ASSESSMENT OF FOUR LANING OF E-W CORRIDOR BETWEEN DARBHANGA & MUZAFFARPUR

A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF URBAN AND RURAL PLANNING

By

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CERTIFICATE

Certified that the report entitled **"ASSESSMENT OF FOUR LANING OF E-W CORRIDOR BETWEEN DARBHANGA & MUZAFFARPUR"**, which has been submitted by **Mr. BINIT KUMAR**, for partial fulfillment of the requirement for the award of the degree of **Master of Urban and Rural Planning**, submitted in the Department of Architecture and Planning, Indian Institute of Technology- Roorkee, is his own work done by him under our supervision and guidance. The matter embodied in this dissertation has not been submitted by him for the award of any other degree of this or any other institute.

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CANDIDATE'S DECLARATION

I hereby certify that this report entitled **"ASSESSMENT OF FOUR LANING OF E-W CORRIDOR BETWEEN DARBHANGA & MUZAFFARPUR"**, which has been submitted in partial fulfillment of the requirement for the award of the degree of **Master of Urban and Rural Planning**, submitted in the Department of Architecture and Planning, Indian Institute of Technology- Roorkee, is an authentic record of my own work carried out during the period from July 2011 to June 2012, under the supervision and guidance of **PROF. RAJESH CHANDRA & DR. R. K. JAIN**, Department of Architecture and Planning, Indian Institute of Technology, Roorkee, India.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree of this or any other institute.

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BINIT KUMAR

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ABBREVIATION

ATMS- Advance Traffic Management System

BOT- Built Operate & Transfer

DPR- Detail Project Report

DR- District Road

E-W – East-West

FOB- Flyover Bridge

GQ- Golden Quadrilateral

HTMS- Highway Traffic Management System

IRC- Indian Road Congress

LCV- Light Commercial Vehicle

LHS- Left hand side of highway in the direction of increasing chainage

MDR- Major District Road

MPR- Monthly Progress Report

NH- National Highway

NHDP- National Highway Development Program

PCU- Passenger Car Unit

PPP- Public Private Partnership

RHS- Right hand side of highway in the direction of increasing chainage

ROB- Rail Over Bridge

ROW- Right of Way

TDR- Transfer of Development Rights

U.P.- Uttra Pradesh

EXECUTIVE SUMMERY

IDENTIFICATION OF PROBLEM

After the four laning of highways under NHDP, the vehicular movement on it has increased tremendously and hence, the number of people on the highway. More people on highway mean more potential of highway to do some business along it. Although some facilities have been provided on the roadside by the highway authority but still the demand is much higher than the supply. During the four laning of highway, the ROW has been also been increased and hence, now encroachers have more opportunity and more area to make the encroachment possible along the roadsides.

To guide the construction of highway, the Planning Commission of India and Ministry of Road Transport and Highways, separately framed the manual for the specification and standards for four laning of highway. But during the four laning, some of the important aspects of road design and highway facilities have been neglected on the ground of economy. So, this dissertation aims to identify the demand which has been created by four laning and the supply of facilities which has been provided by comparing the elements of road design and highway facilities with those given in the manual by the ministry. The objectives of the dissertations are-

- To study the various elements of road design and highway facilities provided while four laning and compare it with those given in manual.
- To workout plan proposals for the possible modification in elements of road design.
- To determine the various deciding factors for the location of highway facilities.
- To workout policy level planning proposals to enhance the use of highway facilities.

STUDY AREA

E-W Corridor between Darbhanga and Muzaffarpur has been taken as the study area. The starting point of the study area is the junction of NH57 with NH105 in Darbhanga and the ending point is the chainage 0.00 km of NH57 i.e. Chandani Chock junction in Muzaffarpur, from where onwards NH28 continues as E-W Corridor. This 63 km of new widened highway has increased the connectivity between the town of Darbhanga and Muzaffarpur significantly, reducing the travel time to half. The highway has been constructed on EPC (Engineering, Procurement and Construction) model which is fully funded by NHAI.

DATA COLLECTION

To collect the data related to the highway, traffic surveys were conducted by the author at various places in the different hours of day and that too seperatly for weekdays and weekends. A traveller's survey was conducted to know about the use pattern of highways facilities and what factors attract travellers to visit a particular facility. And a house-hold survey was also conducted for the residents of nearby settlements to know about the use of highway facilities by the rural population and their movement pattern on highway for basic physical and social infrastructures. The sample size for traveller's survey was taken as 100 vehicles including pedestrians and the sample size for house-hold survey was 50.

Data were also collected from secondary sources like from the detailed project report prepared by NHAI for the project of widening. Monthly progress reports prepared by the supervising agency were also reffered. Some satellite imagery were collected from the internet on different scale to look into the highway before four laning, during it and after complition of the project. And finally some data were also collected from the interviews of professions who were or are a part of widening of highway.

ANALYSIS

By analyzing the traffic, it is observed that on Sunday PCU is maximum during the evening hours while it is least during the afternoon. The average PCU on Sunday is observed as 21850 while on weekdays it has been observed almost same thought out the day and the average has been observed as 20153 which is less than the average PCU on Sunday. The average PCU in a day is observed as 21001. The value of PCU is almost half the PCU allowed on a four lane highway by ministry.

Analyzing the composition of fast moving vehicles and slow moving vehicles in the total PCU on highway, it has been observed that on Sundays the composition of slow moving vehicles decreases on either side of highway, as the day passes by while on weekdays, it decreases on LHS and increases on RHS. The reason has been observed as the visit of nearby city by the rural population for various purposes while they return back by the evening.

Similarly analyzing the composition of passenger vehicles and goods vehicles in the total PCU on highway, it has been observed as decreasing on LHS, with the increasing hours of day on Sunday and this implies that goods carrier prefer driving in morning if they are leaving towards north-eastern states of India or towards other parts of the state while on RHS

its increasing percentage shows that they try to return back to distributors, residing in state capital, before night. Decreasing percentage of passenger vehicles and increasing percentage of goods vehicles on either side of the highway on weekdays implies that, as the day passes by, the people movement on highway decreases. It means, among the passenger traffic, mostly, it is the local traffic whose movement on highway is affected by the day and night hours.

From the various traffic surveys, traveller's survey, house-hold survey and visual survey, it has been observed that, rural population of nearby settlements along the highway, uses it for various purposes. They uses it for commuting to the nearest city for occupation, education, health care and recreational activities. The city to city traffic has been observed between the two important cities of North Bihar. The daily commuters prefer staying at home rather than relocating to the other town and the daily commuting is more from medium town to smaller town than vice-versa. The reasons are the availbility of better physical and social infrastuctures and the familiy attachment.

As far as mode of transport is concern, walking has been observed as the primary modes for rural population while cycles and bikes are used for going to distant places. Two wheelers and three wheelers are mostly used for local movement while four wheelers are used mainly for family activities.

Analyzing the distances between the junctions, it is found that the maximum distance between the junctions provided on LHS is 2.91 km whereas on RHS it is 1.89 km. The minimum distance between the junctions is as low as 40 m on LHS and 30 m on RHS. The manual recommends the minimum distance between the junctions to be 3 km whereas none of the junctions are placed at the distance greater than 3 km. The junctions are closely placed near the city area or just outside the city boundary and as one go away from city area it increases. It shows the pattern of settlement growth that, near the city, settlement are growing linearly in the direction of highway and more number of access roads are required from the highway whereas after the influence of city i.e. in the pure rural area, the junctions are placed at comparatively more distances which depicts that settlement are not spreading along the highway but growing in all direction and impact of highway on these settlement are less. It has been further observed that the junctions of brick road to the highway occur frequently whereas junction of cart track to the highway and of pacca road to the highway generally occurs at distance of more than 1km. It can be concluded that the smaller settlements which

are connected by the brick road are found more along the highway than the major settlements which are connected by pacca road or the non-habitable area which are connected by cart track.

The maximum distances between the bus-stops have been observed as 10.53 km while the minimum as 0.94 km. Three wheelers has been observed stopping anywhere on the highway to take passengers whereas light commercial vehicle mainly stops at junctions and only few stops anywhere. The city to city bus stops only at major juncitons whereas few long distance buses stops sometimes at major junctions otherwise it does not stop. None of the public transport vehicles has been found stopping at bus stops. Due to absence of government owned local transport service on this route, bus stops are not in use for the purpose for which it is constructed. Instead, these are used as playground, as drying place for cow dung cakes, for storing construction material and as truck lay-bye.

Distances between truck lay-byes has been analyzed and it has been observed that the distance between two consecutive truck lay-byes are more on RHS than that on LHS. From the survey, the average speed of trucks while going has been observed as slow and while returning back, they drive fast. The reason for driving slow while going is the heavy load on the truck than safely reaching while returning, early reaching is the main reason for driving fast rather than no load. Hence the faster speed while returning is the main reason for more distance between two consecutive truck lay-byes on RHS than on LHS, since the origin point for most of the truck is the capital city and they return back to the same point after delivery of goods to the various parts of state. Truck lay-byes are not used, as of now, by the truck drivers. The reason for not using it, has been observed as the absence of food and absence of public movement, although, the rest-room has been found closed at all the four truck lay-bye. From the survey, it has been observed that, truck drivers usually stop after 2 – 3 hours of continuous driving and the selection of dhaba is based on the availability of entertainments like T.V. etc.

Analyzing the distances between dhabas present on both the sides of highway, the maximum distance has been observed as 8 km while the minimum as 30 m and there are still many dhabas in the process of construction or expansion. The reason is the increasing number of truck traffic because of the recent opening of bridge over Koshi River early this year. Apart from travellers, dhabas are also visited by the local residents of nearby settlement because of

the absence of bar and restaurant in the nearby locality. Similarly it has also observed that workers like farmers and fuel-station employee go to the nearest dhaba for food.

The numbers of fuel stations are not equal on both the sides of highway as recommended by the letter from the ministry and also the distances between them has not been found in relation to that recommended by NHAI. More than half of the fuel-stations have been found located within a distance of 1 to 3 km. It has observed that the fuel stations are also visited by the local residents regularly for the use of fuel in agricultural vehicle, for electric generation through gen-sets and in irrigation through pump-sets. Most of the rural population walks to 1 – 2 km for fuel and they carry it in drum, apart from filling vehicles at station.

Out of 56 puncture shop on the highway, 42 shops are provided on the LHS, while only 14 shops are on the RHS. The reason is the new construction of road on RHS while four laning of highway and hence the old shops on the LHS are still in use while on the RHS, it is yet to encroach.

PROPOSALS

A slip road of width 5.5 m should be provided on the either side of the highway running continuously along it and at the major junctions, it should be continued through underpasses. Slip road should be bi-directional to facilitate the both way user and to avoid crossing the highway. It will help to segregate the slow moving vehicles from highway. It will also make the pedestrian activity more enjoy full and safe. And by utilizing the entire ROW, it will help in prevention of encroachment on the government land.

Major roads should be connected directly to E-W Corridor whereas other roads should be connected to the slip road running parallel to the highway on both the sides. Median opening should be provided only at 4-arm junctions while for the 3-arm junctions, it should be provided at the distance of 1 km on either side so as to maintain the minimum distance between median openings as 2 km.

Bus-bay should be provided with a shorter connectivity to the rural settlement. So that people can come directly here without going to the junction and then coming to bus-stop. And a local bus service should be provided which should stop at all the bus-stops. A small commercial zone should be developed near the bus stop so that the travellers who just want some wafers or soft drinks can buy here. This will help in increasing the use of bus-stop and

will provide facility to travellers, at the same time it will also generate some revenue to the highway authority.

The location of the truck lay-byes should be decided after analyzing the direction of movement of goods on regional and national level. Safety of goods and trucks should be ensured by employing some person at the truck lay-byes and some pubic activities should be encouraged near to rest room to make the place lively throughout the day. Some commercial area should be constructed near the lay-bye by the highway authority and should be leased for various activities related to trucks like dhaba, repair shop etc. This will help in generating revenue to the authority as well as, it will encourage the use of lay-byes by truck drivers.

For travellers, two rest area of different scale should be provided on the highway separately for long distance and short distance travellers. Smaller rest area should be consisting of a dhaba, a small waver's shop, a puncture shop and a washroom. It should be located at the exit of fuel station with ample parking space. The bigger rest area should be provide with the facilities of motel, picnic spot, fun park, tot-lot, conference rooms, seminar halls, marriage halls, party halls, famous eateries, OAT to perform cultural events, art gallery and exhibition area, NHAI regional office, office of highway maintenance department, highway police reporting center, break-down services, crane facility, ambulance facility, first-aid kit, fire extinguishers, ATMS system with traffic news, route news display, commercial center like grocery shops, local fresh agricultural products etc., ATM and ample parking. It will help to promote local agricultural products, to promote local culture, to provide fame to the local performers, to promote local art, in economic upliftment of local artesian, to provide job opportunity to the local population, to generate revenue through conference rooms and seminar halls to recover the cost of construction of highway, to provide social infrastructure like recreational landuse for local area, to provide a platform to launch the public awareness program by government and to provide a landmarks.

Rest area will be used by long distance travellers or by the travellers who require changing the vehicle and the transport for further journey is not available during the night hours. So, it should be provided near the junctions of highway with the road leading to major city. It should be provided on highway but near to city so that it can also be effectively used by city population.

In the rural area, a separate fuel station should be provided to reduce the movement of rural population on highway for basic facilities and hence, safety aspect of highway can be increased.

CONCLUSION & RECOMMENDATIONS

Residents of the nearby settlements uses highway as public space, as a recreational space, as storage for keeping their agricultural products & waste, as front-yard or backyard, as animal rest area etc. Some of the local resident utilizes the potential of the highway for commercial activities and hence fresh encroachment can be seen around the major junctions. The owner of the nearby land changes the landuse of their property from agricultural to non-agricultural and because of the absence of any law these fresh structures inside the building line are not illegal. So, if the preventive measures, as discussed below, are not considered immediately then sooner or later these highways will not be able to provide the design speed of 100 km/h for which these highways are designed.

- Immediate declaration of control line along the highways and to frame a national act which will be implimented on all the land falling within the control line, irrespective of the above said land coming under state juridiction.
- Bye laws to be framed for the rural areas especially along the highway.
- F.S.I and height restiction to be provided in the increasing order as the distance from the highway increases, so that to promote inward growth rather than along the highway.
- Development rights to be seized from the land owners along the highway within the control line and the compensation can be given by the way of providing proportionate transfer of development right (TDR) in the highway facilities like rest-area, fuel-stations, bus-stops developments, etc.

CHAPTER - 1 INTRODUCTION

Road network of any nation is like the nervous system of a human body through which the oxygen, in case of nation its resources like goods, people, etc., travel to the different parts of the body. Roads help in transmission of technology, spread of economy, distribution of infrastructures, communication of knowledge, exchange of culture and hence, the uniform development of nation, apart from just commuting people and goods.

Better road helps people to move easily from one place to another and hence, it contributes to the generation of economy thorough tourism sector. It helps office-goers to commute daily from workplace to their home and hence, the shortage of housing is kept constant. It aids the penetration of industrial products in remote areas of nation and hence, adds to the globalization. It supports MNCs to establish their offices in small and medium towns and hence, contributes to the development of these cities. It brings technology to the rural areas and hence, helps in the advancement of these undeveloped areas. It assists students to commute to larger distances and hence, help them in getting better education at distant places. It transports agricultural products to the market in shorter time maintaining the freshness of product and hence, reduces the wastage of products in transportation. So, better roads help in movement of goods and people in shorter time and hence, saving the natural as well as human resource which ultimately helps in the economic development of the nation and with this aim on 6th Jan'1999*, then prime minister, Atal Behari Vajpayee had laid down the foundation stone for NHDP, National Highway Development Program, under which all the major roads of nation will be widened and upgraded to the international standards.

NHDP involves widening of 47096 km† of road network under seven phases. As of 31st March' 2012, 16416 km‡ has been widened to four lanes including the Golden Quadrilateral connecting four metros of India and two corridors connecting all the four extremes of India, one lateral running from east to west and another longitudinal running north to south.

Under the highway development program, the widening of highway has been done to help the commuters of long distances to reach at the destination in shorter duration. These highways are also used by the local population of rural and urban areas through which these corridors passes.

* Source- http://www.nhai.org/nhdpdates.HTM accessed on 05-06-12
† Source- http://www.nhai.org/WHATITIS.asp accessed on 05-06-12.
‡ Source- http://www.nhai.org/WHATITIS.asp accessed on 05-06-12.

1.1 HIGHWAY SYSTEM

Highways system consists of two sub-systems. One is movable and other is non-movable. Movable sub-system is further categorized in three classes as human beings, animals and vehicles. Non-movable sub-system consists of road structures, roadside structures, roadside plantation and all the geographic features which it crosses.

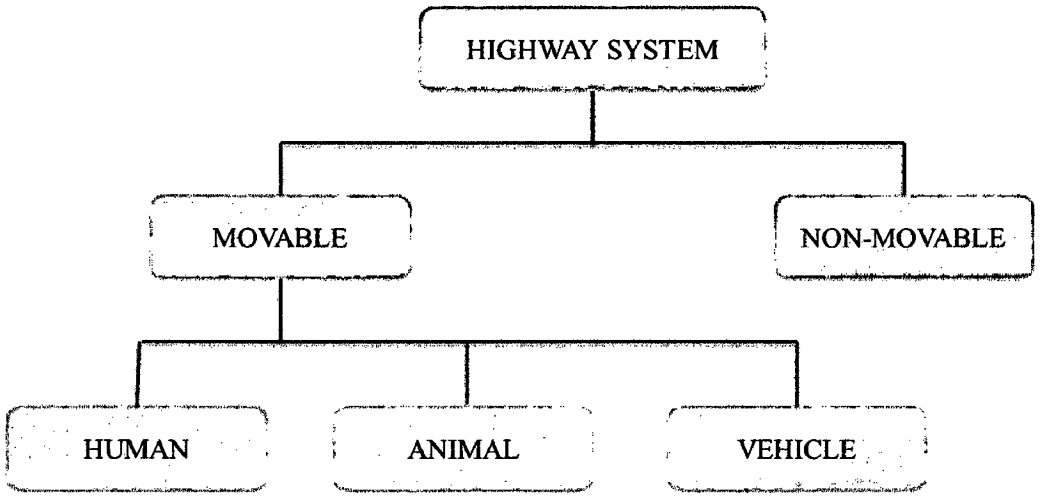


Figure 1: Highway System & Sub-systems

The various uses of highway are listed below:

- Long distance travellers- travelling in private vehicles
  travelling in public vehicles
- Local travellers- travelling in private vehicles
  travelling in public vehicles
- Local residents
- Workers at commercial establishments
- Workers at highway facilities
- Drivers of truck
- Drivers of public transport
- Drivers of feeder service
- Workers at nearby agricultural field
- Highway maintenance workers
- Highway inspecting officials
- Toll plaza worker

Highways are used for various purposes by various groups of people other than local and long distance travellers. For local residents, it is like as public space and for utilities; for workers at commercial establishments, it is a source of livelihood; for workers at highway facilities and at toll plaza, it acts as workplace; for truck driver, it acts as second home; for drivers of public transport, it is their occupation; for workers at nearby agricultural field, it is like an irritating neighbor; for maintenance worker, it is a repetitive work and for highway inspecting officials, it acts as their field work.

Broadly a highway users can be categorized into four components, first is the travellers, second is the residents residing nearby the highway, third is the commercial establishment on the roadside and near the junctions and fourth is the farmer of the nearby agricultural field. The relationship between them is shown in Figure 2.

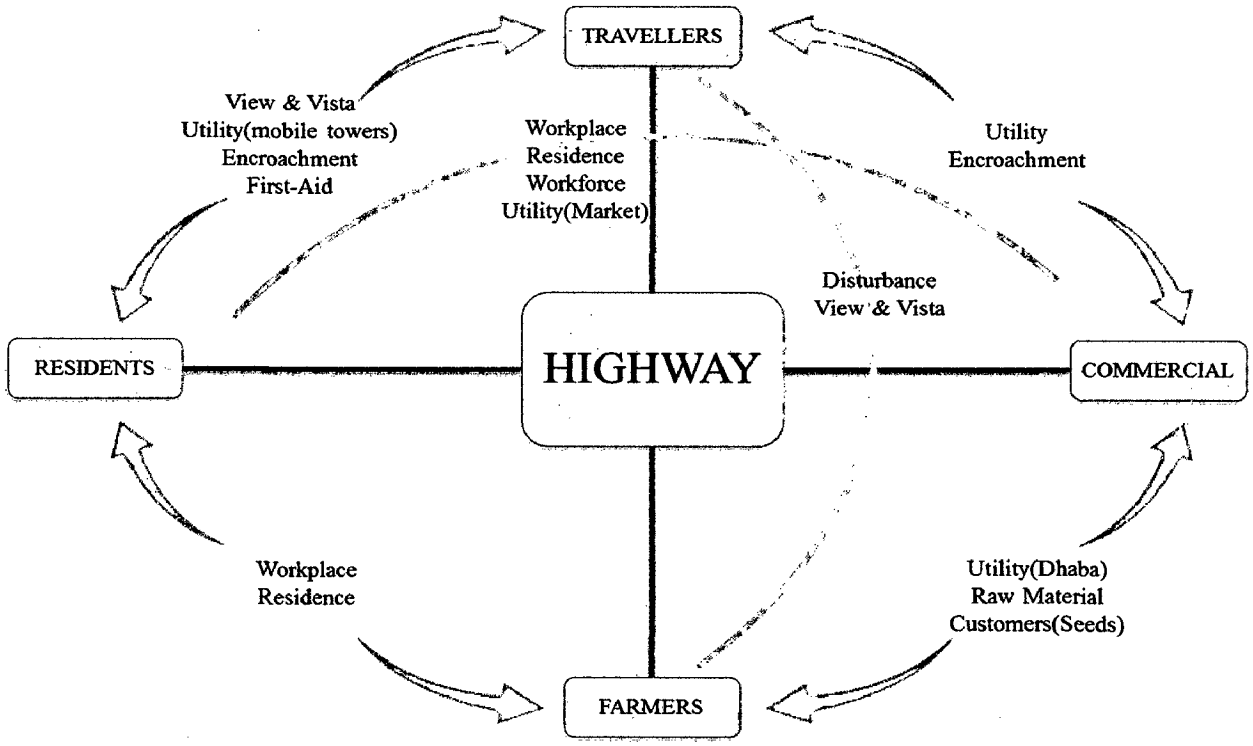


Figure 2: Relationship between various Components of Highway Users

The relation between travellers and residents is very dependent, on one side where travellers get disturbed by their zigzag movement on highway and sudden crossing of highway by the local residents, at the same time in case of any accidents these local people help in calling ambulance or providing the first-aid service. Similarly, where the utilities provided for

travellers are used by local residents like fuel station, on the other hand, the utility provided in the rural areas like mobile towers help travellers to stay connected to the digital world.

Relation between travellers and commercial establishments on the highway is very complex, sometimes when the travellers need these commercial areas then it becomes utility and when they don't need it, they consider it as encroachment. But for commercial establishments travellers are always like customers whom they welcome by encroaching upon the highway.

Farmers of the nearby agricultural field get disturbed by the highway, not only physical disturbance like use of field as toilet or as dust bin, disturbance from the horn and sound producing vehicle but also the mental disturbance like when their land will be taken by government for some other use, or what to do with this land whose market price got high etc. In return for travellers field add on to the view and vista of road. If a field has standing mustard then it gives travellers a nice memory of the highway similarly the row cropping of tall poplar gives a beautiful look from the highway.

The relationship between residents and farmers are like workplace and residence. The farmers working in nearby field stay in the villages near the highway. Similarly residential area and commercial area are dependent on each other. On one side where these commercial area act as workplace for the residents in the nearby area, on the other, the residential area acts as place of residence. The commercial area gets their workforce from these residential areas and in return, commercial area acts as market for these residential areas.

The relation between farmers and commercial area is like customers and market. Farmers visit these commercial establishments like dhaba for food etc. while these commercial establishments like dhaba only, gets their raw material, vegetables etc. from these fields.

Hence, all the various sub-systems of the highway system are dependent on each other and a change in one can be seen in another. So, while planning for it, these various sub-systems and users should be considered as the part of highway.

1.2 TYPES & CAUSES OF ENCROACHMENT

The encroachment of commercial nature along the roadside is of two types, one is temporary and other is permanent. Temporary encroachment becomes permanent if some preventive measures are not taken from time to time. Temporary encroachment involves the items which occupies less space and can be easily shifted by a person or two or which are on the movable

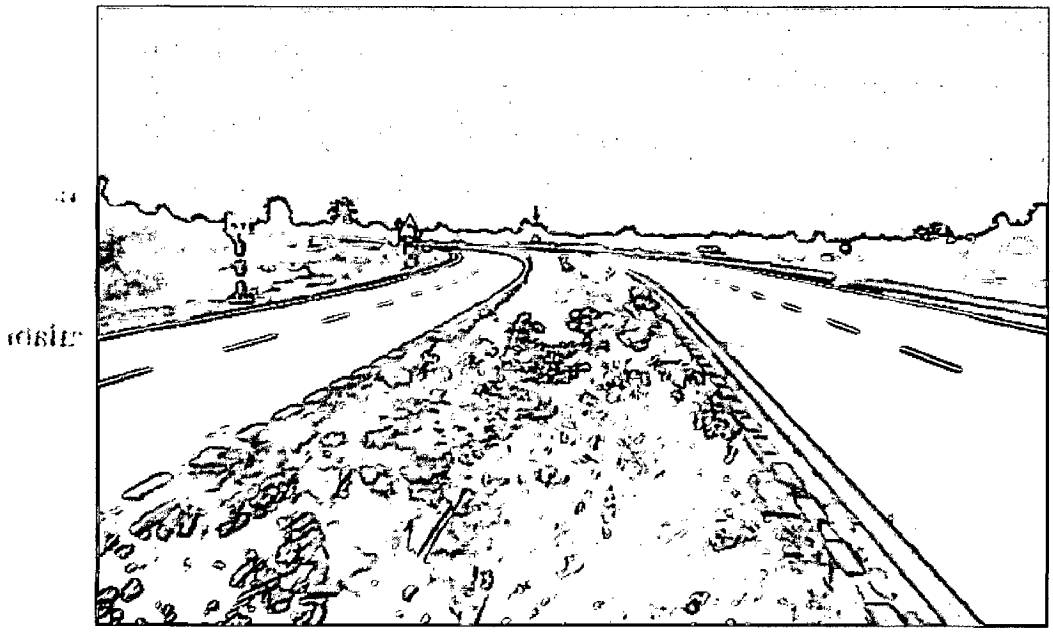
platforms like rickshaw, hand-cart, *thela*, van etc. Temporary encroachment requires less input in setup than in salable items. Later on when the business is popular, then to capture more customers, the encroachers starts spreading and investing in the structures and hence it become permanent. Permanent encroachment is also of the type where the encroachers are removed frequently but they come back again.

The root cause of the commercial encroachment is the opportunity and the availability of resource. The opportunity is in terms of some kind of business and resource is the land. About how encroachment starts, it has been observed that encroachers start with a small and ready to move business which can be packaged and moved easily in case of raid. The area chosen for this illegal business is, of course, the vacant and undeveloped land. Generally owners of private land regularly visit their property, so encroachment does not take place there but the land owned by government remained undeveloped or unclaimed because of the transfer of property between various government organizations. Due of the failure of government agency to regularly visit their property, these lands ultimately result into encroachment. Later this business becomes permanent with time and when the authority try to remove this encroachment, the case goes to court and on the account of livelihood to large number of people court makes theses encroachment legal.

1.3 IDENTIFICATION OF PROBLEM

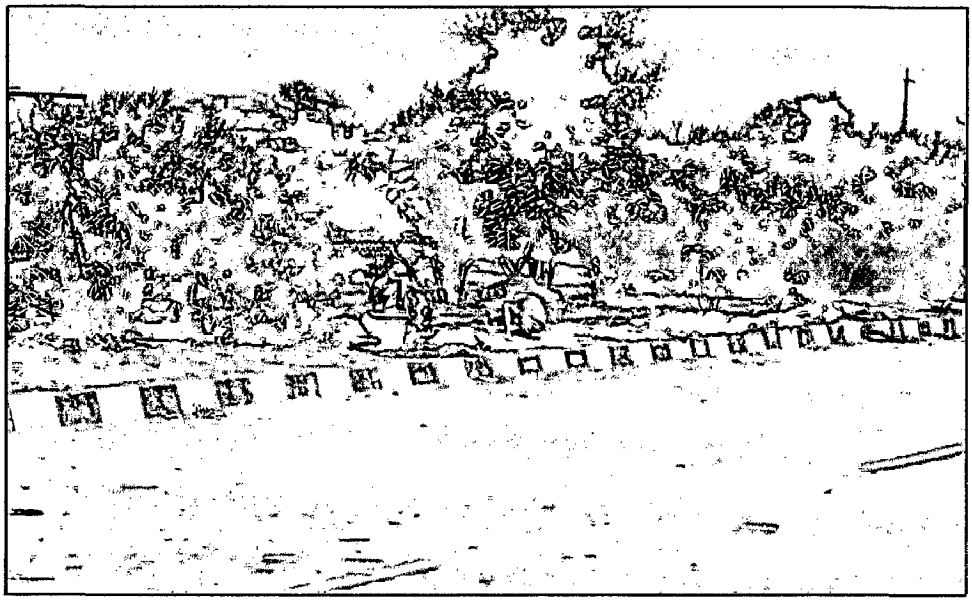
After the four laning of highways under NHDP, the vehicular movement on it has increased tremendously and hence, the number of people on the highway. More people on highway mean more potential of highway to do some business along it. Although some facilities have been provided on the roadside by the highway authority but still the demand is much higher than the supply. During the four laning of highway, the ROW has been also been increased and hence now encroachers have more opportunity and more area to make the encroachment possible along the roadsides. This fact can be observed by analyzing Figure 3 & Figure 4.

The first picture shows median planation provided on the widened highway during the four laning and second picture shows its use by the residents of nearby settlements.



Source- Monthly Progress Report

Figure 3: Highway as Provided after Four Laning



Source- author

Figure 4: Highway at Present

The two pictures shows, what has been provided after the four laning and what is the present condition of these highways. A median, full of plantation to enhance view and vista along the highway has been provided during the four laning but the residents of nearby settlements uses these median as their backyard or front-yard. Likewise, there are various other places where the relationships between various users of highway system are not considered while four laning and the prime focus area was just the highway travellers.

To guide the construction of highway, the Planning Commission of India and Ministry of Road Transport and Highways, separately formed the manual for the specification and standards for four laning of highway. But since, some parts of the highways under NHDP are funded by NHAI, although major part is on BOT (toll) and BOT (annuity), the shortage of fund forced the contracting agency and the client to neglect some of the basic and essential parts given in manual. Due to the negligence of these important aspects, the average speed of the highway has lessened and the safety factor for the highway travellers as well as for local residents along the highway has reduced.

Hence, with the manual for standards of highway and with the actual issues that exist presently on the highway after widening, this dissertation has tried to assess the four laning of highway.

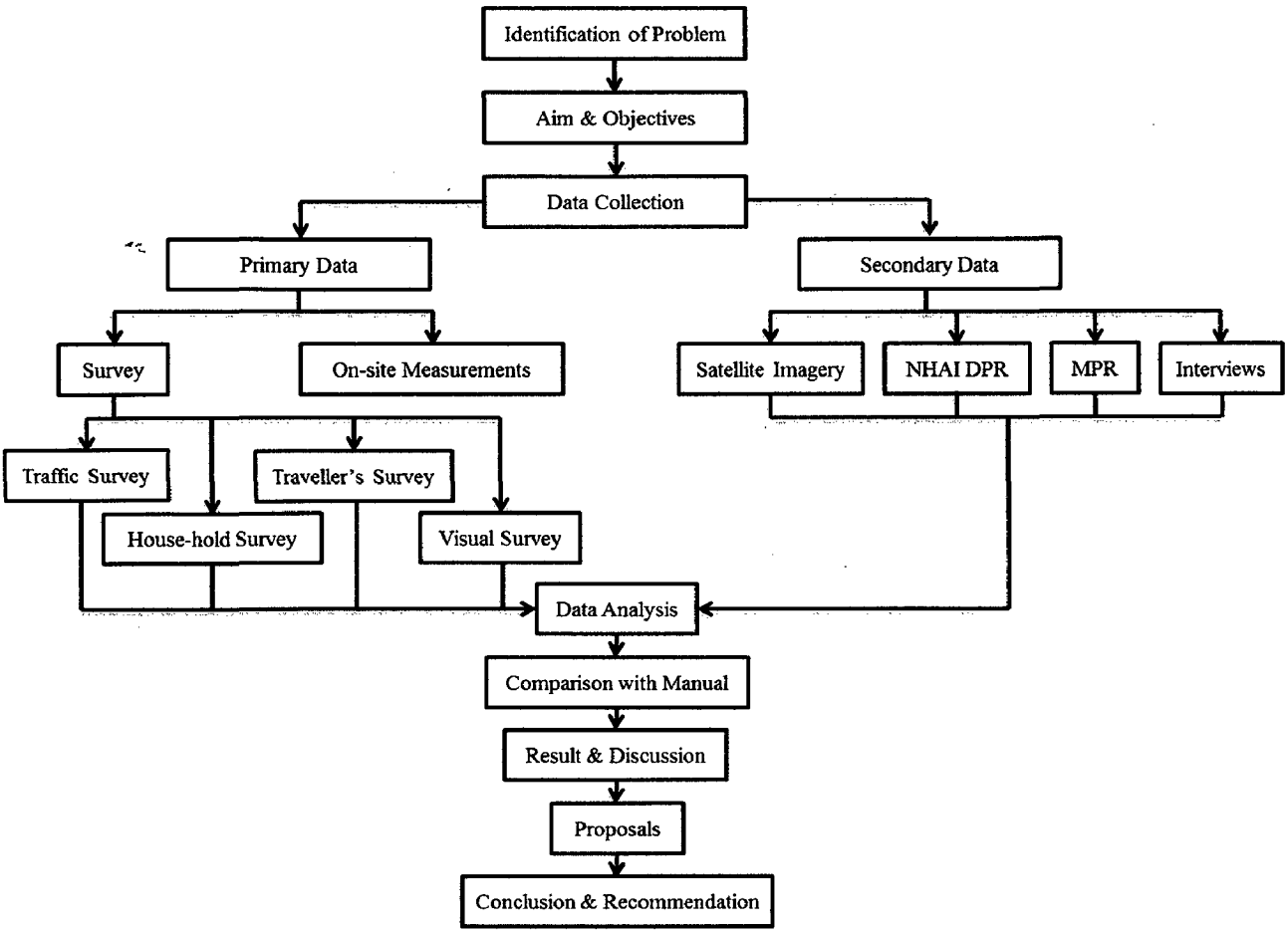
1.4 AIM

To assess the four laning of E-W Corridor based on the Manual provided by Ministry of Road Transport and Highway and Planning Commission of India.

1.5 OBJECTIVES

1. To study the various elements of road design provided while four laning and compare it with the manual.
2. To study the various highway facilities provided while four laning and compare it with those given in manual.
3. To workout plan proposals for the possible modification in elements of road design.
4. To determine the various deciding factors for the location of highway facilities.
5. To workout policy level planning proposals to enhance the use of highway facilities.

1.6 METHODOLOGY



1.7 SCOPE & LIMITATIONS

The study covers the design and locational aspects of the road features and the highway facilities.

The construction details, material details and other technical aspects of highway have been kept outside the scope because of the limitation of time and availability of resources.

The study is applicable to all the divided highways provided in plain and rolling areas whereas it is not applicable to the highways of mountainous and steep section.

1.8 ORGANIZATION OF THE THESIS

Thesis consists of seven chapters. These are briefly described below:

Chapter 1 – (Introduction) identifies the problem of the research. Aim & objectives and the methodology to achieve this aim also form the part of this chapter.

Chapter 2 – (Literature Study) defines the various terminologies used in the transportation planning. It discusses the various rules and acts related to the highway in brief. And it also emphasizes the standards as recommended by the Ministry of Road Transport & Highways and Planning Commission of India for the four laning of highway.

Chapter 3 – (Study Area) introduces the location and length of study area with a brief description of the geographical and political features.

Chapter 4 – (Data Collection) contains all the data collected from different sources like surveys, on-site measurement, secondary data, etc.

Chapter 5 – (Analysis) analyses all the collected data on various factors and these are compared with the manual provided by the ministry and planning commission. The analysis is categorized in five parts as PCU count, vehicle count, traffic pattern, highway design and highway facilities.

Chapter 6 – (Proposals) discusses all the various proposals based on the results and discussions with experts. It is categorized into two parts as highway design and highway facilities.

Chapter 7 – (Conclusion & Recommendation) concludes the entire research. It also contains all the recommendations, apart from proposals, by the author. And finally, the future scope of this research is discussed in this chapter.

CHAPTER - 2 LITERATURE STUDY

2.1 INDIAN ROAD NETWORK

Indian road network is the second largest in the world consisting of approximately 33 lakhs kms. It carries about 65% of freight and 80% passenger traffic. The major categories of road network are shown in Figure 5.

CATEGORIES	LENGTH (KMS)
Primary road system covering National Highways (NH)	65,569
Secondary road system covering State Highways (SH)	1,37,711
Other roads including Major District Roads(MDR) Other District Roads (ODR) & Village Roads(VR)	33,83,344

Source- Road India, Ministry of Commerce & Industry Government of India

Figure 5: Major Categories of Indian Roads

The National Highways are intended to facilitate medium and long distance inter-city passenger and freight traffic across the country. The State Highways are supposed to carry the traffic along major centres within the State. Other District Roads and Village Roads provide villages accessibility to meet their social needs as also the means to transport agriculture produce from village to nearby markets. Major District Roads provide the secondary function of linkage between main roads and rural roads. The length of various classes of roads are given in Figure 6.

CLASS	LENGTH
Access Controlled Expressways	over 1,000 km (620 mi)
4-6 lane Divided Highways (with service roads in congested areas)	over 12,000 km (7,500 mi)
National Highways	66,590 km (41,380 mi)
State Highways	131,899 km (81,958 mi)
Major district roads	467,763 km (290,654 mi)
Rural & other roads	2,650,000 km (1,650,000 mi)
Total	(approx) **3,300,000 km** (2,100,000 mi)

Source- http://en.wikipedia.org/wiki/National_Highway_%28India%29

Figure 6: Length of Various Classes of Roads

National Highways constitute only about 1.7% of the road network but carry about 40% of the total road traffic.

Motor Vehicle Population & Growth of Road Network

While the motor vehicle population has grown from 0.3 million in 1951 to 59 million in 2004, marking a 180 fold increase, the road network has expanded from 0.4 million km to 3.5 million km, a 9 fold increase in terms of length during the same period. Upgrading of roads by way of widening of carriage-ways, improved surface quality, strengthening/reconstruction of old/weak bridges and culverts, etc. has been carried out.

GROWTH OF ROAD NETWORK

CATEGORY	1951 (in kms.)	Dec., 2004 (in kms.)	% Growth
National Highways	22,255	65,569	194%
State Highways	60,000	1,37,711	129%
Other Roads	3,18,000	33,83,344	963%
Total	4,00,255	35,86,624	796%

Source- Road India, Ministry of Commerce & Industry Government of India

Figure 7: Growth of Road Network

The NHs have expanded only about 3 times and SHs have expanded by about 2.4 times in length from 1951 to December, 2001.The main roads have not kept pace with traffic in terms of quality also. Out of the total length of National Highways only 4 percent of their length is four-lane, 58.1% two-lane, and 38% single lane.

Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years.

Trend in Road Traffic

Freight transport by road has risen from 6 Billion Tonne Km (BTK) in 1951 to 1100 BTK in 2000 and passenger traffic has risen from 23 Billion Passenger Km (BPK) to 2875 BPK during the same period. The annual growth of road traffic is expected to be 10 to 11%. Current boom in the automobile sector may even increase the future growth rate of road traffic. While the traffic has been growing at a fast pace, it has not been possible to provide matching investment in the road sector, due to the competing demands from other sectors, especially the social sectors. Many sections of the highways are in need of capacity augmentation, pavement strengthening, rehabilitation of bridges, improvement of riding quality, provision of traffic safety measures, etc. There are congested road sections passing

through towns where bypasses are required. Many old bridges are in need of rehabilitation/replacement along with capacity augmentation.

NHs are the main arterial roads which run through the length and breadth of the country connecting ports, state capitals, industrial and tourist centers and neighbouring countries. NHs constitute less than 2 % of the total road network, but carry nearly 40% of the total road traffic. While their growth in quantitative terms has been rather gradual, from 22,255 km in 1951 to 65,569 km in December, 2004, qualitatively there has been overall improvement. The present level of budget for NHs is about US$ 1000 million per annum. However, the removal of existing traffic deficiencies is estimated to cost about US $ 33 billion.

Development and Management of Road

Responsibility for the development and maintenance of National Highways rests with the Central Govt., while all other roads are the responsibility of the concerned State Govts. and the local bodies. Presently, NHs are being developed, maintained and managed under an agency system. The execution of works and day-to-day management of most NHs are looked after by the Public Works Department PWD and those in the border areas are developed and maintained by the Border Roads Organisation (BRO). The Ministry of Shipping, Road Transport and Highways, Government of India, has the overall responsibility including planning, budgeting and standardisation for National Highways. To give a boost to the development of National Highways, a National Highways Authority of India (NHAI), under Ministry of Road Transport and Highways has been formed to implement important projects on NHs. At present NHAI is implementing NHDP.

Statutes and Institutional Structure

The functions relating to development, maintenance and management of National Highways are carried out by the Central Govt. under the provisions of National Highways Act, 1956. The Act has been amended in June, 1995 to permit private sector participation. The National Highways Act, 1956 empowers the Central Govt. to enter into agreement with any person for development and maintenance of National Highways. The person may be an individual, partnership firm, company, joint venture, consortium or any other form of legal entity, Indian or foreign, capable of financing from own resources or funds raised from financial institutions, banks, open market etc., designing and building the project and operating and maintaining it, collecting fee from users during an agreed period which together with construction period is termed as concession period. Upon expiry of the concession period, the

right of the person to collect the fee and his obligation to operate and maintain the project will cease and the facility will stand transferred to the Central Govt. All policy matters relating to National Highways are decided by the Ministry of Shipping, Road Transport and Highways (MORT&H). NHAI was established under the National Highways Authority of India Act, 1988 but was operationalised in February 1995. The Authority is an Autonomous Body with executive responsibility for the development, maintenance and operation of those National Highways and associated facilities vested in it by the Ministry of Road Transport and Highways. It is intended to take over the management of the entire National Highways on agency basis in a phased manner. The Authority has been entrusted with the execution of the highway projects under ADB-III as well as Japan Bank of International Cooperation (JBIC). In addition, NHAI will also be implementing other externally-aided projects like World Bank-III and maintenance thereof. NHAI will also be implementing other externally-aided projects under World Bank-III and maintenance thereof. NHAI will also be responsible for implementation of the policy of privatisation in highway sector. A Task Force headed by Deputy Chairman, Planning Commission was constituted on October 30, 1998 with the aim of attracting investments to specific infrastructure projects of national and regional importance and ensuring timely completion. The Government, therefore, took up projects for upgradation of NHs and launched the National Highways Development Project (NHDP).

Prior to the launch of NHDP, State Public Works Departments (PWDs) were implementing NH projects. Since the performance of the State PWDs was not found satisfactory, the Government decided (December 1998) that National Highways Authority of India (Authority) would take up NHDP work for expeditious implementation of the project. NHAI outsourced the preparation of Detailed Project Reports (DPRs) to DPR consultants selected through competitive bidding. NHAI followed FIDIC (International Federation of Consulting Engineers) system of project supervision where the project management of the awarded stretch including day-to-day supervision, quality assurance, issuance of working drawings, approval of mix formulae for road layers, approval of variations and their rates, measurements of work done and certification of payments to civil contractors, recommendation of Extension of Time (EOT), levy of liquidated damages (LD) etc is entrusted to an independent technically qualified contractor called Project Supervision Consultant (PSC) selected through competitive bidding. The field formations of NHAI for execution of NHDP comprise Project Implementation Units (PIUs) headed by Project Directors (PD) who are assisted by Managers and other support staff. A PIU may oversee

more than one stretch&/contract. There were 50 PIUs (March 2004) located all over the country. Separate project reports are required to be prepared for each stretch and the works are executed by separate civil contractors engaged through competitive bidding.

2.2 NATIONAL HIGHWAY DEVELOPMENT PROJECT (NHDP)

Under former Prime Minister Atal Behari Vajpayee, India launched a massive program of highway upgrades, called the National Highway Development Project (NHDP), in which the main north-south and east-west connecting corridors and highways connecting the four metropolitan cities have been fully paved and widened into four-lane highways. Some of the busier National Highway sectors in India have been converted to four or six lane expressways – for example, Delhi-Agra, Delhi-Jaipur, Ahmedabad-Vadodara, Mumbai-Pune, Mumbai-Surat, Bangalore-Mysore, Bangalore-Chennai, Chennai-Tada, Delhi-Meerut, Hyderabad-Vijayawada and Guntur-Vijayawada.

Aim & Objectives of NHDP

NHDP's prime focus is on developing international standard roads with facilities for uninterrupted flow of traffic with:

- Enhanced safety features
- Better Riding Surface.
- Better Road Geometry
- Better Traffic Management and Noticeable Signage.
- Divided carriageways and Service roads
- Grade separators
- Over bridges and Underpasses
- Bypasses
- Wayside amenities

NHDP Benefits

Advantages of having a well-developed network of world class highways are:

- Savings in vehicle operating costs
- Faster, comfortable journeys
- Reduced fuel consumption
- Safer travel

- Benefits to trade especially in movement of perishable1 matr
- Reduced maintenance costs
- Safer travel
- All round development of areas

NHDP Phases

National Highways Authority of India (NHAI) under the Ministry of Road Transport & Highways, Government of India has decided to take up the development of various NH corridors on priority under the NHDP programme. Phase I & II comprises of four laning of Golden Quadrilateral and North-South and East-West Corridor. Phase III is the connectivity of state capitals via NHDP Phase I and II, and connectivity to centres of economic importance. Phase IV is the conversion of single lane roads to two lane with paved shoulder. Phase V is the six laning of selected stretch of Golden Quadrilateral and the two corridors. Phase VI is the development of expressways connecting major commercial and industrial cities. Phase VII is the improvement of city road by providing ring roads and bypasses. A road along the north-east border will be provided under SARDP-NE. Major ports will be connceted to main highways under port conncetivity program and others focuses on highway connceting major cities to highway network.

NHDP Phase	Particular	Length (in km)
NHDP- I & II	GQ & NS-EW Corridor	13146
NHDP- III	4 – laning	12109
NHDP- IV	2 – laning	14799
NHDP- V	6 – laning of selected stretches	6500
NHDP- VI	Development of Expressways	1000
NHDP- VII	Ring Roads, Bypasses, Grade Separator, Service Roads etc.	700
SARDP- NE	North- east along border	388
Port Connectivity	Port cities	380
Others	Major cities	1390
Total		**50024**

Source- www.nhai.org

Figure 8: Phasing of NHDP

The main components of NHDP include:

(a) Golden Quadrilateral (GQ)

Length :- 5846 km

Connecting Delhi, Kolkata, Chennai and Mumbai

(b) North-South & East-West Corridors

Length :-7 ,300 km

Kashmir to Kanyakumari -4000 km (with a spur to Cochin) and Silchar to Porbandar-3300 km.

Present Status of NHDP

As of now, Golden Quadrilateral has been announced complete and more than 80% of the corridor widening work has been completed. Out of total of 49,260 km, more than one-third work has been completed till 31st March'12. The details are given in Figure 9.

NATIONAL HIGHWAY DEVELOPEMENT PROJECT(NHDP)

National Highways Development Project is being implemented in 4 phases I, II, III & V at present. The present phases under Phase I, II & III envisages improving more than 32,754 km of arterial routes of NH Network to international standards. The project-wise details NHDP Phase I, II, III & V :

NHDP & Other NHAI Projects
31th March, 2012

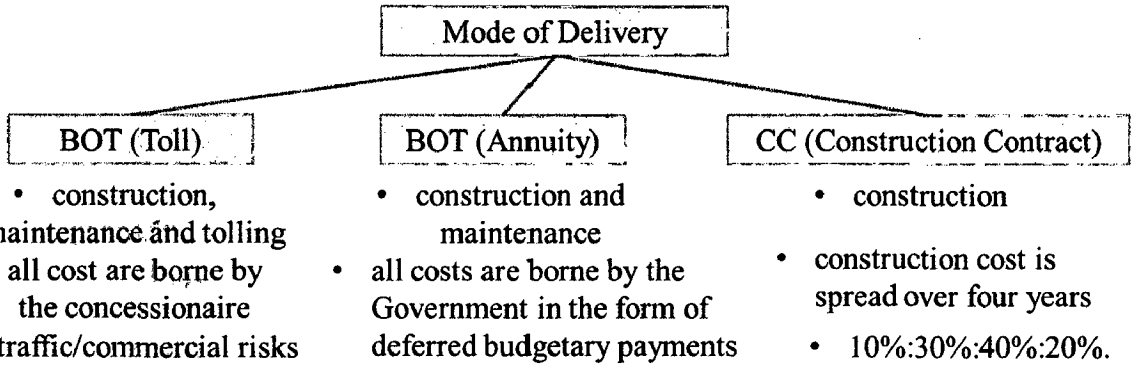
	NHDP										Port Connectivity	Others	Total by NHAI
	GQ	NS-EW Ph. I & II	NHDP Phase III	NHDP Phase V	NHDP Phase VI	NHDP Phase VII	SARDP-NE	NHDP Phase IV	NHDP Total	NH-34			
Total Length (Km.)	5,846	7,142	12,109	6,500		700	388	14,799	47,096	5.5	380	1390	49,260
Already 4/6Laned (Km.)	5,839 (99.88%)	6,011	3,643	910	-	13	34	-	16,416		353	961	17,764
Under Implementation (Km.)	7	711	6,626	3,071	-	28	78	3,318	13,761	5.5	27	409	14,280.5
Contracts Under Implementation (No.)	8	69	93	26	-	2	2	23	221	1	4	5	233
Balance length for award (Km.)	-	420	1,840	2,519		659	276	11,481	16,919		0	20	17,215

Source- www.nhai.org

Figure 9: Present status of NHDP

Mode of Delivery in NHDP

The total length proposed to be developed under NHDP has been split into sections to be covered under different modes of delivery viz. BOT (Toll), BOT (Annuity) and Construction Contract (CC).



Difference between BOT (Toll) and BOT (Annuity)

Briefly stated, the basic difference between BOT (Toll) and BOT (Annuity) is that while in case of the former, construction, maintenance and tolling form part of the concession and budgetary support is restricted to an upfront grant to the concessionaire determined through competitive bidding, in the case of the latter, construction and maintenance form part of the concession and the concessionaire relies on annuity payments determined by competitive bidding and made out of budgetary allocations spread over time. In the former mode, the traffic/commercial risks are borne by the concessionaire and the investment is sustained by toll revenues while in the latter mode, all costs are borne by the Government in the form of deferred budgetary payments. The Government may grant a separate tolling contract for annuity projects if it so decides.

In case of projects where tolling is not contemplated, BOT (Annuity) offers several advantages over construction contracts. Appropriate packaging of BOT (Annuity) projects can help capture the benefits arising out of allocation of construction and maintenance risks to the concessionaire while minimising the downside associated with comparatively high cost of funds. As such, BOT (Annuity) option is superior to the construction contract mode. The term of the annuity is 15 years as per current practice.

Design Speed of Four-lane Highways

Table 1: Design Speed of Four-lane Highways

Nature of Terrain	Cross Slope of the Country (percent)	Design Speed (km / h)	
		Ruling	Minimum
Plain	0 - 10	100	80
Rolling	> 10 - 25	80	65
Mountainous	> 25 - 60	50	40
Steep	> 60	40	30

Source- Manual for four laning of highway, Planning Commission

Capacity of Four-lane Highways

For the purpose of augmentation of the facilities and upgradation of the highway, the design service volume for different terrain conditions and level of service shall be as specified in Table 2.

Table 2: Design Service Volume for Four-lane Highways in PCUs per day

Terrain	Design Service Volume in PCUs per day	
	Level of Service 'B'	Level of Service 'C'
Plain and rolling	40,000	60,000
Mountainous and steep	20,000	30,000

Source- Manual for four laning of highway, Planning Commission

Note: The definition of PCU here is as per IRC Codes and Guidelines and not the definition given in MCA.

Warrants for Six-Laning

Highway shall be widened to 6-lane when total traffic including the traffic on service roads, if any, reaches the design service volume corresponding to Level of Service 'C' for 4-lane highway specified in Table 2.

2.3 DEFINITION OF PCU FROM PAPER NO.498 IRC (P-147)

The main problem in developing the analytical speed-flow relationship is heterogeneity of traffic. The vehicles in the mix produce different impedance due to their varied static and dynamic characteristics. Hence simply adding the number of vehicles does not give the authentic speed flow relationship. For this reason, the vehicles are normally presented in terms of standard type of vehicle using certain conversion factors. Generally, passenger car is adopted as standard vehicle and therefore the factor is known as passenger car unit (PCU). Many researchers have developed methods to estimate PCU for a vehicle type. The interesting point to note is that each of these studies has resulted into different PCU values for the same type of vehicle. There exists large variation in PCU values being adopted in different parts of the world.

The basic concept used to estimate the PCU is that it is directly proportional to the ratio of clearing speed, and inversely proportional to the space occupancy ratio with respect to the standard design vehicle, a car, i.e.

$$PCU_i = \frac{\text{Speed ratio of the car to the } i^{th} \text{ vehicle}}{\text{Space ratio of the car to the } i^{th} \text{ vehicle}}$$

Where,

PCU_i = passenger car unit value of i^{th} type vehicle

Speed ratio of the car to the i^{th} vehicle = V_c/V_i

Space ratio of the car to the i^{th} vehicle = A_c/A_i

V_c = speed of car (km/h)

V_i = speed of i^{th} type vehicle (km/h)

A_c = static (projected rectangular) area of a car (m^2)

A_i = static (projected rectangular) area of ith type of vehicle (m^2)

Therefore, $$PCU_i = \frac{V_c/V_i}{A_c/A_i}$$

2.4 PCU FROM IRC- 64:1990

Although, the conversion factor of PCU depends on compostion of traffic, road gwometics, travel speed but the values of PCU are recommended by IRC -64:1990 and these values of PCU are used in all the government documents. PCU factors are given in Table 3.

Table 3: PCU Factor of Various Types of Vehicle on Rural Roads

Type of Vehicles	PCU
Motor Cycle or Scooter	0.5
Passenger Car	1.0
Auto Rickshaw	1.0
LCV (Jeep)	1.5
LCV (Auto 4 Wheel)	1.5
Mini Bus	1.5
Bus	3.0
Tempo	1.0
Pick-up Van	1.0
Mini Truck	1.5
Truck (2 Axle)	3.0
Truck (3 Axle)	3.0
Truck (4 Axle)	4.5
Truck-trailer	4.5
Agricultural Tractor	1.5
Agricultural Tractor-trailer	4.5
Cycle	0.5
Cycle Rickshaw	2.0
Hand Cart	3.0
Horse-drawn Vehicle	4.0
Bullock Cart	6.0
Pedestrian	0.2*

*PCU of pedestrian is based on the expert opinion.

2.5 STUDY OF VARIOUS ACTS RELATED TO HIGHWAY

2.5.1 Model Highway Bill

All the state highway acts are based on Model Highway Bill. Extract from the act is given below:

2.5.1.1 Section- 2

Definition

(4) building line means a line on either side or any highway or part of a highway, as determined by the highway authority under Section 12of this Act.

(6) control line means a line on either side of a highway or part of a highway beyond the building line, as determined by the highway authority under Section 12 of this Act.

(8) encroachment means occupation of any highway or port thereof, and includes:

(a) the erection of a building or any other structure, balconies, Porches, chajjas or projections, on, over or overhanging the highway land.

(b) occupation of highway land beyond the prescribed period, if any, for stacking building materials or goods of any other description, for exhibiting articles for sale, for erecting poles. awnings, tents. pandals and other similar erections or for parking vehicles or stabling domestic animals or for any other purposes. and

(C) excavations or embankments of any sort made or extended on any highway land.

2.5.1.2 Section-12

Prescription of building and control line

(1) The highway authority may, with the previous approval of the State Government, determine a building line and a control line in respect of any highway or part of a highway in its charge along one or both sides of the highway.

(2) The distance between the middle of a highway and the building line or that between the building line and the control line, which shall be fixed with due regard to the requirements of safety and convenience for traffic and of public health and welfare, may vary in different portions of the highway according to local conditions.

(3) When a highway authority proposes to determine a building and a control line in respect of a highway, the same procedure shall as far as applicable be followed as prescribed under sub-sections (3) to (7) of Section 11 for the prescription of standard width.

(4) The building and control lines as finally determined shall be demarcated on the ground by distinctive stones or other suitable marks which may be painted with different colours and serially numbered.

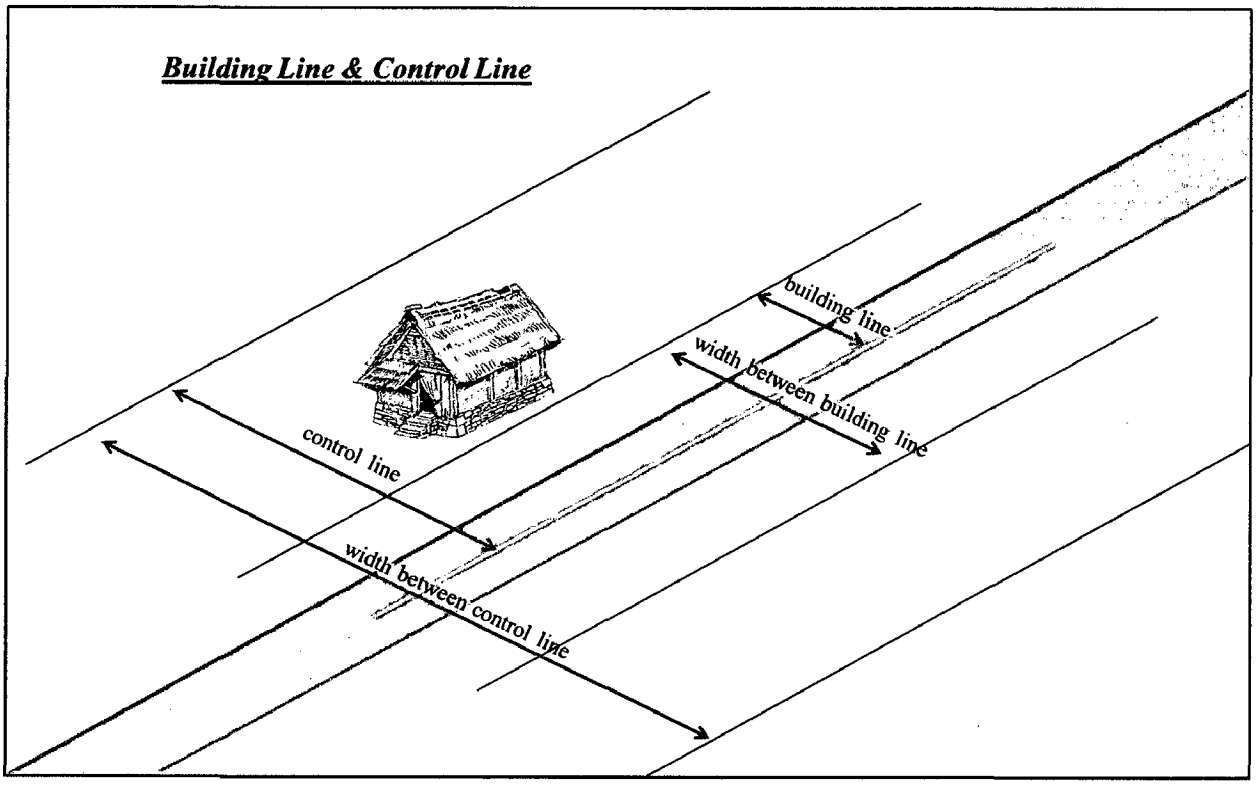


Figure 10: Building Line & Control Line

2.5.1.3 Section- 13

Restriction of building etc. in the area between the highway and the building line

(1) Notwithstanding anything contained in any other law for the time being in force, it shall be unlawful for any person, except the highway authority or any person working on behalf of the highway authority.

(a) to construct or layout any means of access to or from a highway.

(b) to erect or re-erect any building or materially alter the outside appearance of any existing building.

(c) to make any excavation, or

(d) to construct, form or lay out any works, upon land lying nearer to the middle of highway than a distance equal to one-half of its standard width prescribed under Section II, or upon land lying in between the boundary of a highway and the building line determined in respect of the highway under Section 12. Provided, however, these restrictions shall not apply to any works necessary for the repair, renewal, enlargement or maintenance of any sewer, drain, electric line, pipe, duct or other apparatus, constructed in or upon the land before the date on which the restrictions came into force or, with the consent of the highway authority, on or after that date.

(2) Should any building (including a wall) or any part thereof lie within the area between the building line and the middle of a highway, the highway authority may, whenever such building or part has been either entirely or in greater part taken down or burnt down or has fallen down, by notice require such building or part when rebuilt to be set back to the building line.

2.5.1.4 Section- 14

Restriction on buildings etc. between the building and the control lines

(1) Notwithstanding anything contained in any law for the time being in force, no person shall erect or re-erect any building or structure or make or extend any excavation or construct, form or lay out any means of access to a highway upon land lying in between the building and control lines determined in respect of the highway, except with the previous permission of the highway authority in writing.

(2) Every person desiring to obtain the permission referred to in sub-section (1) shall make an application in writing to the highway authority in such form and containing such information in respect of the building, excavation or means of access to which the application relates, and together with such fees as may be prescribed.

(3) On receipt of such application, the highway authority after making such enquiries as it may consider necessary, shall by order in writing either :

(a) grant the permission, subject to such reasonable conditions, if any, as may be specified in the order, or

(b) refuse to grant such permission.

(4) The highway authority shall not ordinarily refuse permission to:

(a) the erection of a building or structure or the making of or extending an excavation which conforms to the requirement of public health and welfare and of safety and convenience of traffic on the adjoining highway, or

(b) the re-erection of building or structure which was in existence on the date on which the restrictions under sub-section (1) came into force, unless such re-erection involved any material alteration to the outside appearance of the building or structure.

(5) When the highway authority refuses the permission, the reasons therefor shall be recorded and communicated to the applicant.

(6) In the event of refusal, the applicant may submit fresh application for permission to the highway authority avoiding the objectionable features on account of which the first application was refused and such a fresh application shall be considered by the highway authority as if ¡t were made for the first time.

(7) If at the expiration of a period of three months after an application has under sub-section (1) or sub-section (6) been made to the highway authority, no order in writing bas been passed by that authority, permission shall be deemed to have been given without the imposition of any conditions. Provided that no such automatic grant of permission shall be presumed if the application is one for the construction, formation or laying out of any means of access.

(8) The highway authority shall maintain a register with sufficient particulars of all permissions given or refused by it under this section and the register shall be available for inspection free of charge by all persons interested and such persons shall be entitled to take extracts there from.

(9) Any person aggrieved by an order under sub-section (2) granting permission subject to conditions or refusing permission, may within 30 days from the date of sub order prefer an appeal to the State Government whose order in the matter shall be final.

2.5.1.5 Section- 19

Highway lands to be deemed Government property

All lands forming part of a highway which do not already vest in the State Government shall, for the purposes of this chapter, be deemed to be Government properly.

2.5.2 The National Highway Act, 1956

2.5.2.1 Section- 3A

Power to acquire land, etc.

(1) Where the Central Government is satisfied that for a public purpose any land is required for the building, maintenance, management or operation of a national highway or part thereof, it may, by notification in the Official Gazette, declare its intention to acquire such land.

(2) Every notification under sub-section (1) shall give a brief description of the land.

2.5.2.2 Section- 3J

Land Acquisition Act 1 of 1894 not to apply

Nothing in the Land Acquisition Act, 1894 shall apply to an acquisition under this Act.

2.5.2.3 Section- 4

National highways to vest in the Union.

All national highways shall vest in the Union, and for the purposes of this Act "highways" include-

(i)all lands appurtenant thereto, whether demarcated or not;

(ii) all bridges, culverts, tunnels, causeways, carriageways and other structures constructed on or across such highways; and

(iii) all fences, trees, posts and boundary, furlong and mile stones of such highways or any land appurtenant to such highways.

2.5.2.4 Section- 5

Responsibility for development and maintenance of national highways.

It shall be the responsibility of the Central Government to develop and maintain in proper repair all national highways; but the, Central Government may, by notification in the Official Gazette, direct that any function in relation to the development or maintenance of any national highway shall, subject to such conditions, if any, as may be specified in the notification, also be exercisable by the Government of the State within which the national highway is ,situated or by any officer or authority subordinate to the Central Government or to the State Government.

2.5.3 The Control of National Highway (Land and Traffic) Act, 2002

2.5.3.1 Section- 2

Definition

(e) "Highway" means a National Highway declared as such under section 2 of the National Highways Act, 1956 (48 of 1956) and includes any Expressway or Express Highway vested in the Central Government, whether surfaced or un-surfaced, and also includes –

i) all land appurtenant to the Highway, whether demarcated or not acquired for such purpose by the State Government to the Central Government;

ii) all bridges, culverts, tunnels, causeways, carriageways and other structures constructed on or across such Highway; and

iii) all trees, railings, fences, posts, paths, signs, signals, kilometre stones and other Highway accessories and materials on such Highways;

(g) "highway land" means the land of which the Central Government is, or is deemed to be, the owner under sub-section (1) of section 23;

(h) "land" includes benefits arising out of land and things attached to the earth or permanently fastened to anything attached to the earth;

(i) "means of access" means any permanent means of access, whether private or public, for vehicles of any kind;

(m) "unauthorised occupation" means any occupation of the highway land, without permission under this Act for such purpose, by a person who –

(i) is trespasser on the Highway; or

(ii) for the time being is paying or is liable to pay to other person rent or any portion of the rent of the premises on a Highway; or

(iii) lives on or otherwise uses any premises on a Highway; or

(iv) is a rent-free tenant of any premises on a Highway; or

(v) is a licensee of any premises on a Highway for its possession; or

(vi) is liable to pay damages to the owner of any premises on a Highway for the use or possession of such premises;

2.5.3.2 Section- 23

Highway land to be deemed as property of Central government. –

(1) All land forming part of a Highway which vest in the Central Government or which do not already vest in the Central Government but have been acquired for the purpose of Highway shall, for the purposes of this Act, and other Central Act, be deemed to be the property of the Central Government as owner thereof.

