M.U.R.P
Thesis

TRANSPORT INFRASTRUCTURE DEVELOPMENT STRATEGIES OF ARTERIAL ROAD- A CASE STUDY OF GORAKHPUR

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TRANSPORT INFRASTRUCTURE DEVELOPMENT STRATEGIES OF ARTERIAL ROAD- A CASE STUDY OF GORAKHPUR

Thesis submitted in partial fulfillment of the requirements for the award of the degree of

MASTERS IN URBAN AND REGIONAL PLANNING

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CERTIFICATE

I hereby recommend that the thesis, entitled **"TRANSPORT INFRASTRUCTURE DEVELOPMENT STRATEGIES OF ARTERIAL ROAD- A CASE STUDY OF GORAKHPUR "** prepared by
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Roll no. **1200106007** under the supervision, is the bonafide work of the student and can be accepted as a partial fulfilment of the requirement for the Master's Degree in Urban and Regional Planning, School of Architecture and Planning BBDU, Lucknow.

This is to certify that the declaration of BELAL RAHMAN is true to the best of my knowledge and that the student has worked under my guidance for one semester in preparing this thesis.

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"In the name of God Who is most beneficial and merciful."

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TRANSPORT INFRASTRUCTURE DEVELOPMENT STRATEGIES
OF ARTERIAL ROAD- A CASE STUDY OF GORAKHPUR

CONTENT

ABSTRACT

Transportation, Infrastructure is generally defined as the physical framework of facilities through which goods and services are provided to the public. A strong correlation exists between per capita GDP and availability of certain services such as telecommunications, power, roads, and access to safe drinking water etc. With the rise in per capita GDP, composition of infrastructure changes significantly. Basic infrastructure such as water and irrigation are more important in less developed countries whereas power and telecommunication play a vital role in highly developed countries. The importance of infrastructure for sustained economic development is well recognized. High transaction costs arising from inadequate and inefficient infrastructure can prevent the economy from realizing its full growth potential regardless of the progress on other fronts. Physical infrastructure covering transportation, power and communication through its backward and forward linkages facilitates growth, social infrastructure including water supply, sanitation, sewage disposal, education and health, which are in the nature of primary services and has a direct impact on the quality of life. The performance of infrastructure is largely a reflection of the performance of the economy. Infrastructure industries are measured by six key infrastructure and core industries (i.e., electricity, crude oil, petroleum refinery products, coal, steel and cement). In this paper, the overall growth and performance of infrastructure services has been examined in depth on the basis of the different parameters such as trends in growth of physical output in infrastructure sectors, telecommunications, power, ports, railways, civil aviation, and post so as to examine whether there is a negative or positive association between infrastructure development and India's economic growth.

Keywords:- Planning, Safety, Crashes, Physical Activity& population Emissions.

INTRODUCTION

INTRODUCTION –

The transportation facilities & mobility characteristics –shapes the settlement pattern & structure of the city and land use –affects the quality and standard of life •Evolution of human settlement & proximity to transport facility highly correlated

TRANSPORTATION –

•Facilitates physical movement of public & goods from one place to another
•Essential to human existence – People travel daily
•System defined by land-use & transport policies
•Intricately linked with urban form & spatial structure
•satisfies mobility need
•supports economic development
•Helps to participate in the global economy
•Implications on welfare, environmental & social justice

NEED OF THE STUDY -

•Transport is integral to society–Changing scenario over last 2 decades led to change in policies at national & state levels
•NUTP–2006, recommends integrated land use & transport policy & priority to the use of public transport & NMT
•The Urban Renewal Mission started in Million Plus Cities–for realization of the policies
•For Implementations of Recommendations by Working Group on Urban Transport for 12th FYP & utilization of fund allocated by GOI for Transport Infrastructure Development.
•For working out plan to: –minimize commuting & maximize self-sufficiency of town –Synchronize development of housing and Jobs –make economic centres accessible –reduce movement demands & long distance travel –increase the safety & convenience for NMT & pedestrian.

BACKGROUND STUDY -

• India With the rapid growth of urban population there has been continuous accretion in number and size of urban centers both -demographically and spatially.
• Burgeoning urban areas are putting strain on the already secant Infrastructure leading to a point of collapse.
• Between 2001 and 2011, the number of people living in urban areas increased from 286 million to 377 million, a rise of 91 million person (Census,2011).
•Transport is integral to society–Changing scenario over last 2 decades led to change in policies at national & state levels

INTRODUCTION

SELECTION OF STUDY AREA- (GORAKHPUR CITY) -

• One of the potential urban growths Centre of North India– developed along major road transportation routes i.e.NH–28 & 29.
•One of highest decadal population growth rate (over30%).
•Largely catered by the fixed route IPT (auto rickshaws), NMT like cycle rickshaw, etc. Which are in onerous state.
•Lack of major public transport like city busses is further aggravating the situation & hampering the growth.
•Gorakhpur City does not have many formal 'on-street' or 'off-street' parking lots. Wherever empty spaces are available, parking is being observed, which restricts and impedes the movement of traffic besides causing severe accidents.

Location:	**In the Eastern Uttar Pradesh, India**
Climate:	**Summer 43°C to 30°C, winter 25 °C to 5 °C**
Best time to visit:	**October to March**
Nearest Airport:	**Gorakhpur Airport**
Nearest Railhead:	**Gorakhpur Junction**
Language spoken:	**Hindi,Bhojpuri, Urdu and English**
Latitude **Longitude**	**26°45' N** **83°24' E**
River	**Rapti river**
Place for visit:	**Geeta Press,Geeta Vatika,Gorakhnath Temple,Vishnu Temple, Ramgarh Tal,Planetarium(Taramandal)**

Types of Traffic-

1- RECURRENT CONGESTION
It generally occurs at the same place, at the same time every weekday or weekend day.

2-NON-RECURRENT CONGESTION
It results due to incidents such as accidents or roadway maintenance

INTRODUCTION

Gorakhpur City Infrastructure -

With the rapid growth of urban population there has been continuous accretion in number and size of urban centers both -demographically and spatially. Provision of Urban Infrastructure has however, not kept pace with increasing size of towns and cities. As a result, burgeoning urban areas are putting strain on the already secant Infrastructure leading to a point of collapse. Large urban centers, although considered to be generator of economic momentum, display a picture of squalor and unhygienic conditions. Traditionally in India, urban local bodies and parasternal agencies have generally been providing urban Infrastructure as part of social and welfare services. By now, the concept .and techniques for providing, delivery operations and maintenance of urban Infrastructure have changed considerably. It is increasingly being felt that government alone with limited budgetary resources would not be in a position to make up with the galloping backlog in urban infrastructure services which are required to be improved, augmented and upgraded to meet the emerging needs of urban areas. With liberalization of economic policies, globalization of market economics, technological advancement, decentralization of planning and development functions, revitalization of municipal agencies, role of private sector participation in development process would be of vital importance. Thus, at a glance, one can easily realize the need of ever increasing Efforts in the direction of improving the physical infrastructure in India Especially in the cities like Gorakhpur, which is the capital city causing tremendous pressure on all services. This study is a step in the direction of understanding the problems regarding the conditions of Infrastructure in Gorakhpur City. Definition of 'Infrastructure' the basic physical systems of a business or nation. Transportation, communication, sewage, water and electric systems are all examples of infrastructure. These systems tend to be high-cost investments; however, they are vital to a country's economic development and prosperity. Infrastructure is defined as the City's roadways, sewer systems, and storm drain. Systems, parks, buildings, and other City facilities. The Public Works Department manages the maintenance and improvement of the City's infrastructure.

