for motor vehicles and traffic congestion.

Traffic congestion is frustrating in so many ways according to this study. According to this research the wear and tear cost also increases due to congestion of traffic, leading to more frequent replacement and repair as compared to those roads where traffic congestion in negligible. Therefore the cycle track option should be adopted at least on those roads where traffic congestion is regular. Total expenditure for the construction of 10 km of cycle track on both sides of the road is Rs. 33,775,200 and total benefit from various factors due to cycle track is Rs. 43,248,555 per year. Net profit due to cycle track is Rs. 9,473,355 per year.

6. FUTURE SCOPE

Based on this study and findings, it is believed that the better analysis can be done on those roads where there traffic capacity is more and can derive an arithmetic formula.

- The relation between the increasing in average speed of vehicles due to no cycle in mixed traffic could be done with more traffic capacity.
- The average speed difference between cyclists in mixed traffic and no cyclists in mixed traffic could be done for far distance for more accurate result.
- The exact pollution emission due to traffic congestion on a specific road could be calculated.
- A deeper study can be adopted for deriving an arithmetic formula.
- The result has been made from less number of data due global pandemic COVID19, hence for further research purposes, more data can be used.

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