(2) The Highway Administration shall cause to be maintained a record in the prescribed manner in which the particulars of the land, relating to the Highway, of which the Central Government is the owner shall be entered and the entries of the particulars of such lands in any record maintained for such purpose before the commencement of this Act shall be deemed to be the entry of the particulars of such lands made in the first said record and accordingly the Central Government shall be deemed to be the owner of the lands regarding which the entries have been made in such records maintained before the commencement of this Act.

(3) Any person claiming against the ownership of the Central Government referred to in sub-section (2) shall make written complaint to the Highway Administration and prove his claim before it and the Highway Administration, after considering the evidence produced by such person, may correct such records or reject the claim.

2.5.3.3 Section- 24

Prevention of occupation of highway land. –

(1) No persons shall occupy any highway land or discharge any material through drain on such land without obtaining prior permission, for such purpose in writing, of the Highway Administration or any officer authorised by such Administration in this behalf.

(2) The Highway Administration or the officer authorised under sub-section (1) may, on an application made by a person in this behalf and having regard to the safety and convenience of traffic, grant permission to such person –

i) to place a movable structure on the Highway in front of any building owned by him or to make a movable structure on support of such building and over the Highway, or

ii) to put up a temporary lawning or tent or other similar construction or a temporary stall or scaffolding on the Highway, or

iii) to deposit or cause to be deposited, building materials, goods, for sale or other articles on any Highway, or

iv) to make a temporary excavation for carrying out any repairs or improvements to adjoining buildings,

and such permission shall be granted subject to the conditions and on payment of the rent and other charges by issuing permit in the form as may be prescribed:

Provided that no such permission shall be valid beyond a period of one month at a time from the date on which the permission has been granted unless it is renewed by the Highway Administration or such officer on an application made by such person for the renewal of the permission.

(3) The permission grated under sub-section (2) shall specify therein –

i) the time up to which the permission is granted;

ii) the purpose of such permission;

iii) the portion of the Highway in respect of which the permission has been granted,

and shall be accompanied with a plan or sketch of such portion of Highway.

(4) The person, to whom the permit has been issued under sub-section (2), shall produce the permit for inspection whenever called upon to do so by any officer of the Highway Administration and shall, on the expiry of the permission granted under such permit, restore the portion of the Highway specified in the permit in such condition as it was immediately before the issuing of such permit and deliver the possession of such portion to the Highway Administration.

(5) The Highway Administration or the officer issuing the permit under sub-section (2) shall maintain a complete record of all such permits issued, and shall also ensure in every case at the expiration of the period upto which the permission under a permit is granted under that sub-section that the possession of the portion of the Highway in respect of which such permission was granted has been delivered to the Highway Administration.

2.5.3.4 Section- 26

Removal of unauthorised occupation. –

(1) Where the Highway Administration or the officer authorised by such Administration in this behalf is of the opinion that it is necessary in the interest of traffic safety or convenience to cancel any permit issued under sub-section (2) of section 24, it may, after recording the reasons in writing for doing so, cancel such permit and, thereupon, the person to whom the permission was granted shall, within the period specified by an order made by the Highway Administration or such officer restore the portion of the Highway specified in the permit in such condition as it was immediately before the issuing of such permit and deliver the possession of such portion to the Highway Administration and in case such person fails to deliver such possession within such period, be shall be deemed to be in unauthorised occupation of highway land for the purposes of this section and section 27.

(2) When, as a result of the periodical inspection of highway land or otherwise, the Highway Administration or the officer authorised by such Administration in this behalf is satisfied that any authorised occupation has taken place on highway land, the Highway Administration or the officer so authorised shall serve a notice in a prescribed form on the person causing or responsible for such unauthorised occupation requiring him to remove such unauthorised occupation and to restore such highway land in its original condition as before the unauthorised occupation within the period specified in the notice.

(7) Notwithstanding anything contained in this section, the Highway Administration or the officer authorised by such Administration in this behalf shall have power without issuing any notice under this section to remove the unauthorised occupation on the highway land, if such unauthorised occupation is in the nature of –

(a) exposing any goods or article –

i. in open air; or
ii. through temporary stall, kiosk, booth or any other shop of temporary nature,

(b) construction or creation, whether temporary or permanent, or

(c) trespass or other unauthorised occupation which can be removed easily without use of any machine or other device,

and in removing such occupation, the Highway Administration or such officer may take assistance of the police, if necessary, to remove such occupation by sue of the reasonable force necessary for such removal.

(8) Notwithstanding anything contained in this section, if the Highway Administration or the officer authorised by such Administration in this behalf is of the opinion that any unauthorised occupation on the highway land is of such a nature that the immediate removal of which is necessary in the interest of –

(a) the safety of traffic on the Highway; or

(b) the safety of any structure forming part of the Highway,

and no notice can be served on the person responsible for such unauthorised occupation under this section without undue delay owing to his absence or for any other reason, the Highway Administration or the office authorised by such Administration may make such construction including alteration of any construction as may be feasible at the prescribed cost necessary for the safety referred to in clause (a) or clause (b) or have such unauthorised occupation removed in the manner specified in sub-section (7).

2.5.3.5 Section- 28

Right to access. –

(1) No persons shall have right of access to a Highway either through any vehicle or on foot by a group of five or more persons except permitted by the Highway Administration either generally or specifically in the manner specified in section 29.

(2) The access to a Highway under sub-section (1) shall be subject to the guidelines and instructions issued by the Central Government from time to time.

(3) The Highway Administration may, by notification in the official Gazette, declare a Highway or any portion thereof to be limited for access in the manner as specified in such notification and may also impose any restriction or control on such access to from or across such Highway as specified in the notification.

2.5.3.6 Section- 38

Construction on highway land. –

(1) Notwithstanding anything contained in any other law for the time being in force, not person other than a Highway Administration or a person authorised by such Administration in this behalf shall construction, install, shift, repair, alter or carry any poles, pillars, advertisement towers, transformers, cable wire, pipe, drain, sewer, canal, railway line, tramway, telephone boxes, repeater station, street, path or passage of any kind on highway land or across, under or over any Highway except with the prior permission in writing of the Highway Administration for such purpose.

2.5.4 U.P. Roadside Land Control Act, 1945 and Modification in Land Acquisition Act, 1894

2.5.4.1 Section- 3

Declaration of controlled area

(1) The State Government may, by notification in the official Gazette, declare any land within a distance of four hundred and forty yards from the centre line of any road to be a controlled area for the purpose of this act :

Provided that in the case of national highway, the highway itself shall not be a controlled area.

2.5.4.2 Section- 4

Plans of controlled area to be deposited at certain offices

(1) The Collector shall deposit at his office and at such other places as he considers necessary, plans showing all lands declared to be controlled areas for the purposes of this Act, and setting forth the nature of the restrictions applicable to the land in any such controlled area

(2) The plans so deposited shall be available to the public for inspection free of charges at all reasonable times.

2.5.4.3 Section- 5

Restrictions on building, etc. in a controlled area

Notwithstanding anything contained in any other law for the time being in force, no person shall erect or re-erect any building, or make or extend any excavation, or lay-out any means of access to a road in a controlled area except with the previous permission of the Collector in writing.

2.6 STUDY OF MEASURES FOR CONTROLLING ENCROACHMENT

Some of the techniques are suggested by the journal IRC-SP-15, 1972. These techniques are discussed below:

1. Acquisition of Adequate Highway Land

One of the most effective methods of ensuring that ribbon development does not take place is to acquire a liberal right of way at the initial stage itself, with an adequate provision for meeting both the present and the anticipated future requirements. The following standards need to be followed in this respect:

Table 4: Land width for different classes of road

Land Width for Different Classes of Road								
Class of road	Land width in meters							
	Plain and rolling country				Mountainous and steep terrain			
	Rural area		Urban areas		Rural area		Urban area	
	Normal	Range	Normal	Range	Normal	Exceptional	Normal	Exceptional
National and State Highways	45	30-60	30	30-60	24	18	20	18
Major District Roads	25	25-30	20	15-25	18	15	15	12
Other District Roads	15	15-25	15	15-20	15	12	12	9
Village Roads	12	12-18	10	10-15	9	9	9	9

Source:- IRC- SP- 15, 1972

2. *Enforcement of Measures for Controlling Building Lines, Set-back Distances, Control Lines, etc.*

In order to prevent overcrowding and preserve sufficient space for future road improvements, it is often advisable to lay down restrictions regarding the building lines, set-back distances, control lines, etc. along the highway. Such measures can also help in securing adequate sight distance and preserving the aesthetic value of the highway. Building Lines express the limits beyond which only any building activity may be permitted. It may also be desirable to limit the nature of building activity even beyond the building lines. In such cases, the concept of "Control Lines" is established, and unrestrained building activity permitted only beyond these lines.

Preferably the following minimum standards should be followed for Building and Control Lines:

Table 5: Standards for building lines and control lines

Standards for Building Lines and Control Lines							
Class of Road	Plain and rolling terrain			Mountainous and steep terrain- Distance between bldg. & road boundary (m)			
	Rural areas		Urban & industrial areas				
	Width between Building Lines (overall width) in m	Width between Control Lines (overall width) in m	Distance between Building Lines & Road boundary (set-back distance) in m	Rural areas		Urban areas	
				Normal	Exceptional	Normal	Exceptional
National and State Highways	80	150	3-6	5	3	5	3
Major District Roads	50	100	3	5	3	5	3
Other District Roads	25/30	35	-	5	3	5	3
Village Roads	25	30	-	5	3	5	3

Source:- IRC- SP- 15, 1972

3. *Control of Sub-Division of Land Abutting Highway Land*

Many a times, land developers propose a large number of streets and subdivide the land into plots, thus resulting in high density in development and congestion on the main highway. The planning authorities must therefore, regulate the sub-division of the land into plots and insist on proper arrangement of streets, open spaces, recreational facilities, etc. so that the effect on roadside development on the main highway is predetermined and taken care of. In short, a satisfactory relationship between the sub-division layout and the main highway should be thought of and suitable regulations framed in safeguarding the ill-effects of intensification of land use.

4. *Control of Access*

Each abutting land owner demands his own access to the main highway, whereas the needs of the highway dictate that the accesses should be controlled and spaced at safe places. A conflict of interests is thus inherent, and it is the function of the government to resolve it to the maximum good of the community. This can be done by enacting suitable legislative measures whereby the government retains the control of granting an access to the abutting land owners or by controlling it in a judicious manner. The control can be either full or only partial. On the other hand, there is an urgent need to partially control the access points on

trunk routes such as National Highways and State Highways, if these highways have to retain their utility and not be impaired by the mushroom growth of access points. It is considered desirable that access points should not be closer than 300 metres. Access points for petrol filling stations can be permitted at suitable intervals depending upon their actual need. While access on new highways could be controlled by suitable laws and even new access points on existing highways, the question that immediately arises is whether the existing access pints on some of the existing highways can be closed legally. In any case, it should be possible to close some of the access points if an alternative connection is given by providing parallel service roads.

5. *Removal of Encroachments*

Encroachments are illegal intrusions by private persons into the right-of-way of the highway. They spring up because of the general lack of vigilance on the part of the highway authorities. They start as insignificant temporary structures but soon they become a permanent feature. Many of our highways are impaired by the presence of a number of encroachments. Legal remedies to evict the encroachers, either summarily or after giving due legal notice, should be resorted to by the highway authorities as soon as they are noticed. Delay in taking appropriate measures can be harmful, as with passage of time the encroacher builds more structures and it becomes extremely difficult to get the same vacated.

2.7 MANUAL FOR SPECIFICATION AND STANDARDS FOR FOUR LANING OF NATIONAL HIGHWAY

- By Ministry of Road Transport & Highways & Planning Commission of India

2.7.1 ROW

The minimum Right of Way for non-urban and urban areas should be as prescribed in IRC:73 and IRC:86 respectively.

2.7.2 Cross-Section

The typical cross section recommended by the Manual is given in Figure 11.

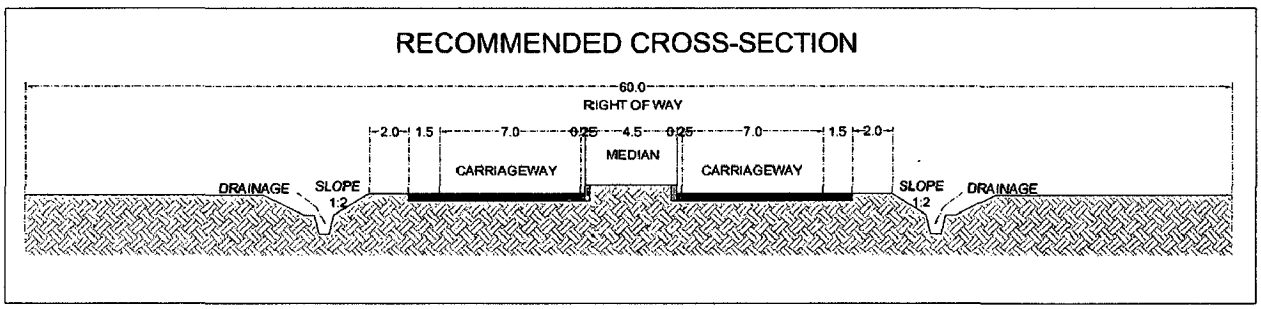


Figure 11: Recommended Cross-Section

2.7.3 Median Openings

Median openings shall be provided at four or more arm intersection and at other locations to facilitate the U-turn for vehicles and not for leading directly to any cross road. The average spacing of median openings shall be around 2 kms. If a number of roads are meeting the highway, then they would be joined together through a service road and an at-grade 'T' intersection would be provided such that the spacing of 2 kms for median openings is maintained.

All median openings shall be provided with additional 3.5 m wide shelter lane by the side of median in both directions for waiting of vehicles to take U turn. Wherever required, horizontal geometrics of the road shall be suitably adjusted. Length of median opening shall not be less than 20 m.

2.7.4 Underpasses

Vehicular Underpass

Wherever a cross road is proposed to be taken below the Project Highway, minimum clearances at underpasses shall be as follows:

Lateral Clearance

(i) Full roadway width at the approaches shall be carried through the underpass. This width shall not be less than 12 m (7 m carriageway + 2 × 2.5 m shoulder width on either side) or as indicated in Schedule-B.

(ii) Guardrails/crash barriers shall be provided for protection of vehicles from colliding with the abutments and piers and the deck of the structures.

Vertical Clearance

Vertical clearance at vehicular underpasses shall not be less than 5.5m.

Pedestrian & Cattle underpasses

The width of cattle and/or pedestrian underpass shall not be less than 5 m. And its vertical clearance should not be less than 3.0 m (to be increased to 4.5m, in case certain categories of animals such as elephant/camel are expected to cross the Project Highway frequently).

In urban / built up areas, pedestrian / cattle crossing facility shall be provided such that pedestrians do not have to walk more than 0.5 km to reach the underpass for crossing the Project Highway. In case the existing slab culverts and minor bridges with span length equal to or more than 5.0 m allow a vertical clearance of more than 2m, these can also be used for pedestrian and cattle crossings by providing necessary flooring, provided the culverts/minor bridges do not cater to perennial flow. In rural stretches, under passes shall be provided at the locations of existing crossing points.

2.7.5 Service Lanes

Local traffic in built up areas shall be separated with provision of service roads. Built up area shall mean all sections of the highway, which are situated within the limits of municipal town(s) and shall also include those sections having continuous length of 200 m or more in non-municipal areas where dwellings / shops have been built on one or both sides of the highway on at least 50 percent of the total length of each such section.

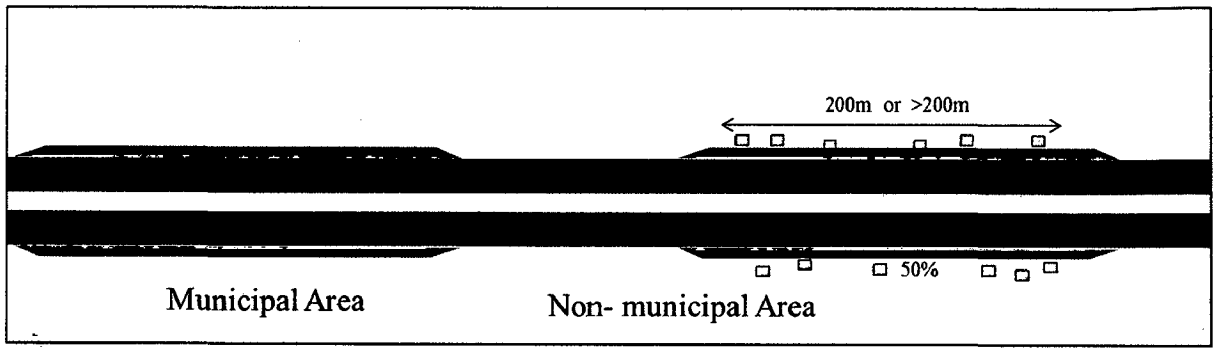
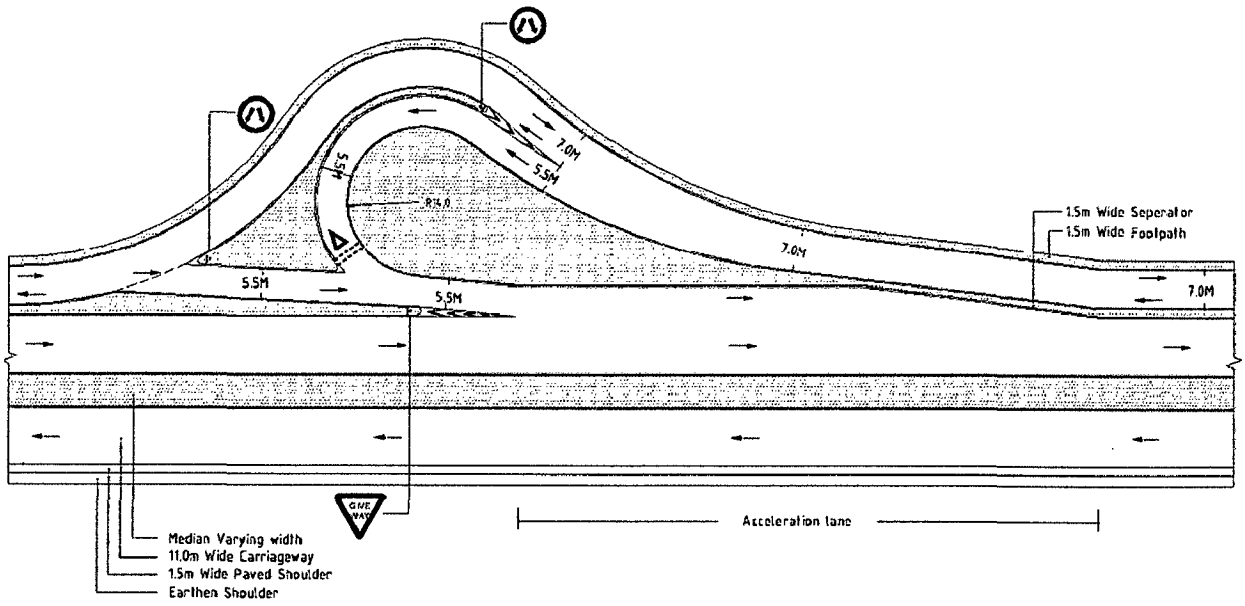


Figure 12: Requirement of service lane

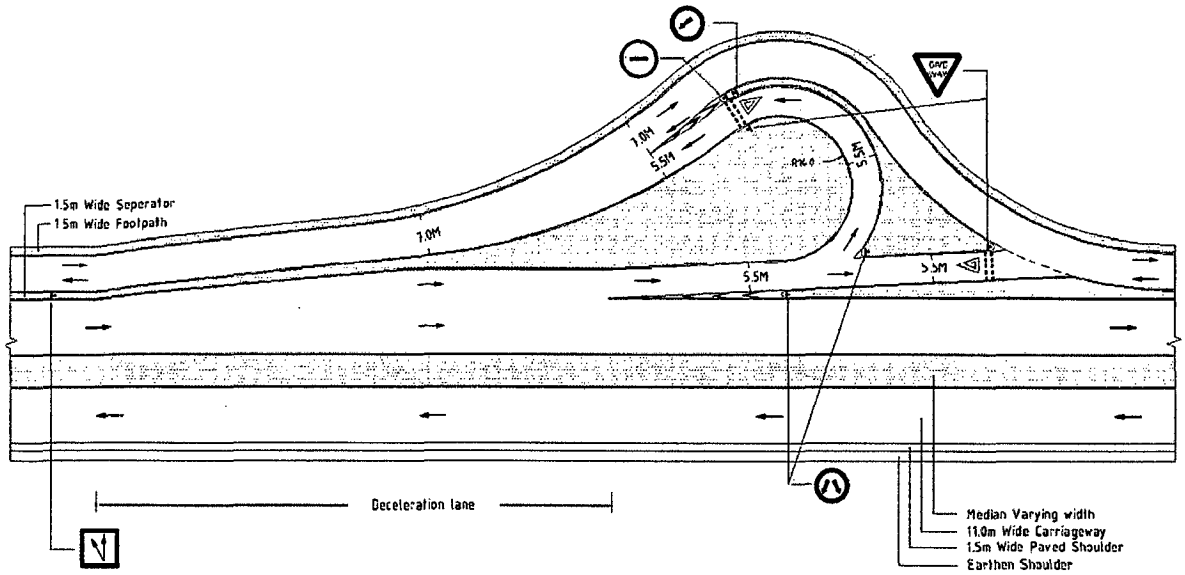
The width of the service road shall be 7.0 m. The service roads shall be provided with end treatment so that the local traffic is able to diverge from and merge to the highway in a safe & efficient manner as shown in Figure 13 to Figure 17.

For the stretches where total length of a bridge is less than 60 m and the service road is required to be provided on both sides of the stream, then the service road shall continue across the stream and suitably designed 2-lane bridge structure shall be provided. In cases involving bridges of 60 m length or more, separate bridge structures may not be provided and service road shall be merged with the Project Highway at 50 m distance before the bridge structure.



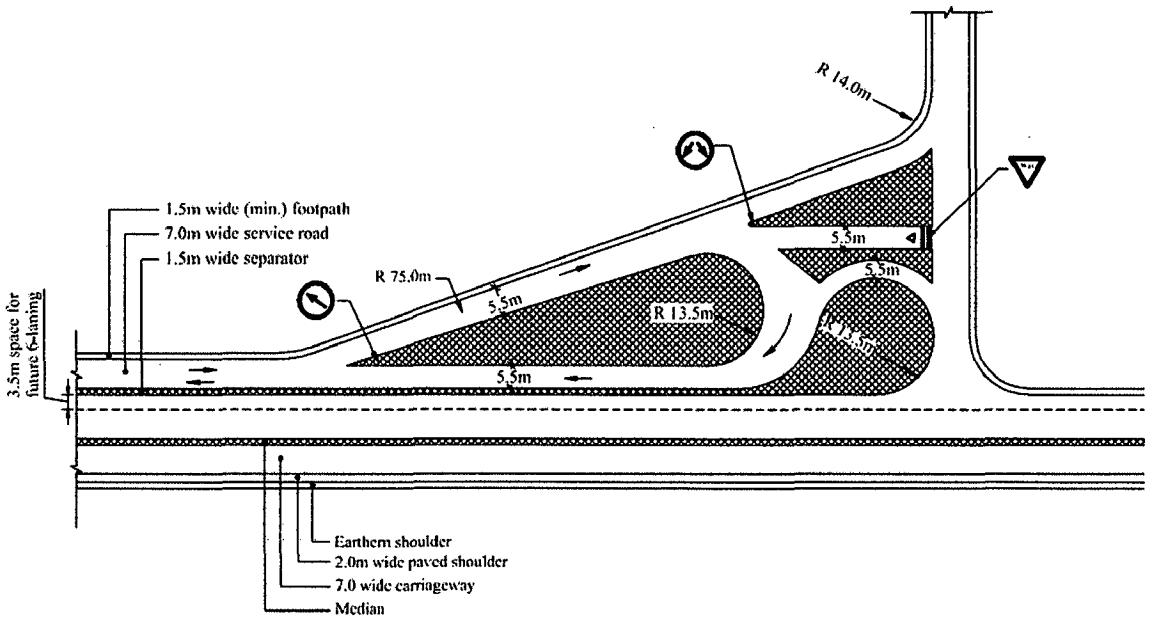
Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 13: Suggestive Layout for Entry Ramp to Highway



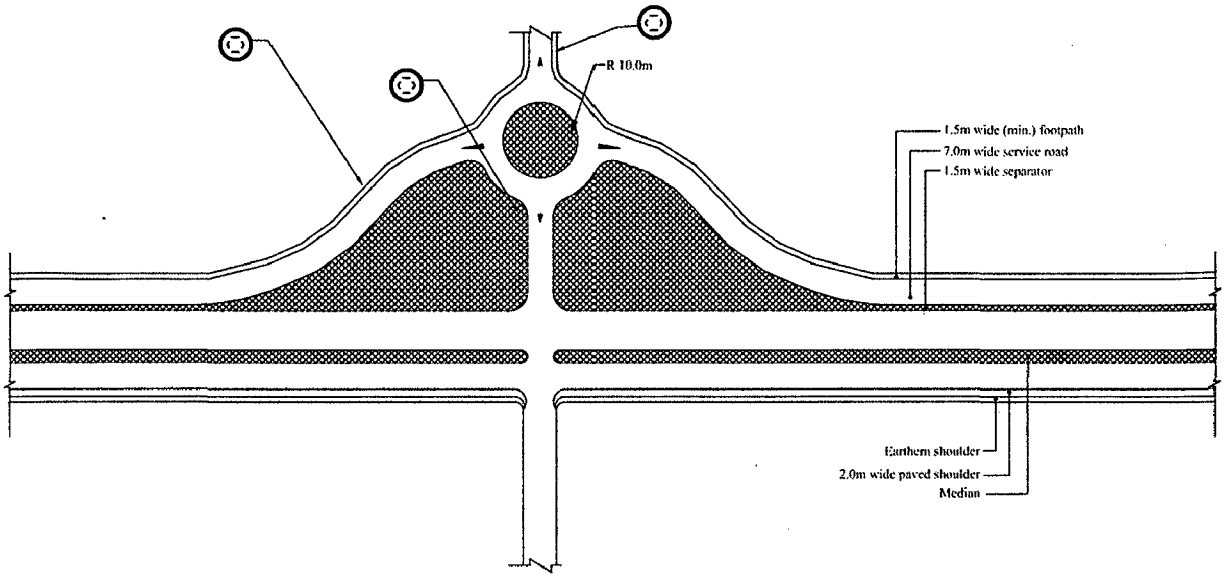
Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 14: Suggestive Layout for Exit Ramp from Highway



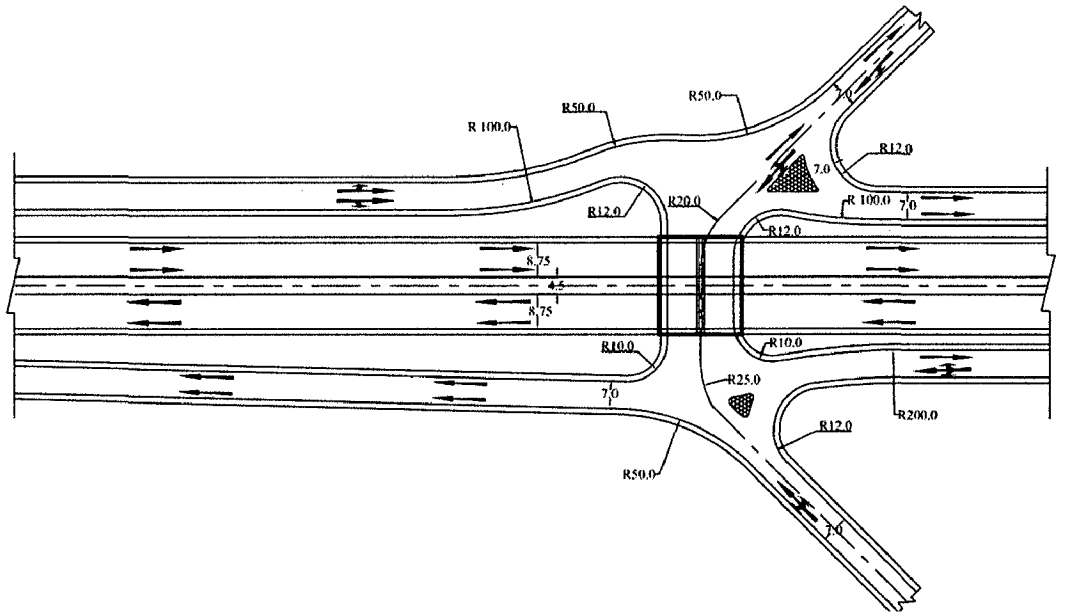
Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 15: Suggestive Layout of Service Road Ending at a Junction with Cross-Road



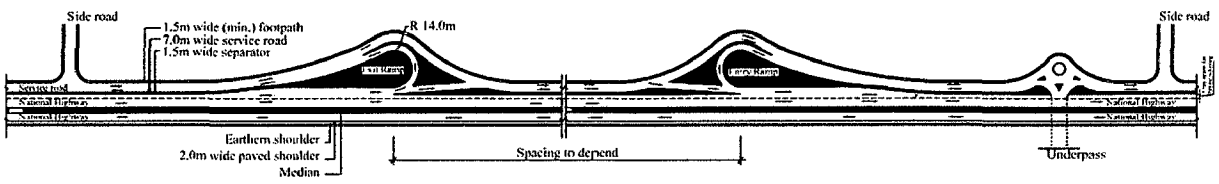
Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 16: Suggestive Layout for Service Road Continuing at Intersection



Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 17: Suggestive layout for connecting service road to underpass on cross road



Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 18: Suggestive Layout Showing Configuration of Service Road, Entry/Exit Ramps, Side Road and Underpass

2.7.6 Intersections

The intersections to be provided shall be one of the following types:

(i) At-grade Intersections

(ii) Grade separated Intersections without ramps

(iii) Interchanges

The types and locations of Intersections, Interchanges and Grade-separated Intersections without ramps shall be based on requirements stipulated in IRC:SP:41, IRC:5, IRC:92, MORTH Specifications for Road and Bridge works.

The existing intersections, which are deficient with respect to the minimum requirements shall be improved to the prescribed standards. Additional land, if any, required for improving the existing intersections shall be provided by the Authority.

At-grade Intersections

1. The type of intersections to be adopted shall be decided on the basis of parameters like number of intersecting legs, traffic volume/speed, type of traffic control etc. Properly designed intersections shall be provided at all at-grade crossings. Rotary shall not be provided.

2. (i) The intersections shall be designed having regard to flow, speed, composition, distribution and future growth of traffic. Design shall be specific to each site with due regard to physical conditions of the site available. The design of different elements of intersection shall be done as per IRC: SP: 41 "Guidelines on Design of At-grade Intersections in Rural and Urban Areas" including other criteria given in this Manual. MORTH-Type Designs for Intersection on National Highways may also be referred to, wherever required to develop suitable layout and design of At-grade Intersections.

(ii) At multi leg intersections, the points of conflict should be studied carefully and possibilities of realigning one or more of the intersecting legs and combining some movements to reduce the conflicting movements shall be examined. The object shall be to simplify the design and appropriate control devices added to ensure more efficient and safe operation.

(iii) The channelizing islands shall start from the edge of the paved shoulder. This principle shall also apply in case of MORTH – Type Designs for Intersections on National Highways.

3. Cross roads shall join directly on to service roads and the entry to and exit from the highway shall be through end connections as shown in figures given under service lane.

4. All intersections shall be designed as at-grade intersections in following manner:

a) All merging and diverging movements to / from the highway shall be either through service road with end treatment or acceleration and deceleration lanes except for the traffic allowed to cross highway at predetermined locations.

b) If the road is crossing the highway, the four arm at-grade intersection shall be designed in accordance with MOSRTH standard drawings. In case the standard drawing has not provided the right turning lane, the same would be provided to accommodate the peak hour right turning traffic.

c) If the road meets the highway at T- intersection, this would be designed as "left in left out". The right turnings from such cross roads shall be permissible at the next intersection or median opening.

Grade separated Intersections and Interchanges

1. Grade separated intersections, without ramps, shall be provided at locations where traffic on cross roads is moderate to heavy. Under this type, two cross roads separate at different grades (as Road Under Bridge or Road Over Bridge). The access from highway to the cross roads in case of such grade separated intersections without ramps, shall be through other existing roads/ service roads.

2. An interchange is justified at locations where traffic on cross road is heavy and an at grade intersection fails to handle the volume of turning, merging and diverting traffic.

3. Geometric Standards for design

The geometric design standards for various elements of grade separators shall be as given in IRC:92. Gradient for approaches shall not be steeper than 2.5 per cent (1 in 40).

4. Design of Structures

Design of structures shall conform to Section 7 of this Manual. Minimum length of viaduct required to be provided shall be specified in Schedule-B.

5. Lighting

Lighting requirement shall be as per Section 12 of this Manual. The top and underside of the grade separated structures and interchange area at the ground level up to 50 m beyond the point from where flaring of the main carriageway takes place shall be provided with lighting.

2.7.7 Pedestrian Crossing

The highway shall be provided with safe crossing facilities for the pedestrians. These shall be only at identified locations such as pedestrian /vehicular underpasses. Pedestrian safety guardrail shall be provided to guide the pedestrian to the selected crossing /identified locations. For this purpose some of the common locations could be bus stops or other such locations with a possibility of peoples congregation from where the pedestrian safety guardrail be provided up to the nearest at-grade intersection or sub-way. The design of these facilities shall be in accordance with IRC-103. At the crossing points drop in the curve shall be provided to facilitate crossing of physically challenge users. Similarly, the gaps in the channeliser shall be provided so as to avoid the need for frequent climbing and getting down from the channelisers.

2.7.8 Bus Bays and Passenger Shelter

1. General

The buses shall be allowed to stop for dropping and picking up passengers only at the bus bays. The bus bays shall conform to the specifications and standards given in manual.

2. Location

The location of the bus bays shall be fixed on the basis of following principles:

(i) The bus stops shall be sited away from bridges and other important structures and embankment sections more than 3 m high.

(ii) As far as possible, bus bays shall not be located on horizontal curves or at the summit of vertical curves.

(iii) The location shall have good visibility, not less than the safe stopping sight distance.

(iv) The bus bays shall not be located too close to the road intersections. A gap of 300m from the tangent point of intersections to start/end of the bus bay shall be desirable. At minor intersections (e.g. junctions with village roads), distance of 60m may be adopted. However, if a substantial volume of buses is to turn right at the intersection, it is necessary that the bus bay shall be located sufficiently ahead of the intersection so that the buses can be maneuvered easily from the pick-up stop on the left hand side to the extreme right lane for turning. The location of the bus bays may be fixed after due consultation with the local communities expected to use such facilities.

(v) At major four-way intersections involving transfer of a substantial number of passengers from one pick-up stop to the other, it might be desirable to construct a single, composite bus stop of suitable design to cater to all the bus routes collectively.

(vi) In hilly areas, the bus bays shall be located, preferably, where the road is straight on both sides, gradients are flat and the visibility is reasonably good (usually not less than 50 m). Subject to these requirements, it will be advisable to choose locations where it is possible to widen the roadway economically for accommodating bus bays.

(vii) Where grade separator is provided, the location of bus bays shall be as under

(a) Sufficiently away from the ground intersection.

(b) Sufficiently away from the longitudinal slope of the approaches.

(viii) The bus bay and passenger shelter shall be designed to provide for safe and convenient use by physically challenged persons as well.

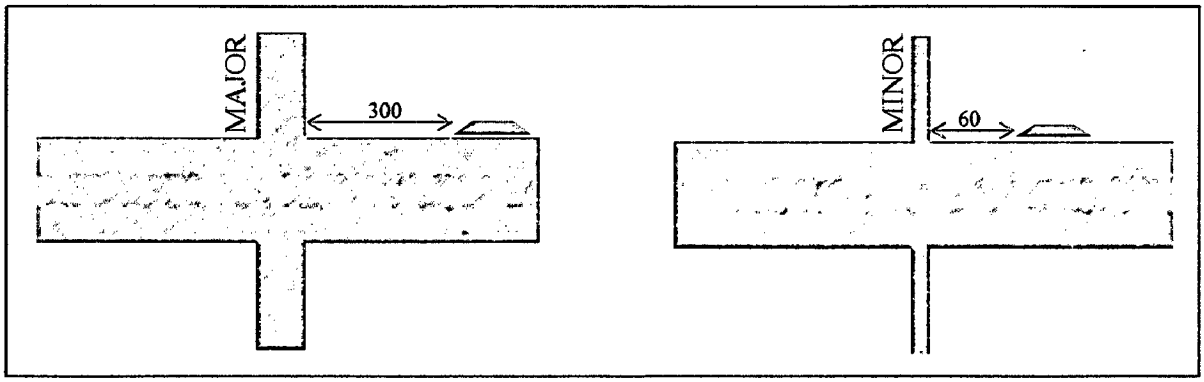
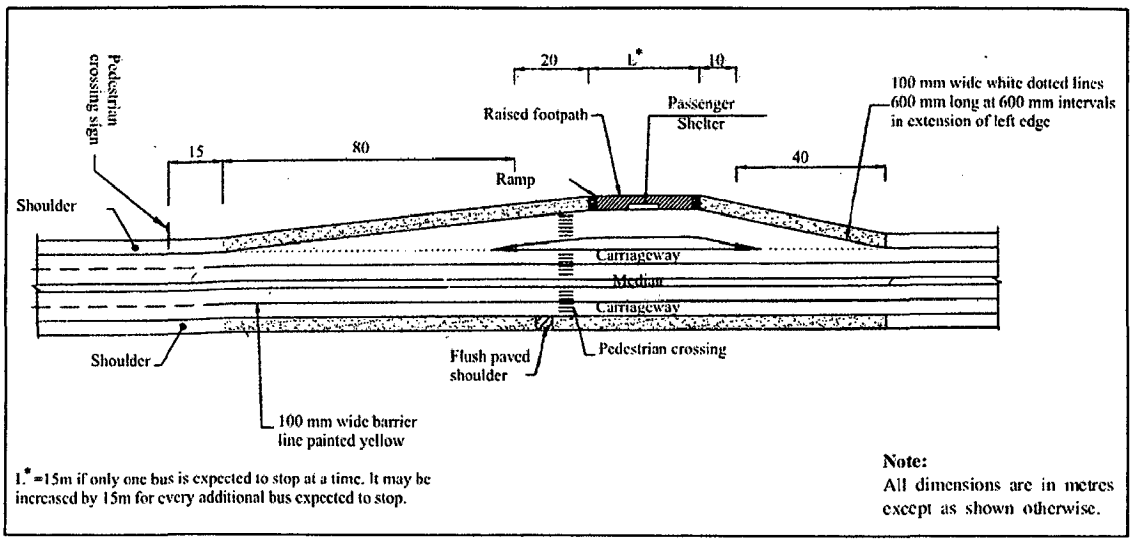


Figure 19: Location of Bus-stop w.r.t. Major & Minor Intersections

3. Layout and Design

(i) For plain area, typical layouts of bus bays given in Figure 20 shall be adopted. The length "L" shown shall be 15 m, which shall be increased in multiples of 15 m if more than one bus is likely to halt at the bus bay at one time.



Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 20: Layout of bus stop

(ii) The channelizing island between the paved shoulder and bus-bay shall not be raised; it shall be paved.

(iii) Bus bays shall be provided on both carriageways of the highway for each direction of travel independently. At intersections, the bus bays for up and down direction shall be located on farther sides of the intersection.

(iv) The bus bay shall be provided with a shelter for passengers. The shelter shall be structurally safe and aesthetic in appearance, while also being functional so as to protect the waiting passengers adequately from sun, wind and rain. If the shelter is constructed on the hillside, slopes shall be properly dressed and suitably protected to avoid slips. The shelter shall be set back from the kerb line by at least 500 mm.

4. Pavement

The pavement in the bus bays shall have adequate crust with respect to the wheel loads expected. Also, the surfacing shall be strong enough to withstand forces due to frequent braking and acceleration by the buses. The colour and texture of the bus bay surfacing shall be preferably distinctive from that of the main carriageway.

5. Drainage

(i) The bus bays shall have proper cross slope to drain off the excess water. No water, which is likely to splash on the waiting passengers, shall be allowed to collect near the bus shelters.

(ii) Suitable kerb gutter section with requisite longitudinal slope and outlets at intervals to ensure quick disposal of water shall be provided.

6. Road Markings

Pavement markings as specified in Section 9 of this Manual shall be provided at the bus stops with the word 'BUS' written prominently on the pavement. Pedestrian crossings shall be marked slightly behind the standing position of the buses in order to reduce pedestrian conflicts. The kerbs shall be marked with continuous yellow line to indicate "No Parking"

2.7.9 Truck Lay-byes

The Concessionaire shall construct and maintain adequate number and size of truck lay-byes for parking of trucks by the side of the highway. The guidelines, as given here, shall be followed in regard to location, size and facilities to be provided at the truck lay-byes.

Location and size

Truck lay-byes shall, in general, be located near check barriers, interstate borders, places of conventional stops of the truck operators, etc. The places be identified on the basis of field survey and shall have adequate space for facilities and for future growth.

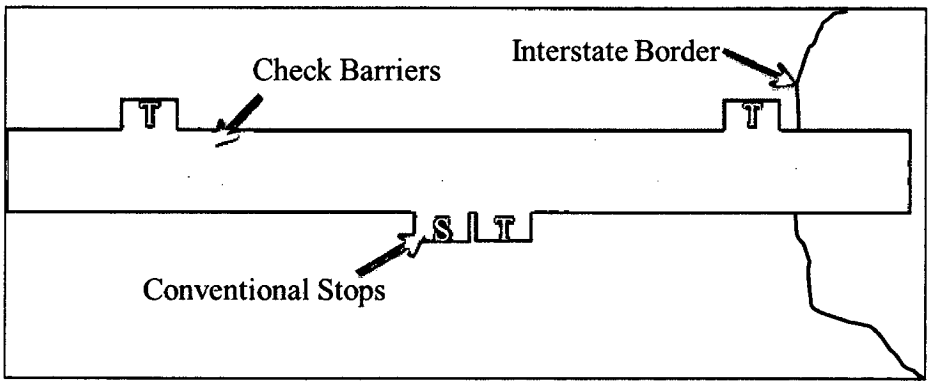


Figure 21: Schematic Diagram for the Location of Truck Lay-bye

Facilities

The truck lay-byes shall have the following facilities:

i. Paved parking,

ii. Rest areas with toilets, drinking water,

iii. Telephone.

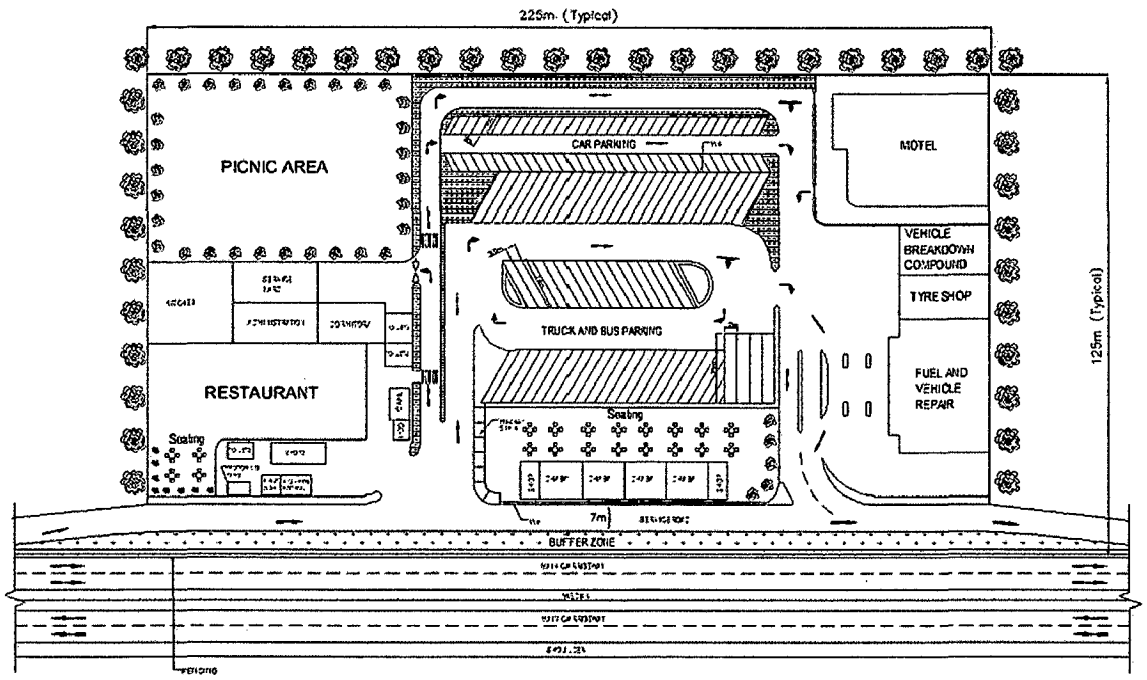
Lighting

The truck lay-byes and 50 m length of the highway on its either side shall be illuminated at night to provide a minimum illumination of 40 Lux. Suitably designed electric poles having aesthetic appeal and energy saving bulbs may be used to provide required illumination. Alternatively, photo voltaic lamps may be used.

2.7.10 Rest Area

Layout

Layout of the Rest area shall be as shown in the Figure 22. The location for the Rest areas shall be indicated in the contract document. The Rest area shall be provided on the lands included in the site and procured by the Authority. Within the areas so provided, the concessionaire shall construct and operate, or cause to be constructed and operated, paid facilities such as toilets, telephones, cafeteria, parking, etc.



Source- Manual for Specifications and Standards for 4-laning of NH through PPP

Figure 22: Typical Layout of Rest Area

2.7.11 Other Highway Facilities

2.7.11.1 Highway Patrol

The highway shall be provided with highway patrol unit(s) for round the clock patrolling so as to provide assistance to the users in case of any need, monitor the travel conditions to provide information to the control section and to undertake immediate measures for managing the traffic flow in case of any incident.

2.7.11.2 Ambulances

The highway shall be provided with ambulance services so that the response time is not more than 10 minutes of the call.

2.7.11.3 Cranes

The highway shall be provided with cranes with capacity to tow-away the disabled vehicles. Cranes shall be available at the site of the incident within 30 minutes of call to clear the disabled/accidented vehicles.

2.7.11.4 Telecom System

A Telecom System shall be provided at Toll plaza location with all necessary equipment as specified in manual.

2.7.11.5 Medical Aid Posts

Medical Posts shall be established at Toll Plaza locations in accordance with the manual.

2.7.11.6 Highway Traffic Management Systems (HTMS)

A real time system working round the clock shall be established for informing the road users of the road, traffic, and weather conditions on the highway when the daily traffic exceeds 40,000 PCUs; for making interventions as required for smooth, safe and efficient traffic operation; and for providing rescue and relief to the users in distress. The system shall be capable of

i. acquisition of data from various sources such as the road, the users, the maintenance and operation patrol, the ambulance, and the intervention team
ii. three way communication between the data source and a Central Control Room, the Control Room and the data sources and display units, and between the maintenance and operation teams, through a transmission system, and
iii. a Central Control Room to process all data and control the highway operation.

2.7.12 Plantation

Set-back distance of trees and other plantation

Trees on the roadside shall be sufficiently away from the roadway so that they are not a hazard to road traffic or restrict the visibility. Most vulnerable locations in this regard are the inside of curves, medians, junction corners and cut slopes. Trees shall be placed at a minimum distance of 14 m from the centre line of the extreme traffic lane to provide recovery area for the vehicle that runs off the road. A second row of trees 6m further away will also be planted wherever possible. Preferably the first row of trees shall consist of species with thick shade and other rows of vertical type providing thin shade. Expansion of the Project Highway to 6-lanes shall be taken into consideration while locating the trees so that land is free of trees when further widening takes place. The distances for alternative rows of trees shall be reckoned from the nearest edge of the unidirectional carriageway. No plantation shall be allowed on the embankment slopes.

Plantation in medians

In the sections of the Project Highway where median width is more than 3 m, shrubs shall be planted and maintained to cut off headlight glare from traffic in the opposite direction. Flowering plants and shrubs are eminently suited for the purpose. These shall be planted either in continuous rows or in the form of baffles. The height of shrubs shall be maintained at 1.5m to cut off the effect of traffic lights coming from the opposite direction.

In the sections, where the width of median is less than 3 m, shrubs or flowery plants may be planted in between crash barriers or other means like metal/plastic strips to cut off glare shall be provided.

The shape of shrubs and plants shall be suitably regulated so that there is no overgrowth either vertically or horizontally beyond the edge of the paved median.

In the vicinity of road intersections and median openings, median plantation shall be avoided or restricted to low-growing varieties to ensure adequate visibility.

2.7.13 Operation & Maintenance Center

There shall be operation and maintenance centre(s) either at the toll plaza(s) or at any other location along the Highway. The operation and maintenance centre would have following minimum facilities:

(i) Main control centre and Administrative block.

(ii) Equipment for operation and maintenance and storage space for them.

(iii) Storage space for equipment and material for traffic signs and markings.

(iv) Workshop.

(v) General garage and repair shop.

(vi) Testing laboratory.

(vii) Parking space for minimum 4 number of large vehicles and for other expected vehicle during peak hours including those for working staff and visitors.

2.7.14 Fuel Station from Letter No. RW/ NH-33023/19/99-DO-IIIdated 25.09.2003

According to the letter, numbered RW/ NH-33023/19/99-DO-IIIdated 25.09.2003 from Ministry of Road Transport and Highways, Government of India, the Norms for the Access for Fuel Stations should be as follow:

Generally speaking, the fuel stations should be a part of the Rest Area complex. Rest areas should have various other amenities for users e.g. place for parking, toilets, restaurant, rest rooms, kiosk for selling sundry items etc. This aspect should be incorporated while planning for improvement and up gradation of the National Highway Sections and / or planning for new fuel stations along National Highways. The rest area complex be planned subject to the commercial viability.

In case of service roads having been constructed, the access to the fuel station shall be from service roads and not from the main carriageway. This aspect has to be kept into consideration while planning for location of new fuel stations.

Minimum Distance from Intersection

For the siting of fuel stations along National Highways, its minimum distance from an intersection would be:

For Plain and Rolling terrain

Non-Urban (Rural) Stretches

(i) Intersection with NHs/SHs/MDRs	1000m
(ii) Intersection with Rural Roads with carriageway width of 3.5m or more	300m

(iii) Intersection with Rural Roads and all other earth tracks with carriageway width less than 3.5m. 100m

Urban Stretches

(a) Urban Area with population of more than 20,000 and less than one lakh.

(i) Intersection with any category of roads of carriageway width of 3.5m and above. 300m

(ii) Intersection with roads of carriageway width of less than 3.5m 100m

(b) Urban Area with population of one lakh and above.

(i) Intersection with any category of road (irrespective of carriageway width) 100m

Minimum Distance between Two Fuel Station

The minimum distance between two fuel stations along the National Highway would be as given below:

Plain and Rolling Terrain in Non-urban (Rural) Areas

(i) Undivided carriageway (for both sides of carriageway) 300m
(including deceleration and acceleration lanes)

The distance from check barrier/toll plaza would be at least 1 km and no check barrier/toll plaza would be installed within 1 km of fuel station/rest area.

Minimum plot size of fuel station shall be 35 m (frontage) X 45 m on divided carriageway in plain/rolling terrain. While planning the layout for various facilities inside the fuel stations, it has to be ensured that fuel pumps are located beyond Building Lines and Fuel Station office building etc. at a safe distance as prescribed by Fire Department or other authorities. The buffer strip would extend minimum 3m inside the Fuel Station plot, beyond ROW. Building Lines should be taken as 80m in plain and rolling terrain.

The Oil Company / owner shall have to enter into an Agreement for the license deed with the Government (Ministry of Road Transport and Highways –MORTH), for the use of NH land. There would be onetime fee of Rs. 1 lakh in consideration of this Agreement. The validity of the Agreement would be for a period of 15 years.

Access to Fuel Station

The entry to fuel station shall be through deceleration lane of minimum length of 70m and width of 5.5m, the exit through acceleration lane of minimum length of 100m and width of 5.5m as given in Figure 23.

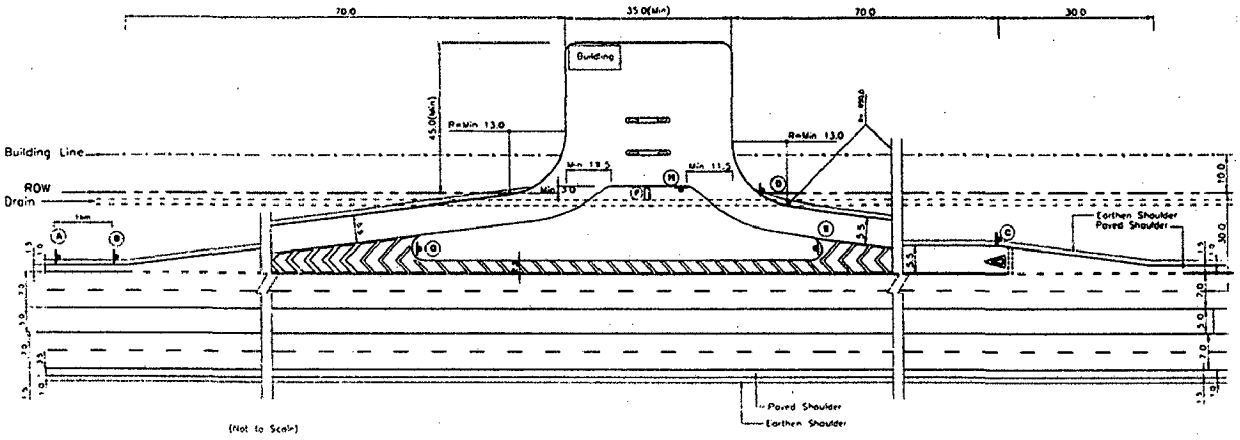


Figure 23: Access to Fuel Station on Divided Highway

The access lanes, service road and separator island in the layout would be accommodated within the available ROW of the highway but fuel pumps would be located beyond Building Line. The fuel station office building etc. shall be located at the safe distance as prescribed by the Fire Department or other authorities.

General Conditions of Siting

While considering the proposal for new fuel stations, it would be ensured that the fuel stations on a corridor are well distributed on both sides of the highways so that vehicles normally do not have to cut across the traffic to reach them. The fuel stations would be serving only the traffic moving on the adjacent lane. For the vehicles traveling in the lanes in opposite direction, separate fuel stations need to be planned for which permission would be considered keeping also in view of its location and distance norms.

In order to provide safe length for weaving of traffic, fuel station along National Highways shall be located at the minimum distance from an intersection (gap in the central median be treated as intersection).

If two or more fuel stations are to be sited in close proximity for some reasons, these would be grouped together to have a common access through a service road of 7.0 m width and connected to the highway through acceleration, deceleration lanes, as given in Figure 24.

From these considerations, the permission for the new fuel stations would be considered only if it is either in proximity to the existing one so that the common access can be provided or the new one located at the distance of more than 1000m.

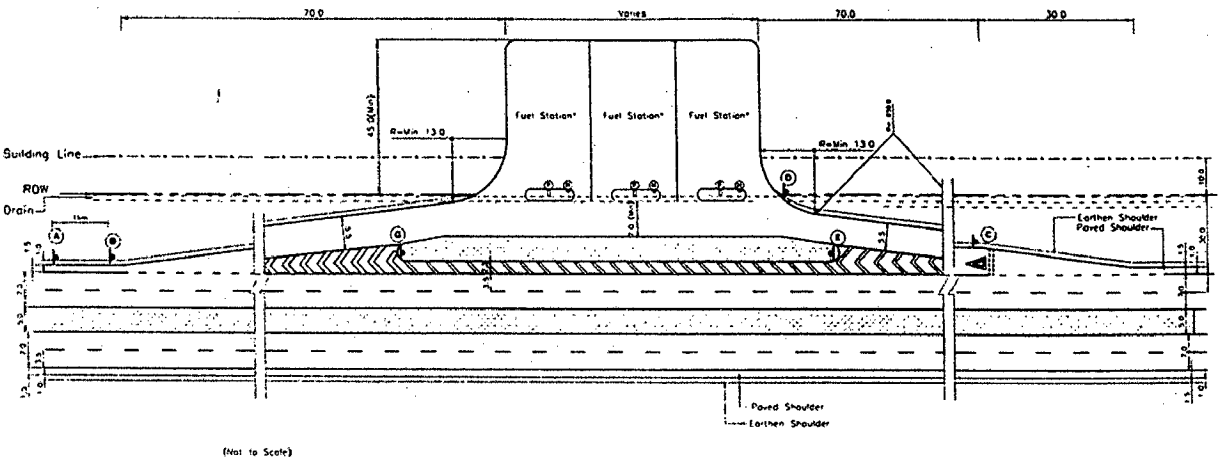
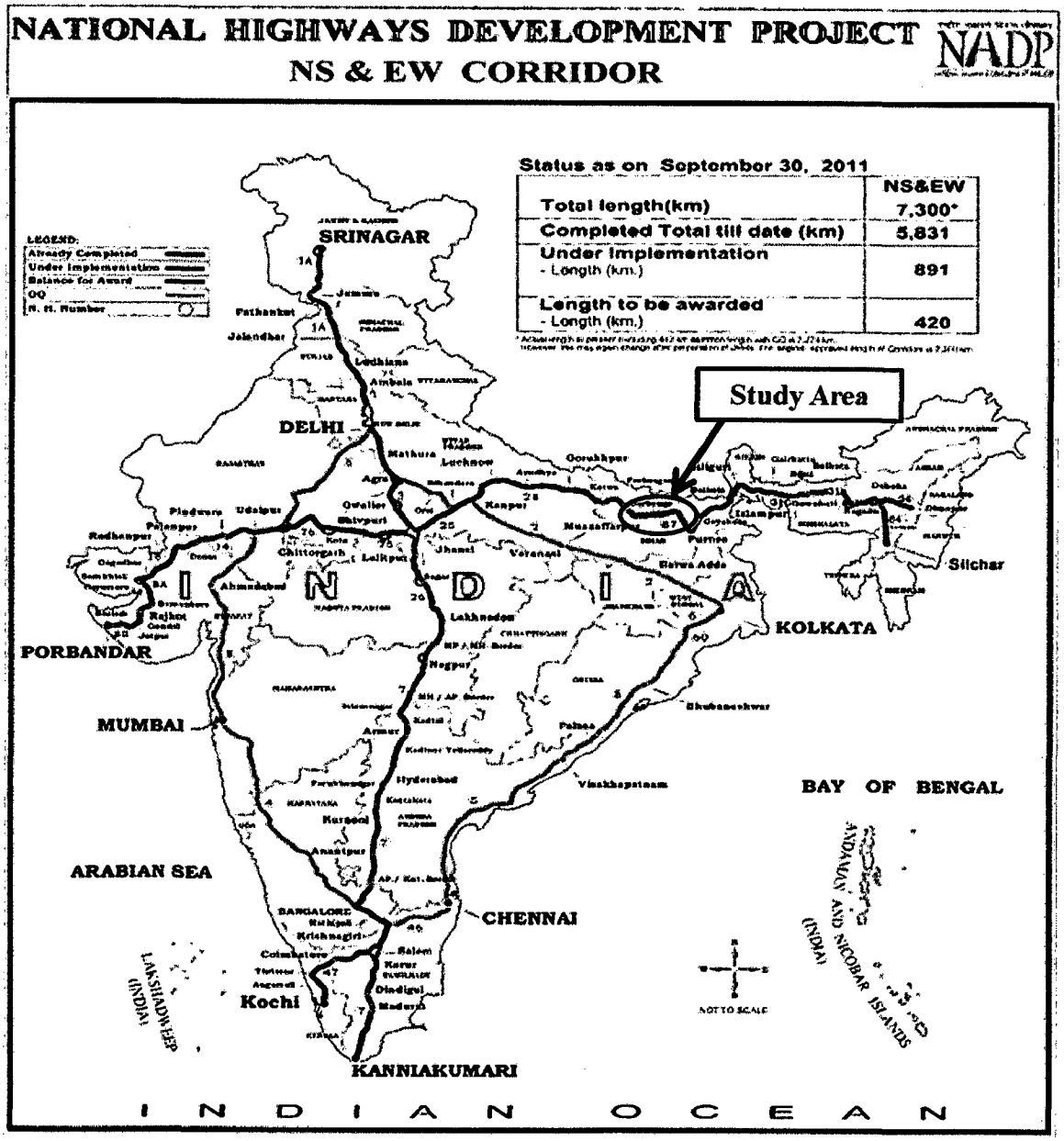


Figure 24: Access to Continuously Placed Fuel Stations on Divided Highway

For installation of new fuel station within the 1000m distance of existing fuel station in plain/rolling terrain and 300m in hilly/mountains terrain and urban stretch, new entrant would be responsible for construction and maintenance of the common service road, deceleration & acceleration lanes, drainage and traffic control devices.

CHAPTER - 3 STUDY AREA

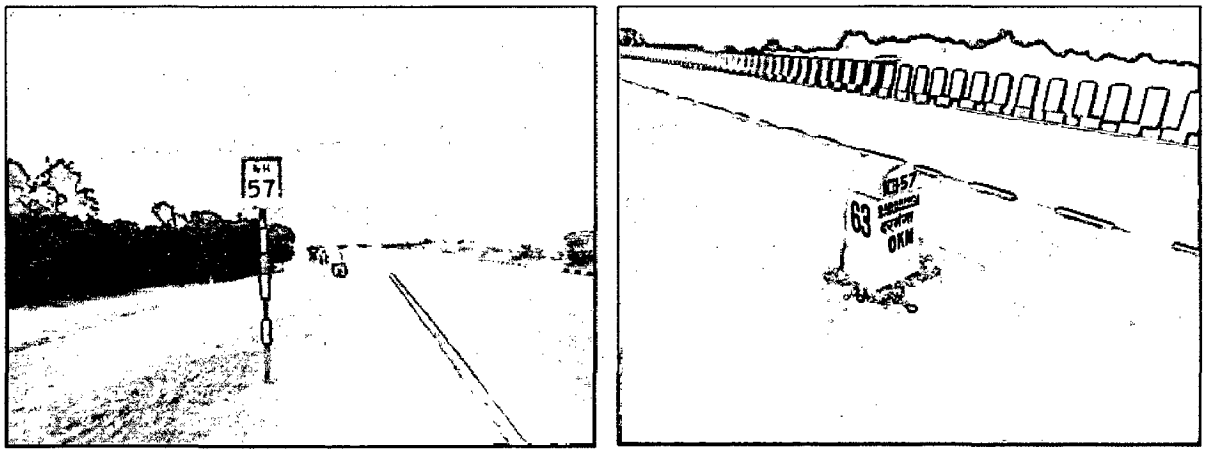
E-W Corridor between Darbhanga and Muzaffarpur has been taken as the study area. This is shown in Figure 25. East-west Corridor connects the Porbandar in Gujrat to Silchar in Arunachal Pradesh, the easternmost motorable point of India. It meets with Golden Quadrilateral at Agra and North-south Corridor at Indore, so that the entire country can be easily accessed. As of now, more than 90% of the construction work on this highway is complete. The new widened highway has increased the connectivity between the town of Darbhanga and Muzaffarpur significantly, reducing the travel time to half.



Source- www.nhai.org

Figure 25: Study Area w.r.t. Map of India

Study area is a part of NH 57 which runs from Muzaffarpur to Purnia, for a length of 310 km conncecting six northern districts of Bihar, namely Muzaffarpur, Darbhanga, Madhubani, Supaul, Araria and Purnia.

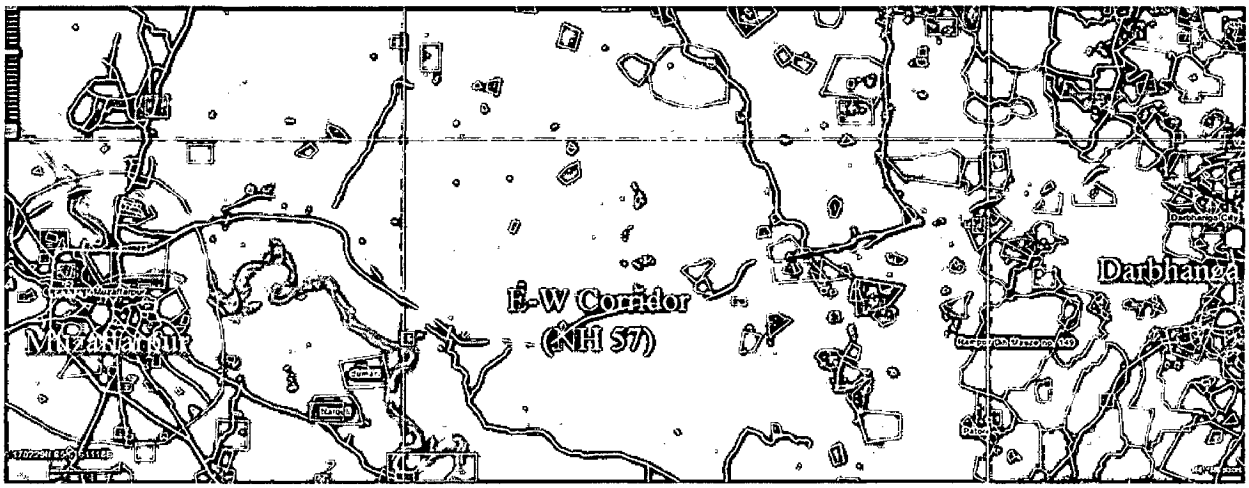


Source- author

Figure 26: National Highway 57, a part of E-W Corridor

3.1 LOCATION & LENGTH

The starting point of the study area is the junction of NH57 with NH105 in Darbhanga and the ending point is the chainage 0.00 km of NH57 i.e. Chandani Chock junction in Muzaffarpur, from where onwards NH28 continues as E-W Corridor. The geographical cordinates of the starting point is $26^0$11'12" N & $85^0$54'05" E while that of ending point is $26^0$09'16" N & $85^0$20'28" E. This 63 km long highway in the study area, conncets two districts i.e. Muzaffarpur and Darbhanga. This is shown in Figure 27.