INTRODUCTION

Religious Places & Historical Background –

Gorakshnath Temple-

Gorakshanath temple is a symbol of the identity of the city. The city itself was named after Mahayogi Guru Gorakshnath. According to popular belief Guru Gorakshnath did tapasya in Treta Yug at the place where the magnificent temple stands today. The temple is built on 52 acre of land in the heart of the city on Gorakhpur-Sonauli national highway. It is not only a peeth of the Nath sect but an example of Indian sculpture. In the garbh grih of the temple, Guru Gorakshnath is depicted as an incarnation of Lord Shiva in deep meditation. His charan paduka has been kept near his meditation site. The sacred pond (Mansarover) situated in the east has been now converted into a boating place by the temple authorities. It is believed that Bhima one of the five Pandavas slept here and a huge pit was created and later it became pond. The temple literature reveals that the temple structure and shape was changed from time to tme. It is also said that several attempts were made to demolish the temple during Mughal period. The present form of the temple was conceptualized by late Mahant Digvijaynath and previous head priest of the temple late. Mahant Aveiydyanath.Though large number of devotees of guru Gorakshnath visits the temple every day but their number increase many folds on every Tuesday and Saturday. Thousands God devotees assemble in the temple premises during the famous Khichari mela (January 14 onwards) which is the main festival of the temple. Leela Chitra Mandir, Geeta Press.

Vishnu Mandir - The famous temple associated with a large Idol of God Vishnu made in 12th century "Pal Kalin Kalin Kasauti" Stone. Ramleela is organized on the eve of Festival Dussehera here and the procession is so grand and in a very traditional that it fetches the tourist visit in the season.

Arogya Mandir Arogya Mandir - established by Late Sri. Bitthal Das Modi in 1940. The new and beautiful building was completed in 1961. It is approximately 2 km from Gorakhpur city and 4 km from the railway station. It is made in an open area and covered with hundreds of eucalyptus and mango trees. The concept of treatment is Naturopathy.

Suraj Kund - Sun temples are rare in India or abroad. The people of Gorakhpur are lucky to have one sun temple, which is located in the north western part of the city, beyond railway line. It wide range of 10 acres of land. The main temple is located in the middle of the tank & is surrounded by water from all sides. It is one of the 26 Surya Kund of the Country and it is believed to be the worshipping & resting places of Lord Ram. Presently Kali temple, Annapurna temple & Ram Sita temple do also exist here. About 100–125 years ago, Baba Muneshwar Das, who was an ardent worshipper of Lord Sun, is said have dug the present Suraj Kund (tank) himself to initiate the worshipping of Lord Sun & Lord Laxmi Narayan.

AIM, OBJECTIVE, NEED

AIM –

To evaluate the concerns related to the mobility of the Main Central Arterial road and suggest measures that will increase the mobility and provide easy access along Arterial main road.

OBJECTIVE –

1- To assess the existing situation of study area, its transport infrastructure, mobility Conditions & associated problems.
2- To analyze the feasibility of sustainable mode of transport and its impact on mobility by 2041.
3- To work out plan and evolve policy guidelines for street vendors, on-street & off-street parking and removal of illegal encroachment along the roads.
4- To evaluate the current level of services for the existing interchange.
5- To evaluate the current level of services for the existing interchange.

SCOPE –

1- To study the existing traffic by conducting field study in the study area and assess the existing mobility level of the Arterial junctions.
2- To estimate the future traffic volume and mobility level. Proposing spatial as well as regulatory interventions to increase the mobility of the Arterial roads.
3- If the policies are implemented in time, sustainable mobility and transportation would be achieved in the system which will result in enhancing passenger accessibility.

LIMITATION –

1- In short interval, it would be colossal task to study and analyze all factors affecting the demand & supply of transportation & its associated problems and their impacts on mobility of the whole city.
2- The study will be limited to the study area (Main Central Arterial road) only. And based on this study, recommendations will be formulated for the urban highway & arterial roads of city.

AIM, OBJECTIVE, NEED

METHODOLOGY–

1. • Background study of the site and problems identified.
2. • Aim and objective of the study (Understanding the parameters related to study).
3. • Selection of study area : Site having Scope and limitations.
4.. • Data collection – Primary and Secondary Survey .
5. • Detailed map of existing Conditions and issues related to Livelyhood
6.. • Analysis for the issues and Problem Generated.
7. • Providing Proposals and Governance system.

EXPECTED OUTCOME –

The expected outcome is to ensuring the safer route to divert the existing traffic flow while analysing the peak hour traffic volume on the basis of the inter-comparative analysis the recommendation and strategies for effected route and area .

DEMOGRAPHY

DEMOGRAPHIC PROFILE (GORAKHPUR CITY)-

Gorakhpur city is governed by Municipal Corporation which comes under Gorakhpur Metropolitan Region. The Gorakhpur city is located in Uttar Pradesh state of India.

In 2011, Gorakhpur had population of 4,440,895 of which male and female were 2,277,777 and 2,163,118 respectively. In 2001 census, Gorakhpur had a population of 3,769,456 of which males were 1,923,197 and remaining 1,846,259 were females. Gorakhpur District population constituted 2.22 percent of total Uttar Prades population. In 2001 census, this figure for Gorakhpur District was at 2.27 percent of Uttar Pradesh population.
There was change of 17.81 percent in the population compared to population as per 2001. In the previous census of India 2001, Gorakhpur District recorded increase of 22.94 percent to its population compared to 1991.

Gorakhpur Child Population 2011-

In census enumeration, data regarding child under 0-6 age were also collected for all districts including Gorakhpur. There were total 628,442 children under age of 0-6 against 694,213 of 2001 census. Of total 628,442 male and female were 329,252 and 299,190 respectively. Child Sex Ratio as per census 2011 was 909 compared to 934 of census 2001. In 2011, Children under 0-6 formed 14.15 percent of Gorakhpur District compared to 18.42 percent of 2001. There was net change of -4.27 percent in this compared to previous census of India.

Gorakhpur Slums 2011 –

Total no. of Slums in Gorakhpur city numbers 8,056 in which population of 49,268 resides. This is around 7.32% of total population of Gorakhpur city.

Gorakhpur Houseless Census -

In 2011, total 945 families live on footpath or without any roof cover in Gorakhpur district of Uttar Pradesh. Total Population of all who lived without roof at the time of Census 2011 numbers to 4,214. This approx 0.09% of total population of Gorakhpur district

Gorakhpur District Density 2011 –

The initial provisional data released by census India 2011, shows that density of Gorakhpur district for 2011 is 1,337 people per sq. km. In 2001, Gorakhpur district density was at 1,135 people per sq. km. Gorakhpur district administers 3,321 square kilometers of areas.