Source- www.wikimapia.org

Figure 27: Study Area

The part of NH 57 within the study area has been constructed by NHAI, under the two Package BR-8 & BR-9. The highway has been constructed on EPC (Engineering, Procurement and Construction) model which is fully funded by NHAI. The Contracting Agency for the two package is M/s B. Seenaiah & Co. (Projects) Ltd. - C & C (JV) and the Supervision Consultant is M/s Scott Wilson Kirkpatrick India Pvt. Ltd where as the drawings are prepared by Mahendra Raj Consultants, New Delhi.

Table 6 shows the the old length of NH 57 and its new length and the total length consturted under four laning.

Table 6: New Alignment and Old Alignment of NH 57

Package No	New alignment (in Km)	Old alignment (in Km)	Total
BR-8	7.00	25.05	32.05
BR-9	9.90	27.85	37.75

Source- Monthly Progress Report

Out of the total length of 63 km within the study area, the old length of NH 57 is 49.85 km while the new bypass has been constructed for 13.15 km during the four laning.

The work of four laning started on 28th Jan 2006 while it has been completed on 31st May 2011. During the four laning, a new two-way road parallel to the existing road has been constucted on RHS while the existing road on LHS has been upgraded to two-lane configuration thus making it a four lane National Highway. This is shown in Figure 28.

Phases of Four Laning

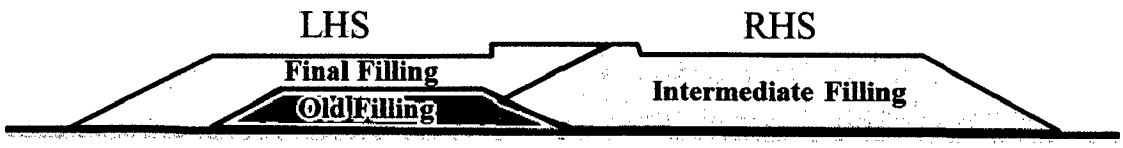
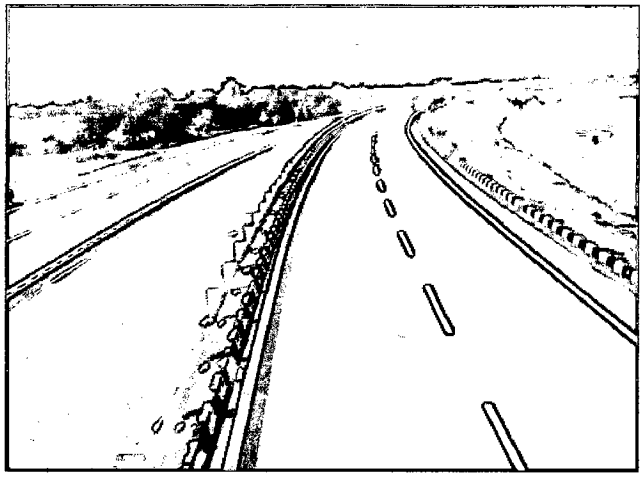


Figure 28: Method of Soil Filling During Four Laning

Although, at some places, the final filling as shown above, has been escaped. This is shown in Figure 29.



Source- Monthly Progress Report

Figure 29: Picture showing LHS & RHS of NH 57

3.2 DISTRICT PROFILE

The highway connects two major district of North Bihar, i.e. Darbhanga and Muzaffarpur. Darbhanga is one of the oldest towns of Bihar and is the Capital of Mithilanchal region whereas Muzaffarpur is the commercial center of North Bihar. As commercial point of view, there are four regions in Bihar which covers the commercial activity in the entire state and Muzaffarpur is one of them. All the regional offices of banks, insurance company, etc. are located in Muzaffarpur and for that matter Darbhanga comes in Muzaffarpur region.

The population and the area of two districts is given in Table 7.

Table 7: Area & Population of Darbhanga & Muzaffarpur District

District	Area (sq km)	District Polulation (2011)	Population Density
Darbhanga	2279	3921971	1721 per sq km
Muzaffarpur	3173	4778610	1506 per sq km

Source- www.census.gov.in

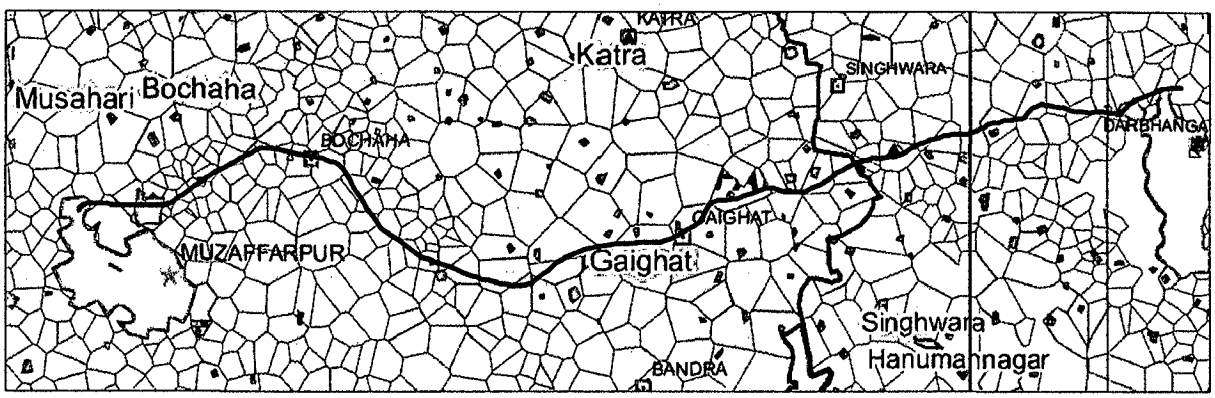
3.3 ADMINISTRATIVE BOUNDARY

As discussed above, the study area of 63 km falls within the jurisdiction of two districts. The district name, block name and police station for the various section of highway is given in Table 8 and a GIS map is shown in Figure 30.

Table 8: District, Blocks & Police Station jurisdiction of various section of highway

S. No.	From Chainage	To Chainage	District	Block	Police Station
1	0+000	5+000	Muzaffarpur	Kanti	Kanti
2	5+000	8+000	Muzaffarpur	Mushari	Mushari
3	8+000	24+200	Muzaffarpur	Bochaha	Bochaha
4	24+200	37+750	Muzaffarpur	Gaighat	Gaighat
5	37+750	45+096	Muzaffarpur	Giaghat	Giaghat
6	45+096	54+876	Darbhanga	Singhwara	Simri
7	54+876	57+837	Darbhanga	Sadar	Sadar
8	57+837	58+122	Darbhanga	Bahadurpur	Sadar
9	58+122	62+890	Darbhanga	Kewati	Sadar
10	62+890	69+800	Darbhanga	Sadar	Sadar

Source- Monthly Progress Report



Source- www.gis.nic.in

Figure 30: GIS Map showing Administrative Boundary

3.4 SETTLEMENTS

There are total ten major settlement located along the highway in the study area of 63 km. The name of the major settlements are given below:

Garha, Majhauli, Sharfuddinpur, Gaighat, Keosta, Atarbel,

Beniabd, Simri, Bastawara & Mabbi Village

Figure 31 shows the location of settlements w.r.t. highway.

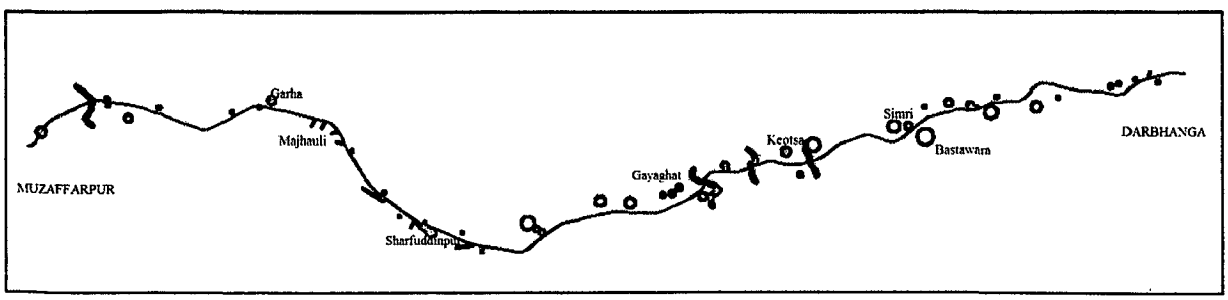


Figure 31: Settlements along the Highway

3.5 CONNECTIVITY TO STUDY AREA

The highway between the study area meets with four-lane NH 28 at Km 0.00. While NH 77 crosses it at Km 6.00, NH 105 originates from it at Km 63.00. A railway line is crossed by it in the district of Darbhanga. Several other State Highways, MDR, DR, REO Roads and Village roads are either connected to NH-57 or crossing it at different locations.

The airport at Darbhanga is located just 1 km away from the highway, but it is not used for commerical purposes. The commerical airport is at Patna, almost 90 km away from the starting point of NH 57.

3.6 GEOGRAPHIC FEATURES

3.6.1 Terrain

The entire stretch within the study area passes through the plain terrain with an average altitude of 52 m. The water table is about 8 m.

3.6.2 Land

The study area is located in North Bihar in the very heart of Mithilanchal having fertile alluvial plains of North India. There is no forest area in the road stretch. The land utilization pattern indicates that 78% of total geographical area in Muzaffarpur and 82% in Darbhanga district are cultivated. Paddy is the main crop cultivated in Kharif season. Other crops are wheat, maize, pulses, oilseeds, sugarcane & marua. The study area has trees like Mango, Sisao, Litchi, Jackfruit, Jamun, Guava, and Palm etc.

Dense population, agriculture based economy, absence of big and small industries and the resultant migration of manpower has led to the weak state of economy in the study area. The per capita income of the people in Darbhanga and Muzaffarpur districts are Rs. 4272 and 4198 respectively as per data with the local administration.

3.6.3 Soil

The soil of the study area is mainly alluvial soil, which comes under sandy loam clayey soil category. The soil of the area may be divided into three types, balsundri, a sandy loam banger or chikua, a clayey soil with an admixture of sand and marinara, a clay soil with little or no sand. The soil in the stretch comes under banger or chikua type i.e. clayey soil with an admixture of sand. The soil is highly fertile and excellent for cultivation of vegetables and cereal crops.

3.6.4 Climate

The study area enjoys a dry and healthy climate. There are three well-defined seasons, the winter, the summer, and the rainy season. The cold weather begins in November and continues up to February, though March is also somewhat cool. May is the hottest month when the temperature goes up to 45^0 C. Rain sets in towards the middle of June and temperature falls and humidity rises. The rain continues till the middle of October. Average rainfall is 1164 mm and around 92% of rainfall is received during the monsoon months.

3.6.5 Temperature

In Muzaffarpur district the mean maximum temperature is 44.57 degree Celsius in the month of May and mean minimum temperature is 4.70 degree Celsius in January. Similarly, in case of Darbhanga district the mean maximum temperature is 42.91 degree Celsius in the month of May and means minimum temperature is 5.20 degree Celsius.

3.6.6 Rainfall

The study area enjoys good rainfall with an annual average of 1164 mm. The rainfall in the monsoon season from June to September constitutes about 83 percent of the annual rainfall. Generally the rainiest month of the year is July and highest rainy days are in the month of August. The lowest rainy days are in the month of January. On an average there are about 52 rainy days in a year. Winter rains are rare.

3.6.7 Rivers

There are four rivers in the study area. While the three crosses the highway once, Bagmati crosses it twice. The location of rivers is given in Table 9.

Table 9: Location of Rivers Enroute

River	Chainage
Budhi Gandak	3.8
Siyari River	28.3
Bagmati	40.2
Sobhan	54.9
Bagmati	59.1

Source- Monthly Progress Report

3.7 BENEFITS OF FOUR LANING OF NH 57

4-Laning and rehabilitation of NH 57 meets the longstanding development and strategic needs of the remote northern region of Bihar. In addition to providing smooth flow of uninterrupted traffic from East to West, it is helping to connect West Champaran districts with eastern most district of Kishanganj of Bihar by a much shorter and convenient route. It is also providing an alternate and shorter route between the eastern districts of Uttar Pradesh and the northern districts of West Bengal. This road has reduced the travel distance for through traffic from Assam/North Bengal to central India. The 4-laning is providing the following advantages: -

- Employment generation in rural areas.
- Uplift of rural people living below poverty line.
- Generation of small scale fruit canning industries/agro processing industries like Litchi, Mango, Makhana etc.
- Saving in time, cost of fuel and the maintenances of vehicle etc.
- Better communication between production units and market for agriculture and industrial goods.
- Improvement in quality and standard of living.

CHAPTER - 4 DATA COLLECTION

4.1 PRIMARY DATA

4.1.1 Traffic Survey

Location and time of traffic survey- Traffic survey was conducted by the author at vaious location in the study area. The location were choosen based on the influence of nearest city on the highway and presence of major rural settlement along the highway. The location and time of traffic survey are given in Table 10.

Table 10: Location & Time of Traffic Survey

Survey Location	Survey Date	Survey Time
@ 55 km	26-Feb	9:02 AM
@ 55 km	26-Feb	5:16 PM
@ 63 km	26-Feb	5:45 PM
@ 63 km	26-Feb	5:55 PM
@ 55 km	27-Feb	9:33 AM
@ 55 km	27-Feb	12:07 PM
@ 55 km	28-Feb	12:11 PM
@ 9 km	28-Feb	1:51 PM
@ 9 km	28-Feb	2:01 PM
@ 0 km	28-Feb	2:34 PM
@ 0 km	28-Feb	2:45 PM
@ 36 km	28-Feb	4:28 PM
@ 55 km	28-Feb	5:17 PM

The survey location was choosen at chainage of 55 km since this place is outside the influence of city area where the rural character dominates. The chainage of 0 km and 63 km are the extreme ends of the study area. Chainage 9 km was choosen since the road coming from the important town in the region, Muzaffarpur, meets here with the highway. Chainage 36 km is the major junction where road leading to the major rural settlement connects to highway.

Tools used in survey- High resolution (8 megapixel) digital video recording camera and a stopwatch with a precision of 0.5 sec.

Methodology of traffic survey- The survey was conducted for a interval of 10 minutes. A high resoulution camera with a recording facility was placed on the edge of the highway, from where the traffic on both the sides of the highway were clearly visible without any obstruction. The camera was placed on a elevted firm surface so that it not shake with the

movement of heavy vehicles. The video recoding of the traffic was started and the time of start was recorded in the stop watch. Exact after 10 minutes of the start of video, it was stopped. Now this video was played on the compatible player in computer and details of traffic was filled in the traffic survey form. The help of digital technology in the traffic survey was taken to completely eliminate the manual error.

TRAFFIC SURVEY DATA SHEET

Survey Time	Survey Date	Traffic Direction	Survey Location	Type of Vehicles																					
				Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV (Jeep)	LCV (Auto 4 Wheel)	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck (2 Axle)	Truck (3 Axle)	Truck (4 Axle)	Truck-trailer	Agricultural Tractor	Agricultural Tractor-...	Cycle	Cycle Rickshaw	Hand Cart	Horse-drawn Vehicle	Bullock Cart	Pedestrian
9:02 AM	26-Feb	RHS	@ 55 km	13	8		3			1		2		3	1	1			2	10					
9:02 AM	26-Feb	LHS	@ 55 km	13	8	2	3	1	3		1	1	1	1	5	4	1		1	10	3	1			1
5:16 PM	26-Feb	RHS	@ 55 km	20	9	4	2	1		2				2	11	7				10	1				
5:16 PM	26-Feb	LHS	@ 55 km	21	19	2	2			2		2	2	1	6					13					
5:45 PM	26-Feb	RHS	@ 63 km	18	18	2						2		2	6	2	2		2	8					
5:45 PM	26-Feb	LHS	@ 63 km	10	2					4		4	2	4	4					22					
5:55 PM	26-Feb	RHS	@ 63 km	14	4					2					4	2				4	2				
5:55 PM	26-Feb	LHS	@ 63 km	8	16			2				4		4						16					4
9:33 AM	27-Feb	RHS	@ 55 km	20	7	1	1	1	2	3	1	2	1	4	1	1			1	4					
9:33 AM	27-Feb	LHS	@ 55 km	27	11	4	4	1	2	3		1							2	12					
12:07 PM	27-Feb	RHS	@ 55 km	24	8	2	4	1		1	1	1		3	1				1	8	1			1	
12:07 PM	27-Feb	LHS	@ 55 km	30	10	2	5	1	1	3	1	3			7	3				16					
12:11 PM	28-Feb	RHS	@ 55 km	11	10	1	1	1		1		3	2	2	1	1			1	6					
12:11 PM	28-Feb	LHS	@ 55 km	34	7	5	4			3		1		7	2				2	10					1
1:51 PM	28-Feb	RHS	@ 9 km	5	4	4						1	1	5	4					1					1
1:51 PM	28-Feb	LHS	@ 9 km	6	4	3						2		1	1					1					2
2:01 PM	28-Feb	RHS	@ 9 km	31	12	8	1		2	3		3	2	1	2	2				5					
2:01 PM	28-Feb	LHS	@ 9 km	67	9	15				4		1	1	1	2					29	1				
2:34 PM	28-Feb	RHS	@ 0 km	8	8	2		1			1			7	9	1			2	2					
2:34 PM	28-Feb	LHS	@ 0 km	5	5	4								3	4	4				5					
2:45 PM	28-Feb	RHS	@ 0 km	4	12									6	8	2									
2:45 PM	28-Feb	LHS	@ 0 km	6	4	6				2					2		2								
4:28 PM	28-Feb	RHS	@ 36 km	22	4	6	4	2				2	2	6	4										
4:28 PM	28-Feb	LHS	@ 36 km	18	4	6		2		4					2				2	2					
5:17 PM	28-Feb	RHS	@ 55 km	23	11	4	2	1		1	1	1	2	3	8	2				17	1				
5:17 PM	28-Feb	LHS	@ 55 km	17	5	2	3			3	1	3	1	1		2			1	8					

4.1.2 Traveller's Survey

A survey was conducted for the travellers on the highway. The sample size was taken as 100. The various numbers of vehicles surveyed is given in Table 11.

Table 11: Number of Various types of Vehicles Surveyed

Type of Vehicle	No. of survey vehicles
Two Wheelers	31
Three Wheelers	6
Car	8
LCV	3
Bus	5
Pick-up	3
Truck	22
Tractors	3
Cycle	7
Cycle Rickshaw	2
Hand cart	1
Animal Driven	1
Pedestrian	8
Total	100

The numbers of vehicle chosen for survey are based on the traffic composition and availability of respondents on the highway. The survey was conducted during the various hours of day and at various locations in the study area, so as to cover all types of local and national movement.

4.1.3 House-hold Survey

House-hold survey was carried out for the residents of nearby settlements. The sample size was taken as 50 house-holds. The outputs of survey are shown at the relevant place during analysis.

4.1.4 Visual Survey

Visual surveys were carried out by the author for entire stretch of study area. The surveys were done for consecutive six days. The major junctions were given more importance and were observed during the various hours of day. The conditions of settlements which are near to highway were also surveyed visually. The visual surveys were recorded in the form of images and videos so that it can be referred later.

4.1.5 On-Site Measurements

The measurements of certain important features of highway like lane width, median width, shoulder width, underpass height, etc. were taken by author at random places to cross check these data with the data given in the DPR provided by NHAI.

4.2 SECONDARY DATA

4.2.1 Satellite Imaginary

Images taken by satellites were collected on different scales like 1:10000 and 1:2000. The images were taken from various time periods especially before four laning of highway, during the construction and latest images clicked on 2nd Dec'11. The old NH 57 before the four laning is shown in Figure 32.

Source- www.google.com

Figure 32: NH 57 Before Four Laning

The recent image of the same part of NH 57 as shown above is taken on the scale of 1:2000. This is shown in Figure 33.

Source- www.wikimapia.org

Figure 33: Widened NH 57 on Scale of 1:2000

4.2.2 Monthly Progress Report

The monthly progress reports (MPR) are prepared for each month by the supervising agency which is M/s B. Seenaiah & Co. (Projects) Ltd. - C & C (JV), in this case. So, monthly progress reports of various months from the starting of project to present time were collected from their site office located in the town of Darbhanga. MPR are prepared separately for each stretches of highway on which bidding were done. Since study area falls in BR8 and BR9, so MPRs were collected for both the stretch. MPR contains all the basic information of stretch, the details of chainage of each road features, the flow of money, the condition of site and the schedule of site visits.

4.2.3 Interview Of Various Stakeholder of Highway

The interview of some professionals related to the highway like the head of the contracting agency which is M/s B. Seenaiah & Co. (Projects) Ltd. - C & C (JV), in this case and Resident Engineer of supervising agency which is is M/s Scott Wilson Kirkpatrick India Pvt, in this case were conducted by the author. Some important data and suggestions were recorded on paper during the interview.

4.2.4 NHAI Archive (DPR)

The detailed project report were referred from the regional office of NHAI, which is located in the town of Darbhanga and which looks after the stretch of BR7, BR 8 and BR9. The cover page of the DPR is shown in Figure 34.

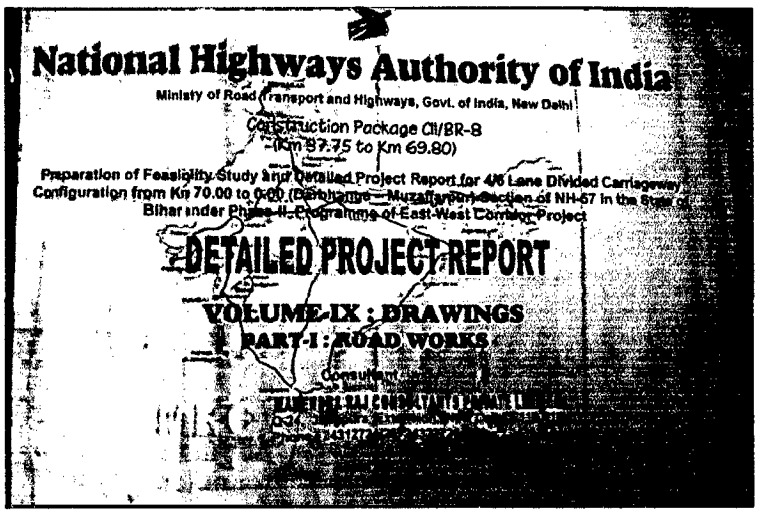


Figure 34: Cover Page of Detailed Project Report

DPR contains all the details drawing of the entire stretch, junctions layout plan, the cross-section of road at various locations and the chainage of various highway facilities.

4.2.4.1 *Right of Way*

The right of way (ROW) throughout the stretch of E-W Corridor between Muzaffarpur and Darbhanga has been observed to be 60m. Land was acquired by the NHAI and handed over to the authority engaged in the construction of highway. As discussed in later sections, the main highway width is 26 m and at some places plantation within the ROW on the either sides of highway is under process.

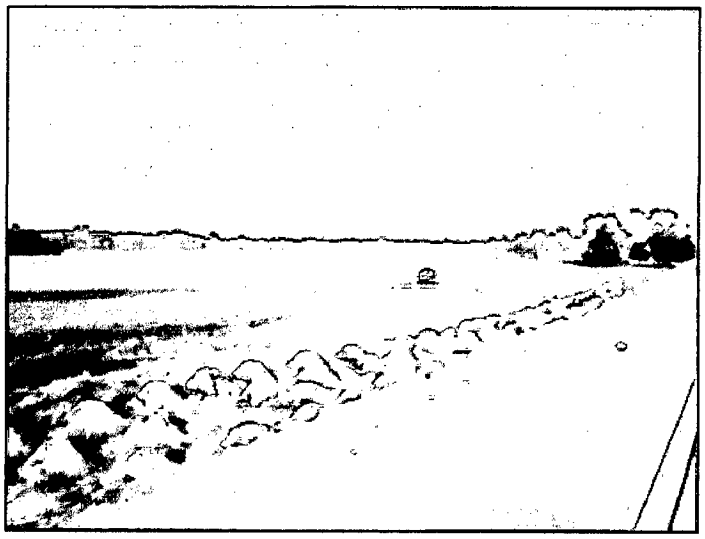


Figure 35: Plantation within ROW

4.2.4.2 Cross-Section

The typical cross-section of the highway within the study area has been observed as illustrated in Figure 36.

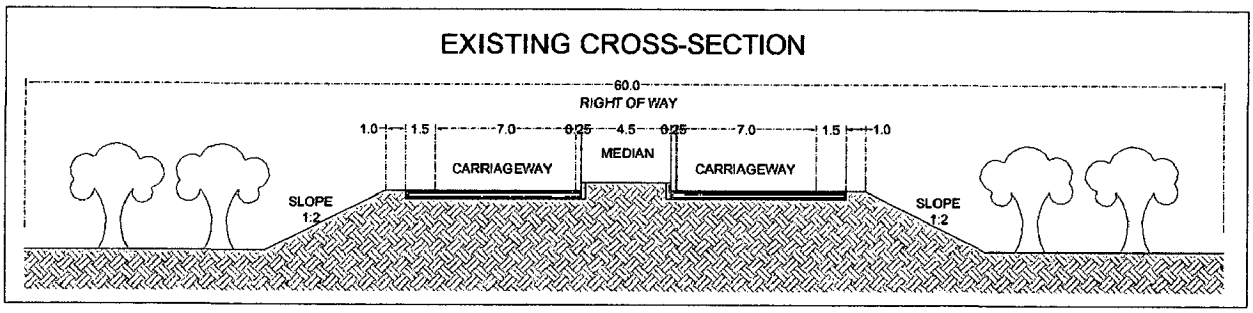


Figure 36: Existing Cross-Section

Earthen shoulder of only 1 m has been construed on either side of the main-carriageway, whereas the recommend earthen shoulder width is 2 m minimum. And, hence, the width of the highway is only 24 m as against the recommended with of 26 m. Drainage is not provided throughout the length of highway within the study area.

4.2.4.3 Median Openings

Median openings are provided at all the junction, at the end of some bridge and at some location. The length of median opening is 20 m at junction while it is 5 m at other places. A median opening is shown in Figure 37.

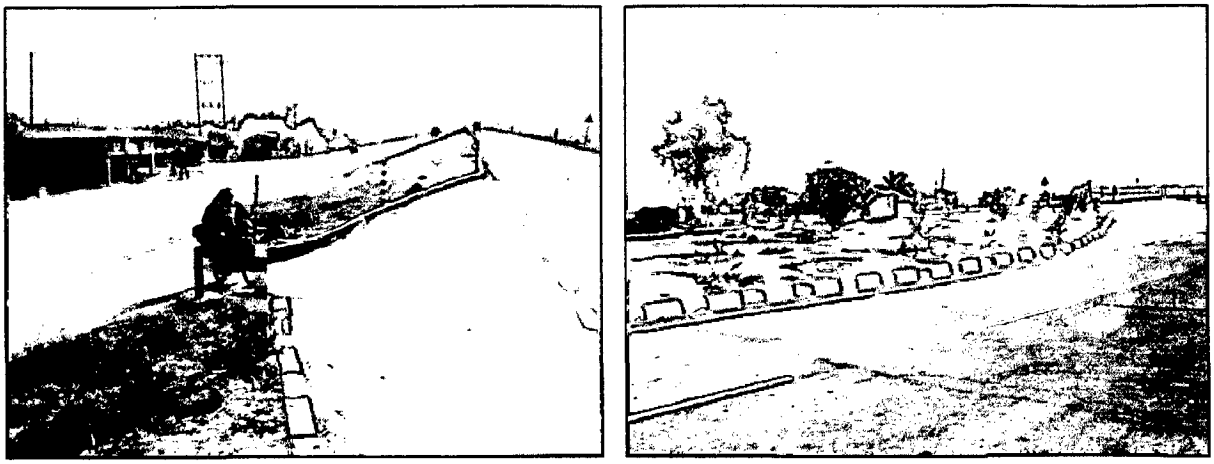


Figure 37: Median Opening in E-W Corridor

4.2.4.4 FOBs & ROBs

There are two FOB provided in the study area of 63 km, during the four laning of highway. The location and other details are given in the Table 12.

Table 12: Location of FOBs

S. No.	Chainage	Over	Width of Cross Road	Span
1	5.980	NH 77	4 - lane	1 x 25.85 m
2	63.02	NH 105	2 - lane	1 x 25.85 m

The flyover bridges are provided wherever any national highway crosses the E-W Corridor. The map showing the location of FOB is given in Figure 38.

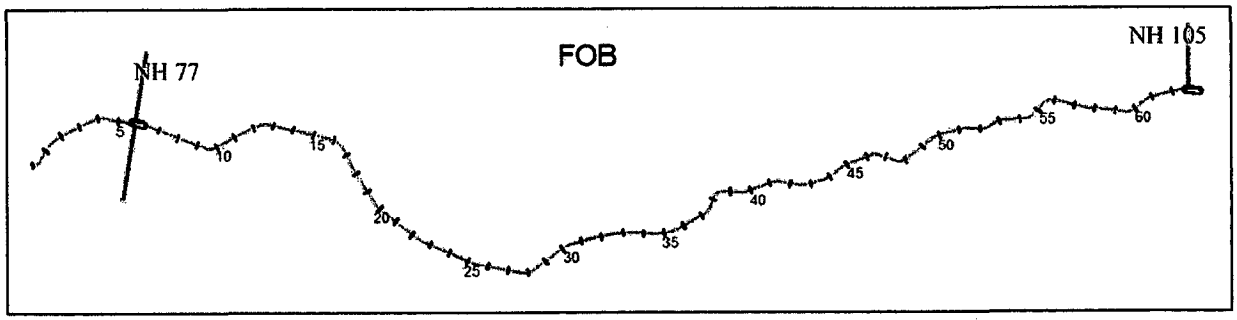


Figure 38: Location of FOBs

The FOB over NH 105 is shown in Figure 39.

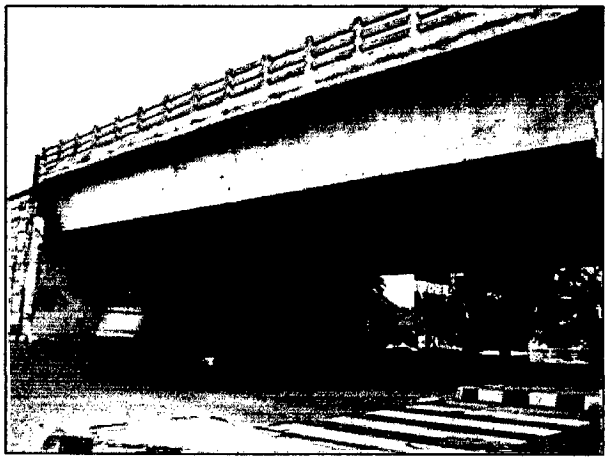


Figure 39: A view of FOB on NH 105

The rail-over bridge is only provided near the Darbhanga on Darbhanga-Sitamarhi broad gauge line. The chainage of the ROB is 61.954 km. The location of ROB is shown in Figure 40.

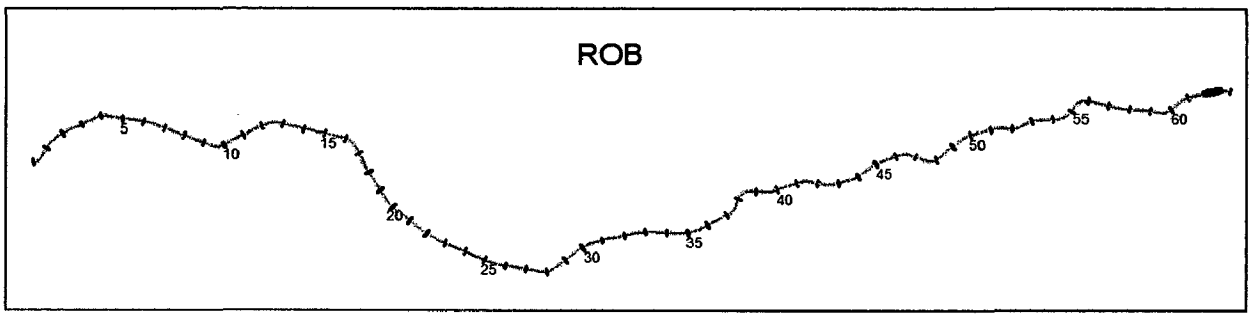


Figure 40: Location of ROBs

4.2.4.5 Underpasses

There are total 6 underpasses provided in the study area of 63 km. The locations are given in Table 13 and Figure 41.

Table 13: Location of Underpasses

S. No.	Chainage	Size
1	13.90	5.5 X 3.5 m
2	22.36	5.5 X 3.5 m
3	23.55	5.5 X 3.5 m
4	46.33	5.5 X 3.5 m
5	58.46	5.5 X 3.5 m
6	59.46	5.5 X 3.5 m

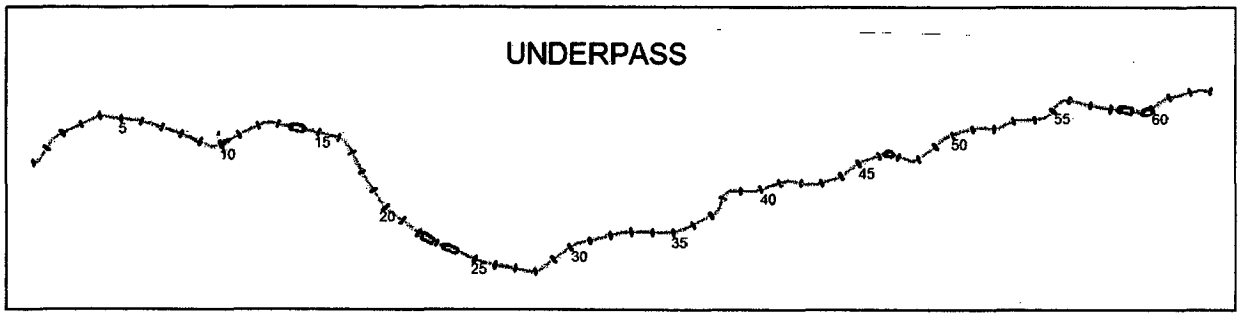


Figure 41: Location of Underpasses

Pedestrian and cattle underpass are not provided within the stretch.

4.2.4.6 Service Lanes

Slip road of width 5.5 m is provided parallel to the highway on either side near five underpass but on the underpass at chainage 46.5 km, it is provided only on one side. The service lanes are shown in Figure 42.

Figure 42: Presence and Absence of Service Lanes near Underpass

4.2.4.7 Intersections

From the DPR provided by NHAI and site survey conducted by author during the month of Feb'12, it was observed that there are total 122 junctions within the study area of 63 km. All of these junctions are categorized in certain type based on the layout plan as proposed in the DRP. The junctions falling within the BR-9 are categorized in type A, C, D, E, F, G and H. Similarly junctions of BR-8 are categorized in type B, D, E, F, G and H, according to their respective DPRs.

The location of junctions, the sides of highway on which the junction is located, width of the cross road, whether it is 3-arm or 4-arm, category, plan type, connection type and type of cross roads are given in the Table 19.

The total no. of 3-arm junctions are 50 where are 72 junction are 4-arm. There are total 101 junctions on LHS and 95 junctions on RHS with all the 4-arm junctions taking common on both the sides. The numbers of each type of junctions are given in Table 14 .It is observed that the almost half of the junctions are of type D which is a 4-arm junction.

Table 14: Numbers of Each Category of Junction

Category	Total no.
A	1
B	1
C	1
D	60
E	10
F	26
G	21
H	2

The numbers of type of cross roads at each junction is given in Table 15. Cart track is a kind of earthen road. From the table it can be observed that the one-fifth of the junctions are just the connections of cart track to the highway.

Table 15: Numbers of Different Type of Cross Road

Type of Cross Road	Total no.
Cart Track	27
Brick Road	46
Pacca Road	49

Out of these 122 junctions in the stretch of 63 km only three junctions are with the national highway, two are with the old national highway where now bypass to the city has been constructed and one each for state highway and old state highway. Rest all junctions are either with the village road or other district road.

Table 16: Number of Cross Roads of Different Widths

Width of Cross Road	Total no.
4- lane	2
2- lane	2
Single lane	118

The number of different types of cross road of various width at all the 122 junctions are given in Table 16. Two NHs, NH 28 and NH 77 which meets with the highway NH 57 are of four lane width. The old alignment of NH 57 which connects the highway to the town of

Muzaffarpur is of two lane. The other two lane cross road is the connection of highway with NH 105 at the end of the study area. The all others cross road at 118 junctions are just single lane wide.

On the basis of traffic survey conducted before preparation of DPR, all of these 122 junctions were categorized in major and minor junctions. The numbers of each type of junctions are given in Table 17.

Table 17: Number of Major & Minor Junctions

Type of Junction	Total no.
Major	9
Minor	113

There are all together 9 major junctions including the starting point of highway NH 57 and rest 113 junctions are considered as minor junctions in the detail project report provided by the NHAI.

Table 18: Number of Different Types of Junctions on the basis of Plan Type

Plan Type	Total no.
X	62
Y	22
T	28
Staggered	10

Similarly dividing the junctions on the basis of its plan type, it is observed from the Table 18 that there are total 63 junction of X type which is almost half of the total number. These X type consist of all D type and two H type junctions. Y type junctions are 22 in numbers which consist of all G type and one B type. T junctions which includes all 26 F type junctions and one A and one C are 28 in number and rest 10 junction which are of E type are staggered in its plan type.

Table 19: Junction Chart

Sl. No.	LHS Chainage	RHS Chainage	Width of Cross Road	Major / Minor	3-arm / 4-arm	Category	Plan Type	Connection Type	Type of Cross Road
1	0	0	4- lane	Major	3	A	T	NH-NH	NH 28
2	0.97	0.97	Single lane	Minor	4	E	Staggered	NH-VR	Pacca Road
3	2.225	2.225	Single lane	Minor	4	D	X	NH-VR	Cart Track
4	4	4	Single lane	Minor	4	D	X	NH-VR	Brick Road
5	4.76	4.76	Single lane	Minor	4	D	X	NH-VR	Cart Track
6	5.07	5.07	Single lane	Minor	4	D	X	NH-VR	Cart Track
7	5.98	5.98	4- lane	Major	4	H	X	NH-NH	NH 77
8	6.23	6.23	Single lane	Minor	4	D	X	NH-VR	Brick Road
9	7.025	7.025	Single lane	Minor	4	D	X	NH-VR	Brick Road
10	7.225	7.225	Single lane	Minor	4	D	X	NH-VR	Brick Road
11	7.85	7.85	Single lane	Minor	4	D	X	NH-VR	Cart Track
12	8	8	Single lane	Minor	4	D	X	NH-VR	Brick Road
13	8.94	8.94	Single lane	Minor	4	D	X	NH-VR	Brick Road
14	9.31	9.31	Single lane	Minor	4	D	X	NH-VR	Cart Track
15		9.7	2- lane	Major	3	C	Y	NH-Old NH	Old NH
16	10.85	10.85	Single lane	Minor	4	D	X	NH-VR	Pacca Road
17	11.03	11.03	Single lane	Major	4	D	X	NH-VR	Pacca Road
18	11.28		Single lane	Minor	3	G	Y	NH-VR	Cart Track
19		11.39	Single lane	Minor	3	G	Y	NH-VR	Pacca Road
20	11.75	11.75	Single lane	Minor	4	D	X	NH-VR	Pacca Road
21	12.32	12.32	Single lane	Minor	4	D	X	NH-VR	Pacca Road
22	12.44		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
23	12.67	12.67	Single lane	Major	4	D	X	NH-VR	Pacca Road
24	13.23		Single lane	Minor	3	F	T	NH-VR	Cart Track
25	13.4	13.4	Single lane	Minor	4	D	X	NH-VR	Brick Road
26	13.6	13.6	Single lane	Minor	4	D	X	NH-VR	Pacca Road
27	13.95	13.95	Single lane	Minor	4	D	X	NH-VR	Pacca Road
28	14.45		Single lane	Minor	3	F	T	NH-VR	Pacca Road
29	15.01	15.01	Single lane	Minor	4	D	X	NH-VR	Cart Track

Sl. No.	LHS Chainage	RHS Chainage	Width of Cross Road	Major / Minor	3-arm / 4-arm	Category	Plan Type	Connection Type	Type of Cross Road
30	15.35	15.35	Single lane	Minor	4	D	X	NH-VR	Brick Road
31		15.72	Single lane	Minor	3	F	T	NH-VR	Cart Track
32	15.92	15.92	Single lane	Minor	4	D	X	NH-VR	Brick Road
33	16.63	16.63	Single lane	Minor	4	D	X	NH-VR	Brick Road
34	17.36	17.36	Single lane	Minor	4	D	X	NH-VR	Pacca Road
35	17.92	17.92	Single lane	Minor	4	E	Staggered	NH-VR	Brick Road
36	18.68	18.68	Single lane	Minor	4	E	Staggered	NH-VR	Cart Track
37	19.54	19.54	Single lane	Minor	4	E	Staggered	NH-VR	Brick Road
38	20.15	20.15	Single lane	Minor	4	E	Staggered	NH-VR	Brick Road
39	20.62	20.62	Single lane	Minor	4	D	X	NH-VR	Pacca Road
40	21.2		Single lane	Minor	3	G	Y	NH-VR	Cart Track
41	21.32	21.32	Single lane	Minor	4	D	X	NH-VR	Brick Road
42	21.85	21.85	Single lane	Minor	4	D	X	NH-VR	Brick Road
43	22.48	22.48	Single lane	Major	4	D	X	NH-VR	Pacca Road
44	23.17	23.17	Single lane	Minor	4	D	X	NH-VR	Brick Road
45	23.68	23.68	Single lane	Minor	4	D	X	NH-VR	Brick Road
46	23.75		Single lane	Minor	3	G	Y	NH-VR	Cart Track
47		24.3	Single lane	Minor	3	F	T	NH-VR	Brick Road
48	24.62	24.62	Single lane	Minor	4	D	X	NH-VR	Cart Track
49	25.68	25.68	Single lane	Minor	4	D	X	NH-VR	Pacca Road
50	26.69	26.69	Single lane	Minor	4	D	X	NH-VR	Pacca Road
51	27.11	27.11	Single lane	Minor	4	D	X	NH-VR	Brick Road
52		29	Single lane	Minor	3	G	Y	NH-VR	Cart Track
53	29.3	29.3	Single lane	Minor	4	E	Staggered	NH-VR	Pacca Road
54	30.3		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
55	30.97	30.97	Single lane	Minor	4	E	Staggered	NH-VR	Brick Road
56	32.51		Single lane	Minor	3	B	T	NH-SH	SH
57		32.59	Single lane	Minor	3	G	Y	NH-VR	Pacca Road
58	33.87	33.87	Single lane	Minor	4	D	X	NH-VR	Pacca Road
59		34.38	Single lane	Minor	3	F	T	NH-VR	Cart Track
60	34.9	34.9	Single lane	Minor	4	D	X	NH-VR	Cart Track

Sl. No.	LHS Chainage	RHS Chainage	Width of Cross Road	Major / Minor	3-arm / 4-arm	Category	Plan Type	Connection Type	Type of Cross Road
61	35.55	35.55	Single lane	Minor	4	D	X	NH-VR	Pacca Road
62	36.14	36.14	Single lane	Minor	4	D	X	NH-VR	Brick Road
63	37.05	37.05	Single lane	Minor	4	D	X	NH-VR	Brick Road
64	37.69	37.69	Single lane	Minor	4	D	X	NH-VR	Brick Road
65	39.17	39.17	Single lane	Minor	4	D	X	NH-VR	Brick Road
66		39.93	Single lane	Minor	3	F	T	NH-VR	Pacca Road
67	40.87	40.87	Single lane	Minor	4	D	X	NH-ODR	Pacca Road
68		41.19	Single lane	Minor	3	F	T	NH-VR	Pacca Road
69	41.59		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
70	42.31	42.31	Single lane	Minor	4	E	Staggered	NH-VR	Cart Track
71	43.04	43.04	Single lane	Minor	4	D	X	NH-VR	Brick Road
72	43.55	43.55	Single lane	Minor	4	D	X	NH-VR	Cart Track
73	44.1	44.1	Single lane	Minor	4	D	X	NH-VR	Brick Road
74	44.82		Single lane	Minor	3	F	T	NH-VR	Brick Road
75	45.49	45.49	Single lane	Minor	4	D	X	NH-VR	Cart Track
76	46.48	46.48	Single lane	Minor	4	D	X	NH-VR	Pacca Road
77	47.03	47.03	Single lane	Minor	4	D	X	NH-VR	Cart Track
78	47.38		Single lane	Minor	3	G	Y	NH-VR	Brick Road
79	47.73	47.73	Single lane	Minor	4	D	X	NH-VR	Pacca Road
80	48.2	48.2	Single lane	Minor	4	D	X	NH-VR	Brick Road
81		48.65	Single lane	Minor	3	G	Y	NH-VR	Brick Road
82	48.71	48.71	Single lane	Major	4	D	X	NH-VR	Brick Road
83	49.6		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
84	49.64	49.64	Single lane	Minor	4	E	Staggered	NH-VR	Pacca Road
85	49.71	49.71	Single lane	Minor	4	D	X	NH-VR	Pacca Road
86		50.27	Single lane	Minor	3	G	Y	NH-VR	Brick Road
87	50.66		Single lane	Minor	3	F	T	NH-VR	Brick Road
88	50.78		Single lane	Minor	3	F	T	NH-VR	Brick Road
89		51.03	Single lane	Minor	3	F	T	NH-VR	Cart Track
90	51.49	51.49	Single lane	Minor	4	D	X	NH-VR	Brick Road
91	51.9		Single lane	Minor	3	F	T	NH-VR	Pacca Road

Sl. No.	LHS Chainage	RHS Chainage	Width of Cross Road	Major / Minor	3-arm / 4-arm	Category	Plan Type	Connection Type	Type of Cross Road
92		51.98	Single lane	Minor	3	F	T	NH-VR	Brick Road
93		52.02	Single lane	Minor	3	F	T	NH-VR	Cart Track
94		52.05	Single lane	Minor	3	G	Y	NH-ODR	Old SH
95	52.25		Single lane	Minor	3	F	T	NH-VR	Pacca Road
96	52.57		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
97		52.63	Single lane	Minor	3	F	T	NH-VR	Pacca Road
98		52.95	Single lane	Minor	3	G	Y	NH-VR	Brick Road
99	53.22	53.22	Single lane	Minor	4	D	X	NH-VR	Brick Road
100	53.91		Single lane	Minor	3	F	T	NH-VR	Cart Track
101	54.6		Single lane	Minor	3	F	T	NH-VR	Cart Track
102	54.98	54.98	Single lane	Minor	4	D	X	NH-VR	Brick Road
103	55.37	55.37	Single lane	Minor	4	D	X	NH-VR	Brick Road
104	55.85		Single lane	Minor	3	F	T	NH-VR	Cart Track
105	56.58		Single lane	Minor	3	F	T	NH-VR	Brick Road
106	56.69		Single lane	Minor	3	F	T	NH-VR	Brick Road
107	56.84	56.84	Single lane	Minor	4	D	X	NH-VR	Brick Road
108		57.47	Single lane	Minor	3	G	Y	NH-VR	Pacca Road
109	58.42		Single lane	Minor	3	F	T	NH-VR	Cart Track
110		58.67	Single lane	Minor	3	F	T	NH-VR	Pacca Road
111	58.73		Single lane	Minor	3	F	T	NH-VR	Pacca Road
112	58.82		Single lane	Minor	3	F	T	NH-VR	Pacca Road
113		58.95	Single lane	Minor	3	F	T	NH-VR	Brick Road
114	59.15		Single lane	Minor	3	G	Y	NH-VR	Pacca Road
115		59.28	Single lane	Minor	3	G	Y	NH-VR	Pacca Road
116	59.78	59.78	Single lane	Major	4	D	X	NH-Old NH	Old NH 57
117	60.35	60.35	Single lane	Minor	4	D	X	NH-VR	Pacca Road
118	60.42		Single lane	Minor	3	G	Y	NH-VR	Brick Road
119	60.91		Single lane	Minor	3	G	Y	NH-VR	Cart Track
120	61.27	61.27	Single lane	Minor	4	E	Staggered	NH-VR	Pacca Road
121	61.78	61.78	Single lane	Minor	4	D	X	NH-VR	Brick Road
122	63.02	63.02	2-lane	Major	4	H	X	NH-NH	NH 105

4.2.4.8 Pedestrian Crossings

Pedestrian crossings are provided near the bus-stops and at junctions. This is shown in Figure 43.

Figure 43: Picture showing the Pedestrian Crossing

4.2.4.9 Bridges & Culverts

Major bridges are provided over the river Budhi Gandak, Siyari, Bagmati and Shobhan. The locations of rivers are given in Table 9 and the locations of major bridges are given in Table 20.

Table 20: Location of Major Bridges

S. No	Chainage	Span(m)
1	1.375	2x28.50
2	3.8	10x28.50
3	5.495	3x28.50
4	28.285	5x28.50
5	29.515	3x26.20
		1x12.80
6	32.01	2x38.68
7	33.3	2x38.68
8	37.65	3x40.25
9	40.25	4x25.80
10	41.36	2x40.20
11	42.758	1x26.80
		1x 26.80
		1x13.40
12	43.204	4x26.05
13	45.404	1x26.80
		1x26.80
		1x13.40

S. No	Chainage	Span(m)
14	50	1x26.80
		2x26.80
		1x13.40
15	54.876	2x56.00
		2x13.34
16	56.837	2x40.20
17	59.12	3x27.30

There are total 17 of each major bridges and minor bridges. The major bridges remain dry most of the year. These are provided with hard flooring. The locations of minor bridges are given in Table 21.

Table 21: Location of Minor Bridges

S. No	Chainage	Span(m)
1	11.988	1x25.80
2	30.6	1x39.36
3	31.065	1x39.36
4	31.386	1x39.36
5	35.35	1x39.36
6	36.075	2x26.00
7	38.83	2x26.80
8	39.362	2x26.80
9	43.598	1x40.20
10	44.794	1x40.20
11	45.096	1x40.20
12	50.906	2x26.80
13	53.15	2x26.80
14	53.503	2x26.80
15	55.29	1x40.20
16	57.338	1x26.80
17	58.122	2x26.80

There are total 248 culverts. The total no. of the various types of culverts provided in the stretch is given in Table 22.

Table 22: Numbers of Various Types of Culverts

Type of Culvert	Number
Brick Masonry Slab Culvert	170
Box Culvert	78
Pipe Culvert	0
Total	248

All culverts are less than 5 m in length and their height is less than 2 m.

4.2.4.10 Bus Bays and Passenger Shelter

There are total 15 bus stops provided on E-W Corridor between Darbhanga and Muzaffarpur within a distance of 63 km on either side of the road. The locations of bus-bays are shown in Table 23.

Table 23: Location of Bus-Bays

S. No.	Chainage	S. No.	Chainage
1	10.52	9	40.04
2	15.19	10	41.12
3	16.13	11	48.5
4	17.62	12	52.52
5	20.85	13	56.63
6	23.28	14	59.1
7	25.27	15	60.15
8	35.8	---	---

The layout of bus-bay is shown in annexure. The bus-bays are provided with a passenger shelter. Pictures of the bus-bay and passenger shelter is shown in Figure 44.

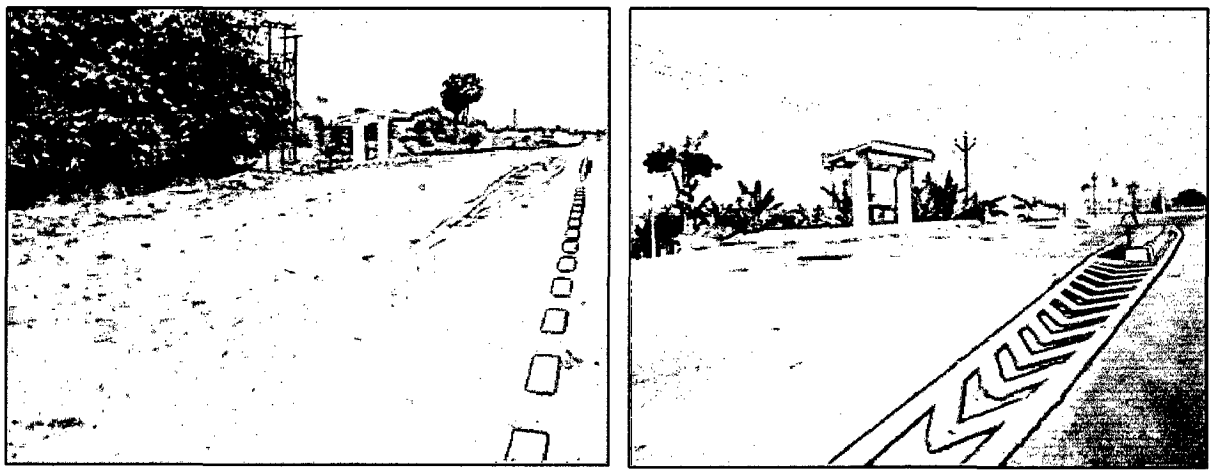


Figure 44: Bus-Bay and Passenger Shelter

4.2.4.11 Truck Lay-byes

Truck lay-byes are provided four in numbers. Two on either side of the highway within a distance of 63 km between Darbhanga and Muzaffarpur on E-W Corridor. The locations are shown in Table 24.

Table 24: Location of Truck Lay-byes

S. No.	Chainage	Side of Highway
1	7.00	RHS
2	9.50	LHS
3	42.40	LHS
4	48.20	RHS

Map below shown in Figure 45, shows the location of truck lay-byes.

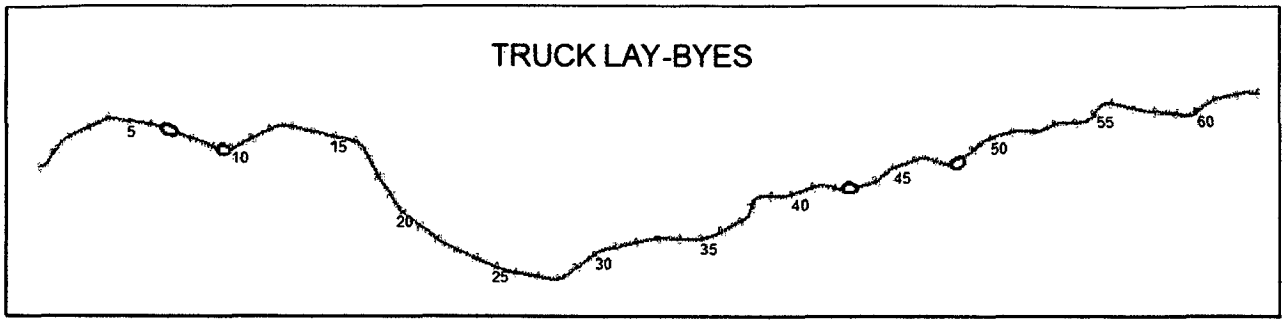


Figure 45: Location of Truck Lay-byes

The layout of the truck lay-bye is shown in annexure. The truck lay-byes are provided with a rest room, consisting of two rooms. The pictures below in Figure 46, shows the lay-bye provided at 48 km on RHS and the next picture shows the rest-room provided at lay-bye for truck drivers.

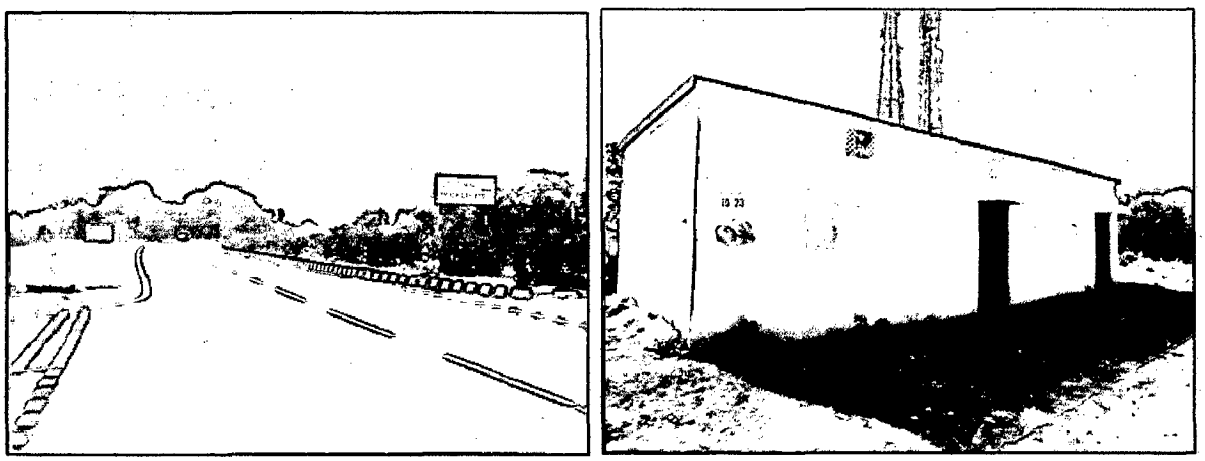


Figure 46: Truck Lay-bye at 48 km

4.2.4.12 Fuel Station

There are total of 18 fuel station on E-W Corridor between Darbhanga and Muzaffarpur, within a distance of 63 km. The location and the name of the agency is given in Table 25.

Table 25: Location of Fuel Stations and Name of the Company

S. No.	Chainage	Direction	Company
1	5.98	RHS	HP
2	10.15	RHS	HP
3	10.35	RHS	IBP
4	14.08	RHS	IOCL
5	16.98	LHS	IBP
6	18.6	LHS	IOCL
7	20.48	LHS	HP
8	21.68	LHS	IOCL
9	24.93	RHS	UNDER CONSTRUCTION
10	26.55	LHS	IBP
11	34.92	RHS	HP
12	40.71	LHS	HP
13	45.79	RHS	UNDER CONSTRUCTION
14	48.37	RHS	IOCL
15	56.22	RHS	RELIANCE (CLOSED)
16	57.98	RHS	HP
17	60.29	LHS	IBP
18	62.85	RHS	HP

Out of these 18 fuel station, at present 15 are working. Two pumps are under construction whereas one which below to Reliance is closed.

There are 7 fuel stations on LHS, i.e. while going from Muzaffarpur to Darbhanga and 11 are on RHS, i.e. while going from Darbhanga to Muzaffarpur.

4.2.4.13 Toll Plaza

One toll plaza is provided between Darbhanga and Muzaffarpur. The location of the toll plaza is at 26.200 km.

4.2.5 Dhabas

There are total 31dhabas in the length of 63 km on E-W Corridor between Muzaffarpur and Darbhanga. The chainage of these dhabas are given in Table 26.

Table 26: Location of Dhaba

S. No.	Chaingae	Side
1	9.97	LHS
2	10.18	LHS
3	10.21	RHS
4	10.44	LHS

S. No.	Chaingae	Side
5	12.18	RHS
6	17.03	RHS
7	18.65	LHS
8	20.45	LHS
9	22.87	LHS
10	23.34	RHS
11	24.06	RHS
12	24.17	LHS
13	24.32	RHS
14	24.76	RHS
15	30.43	RHS
16	31.76	LHS
17	33.18	RHS
18	35.71	LHS
19	40.67	LHS
20	40.85	LHS
21	41.06	LHS
22	41.21	LHS
23	41.26	RHS
24	42.27	RHS
25	42.3	LHS
26	42.33	LHS
27	45.82	LHS
28	47.25	RHS
29	48.41	LHS
30	56.52	LHS
31	57.98	LHS

The map showing the location of these dhabas are given in Figure 47.

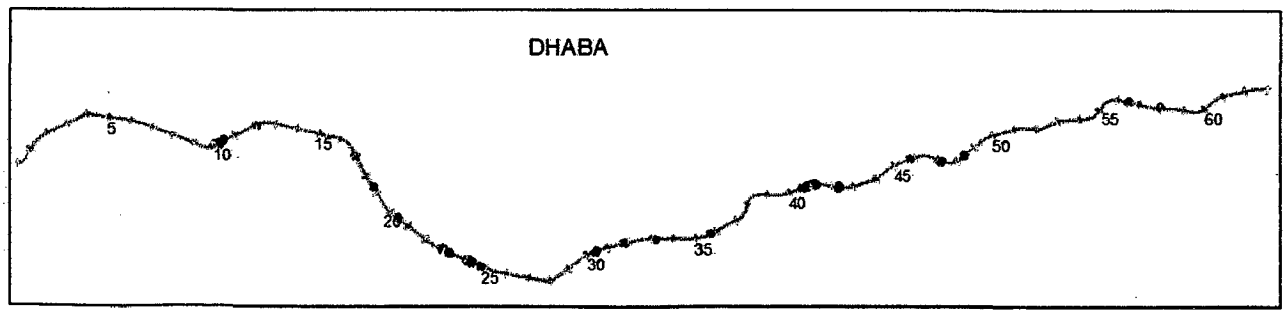


Figure 47: Location of Dhabas

While there are many dhabas existing from a long time, some dhabas are newly constructed or still in the process of construction. The old dhabas and dhabas under construction are shown in Figure 48.

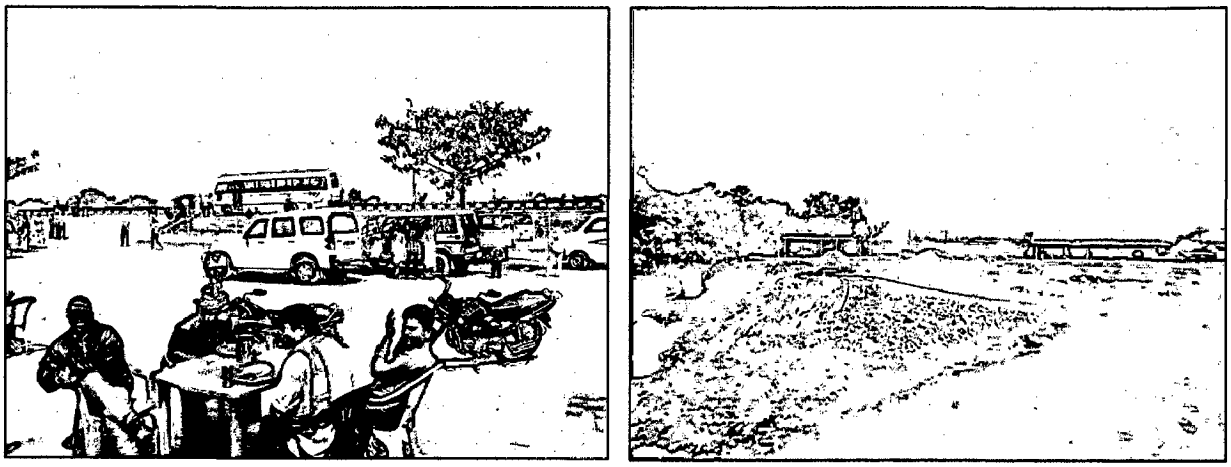


Figure 48: Existing Dhabas and New Construction of Dhaba

4.2.6 Puncture Shop & Repair Shop

There are total 56 punctures shop provided within a distance of 63 km on the E-W Corridor between Darbhanga and Muzaffarpur. The location of puncture shops is shown in Table 27.

Table 27: Location of Puncture Shops

S. No.	Chainage	Side	S. No.	Chainage	Side
1	0.05	LHS	29	33.82	LHS
2	0.07	LHS	30	36.06	LHS
3	0.09	LHS	31	37.09	RHS
4	0.92	LHS	32	37.16	LHS
5	5.08	RHS	33	39.92	LHS
6	9.98	LHS	34	40.75	LHS
7	10.1	RHS	35	41.23	LHS
8	10.23	RHS	36	41.27	RHS
9	10.36	LHS	37	42.27	LHS
10	10.42	LHS	38	42.36	LHS
11	12.11	RHS	39	44.72	LHS
12	12.71	RHS	40	45.85	LHS
13	15.88	LHS	41	47.68	LHS
14	16.97	LHS	42	48.38	LHS
15	17.35	RHS	43	48.81	LHS
16	18.42	LHS	44	49.42	LHS
17	18.65	LHS	45	49.72	LHS
18	21.21	LHS	46	52.07	LHS
19	21.65	LHS	47	54.99	LHS
20	21.71	LHS	48	56.56	LHS
21	22.91	LHS	49	57.95	LHS
22	24.19	LHS	50	58.02	LHS
23	24.34	RHS	51	59.22	LHS
24	24.66	RHS	52	60.18	LHS

S. No.	Chainage	Side	S. No.	Chainage	Side
25	24.75	RHS	53	60.23	LHS
26	26.59	LHS	54	60.32	LHS
27	29.3	RHS	55	60.36	LHS
28	30.41	RHS	56	61.02	RHS

4.2.7 Rest Area

Rest area has not been provided anywhere in the stretch of 63 km of E-W Corridor between Darbhanga and Muzaffarpur.

4.2.8 Other Highway Facilities

Other highway facilities like highway patrol, ambulance service, crane service, emergency phone, medical aid post and highway traffic management systems are not provided on E-W Corridor between Darbhanga and Muzaffarpur.