Gorakhpur Religion 2011 -

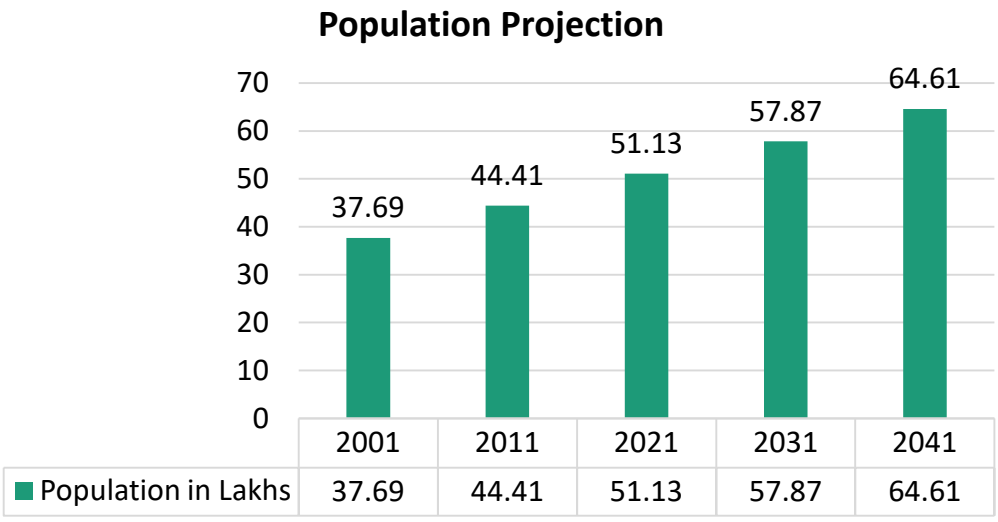
Hinduism is majority religion in Gorakhpur city with 90.28 % followers. Islam is second most popular religion in city of Gorakhpur with approximately 9.09 % following

DEMOGRAPHY

Description	2011	2001
Population	44.41 Lakhs	37.69 Lakhs
Actual Population	4,440,895	3,769,456
Male	2,277,777	1,923,197
Female	2,163,118	1,846,259
Population Growth	17.81%	22.94%
Area Sq. Km	3,321	3,321
Density/km2	1,337	1,135
Proportion to Uttar Pradesh Population	2.22%	2.27%
Sex Ratio (Per 1000)	950	960
Child Sex Ratio (0-6 Age)	909	934
Average Literacy	70.83	58.49
Male Literacy	81.80	73.57
Female Literacy	59.36	42.88
Total Child Population (0-6 Age)	628,442	694,213
Male Population (0-6 Age)	329,252	358,952
Female Population (0-6 Age)	299,190	335,261
Literates	2,700,328	1,798,769
Male Literates	1,593,890	1,150,850
Female Literates	1,106,438	647,919
Child Proportion (0-6 Age)	14.15%	18.42%
Boys Proportion (0-6 Age)	14.45%	18.66%
Girls Proportion (0-6 Age)	13.83%	18.16%

DEMOGRAPHY

Description	Total	Percentage
Hindu	4,009,037	90.28 %
Muslims	403,847	9.09 %
Christian	9,662	0.22 %
Sikh	2,123	0.05 %
Buddhist	2,848	0.06 %
Jain	460	0.01 %
Others	207	0.00 %
Not Stated	12,711	0.29 %



LITERATURE STUDY

Traffic Volume –

Traffic volume is the number of vehicles that pass a point, on a highway, on a particular lane, in a particular direction, in a given unit time, generally in per unit hour.
There is a term, Traffic Capacity, which represents the capacity of a road to accommodate the traffic volume. It is defined as below.

Traffic Capacity -

is expressed as the maximum number of vehicles in a lane or a road that can pass a given point in unit time, usually an hour, i.e., vehicles per hour per lane or roadway.

Similarities and Differences between the Traffic Capacity and Traffic Volume -

The only similarity between the two is that Traffic capacity and traffic volume, have the same units of 'number of vehicles in a given unit of time'.

The difference between the two is that traffic volume represents the actual rate of flow of the traffic and responds to the variation in the traffic demand, while capacity indicates a capability or maximum rate of flow with a certain level of service characteristics that can be carried by the road. The traffic capacity of a roadway depends upon a number of prevailing roadways and traffic conditions.

Passenger Car unit PCU -

It is a vehicle unit used for expressing highway capacity. One car is considered as a single unit, cycle, motorcycle is considered as half car unit. Bus, truck causes a lot of inconvenience because of its large size and is considered equivalent to 3 cars or 3 PCU.

Type of Vehicle	PCU
Car, taxi, pick up	1.0
Cycle, motor cycle	0.5
Bus, truck,	3.0 (4.o in some cases)
Cycle	0.2
E- Rikshaw	0.8
Rikshaw	1.5

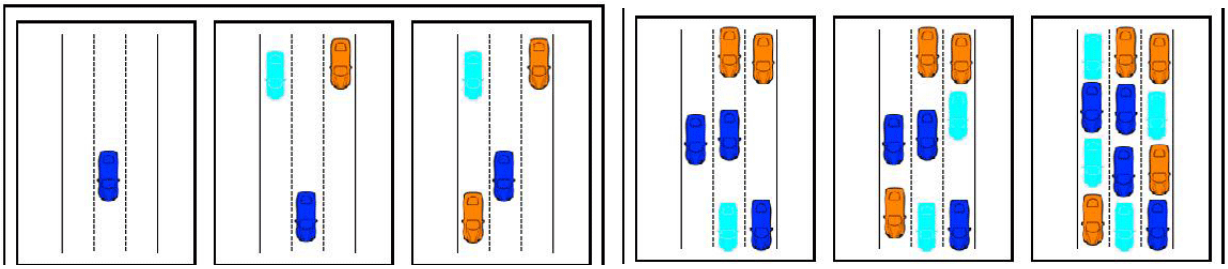
Volume -

Number of vehicles crossing a point on the road during a specific time period. It is carried out for :
-Design and extension of existence road,
-Traffic trend and pattern,
-Geometric and structural design of new road,
-Design of footpath, cross wall,
-Pedestrian signals,
-Plan of one way traffic
-Other regulatory measures on the road

LITERATURE STUDY

Basic capacity –

is the maximum number of vehicles(PCU) that can pass a given point on a lane or roadway during one hour under the most nearly ideal roadway and traffic conditions which can possibly be attained. Two roads that have the same physical features will have the same basic capacities irrespective of the traffic conditions.



LOS	Traffic Condition	Average Speed (kph)
A	Free Flow	> 67.2
B	Free Flow	> 54.4 to 67.2
C	Moderate	> 43.2 to 54.4
D	Moderate/Heavy	> 33.6 to 43.2
E	Heavy Traffic	> 25.6 to 33.6
F	Forced Flow/ Stop and Go	≤ 25.6

Source: U.S. Highway Capacity Manual and DPWH Highway Planning Manual

Practical Capacity –

is the maximum number of vehicle that can pass a given point on a lane or roadway during one hour, without traffic density being so great as to cause unreasonable delay, hazard or restriction to the driver's freedom to man-oeuvre under the prevailing roadway and traffic conditions.
It is the practical capacity which is of primary interest to the designers who strive to provide adequate highway facilities and hence this is also called the design capacity.

Determination of Theoretical Maximum Capacity -

Using the relation, C = 1000*V/S, one can easily determine the Theoretical Maximum Capacity. Here, C = Capacity of a single lane, vehicle per hour.
V = Speed, kmph; S = Average center to center spacing of vehicles, when they follow one behind the other as a queue or space headway.

The capacity depends upon the Speed and Spacing. Spacing is governed by the safe stopping distance required by the rear vehicle in case the vehicle ahead stops suddenly.

The capacity depends upon Speed and Spacing. Spacing is governed by the safe stopping distance required by the rear vehicle in case the vehicle ahead stops suddenly. Numerically spacing is given by, S = Sg + L Where Sg is the space gap(Head to rear) between the vehicles and L is the average length of the vehicle, both combined make the center to center spacing of the vehicles.

Here, Sg = 0.278 *V*t, where 'V' is in Kmph and Sg in meters(m,) and 't' is the total reaction time of the driver, generally assumed to be equal to 0.70 to 0.75.

Assuming t = 0.70 seconds; S = (0.7v + L) = (0.2V + L), m
Thus knowing the design speed, the spacing S can be found and thus the theoretical capacity of the lane can be found.

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Level of service (LOS) –

is a qualitative measure used to relate the quality of motor vehicle traffic service. LOS is used to analyze roadways and intersections by categorizing traffic flow and assigning quality levels of traffic based on performance measure like vehicle speed, density, congestion, etc

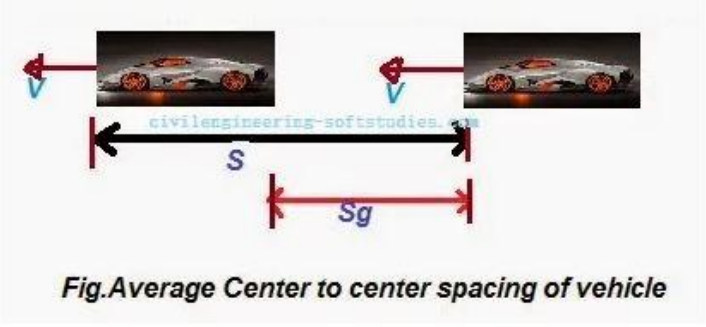


Fig.Average Center to center spacing of vehicle

Level of service	- through-flow at intersection - waiting times / mean waiting time at approach	Traffic quality
A	- almost undisturbed - majority of vehicles without waiting (≈ 5s) / ≤ **15 s**	excellent
B	- disturbed to a low extent - acceptable waiting times / ≤ **25 s**	good
C	- frequent influence of motor vehicles with right-of-way - waiting times much longer / ≤ **25 s**	satisfactory
D	- all motor vehicles are disturbed - for some motor vehicles partly longer waiting times/ ≤ **45 s**	sufficient
E	- constant disturbance with temporary overload - very long and very dissipated waiting times / **> 45 s**	poor
F	- overload during the entire hour of time (inflow greater than capacity) - very long waiting times / **no data**	completely unsatisfactory

Level of Service of Urban and Rural Roads
-A Case study in BHIMAVARAM.

State of the art and methodology – This section gives sound knowledge on level of service concept under heterogeneous traffic conditions on Indian urban roads. A detail literature study was carried out and presented an outline of various researchers' findings.

Study corridors and Objectives – Four different study corridors in and around Bhimavaram, Andhra Pradesh, India were chosen to define LOS for different types of roads. In which two corridors come under urban roads categories (Refer Fig. 1, Fig. 2) and two corridors comes under Rural roads categories (Refer Fig. 3, Fig. 4). Bhimavaram is densely populated town with different type of transport network. After the result is obtained it is easy to know how LOS will be vary for urban and rural roads. Section length of 21 meters was considered. The objectives of this project are to find volume of vehicle in each corridor, to find difference in composition in peak hour and non-peak hour, to determine Average speed of vehicles in each corridor, to find difference in LOS grades for urban and Rural areas.

Fig. 1 Vishnu College Road (Corridor-1)

Fig. 2 Undi Bypass Road (Corridor- 2)

Fig. 3 Ramayanapuram Village Road (Corridor-3)

Fig. 4 Jagannadapuram Village (Corridor-4)

Table: 1 Road Characteristics

S.No	Name of Road	Class of Road	Lane Characteristics	Length of Road (m)
1.	Vishnu college road	Sub Arterial	2 Lanes (Two Lane)	2900
2.	Undi Bypass road	Sub Arterial	2 Lanes (Two Lane)	2200
3.	Ramayanapuram	Sub Arterial	2 Lanes (Two Lane)	1300
4.	Jaganadhapuram	Sub Arterial	2 Lanes (Two Lane)	1500

CASE STUDY

Methodology –

The vehicles were classified into four categories: motorized two wheelers, cars/Autos, heavy vehicles, pedestrian. In this project LOS grades were defined mainly by using V/C ratio and Average speed method which were possible in selected corridors. There are many methods like cluster analysis, Percentage speed reduction, Fuzzy set theory and many more to define LOS of roads but these two methods were common and best methods to define LOS in suburban and rural areas. All four corridors were free from pedestrian activities, bus stop, vehicles parking.

Level of service (LOS) concept –

The term level-of-service has been introduced by Highway capacity Manual (HCM) which represents the level of facility a user can experience from a road under various operating characteristics and traffic volumes. The Highway capacity manual is a publication National Academics of Science which contains concepts, guidelines and procedures for knowing capacity and quality of service of highway facilities. Capacity gives a quantitative measure of traffic, whereas Level of service gives a Qualitative measure. Capacity of the road could be constant whereas the actual flow rate will be different for different days, times in a day itself. Depending upon v/c ratio and travel speed, HCM has defined six Level of Services i.e. A to F.

i) **LOS A:** This grade represents best operating conditions for a user with free flow of traffic and with an average speed of vehicles obtaining 90% of its free flow speed. Volume to capacity ratio for this grade is less than 0.125.

ii) **LOS B:** This grade indicates stable flow of traffic and users can go in their desired speed. The volume to capacity ratio for this grade lies between 0.125 and 0.276 and the average speed is 70 % to 80 % of free flow speed.

iii) **LOS C:** This grade also indicates stable flow of traffic. The average speed varies from 50 % to 60 % leads to gradual decrease in level of comfort. The volume to capacity ratio for this grade is between 0.276 and 0.479.

iv) **LOS D:** This grade indicates nearly an unstable flow of traffic with high density of vehicles. The average speed of vehicles is about 40 % 50 % and the drivers are restricted to go in their desired speed. The volume to capacity ratio for this grade lies between 0.479 and 0.715 that indicates poor level of comfort

v) **LOS E:** This grade cannot allow drivers to go with their desired speed as it indicates high density of vehicles with average speed of vehicle dropped to 30 % to 40 %. The volume to capacity ratio for this grade lies between 0.715 and 1.0 which gives extremely poor comfort and convenience to passengers.

vi) **LOS F:** average speed is dropped to 25 percent to 35 percent indicating the driver's comfort, patience and convenience as very poor. The volume to capacity ratio is greater than 1.000 for this grade.

Theoretical capacity :

Capacity is maximum no. Of vehicles that can pass a point in lane in one hour. The formula for theoretical capacity is given below, Theoretical capacity(C)=1760*V/I Where V=constant vehicular speed expressed in miles per hour I=intra vehicular lead expressed in yards

.