4.2.9 Plantation

Highway is provided with median plantation and the roadside plantation on the either side of the highway. Since these are planted recently, so they cannot be found standing as of now. The height of median planation is sufficient to stop the light coming from vehicle in opposite direction. This is shown in Figure 49.

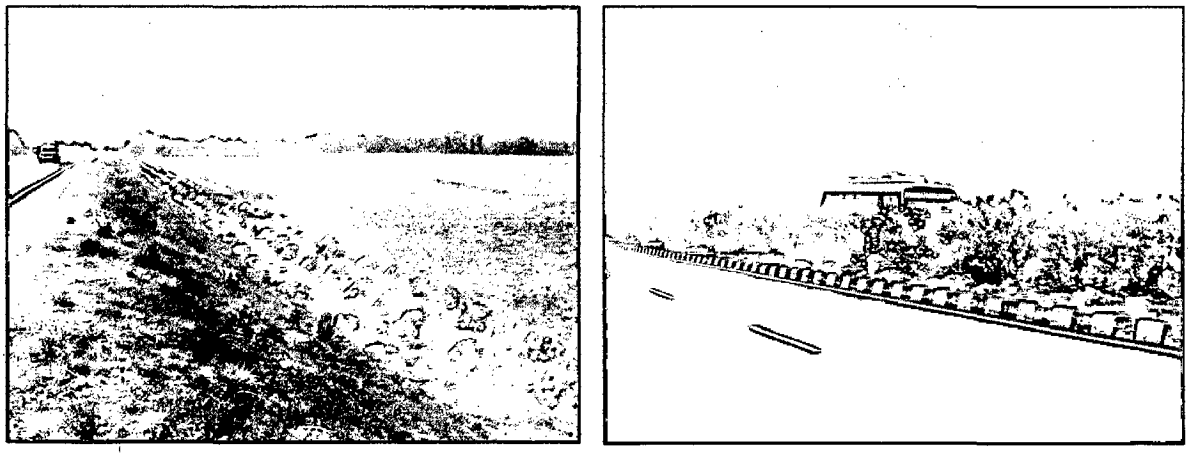


Figure 49: Plantation on the Sides and Median Plantation

4.2.10 Operation & Maintenance Center

Operation & maintenance center is not provide on the highway within the study area.

CHAPTER - 5 ANALYSIS

5.1 PCU COUNT

The traffic surveys were carried out on various days of week and during the various hours of day. The PCU of Sunday is given in Table 28.

Table 28: PCU Count on Sunday

Time	PCU
Sunday Morning	20765
Sunday Afternoon	18288
Sunday Evening	26496
Sunday (Average)	21850

It is observed that on Sunday PCU is maximum during the evening hours while it is least during the afternoon. The average PCU on Sunday is observed as 21850.

The PCU on weekday is given below in Table 29.

Table 29: PCU Count on Weekday

Time	PCU
Weekday's Morning	18360
Weekday's Afternoon	21002
Weekday's Evening	21096
Weekday (Average)	20153

The PCU has been observed almost same after morning. It is observed that it is increasing as the time of the day. The average PCU on weekday has been observed as 20153 which is less than the average PCU on Sunday.

Averaged PCU for a different time of day is given in Table 30.

Table 30: Average PCU Count in a Day

Time	PCU
Morning	19562
Afternoon	19645
Evening	23796
Day (Average)	21001

It is observed that PCU count is minimum during the morning peak-hour then it increases as the day passes. It is observed maximum during the evening peak-hour. The average PCU in a day is observed as 21001. The value of PCU is almost half the PCU allowed on a four lane highway by ministry.

Fast Moving Vehicles Vs Slow Moving Vehicles

According to IRC code, fast moving vehicles and slow moving vehicles are categorized as given in Table 31.

Table 31: Categorization of Fast & Slow Moving Vehicle

Fast Moving Vehicle	Motor Cycle or Scooter
	Passenger Car
	Auto Rickshaw
	LCV (Jeep)
	LCV (Auto 4 Wheel)
	Mini Bus
	Bus
	Tempo
	Pick-up Van
	Mini Truck
	Truck (2 Axle)
	Truck (3 Axle)
	Truck (4 Axle)
	Truck-trailer
	Agricultural Tractor
	Agricultural Tractor-trailer
Slow Moving Vehicle	Cycle
	Cycle Rickshaw
	Hand Cart
	Horse-drawn Vehicle
	Bullock Cart
	Pedestrian

The composition of fast moving vehicles and slow moving vehicles in the total PCU on highway has been analyzed differently for weekends and weekdays and further separately for LHS and RHS on morning peak-hour and evening pick-hour. These are shown in Figure 50 & Figure 51.

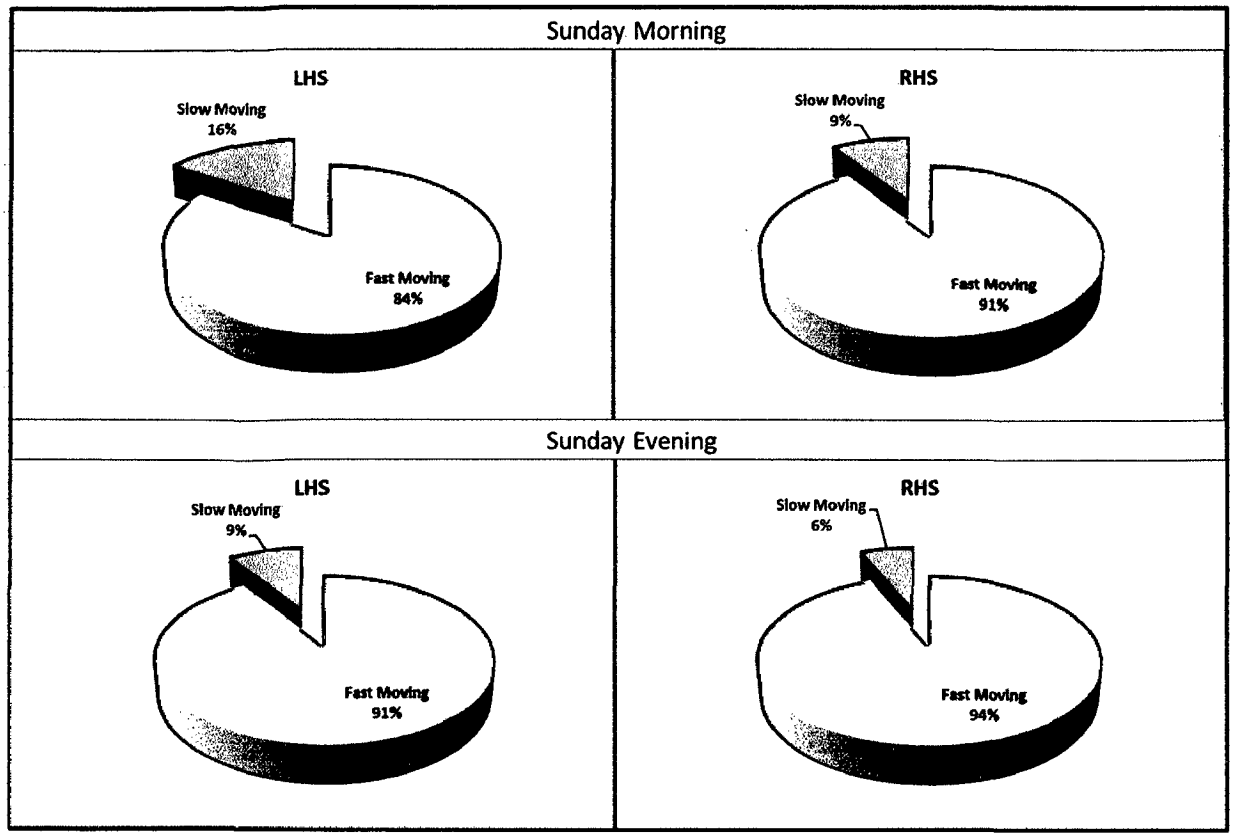


Figure 50: PCU Count on Sunday for Fast & Slow Moving Vehicle

On Sunday morning, the composition of slow moving vehicle in the total PCU on LHS has been observed as 16% while on RHS, it has been observed as 9%. By the evening, the slow moving vehicle on LHS decreases to 9% while on RHS, it decreases to 6%.

It is found that the slow moving vehicles are decreasing as the day passes by. The reason could be the non-availability of head-light to drive the non-powered vehicle in dark. On LHS, the composition of slow moving vehicle has been observed more throughout the day than that on RHS. It means on Sundays, more people on slow moving vehicles, go towards the city from rural areas than coming from the city.

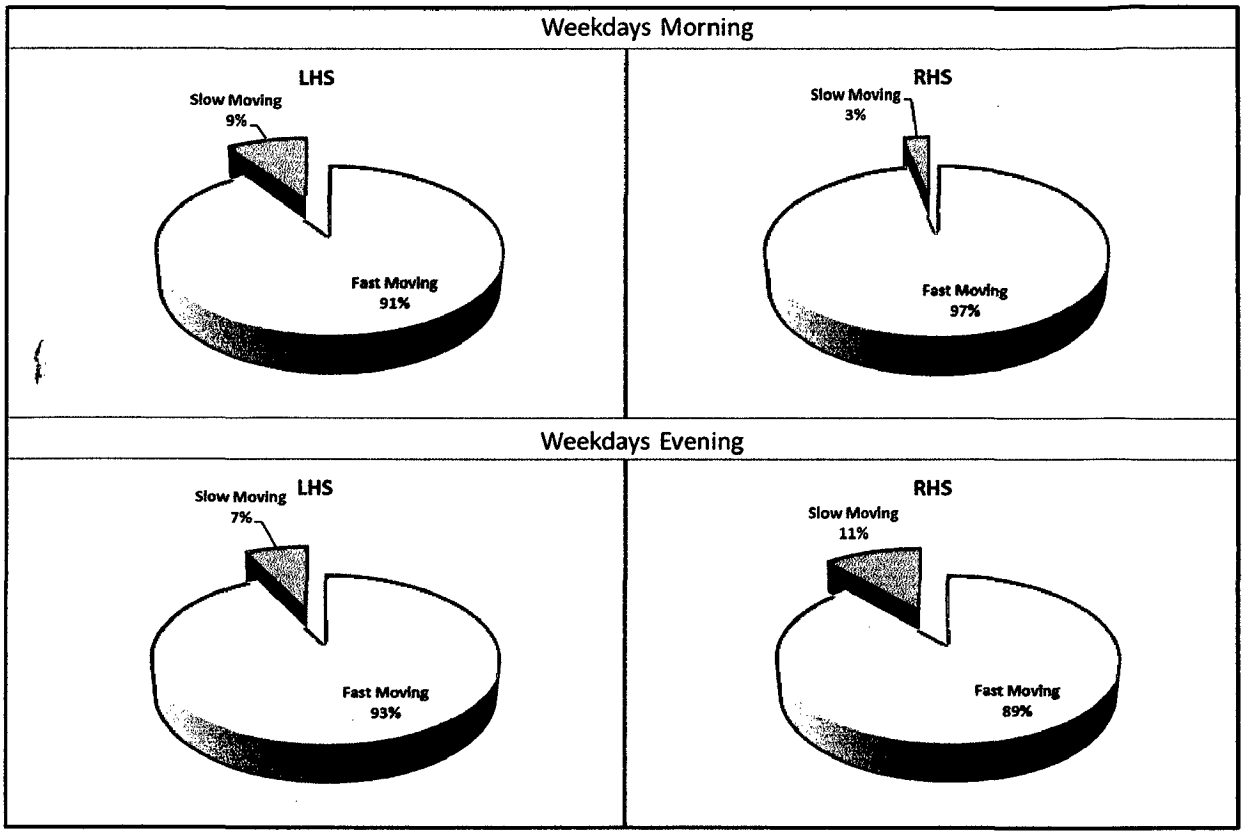


Figure 51: PCU Count on Weekday for Fast & Slow Moving Vehicle

Analyzing the PCU composition of slow moving vehicles vs fast moving vehicle on the weekday's morning, it has been observed that slow moving vehicles just accounts for 9% of total PCU on LHS while on RHS, it is just 3%. By the evening on LHS, slow moving vehicles decreases to 7% while on RHS, it increases to 11%.

On LHS, the slow moving vehicles decreases while that on RHS it increases as the day passes by. The reason could be that on weekdays, rural population goes to city for various purposes while they return back by the evening.

Passenger Vehicles Vs Goods Vehicles

All types of vehicle using highway have been categorized in two classes as given in Table 32.

Table 32: Categorization of Passenger Vehicle and Goods Vehicle

Passenger Vehicle	Motor Cycle or Scooter
	Passenger Car
	Auto Rickshaw
	LCV (Jeep)
	LCV (Auto 4 Wheel)
	Mini Bus
	Bus
	Cycle
	Cycle Rickshaw
	Horse-drawn Vehicle
	Pedestrian
Goods Vehicle	Tempo
	Pick-up Van
	Mini Truck
	Truck (2 Axle)
	Truck (3 Axle)
	Truck (4 Axle)
	Truck-trailer
	Agricultural Tractor
	Agricultural Tractor-trailer
	Bullock Cart
	Hand Cart

The composition of passenger vehicles and goods vehicles are analyzed separately for weekends and weekdays. These are further analyzed separately for either sides of highway and that too in the morning peak-hour and evening peak-hour. These are shown in Figure 52 & Figure 53.

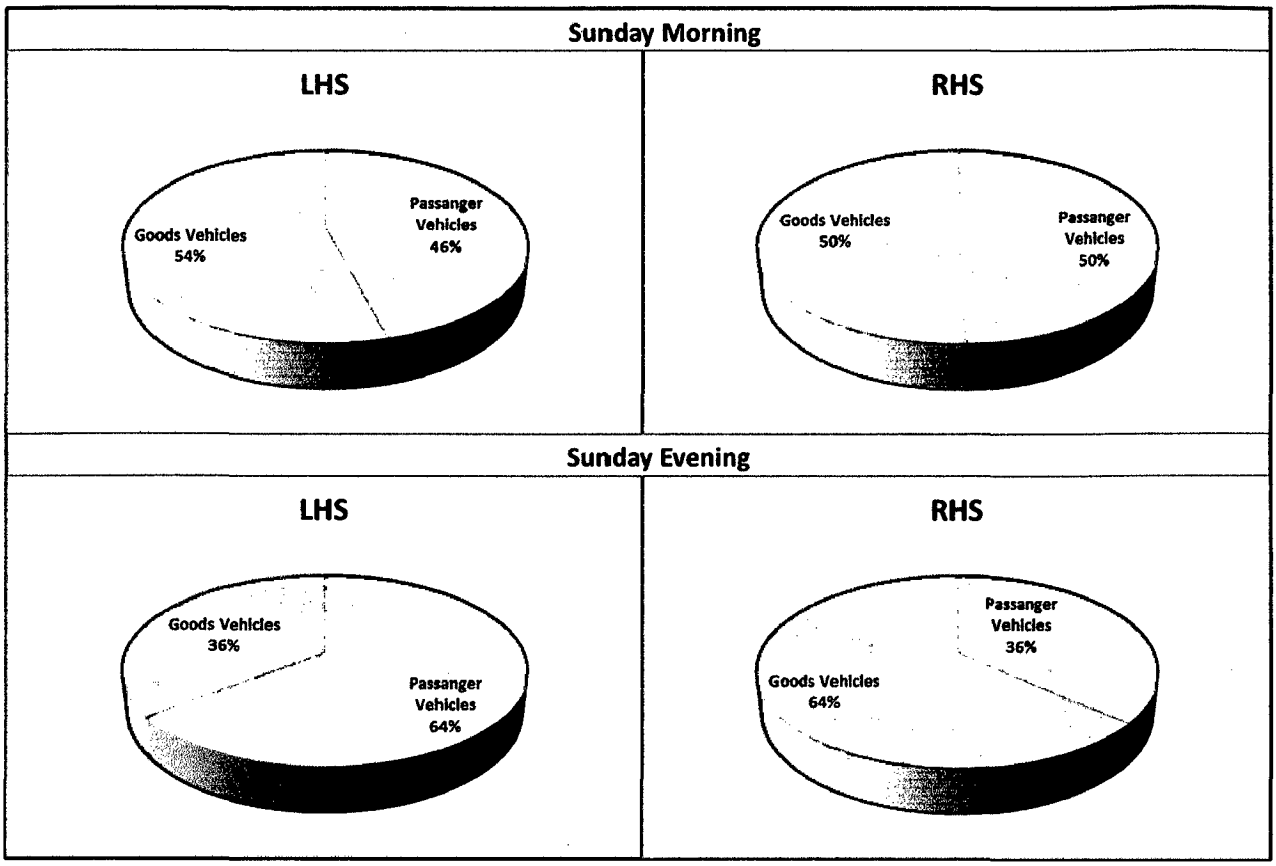


Figure 52: PCU Count on Sunday for Passenger & Goods Vehicle

It has been analyzed from the traffic survey that, on Sunday morning goods vehicle contributes for 54% of traffic on highway whereas passenger vehicle accounts for rest 46% on LHS. On the other side of the highway, i.e. on RHS, from Darbhanga towards Muzaffarpur, it has been observed that goods vehicles and passenger vehicles are contribute equally in total PCU on highway. By the evening, on LHS, the goods vehicle decreases to 36% while on RHS it increases to 64%. Passenger vehicle increases on LHS while it decreases on RHS.

Decreasing contribution of goods vehicle on LHS, with the increasing hours of day, implies that goods carrier prefer driving in morning if they are leaving towards north-eastern states of India or towards other parts of the state while on RHS its increasing percentage shows that they try to return back to distributors, residing in state capital, before night.

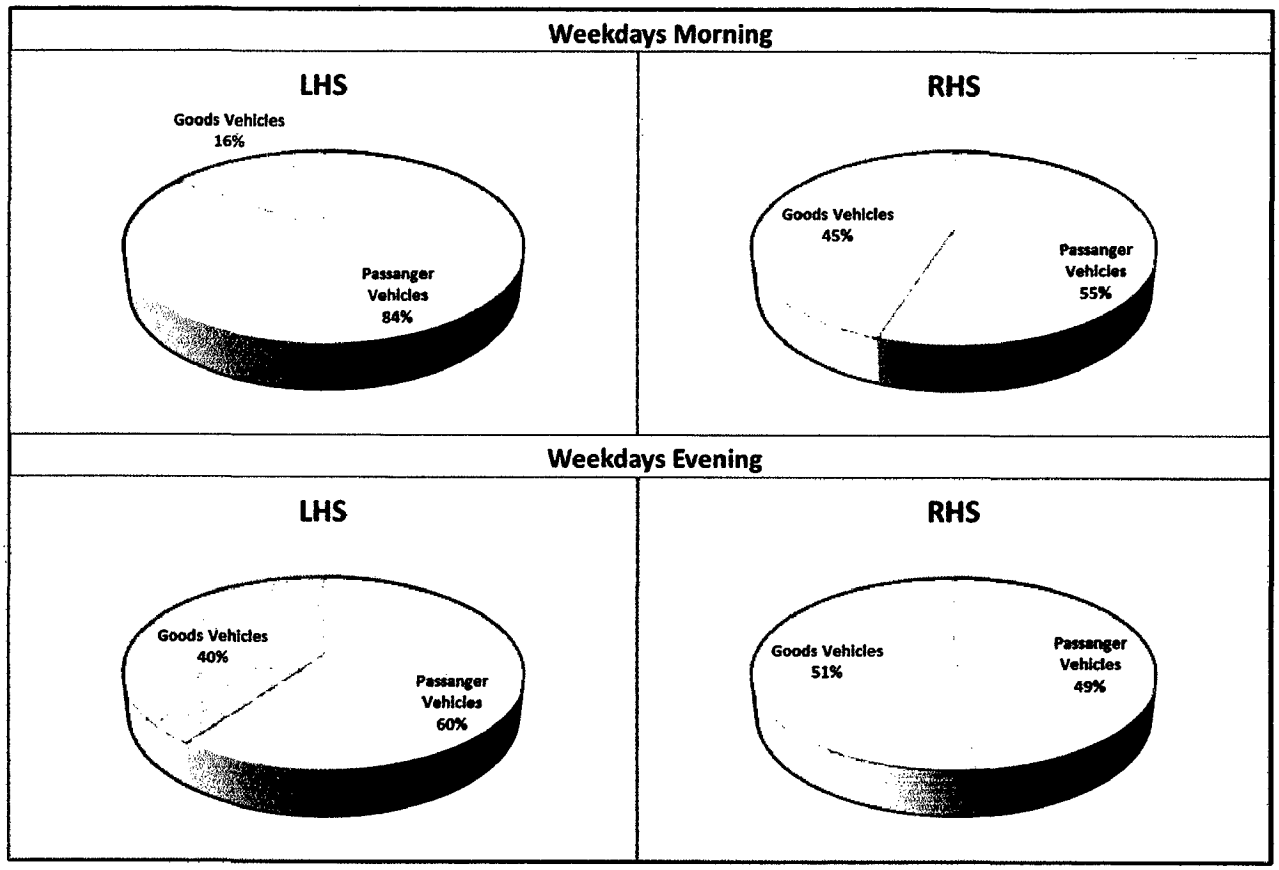


Figure 53: PCU Count on Weekday for Passenger & Goods Vehicle

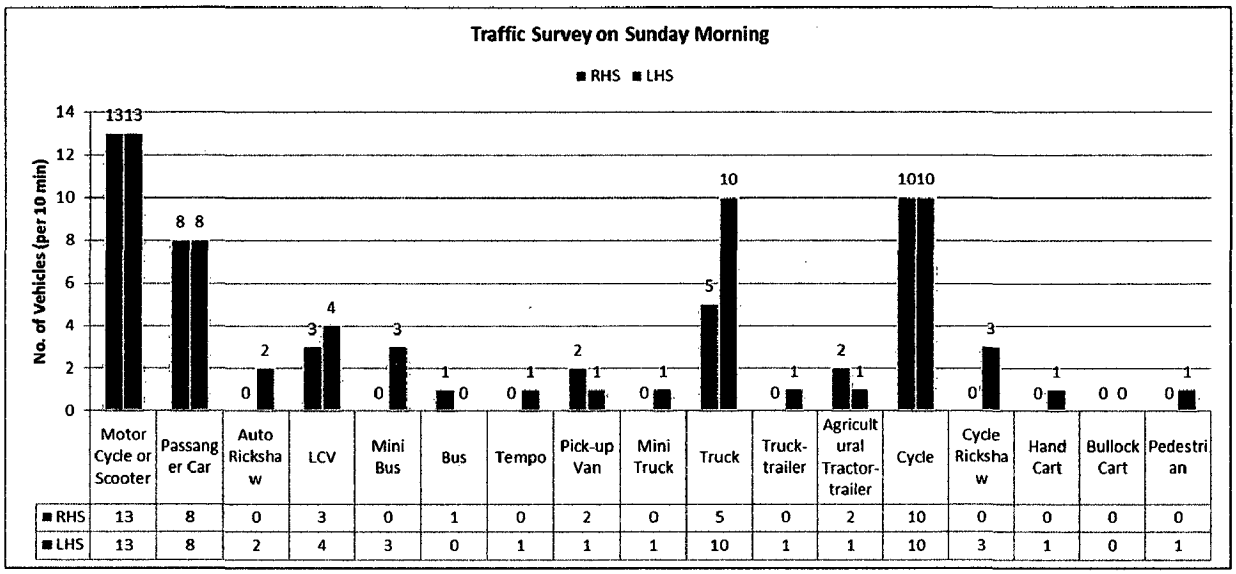
Analyzing the PCU composition on the basis of goods vehicles and passenger vehicles on weekdays, it has been observed that goods vehicles contributes for only 16% of the total PCU on LHS while passenger vehicle accounts for rest 86%. Similarly on RHS, goods vehicle's contribution in total PCU is 45% while rest 55% comes under passenger vehicle. By the evening, goods vehicle percentage in total PCU on LHS increases to 40 while on RHS, it increases to 51%.

Increasing percentage of passenger vehicles and decreasing percentage of goods vehicles on either side of the highway implies that, as the day passes by, the people movement on highway decreases. It means, among the passenger traffic, mostly, it is the local traffic whose movement on highway is affected by the day and night hours.

5.2 VEHICLE COUNT

From the traffic survey conducted on Sunday morning at chainage 55 km, it is observed that the overall traffic on LHS is more than the traffic on RHS. The numbers of various types of vehicle passing in 10 minutes is shown in Figure 54.

Figure 54: Traffic Survey on Sunday Morning



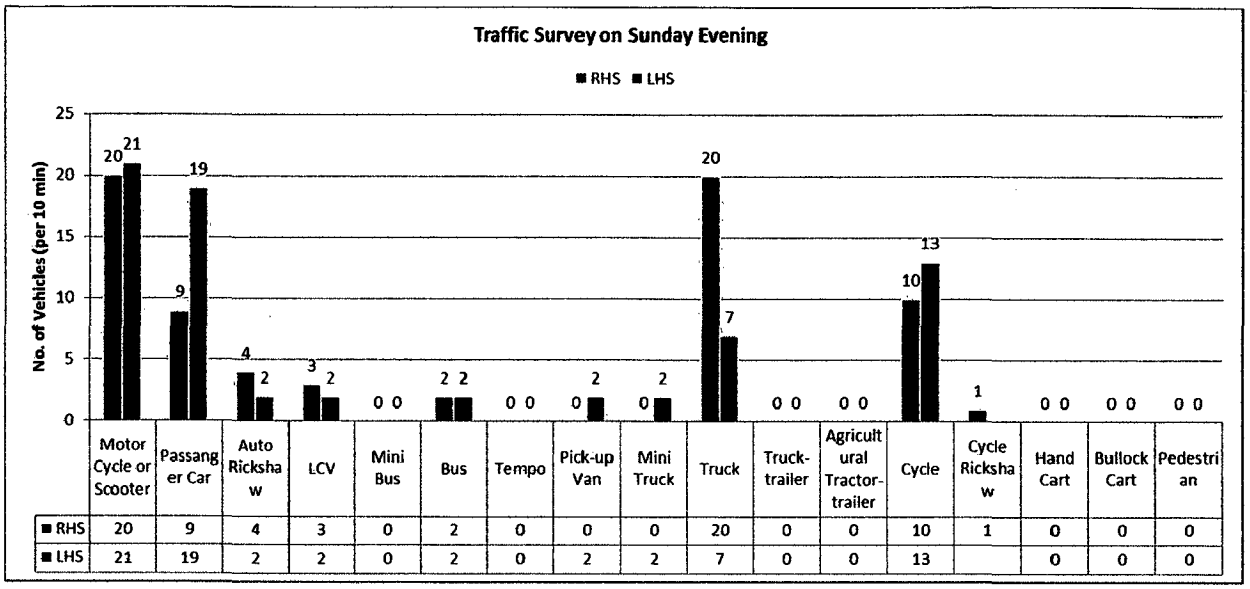
The privated vehicles like motorcycles, cars and cycle are observed to be same on either side whereas the diffrence between the public vehicle is observed to be less. The main difference is between the number of trucks. The trucks on LHS is being observed alomost as double the number on RHS. It means that trucks movement towards the N-E states of the country is observed to be more on weekend morning.

Findings:

- More trucks on LHS- movement of goods from distributers to resellers takes place on holidays
- More local public transport on LHS- movement of rural population towards the city is more on holidays

Similarly from the survey conducted at Sunday evening, it is observed that the traffic on LHS is more than RHS except trucks. The numbers of vehicles passing in 10 minutes is shown in Figure 55.

Figure 55: Traffic Survey on Sunday Evening



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
RHS	20	9	4	3	0	2	0	0	0	20	0	0	10	1	0	0	0
LHS	21	19	2	2	0	2	0	2	2	7	0	0	13		0	0	0

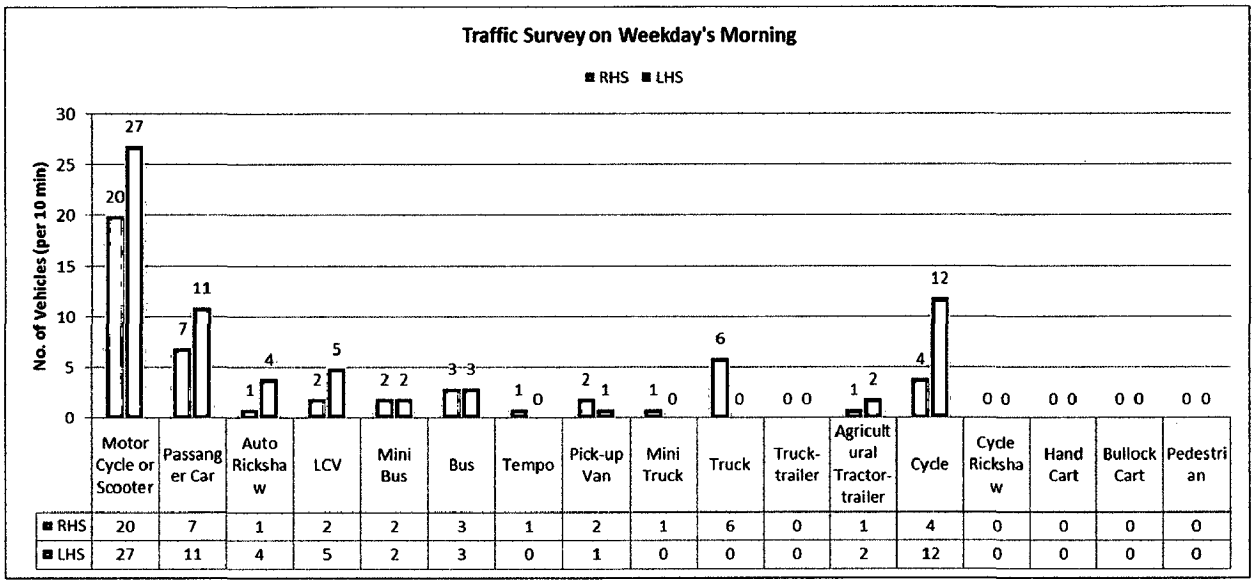
The numbers of local vehicles used by rural population like motorcylces and cycles are observed to be same whereas the differences are observed in the national traffic. The numbers of cars are observed to be more on LHS while the number of turcks are observed more on RHS.

Findings:

- More car on LHS- familiy activities like marriage ceremony are more in evening
- More trucks movement in evening on RHS- After delivery of goods to resellers, turcks return back to capital before night.

From the traffic survey conducted on weekday's morning, it is observed that the overall traffic on LHS is more than that on RHS. It is shown in Figure 56 about the number of vehicles passing in the duration of 10 minutes.

Figure 56: Traffic Survey on Weekday's Morning



The number of local traffic which includes motorcycles and cycles are more on LHS. Similarly the local public vehicles like auto-rickdhaw and light commerical vehicles are more on LHS.

The movement of local tranports are more on LHS, it means that people movement toward Darbhanga is more. The reason is found from the house-hold survey, which is given in Table 33.

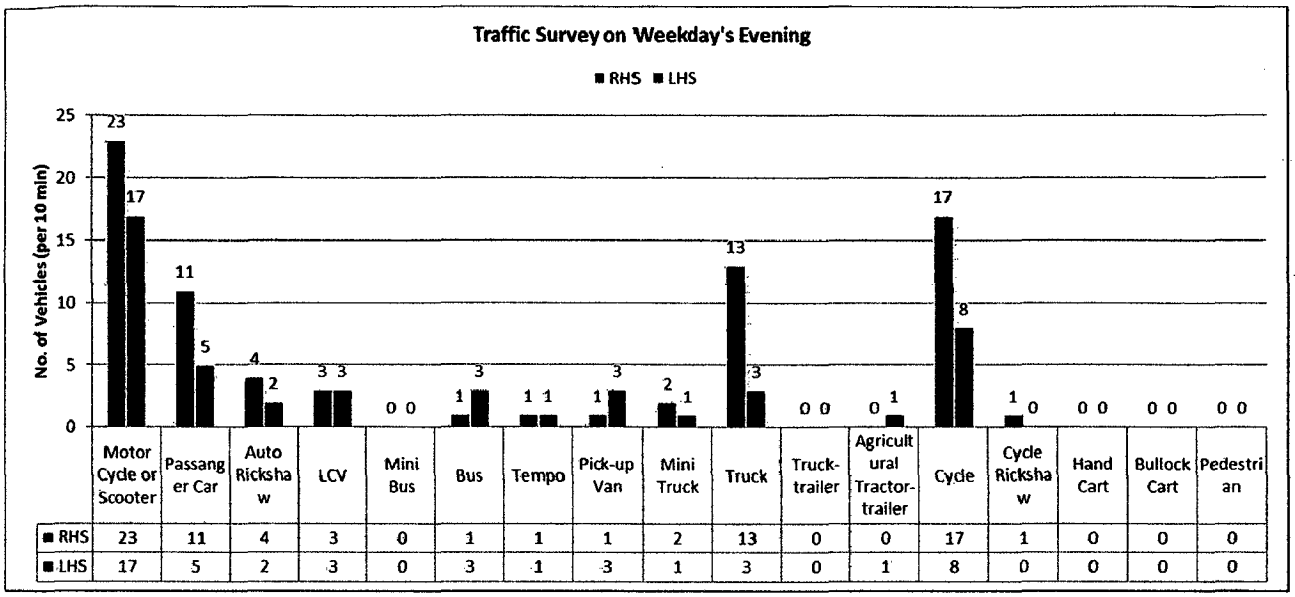
Table 33: Purpose of Visit to Nearby City by Rural Population

Purpose of visit by rural population to nearby city (in %)					
Destination	**Occupation**	**Education**	**Health Services**	**Recreation**	**Visiting Government Offices**
Within Village	54	42	0	0	0
Within Block	12	28	12	0	0
Nearby District Town	34	30	88	100	100

From the house-hold survey, it is found that 34% of rural population go to near by town for their occupation and since the traffic survey was carried out at the morning pick-time i.e. at 9 AM, so the office goers are obseved more on the LHS on weekday's morning.

From the traffic survey carried out in the evening of weekdays, it is observed that the traffic on RHS is more than the traffic on LHS. This is shown in Figure 57.

Figure 57: Traffic Survey on Weekday's Evening



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
RHS	23	11	4	3	0	1	1	1	2	13	0	0	17	1	0	0	0
LHS	17	5	2	3	0	3	1	3	1	3	0	1	8	0	0	0	0

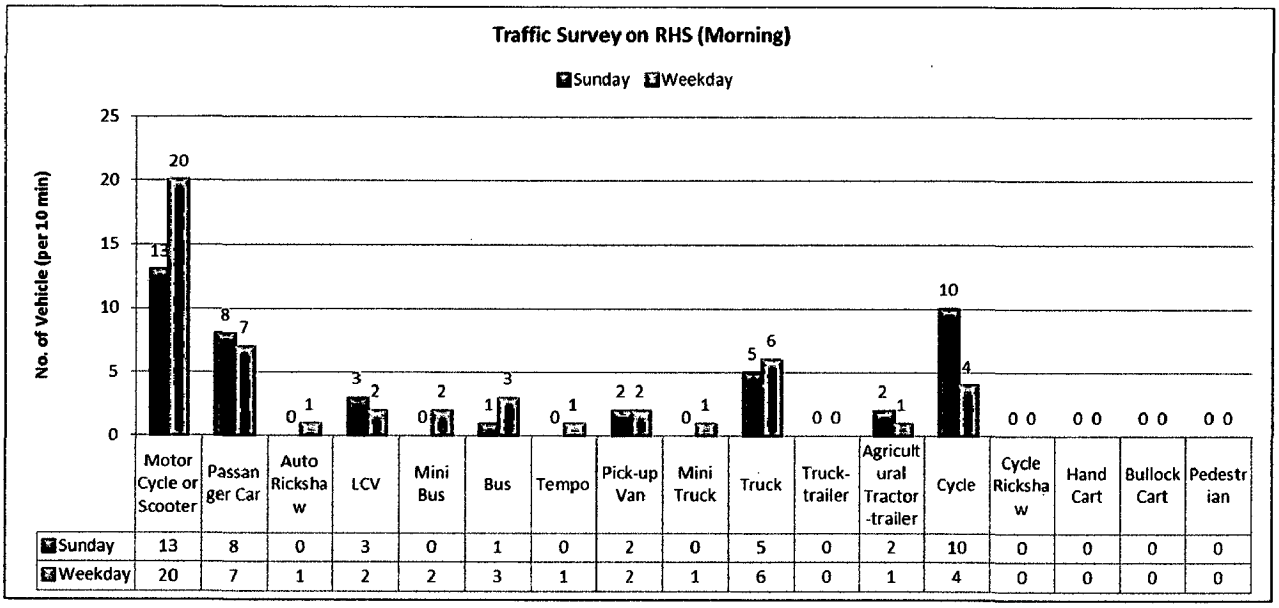
The number of private vehicles which includes cycle, motorcycles and cars are observed to be more on RHS. The number of trucks are also more than on RHS that on LHS. The local public transport like auto-rickshwas are also found to be more.

Findings:

- More private and public transport- returning of people from the distric town to rural areas
- More trucks on RHS- trucks generally returun from the other parts of state to capital city so they return back by nigt to take the fresh assignment on the next day.

The traffic survey of RHS carried out on the morning of different day is given in Figure 58.

Figure 58: Traffic Survey on RHS (Morning)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Sunday	13	8	0	3	0	1	0	2	0	5	0	2	10	0	0	0	0
Weekday	20	7	1	2	2	3	1	2	1	6	0	1	4	0	0	0	0

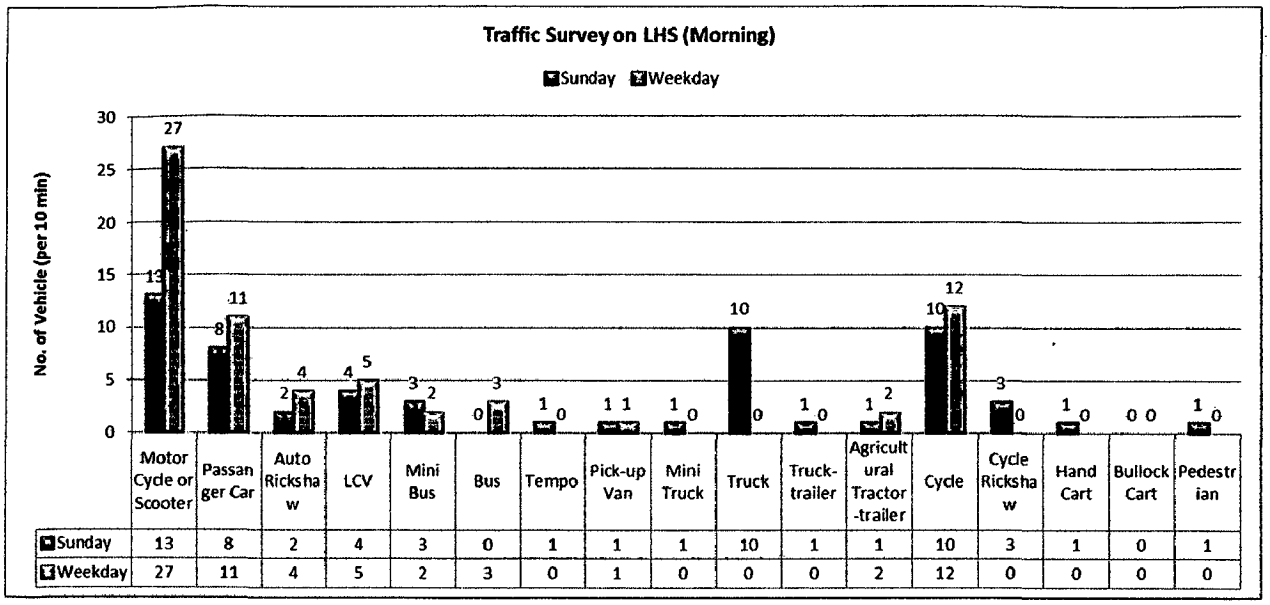
It is observed that on RHS, from Darbhanga to Muzaffarpur, the motorcycles are observed more on weekday's morning, while the numbers of cars are more on Sunday's morning. The public transports like auto-rickshaws and bus are more on weekdays. The trucks movements are also observed to be more on weekdays.

Findings:

- More motorcycles on weekdays- daily commuters like office goers from Darbhanga town to Muzaffarpur town and from Darbhanga town to rural areas are more
- More cars on Sundays- family activity is found more on holidays
- More bus on weekdays- daily commuters from small towns to capital town are more
- More trucks on weekdays- goods movement from distributors to resellers are more on Sundays while returning of vehicles from far-flung areas are more on weekdays

Traffic survey for LHS on the mornings of different days of weeks is given in Figure 59.

Figure 59: Traffic Survey on LHS (Morning)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor -trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Sunday	13	8	2	4	3	0	1	1	1	10	1	1	10	3	1	0	1
Weekday	27	11	4	5	2	3	0	1	0	0	0	2	12	0	0	0	0

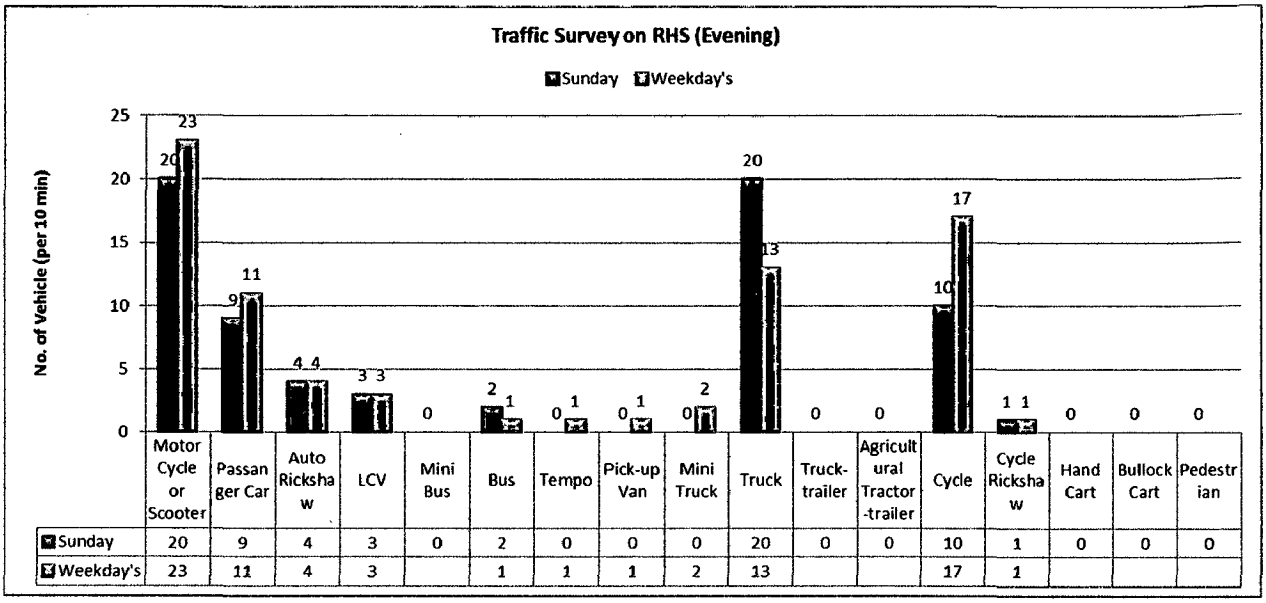
From the table it is observed that on LHS, from Muzaffarpur to Darbhanga, the numbers of private vehicles like motorcycles, cycles and cars are more on weekdays. The movement of local public transports like auto-rickshaws and light commercial vehicles are also observed more on weekdays whereas the movements of trucks are observed to be more on Sundays.

Findings:

- More private vehicle- daily commuters from rural parts of district to district town and from Muzaffarpur to Darbhanga is more
- More local public transport- daily commuter like office goers are more from rural areas to nearby district
- More bus- daily commuters from capital town to small towns are more
- More trucks- the movement of goods from the capital town to other parts of states are more on Sundays

From the traffic survey carried out on RHS, it is observed that the overall traffic on weekday's evening is more than that on Sundays except trucks. It is shown in Figure 60.

Figure 60: Traffic Survey on RHS (Evening)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Sunday	20	9	4	3	0	2	0	0	0	20	0	0	10	1	0	0	0
Weekday's	23	11	4	3		1	1	1	2	13			17	1			

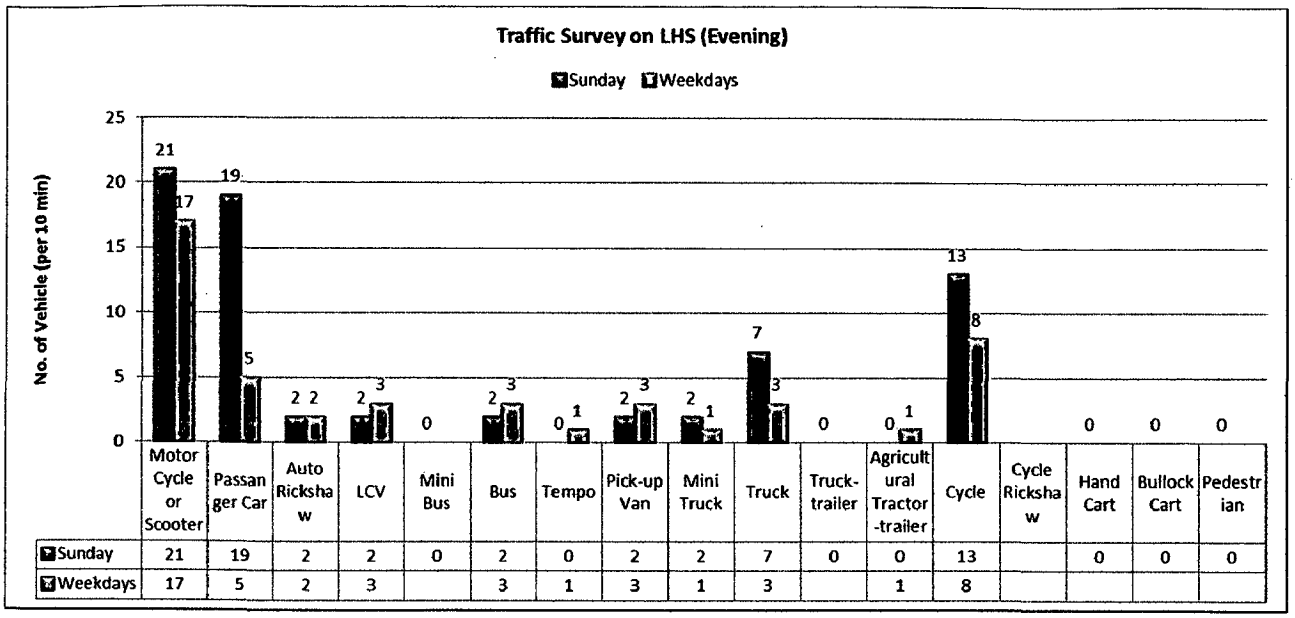
It is observed that on RHS, from Darbhanga to Muzaffarpur, the numbers of private vehicles are more on weekdays than that on Sundays. The numbers of local public transports are observed to be equal on all the days of week. The movements of small goods carrier like tempo, pick-up and mini trucks are more on weekdays while the movements of trucks are more on Sundays.

Findings:

- More private vehicles like cycle, motorcycle and car- returning of people from district town to the rural areas after office or workplace
- More small goods carrier- movement of short distance goods vehicle are more on weekdays
- More trucks on Sundays- Movements of long distances goods vehicle is more on Sundays

Traffic survey carried out on LHS, in the evenings of different days of week is given on Figure 61.

Figure 61: Traffic Survey on LHS (Evening)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor -trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Sunday	21	19	2	2	0	2	0	2	2	7	0	0	13		0	0	0
Weekdays	17	5	2	3		3	1	3	1	3		1	8				

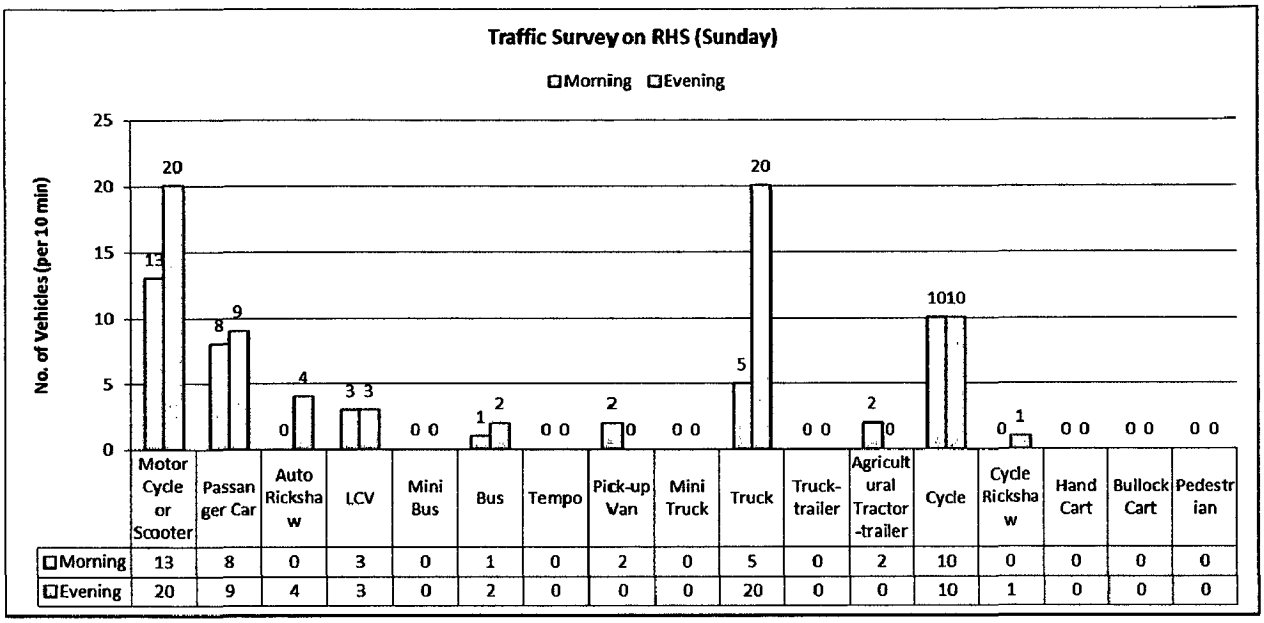
It is observed that on LHS, from Muzaffarpur to Darbhanga, the numbesr of private vehicles are more on Sunday evening than on weekday's evening. The numbers of public transports like auto-rickshaw, light commercial vehicles and bus are observed to be equal throughout the week while the movement of trucks is observed more on Sundays.

Findings:

- More private transport on Sundays- movement of rural population to the nearby city for recreational and entertainment activities.
- More trucks on Sundays- the movement of goods vehicle is more on Sundays since retailers prefer holidays for stock activities

Traffic survey carried out for RHS on Sunday, for the two peak-time of day i.e. at 9 AM and 5 PM is given on Figure 62.

Figure 62: Traffic Survey on RHS (Sunday)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Morning	13	8	0	3	0	1	0	2	0	5	0	2	10	0	0	0	0
Evening	20	9	4	3	0	2	0	0	0	20	0	0	10	1	0	0	0

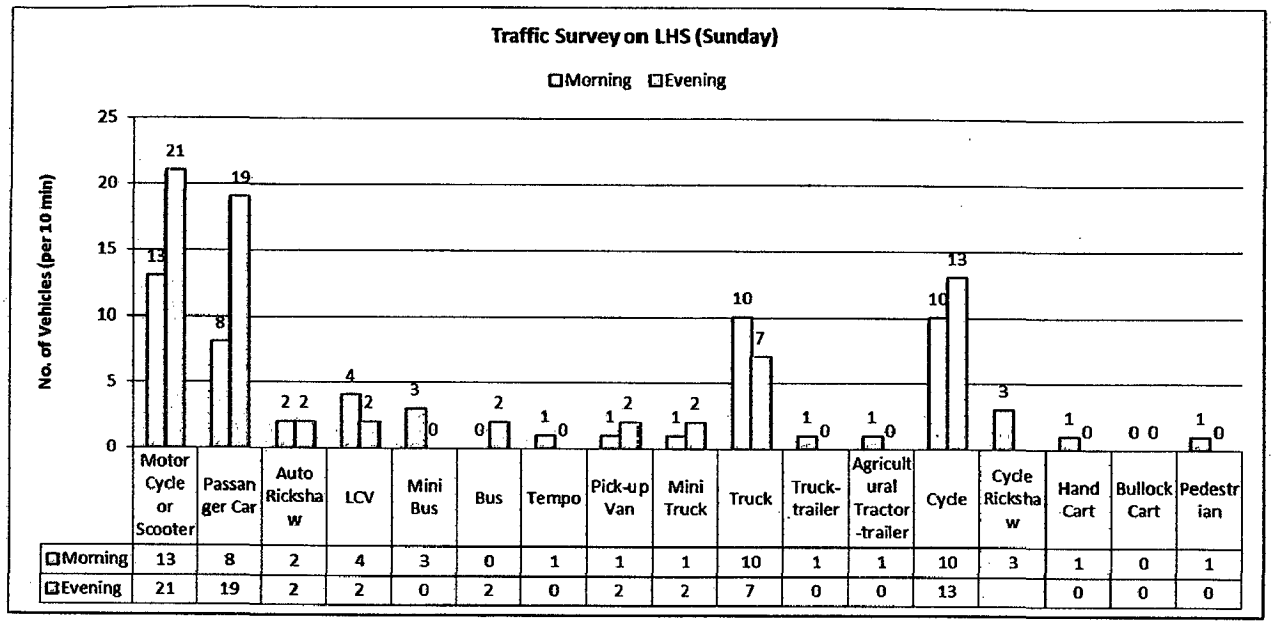
It is observed that on RHS, from Darbhanga to Muzaffarpur, the number of two wheelers and three wheelers are more in evening than morning. The numbers of cars, cycles and light commercials vehicles are not changing much throughout the day while the numbers of trucks are much higher in evening than morning.

Findings:

- Increasing number of two wheelers and three wheelers- movement of rural population to and from district town is high on weekends
- Increasing number of trucks- while returning from far-flung areas to capital town after delivery of goods, it turns out to be dark

From the traffic survey carried out for LHS on Sunday, it is observed that overall traffic increases from morning pick-time to evening pick-time. It is shown in Figure 63.

Figure 63: Traffic Survey on LHS (Sunday)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Morning	13	8	2	4	3	0	1	1	1	10	1	1	10	3	1	0	1
Evening	21	19	2	2	0	2	0	2	2	7	0	0	13		0	0	0

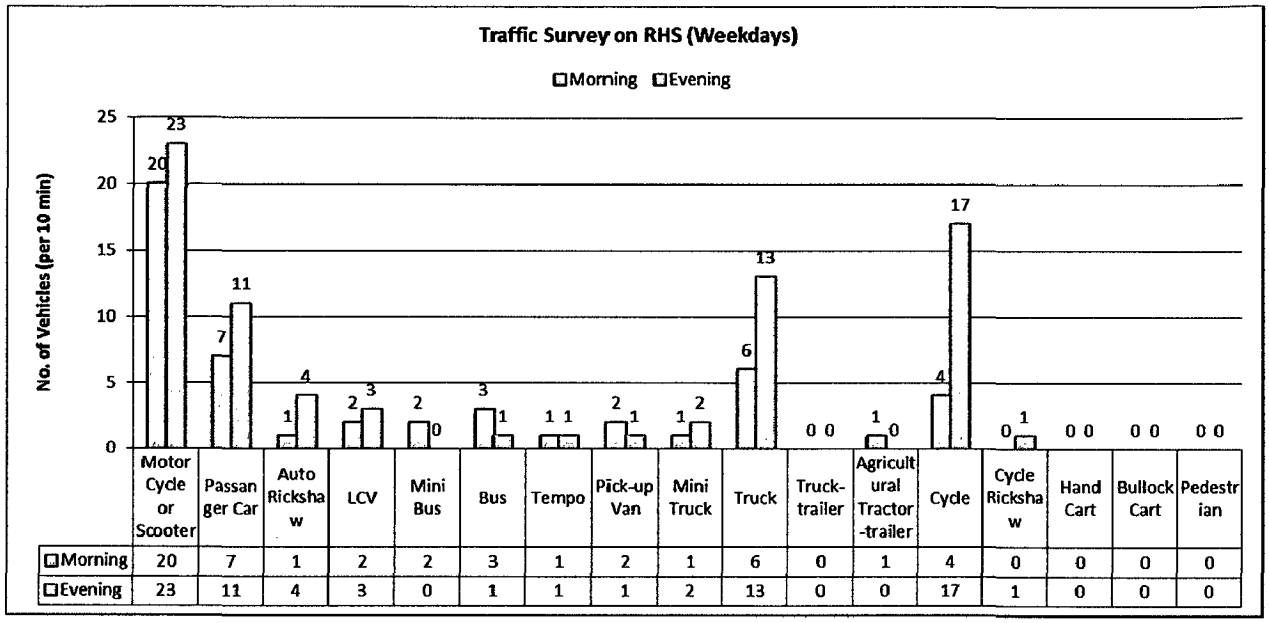
It is observed from the traffic survey for LHS, from Muzaffarpur to Darbhanga, the numbers of private vehicles like cycles, motorcycles and cars increases from morning to evening. The movemnt of long distance bus service also increases while the movement of local public trasnport decreases. The number of small goods carreier increases while the number of trucks decreases.

Findings:

- Increase in the number of private vehicle- movement of rural population to district town for recreational and entertainment activities
- Increase in the number of long distance buses- returning back of people to home town before start of week
- Decrease in number of trucks- the movement of goods vehicles takes place on Sundays and holidays and hence for the various parts of state, it leaves in morning

Traffic survey for RHS was carried out on various working days of week for the two pick-time of the day, i.e. at 9 AM and 5 PM. It is given in Figure 64.

Figure 64: Traffic Survey on RHS (Weekdays)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Morning	20	7	1	2	2	3	1	2	1	6	0	1	4	0	0	0	0
Evening	23	11	4	3	0	1	1	1	2	13	0	0	17	1	0	0	0

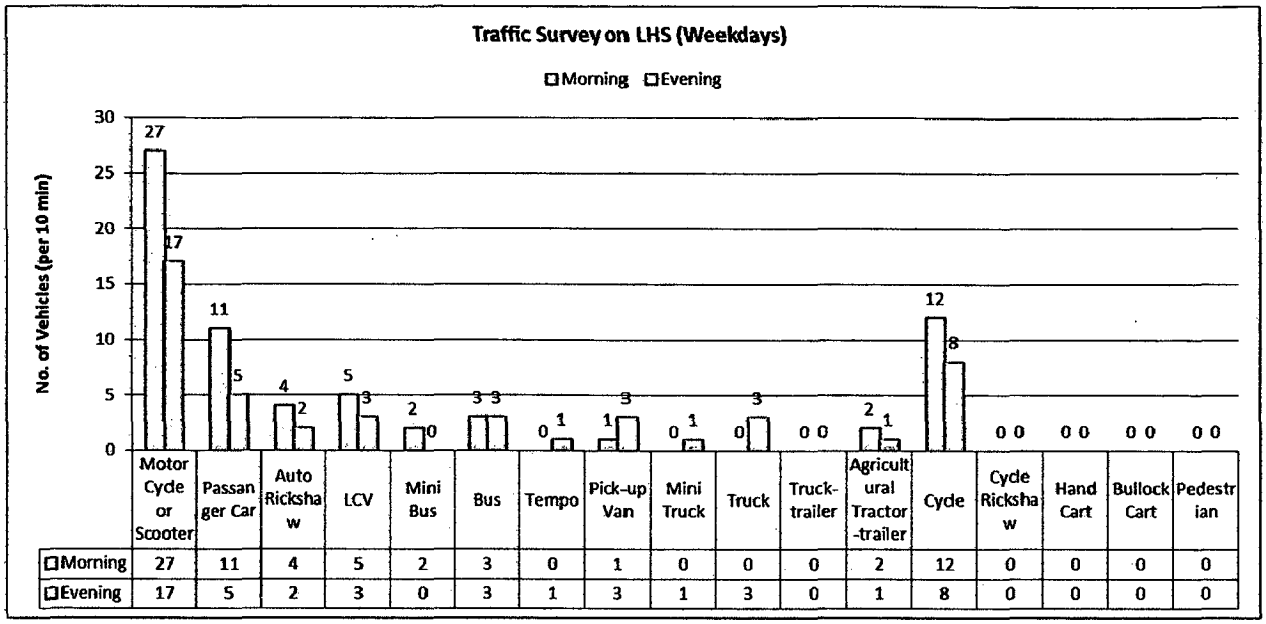
From the survey on RHS, from Darbhanga to Muzaffarpur, it is observed that the overall traffic is increasing from morning to evening. The numbers of private vehicles like cycles, motorcycles and cars are increasing. The movement of short distance public vehicles is observed to be increasing while that of long distance public vehicles is decreasing from morning to evening. The numbers of trucks are also increasing.

Findings:

- Increase in the number of private transports- returning back of daily commuters from district town to rural areas and other towns
- Increase in number of local public transport- retuning of rural population from district town
- Increase in number of trucks- it turns out to be dark while returning from far-flung areas of state

From the traffic survey carried out for LHS on the working day, it is observed that overall traffic decreases from morning peak-hour i.e. 9 AM to evening peak-hour i.e. 5 PM. It is shown in Figure 65.

Figure 65: Traffic Survey on LHS (Weekdays)



	Motor Cycle or Scooter	Passanger Car	Auto Rickshaw	LCV	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck	Truck-trailer	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Bullock Cart	Pedestrian
Morning	27	11	4	5	2	3	0	1	0	0	0	2	12	0	0	0	0
Evening	17	5	2	3	0	3	1	3	1	3	0	1	8	0	0	0	0

It is observed that on LHS, from Muzaffarpur to Darbhanga, the number of private vehicles which includes cycles, motorcycles and cars are decreasing from morning to evening. The number of short distance public transport is decreasing while the number of long-distance public transport remains unchanged. The movement of all kind of goods vehicles is also observed to be increasing.

Findings:

- Decrease in the number of private transport- public movement toward the district town from rural areas are more in morning because of location of basic social infrastructures like banks, post offices and other government offices in the nearby city

5.3 TRAFFIC PATTERN

From the traveller's survey of 100 vehicles including pedestrians, the movement pattern has been observed. This is given in Table 34.

Table 34: Movement Pattern of Vehicles

Type of Vehicle	Beyond Cities	Between Cities	From City to Rural Area	Within Rural Area
Two Wheelers	2	11	14	4
Three Wheelers	0	0	3	3
Car	6	2	0	0
LCV	0	0	3	0
Bus	4	1	0	0
Pick-up	0	2	1	0
Tractors	0	0	1	2
Cycle	0	0	2	5
Cycle Rickshaw	0	0	0	2
Hand cart	0	0	0	1
Animal Driven	0	0	0	1
Pedestrian	0	0	0	8

It has been observed that maximum bikes are going from rural area to city or vice-versa. Three wheelers mainly move either between city to rural area or between rural areas whereas all the other local public transport moves between city to rural area only. Car and bus moves either between citites or beyond cities. Pick-up is used for transporting goods either between cities or from city to rural area. Except few cycles, all the slow moving vehicle inclusing pedestrian has been observed commuting only within rural areas.

Out of the 31 two wheelers surveyed, 20 has been found either going for office or coming back from the workplace, 2 on official work like meetings etc., 5 for business, 1 for tour to other parts of country and 3 for familiy actitites. Similarly, out of 8 car user, 1 has been found to office, 2 on the official work, 1 for business, 3 for familiy activities and 1 for going to Patna to catch train. This is shown in Table 35.

Table 35: Purpose of Travel

Type of Private Vehicle	Office	Official Work	Business	Tour	Family Activity	To catch Train	To catch Flight
Two Wheelers	65%	6%	16%	3%	10%	0%	0%
Car	13%	25%	12%	0%	38%	12%	0%

It has been observed that mainly two wheelers are used for going to office by both urban and rural population and cars are used for family activities and some other four wheelers like jeeps which belong to government officials are used for official works.

From the house-hold survey, it has been observed that rural population visit to near by city for various purposes and their fequency of visit is given in Table 36.

Table 36: Frequency of Visit to Nearby City by Rural Population

Purpose of visit by rural population to nearby city					
Frequency	**Occupation**	**Education**	**Health Services**	**Recreation**	**Visiting Government Offices**
Daily	15	9	0	0	0
Weekly	1	0	0	0	0
Occasionally	1	6	44	50	50

It has been observed that out of 17 respondent who visit to nearby city for occupation, 88% go daily while 6% go weekly and 6% go occasionally. For education, out of 15 respondents who visit to nearby city for the purpose, 60% go to school and colleges everyday while 40% go to colleges occasionally only for exams. For health services all of the 44 respondents who visit nearby city because of the absence of hospitals in the rural area, visit occasionally. For recreation entire rural population have to go to nearby city but they go occasionally. All the government offices like DTO, courts etc. are located in district towns, so entire rural population have to visit these offices occasionally.

It is found that the daily visitor among the rural population are mainly for occupation and for education while they also visit occasional to nearby city for various purposes. And the vehicle used as the medium of tranpsort is two wheeler or three wheeler.

From the traveller's survey, the percentage of daily commuters and weekends commuters have been observed out of the total private vehicles which commute between the cities on weedays and weekends. This is given in Table 37. It is observed that from the two wheelers 72% of people commutes daily between the cities while 28% of people commute occasionally whereas 50% of car users commute everyday while rest 50% commute occasionally.

Table 37: Frequency of City to City Commuters

Frequency of Commuters	Percentage (out of city to city commuters)
Two wheelers	
Daily Commuters	72
Occasional Commuters	28
Four wheelers (Private)	
Daily Commuters	50
Occasional Commuters	50

Further from the traveller's survey, given in Table 38, it is found that out of the total person who commute everyday between the cities of Darbhanga and Muzaffarpur, 44% of people reside in Darbhanga and commute to Muzaffarpur everyday while 56% of people reside in Muzaffarpur and commute to Darbhanga. It is observed that percentage of population residing in Muzaffarpur and commuting to Darbhanga is more than vice-versa.