Table 2 LOS Characteristics for urban and suburban Arterials

S. No.	LOS	Operating Characteristics
1	A	✓ Average overall travel speed is 50 kmph or more ✓ Free flow ✓ v/c ratio is 0.6 or less and factor at intersections is 0.0 ✓ Peak Hour Factor is 0.7 or less.
2	B	✓ Average overall travel speed is 40 kmph or more ✓ Stable flow but negligible delays ✓ v/c ratio is 0.7 or less and load factor at intersections is 0.11 or less ✓ Peak Hour Factor is 0.8 or less.
3	C	✓ Average overall travel speed is 30 kmph or more ✓ Stable flow and acceptable delays ✓ v/c ratio is 0.8 or less and load factor at intersections is 0.3 or less ✓ Peak Hour Factor is 0.85 or less.
4	D	✓ Average overall travel speed is 25 kmph or more ✓ Unstable flow and tolerable delays ✓ v/c ratio is 0.9 or less and load factor at intersections is 0.7 or less ✓ Peak Hour Factor is 0.9 or less.
5	E	✓ Average overall travel speed is 25 kmph or more ✓ Unstable flow & intolerable delays ✓ Congestion and load factor at intersections is 1.0 or less ✓ Peak Hour Factor is 0.95 or less.
6	F	✓ Average overall travel speed is 15 kmph or less ✓ Forced flow & Jammed conditions ✓ v/c ratio exceeds 1.0 and overloaded intersections

Table 3: LOS based on Average travel speed of vehicles on urban roads

S. No.	Urban street class	1	2	3	4
1	LOS A	>72	>59	>50	>41
2	LOS B	>56-72	>46-59	>39-50	>32-41
3	LOS C	>40-56	>33-46	>28-39	>23-32
4	LOS D	>32-40	>26-33	>22-28	>18-23
5	LOS E	>26-32	>21-26	>17-22	>14-18
6	LOS F	<26	<21	<17	<14

Results and discussions : Field studies were carried out manually i.e. for volumetric survey no.of vehicles passed through that corridor in specific time was counted and noted.

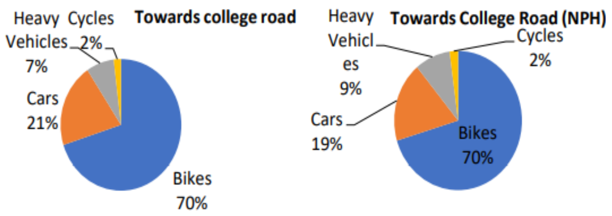


Fig. 11 (a) During peak hour Fig. 11 (b) During Non-peak hour

Fig: 11 Traffic volume at Vishnu college road

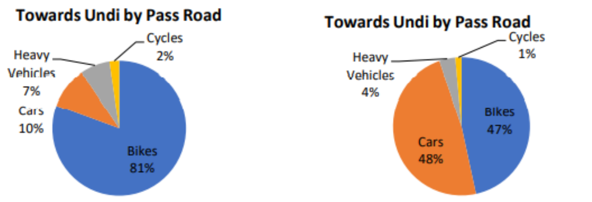


Fig. 12 (a) During peak hour Fig. 12 (b) During Non- peak hour

Fig: 12 Traffic volume at Undi Bypass road

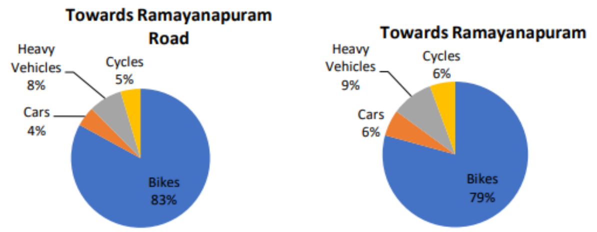


Fig. 13 (a) During peak hour Fig. 13 (b) During Non-peak hour

Fig: 13 Traffic volume at Ramayanapuram road

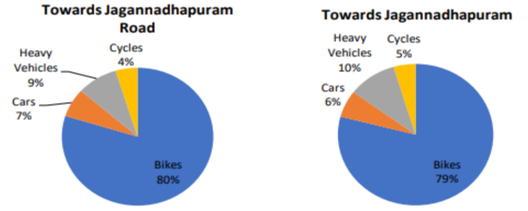
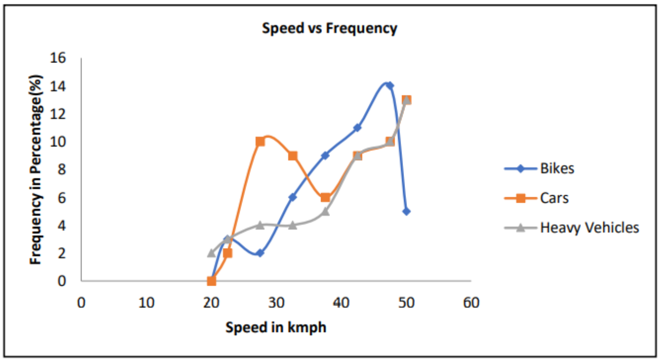
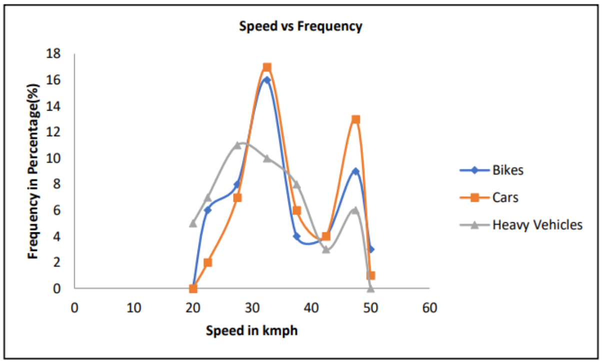


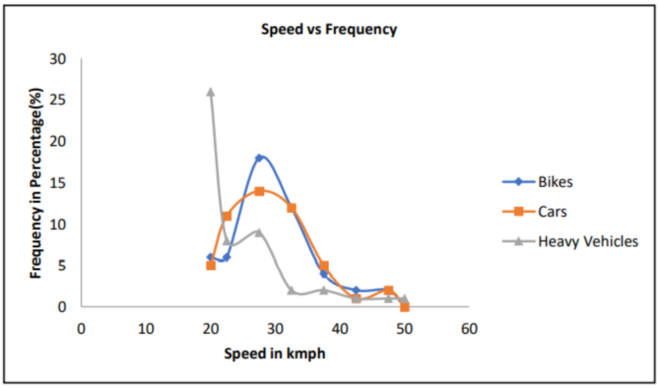
Fig. 14 (a) During peak hour Fig. 14 (b) During Non-peak hour

Fig. 14 Traffic volume at Jaganadhapuram road

Average speed studies – Average speed studies were carried out along a selected study Corridor by manual method i.e. using stop watch method. These studies were conducted in both peak and non-peak hour. Average speeds for all selected four corridors were obtained from speed distribution curves (Speed vs Frequency). In Corridor-1 maximum no. of vehicles travelled at the speed of 45-50 kmph (Refer Fig. 15). In Corridor-2,3,4 the maximum vehicles travelled at a speed of 25-30 kmph (Refer Fig. 16 to Fig. 18).