Table 38: Type of Daily City to City Commuter

Type of Commuters	Percentage
Reside in Darbhanga and go to Muzaffarpur everyday	44
Reside in Muzaffarpur and go to Darbhanga everyday	56

The various resaons for commuting instead of residing in the other town has been noted by the traveller's survey. This is shown in Table 39. It is observed that out of the total 4 survey persons who reside in Darbhanga and commute to Muzaffarpur everyday, 50% quoted the reason for residing as family attchment whereas 25% quoted reason to be higher rent and 25% said commuting is easy. Similarly, out of the total 4 persons who commute to Darbhanga but reside in Muzaffarpur, 20% quoted better infrastructure in the city as reason while 40% quoted better schooling for their children as the reason. 20% of people have given family attchment as the resaon for residing in that city whereas rest 20% said commuting is easy.

Table 39: Reason for Daily Commuting

Reason for Commuting	Darbhanga to Muzaffarpur	Muzaffarpur to Darbhanga
Better physical infrastructure	0	20
Better schooling for children	0	40
Family attchments	50	20
Higher rent	25	0
Commuting is easy	25	20

It is observed that instead of residing in the town where the person is working, the daily commuters are preferring to stay in the home town and the main reason for the people residing in medium town as Muzaffarpur, is better schooling for children whereas the main reason for people residing in smaller towns like Darbhanga, is the family attchments.

Observations

Combining the vehicle count and traveller's sruvey, following points have been observed:

- Movement of two wheelers depicts mainly the travel pattern of the office goers or occupational movement. Rural population which lives nearby city, go to the city area for their occupation. The urban population go to the rural area since their offices are locacted there but residence is in town. The urban population from small city go to medium city because they prefer commuting than residing in medium city. The urban population of medium city go to smaller city since they also prefer to commute than to settle there.
- The movement of three wheelers mainly shows the movement pattern of rural population. The people from nearby rural area go to the nearby city for their occupation as well as for use of basic social infrastructures likes banks, post office, government offices etc. And this movement is observed to be more towards the city during morning while they come back by evening. The movement of rural population is also observed to be more on weekends because of their visit to nearby city for recreational and family activities and this movement takes place only in evening time.
- The movement of car shows the movement of urban population for the familiy activities. It is found that the familiy activities are more on Sundays and holidays throughout the day.
- Movement of long distance public transport like buses shows the movement of urban population between capital city of state and other smaller cities. Buses are observed to be more on weekdays throughout the day while on Sundays, it is more during the evening time to facilitate the return of people to home, who are out on family activites and to workplace, who went to home on weekends.
- Movement of goods vehicles are found to be throughout the week for short distances but the movement of goods from distributors in capital to resellers in other parts of state takes place on Sunday moring from Patna and it return back before night on same day or other day so that it should be made available to the wholesale market in the morning of next day.

5.4 HIGHWAY DESIGN

Highway design consists of the following parameters of roads.

Highway design includes

- Right of way
- Cross-section
- Median opening
- Vehicular underpass
- Facilities for pedestrian and cyclist
- Cattle underpass
- Intersection treatment
- Service road for separation of local traffic
- Access from private property
- Pedestrian crossing
- Bridges & culverts

5.4.1 Right of Way

From the visual survey conducted by author for the different hours of day, it is observed that apart from transportation, various activities are taking place inside the ROW. Some of the activities are shown in Figure 66.

ROW is-

- Used for commercial activities
- Used for storing construction material
- Used as storage of agricultural products
- Used for drying of cow-dung cakes
- Used as solid waste dump yard
- Used as public place

Figure 66: Pictures Showing Various Uses of ROW

Observations

- ROW is free of built structures in the new alignment
- In the old alignment, the built structures has not been demolished by the authority

Land has been acquired by NHAI but the old settlements and structures which are standing in the ROW have not been demolished or moved. The stretch where the new alignment is laid like the stretch between chainage 0.00 to 9.70 and after 63.2, the ROW consist of agricultural land and hence ROW is free of any built structures but rest of the length which follows the old alignment, the ROW consists of the built structures. Actually there structures were the private property but the authority has now purchased these lands as a part of the ROW widening but the authority is not able to demolish the structure and free the ROW.

It is observed from the house hold survey that the person affected due to widening of ROW have been paid the compensation money but since these structures are still standing, so they have not vacated it.

From the interview of employee of contracting agency, it is observed that in the bill of quantity (BOQ) prepared by the contracting agency, only the cost of removal of structures falling within the main-carriageway was included. Hence the contracting agency has removed the only needed part as per the agreement.

From the house-hold survey, the type of structures within the ROW has been observed as given in Table 40.

Table 40: Percentage composition of Type of Structures within ROW

Type of Structure	Percentage
Mud	68
Brick	26
Concrete	6

The structures are mainly the ground structures and these structures are mostly located near the junctions, which are mainly used for commercial activities catering to the need of local travellers and nearby villagers. Due to the commercial nature of these structures a large number of people move around these structures occupying the road space and hence effectively reducing the width of main-carriageway.

5.4.2 Cross-Section

From the house-hold survey conducted for the residents of nearby settlements, it has been observed the walking is the primary modes of transport for rural population while cycles and bikes are used for going to distant places. This is given in Table 41.

Table 41: Percentage Composition of Primary Mode of Transport

Primary Mode of Transport	Percentage
Walking	40
Cycle	30
Motorized Two wheeler	30
Car	0
Animal Driven	0

It is also observed from the traffic survey conducted at chainage 55 km, that slow moving powered vehicles like agricultural tractor and non-powered vehicles like cycle, hand cart and animal driven vehicles are in good in number on highway. This is given in Table 42.

Table 42: Composition of Slow Moving Vehicles

TRAFFIC SURVEY DATA SHEET																								
				Type of Vehicles																				
Survey Time	Survey Date	Traffic Direction	Survey Location	Motor Cycle or Scooter	Passenger Car	Auto Rickshaw	LCV (Jeep)	LCV (Auto 4 Wheel)	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck (2 Axle)	Truck (3 Axle)	Truck (4 Axle)	Truck-trailer	Agricultural Tractor	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Horse-drawn Vehicle	Bullock Cart	Pedestrian
9:02 AM	26-Feb	RHS	@ 55 km	13	8		3			1		2		3	1	1			2	10					
9:02 AM	26-Feb	LHS	@ 55 km	13	8	2	3	1	3		1	1	1	1	5	4	1		1	10	3	1			1
5:16 PM	26-Feb	RHS	@ 55 km	20	9	4	2	1		2				2	11	7				10	1				
5:16 PM	26-Feb	LHS	@ 55 km	21	19	2	2			2		2	2	1	6					13					
9:33 AM	27-Feb	RHS	@ 55 km	20	7	1	1	1	2	3	1	2	1	4	1	1			1	4					
9:33 AM	27-Feb	LHS	@ 55 km	27	11	4	4	1	2	3		1							2	12					
12:07 PM	27-Feb	RHS	@ 55 km	24	8	2	4	1		1	1	1		3	1				1	8	1			1	
12:07 PM	27-Feb	LHS	@ 55 km	30	10	2	5	1	1	3	1	3			7	3				16					
12:11 PM	28-Feb	RHS	@ 55 km	11	10	1	1	1		1		3	2	2	1	1			1	6					
12:11 PM	28-Feb	LHS	@ 55 km	34	7	5	4			3		1		7	2				2	10					1
5:17 PM	28-Feb	RHS	@ 55 km	23	11	4	2	1		1	1	1	2	3	8	2				17	1				
5:17 PM	28-Feb	LHS	@ 55 km	17	5	2	3			3	1	3	1	1		2			1	8					

Slow moving vehicles are dominant on the rural stretch of highway but the dedicated lane for these vehicles are not provided during the four laning. So, these slow moving vehicles occupy one carriageway from the dual carriageway on either side. To segregate these vehicles a dedicated lane should be provided on the either side of the highway.

5.4.3 Median Openings

The length of median opening provided to facilitate U-turn is 5 m which is less than 20 m as recommended by the Manual. At some places median openings are provided even on the slopes hence vehicles faces problem while crossing.

During the survey, people's behavior of crossing the highway has been noted. The methods of crossing the highway for various types of vehicle are given in Table 43.

Table 43: Methods of Crossing Highway for Various Types of Vehicle

Methods of Crossing Highway	Percentage
For Cyclist	
Follow traffic rule	0
Lifting cycle and crossing anywhere	59
Driving in wrong direction and then crossing at median opening	41
For Motorcyclist	
Follow traffic rule	6
Driving in wrong direction and then crossing at median opening	94
For Car	
Follow traffic rule	100
Driving in wrong direction and then crossing at median opening	0

For Animal Driven	
Follow traffic rule	0
Driving in wrong direction and then crossing at median opening	100

So, from above table it is observed that the non-motorized vehicle which includes cycle and animal driven vehicles either drive in the wrong direction and then crosses the highway at the nearest median opening or lift their cycles. Hence to facilitate the movement of non-powered vehicle, so that it does not have to travel to long distances to follow traffic rule and to avoid driving in wrong direction on highway, a bidirectional track can be provided on either side of highway.

5.4.4 Underpasses

Underpasses are provided only below the FOB to facilitate the movement of local vehicle crossing the highway. These underpasses are also used for pedestrian crossing. The underpass is shown in Figure 67.

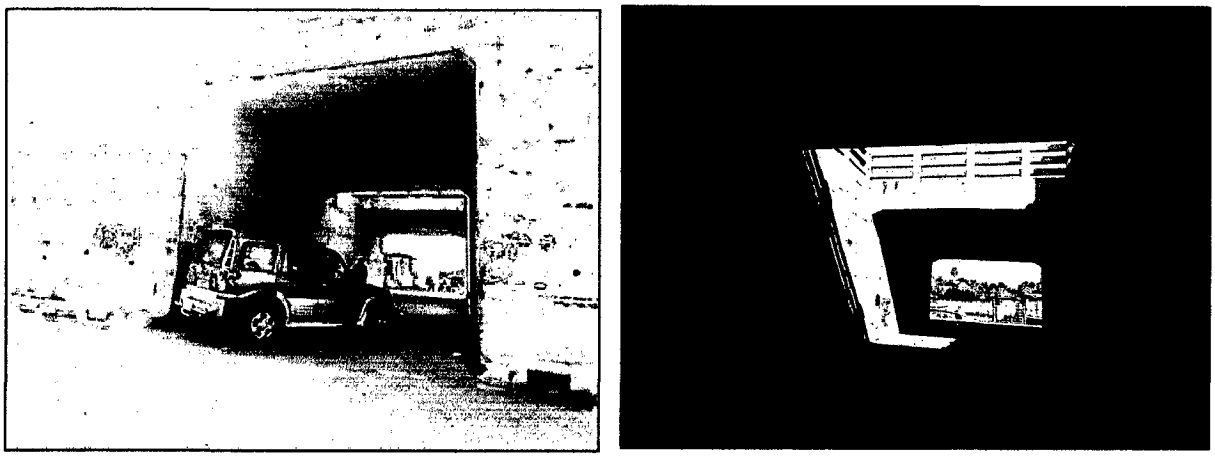


Figure 67: A view of Underpass

Apart from these 6 underpasses provided within a distance of 63 km, not a single underpass is provided for the cattle crossing and for pedestrian crossing. So cattle cross the highway on the surface and while crossing many a times it can be seen gazing the median plantation.

5.4.5 Intersections

Analyzing the distances between the junctions, it is found that junctions are placed much closer than the standard provided by the Planning Commission and Ministry of Surface Transport. The standard recommends the minimum distance between the junctions to be 3 km whereas none of the junctions are placed at the distance greater than 3 km. The maximum distance between the junctions provided on LHS is 2.91 km whereas on RHS it is 1.89 km.

The minimum distance between the junctions is as low as 40 m on LHS and 30 m on RHS. These distances are shown separately for LHS and RHS in the Figure 68 and Figure 69.

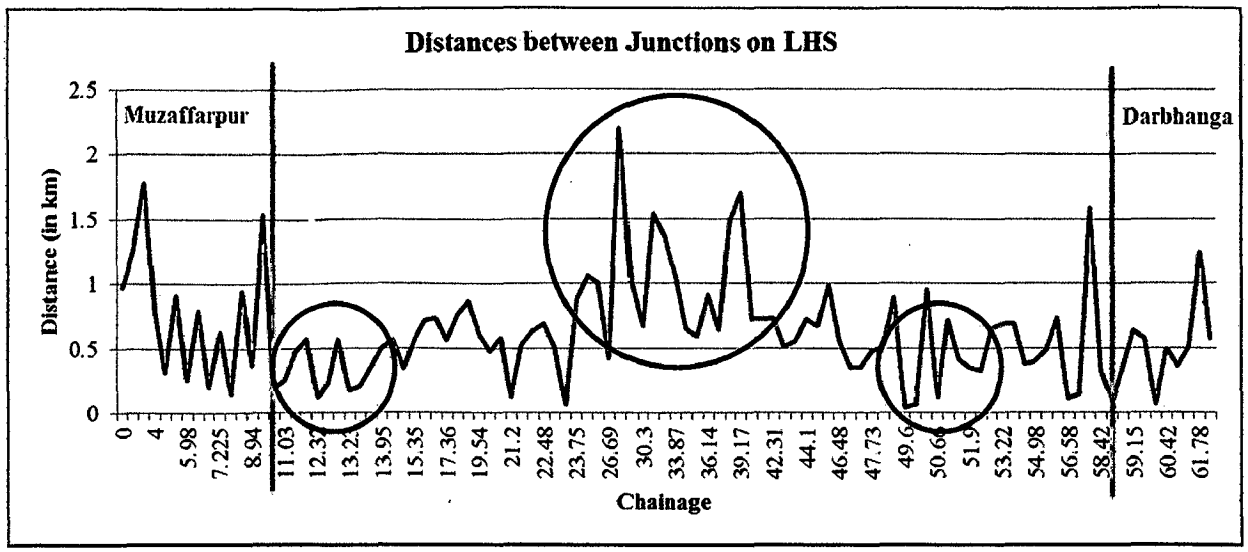


Figure 68: Distances between Junctions on LHS

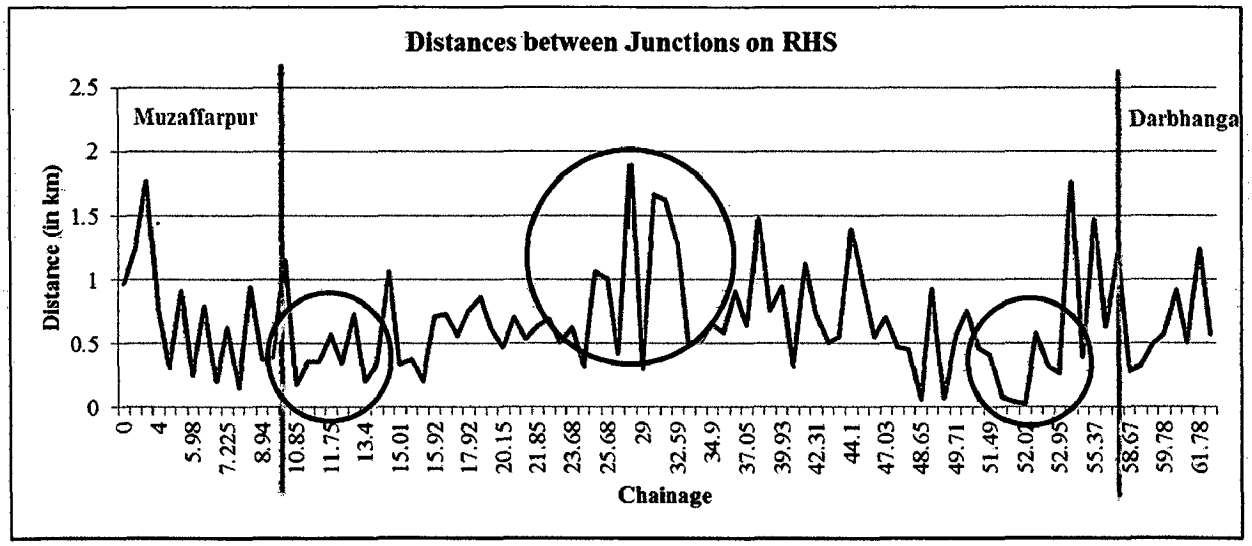


Figure 69: Distances between Junctions on RHS

From the above line graphs, it is observed that the junctions are closely placed near the city area or just outside the city boundary and as one go away from city area it increases. It shows the pattern of settlement growth that near the city, settlement are growing linearly in the direction of highway and more number of access roads are required from the highway whereas after the influence of city i.e. in the pure rural area, the junctions are placed at comparatively more distances which depicts that settlement are not spreading along the highway but growing in all direction and impact of highway on these settlement are less.

Junctions include three type of roads connecting to the highway. These are cart tracks, brick roads and pacca roads. The consecutive distance between each type of road on one side of the highway is given in the Figure 70.

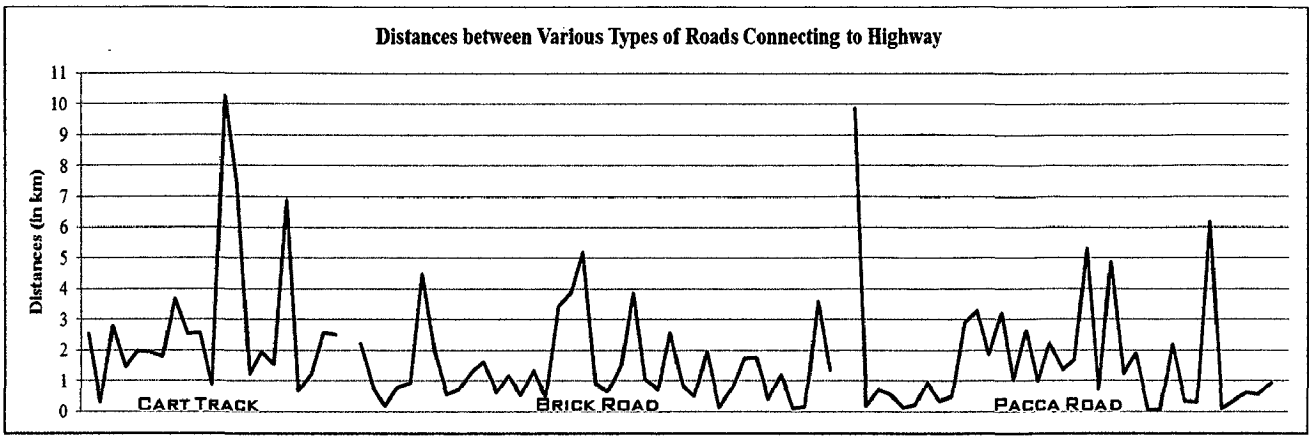


Figure 70: Distances between Various Types of Roads

From the above figure, it can be observed that the distances between the junctions where cart tracks are connecting to the highway is less than 1 km only at four places whereas this distance for brick roads and pacca roads are observed at frequent places. Similarly distance of more than 3 km for cart track is observed at only four places whereas for brick road and pacca road it is observed at six places.

It is further observed that the junctions of brick road to the highway occur frequently whereas junction of cart track to the highway and of pacca road to the highway generally occurs at distance of more than 1 km but still these distances are less than the recommended distance of 3 km by Highway Manual. It can be concluded from the Figure 70 that the smaller settlements which are connected by the brick road are found more along the highway than the major settlements which are connected by pacca road or the non-habitable area which are connected by cart track.

5.4.6 Pedestrian Crossing

From the house-hold survey it is observed that 98% of pedestrians cross the highway wherever they need to cross it. Only 2% population of nearby settlement are using crossing provided near the junctions.

Table 44: Method of Pedestrian Crossing

Method of Crossing	Percentage
Only uses pedestrian crossing	0
Uses pedestrian crossing sometimes	2
Crosses anywhere	98

When asked about the reason, 100% replied, these are provided at wrong places, hence apart from providing it at junction or at bus-stop, pedestrian crossing should also be provided near the usual places of crossing highway by villagers.

5.4.7 Bridges & Culverts

It is observed that all the minor bridges remain dry most of the year and they are also provided with the hard flooring but still these are not used by pedestrian to cross the highway. Sometimes it is used for cattle crossing. The reason has been asked in the survey, which is given in Table 45.

Table 45: Various Reasons for not using Minor Bridge as Underpass

Reasons	Percentage
Absence of approach road	78
Surface crossing is adequate	4
No knowledge about its use as crossing	18

The absence of approach road has been observed as the main reason for the ignorance of use of minor bridges as pedestrian and cattle crossing. It is also observed that all the minor bridges are more than 5m in length. Hence, it should be provided with an access road to use it as underpass.

5.5 HIGHWAY FACILITIES

5.5.1 Bus Bays and Passenger Shelter

Analysing the distance between the bus-stops provided between Darbhanga and Muzaffarpur on E-W Corridor, as shown in Figure 71, it is found that the maximum distance between the bus-stops is as high as 10.53 km and the minimum distance between the stops is 0.94 km.

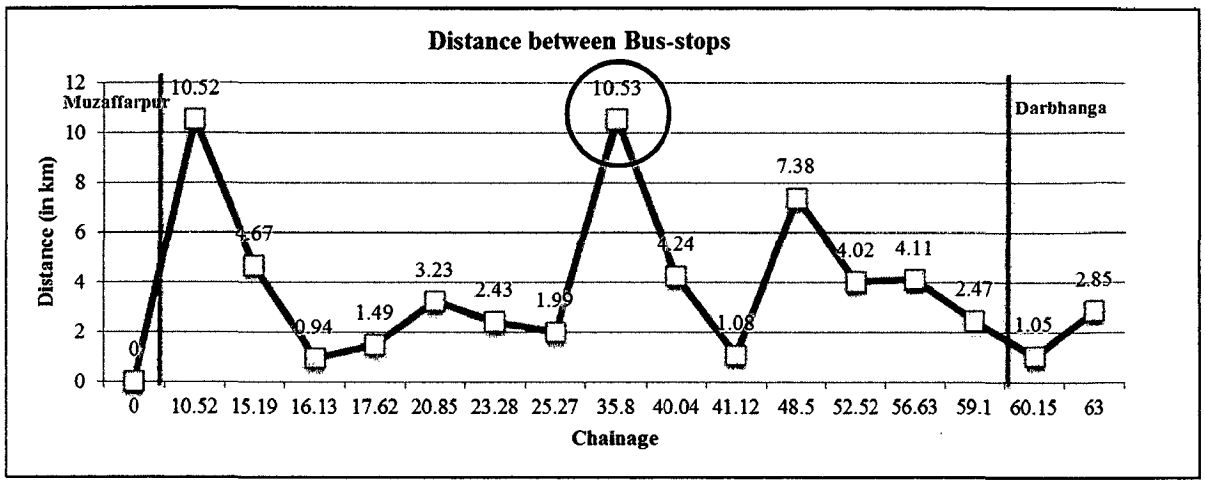


Figure 71: Distance between Bus-stops

While going from 0 km towards Darbhanga on NH 57, the first bus-stop is after 10.52 km which is provided just after the meeting of road coming from Muzaffarpur to highway. There is not a single bus-stop in the newly constructed bypass. Similarly after 25.27 km the next stop is after a distance of 10.53 km while there are two bus-stops within a kilometer at 16 km.

By overlapping the locations of bus-bays on the junction map, it is found that the distance between the minor junction and bus-stop is at least 60 m and between the major junction and bus-stop is at least 300 m as suggested by the Manual. Figure 72 shows the location of bus-stop w.r.t. minor junction and w.r.t. major junctions respectively.

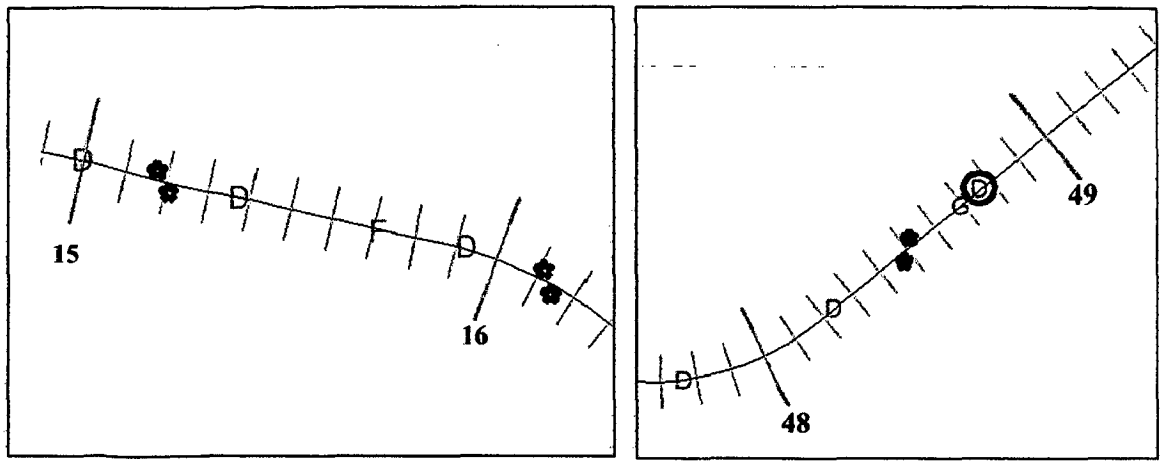


Figure 72: Overlapping Location of Bus-bays on Junction Map

The exception to the above is just the one case where the junction is at chainage 56.58 km and bus-bay is provided at 56.63 km. So, the distance between them is just 50 m, 10 m less than recommended gap. Actually, here the minor junction has been merged into the deceleration lane of bus-bay.

From the traveller's survey, the places where the public transport vehicles stop has been observed as shown in Table 46.

Table 46: Places to Stop Public Vehicle

Type of Public Vehicle	At Bus stop	At Major Junction	At Junction	Anywhere	Nowhere
Three wheelers	0	0	0	100	0
Light Commercial Vehicles	0	0	67	33	0
Bus (City to City)	0	100	0	0	0
Bus (Capital to City)	0	25	0	0	75

It is observed that three wheelers stops anywhere on the highway to take passengers and to drop them. Light commerical vehicle mainly stops at junctions and few stops anywhere. The city to city bus stops only at major juncitons whereas few long distance buses stops at major junctions while other doesn't stop anywhere on the highway. Hence, it can be found that none of the public transport vehicles stop at bus stops.

Similarly, by house-hold survey, the places where restidents of nearby settlements and the rural population board public transport has been observed, as given in Table 47.

Table 47: Places Used by Residents to Board Local Public Transport

Place where residents board local transport	Three Wheelers (in %)	Light Commercial Vehicle (in %)	Bus (in %)
At Bus Stop	0	0	0
At Junction	0	90	100
Anywhere	100	10	0

It is found that residents force the three wheelers to stop anywhere on the highway, depending on their need while for light commercial vehicle residents try to stop them anywhere but sometimes driver stop the vehicle whereas majorly he stops the vehilce at junctions only. In case of bus all the residents board it on the junctions only. Hence, it is found that none of the residents go to bus stop to catch the local transport, stating reason that it is away and why to go there when he has option to board at juctions.

From the house-hold survey, it has been observed that the distance of boarding the local transport is as given in Table 48.

Table 48: Distance of Nearest Boarding Point for Local Public Transport by Rural Population

Distance	No. of respondents	Percentage of respondents
< 200 m	18	36
200 - 500 m	15	30
500 m - 1 km	9	18
1 - 2 km	5	10
> 2 km	3	6

From the visual survey, also, it has been observed that bus-bays are located away from the settlement and since government local bus services are not available on the route, so most of it is not in use for the purpose for which it is constructed. As shown in Figure 73, the dust in the bus-bay shows that, it is not used as bus-stop and in next picture show that, the bus passes without stopping at bus-stops.

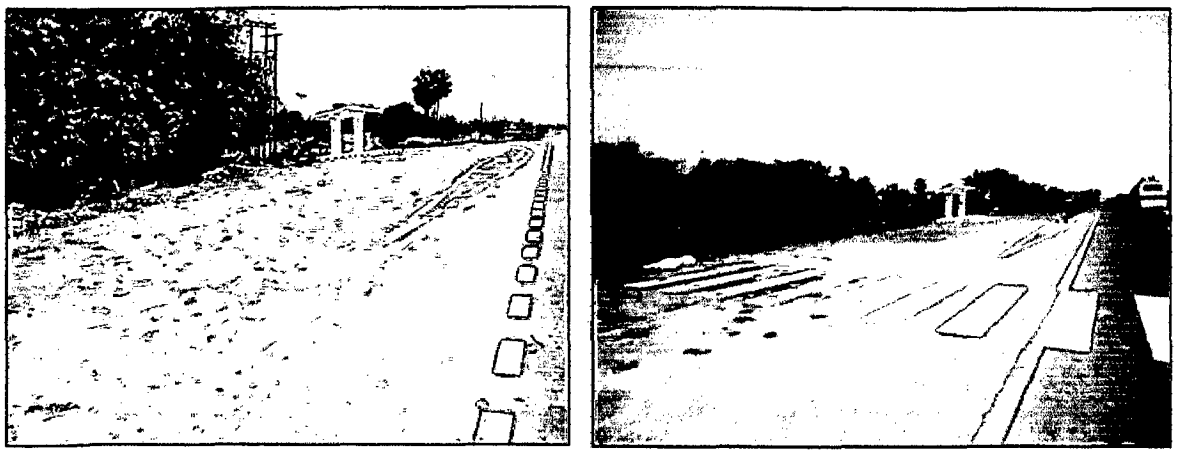


Figure 73: Bus-bays are Not Used as Bus-stops

Instead, bus-bays are used for various other purposes by local residents and travellers. These are listed below and shown in Figure 74.

Uses of bus-bays as:

- Playground by local residents
- Drying place for cow dung cakes
- Small rest area by travellers
- Lay-bye by truck drivers
- Storage for construction material by local residents and commercial establishments

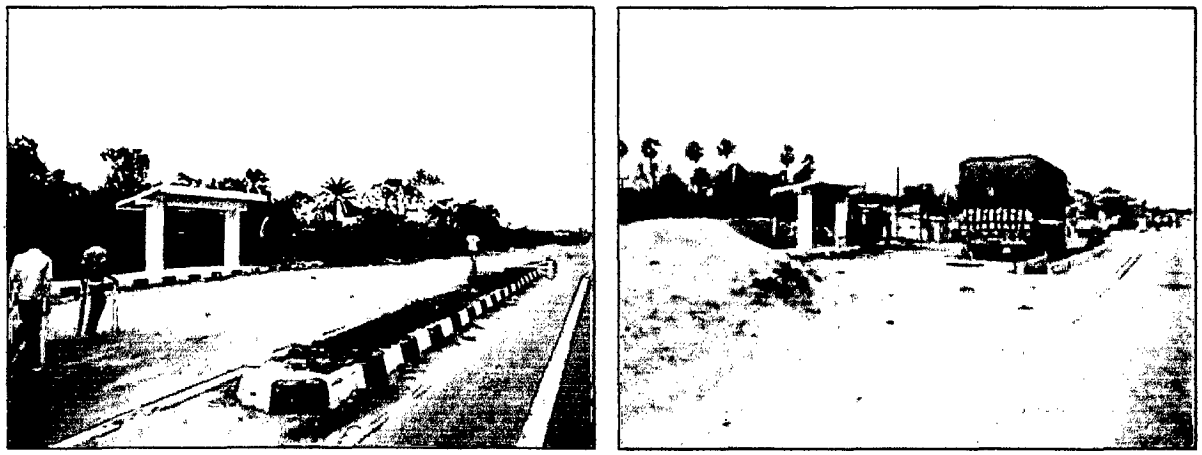


Figure 74: Various Uses of Bus-bays

Now overlapping the location of bus-stops on the settlement map, as shown in Figure 75, it is found that bus-stops are provided only to cater the population residing along the highway while it is not provided to cater the rural population residing within the 1 km of the highway on either side.

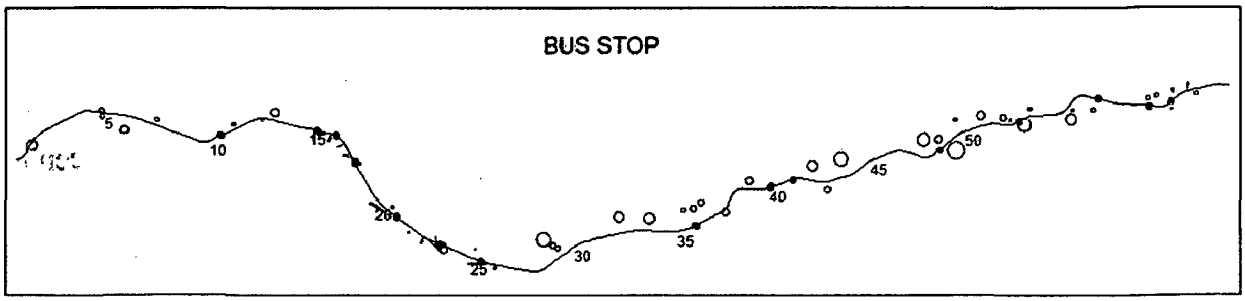


Figure 75: Overlapping Location of Bus-stop on Settlement Map

Hence, it can be concluded that while deciding the location of bus-bays following factors should also be considered:

- Population in surrounding area
- Location of access road
- Location of junction which connects highway to remote areas and availability of feeder service at junction
- No. of local buses running on the highway

5.5.2 Truck Lay-byes

Distances between truck lay-byes provided on E-W Corridor between Darbhanga and Muzaffarpur are shown in Table 49.

Table 49: Distance between Two Consecutive Truck Lay-byes

Side of Highway	Distance between two consecutive Truck Lay-byes
LHS	32.9 km
RHS	41.2 km

It is observed that the distance between two consecutive truck lay-byes are more on RHS than that on LHS.

From travellers survey it is observed that truck drivers drive at various speeds on the highway while going and while returning. This is shown in Table 50.

Table 50: Various Speeds at which Trucks moves

Speed (km per hour)	While going		While returning	
	No.	Percentage	No.	Percentage
< 40	7	54	0	0
40-60	6	46	3	33
60-80	0	0	6	67
>80	0	0	0	0

Out of total 22 trucks surveyed, 13 trucks were going while 9 trucks were returning. Out of 13 trucks which were going, 54% is observed to be driving at speed less than 40 km per hour, 46% at speed between 40 to 60 km per hour and no one was driving at speed more than 60 km per hour. Similarly, out of 9 vehicles which were returning, 33% at speed between 40 to 60 km per hour while rest 67% at speed between 60 and 80 and none of the trucks has been observed driving at speed less than 40 km per hour or more than 80 km per hour while returning.

It is observed from the above table that the average speed of trucks while going remains slow and while returning back, they drive fast.

The reason for faster speed while returning is known, again, from the traveller's survey. This is given in Table 51.

Table 51: Various Reasons for Fast or Slow Driving by Truck Drivers

Reason	While going		While returning	
	No.	Percentage	No.	Percentage
Safely reaching	3	23	0	0
Earlier reaching	2	15	7	78
Heavy load	8	62	0	0
No load	0	0	2	22

Out of 13 trucks which were going, 62% said the main reason for driving slow while going is the heavy load on the truck than safely reaching while out of 9 trucks which were returning, 78% said early reaching as the main reason for driving fast rather than no load.

Now, from the traveller's survey, the type of movement of trucks and the distance from origin to destination is observed. This is given in Table 52.

Table 52: Type of Movement of Trucks

Distance	Type of movement	Number	Percentage
< 100 km	between nearby cities	2	9
100 - 200 km	from capital city to other city	12	55
200 - 500 km	within state	2	9
>500 km	national traffic	6	27

It is found that more than half of the trucks while ply on highway, travels between capital city of state to other parts of state. The reason for this is the location of distribution of goods from wholesalers in the capital to retails in other cities.

From the above analysis, it can be concluded that faster speed while returning is the main reason for more distance between two consecutive truck lay-byes on RHS than on LHS, since the origin point for most of the truck is the capital city and they return back to the same point after delivery of goods to the various parts of state.

Further, from the traveller's survey, the usual time gap between the two consecutive brake journeys for various purposes is found. This is given in Table 53.

Table 53: Frequency of Braking Journey by Trucks

Time gap between brakes	Number of trucks taking brakes for various reasons							
	For snacks		For food		Short term rest		Cooing of vehicle	
	No	%	No	%	No	%	No	%
< 2 hours	0	0	2	9	0	0	0	0
2 – 3 hours	19	86	8	36	17	77	0	0
3 – 4 hours	3	14	11	50	5	23	3	14
> 4 hours	0	0	1	5	0	0	19	86

It is observed that for 86% of truck drivers, the time gap between brake journeys is mainly 2 – 3 hours for snacks, while it is only 14% for 3 – 4 hours. Similarly for food, 50% takes brake within each 3 – 4 hours of driving while 36% takes in between 2 – 3 hours. For short term rest, only 23% takes brakes after 3 hours of journey while 77% takes between 2 – 3 hours of driving and for cooling down of vehicle 14% takes brakes in between 3 – 4 hours while rest 86% takes replied their vehicle need cooling after 4 hours of continuous drive.

It is observed from the above table that majority of truck driver combine snacks, food and short term rest and they usually stop after 2 – 3 hours of continuous driving.

Further, from the survey, it is also found out that the usual time gap between the brakes at dhaba depends on the climate of area. This is shown in Table 54.

Table 54: Average Time Gap Between Journey-brakes in Different Seasons

Avg. time gap b/w brakes	Season					
	Summer		Winter		Monsoon	
	No.	%	No.	%	No.	%
< 2 hours	0	0	0	0	11	50
2 – 3 hours	18	82	9	41	7	32
3 – 4 hours	4	18	13	59	4	18
> 4 hours	0	0	0	0	0	0

It is found that during summer, 82% of truck drivers take brake for food and rest after travelling for 2 to 3 hours while during winter almost 60% take brake after driving for 3 to 4

hours. During monsoon, half of the truck drivers take brake before 2 hours while 38% drive continuously for 2 to 3 hours without brake.

During summer due to hot climate the frequency of taking brakes increases and hence the time gap decreases. During winter the pleasant weather help in driving long distances without taking brake provided the visibility is not much affected due to fog while during monsoon the gap depends totally on the rain. If it is raining heavily, then the time gap between brakes decreases.

From the survey of truck drivers and helpers, the place of sleep is observed. This is given in Table 55.

Table 55: Various Places for Night-halting by Truck Drivers

Place of Rest	No. of truck drivers & helpers	Percentage of truck drivers & helpers
In hotels	0	0
At dhaba	8	36
Inside vehicle	14	64

It is observed that for long term rest like sleeping during the night, 36% of truck drivers sleep at dhaba while 64% sleep inside vehicle. They never sleep in hotels. The reason for sleeping inside or on the roof of vehicle is mainly the safety of goods and truck.

The truck drivers stop at dhabas or other place instead of truck lay-bye provided. The reason is found from the traveller's survey. This is given in Table 56.

Table 56: Various Reasons for Staying at Dhaba by Truck Drivers

Reason	Number of trucks	
	No.	Percentage
Better food	1	5
Availability of entertainment	14	64
Availability of cot	7	32

It has been observed that the criterion of choosing a particular dhaba by the truck drivers is mainly the availability of entertainment like T.V. etc.

From the visual survey, the rest room constructed for truck drivers to rest at truck lay-bye was found to be closed and the lay-bye was also observed as deserted. This is shown in Figure 76.

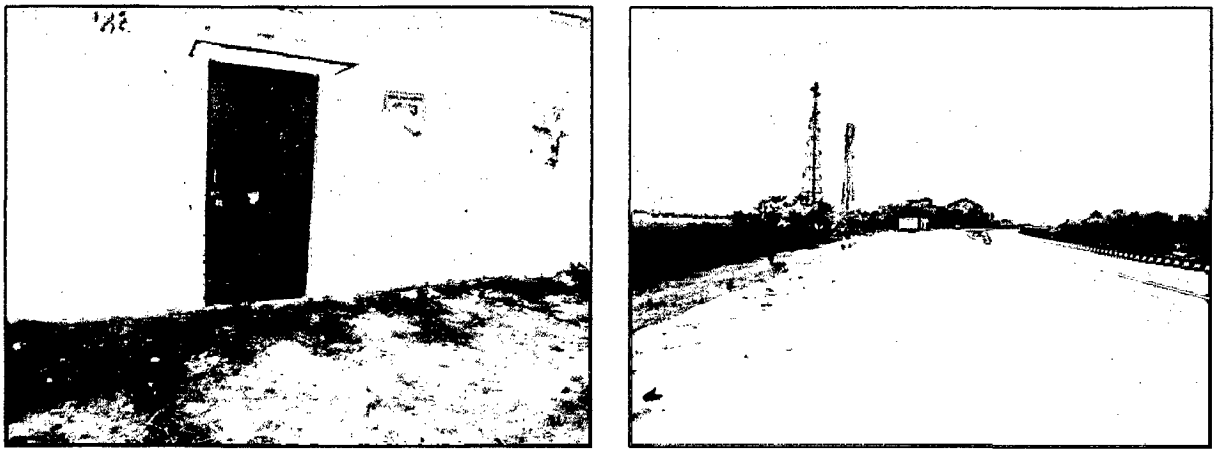


Figure 76: Picture showing Closure of Rest Room and Deserted Truck Lay-bye

The main reason for not using truck lay-byes during night is observed from the survey of truck drivers. This is given in Table 57.

Table 57: Percentage of Truck Drivers with Various Reasons for Not Using Truck Lay-bye

Factors	Primary factor	Secondary factor	One of the factor	Not the factor
Absence of food	86	14	0	0
Absence of entertainment	32	45	14	9
Absence of public movement	100	0	0	0
Closure of rest room	0	27	59	14

It is observed that truck drivers don't stop at lay-bye during night because 86% consider absence of food as the primary factor whereas only 32% consider absence of entertainment as the prime factor. All the truck drivers consider absence of public movement as the primary factor while no one consider closure of rest room as the primary factor.

Hence it is observed that because of absence of public movement at truck lay-bye, the place look deserted and drivers fear of living in isolation. Instead they prefer bus-stops where the place for laying trucks is available as well as the settlements are located not far from the stop. This is shown in Figure 77.

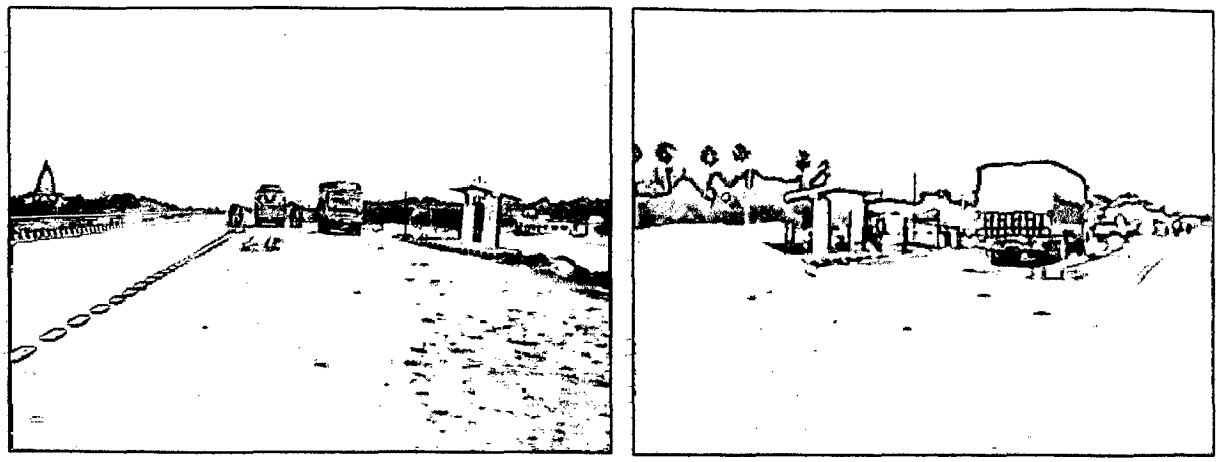


Figure 77: Use of Bus-Bays as Truck Lay-byes

Hence while deciding the location of truck lay-bye following factors should also be considered:

- No. of trucks on the highway
- General trend of movement of trucks like day or night
- Pattern of movement of goods in the region i.e. the location of distributor, yard, etc.
- Climatic condition of the area- frequency of stops by truck drivers
- Availability of food for truck drivers
- Availability of entertainment for truck drivers
- Public movement throughout the day and night near the lay-bye

5.5.3 Dhabas

Analyzing the distances between dhabas present on both the sides of highway, it is found that the maximum distance between the dhabas is almost 8 km whereas the minimum distance is only 30 m . This is shown in Figure 78.

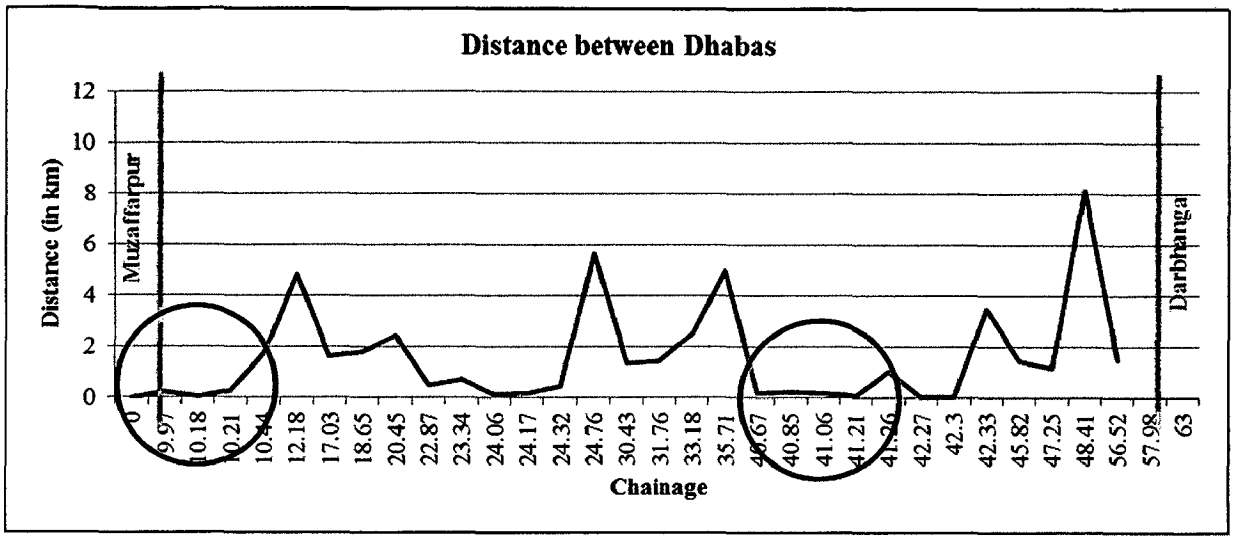


Figure 78: Graph showing Distance between Dhabas

It is observed that the dhabas are placed closer to each other just after the junction where the road coming from the Muzaffarpur town meets the highway. Similarly it is also found placed near to each other at chainage between 40.67 and 42.33 km. There are eight dhaba within a distance of 1.7 km.

Considering just the right side of the highway, i.e. from Darbhanga to Muzaffarpur, the distance between dhabas is observed as given in Figure 79.

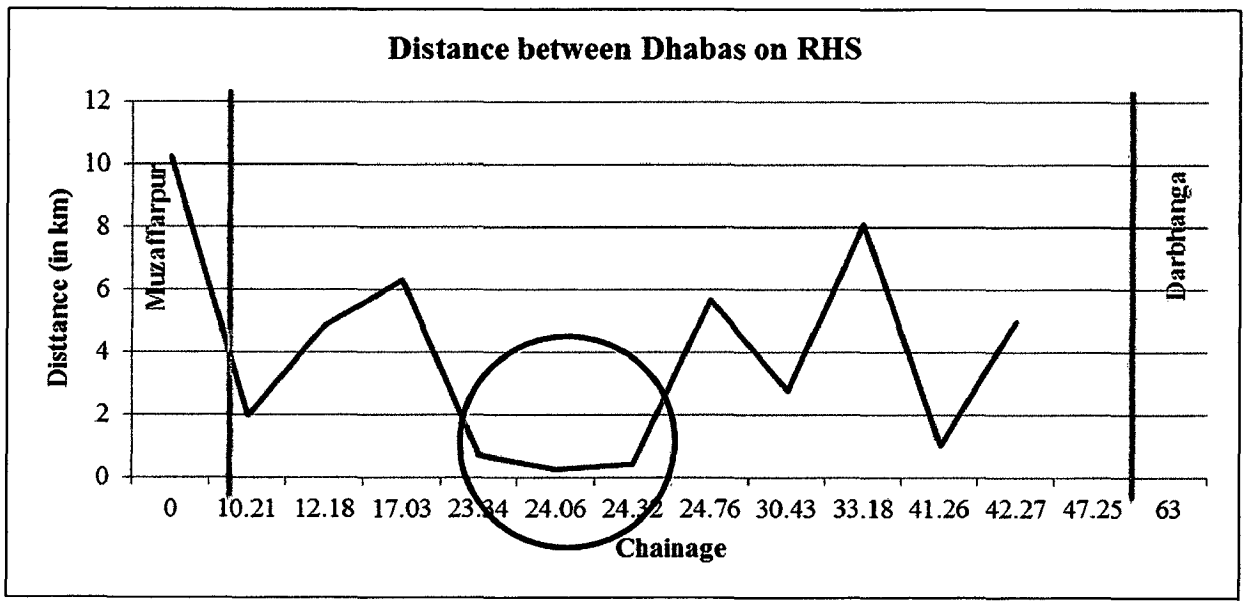


Figure 79: Graph showing Distance between Dhabas on RHS

It is observed that the distance between dhabas on RHS is generally more than 2 km except between the chaingae 23.34 km to 24.76 km, where the least distance is observed as 260 m. There are continuously four dhabas within a distance of 1.42 km.

The first Dhaba while going from Darbhanga is located at chainage of 42.27 km meaning after travelling a distance of 20.8 km and the last dhaba is at chainage 10.21 km meaning there is no dhaba for a length of 10.21 km.

Similarly, considering only the dhabas on the left side of highway, i.e. from Muzaffarpur to Darbhanga, the maximum distance of 8 km is observed between three pairs of consecutive dhabas while the least distance is observed as 30m. This is shown in Figure 80.

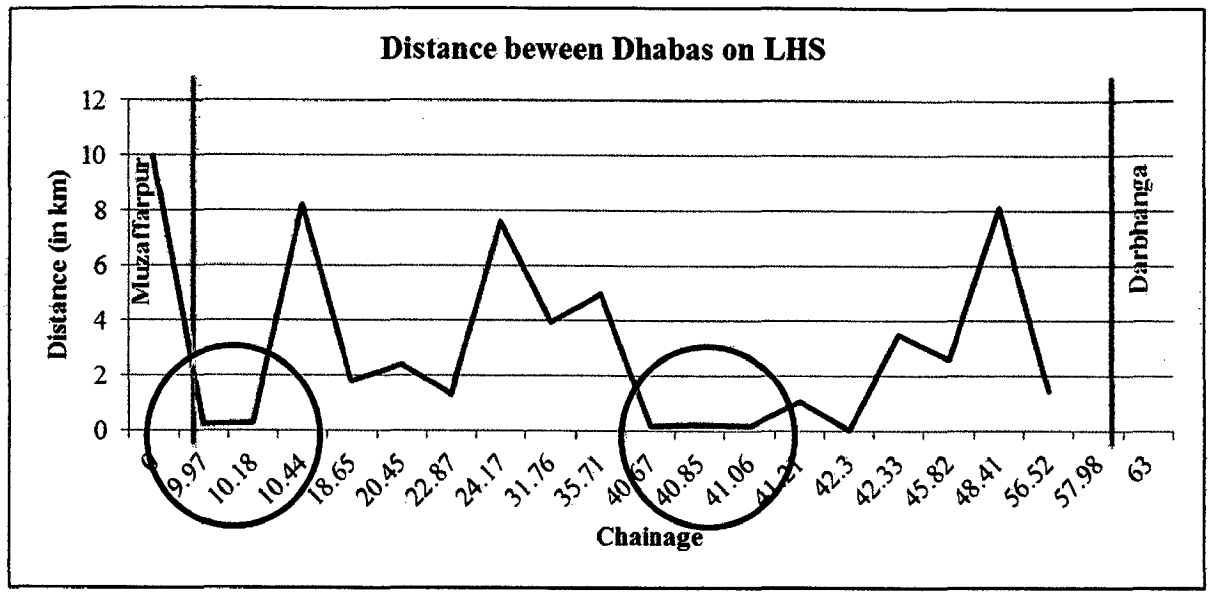


Figure 80: Graph showing Distance between Dhabas on LHS

There are three consecutive dhaba within a distance of 1.47 km, after the junction where the road coming from Muzaffarpur town meets the highway. Similarly there are four dhabas just within half kilometer after the chainage 40.67 km.

The first dhaba while going from Muzaffarpur town to Darbhanga is after a distance of 9.97 km while the last dhaba before reaching Darbhanga is at 56.52 km meaning there is no dhaba for the rest distance of 6.5 km.

By the visual survey it is observed that there are still many dhabas in the process of construction or expansion. The reason is the increasing number of truck traffic because of the recent opening of bridge over Koshi River early this year. Figure 81 shows the two pictures clicked on the different days for the same dhaba.

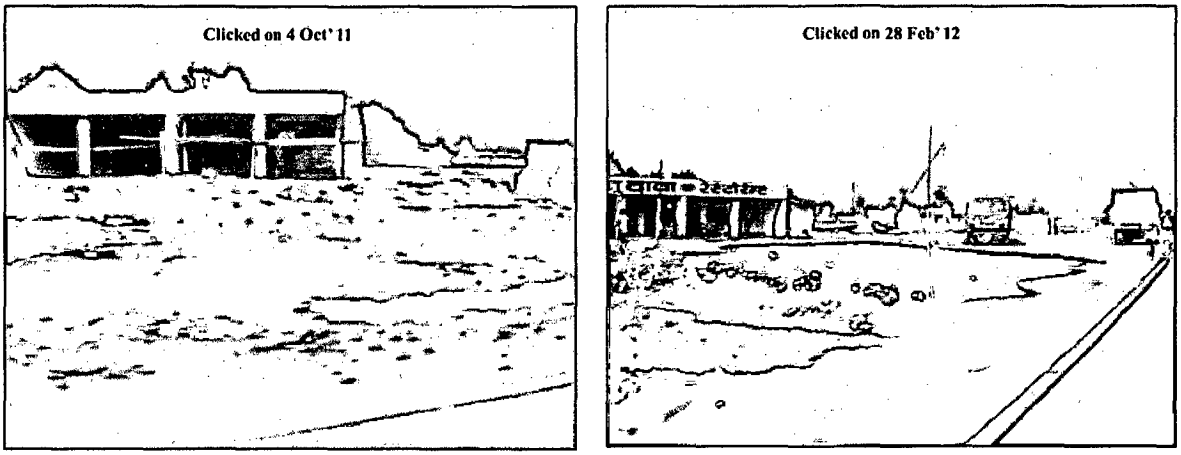


Figure 81: Picture showing the same Dhaba on Different Dates

The first picture shows the dhaba at the time of its construction and second picture shows the completed dhaba and its use by the truck drivers.

The numbers of dhaba is directly proportional to the frequency of visit to dhaba by its various types of user. From the traveller's survey, the frequency of visit to dhaba by the various types of vehicle is observed. This is shown in Table 58.

Table 58: Frequency of Visit to Dhaba

Type of Vehicle	No. of survey vehicles	Frequency of visit to dhaba (response in percentage)			
		Always	Frequently	Sometimes	Never
Two Wheelers	31	0	52	32	16
Three Wheelers	6	0	0	0	100
Car	8	25	37	25	13
LCV	3	0	0	0	100
Bus	5	80	0	0	20
Pick-up	3	34	33	33	0
Truck	22	100	0	0	0
Tractors	3	0	0	33	67
Cycle	7	0	0	28	72
Cycle Rickshaw	2	0	0	0	100
Hand cart	1	0	0	0	100
Animal Driven	1	0	0	0	100
Pedestrian	8	0	0	0	100

It is observed that out of total 100 respondents, 52% of bikers said, they frequently go to dhaba while 32% go sometimes and 16% never go to dhaba. Similarly from other category of private vehicle, i.e. car, 27 % visit dhaba always, 37% frequently, 25% sometimes and 13% never visit. Each of one third of pick-up visit dhaba always, frequently and sometimes. Similarly one third of tractors visit dhaba sometimes while the rest two third never visit.

Among the cycle user only 28% visit sometimes while rest 72% never visit dhaba. All the long distance buses stops at dhaba while city to city buses never stop. All the trucks stop at dhaba during each trip while three wheelers, cycle rickshaws, hand carts, animal driven vehicles and pedestrians never visit dhaba.

It is observed that apart from long distance buses and trucks which mandatory stops at dhaba during its journey, it is also visited by two-wheelers, cars and pick-ups.

The main purpose of visit to dhaba by the above said vehicles is found by the traveller's survey which is given in Table 59.

Table 59: Percentage of Various Types of Vehicle Visiting Dhaba for Various Purposes

Main purpose of visit to dhaba	Motorcycle		Car		Bus		Pick-up	
	No.	%	No.	%	No.	%	No.	%
For cold drinks	7	27	1	13	0	0	0	0
For hot drinks	11	42	2	29	0	0	0	0
For wavers	0	0	0	0	0	0	0	0
For snacks	6	23	2	29	0	0	0	0
For food	0	0	2	29	4	100	2	67
For short term rest	2	8	0	0	0	0	1	33
For long term rest	0	0	0	0	0	0	0	0
For cooling vehicle	0	0	0	0	0	0	0	0
Total	26	100	7	100	4	100	3	100

From the above table it is observed that mostly motorcycles stops at dhaba either for cold drinks, hot drinks, snacks or for short term rest. Car users visit dhaba for cold drink, hot drinks, snacks and short term rest. The main purpose of visit to dhaba by all the long distance buses is the food. The pick-up drivers visit dhaba either for food or short term rest.

And the duration of their stay at dhaba depends on the purpose for which they stopped there. But many a times, because of the ancillary activities at dhaba like rest, repairing punctured tyre etc., they stay for more time. The average duration of stay of each type of dhaba user is given in Table 60.

Table 60: Average Duration of Stay at Dhaba by Various Types of Vehicle

Avg. duration of stay at dhaba	Type of Vehicle							
	Motorcycle		Car		Bus		Pick-up	
	No	%	No	%	No	%	No	%
< 15 min	18	69	1	14	0	0	0	0
15 – 30 min	8	31	5	72	4	100	0	0
30 – 60 min	0	0	1	14	0	0	3	100
> 60 min	0	0	0	0	0	0	0	0

It is observed that more than two-third of the motorcyclist generally stay at dhaba for less than 15 minutes while the rest one-third stay for 15 to 30 minutes. Almost all the car users stay at dhaba for an average duration of 15 to 30 minutes while all the bus stay for almost half an hour. Pick-up drivers stay for a duration of 30 to 60 minutes.

So, it is found that all passenger vehicle that have to reach the destination on time, stay at dhaba for short duration of less than half an hour while the local goods vehicle stay for more than half an hour but less than an hour.

Apart from travellers, dhabas are also visited by the local residents of nearby settlement. This fact is observed by the house-hold survey which is shown in Table 61.

Table 61: Frequency of Visiting Dhaba by Local Residents

Frequency	No. of respondents	% of respondents
Frequently	1	2
Sometimes	3	6
Very rarely	12	24
Never	34	68

It is observed from the survey that only 2% of local residents visit dhaba frequently, while 6% only sometimes. One-fourth of the residents go to dhaba very rarely while 68% never go.

It is observed that one quarter of local residents visit dhaba but very rarely and when asked about the reason for visit to dhaba, the response was observed as given in Table 62.

Table 62: Reason for Visiting Dhaba by Local Residents

Reason for visit to dhaba	No. of respondents	% of respondents
Absence of restaurant nearby	3	19
Absence of bar nearby	9	56
For food while working in field	3	19
For food while working in isolated commercial establishments like petrol pumps	1	6

It is observed that out of 50 resondents,16 respondents visit dhaba and among them almost 20% visit because the restaurant is not present in the nearby rural settlement. Similarly due to the absence of bar in villages, 56% of local residents go to dhaba for drinks. Almost 20% of the farmers who work in the agricultural field near to dhaba, go there for food if they don't carry it from home and 6% of the local respondents said while working at the commercial establishments where the canteen is not available they go to dhaba for food.

It is found that a large number of rural population who go to dhaba just go there because of the absence of bar in the nearby locality. Similarly it is also observed that workers like farmers and petrol pump employee go to the nearest dhaba for food.

Hence, it can be concluded that while deciding the location of dhaba, following factors should also be considered:

- No. of vehicles travelling long distance
- Climatic condition of the area- frequency of stops by travellers, frequency of puncturing of tyres
- Location of chungi naka or state border
- Location of hilly area- before travelling in the hilly area truck-drivers prefer a brake
- Visit of dhaba by the farm labors in the nearby field
- Availability of settlements without bar and restaurants
- Presence of institution or organization including fuel-station without canteen facility
- Location of dhaba with respect to the origin and destination of bus services

From the various surveys, it is also observed that following factors determines the workability of dhaba:

- Size of dhaba
- Location from the nearest city
- Location from the origin of bus-services
- Location from chugi naka or state border
- Location from junctions
- Location w.r.t. sides of highway LHS or RHS
- Availability of parking
- Availability of recreational activities like T.V. and cots
- Availability of petrol pumps and air-check
- Availability of ladies toilet

5.5.4 Fuel Stations

There are total 18 fuel stations on the highway within the study area of 63 km. Out of these, there are 7 fuel stations on LHS while 11 are on RHS. The numbers of fuel stations are not equal on both the sides of highway as recommended by the letter from the ministry.

The distances between the fuel stations, considering each side of the road as independent to avoid the turning of vehicle for fuel, as given in Table 63.

Table 63: Distance between Fuel Stations on Each Side of Highway

S. No.	Chainage	Distance with previous
LHS		
1	16.98	16.98
2	18.6	1.62
3	20.48	1.88
4	21.68	1.2
5	26.55	4.87
6	40.71	14.16
7	60.29	19.58
RHS		
1	5.98	5.98
2	10.15	4.17
3	10.35	0.2
4	14.08	3.73
5	24.93	10.85
6	34.92	9.99
7	45.79	10.87
8	48.37	2.58
9	56.22	7.85
10	57.98	1.76
11	62.85	4.87

It is observed that the maximum distance between the fuel stations on LHS, i.e. from Muzaffarpur to Darbhanga is 19.58 km while the least distance is 1.2 km. Similarly the maximum distance between the fuel stations on RHS, i.e. from Darbhanga to Muzaffarpur is 10.87 km while the least distance is just 200 m.

It is found that the fuel stations are neither located equal in number on both the sides of highway nor they are located regularly on any of the sides.

Analyzing the location of fuel-stations considering that the travellers will take a U-turn and will come back to the fuel station provided on the other side of highway i.e. considering LHS and RHS as a whole, it is found that the maximum distance between two consecutive fuel stations is 8.37 km and the least distance is 200 m. This is shown in Table 64.

Table 64: Distance between Fuel Stations on both the sides

Chaingae	Distance with previous
5.98	5.98
10.15	4.17
10.35	0.2
14.08	3.73
16.98	2.9
18.6	1.62
20.48	1.88
21.68	1.2
24.93	3.25
26.55	1.62
34.92	8.37
40.71	5.79
45.79	5.08
48.37	2.58
56.22	7.85
57.98	1.76
60.29	2.31
62.85	2.56

The location of these fuel stations which are just 200 m away from each other, on same side of highway, is at 10.15 km and 10.35 km and there meets the road coming from Muzaffarpur town just before these fuel stations at 9.7 km. So, this can be analyzed that the urban population is using these fuel stations as they join the highway or before going inside the town, they fill the fuel.

The distance of 200 m between two fuel station is less than the minimum distance of 300 m as prescribed by the letter from Ministry of Road Transport and Highway.

The maximum distance between the fuel stations within the study area is observed to be 8.37 km. It means the nearest fuel-station is almost 8 km away on either side.

Now plotting the frequency of the distance between the fuel-stations, as shown in Figure 82, it is observed that the fuel-stations are not regularly located rather more than half of the fuel-stations are located within a distance of 1 to 3 km.

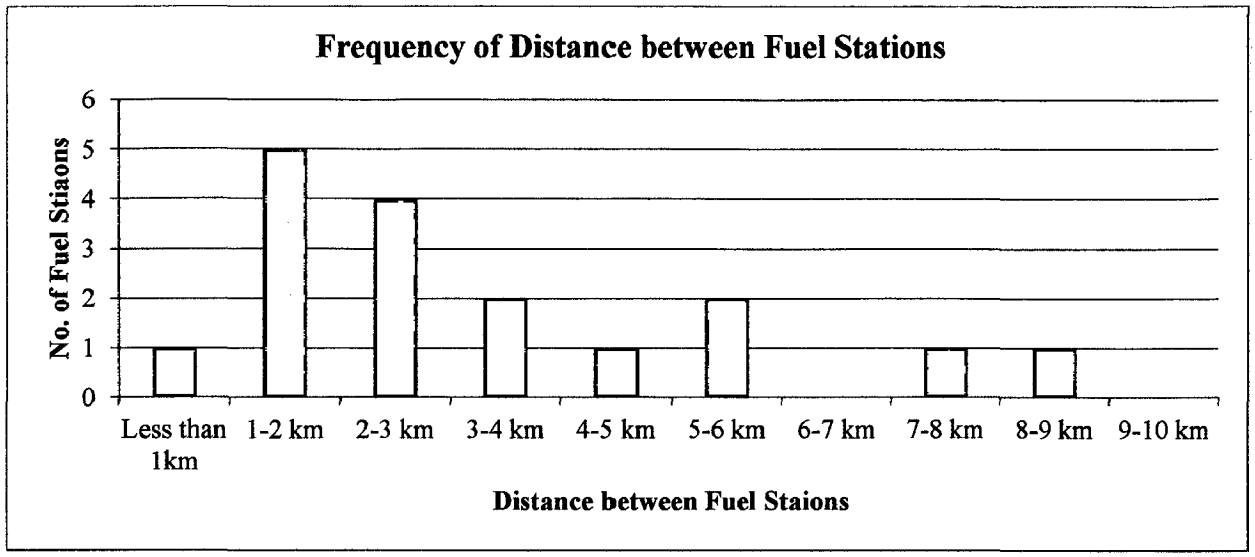


Figure 82: Frequency of Distance between Fuel Stations

Now overlapping the location of fuel stations on the map of junction, as shwon in Figure 83, it is observed that the distance between the major junction and fuel station is more than 300 m and that between the minor junction and fuel station is more than 100 m as recommended by the letter from ministry, except at two places. In first case the fuel station is provided just near the minor junction and in second, it is provided only at 50 m from the juction of SH with NH where the recommended minimum distance is 1000m. This is shown in Figure 84.

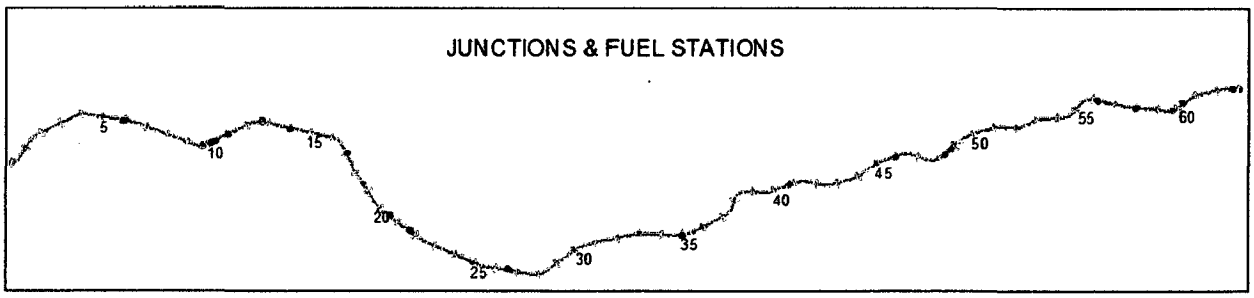


Figure 83: Location of Fuel Stations overlapped on Junction Map

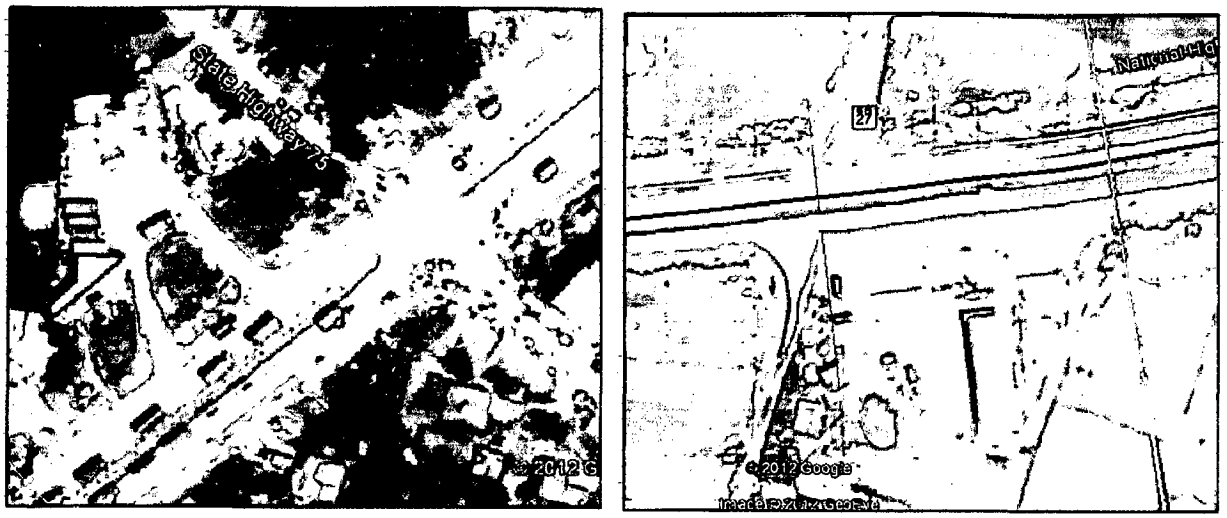


Figure 84: Fuel Station is provided near to Intersection

From the house-hold survey of nearby residents, it is observed that the fuel stations are also visited by them regularly for various purposes. This is shown in Table 65.

Table 65: Quantity of Fuel Required for Various Purposes by Rural Population

Fuel required for	No. of house-hold		Quantity (ltr.)	
	No.	%	Avg. consumption per day	Total consumption per day
Private vehicle	9	18	0.5	4.5
Agricultural vehicle	2	4	3	6
Gen-sets	1	2	4	4
Pump-sets	2	4	0.2	0.4
Multiple use	3	6	5	15
Not needed	27	54	0	0
Total	50	100	---	29.9

It is observed that mainly rural population requires fuel for private vehicles like motorcycles. The other uses include the use of fuel for agricultural vehicle, for electric generation through gen-sets and in irrigation through pump-sets.

By finding out the average consumption of fuel for different purposes, it is observed that total consumption of fuel for every 50 house-hold in rural area is almost 30 ltr. considering petrol and diesel as same. So, the per house-hold per day fuel consumption is 0.6 ltr. Hence while deciding the location and number of fuel stations this demand of rural population should also be considered.

Now overlapping the location of fuel stations on the settelement map, it is found that between 25 km and 35 km, there exist some settlement but fuel station is not provided. Similarly between 35 km to 45 km there is only two fuel station while the rural population is high.

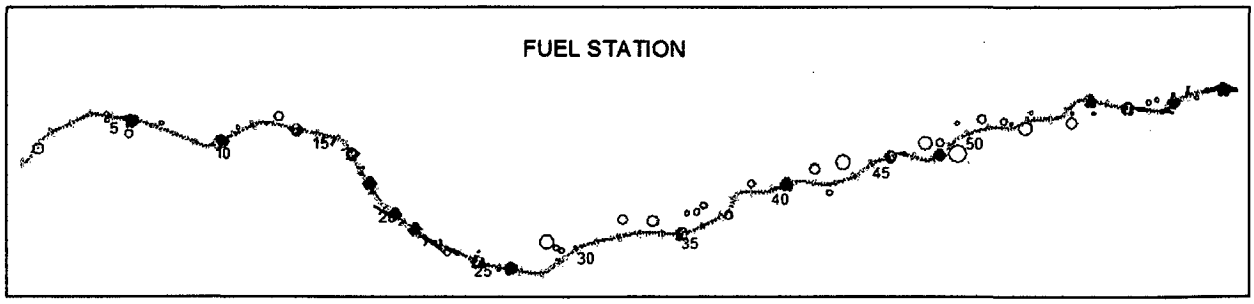


Figure 85: Overlapping Location of Fuel Station on Settlement Map

From the house-hold survey, the distance of the nearest fuel station has been observed as given in Table 66.

Table 66: Distance of Nearest Fuel Station

Distance	No. of House-hold	Percentage of House-hold
< 500 m	7	14
500 m - 1 km	12	24
1 - 2 km	25	50
2 - 5 km	3	6
> 5 km	3	6

It is found that for maximum of rural population the fuel station is located in between a distance of 1 – 2 km. Similarly, the mode of transport for carrying fuel has been observed by the house-hold survey. This is given in Table 67.

Table 67: Mode of Transport for Carrying Fuel

Mode of Transport	No. of House-hold	Percentage of House-hold
Take vehicle to fuel station	15	66
Carry in drum by hand	1	4
Carry in drum by animal cart	1	4
Carry in drum by rickshaw	1	4
Carry in drum by agricultural tractor	5	22

It is observed that among the people who need fuel, the private vehicle owners take their vehicle to the fuel station while the agricultural vehicle owner take their tractors to station. Others carry in drum and for that they use animal cart, rickshaw, tractor or they carry in hand if it is nearby.

Apart from rural population residing near the highway, there are various other factors on which the location of fuel stations depends. These are given below.

Determining factors for the location of Fuel-station

- No. of vehicles of each vehicle type on highway
- Tank capacity and fuel efficiency of each type of vehicle
- Economic condition of travellers especially daily travellers like money spent on filling fuel- auto rickshaw drivers invest less in filling fuel at one time
- Availability of electricity in the surrounding villages along highway and its duration of supply
- Climatic condition of the area like use of gen-sets in the surrounding area in case of non-availability of electricity
- Presence of road side structures which are dependent on gen-sets for electricity
- Economic condition of surrounding population like use of private vehicles
- Economic condition of farmers like use of tractors in farm lands
- Type of agricultural activities, in the field along the highway, like frequency of ploughing
- Source of irrigation like use of pump sets in ground water extraction and surface water irrigation
- Cultural character of surrounding population e.g. during the months of marriage fuel consumption increases in hiring vehicles and gen-sets, similarly their use increased during festivals

5.5.5 Puncture Shops & Repair Shops

Out of 56 puncture shop on the highway, 42 shops are provided on the LHS, while only 14 shops are on the RHS. Now, plotting the frequency distribution of the distances between the puncture shop separately of each side, as shown in Figure 86, it is found that on LHS, almost half of the puncture shops are located within a distance of 1 km from the previous one. While on RHS, the maximum number of puncture shops are located after a distance of 2 to 3 km from previous.

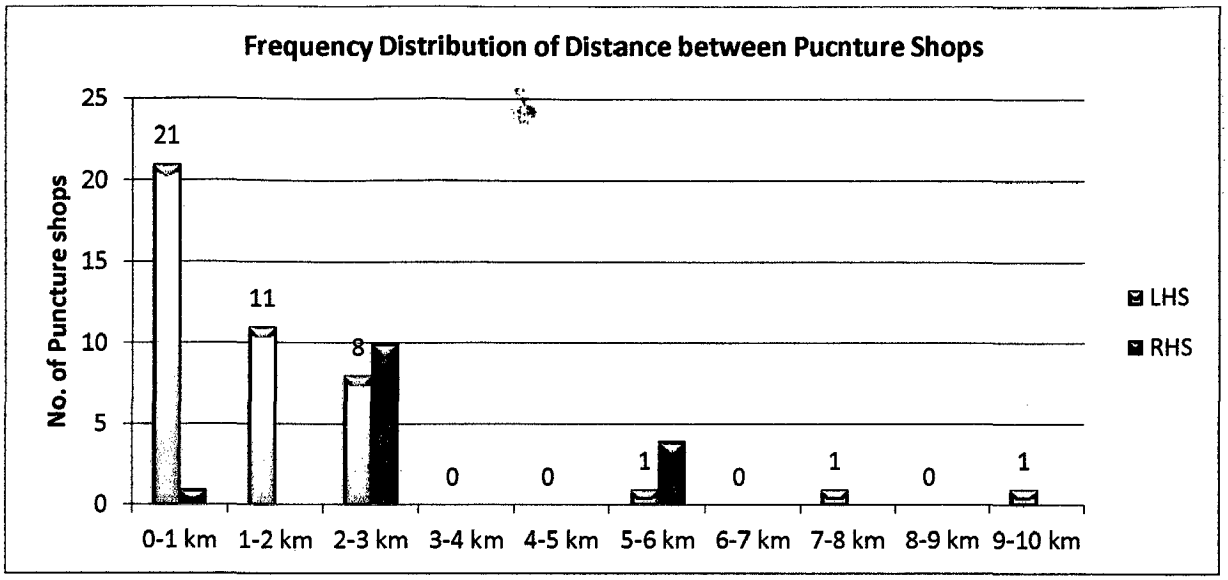


Figure 86: Frequency Distribution of Distance between Puncture Shops

It is observed that most of the puncture shops are located on LHS. The reason is the new construction of road on RHS while four laning of highway, it is discussed in section 3.1, and hence the old shops on the LHS are still in use while on the RHS, it is yet to encroach.

Mostly the puncture shops are provided with dhaba so that all vehicles except those which don't have stepney can repair their tyre while having food. Many puncture shops are also located near the junctions to catch the maximum customers. This is shown in Figure 87.

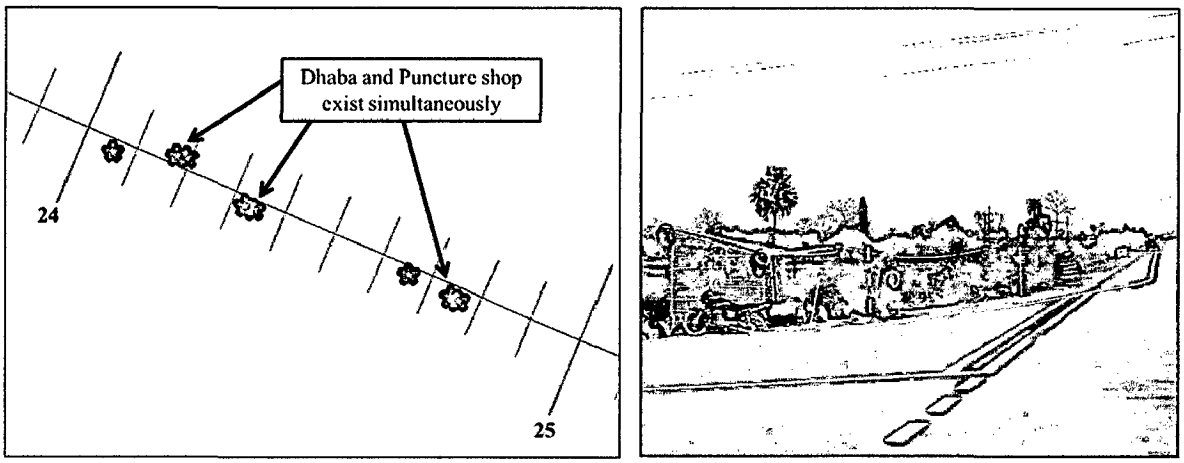


Figure 87: Location of Puncture Shop w.r.t Dhaba

From the visual survey, it is observed that most of these puncture shops are located either on hard shoulder provided on the either side of highway or in ROW. And for repairing punctures they encroach upon the main carriageway, as shown in Figure 88, hence obstructing the movement of slow moving vehicle which are using the left lane.

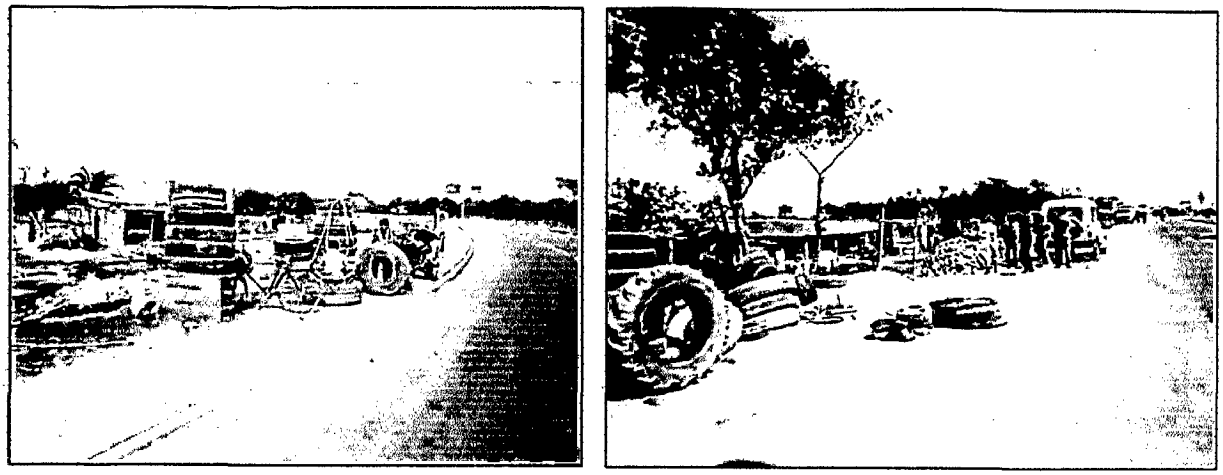


Figure 88: Encroachment on Road by Puncture Shop

Hence, it can be concluded that while deciding the location of puncture shops following factors should also be considered:

- No. of vehicles on the highway without stepney like bike, tractor, cycle-rickshaw, cycle etc.
- Climate condition of the area- frequency of puncturing of tyres
- Location of dhaba- so that repairing can be done along with snacks

CHAPTER - 6 PROPOSALS

6.1 HIGHWAY DESIGN

6.1.1 ROW & Cross-Section

The old built structures which are falling within the ROW are not illegal structures since, previously, it was on the private property which is now vanished in NHAI. These structures are helping encroachment to spread along the highway. Hence, it should be removed at earliest.

Further, the study on the causes of encroachment reveals the fact that encroachment takes place on the undeveloped lands which are not regularly checked by the owner. So, the land within the ROW should be fully utilized to reduce the chance of being it encroached by the villagers.

Hence, a slip road of width 5.5 m has been proposed on the either side of the highway. The proposed cross-section for the highway is shown in Figure 89.

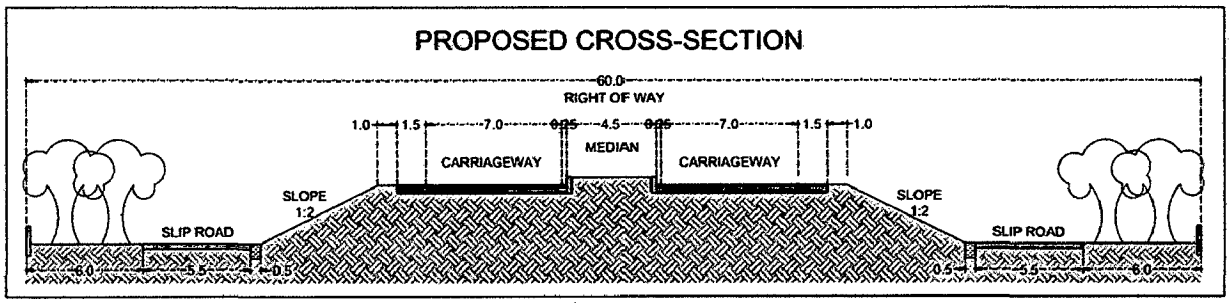


Figure 89: Proposed Cross-Section

The slip road should be running continuously along the highway and at the major junction, it should be connected via underpass which is discussed later in section 6.1.2.1. Slip road should be bi-directional to facilitate the both way user and to avoid crossing the highway. A view of slip road on either side of highway is shown in Figure 90.

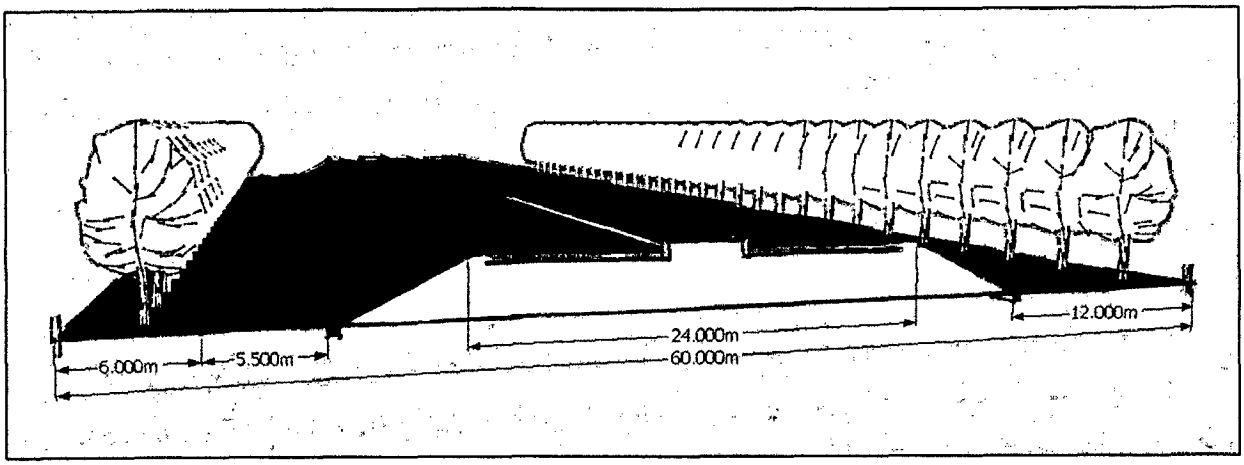


Figure 90: Proposed Cross-section

The advantages of slip road are listed below.

- To facilitate the users who don't want to move on the high speed highway in fear of accident.
- To facilitate the user who want to move in shadow during the hot weather.
- To make the pedestrian activity more enjoy full and safe.
- To facilitate the access of agricultural vehicle to the agricultural field.
- To prevent the vehicles to move in the wrong direction on the highway to cross the road.
- To segregate the slow moving vehicles like animal-cart from the speedy highway.
- To prevent the encroachment on the government land since all the lands are fully utilized.

6.1.2 Intersections Treatment

Out of 122 junctions 13 junctions are already treated by providing FOB or Underpass during the four laning of highway. So, the remaining 109 junctions which are at-grade, needs further treatment in terms of modification in its design.

Table 68: Junctions Need to be Treated

Item	Numbers
Total Junctions	122
Junctions – grade separated during four laning	13
Junctions – still are at-grade	109

Figure 91 shows the location of junctions which are treated and Figure 92 shows the location of junctions which needs further treatment.

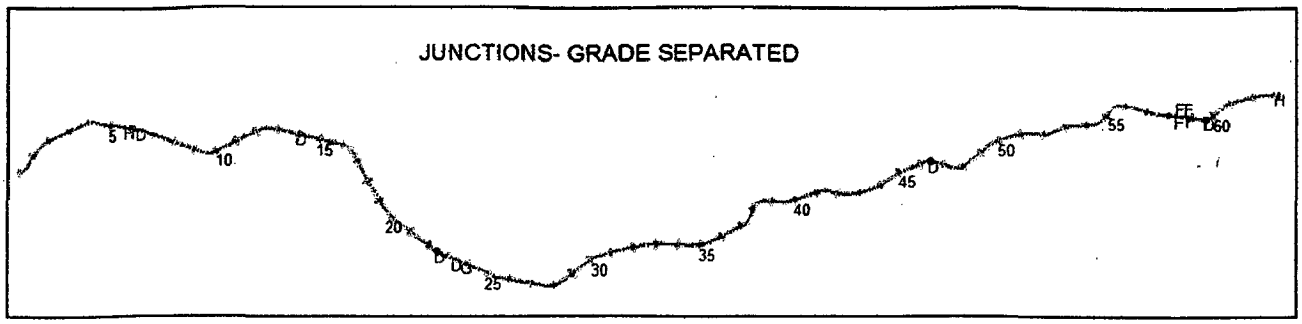


Figure 91: Location of Junctions which are Grade Separated

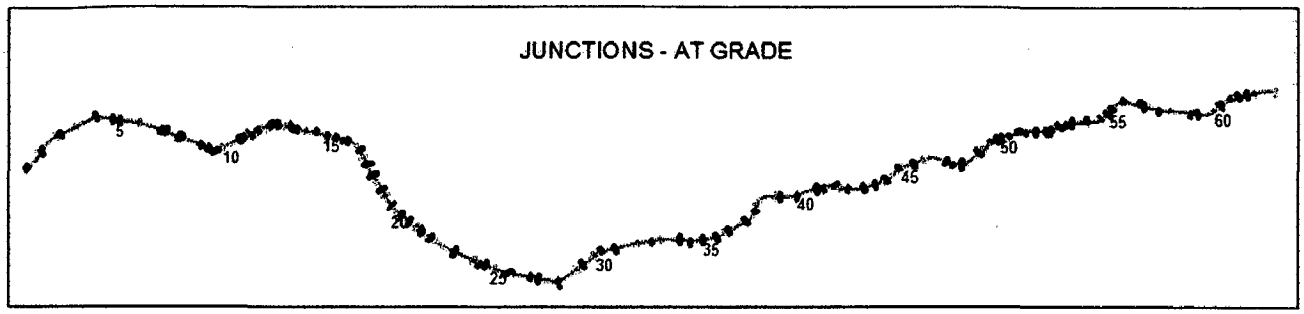


Figure 92: Location of Junctions which are At Grade

To identify the major and minor junctions, the existing junction map has been overlapped with the settlement map. The settlement map is given in Figure 93. The identification has been done on the basis of traffic survey, PCU counts and the type of settlement to which these junctions leads.

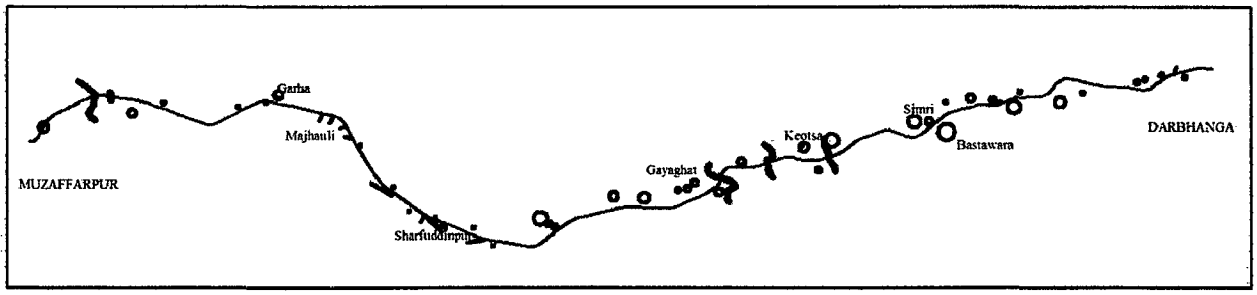


Figure 93: Settlements along the Highway

By overlapping it is observed that 17 junctions have potential of major junctions and remaining 92 junctions can be categorized as minor junctions. This is shown in Table 69.

Table 69: Junctions Identified as Major and Minor

Items	Numbers
Junctions need to be treated	109
New Junction to be added	1
Junctions identified as Major Junctions	17
Junctions identified as Minor Junctions	92
3- arm Major Junctions	8
4- arm Major Junctions	10

The proposal for major junction and minor junctions are given separately.

6.1.2.1 Major Junction

Major roads should be connected directly to E-W Corridor whereas other roads should be connected to the slip road running parallel to the highway on both the sides.

The location of the identified major junctions is given in Figure 94.

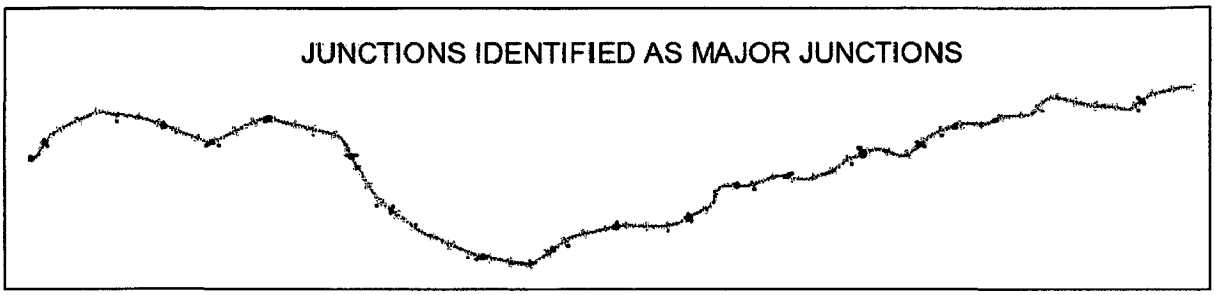


Figure 94: Location of Junctions Identified as Major Junctions

Out of 18 major junctions 8 are 3-arm junction whereas remaining 10 are 4-arm junctions. The chainage of 4-arm and 3-arm junctions are shown in Table 70.

Table 70: Chainage of Major Junctions

4-arm	3-arm
0.97	0
7.225	9.7
12.67	29.3
17.36	32.51
20.62	39.17
25.68	41.59
36.14	50.78
45.07	52.63
48.65	----
60.35	----
Total= 10	Total= 8

Median opening has been provided only at 4-arm junctions in the proposal while for the 3-arm junctions, it is provided at the distance of 1 km on either side. But if there exist some other 4-arm junction nearby then the median opening for 3-arm has been shared with the median opening of 4-arm junction to maintain the minimum distance between median openings as 2 km. The chainage of median opening and the distances between them is shown in Table 71.

Table 71: Location of Median Opening & Distance between Median Opening

Median Location	Distance between Median Opening
0	-
0.97	6.255
7.225	2.475
9.7	2.97
12.67	4.69
17.36	3.26
20.62	5.06
25.68	2.62
28.3	2
30.3	3.21
33.51	2.63
36.14	2.03
38.17	2
40.17	2.42
42.59	2.48
45.07	3.58
48.65	3.13
51.78	2
53.78	6.57
60.35	-

Graph is shown in Figure 95 for the distance between median openings. From the graph it can be observed that nowhere the distance between median openings is less than 2 km.

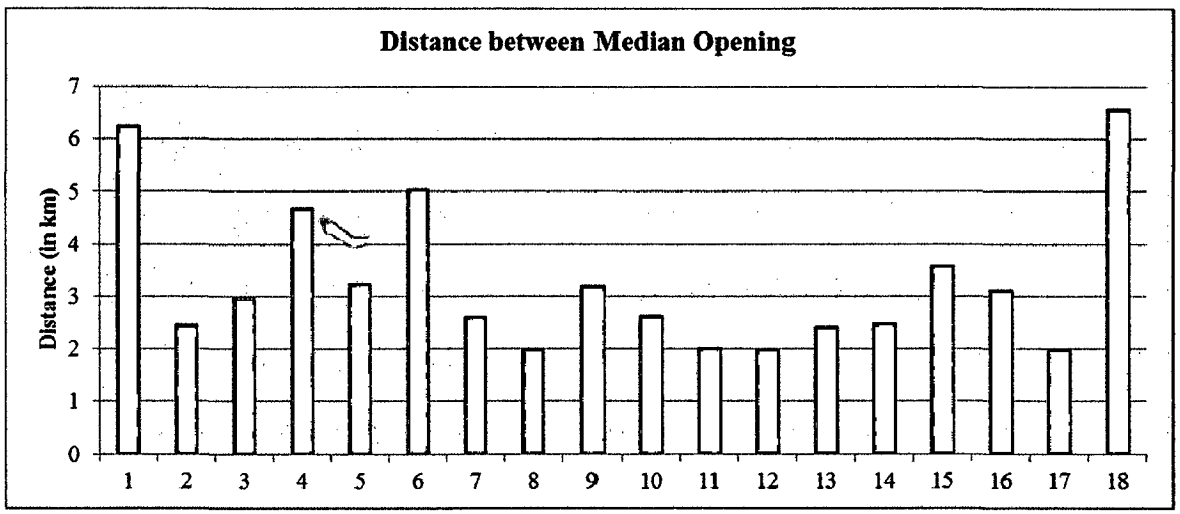


Figure 95: Graph showing Distance between Median Opening

The solutions for major junctions are categorized in three parts. The first solution is for the Junction of NH 57 to NH 28, second is for the Junction of E-W Corridor with the old NH 57 which connects to Muzaffarpur town and the third solution is for all the other major junctions which will be connect to the highway.

1. *Junction of NH 57 & NH 28*

The type of junction and its drawing for junction at chainage 0 km of NH 57 is given in annexure. The junction is the ending part of NH 28 which forms the part of E-W Corridor and from here onward NH 57 becomes the part of Corridor. The solutions to solve the problem of this junction are discussed below.

Theoretical Solution

Since NH 28 up to chainage 520 km and NH 57 from chainage 0 km form the E-W Corridor, so connection between the above said sections should be continuous. It means NH 57 should be connected to NH 28 without any obstacle or junction and the solution should be provided in such a manner that the traffic going from NH 57 to NH 28 and vice-versa should not be disturbed. The solution is shown in Figure 96.

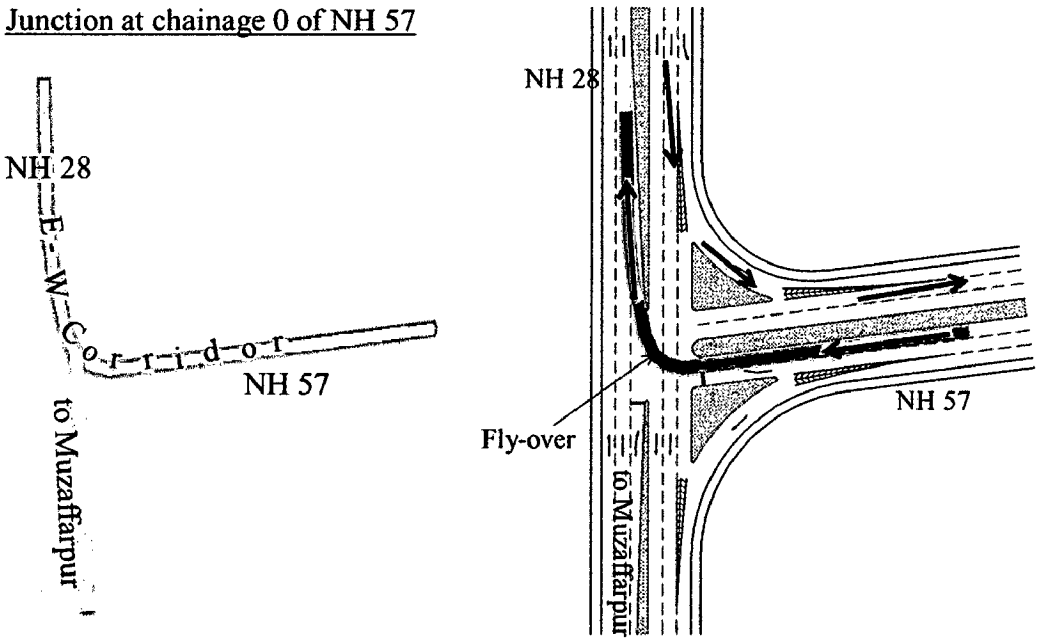


Figure 96: Theoretical Solution for Junction at 0 km

Analytical Solution

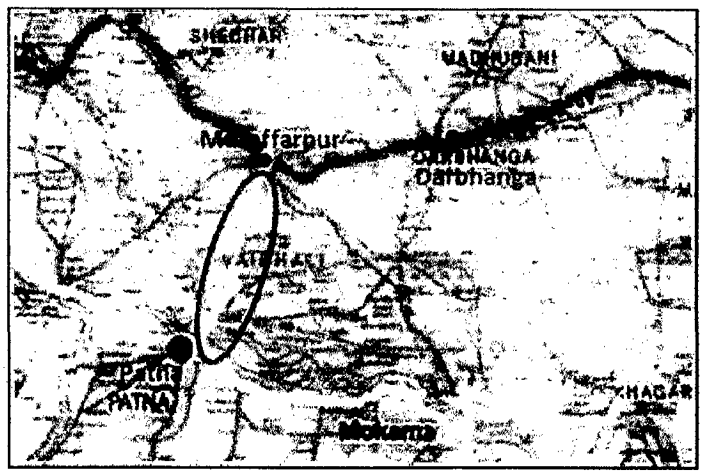
A survey was conducted on 28th Feb'12 at 2:34 PM to analyze the traffic movement at the junction. The details of the composition and movement of traffic from various directions are given in Figure 97.

TRAFFIC SURVEY DATA SHEET																							
Direction	Type of Vehicles																						PCU
	Motor Cycle or Scooter	Passenger Car	Auto Rickshaw	LCV (Jeep)	LCV (Auto 4 Wheel)	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck (2 Axle)	Truck (3 Axle)	Truck (4 Axle)	Truck-trailer	Agricultural Tractor	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Horse-drawn Vehicle	Bullock Cart	Pedestrian	
NH 57 to NH 28	3	2	1					1			1	1				1							2304
NH 28 TO NH 57	1	2	2								2	2	4				3						5184
NH 57 to Muzaffarpur town	5	6	1		1						6	8	1			1	2						9072
Muzaffarpur town to NH 57	4	3	2								1	2					2						2448
NH 28 to Muzaffarpur town	31	9	7	3	2	3	3	1	2		5	6	3	2	1	1	7		1				17784
Muzaffarpur town to NH 28	30	9	22	5	5	1	4		1			2					9						12384

Figure 97: Traffic Survey at Junction of NH 57 & NH 28

From the survey it was observed that the two wheelers movement between NH 28 and Muzaffarpur is high. Similarly the light commercial vehicle and feeder service like auto-rickshaw are more on these directions whereas the truck movement is observed more between NH 57 to Muzaffarpur town. The overall PUC on the junction was observed maximum in the direction of traffic from NH 28 to Muzaffarpur town.

It is analysed from the above chart that the trucks movement is high from NH 57 to Muzaffarpur town and from NH 28 to Muzaffarpur town. The reason to this observation is that the shortest road connecting the E-W Corridor to the capital of Bihar i.e. Patna passes through the town of Muzaffarpur. Hence Patna is connected to the other parts of country through this route. This is shown in Figure 98.

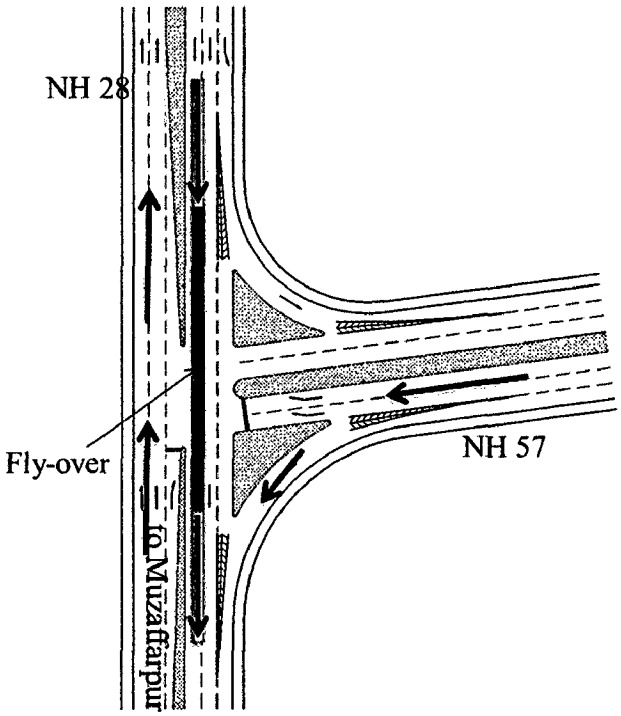


Source (Base map) - http://bsrdcl.bih.nic.in/

Figure 98: Location of Patna w.r.t. E-W Corridor

Since the PCU values of routes from NH 28 to Muzaffarpur and other way are higher whereas the movement of heavy vehicle is maximum in the route from NH57 to Muzaffarpur,

so while planning the solution for this junction is should be taken in consideration the above mentioned routes should be free from any obstructions. The two routes i.e. from NH 57 to Muzaffarpur and from Muzaffarpur to NH 28 are on left hand side so traffic conflict will not occur. Hence proposing a flyover for traffic from NH 28 to Muzaffarpur will solve the junction problem. This is shown in Figure 99.



Junction at chainage 0 of NH 57

Figure 99: Analytical Solution for Junction at 0 km

2. *Junction of E-W Corridor with the old NH 57 which connects to Muzaffarpur town*

A traffic survey was conducted on 28th Feb'12 at 1:51 PM to analyze the movement of traffic at the junction. The details of the composition and movement of traffic from various directions are given in Figure 100.

TRAFFIC SURVEY DATA SHEET																							
Direction	Type of Vehicles																						PCU
	Motor Cycle or Scooter	Passenger Car	Auto Rickshaw	LCV (Jeep)	LCV (Auto 4 Wheel)	Mini Bus	Bus	Tempo	Pick-up Van	Mini Truck	Truck (2 Axle)	Truck (3 Axle)	Truck (4 Axle)	Truck-trailer	Agricultural Tractor	Agricultural Tractor-trailer	Cycle	Cycle Rickshaw	Hand Cart	Horse-drawn Vehicle	Bullock Cart	Pedestrian	
Byepass to Darbhanga	6	4	5				2		1		1	1					11						4392
Darbhanga to Byepass	2	6								2	1	2	1				1						3456
Muzaffarpur town to Darbhanga	61	5	10				2					1					18	1					9432
Darbhanga to Muzaffarpur town	28	6	8	1		2	3		3								4						6696
Muzaffarpur town to Byepass	1												1										720
Byepass to Muzaffarpur town										1													216

Figure 100: Traffic Survey at Junction of NH 57 with Old NH 57

It is observed from the above figure that the PCU values are higher in the direction of Muzaffarpur town to Darbhanga and in the reverse direction. By looking at the composition of traffic it is observed that mostly two wheelers and three wheelers vehicle are crossing this junction in the above said direction. This fact is shown in Figure 101.

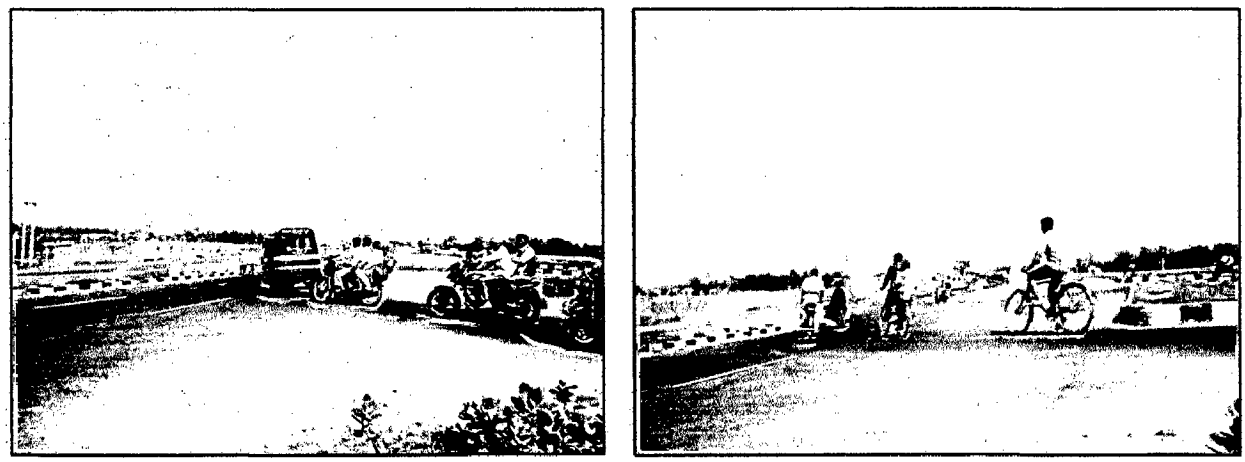
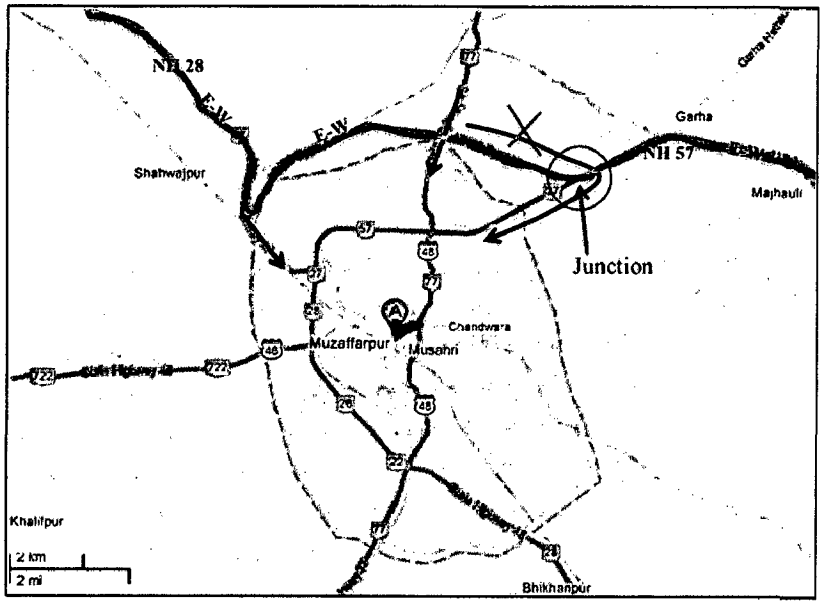


Figure 101: Picture showing Movement of Local Traffic towards Darbhanga at 9.7 km

It is analyzed that the traffic going from Muzaffarpur town to Darbhanga collides frequently with the traffic on the E-W Corridor. So there is a need to solve this issue. Another important point is that the traffic collision between the vehicle coming to Muzaffarpur from Bypass side and vehicles going from Darbhanga to Bypass occur rarely because the vehicle are hardly seen in the direction from Bypass to Muzaffarpur town. The reason is that the vehicle which wants to come to Muzaffarpur town directly comes inside from E-W Corridor through junction at 0 km. Similarly the vehicle coming from the side of NH 77 has shorter direct route. Hence very rarely vehicle take the longer route to come to Muzaffarpur town via junction at 9 km. This fact is shown in the Figure 102.

Another analysis shows that because of the availability of high speed alternate route, i.e. E-W Corridor, the heavy vehicle going from Muzaffarpur town towards Darbhanga takes the Corridor at 0 km. So, while planning the proposal for junction at KM 9, it should be noted that the heavy vehicle can be made to follow the route of E-W Corridor at KM 0 or at FOB on the Corridor above NH 77 rather than moving on the narrow lanes of city and to join the Corridor at KM 9.



Source (Base map) - http://maps.google.co.in

Figure 102: E-W Corridor w.r.t Muzaffarpur town

Since the traffic from Muzaffarpur town toward Darbhanga consist of smaller vehicles like two wheelers and three wheelers, so proposing a underpass of width 5.5m in the above said direction will solve the problem of conflict of local traffic of city with the national traffic of E-W Corridor. This is shown in Figure 103.

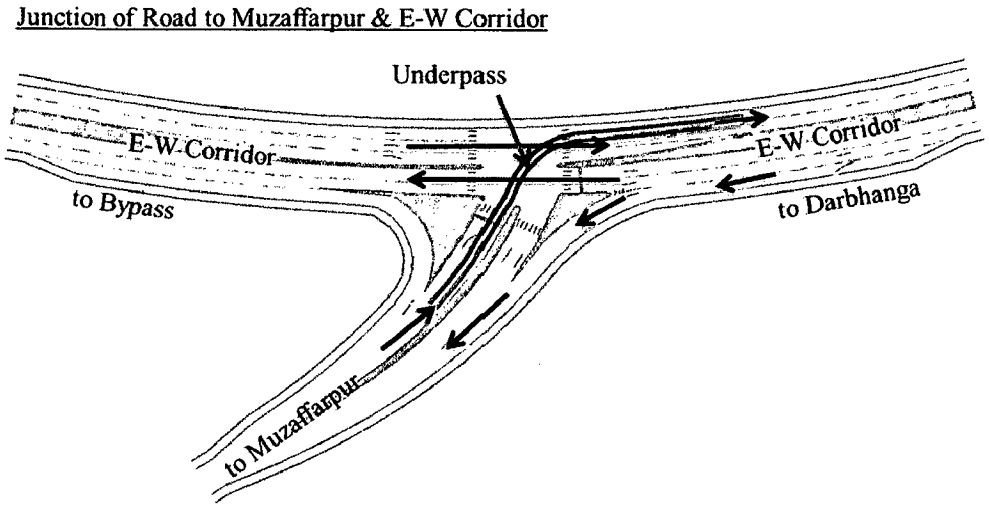


Figure 103: Proposal for Junction at 9 km

3. *Other Major Junctions*

A visual survey was conducted during the different hours of the day for consecutive three days for Junction at Simri and for Junction at Gaighat. During the survey the following points were observed.

Observations

- At the major rural junction more of local traffic which consists of two wheelers and three wheelers are observed to be dominating.
- From the cross roads mostly the movement of two wheelers are observed.
- The pedestrian crossings are provided but people are not following it.
- Vehicles from the cross road are crossing the highway without waiting at stop line and watching the movement of traffic on the highway, hence it increases the risk of accidents at junctions.
- Local public transport which consist of three wheelers like auto-rickshaw and four wheelers like Jeeps and other light commercial vehicle, are dominating at major junctions.
- At some major junctions local public transport vehicle terminates, it is observed that these vehicles are parked on the main carriageway making a queue on both the sides of highway in both directions.
- Feeder services like cycle rickshaws are parked on the center of cross road.
- The average standing time for local transport vehicle is observed to be 30 minutes at terminals and 5 minutes at other junctions where it is available but not terminating.
- The local transport vehicles are observed to be waiting for passengers on the main carriageway and hence reducing the effective width of highway.
- At all the junctions, it is observed that the local transport vehicles are stopping right in front of the junction hence blocking the cross road for most of the time.
- People movement on highway to catch the local transport and getting down from the public vehicle puts a treat of accident.
- The movements of three wheelers are observed to be random. They take U-turn at any place and move in the wrong direction of road and hence increasing the chance of accident.

- It is observed that bike riders crosses the road wherever they find the cut, they travel in the wrong direction and uses pedestrian walk-way while travelling in the wrong direction.

From the house-hold survey carried out on the residents of nearby settlements, the type of vehicles which are owned by the rural population has been observed. This is given in Table 72.

Table 72: Type of Vehicles Owned by Rural Population

Type of Vehicle	No. of House-holds
Cycle	22
Motorized Two Wheeler	18
Car	1
Agricultural Tractor	5
Three Wheeler	3
Animal Driven	16
Other	0

It is observed that 44% of rural population has cycle, 36% has two-wheelers and only 2% has four wheelers. The dominance of two wheelers on the rural road is due to the affordability of bikes and its better fuel efficiency. The four wheelers are observed very less because of the higher price, higher maintenance and narrow rural roads. Visual survey reveals that the condition of rural road is better and also ROW of can support the movement of four wheelers but due to various uses of ROW like for storing agricultural products, as animal rest area, for drying of cow-dung cake etc. reduces the effective drive area.

From the visual survey and the house-hold survey as given in Table 43, it has been observed that many a time bikes take shortcuts. These shortcuts by the bikes are due to the fact that the vehicle size facilitates the movement on even in the narrow space. The zigzag movements of bikes disturb the drivers of other vehicle and hence increased the chance of accident. So, if many a time bikes skip from the accidents because of its size but many accidents happen to save them.

Hence an underpass which facilitates the movement of two wheelers, three wheelers and light motor vehicles (LMVs) like cars, jeep, pickup, etc. should be provided across the highway at major junctions.

Points to be taken care of while planning the solution for major junctions-

- A parking for feeder service should be provided near the junction.
- A stop should be provided for local public transports like Jeeps and auto-rickshaws.
- A buffer space for people should be provided so that they should not directly come over to the speedy highway.
- A underpass for pedestrians and bikes should be located near the junction.
- A food zone should be provided at the junctions where local public transport terminates.
- Encroachment should be removed from the junction so that driver of highway gets a clear vision of the traffic coming from cross road.

Proposal for Major Junctions

Since the height of the new highway is observed to be more than 3 m at many places so a underpass of height 3m should be provided perpendicular to the highway to connect to cross road. The underpass should be 5.5 m wide to facilitate the movement of pedestrian, bikes and three wheelers like auto-rickshaws which acts as feeder services to connect the inner rural areas to the highway.

The slip road (5.5 m width), as discussed in section 6.1.1, which is running parallel to the highway on either side should go underground at junction to maintain its continuity and it should join the underpass on both the sides so that vehicle movement from slip road to cross road can be facilitated.

A schematic diagram for the solution of the major junction is shown in Figure 104.

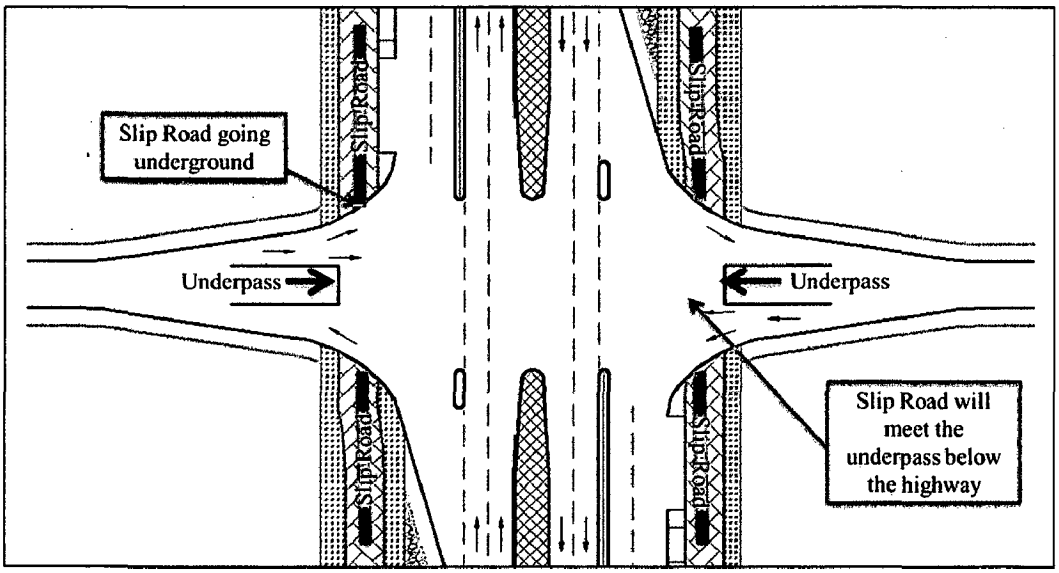


Figure 104: Proposal for Major Junctions

Vehicle Movement at Junctions

The vehicle going from the cross road to left side will come to the buffer zone and will follow the side lane to join to the main carriageway. The vehicle going toward right side from the cross road will wait in the buffer zone for the clearance of traffic on highway to cross the road. The vehicle from the highway turning right at the junction will wait in the right turning lane provided near the median opening and after the clearance of highway traffic it will cross the road. This is shown in Figure 105.

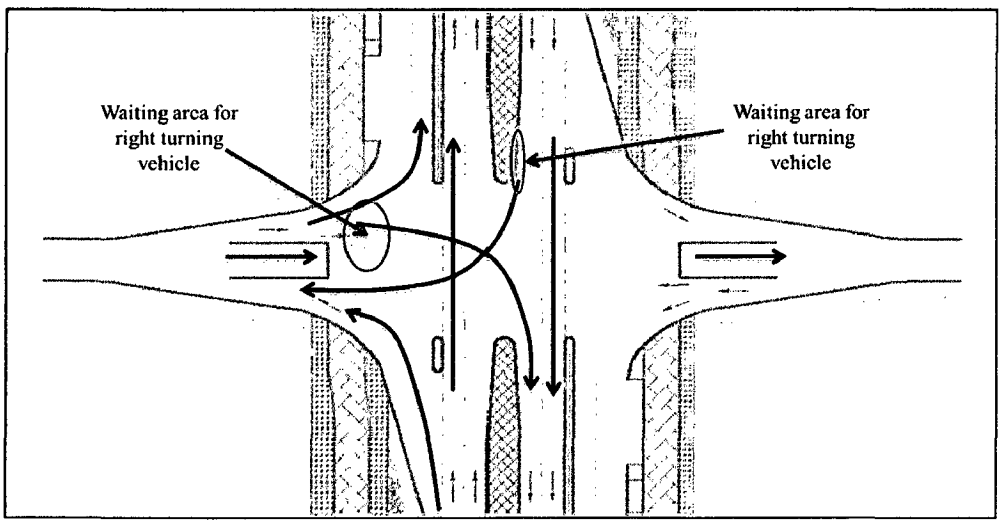


Figure 105: Diagram showing Vehicle Movement at Junctions

Vehicle Movement Below Junction

The vehicles going straight from the cross road, will cross the highway through underpass. The vehicles going left from the cross road to slip road will turn left. Vehicles turning right

from the cross road will have option to take either of slip road since both the slip roads are bi-directional. So, a non-powered vehicle will not have to travel for longer distance for a shorter distance on the same side but in opposite direction. The movement of vehicle below ground is shown in Figure 106.

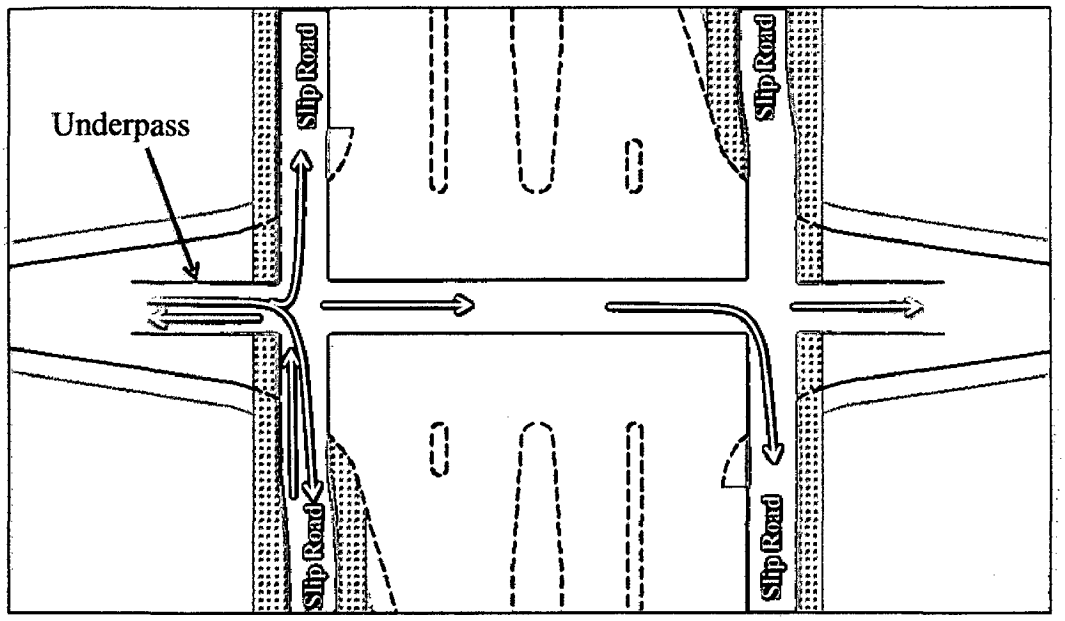


Figure 106: Diagram showing the Movement of Vehicle Below Junction

Buffer Zone

A buffer zone is created for pedestrian movement. It is placed just in front of the junction so that public activities like waiting for local public transport and commercial activates during this waiting period can be done without obstructing the highway traffic on main carriageway. The placement of buffer junction w.r.t. main carriageway is shown in Figure 107.

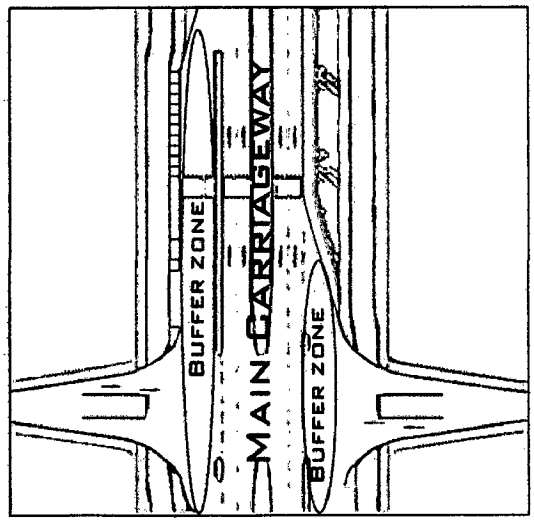


Figure 107: Diagram showing Buffer Zone for Pedestrian Movement

Facilities at Junctions

The following facilities are proposed near the major junctions in the buffer zone-

- Local Public Transport Stop
- Cycle Rickshaw Parking
- Commercial Area

As discussed in section 6.1.2.1, a stop for local public transports is required near the junction. The stop will act as both short time waiting area and longtime parking place if the junction acts as terminal point for local transport. The boarding and de-boarding of public transports will take place near the junction and the same time, it will neither obstruct the movement of traffic on main carriageway nor on cross road.

A cycle rickshaw parking is provided in between the junction and the stop for local transport, so that after getting down from the local transport, the public going inside the rural area can take the cycle rickshaw immediately. Hence the junction will be free of any feeder parking. These facilities are shown in Figure 108.

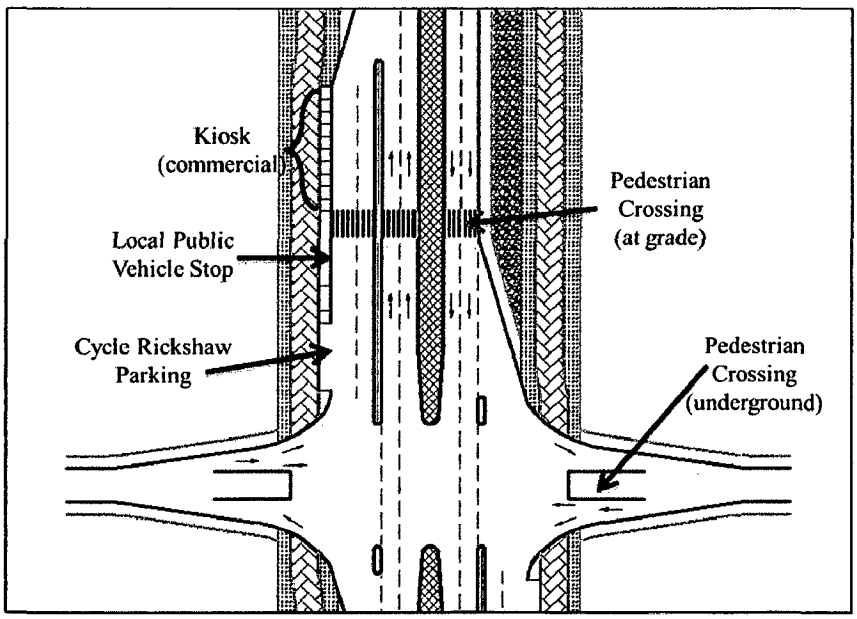


Figure 108: Diagram showing the Facilities Provided at Junctions

It is observed that near the junction, as shown in Figure 109, commercial activities are taking place which facilitate the waiting passengers and it also caters to the need of rural people who buy things while going back to home. So, a commercial zone is provided near the local transport stop. The shop will be like a kiosk, with an internal dimension of 2.5m X 2.5 m. It will contain all types of shops which are presently encroaching the junctions.

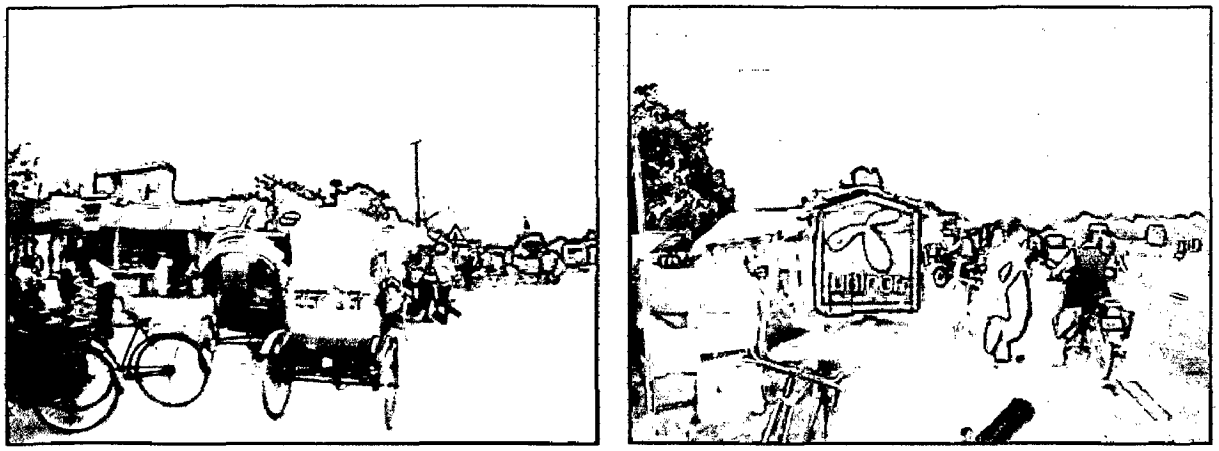


Figure 109: Pictures Showing Commercial Activities at Junctions

From the study done by the author on the causes of encroachment it is found that one of the reasons is the opportunity and potential of place. So, the potential of the junction for commercial activities can be found by the level of present encroachment and by analyzing the population which are dependent on this junction, meaning the rural population which need to cross this junction for their access to highway. To avoid the encroachment of these junctions, two things can be done-

1. Utilizing the opportunity through developing the planned commercial area by highway authority.
2. Preventing people to encroach the junction in future.

1. Utilizing the opportunity-

It means that government itself will construct the required numbers of shop of various sizes by analyzing the demand and then lease it to the public who want to operate shop at junction. This way the encroachment can be regularized as well as some revenues can be generated.

2. Preventing people to encroach the junction-

It is observed by visual survey, shown in Figure 110, that people are encroaching on the government land near the junction which is provided as the shoulder. They erect their temporary structures on this small land. These encroachments can be prevented by concept given in next paragraph.