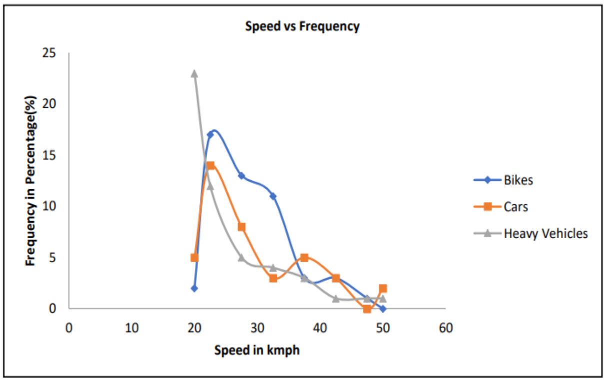
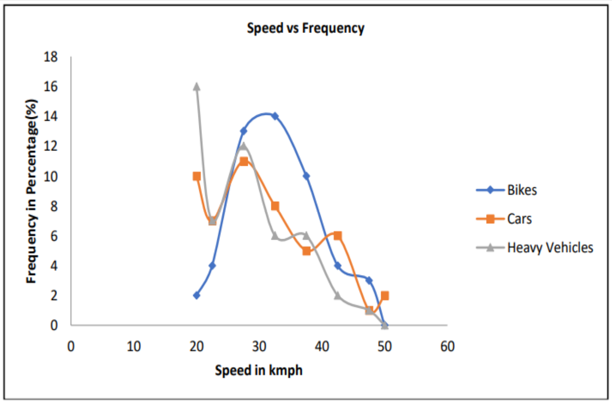
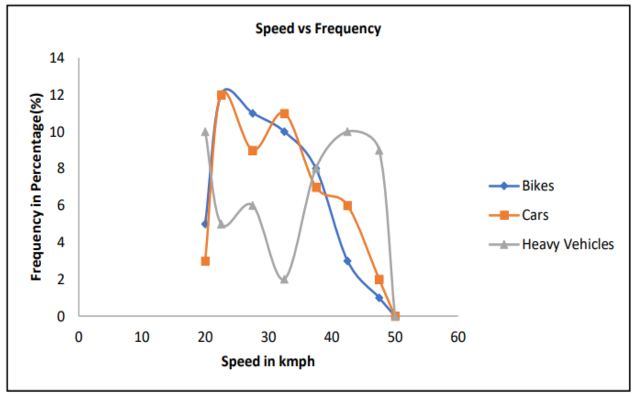
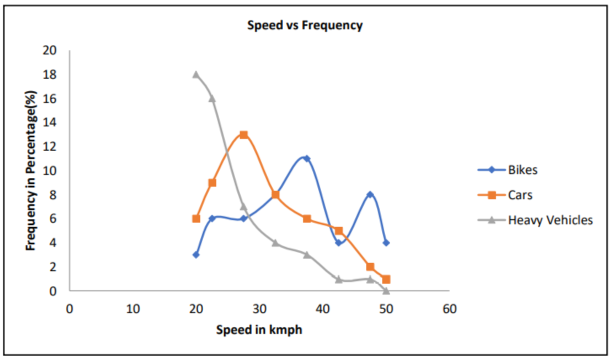
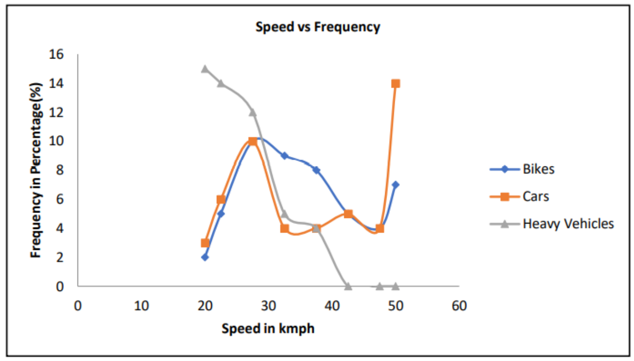


Fig. 16 (b) Average speed of vehicles at corridor-2 in Non-Peak hour









LOS based on Average speed and V/C ratio –

Above observations were calibrated and values were compared to standard values which is given in HCM 2000 (Refer Table-2, Table-4). The final LOS grades of selected four corridors were given in below table.

Table:7 LOS of selected corridors based on V/C ratio and Average speed

S.No	Speed (kmph)	V/C Ratio	LOS Grades
Corridor-1	31.65	0.48	D
Corridor-2	24.46	0.96	E
Corridor-3	28.51	0.48	D
Corridor-4	25.84	0.73	E

Conclusion –

LOS criterion based on various factors are discussed and presented in detail. A keen insight into level of service concept for urban and rural roads was given and methods to define compatibility level of urban roads under heterogeneous traffic were addressed based on the literature survey study. Volume to capacity ratio is found to be the easiest method to determine LOS from the various methods which are available. Level of service characteristics for urban and sub-urban arterials roads were also summarized for 6 categories (Refer Table 1). LOS based on average travel speed, v/c ratio and percentage speed reduction (PSR) are discussed and presented (Refer Table 2 to Table 5). It is observed that LOS grades for Vishnu college road (corridor-1) and Ramayanapuram village (corridor-3) was LOS-D and Undi bypass road (corridor-2) and Jaganadhapuram village (corridor-4) were LOS-E grade. Corridors-2, Corridor-4 was observed to have poor LOS grades because the road conditions were not up to the mark. The limitation of our study is that we need to consider more no. of vehicles in order to obtain better results.

CASE STUDY

STUDY ON CAPACITY AND LEVEL OF SERVICE FOR URBAN AREAS UNDER MIXED TRAFFIC CONDITIONS": A CASE STUDY OF SRINAGAR CITY.

Need of the Study – Every citizen of Srinagar must have experienced the worst traffic jams seen in the recent times. Sometimes one gets caught for hours together. Due to the rise of urbanization and number of private vehicles in most parts of city badly affected the capacity and level of service of roads in their present condition. At peak hours the student community suffers the most as they are not able to reach their destinations on time. There is a need of study to find the actual causes of huge traffic jams in the city and in this study the same will be done to find the suitable solution to enhance the traffic conditions ,traffic management, capacity and level of service of the above mentioned roads by performing the various traffic studies on the given road stretches. In this study we will look forward to find the possible causes and their solutions to smoothen the traffic condition of the city.

Objectives –

•To determine the capacity of above mentioned specific roads based on speed flow behavior under mixed traffic conditions.

•To establish the Level of Service thresholds for the prevailing traffic conditions of above mentioned roads of Srinagar city.

•To propose the traffic improvement measures for the selected road stretch .

•Apart from managing traffic on the road, this study also aims to maintain the road infrastructure in good condition.

•Introduction of Rotary intersection and signals at feasible stretches of above roads To determine observed speed ranges for existing traffic.

•To determine various parameters influencing the level of service.

Methodology –

•The Methodology Adopted for the study will be as follows:

• A detailed site observations and investigations will be done which involves the reconnaissance, topographical studies and video graphic surveys. Preliminary surveys are carried to collect the primary information about road condition, no. of lanes, shoulder condition, width of road etc .

• Field Traffic surveys are to be conducted to collect the data on selected vehicular volume and vehicular speed on chosen road sections of the city.