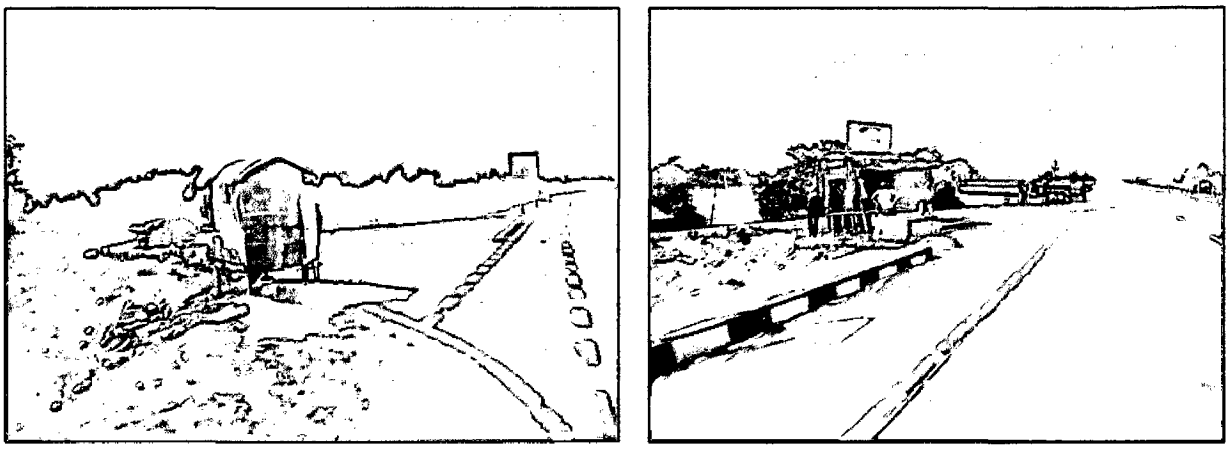


Figure 110: Picture showing Encroachment at Junction

In older time the concept of fortification was used by the kings. They were constructing a wall all around or digging a trench. Hence, fortification was by done by creating a level difference. Now in the case of junctions, when the road is already elevated, a retaining wall can be erected all around the junction to have a level difference between highway and land below highway and this land below highway can be used for slip road. The concept is shown in Figure 111.

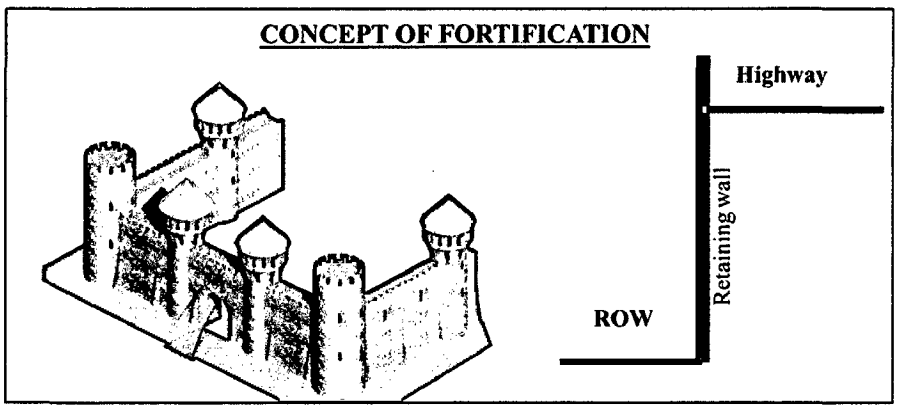


Figure 111: Concept of Fortification to Prevent Encroachment at Junctions

3-arm Major Junctions

For 3-arm major junctions everything will remain same as 4-arm junctions except the median opening. As discussed in section 2.7.3, the Manual allows the median opening for four or more arm junctions but not for 3-arm. So, by following the guidelines of manual median opening is provided at 1 km on either side of junction to maintain the minimum distance of 2 km between the median openings. The Figure 112 shows the location of median opening w.r.t. junction.

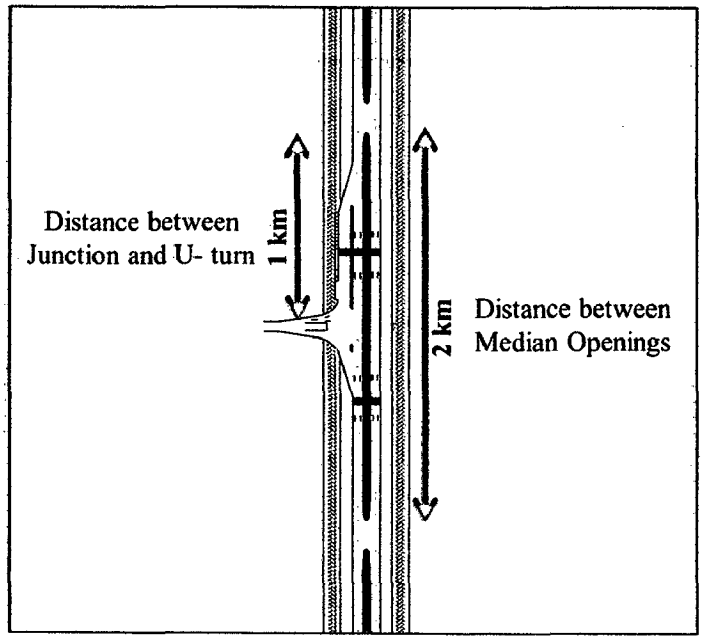


Figure 112: Diagram showing the Location of Median Opening w.r.t. Junction

The connection between underpass and slip road and the movement of vehicles at junction are shown in Figure 113.

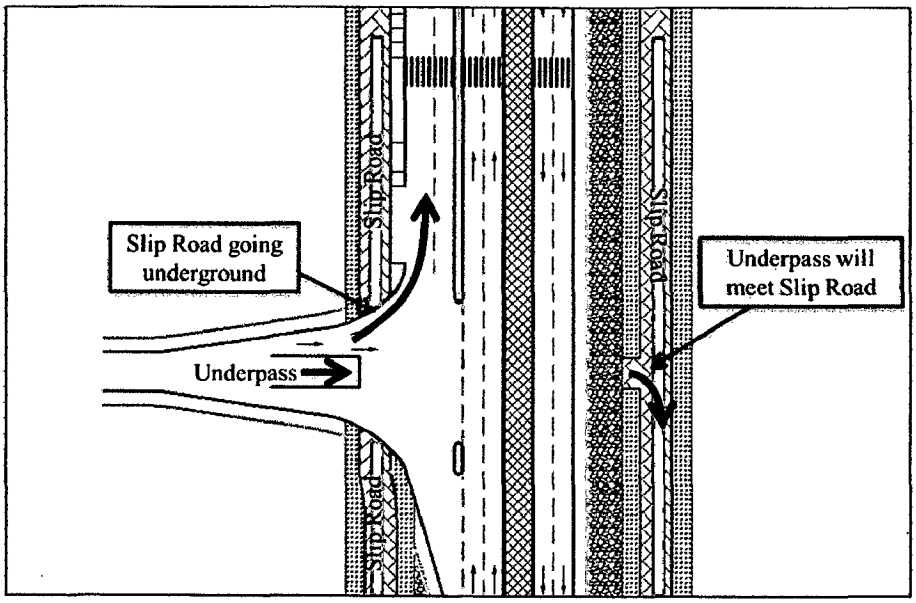


Figure 113: Diagram showing the Movement of Vehicles at T- Junctions

The non-powered vehicle and bikes taking right turn from the cross road will cross the highway through underpass whereas the heavy powered vehicles will first take left turn and then after travelling for 1 km, they will take U-turn.

6.1.2.2 Minor Junction

The total number of junctions which come under the category of minor junction is 92. The locations of these minor junctions are shown in Figure 114.

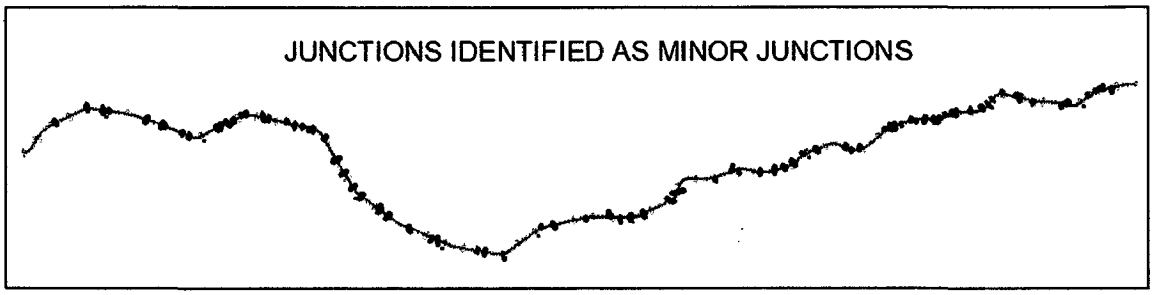


Figure 114: Location of Junctions Identified as Minor Junctions

From the visual survey it is observed that the rural roads are dominated by the bikes, cycles and pedestrian movements and the movement of agricultural vehicle and animal cart are seen rarely. This is shown in Figure 115. From the house-hold survey, as given in Table 72, it is found that only 2% of rural population has four wheelers. So, while planning the solution for minor junctions, it should be noted that only bikes and tractors will be the vehicles using these roads apart from cyclist, pedestrians and cattle.

Figure 115: Picture showing Minor Junctions as Provided during Four Laning

From the house-hold survey as given in Table 44, it is observed that the 98% of rural population crosses the highway wherever they like. So, while planning the proposal for minor junctions, it should be noted that a pedestrian and cycle crossing should be provided near to the meeting point of rural roads to the highway.

Proposal

All the minor junctions which are usually of cart track (earthen road) and brick road should meet the slip road instead of meeting the highway directly. Firstly the traffic from rural road will go through the slip road which facilitates the bidirectional movement then wherever the connection to the highway is found, the vehicle will join the highway. To facilitate the crossing of highway the underpass should be provided to join the slip road running parallel on both the sides of highway. And as recommended by the Manual, discussed in section 6.1.3, the minor bridges can also be used for crossing in dry weather provided it has hard flooring. The schematic diagram showing the connection of rural roads to slip road is shown in Figure 116.

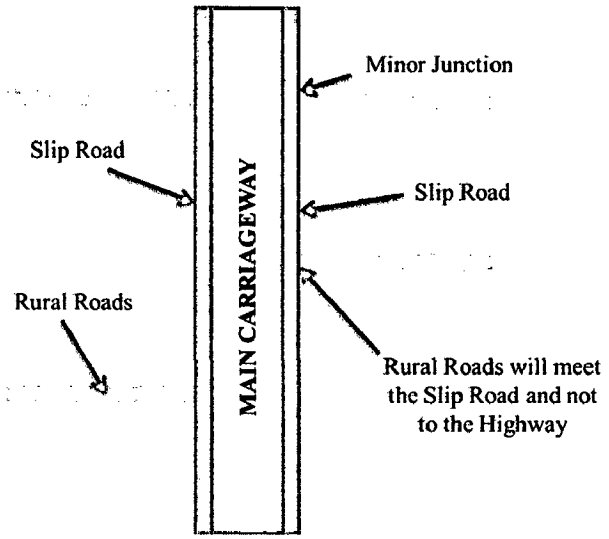


Figure 116: Schematic Diagram showing Minor Junctions

There are various advantages of connecting the rural roads to slip roads like it will avoid the direct joining of vehicle from cross road to the highway, it will reduce the number of punctures in the highway and hence will increase the distance between junctions and it will segregate the slow moving vehicles like animal-cart from the speedy highway.

The slip road, running parallel to the highway on either side, should meet it with the provision of acceleration and deceleration lane. A ramp going up from the slip road should merge into the acceleration lane to facilitate the vehicle coming from slip road to join the highway. Similarly, another ramp going down from deceleration lane to slip road should facilitate the highway vehicle to join the slip road. This is shown in Figure 117.

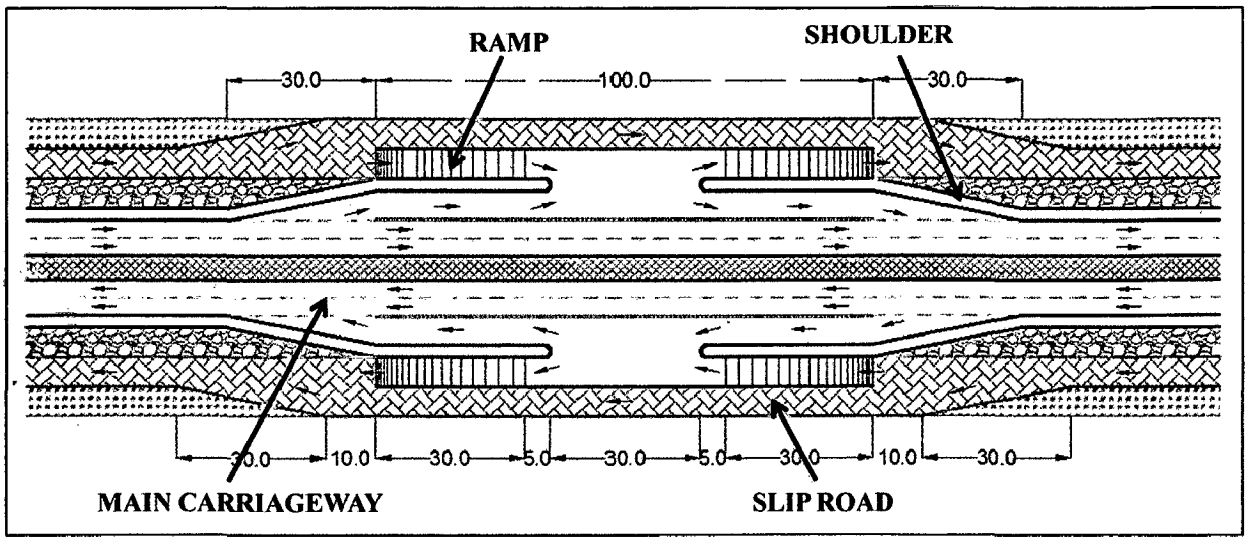


Figure 117: Connection of Slip Road with Highway

6.1.3 Use of Minor Bridges as Pedestrian/Cattle Crossings

The slip road, as proposed in section 6.1.1, running parallel to the highway on either side, should be connected to the minor bridges, so that the pedestrian which are moving on the slip road can use it for crossing highway. Apart from this these can be also used by cattle. The underpass will also facilitate the crossing of highway by motorcyclists since it requires less space for the movement of bikes. Considering the minor bridges, there will be total of 23 underpasses including the 6 provided during the four laning.

6.1.4 Use of Old Alignment to Segregate Local Traffic from Highway

Old alignment, as shown in Figure 118, has shorter length. As, the new alignment is a kind of bypass hence, all the old settlements are on old alignment. Presently old alignment is not used because of the absence of bridges on the rivers. If the bridges for two wheelers and light vehicle are provided on the old alignment then automatically, the local traffic will switch over to this because of the shorter route and hence, the disturbance to the national traffic by the movement of local traffic on highway will reduce.

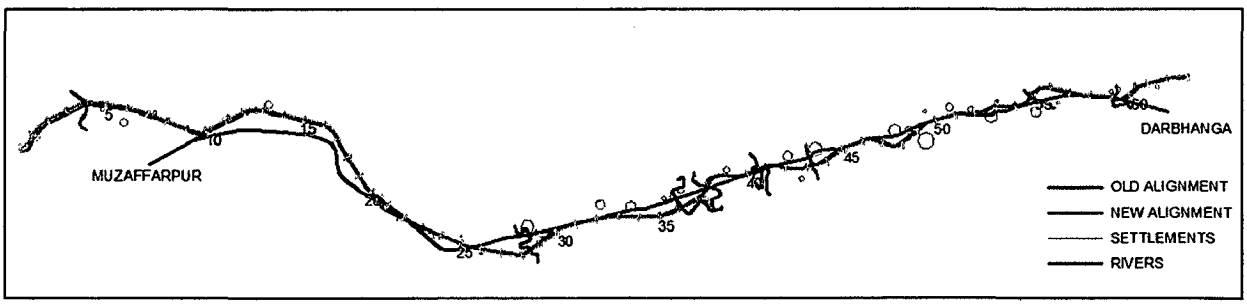


Figure 118: Use of Old Alignment

6.2 HIGHWAY FACILITIES

6.2.1 Bus Bays and Passenger Shelter

Bus-bay should be provided with a shorter connectivity to the rural settlement. So that people can come directly here without going to the junction and then coming to bus-stop. And a local bus service should be provided which should stop at all the bus-stops and its frequency should be high during the morning peak-hour i.e. 9-10 AM and evening peak-hour i.e. 5-6 PM. Shorter connectivity will help the villagers in using bus-stop for catching public transport, since taking a shorter route and reaching on the highway at earliest is the human tendency.

A small commercial zone should be developed near the bus stop so that the travellers who just want some wafers or soft drinks can buy here. This will help in increasing the use of bus-stop and will provide facility to travellers, at the same time it will also generate some revenue to the highway authority.

6.2.2 Truck Lay-byes

The location of the truck lay-byes should be done after analyzing the direction of movement of goods on regional and national level like the location of railway goods yard, the location of wholesale distributors and location of other distributors.

Safety of goods and trucks should be ensured by employing some person at the truck lay-byes for the said purpose or rest room should be provided with wide transparent windows, so that the trucks and goods can be observed from the inside of room. Since truck drivers don't prefer to stay in isolated place during night, so some pubic activities should be encouraged near to rest area to make the place lively throughout the day.

Trucks and dhabas are dependent on each other and for newly constructed truck lay-byes it is like "you first, you first" situation between them. Trucks doesn't go to lay-byes since there is no dhaba and dhaba people doesn't relocate it to truck lay-byes since there is no trucks .So, it is like who will go there first. Hence, it is the opportunity for the authority to construct some commercial area and lease it for various activities related to trucks like dhaba, repair shop etc. This will help in generating revenue to the authority as well as, it will start the use of lay-byes by truck drivers.

6.2.3 Rest Area

Now for travellers, other than truck drivers since they will have to stop at truck lay-bye only, two rest area of different scale should be provided on the highway separately to facilitate the long distance and short distance users.

For short distance travelers which mainly want to have a small break to relax and have some snacks, a small rest-area should be provided near every fuel station. It should be consisting of a dhaba, a small waver's shop, a puncture shop and a washroom. The rest area should be located at the exit of fuel station but slightly inward so that people from fuel stations as well as highway can access the rest area. It should be provided with ample parking space so that it should not obstruct the traffic movement on highway as well as inside the fuel station.

For long distance travellers another rest area of bigger scale should be provide. Following facilities should be provided at the rest area.

Components of Rest-Area

- Motel
- Picnic spot
- Fun park
- Tot-lot
- Conference rooms
- Seminar halls
- Marriage halls
- Party halls
- Famous eateries like Mc' D or KFC
- OAT to perform cultural events
- Art gallery and exhibition area
- NHAI regional office
- Office of highway maintenance department
- Highway Police reporting center
- Break-down services, crane facility
- Ambulance facility and first-aid kit
- Fire extinguishers
- ATMS system, Traffic news, Route news display

- Commercial center like grocery shops, local fresh agricultural products etc.
- ATM
- Ample parking

Advantages of rest-area are given below. It will help:

- To facilitate the long distance travellers
- To promote local agricultural products
- To promote local culture
- To provide fame to the local performers
- To promote local art
- In economic upliftment of local artesian
- To provide job opportunity to the local population
- To generate revenue through conference rooms and seminar halls to recover the cost of construction of highway
- To provide social infrastructure like recreational landuse for local area
- To provide a platform to launch the public awareness program by government
- To provide a landmarks

Rest-area can be constructed in phase manner like the profit from phase I can be utilized to construct the phase II and likewise.

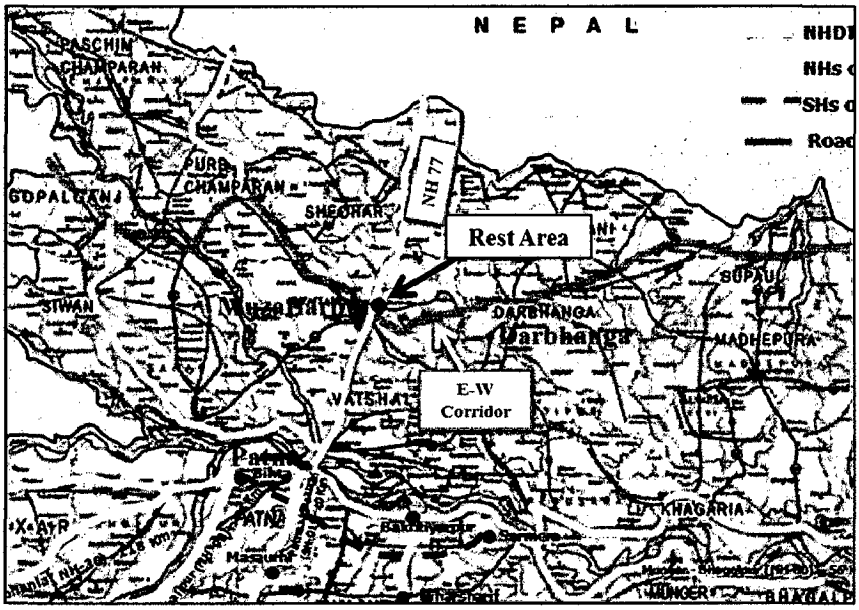
Deciding factors for the location of Rest-area

- Nearness to the city or major settlement to maximize the population within the area of influence
- Nearness to the city so that the office uses can easily commute
- Availability of public transport from the nearest city
- Near to city or settlement where hotels are not available
- Change of mode of transport
- Pattern of movement of long distance buses on the basis of origin and destination.
- Composition of local traffic and national traffic on the highway.

Location of Rest-Area

Rest area will be used by long distance travellers or by the travellers who require to change the vehicle and the transport for further journey is not available during the night hours. On

the basis of satellite imaginary and from the expert's opinion, it is found that in Muzaffarpur, junction of highway with NH 77 will be the best location of rest area since, NH 77 connects the highway to Nepal border and a large number of people from Bihar commute to different area in Nepal. This is shown in Figure 119.



Source (Base map) - http://bsrdcl.bih.nic.in/

Figure 119: Location of Proposed Rest Area in Muzaffarpur

6.2.4 Fuel stations

In the rural area a separate fuel station should be provided to separate the fuel station on the highway for the use of highway vehicle. By providing it in the rural settlement, the movement of local public on the highway for fuel filling can be reduced and hence safety aspect of highway can be increased.

CHAPTER - 7 CONCLUSION & RECOMMENDATION

Highways passes through the rural areas of India for most of its length and although, the settlement along the alignment have been relocated but still many settlements can be seen along the highways. These highways are recently widened, so the traffic movement is not high at present, but sooner it will increase tremendously. The rural population along the highway are still surprised by the widened roads and considering it as gift from the government, they uses it as public space, as a recreational space, as storage for keeping their agricultural products & waste, as front-yard or backyard, as animal rest area etc. Some of the local resident utilizes the potential of the highway for commercial activities and hence fresh encroachment can be seen around the major junctions. The owner of the nearby land changes the landuse of their property from agricultural to non-agricultural and because of the absence of any law these fresh structures inside the building line are not illegal. So, if the preventive measures are not considered immediately then sooner or later these highway will converts into an arterial road and it will not be able to provide the design speed of 100 km/h for which these highways are designed.

Recommendations

Proposals, as discussed in Chapter 6, will help in the reduction of potential of highway to commerce by utilizing the opportunity of business by the highway authority rather than by locals and hence, the encroachment along the highway will reduce. Similarly, by utilizing the entire land falling within ROW, the resource for encroachment can be eliminated. So, the present problems of highway can be solved but in future, to avoid these kinds of disturbances to the highway, the objective of planning should focus on the inward growth and prevention of development of human settlements along the highway. And to achieve this objective following recommendations are suggested based on the study of various acts pertaining to the development along national highways.

- Immediate declaration of control line along the highways and to frame a national act which will be implemented on all the land falling within the control line, irrespective of the above said land coming under state jurisdiction.
- Bye laws to be framed for the rural areas especially along the highway.
- F.S.I or F.A.R. to be provided in the increasing order as the distance from the highway increases, so that, to reduce the population density along the highway.

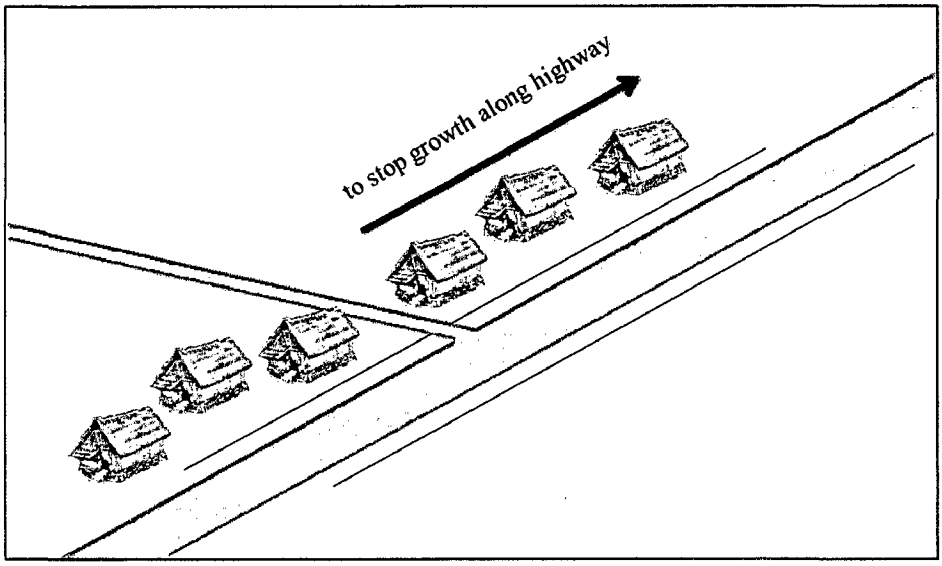


Figure 120: Objective of Future Planning along Highway

- Height restrict should be provided inversely proportional to the distance from highway to lower the impact on highway.

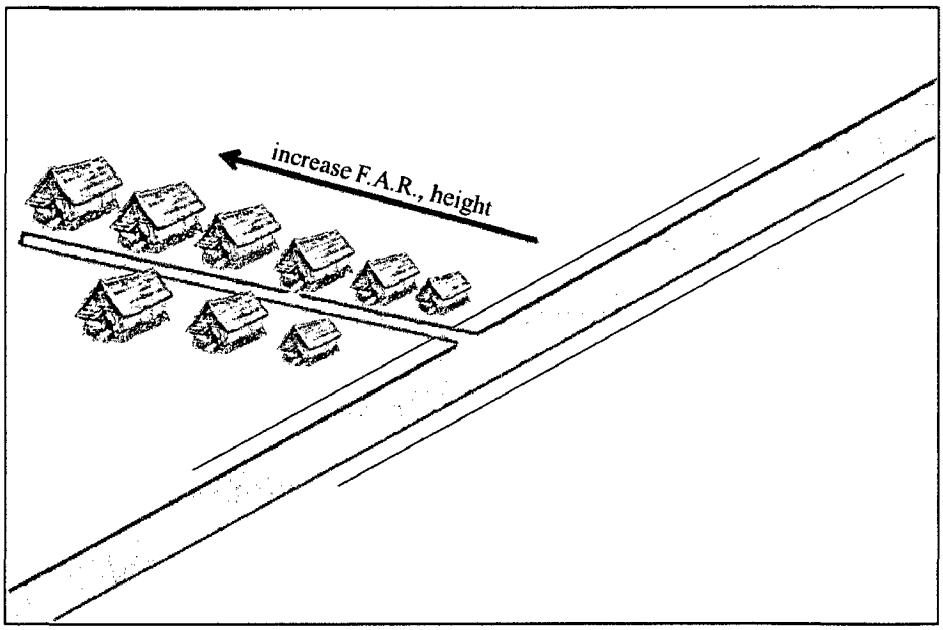


Figure 121: Methods to Achieve the Objectives of Future Planning along Highways

- Development rights to be seized from the land owners along the highway within the control line and the compensation can be given by the way of providing proportionate transfer of development right (TDR) in the highway facilities like rest-area, fuel-stations, bus-stops developments, etc.

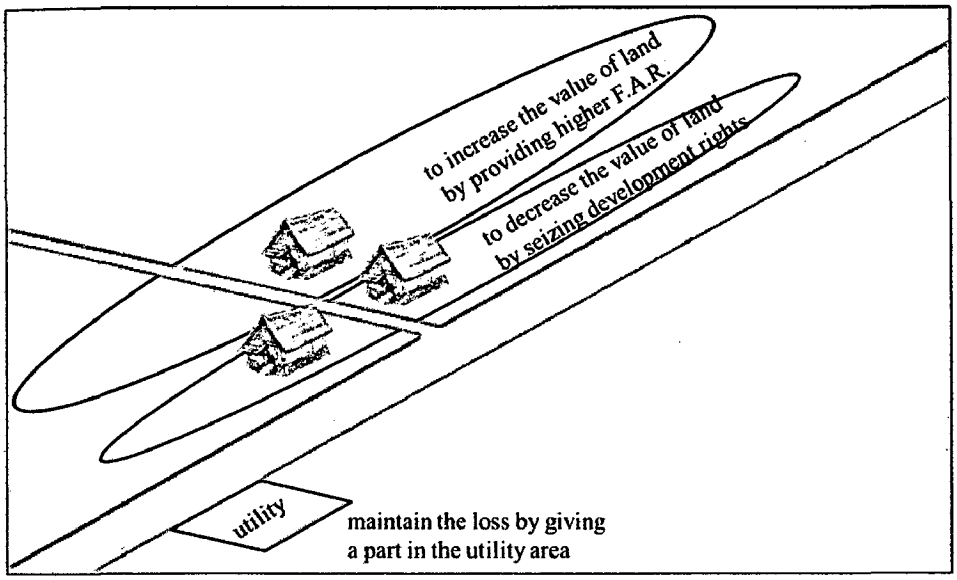


Figure 122: Methods to Achieve the Objectives of Future Planning along Highways

- Green belt to be proposed in the corridor master plan along the highway.
- Strict enforcement of laws and acts pertaining to highway.
- Periodic inspection by the professional from NHAI, Planning Commission and other regulatory body.
- High penalities for defaulters.

Scope for Further Studies

- The location of various highway facilities can be calculated through MCDM (Multi criteria decision making) approach since it dependence on various factor. Eg. Location of fuel station depends on no. of vehicles on highway, fuel efficiency of each type of vehicle, the tank capacity of each vehicle, the economic condition of the vehicle owner, etc.

  Hence, an equation can be drived for calculating the location and numbers of fuel stations as

  $$y = f(x_1, x_2, x_3, x_4, \ldots\ldots)$$

  where, y= number of fuel station
  x_1= no. of each type of vehicles
  x_2= fuel efficiency of each type of vehicles
  x_3= tank capacity of each type of vehicles
  x_4= economic condition of vehicle owner
  x_5=.....
- A guideline of the national scale can be prepared to regulate the developments within the control line along all the highway of India.
- A Corridor Master Plan can be prepared for the entrie length of corridor.

REFERENCES

1. CHANDRA, DR. SATISH; Paper No.498 "CAPACITY ESTIMATION PROCEDURE FOR TWO-LANE ROADS UNDER MIXED TRAFFIC CONDITIONS", Published by Indian Road Congress, New Delhi

2. DETAILED PROJECT REPORT- CONSTRUCTION PACKAGE CII/BR-8, VOLUME- IX: DRAWINGS, PART-I: ROAD WORKS, Prepared by Mahendra Raj Consultants, New Delhi; Published by National Highway Authority of India, Ministry of Road Transport and Highways, Govt. of India, New Delhi

3. DETAILED PROJECT REPORT- CONSTRUCTION PACKAGE CII/BR-9, VOLUME- IX: DRAWINGS, PART-I: ROAD WORKS, Prepared by Mahendra Raj Consultants, New Delhi; Published by National Highway Authority of India, Ministry of Road Transport and Highways, Govt. of India, New Delhi

4. FINANCING OF THE NATIONAL HIGHWAY DEVELOPMENT PROGRAMME, (2006) Published by The Secretariat for the Committee on Infrastructure Planning Commission, Government of India Yojana Bhawan, Parliament Street New Delhi - 110 001 (Page 4-27)

5. FOUR LANING OF HIGHWAYS THROUGH PUBLIC PRIVATE PARTNERSHIP MANUAL OF SPECIFICATIONS & STANDARDS, Published by Planning Commission, Government of India, New Delhi http://infrastructure.gov.in/pdf/four_lane.pdf

6. IRC- 64 :1990- "GUIDELINES FOR CAPACITY OF ROADS IN RURAL AREAS", Published by Indian Road Congress, New Delhi

7. MANUAL FOR SPECIFICATIONS AND STANDARDS FOR FOUR LANING OF NATIONAL HIGHWAYS THROUGH PUBLIC PRIVATE PARTNERSHIP, Published by Department of Road Transport & Highways Ministry of Shipping, Road Transport & Highways Government of India http://morth.nic.in/writereaddata/linkimages/SSL_Manual4lane726136537.pdf

8. MONTHLY PROGRESS REPORT OF PACKAGE BR-8 (OCTOBER, 2010), Published by Scott Wilson Kirkpatrick India Pvt. Ltd.

9. MONTHLY PROGRESS REPORT OF PACKAGE BR-9 (OCTOBER, 2010), Published by Scott Wilson Kirkpatrick India Pvt. Ltd.

10. NATIONAL HIGHWAYS DEVELOPMENT PROJECT PHASE-I Report No.7 of 2005 (PSUs) Page no.- 5 Chapter- I http://saiindia.gov.in/english/home/Our_Products/Audit_Report/Government_Wise/union_audit/recent_reports/union_performance/2004_2005/Commercial/Report_no_7/3-NHAI-Report.pdf

11. ROAD INDIA Published by Investment Promotion & Infrastructure Development Cell Secretariat for Industrial Assistance Department of Industrial Policy & Promotion Ministry of Commerce & Industry Government of India Udyog Bhawan New Delhi 110 011

Websites:

www.census.gov.in accessed on April 10, 2011

http://www.nhai.org/balancelength.htm accessed on Nov. 24, 2011

http://www.nhai.org/nhdpbulding.htm accessed on Nov. 24, 2011

http://www.nhai.org/advantagenhdp.htm accessed on Nov. 24, 2011

http://www.nhai.org/WHATITIS.asp accessed on June 5, 2012

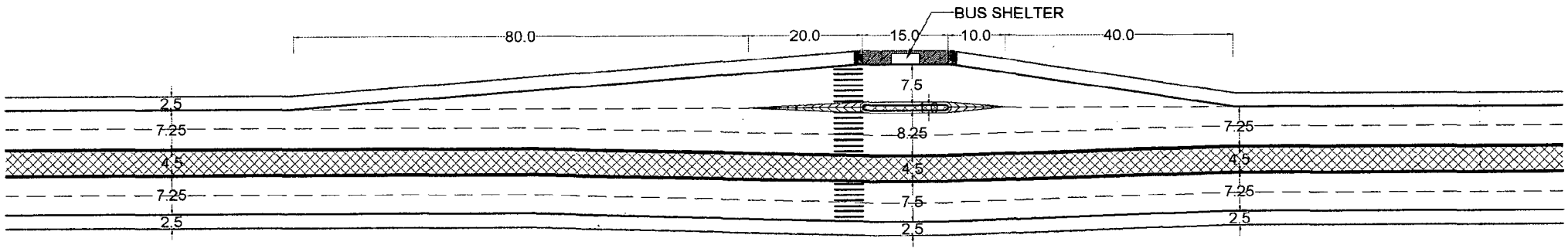
http://www.nhai.org/nhdpfinance.htm accessed on Nov. 24, 2011

http://www.nhai.org/contractsawards.asp accessed on Nov. 24, 2011

http://en.wikipedia.org/wiki/National_Highway_%28India%29 accessed on Nov. 11, 2011

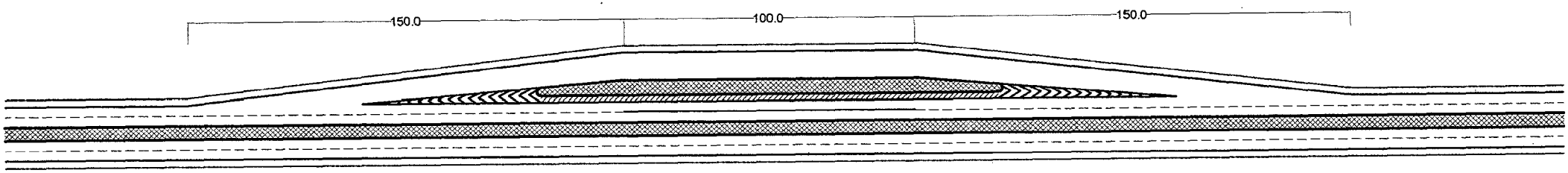
ANNEXURE

7.1 ANNEXURE I- LAYOUT OF BUS-BAY



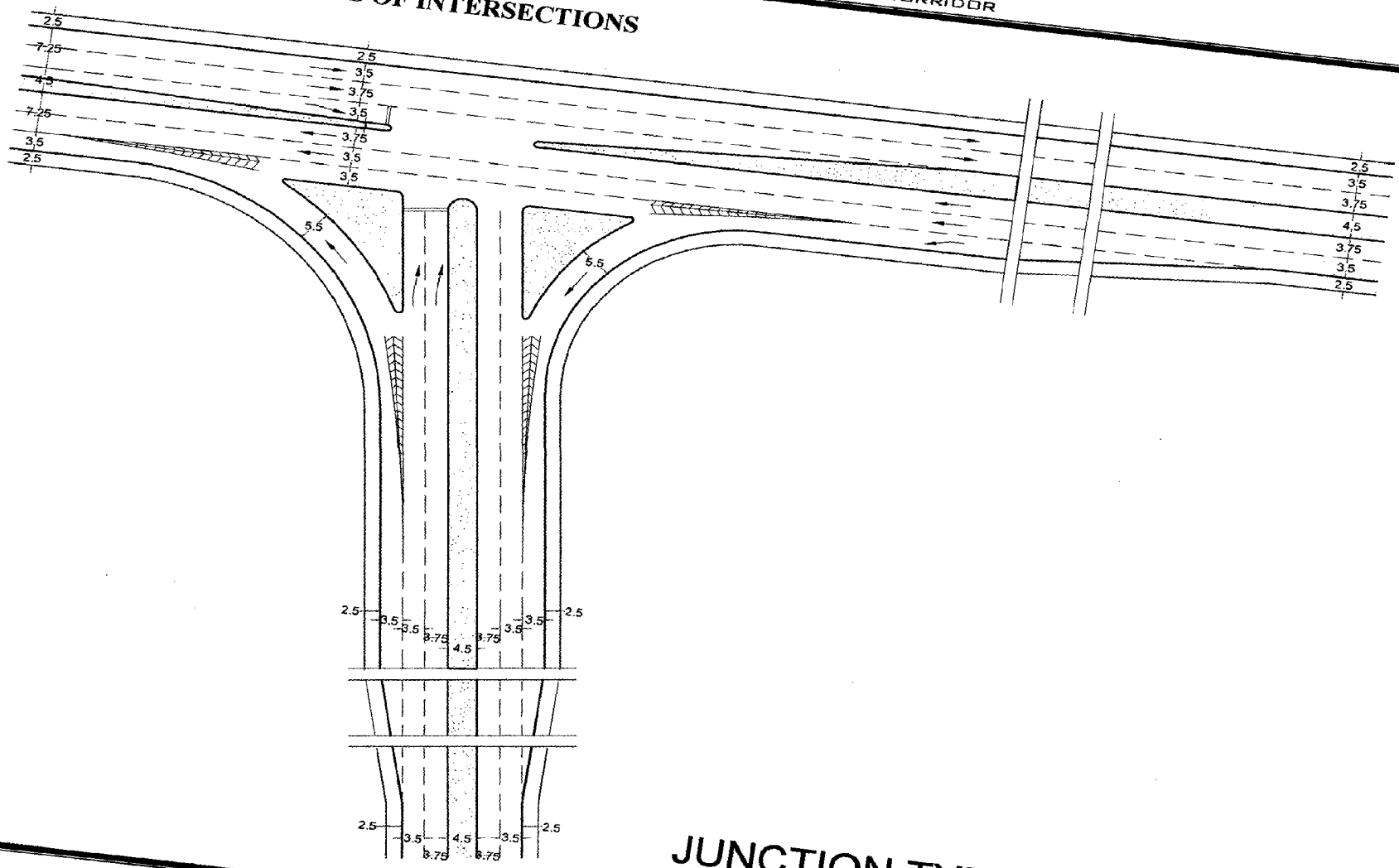
LAYOUT FOR BUS-BAY

7.2 ANNEXURE II- LAYOUT OF TRUCK LAY-BYE

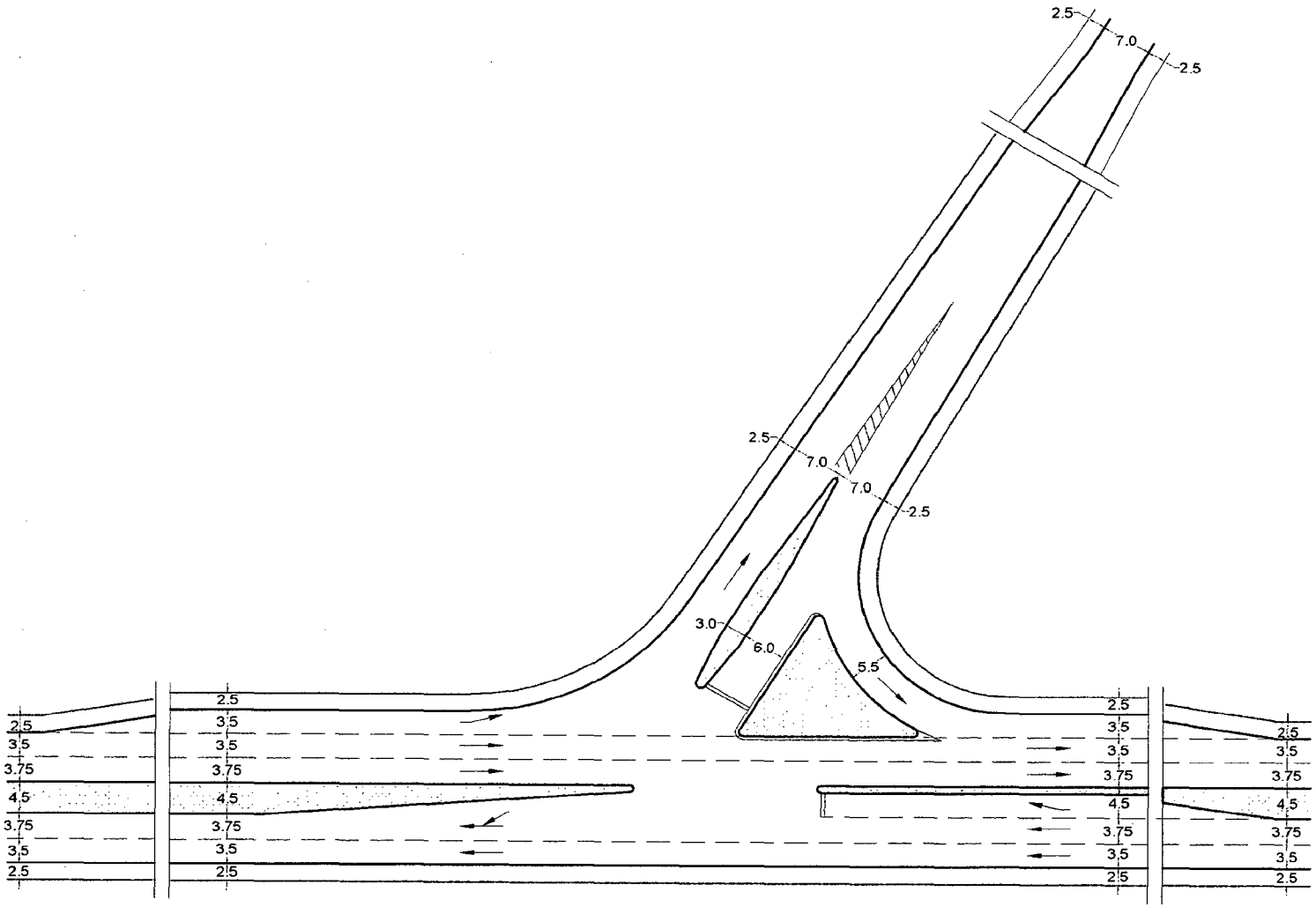


LAYOUT FOR TRUCK LAY-BYE

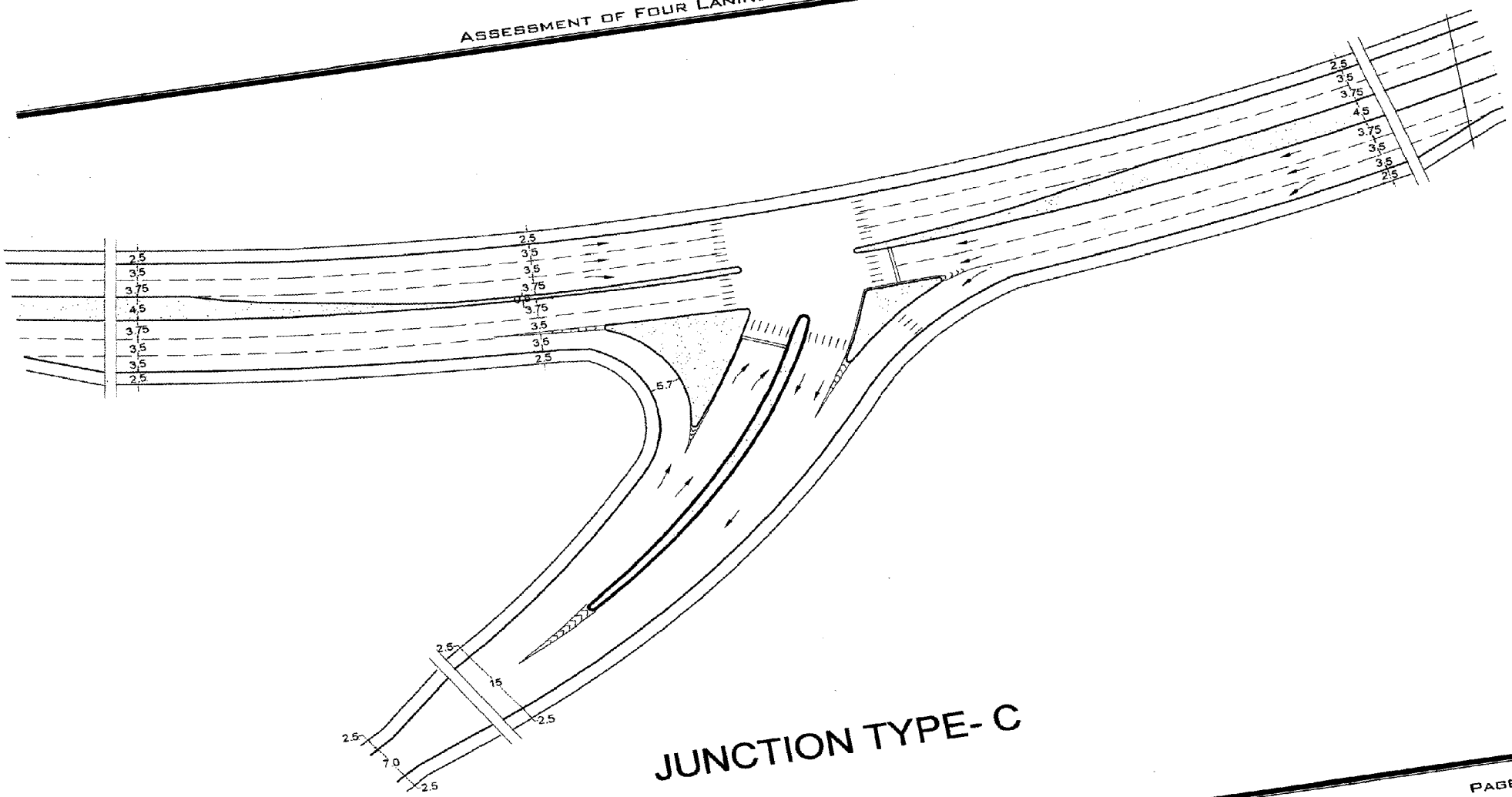
7.3 ANNEXURE III- DRAWINGS OF INTERSECTIONS



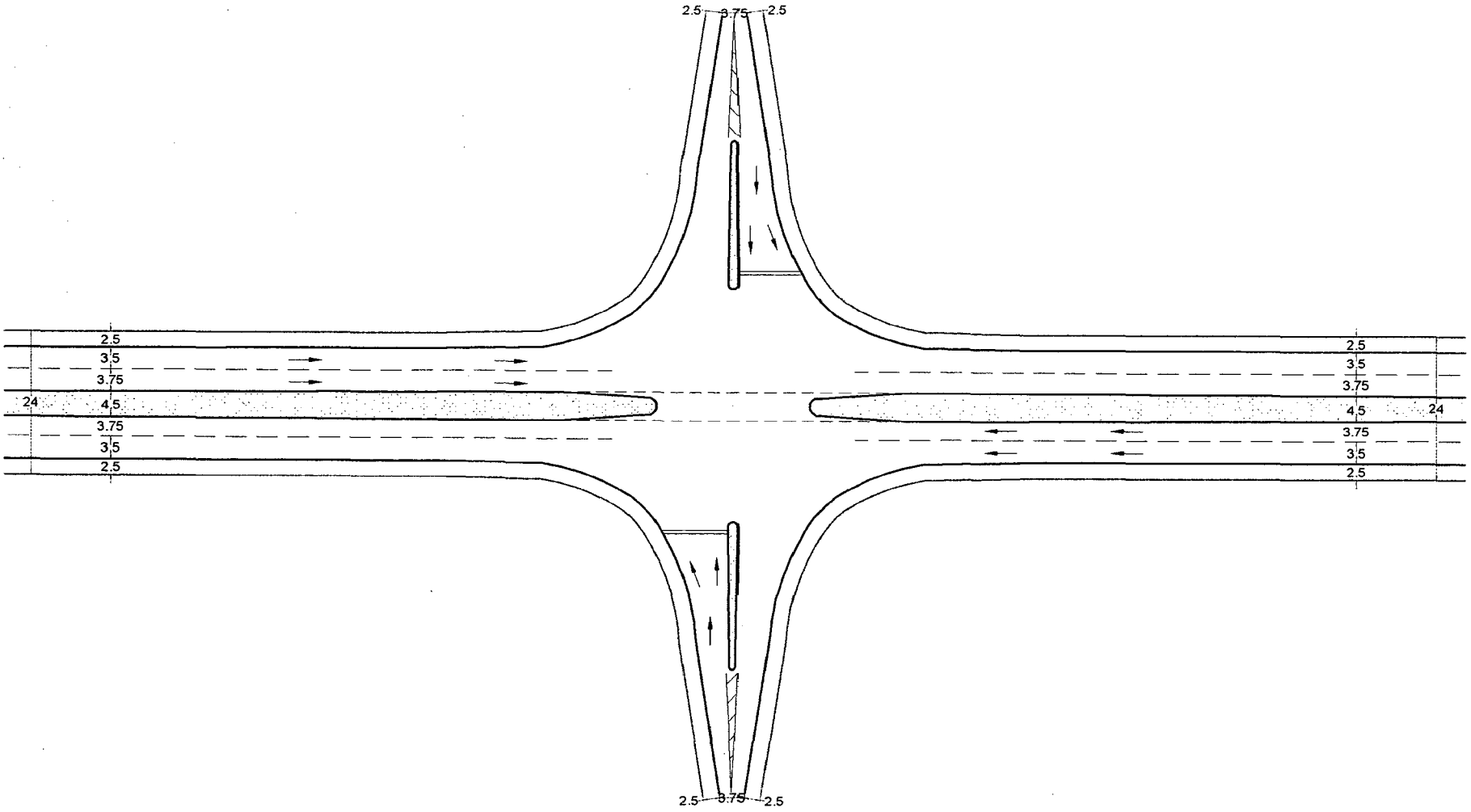
JUNCTION TYPE- A



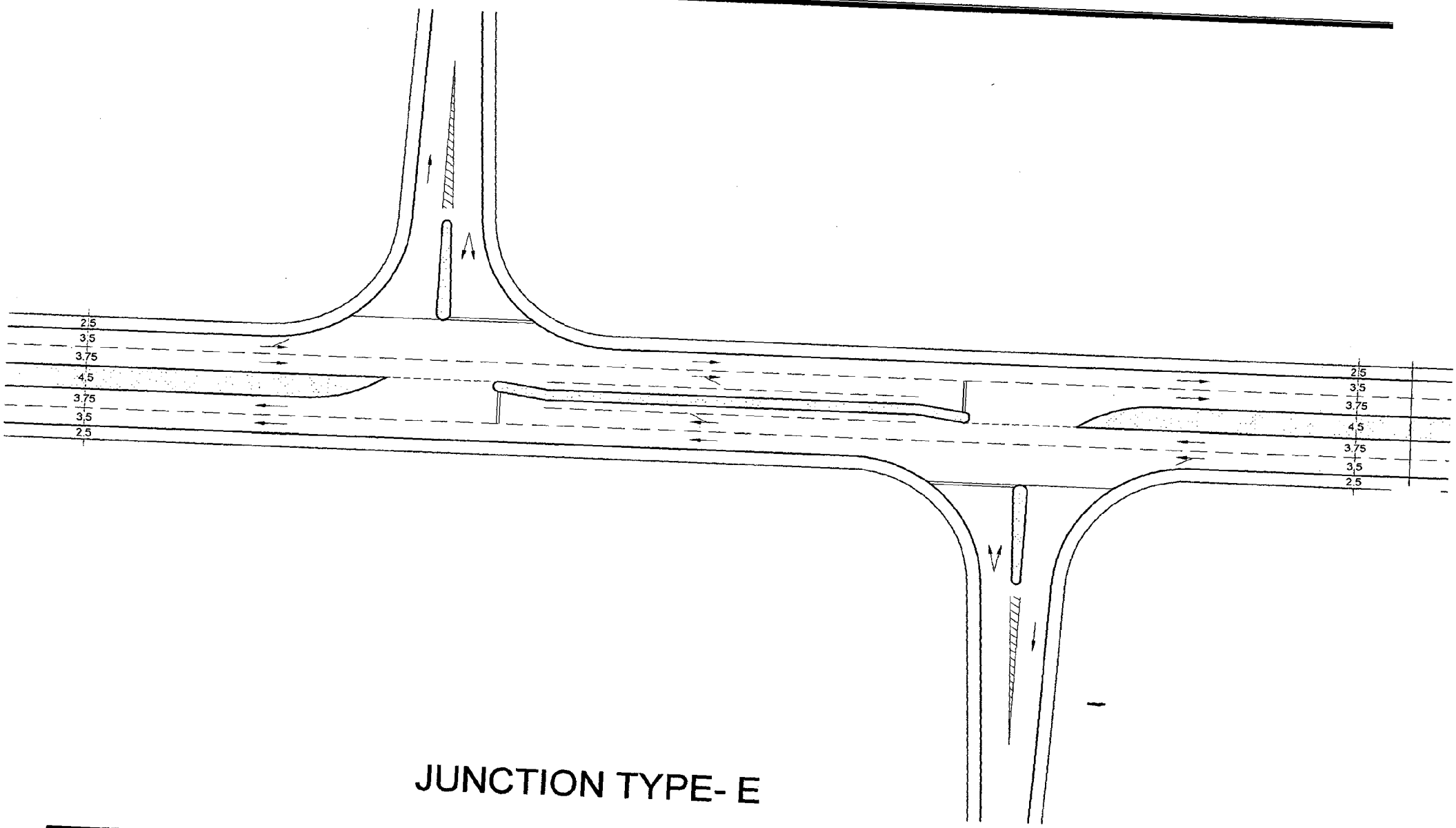
JUNCTION TYPE- B



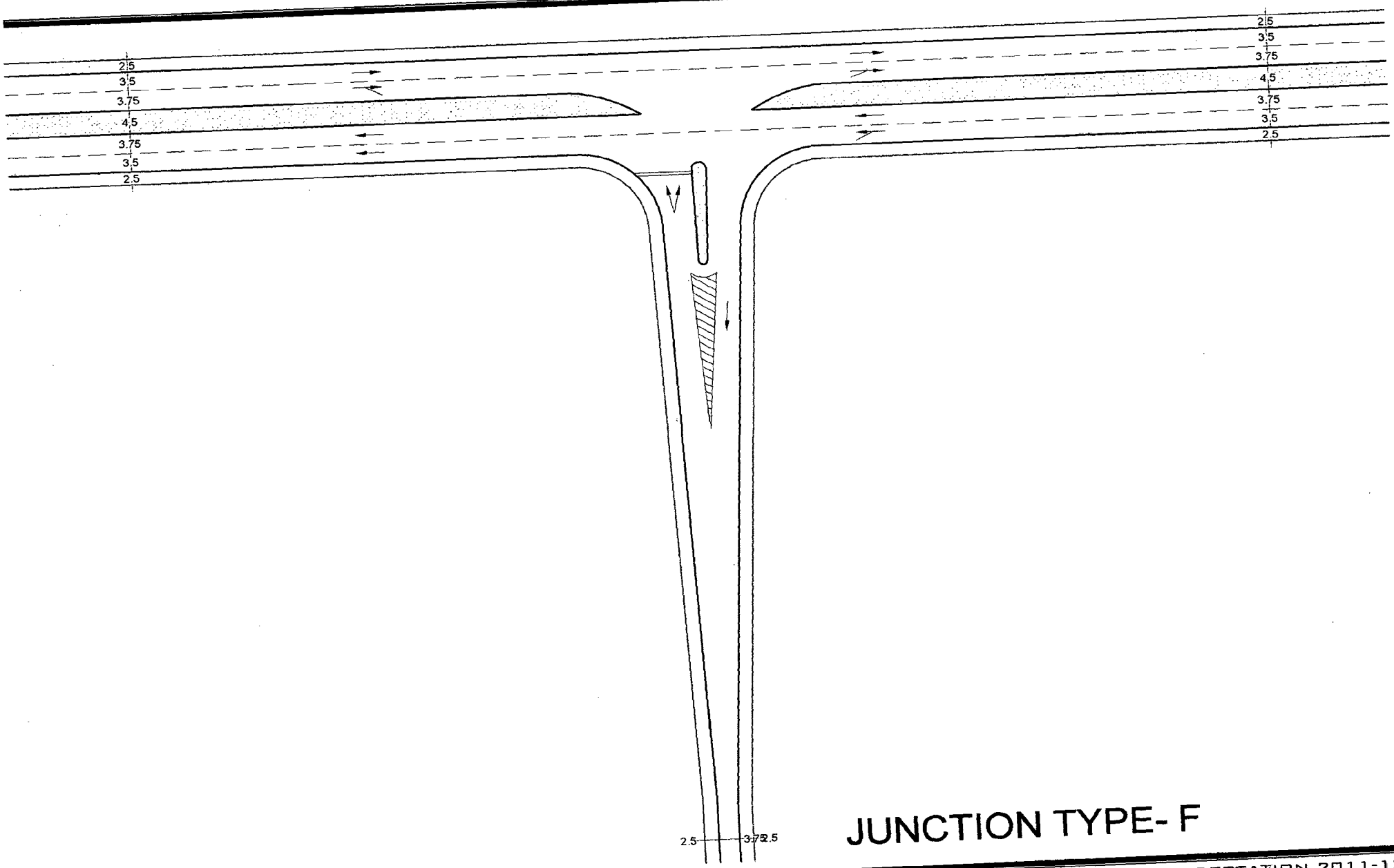
JUNCTION TYPE- C



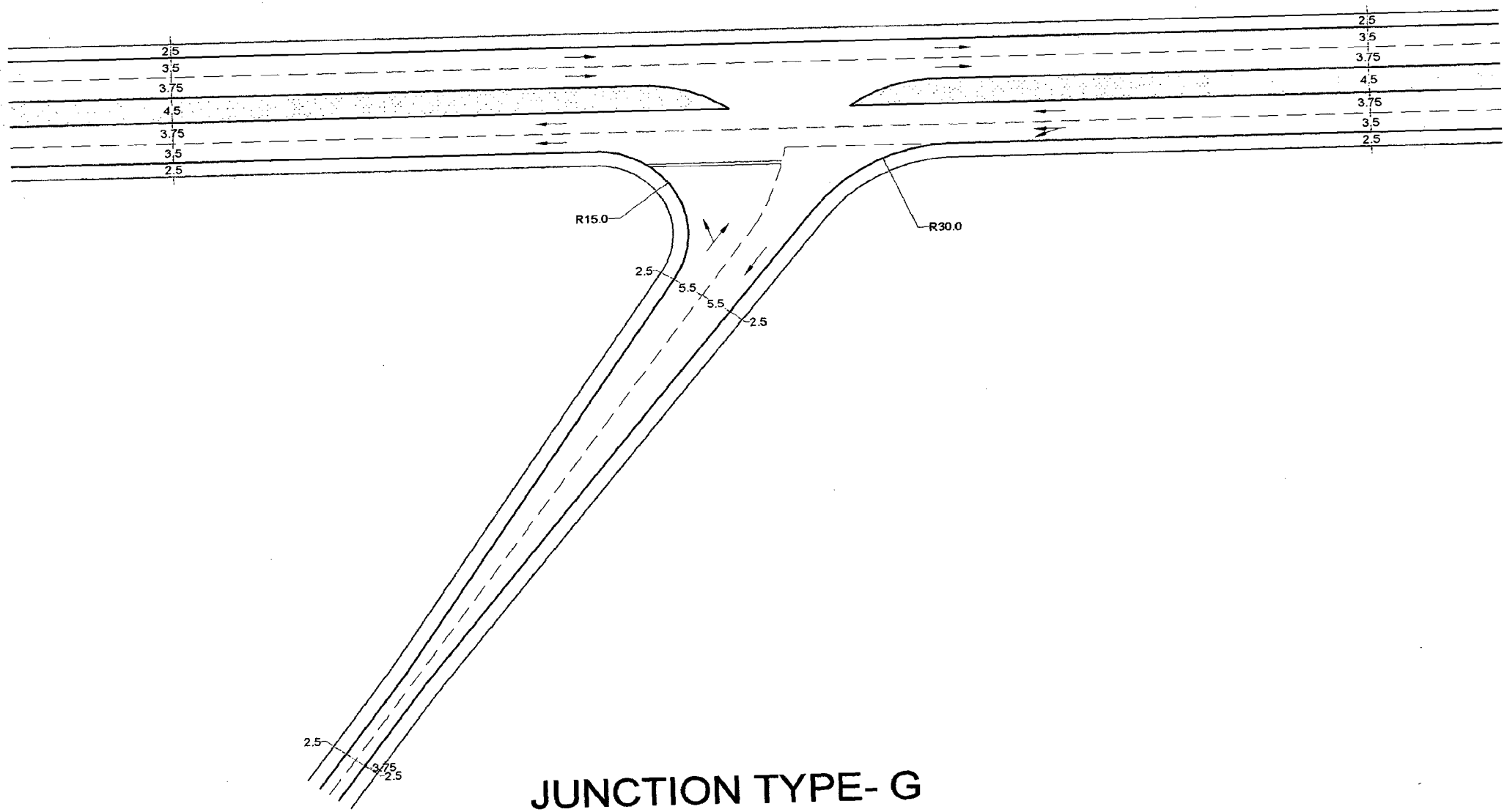
JUNCTION TYPE- D



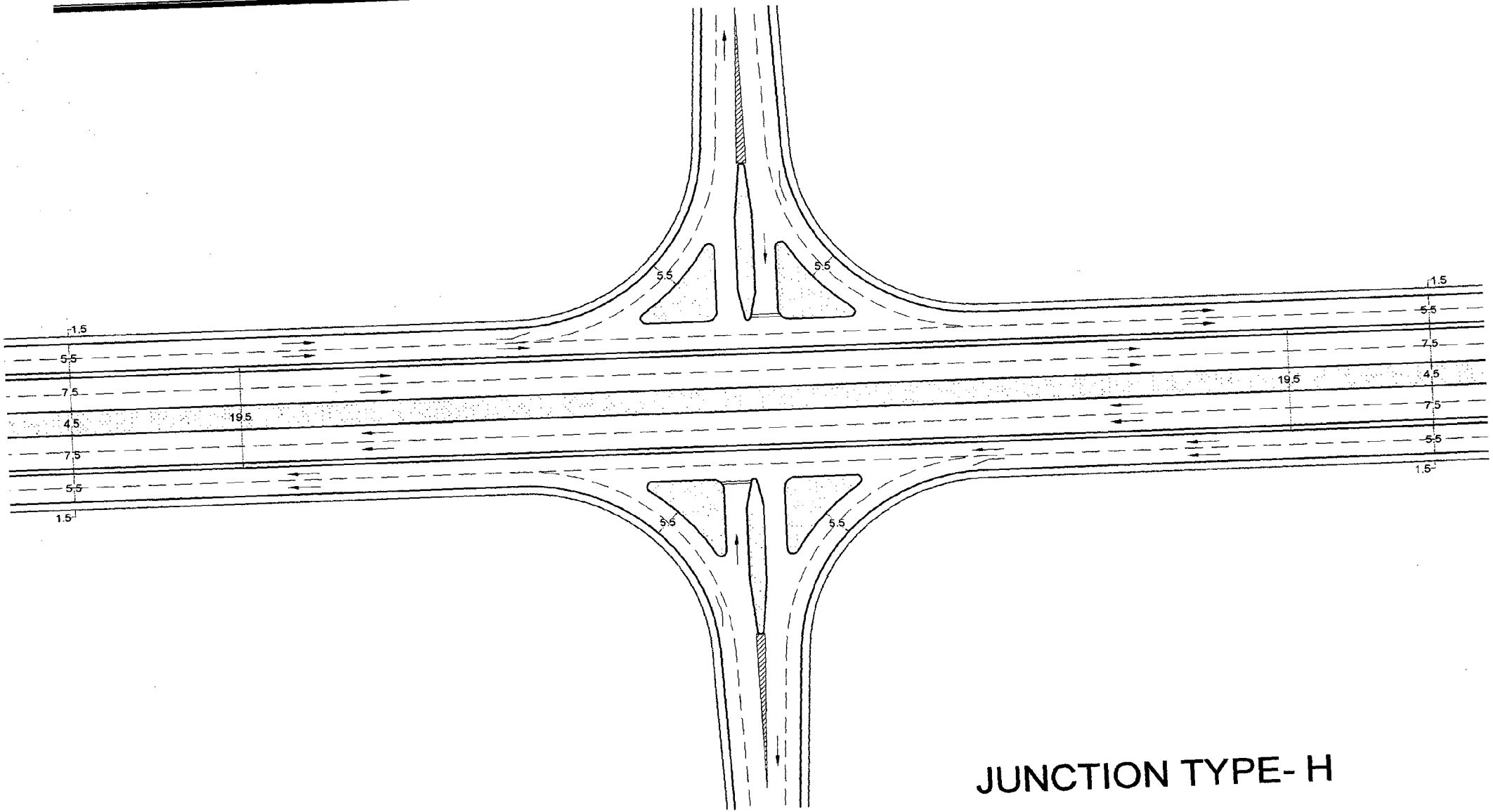
JUNCTION TYPE- E



JUNCTION TYPE- F



JUNCTION TYPE- G



JUNCTION TYPE- H

7.4 ANNEXURE IV- QUESTIONNAIRES FOR TRAVELLER'S SURVEY

Place - ..... Date - ..... Time - .....