• After performing various traffic volume studies and collection of data, the data will be analyzed by suitable methods to estimate the capacity, level of service of the selected road stretch.

• Various surveys will be conducted during the study to check the need of signaling system and rotary intersection provisions for given road stretchs.Causes of massive traffic jams in the city and their solutions will be given second prior importance.

Data Collection –

• Field studies were carried out by adopting videography technique to observe the traffic flow and speed on selected roads. A straight road segment of 60 m length was selected. Segment was free from street parking, bus stop and pedestrian activities and also it was far from any intersection. To capture the movement of vehicles at a wide range camera was kept on a tripod

•stand at first point and last point. Volume count for mixed traffic, the data was collected by manual method. The spot speed data was collected simultaneously using videography method manually. All the relevant data were collected by manual method at the selected stretch in three different areas during the working days.

Study Location –

The study is carried out on the important traffic corridor of Srinagar city .The main study area was Rangreth Road, Airport Road, Nowgham-Chanpora-Rambagh, Parimpora-Qamarwari, Bemina Chowk, and Athwajan-Pantha Chowk are the few roads of Srinagar City which shows major traffic jams due to congestion, two lane road network and heavy density of mixed traffic in peak hours

The level of service is then calculated by the ratio : LOS = V/C
V= VOLUME C= CAPACITY OF LANE

Determination of Theoretical Maximum Capacity –

Using the relation: C = 1000.V/S one can easily determine the theoretical Maximum Capacity; Here, C = Capacity of a single lane, vehicle per hour V = Speed, kmph S = Average center to center spacing of vehicles, when they follow one behind the other as a queue or space headway, m. Thus capacity depends upon the Speed and Spacing. Spacing is governed by the safe stopping distance required be the rear vehicle in case the vehicle ahead stops suddenly.

Figure 2 chanpora road


Figure 4 bemina road


Figure 3 Rangreth road


Figure5.qamawari road

Parimpora-Qamarwari road: The traffic volume and existing capacity ratio of Parimpora-Qamarwari road is 0.730, 0.374, 1.050 at 9:30-10:30, 11:30-12:30, 4:30-5:30 respectively. Therefore s the LOS of the road is E and F during peak hours and C during mid hours.

 Rangreth Road: The traffic volume and existing capacity ratio of Parimpora-Qamarwari road is 1.014, 0.472, 0.899 at 9:30-10:30, 11:30-12:30, 4:30-5:30 respectively. Therefore s the LOS of the road is Fand E during peak hours and C during mid hours.

 Athwajan-Pantha Chowk of Srinagar: The traffic volume and existing capacity ratio of Parimpora-Qamarwari road is 0.720, 0.380, 0.903 at 9:30-10:30, 11:30-12:30, 4:30-5:30 respectively. Therefore s the LOS of the road is E and F during peak hours and C during mid hours

CASE STUDY

LEVEL OF SERVICE(LOS)	V/C RATIO
A	<0.125
B	0.125-0.276
C	0.276-0.479
D	0.479-0.715
E	0.715-1.00
F	>1.00

ROAD	LOS 9:30-10:30 AM	LOS 11:30-12:30	LOS 4:30-5:30 PM
Parimpora-Qamarwari road	E	C	F
Rangreth Road	F	C	E
Athwajan-Pantha Chowk of Srinagar	E	C	E

Conclusion –

Parimpora-Qamarwari Road has LOS of "E AND F" during peak hours which means the vehicle approaches unstable flow and traffic congestion. And having LOS 'C' during mid hour with stable flow. The Urban streets should have minimum LOS of 'C',Worst LOS comes during peak hour .so to avoid these traffic congestion during peak hour on Parimpora-Qamarwari Road we have to increase the carriage width of the lane and also we can construct an median of suitable length. Athwajan-Pantha Chowk has LOS "E AND E" during peak hours which means the vehicle approaches unstable flow and traffic congestion. And having LOS 'C' during mid hour with stable flow. The Urban streets should have minimum LOS of 'C',Worst LOS comes during peak hour.The traffic congestion during peak hour on Athwajan-Pantha Chowk is due the worse condition of the road (i.e. potholes)and also on the road there are many stone quarries and due to the movement of trucks the road congests at peak hours.To avoid these traffic congestion we need to make the road serviceable (by repairing the existing surface coarse) and also we can restrict the truck movement's during the peak hours, Rangreth Road has LOS "F AND E" during peak hours which means the vehicle approaches unstable flow and traffic congestion. And having LOS 'C' during mid hour with stable flow.

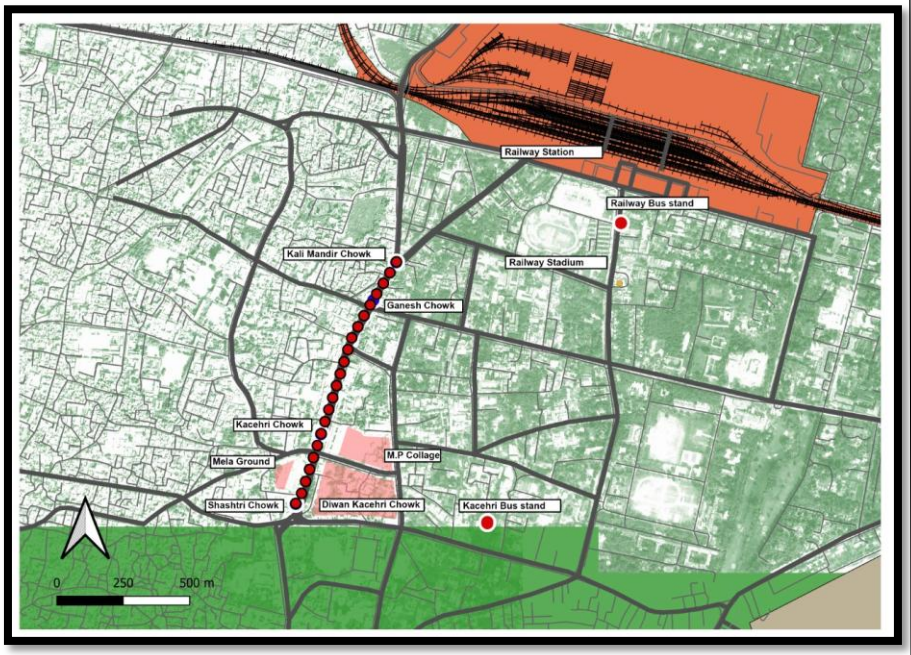
SITE STUDY

REGIONAL LINKAGES :
AIR / RAIL / ROAD
AIR -

Gorakhpur links many main cities of the region by Airways -
Namly- Kolkata, Bombay, Nagpur, Chennai, Delhi, Vishakapatnam, Banglore, & others major airports.

RAIL - Gorakhpur railway (NER) has world's longest platform & it's well connected by railway with India's major cities.

ROAD - (NH-28 & NH-29) Gorakhpur links many main cities of the region by highway namely, Lucknow, Ayodhya, Gopalganj, Barauni, Banaras, Bihar, Nepal etc.



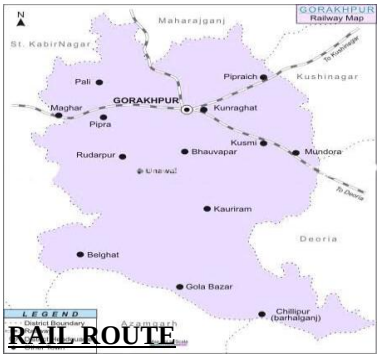
Type of road	Road length (km)
National Highways	5570
State Highways	8551
Major District Roads	7345
Other District Roads	29179
Village Roads	82459

GORAKHPUR'S CITY MASTER PLAN PROCESS-

In 1973, the Urban Planning and Development Act were adopted to ensure that Gorakhpur will prepare a development plan for city growth. The first master plan covered the period of 1971 to 2001.
The second master plan (the current guiding plan) covers the period of 2001 through 2021.

NATIONAL HIGHWAYS CONNECTING MAJOUR AREAS -

1) NH-28 Continues to Bihar, Jharkhand and orissa.
2) Kolkata.
3) Sunauli/ Nepal Border.
4) Delhi NCR.
5) Madhya pradesh Via Allahabad.

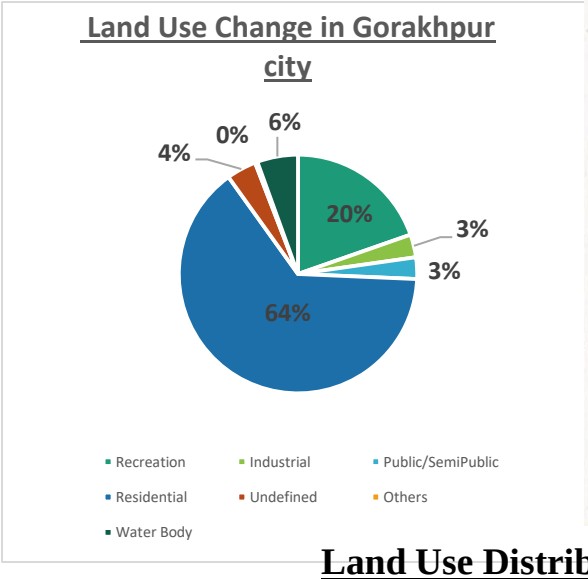


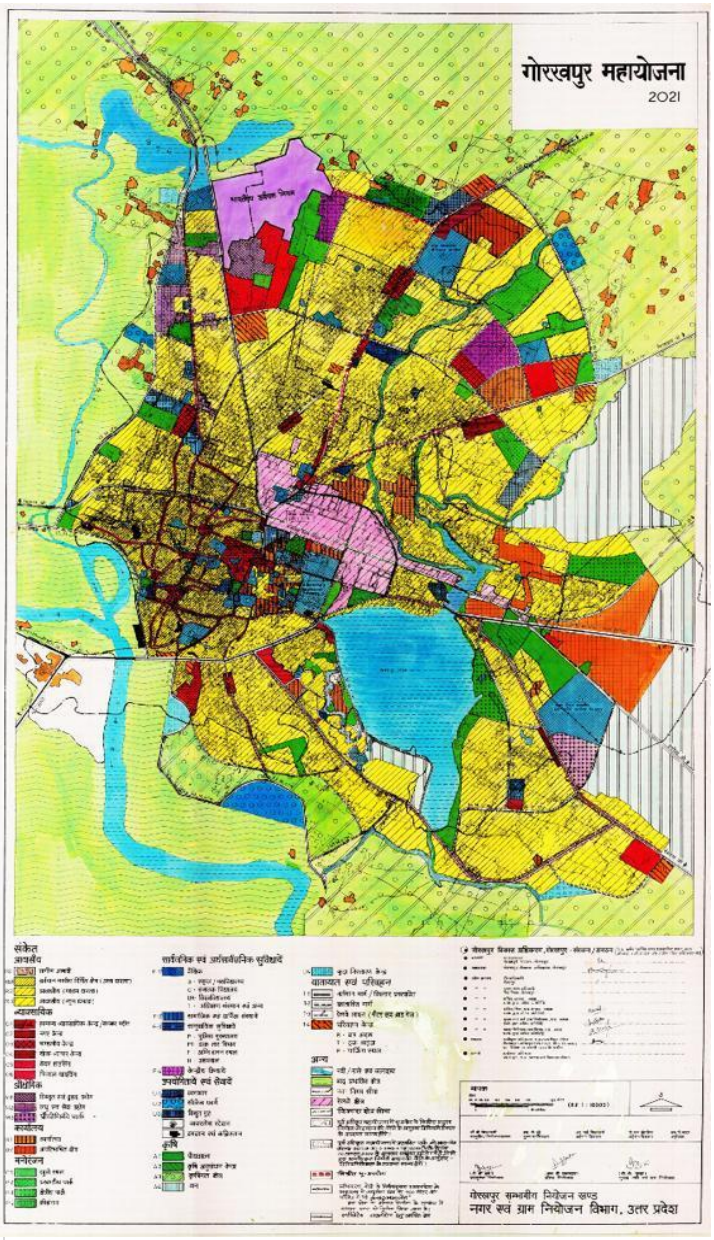
RAIL ROUTE

MAP SHOWING ALL THE EXTERIAL PERIFFIRAL ROADS/NH's

SITE STUDY

Land Use	1971–2001	2001–2021
Total (ha)	6128.01	11188.33
Residential	49.34	51.14
Commercial	4.06	4.76
Industrial	11.4	5.24
Government	7.97	5.68
Public use	8.07	7.25
Recreation	13.4	8.75
Transport	3.76	6.27
Railways	-	3.68
Other	-	7.23





Land Use Distribution in Gorakhpur city

Land Use	2002	Per cent	2012	Per cent	Area Change 2003-2012	Per cent Change 2003-12
Recreation	2814.996	19.61	2819.935	19.65	4.939	0.18
Industrial	445	3.10	445	3.10	0	0.00
Public/Semi Public	420.145	2.93	420.145	2.93	0	0.00
Residential	6654.411	46.36	9248.976	64.43	2594.565	38.99
Undefined	579.329	4.04	579.329	4.04	0	0.00
Others	2636.111	18.36	46.659	0.33	-2589.452	-98.23
Water Body	804.35	5.60	794.298	5.53	-10.052	-1.25
Total (Developed)	14354.342	100.00	14354.342	100.00		

SITE STUDY

Interial Arterial road of our Scope-

The selected chosen strech comprises of a 1200 mts span carrying a heavy Rush and traffic. Specially in the peak hours of 10:00-12:00AM and evening of 5:00-7:00PM.

The Strech Comprises of Total 4 Junctions Namely-

a) Kacheri Chauraha/Shashtri Chauraha.
b) Golghar Chauraha.
c) Ganesh Chauraha.
d) Kali Mandir Chauraha

The major issues seen in these junctions my be listed as-

1) Illegal Road encrochment.
2) Un-organised parking system.
3) Street Vendors.
4) Traffic Signal missfollowed.
5) Diversions between Junctions.

Kacheri Chauraha/Shashtri Chauraha.

Golghar Chauraha

Ganesh Chauraha

Kali Mandir Chauraha

DATA COLLECTION & ANALYSIS

DATA COLLECTION & ANALYSIS

DATA COLLECTION & ANALYSIS

PROPOSAL