Type of traveller – private / public / public local / goods Type of vehicle- .....

No. of passengers-... Relation between passengers- *Family / friend / known / strangers*

PART- A

1) **Origin?** *Darbhanga town / Muzaffarpur town / on highway between Darbhanga & Muzaffarpur / Darbhanga district / Muzaffarpur district / other nearby district / Patna / >200km*
2) **Destination?** *Darbhanga town / Muzaffarpur town / on highway between Darbhanga & Muzaffarpur / Darbhanga district / Muzaffarpur district / other nearby district / Patna / >200km*
3) **Purpose of travel?** *Office / official work / business / family activity / to catch train / to catch flight / tour*
4) **If you are commuting between the cities then what is the frequency of commuting?** *Daily / Occasionally*
5) **If you are a daily city to city commuter then in which category you fall?** *Reside in Darbhanga and go to Muzaffarpur everyday / Reside in Muzaffarpur and go to Darbhanga everyday*
6) **If you are a daily city to city commuter then what is the reason for daily commuting?** *Better physical infrastructure / Better schooling for children / Family attachments / Higher rent / Commuting is easy*
7) **Why did you choose this time of the day for travelling through this stretch?** *Not by choice/ light from approaching vehicle disturbs in night / chance of robbery during night / lesser traffic during night / lesser local public movement during night*

PART- B

1) **Where do you stop your vehicle?** *At bus stop / At major junction / At junction / Anywhere / Nowhere*
2) **How often you visit to dhaba?** *Always / Frequently / Sometimes / Never*

3) **If you visit dbaha then what is the main purpose of your visit?** *For cold drinks / For hot drinks / For wafers / For snacks / For food / For short term rest / For long term rest / For cooling vehicle*
4) **If you visit to dhaba then for how much time you stay there?** *< 15 min / 15 – 30 min / 30 – 60 min / > 60 min*
5) **If your bike gets punctured (vehicles without stepney), how do you carry it to puncture shop?** *Carry on foot / tow / call for breakdown service / call puncture wala to the spot*
6) **What is the average distance travelled by you for repairing puncture?** *< 200m / 200 – 500 m / 500 m – 1 km / 1 – 2 km / 2 – 5 km / > 5 km*

PART- C (Trucks)

1) **If you are going to deliver goods, at what speed you are driving?** *< 40 km per hour / 40 – 60 km per hour / 60 -80 km per hour / > 80 km per hour*
2) **If you are returning after delivering goods, at what speed you are driving?** *< 40 km per hour / 40 – 60 km per hour / 60 -80 km per hour / > 80 km per hour*
3) **What is the reason for your this speed?** *Safely reaching / Earlier reaching / Heavy load / No load*
4) **What is the average time gap?**

   For snacks - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*

   For food - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*

   For short term rest - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*

   For cooling of vehicle- *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*
5) **What is the average time gap between the two consecutive brakes in journey?**

   Summer - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*

   Winter - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*

   Monsoon - *< 2 hours / 2 – 3 hours / 3 – 4 hours / > 4 hours*
6) **Where do you sleep at night?** In hotel / At dhaba / Inside vehicle
7) **If you visit a dhaba, then what is the reason for visiting this particular dhaba?** *Better food / Availability of entertainment / Availability of cot*
8) **How did you find this dhaba?** *Signboard / visible / known / returned back*
9) **Was the public facility at dhaba like sitting area, toilets etc. sufficient?** *Yes / no*
10) **How did you find ancillary activities at the dhaba?** *Excellent / good / satisfactory / poor / very poor*

11) **Where did you park your vehicle?** *on highway / ROW / private land / parking is provided*

12) **For how long did you park your vehicle?** *<15min / 15-30 / 30-1h / 1-2 / 2-4 / >4*

13) **What is the prime reason for not stopping your vehicle in the newly constructed truck lay-bye?**

Absence of food – *primary factor / secondary factor / one of the factor / not the factor*

Absence of entertainment – *primary factor / secondary factor / one of the factor / not the factor*

Absence of public movement – *primary factor / secondary factor / one of the factor / not the factor*

Closure of rest room – *primary factor / secondary factor / one of the factor / not the factor*

PART- D

1) **Was the height of the greenery on median adequate to stop light and allow the visibility?** *Yes / some places / no / didn't observe*
2) **Have you ever faced problem while crossing road?** *Yes / sometimes / no*
3) **If yes, why?** *Heavy traffic / design of cut / slope at cut / height of vegetation at median / absence of lighting*
4) **Why did you stop at petrol pump?** *(MCQ) always only for petrol / sometime only for air / sometimes only for toilet / sometimes only for water / sometimes only for puncture / sometimes only for first-aid kit or police help*
5) **Are the facilities at petrol pump sufficient?**

Place- ..... Air- yes / no Puncture- yes / no Toilet- yes / no First aid- yes / no Emergency phone- yes / no

6)
7) **If it (like dhaba, petrol pump, puncture or repair shop, temple, eateries, etc.) is on other side of road, where do you cross highway?** *Before take the cut and travel in wrong direction for some time / take the cut afterwards and then take U-turn to travel in right direction*
8) **After doing your work, again where do you cross highway?** *Travel in right direction and then crosses and take U-turn / travel in wrong direction and then crosses the road*
9) **Any suggestions/comments about the existing facilities**.....

Any addition of facility on highway.....

7.5 ANNEXURE V- QUESTIONNAIRES FOR HOUSE-HOLD SURVEY

Place- …….. Side of road – north / south

Dist b/w house & ROW- ……. Dist b/w house & road side line- ……..

Surroundings- Roadside……..Backside……L.H.S……R.H.S……..

PART - A

1) **Ownership** – *rented / owned / other*
2) **Age of house-** *<5 years / 5-20 years / 20-50 years / >50 years*
3) **Type of house** – *detached / semi-detached / apartment / row-housing*
4) **Physical condition of house** – *good / livable / depilated*
5) **Material of house** – *concrete / brick / mud-brick / mud / bamboo / other*……..
6) **Material of roof-** *concrete / lime / asbestos / tiled / bamboo / thatch / other*……..
7) **No. of rooms** – *1 / 2 / 3 / 4-5 / >5*
8) **No. of floors** – *1 / 2 / 3 / >3*
9) **Primary Occupation-** *agriculture / allied / service / business / transport*
10) **No. of family members-** *<3 / 3-5 / 5-7 / 7-10 / >10*

PART- B

1) **Electric connection** – *yes / no*
2) **Duration of supply** - *<4 hours / 4-12 hours / 12-20 hours / >20 hours*
3) **Water supply** – *surface water / underground water / municipal supply / dual*
4) **Frequency of municipal supply** – *once / twice / thrice / more*
5) **Duration of municipal supply** - *<1 hour / 1-2 hours / 2-4 hours / > 4hours*
6) **Solid waste management** – *yes / no*
7) **Drainage** – *yes, open / yes, closed / no*
8) **Toilets-** *yes, attached / yes, detached / public toilet / open (field) / open (ROW)*
9) **Sewerage** – *discharge into open land / discharge into drainage / septic tank*
10) **Telephone connection** – *yes / yes, removed / never*
11) **Mobile network** – *yes / very less strength / no*
12) **Vehicle owned** – *cycle / gearless / bike / car / tractor / rickshaw / auto / tempo / jeep / mini bus / micro bus / bus / truck / others (JCB etc.)*

PART – C Where do you go for following facilities? Do you use rural road or need to cross highway or travel on the highway or need to go to nearby town or state capital? *Please put the tick mark in the appropriate box.*

S. No.	Facility	Rural road	Crossing highway	on Highway					Nearby town		Patna (capital)
				< 200 m	200-500 m	500 m-1km	1-5 Km	> 5km	Darbhanga	Muzaffarpur	
1	Primary School										
2	Secondary School										
3	Sr. Secondary Sch.										
4	College										
5	Vocational Trainig										
6	Special School										
7	Special College										
8	University										
9	Dispensary										
10	Primary Health Ctr.										
11	Hospital										
12	Maternity Home										
13	Specialty Hospital										
14	Post Office										
15	Police Chocky										

S. No.	Facility	Rural road	Crossing highway	on Highway					Nearby town		Patna (capital)
				< 200 m	200-500 m	500 m-1km	1-6 Km	> 5km	Darbhanga	Muzaffarpur	
16	Police Station										
17	Fire Brigade										
18	Government Office										
19	Playground										
20	Sports Complex										
21	Cinema Hall										
22	Tourist Spot										
23	Temple										
24	Famous Temple										
25	Bank										
26	Vegetable Market										
27	Haat										

1) For what purpose you require fuel? Private vehicle / agricultural vehicle / gen-sets / pump-sets / multiple use / not needed
2) **How far is the fuel station?** *< 500m / 500 m – 1 km / 1 – 2 km / 2 – 5 km / > 5km*
3) **How do you carry petrol/diesel for your requirement?** *Take vehicle / carry in drum- by hand / by animal cart / by rickshaw / by agricultural tractor*

PART- D

1) **Where do you go for following purposes?**

   Occupation – W*ithin village / Within block boundary / Go to nearby city*

   Education – W*ithin village / Within block boundary / Go to nearby city*

   Health services – W*ithin village / Within block boundary / Go to nearby city*

   Recreation – W*ithin village / Within block boundary / Go to nearby city*

   Visiting government offices – W*ithin village / Within block boundary / Go to nearby city*

2) **If you go to nearby city, then what is the frequency of your visit?** *Daily / Weekly / Occasionally*

3) **Where do you board the local public transport vehicles?** *At bus-stop / At junction / Anywhere*

4) **What is the nearest distance of boarding point?** *< 200 m / 200 – 500 m / 500 m – 1 km / 1 – 2 km / > 2 km*

5) **For what purpose do you need to cross highway?** *transport / market / family / friend*

6) **How do you cross highway?** *Uses crossing always(if provided) / not necessarily uses crossing (if provided) / crosses anywhere*

7) **How does animal cross road?** *Animal crossing (if provided) / Anywhere (if crossing provided) / Anywhere*

8) **How do you cross your vehicle?** *Follow traffic rule / Driving in wrong direction and then crossing at median opening / Lifting cycle and crossing anywhere*

9) **What is the reason for not using minor bridge as underpass?** *Absence of approach road / Surface crossing is adequate / No knowledge about its use as crossing*

10) **How frequent you visit to dhaba?** *Frequently / Sometimes / Very rarely / Never*

11) **If you visit to dhaba then what is the reason for your visit?** *Absence of restaurant nearby / Absence of bar nearby / For food while working in field / For food while working in isolated commercial establishments like petrol pumps*

7.6 ANNEXURE VI- DATA SHEET FOR TRAVELLER'S SURVEY

CODES FOR TRAVELLERS SURVEY				
Origin & Destination	**Code**		**Avg. distance travelled by bikers to repair puncture**	**Code**
Beyond cities	1		< 200 m	1
Between cities	2		200 - 500 m	2
From city to rural area	3		500 m - 1 km	3
Within rural area	4		1 - 2 km	4
			2 - 5 km	5
Purpose of travel	**Code**		> 5 km	6
Office	1			
Official work	2		**Type of movement**	**Code**
Business	3		Between nearby cities (<100km)	1
Tour	4		From capital city to other city (100-200km)	2
Family activity	5		Within state (200-500km)	3
To catch train	6		National traffic (>500km)	4
To catch flight	7			
			Speed of trucks	**Code**
Frequency of city to city commuter	**Code**		< 40 km/h	1
Daily	1		40-60 km/h	2
Occasionally	2		60-80 km/h	3
			>80 km/h	4
Type of daily city to city commuters	**Code**			
Reside in Darbhanga and go to Muzaffarpur everyday	1		**Reason for this Speed**	**Code**
Reside in Muzaffarpur and go to Darbhanga everyday	2		Safely reaching	1
			Earlier reaching	2
Reason for daily commuting	**Code**		Heavy load	3
Better physical infrastructure	1		No load	4
Better schooling for children	2			
Family attachments	3		**Time gap between brakes**	**Code**
Higher rent	4		< 2 hours	1
Commuting is easy	5		2 – 3 hours	2
			3 – 4 hours	3
Place to stop public vehicle	**Code**		> 4 hours	4
At Bus stop	1			
At Major Junction	2		**Avg. time gap b/w brakes**	**Code**
At Junction	3		< 2 hours	1
Anywhere	4		2 – 3 hours	2
Nowhere	5		3 – 4 hours	3
			> 4 hours	4

CODES FOR TRAVELLERS SURVEY				
Frequency of visit to dhaba	**Code**		**Place of rest**	**Code**
Always	1		In hotels	1
Frequently	2		At dhaba	2
Sometimes	3		Inside vehicle	3
Never	4			
			Reason for visiting a particular dhaba	**Code**
Main purpose of visit to dhaba	**Code**		Better food	1
For cold drinks	1		Availability of entertainment	2
For hot drinks	2		Availability of cot	3
For wafers	3			
For snacks	4		**Prime factor for not stopping at truck lay-bye**	**Code**
For food	5		Primary factor	1
For short term rest	6		Secondary factor	2
For long term rest	7		One of the factor	3
For cooling vehicle	8		Not the factor	4
Avg. duration of stay at dhaba	**Code**			
< 15 min	1			
15 – 30 min	2		**For not applicable, 0 has been used**	
30 – 60 min	3			
> 60 min	4			

DATA SHEET FOR TRAVELLER'S SURVEY

Vehicles Other Than Trucks (columns 2–44) / Truck (columns 45–62)

S. No.	Origin & Destination: Two Wheelers	Origin & Destination: Three Wheelers	Origin & Destination: Car	Origin & Destination: Light Commercial Vehicles	Origin & Destination: Bus	Origin & Destination: Pick-up	Origin & Destination: Tractors	Origin & Destination: Cycle	Origin & Destination: Cycle Rickshaw	Origin & Destination: Hand cart	Origin & Destination: Animal Driven	Origin & Destination: Pedestian	Purpos: Two Wheeler	Purpos: Car	Freque: Two Wheeler	Freque: Car	Type of Daily City to City Com	Reaso: Darbhanga to Muzaffarpur	Reaso: Muzaffarpur to Darbhanga	Place to Stop: Three wheelers	Place to Stop: Light Commercial Vehicles	Place to Stop: Bus (City to City)	Place to Stop: Buse (Capital to City)	Frequency of Visit to Dhaba: Two Wheelers	Frequency of Visit to Dhaba: Three Wheelers	Frequency of Visit to Dhaba: Car	Frequency of Visit to Dhaba: Bus	Frequency of Visit to Dhaba: Pick-up	Frequency of Visit to Dhaba: Tractors	Frequency of Visit to Dhaba: Cycle	Frequency of Visit to Dhaba: Cycle Rickshaw	Frequency of Visit to Dhaba: Hand cart	Frequency of Visit to Dhaba: Animal Driven	Frequency of Visit to Dhaba: Pedestian	Main purpose: Motorcycle	Main purpose: Car	Main purpose: Bus	Main purpose: Pick-up	Average Durati: Motorcycle	Average Durati: Car	Average Durati: Bus	Average Durati: Pick-up	Avg. Distance Travelled by Bi	Type of Movement For Trucks	Speed: While Going	Speed: While Returning	Reaso: While Going	Reaso: While Returning	Time Gap: For Snacks	Time Gap: For Food	Time Gap: Short Term Rest	Time Gap: Cooing of Vehicle	Avg. Time: Summer	Avg. Time: Winter	Avg. Time: Monsoon	Place of Rest	Reason for Visiting a Particula	Prime Factor: Absence of Food	Prime Factor: Absence of Entertainment	Prime Factor: Absence of Public Movemen	Prime Factor: Closer of Rest Room
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2	2	2	3	3	2	3	2	2	2	1	2	1	2
2	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	2	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	2	2	2	3	2	2	2	2	2	1	1	1	4
6	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	0	2	3	2	4	2	3	1	3	3	1	2	1	2
10	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	2	3	2	4	2	3	1	3	2	2	1	1	3
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	2	3	3	4	2	2	3	2	3	1	1	1	2
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	2	3	2	4	2	3	1	3	3	1	2	1	3
19	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	3	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	1	0	2	4	3	4	2	3	3	3	2	1	2	1	4
24	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	0	2	3	2	4	2	3	1	3	1	1	2	1	3
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	0	2	3	3	2	4	3	3	1	3	2	1	3	1	3
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	2	2	1	2	4	2	3	1	3	2	1	3	1	3
36	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	2	2	3	2	4	2	2	1	3	2	1	1	1	3
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	4	2	2	2	4	3	2	2	3	3	2	2	1	3
39	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	4	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	4	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DATA SHEET FOR TRAVELLER'S SURVEY

S. No.	Vehicles Other Than Trucks																																											Truck																	
	Origin & Destination												Purpos		Freque			Reaso		Place to Stop				Frequency of Visit to Dhaba											Main purpose				Average Durati						Speed		Reaso		Time Gap				Avg. Time					Prime Factor			
	Two Wheelers	Three Wheelers	Car	Light Commercial Vehicles	Bus	Pick-up	Tractors	Cycle	Cycle Rickshaw	Hand cart	Animal Driven	Pedestrian	Two Wheeler	Car	Two Wheeler	Car	Type of Daily City to City Con	Darbhanga to Muzaffarpur	Muzaffarpur to Darbhanga	Three wheelers	Light Commercial Vehicles	Bus (City to City)	Buse (Capital to City)	Two Wheelers	Three Wheelers	Car	Bus	Pick-up	Tractors	Cycle	Cycle Rickshaw	Hand cart	Animal Driven	Pedestrian	Motorcycle	Car	Bus	Pick-up	Motorcycle	Car	Bus	Pick-up	Avg. Distance Travelled by B	Type of Movement For Trucks	While Going	While Returning	While Going	While Returning	For Snacks	For Food	Short Term Rest	Cooing of Vehicle	Summer	Winter	Monsoon	Place of Rest	Reason for Visiting a Particula	Absence of Food	Absence of Entertainment	Absence of Public Movement	Closer of Rest Room
51	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	3	0	2	3	2	4	3	2	1	2	2	1	2	1	3
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	2	2	2	4	2	3	2	3	2	1	3	1	4
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	3	0	3	2	2	4	2	2	2	3	2	1	2	1	3
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	0	4	3	2	2	4	2	3	1	3	2	1	4	1	2
59	2	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	0	2	2	2	4	2	2	3	2	3	1	1	1	3
62	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	2	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	2	3	2	3	3	3	2	2	2	1	4	1	2
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	2	2	3	4	2	2	3	3	3	1	1	1	3
69	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	2	2	1	3	4	2	3	1	3	2	1	2	1	3
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	0	2	3	2	4	2	2	2	2	3	1	1	1	2
72	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	2	3	2	4	2	3	1	2	2	2	2	1	3
75	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	4	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	2	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	4	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	0	0	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

7.7 ANNEXURE VII- DATA SHEET FOR HOUSE-HOLD SURVEY

CODES FOR HOUSE-HOLD SURVEY			
Ownership	**Code**	**Primary mode of transport**	**Code**
Rented	1	Walking	1
Owned	2	Cycle	2
Other	3	Motorized Two wheeler	3
		Car	4
Type of structure	**Code**	Animal Driven	5
Mud	1		
Brick	2	**Destination for the various purposes**	**Code**
Concrete	3	Within village	1
		Within block	2
Age of structure	**Code**	Nearby district town	3
< 5 years	1		
5 - 20 years	2	**Frequency of visit to nearby city**	**Code**
20 - 50 years	3	Daily	1
> 50 years	4	Weekly	2
		Occasionally	3
Physical condition of house	**Code**		
Excellent	1	**Place where residents board local transport**	**Code**
Good	2	At Bus Stop	1
Livable	3	At Junction	2
Bad	4	Anywhere	3
Primary occupation	**Code**	**Distance of nearest boarding point**	**Code**
Agriculture	1	< 200 m	1
Allied	2	200 - 500 m	2
Service	3	500 m - 1 km	3
Business	4	1 - 2 km	4
Transport	5	> 2 km	5
No. of family member	**Code**	**Method of crossing highway by vehicle**	**Code**
< 3	1	Follow traffic rule	1
3 - 5	2	Driving in wrong direction and then crossing at median opening	2
5 - 7	3	Lifting cycle and crossing anywhere	3
7 -10	4		
> 10	5	**Method of crossing highway by pedestrian**	**Code**
		Only uses pedestrian crossing	1
Electric connection	**Code**	Uses pedestrian crossing sometimes	2
Yes	1	Crosses anywhere	3
No	2		

CODES FOR HOUSE-HOLD SURVEY

Duration of electricity supply	Code
< 4 hours	1
4 - 12 hours	2
12 - 20 hours	3
> 20 hours	4
Source of water	**Code**
Surface water	1
Underground water	2
Municipal water	3
Multimodal	4
Toilet	**Code**
Attached	1
Detached	2
Public toilet	3
Open (field)	4
Open (ROW)	5
Mobile network coverage	**Code**
Yes	1
Lower strength	2
No	3
Social Infrastructure	**Code**
Within village	1
Need to cross highway	2
On highway	
< 200 m	3
200 - 500 m	4
500 m - 1 km	5
1 - 5 km	6
> 5 km	7
District town	8
Vehicle owned	**Code**
Yes	1
No	2

Reasons for not using minor bridge as underpass	Code
Absence of approach road	1
Surface crossing is adequate	2
No knowledge about its use as crossing	3
Frequency of visiting dhaba by local residents	**Code**
Frequently	1
Sometimes	2
Very rarely	3
Never	4
Reason for visit to dhaba by local residents	**Code**
Absence of restaurant nearby	1
Absence of bar nearby	2
For food while working in field	3
For food while working in isolated commercial establishments like petrol pumps	4
Fuel required for	**Code**
Private vehicle	1
Agricultural vehicle	2
Gen-sets	3
Pump-sets	4
Multiple use	5
Not needed	6
Distance of nearest fuel-station	**Code**
< 500 m	1
500 m - 1 km	2
1 - 2 km	3
2 - 5 km	4
> 5 km	5
Mode of transport for carrying fuel	**Code**
Take vehicle to fuel station	1
Carry in drum	
By hand	2
By animal cart	3
By rickshaw	4
By agricultural tractor	5

For not applicable, 0 has been used

DATA SHEET FOR HOUSE-HOLD SURVEY

S. No.	General						Physical Infrastructure					Social Infrastructure												Vehicle Owned							Primary Mode of Transport	Destination for the Various Purposes					Frequency of Visit to Nearby City					Place where Residents Board			Distance of Nearest Boarding Point	Methods of Crossing Highway by Vehicle				Method of Crossing Highway by Pedestrians	Reason for not using Minor Bridge as Underpass	Visit to Dhaba		Visit to Fuel Station		
	Ownership	Type of Structure	Age of Structure	Physical Condition of House	Primary Occupation	No. of Family Members	Electric Connection	Duration of Supply	Source of Water	Toilet	Mobile Network Coverage	Primary School	Secondary School	Junior College	College	Primary Health Center	Hospital	Maternity Home	Post Office	Police Chocky	Cinema Hall	Playground	Haat	Cycle	Motorized Two Wheeler	Car	Agricultural Tractor	Three Wheeler	Animal Driven Vehicle	Other		Occupation	Education	Health services	Recreation	Visiting government offices	Occupation	Education	Health services	Recreation	Visiting government offices	Three Wheelers	Light Commercial Vehicle	City to City Bus		For Cyclist	For Motorcyclist	For Car	For Animal Driven			Frequency of visiting Dhaba by Local R	Reason for visit to Dhaba by Local Res	Fuel Required for	Distance of Nearest Fuel Station	Mode of Transport for Carrying Fuel
1	1	2	3	2	1	2	1	1	1	5	1	1	1	2	8	2	8	8	3	4	8	8	2	0	1	0	0	0	1	0	1	1	2	3	3	3	0	0	3	3	3	3	3	2	2	0	2	0	0	3	1	4	0	1	3	1
2	3	1	1	3	3	2	2	0	2	4	2	1	3	5	8	3	8	8	4	5	8	8	3	1	0	0	0	0	1	0	2	3	1	3	3	3	1	0	3	3	3	3	3	2	2	4	3	0	0	0	3	1	3	2	6	4	0
3	3	1	1	3	2	3	1	2	1	5	1	3	1	8	8	5	8	8	2	8	8	8	1	1	0	0	0	0	0	0	2	2	1	3	3	3	0	0	3	3	3	3	2	2	1	3	0	0	0	3	1	4	0	6	2	0
4	3	1	1	3	3	2	2	0	2	4	2	1	3	5	8	4	8	8	4	5	8	8	4	1	0	0	0	0	1	0	2	3	1	3	3	3	1	0	3	3	3	3	2	2	4	3	0	0	0	3	1	3	2	6	5	0
5	3	1	1	3	3	2	2	0	2	5	2	1	1	8	8	4	8	8	4	8	8	8	4	1	0	0	0	0	1	0	2	3	1	3	3	3	1	0	3	3	3	3	2	2	4	3	0	0	0	3	1	4	0	6	5	0
6	3	1	2	4	2	3	1	1	2	5	2	4	5	8	8	5	8	8	1	7	8	8	1	0	0	0	0	0	0	0	1	1	1	3	3	3	0	0	3	3	3	3	2	2	1	0	0	0	0	3	3	4	0	6	1	0
7	1	2	3	2	1	3	2	0	2	4	2	1	2	8	8	1	8	8	3	4	8	8	5	1	1	0	0	0	0	0	3	1	2	3	3	3	0	0	3	3	3	3	2	2	2	3	2	0	0	2	1	4	0	1	3	1
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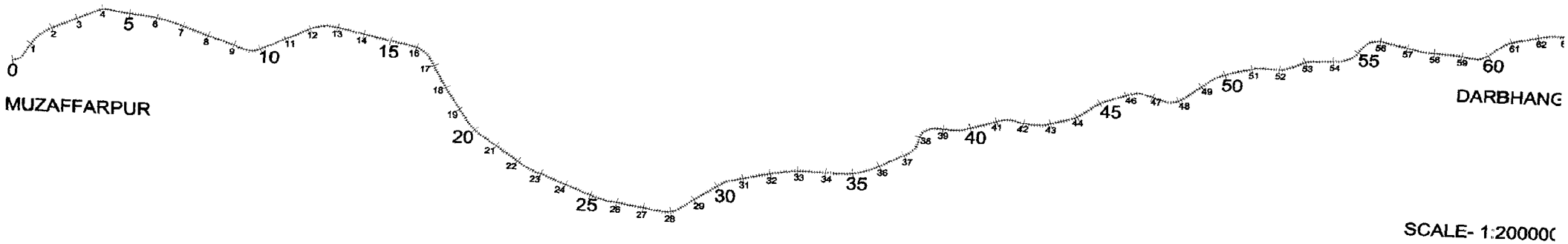
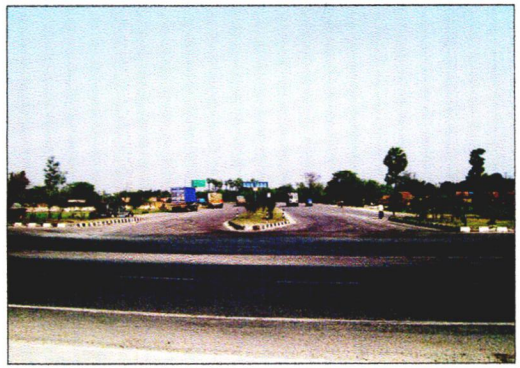
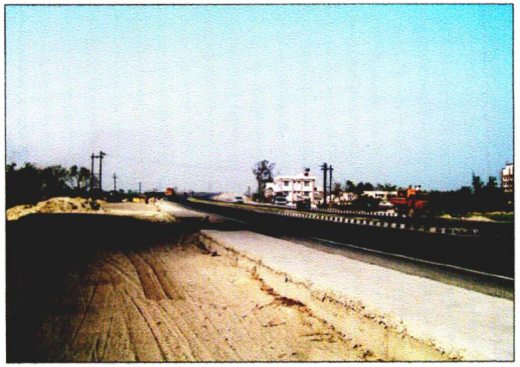
7.8 ANNEXURE VIII- MAP OF E-W CORRIDOR BETWEEN DARBHANGA & MUZAFFARPUR



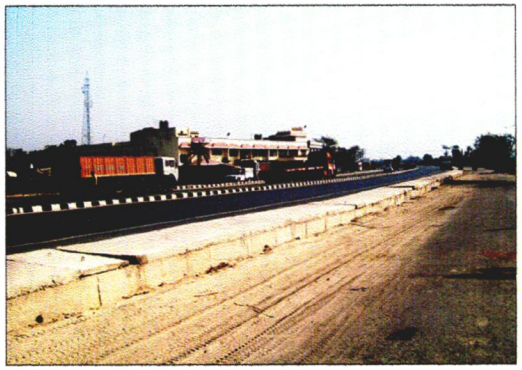


CAMERA 1



CAMERA 2

CAMERA 4



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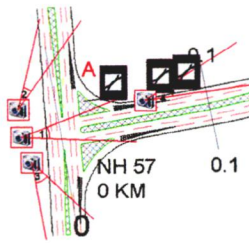


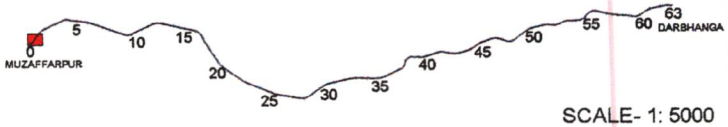
LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY

A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

0.0 KM TO 1.1 KM



SCALE- 1: 5000

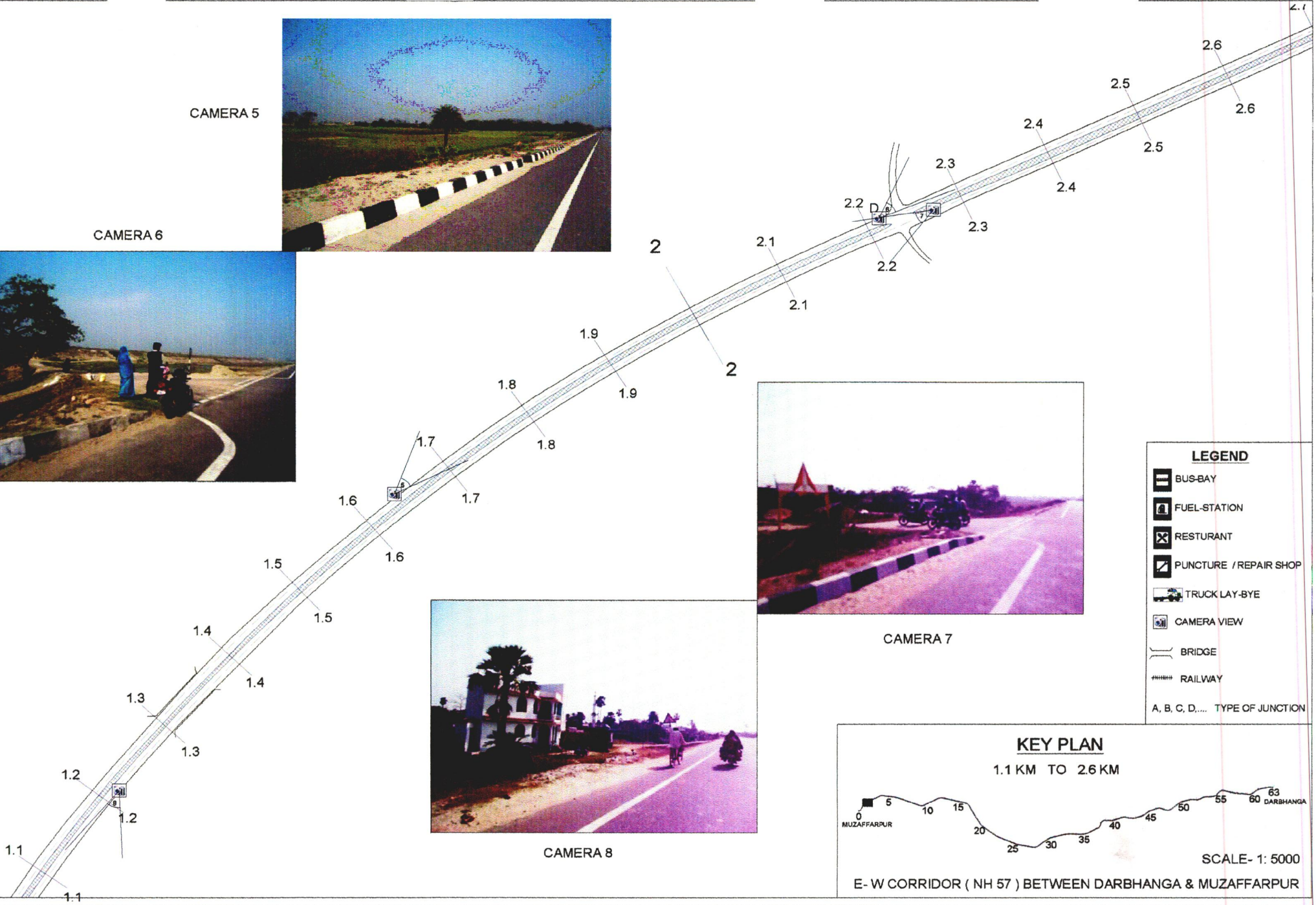
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 5

CAMERA 6

CAMERA 7

CAMERA 8



LEGEND

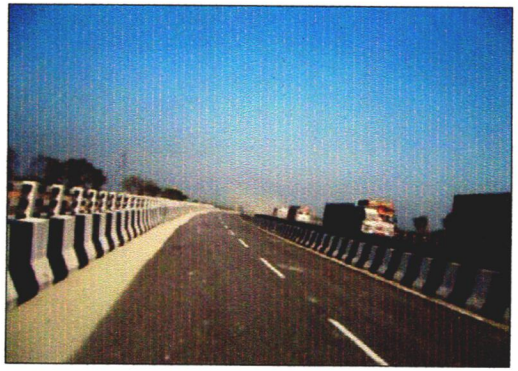
- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

1.1 KM TO 2.6 KM

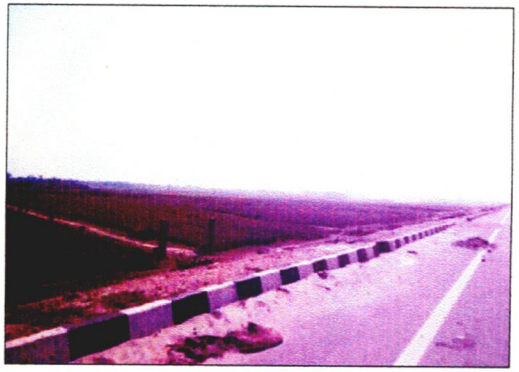
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 10

CAMERA 9



CAMERA 11

CAMERA 12

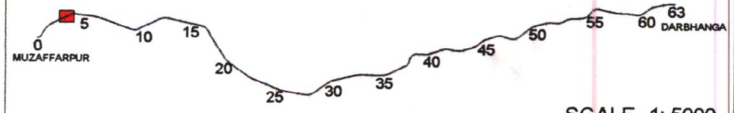
2.6 2.7 2.8 2.9 3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4 D

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

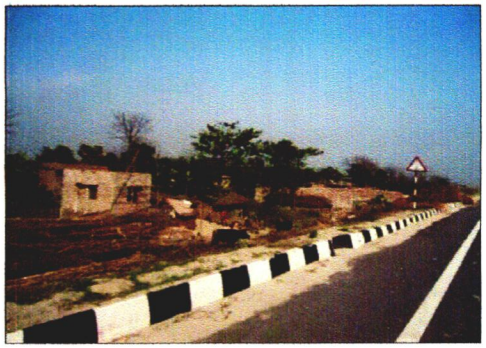
KEY PLAN

2.6 KM TO 4.0 KM



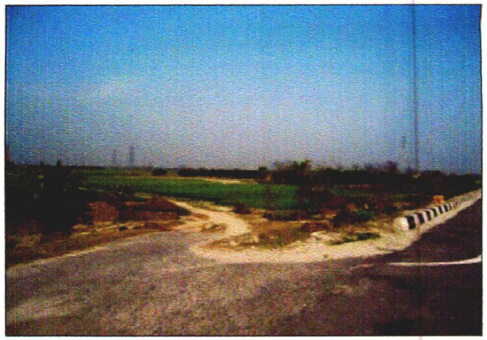
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

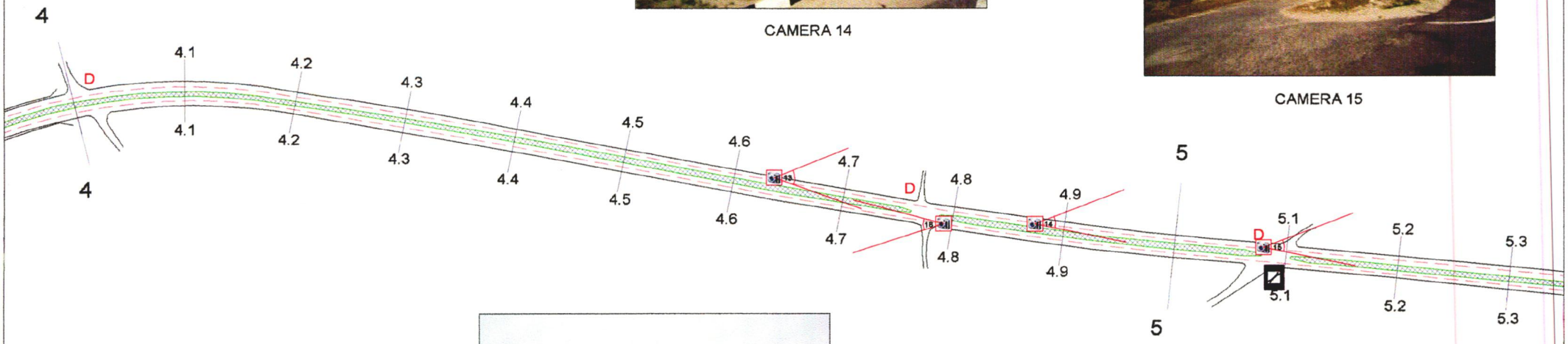


CAMERA 13

CAMERA 14



CAMERA 15



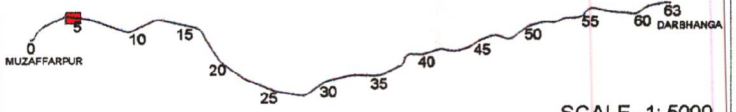
CAMERA 16

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

4.0 KM TO 5.3 KM

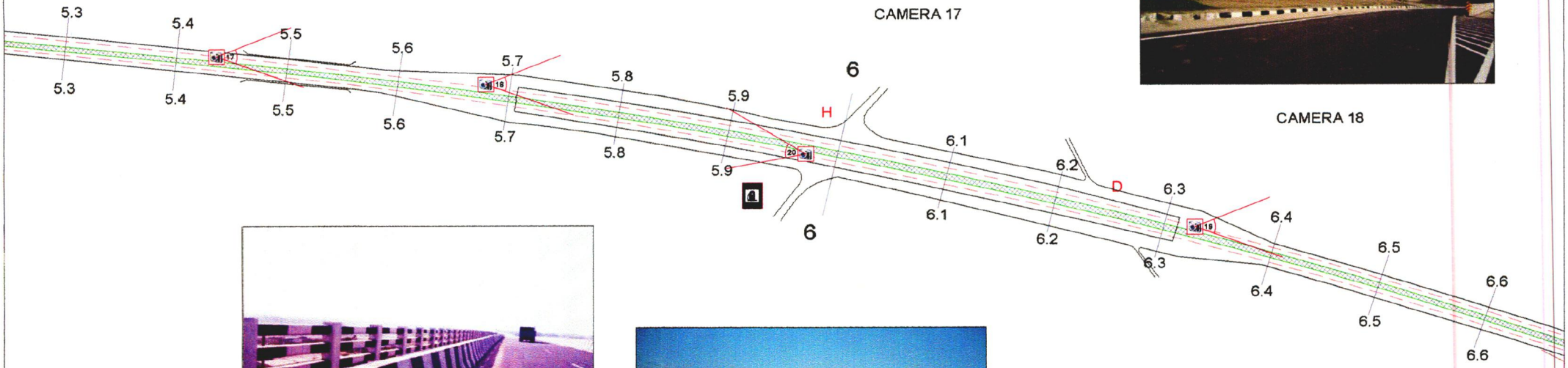


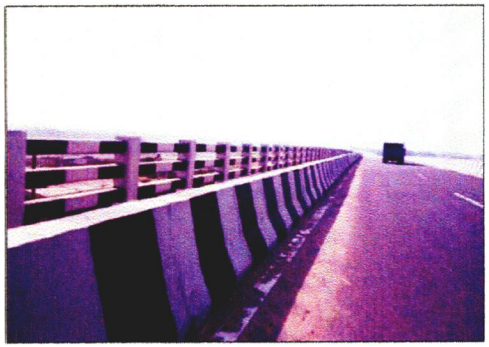
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 17

CAMERA 18





CAMERA 20

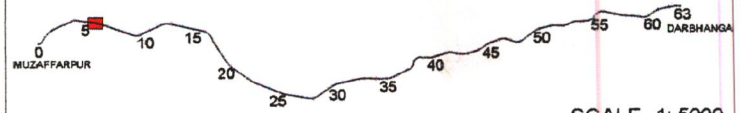
CAMERA 19

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

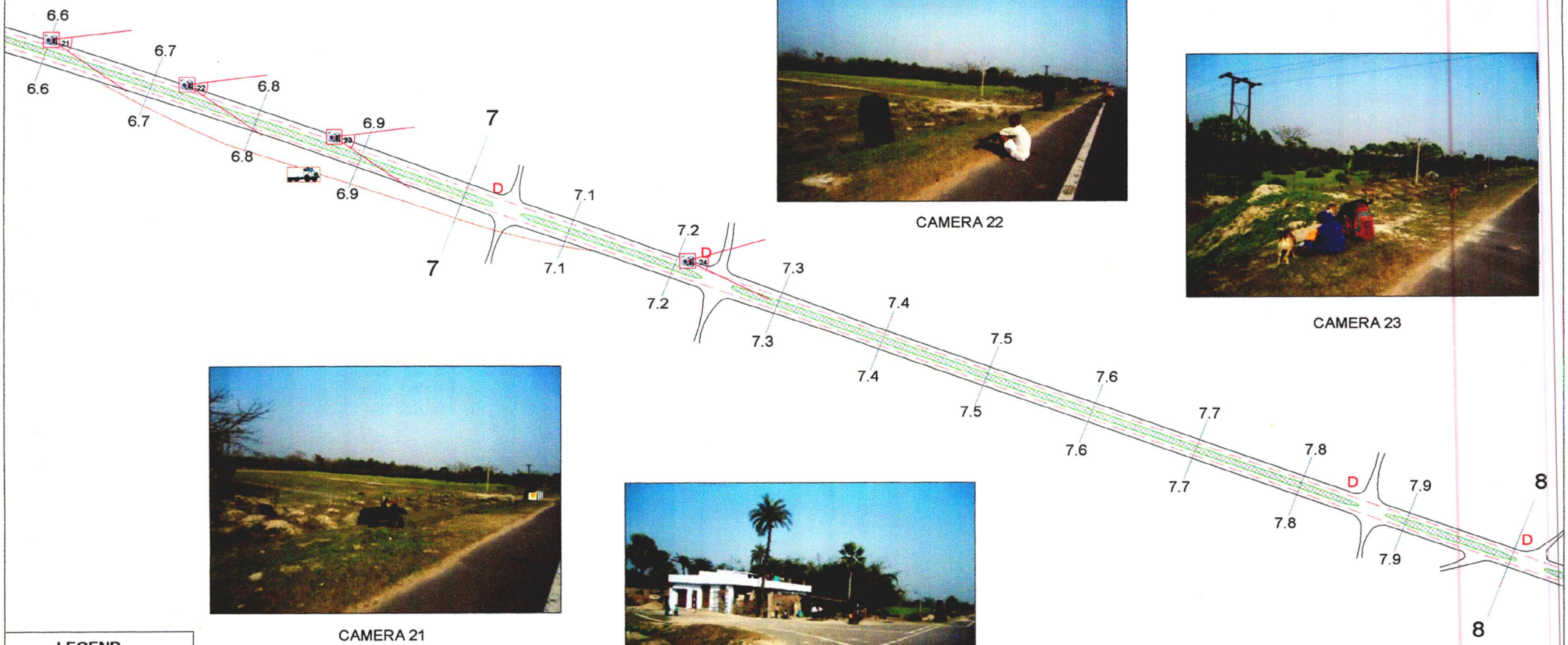
KEY PLAN

5.3 KM TO 6.6 KM



SCALE- 1: 5000

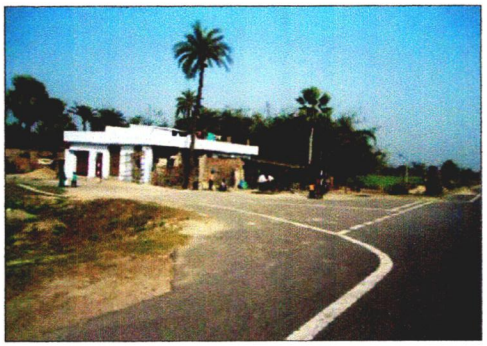
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 22

CAMERA 23

CAMERA 21



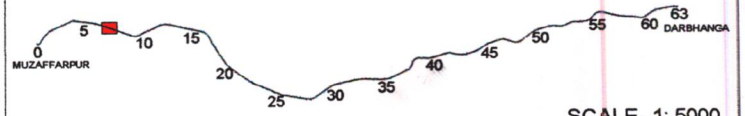
CAMERA 24

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

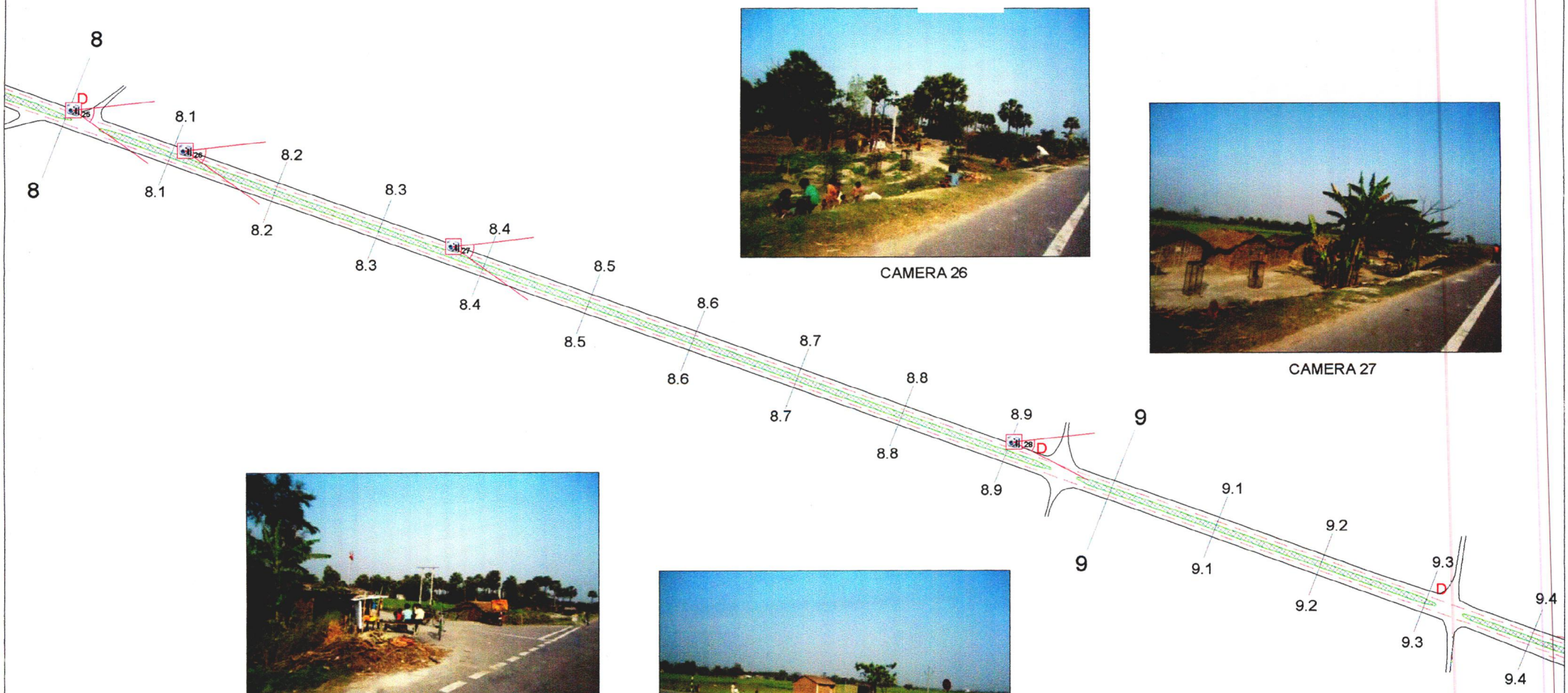
KEY PLAN

6.6 KM TO 8.0 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 26

CAMERA 27

CAMERA 25

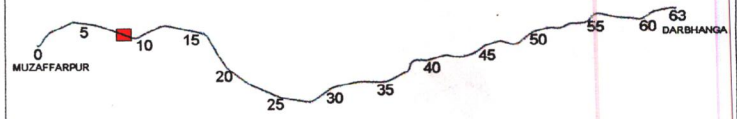
CAMERA 28

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY

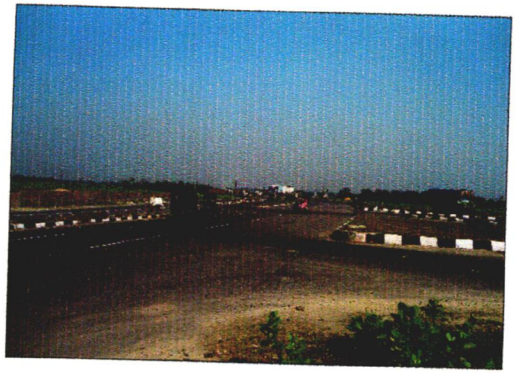
KEY PLAN

8.0 KM TO 9.4 KM



E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

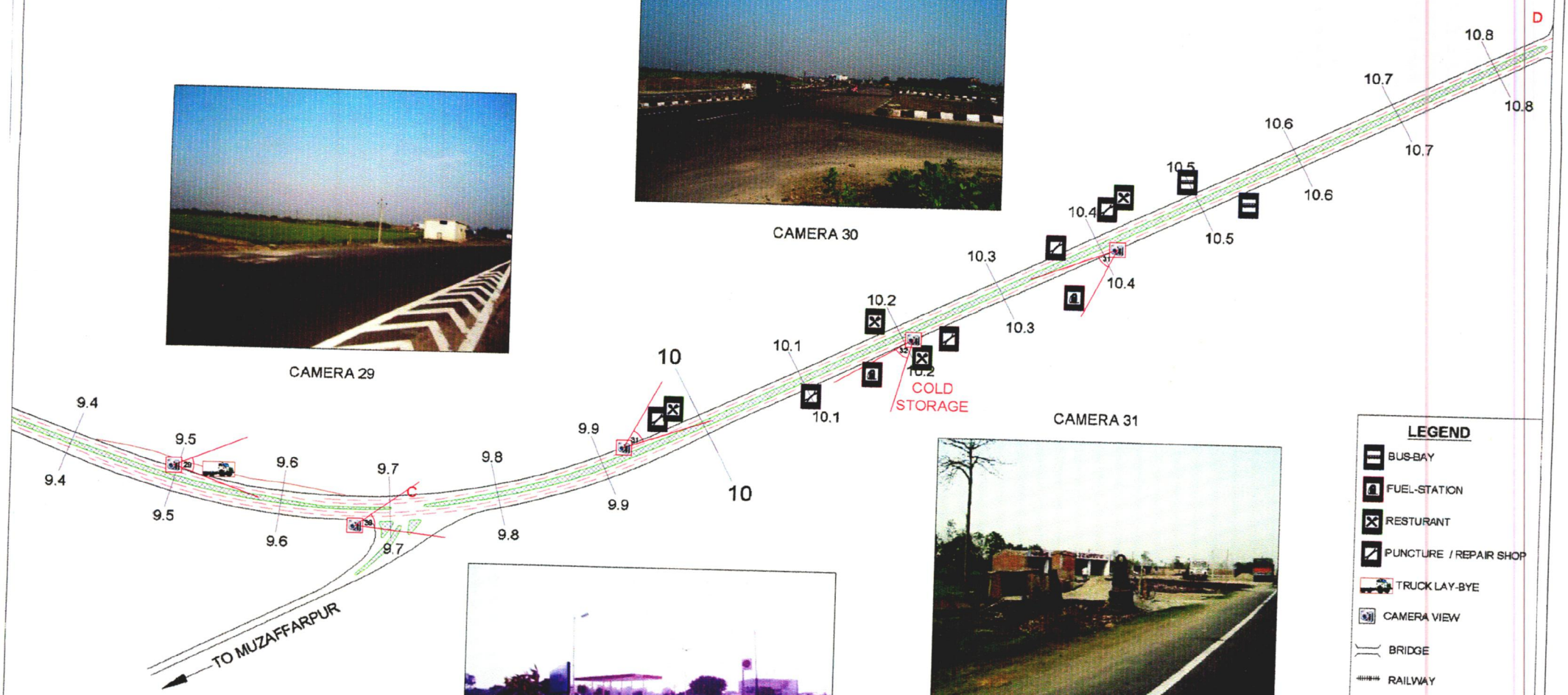
CAMERA 29



CAMERA 30

CAMERA 31

CAMERA 32

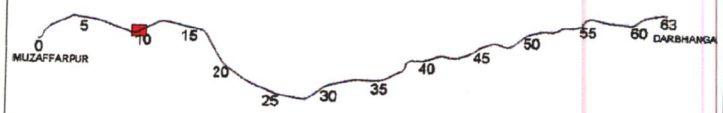


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

9.4 KM TO 10.8 KM



SCALE- 1: 5000

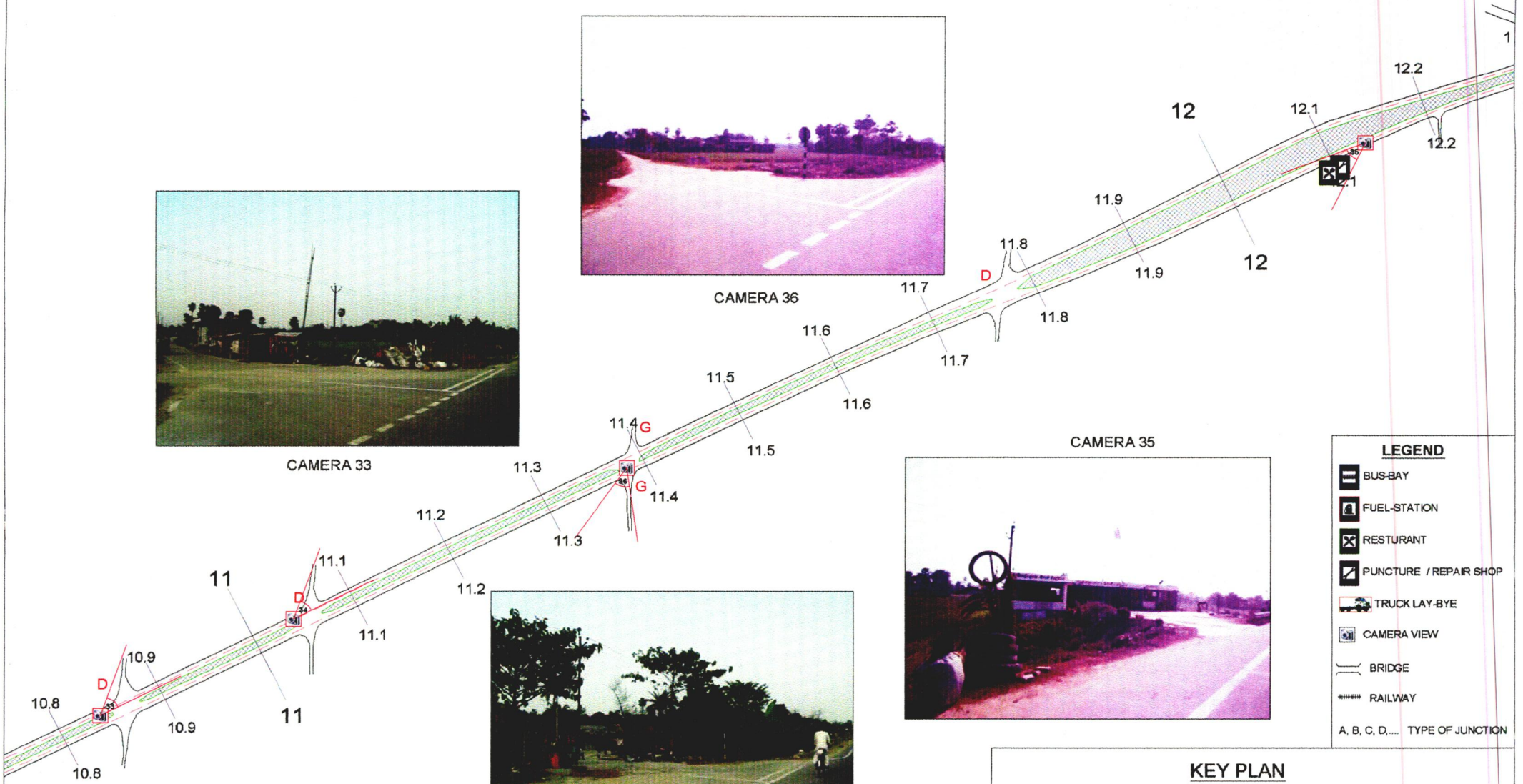
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 33

CAMERA 36

CAMERA 35

CAMERA 34

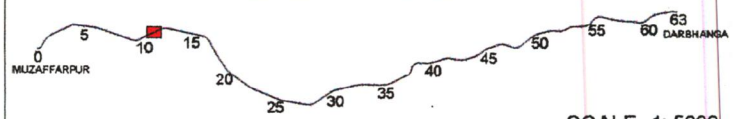


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

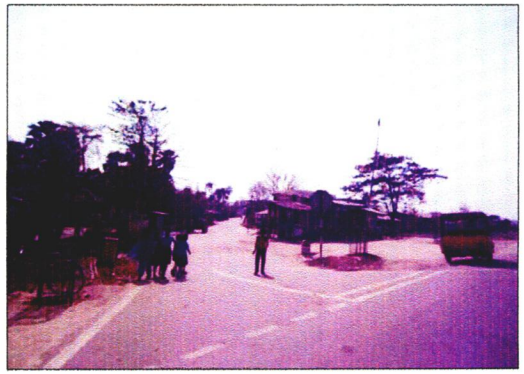
10.8 KM TO 12.2 KM



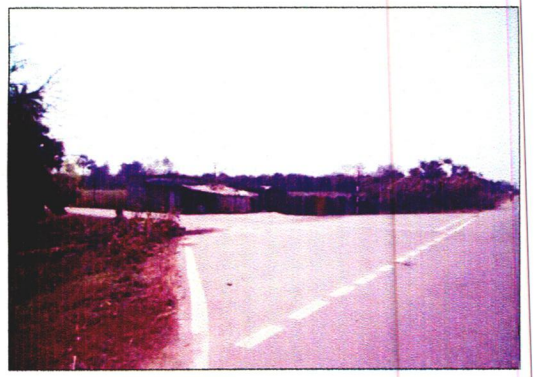
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

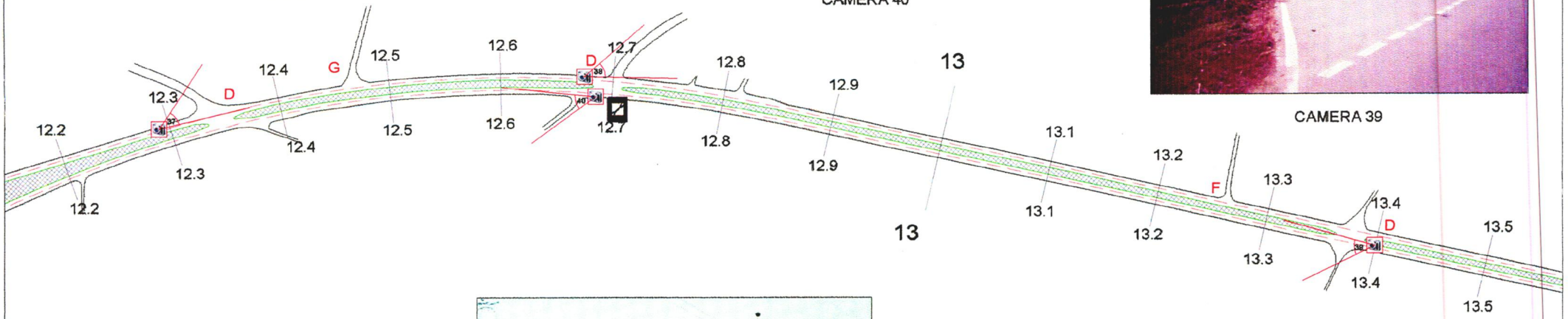
CAMERA 37



CAMERA 40



CAMERA 39



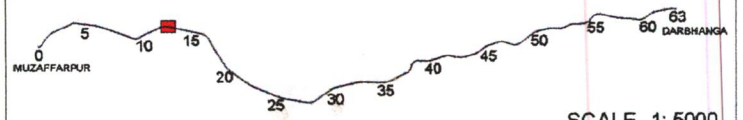
CAMERA 38

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

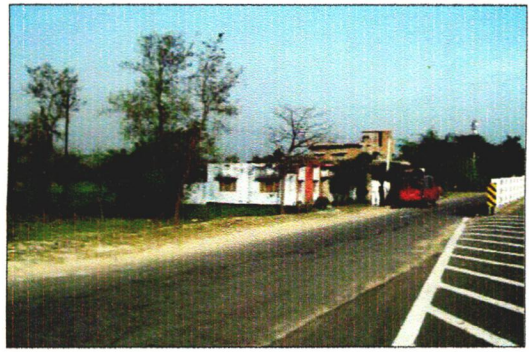
KEY PLAN

12.2 KM TO 13.5 KM



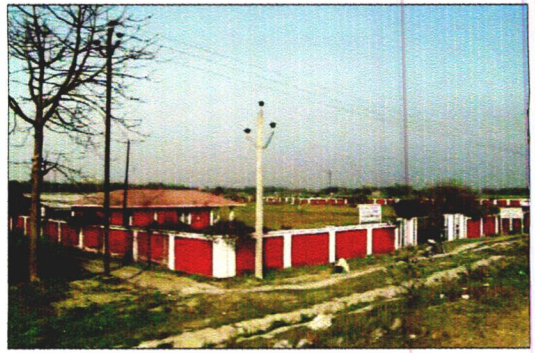
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

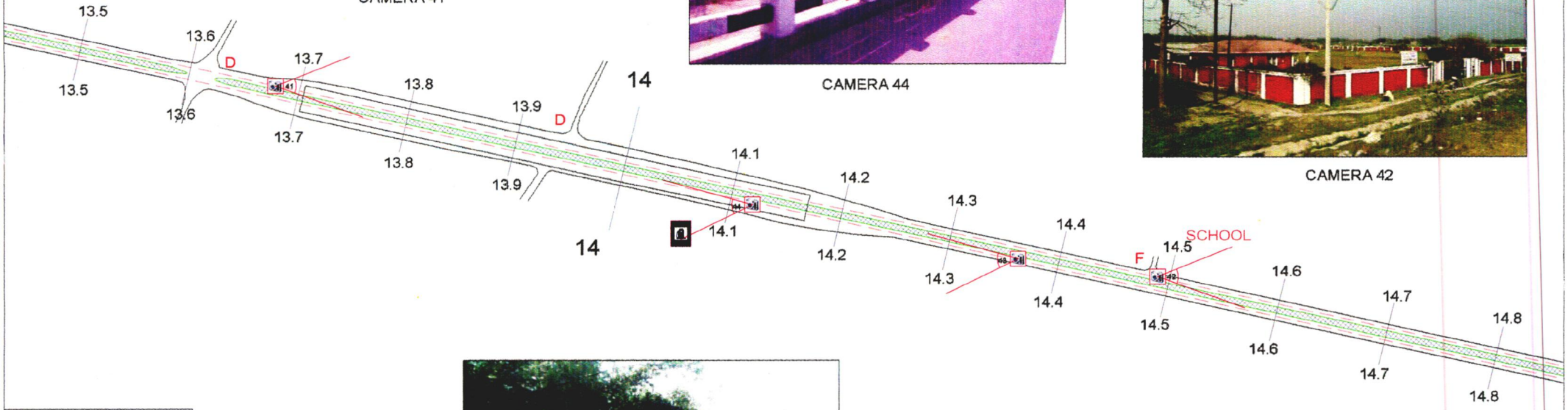


CAMERA 41

CAMERA 44



CAMERA 42



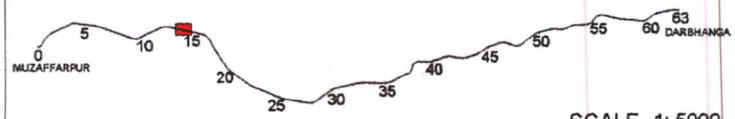
CAMERA 43

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

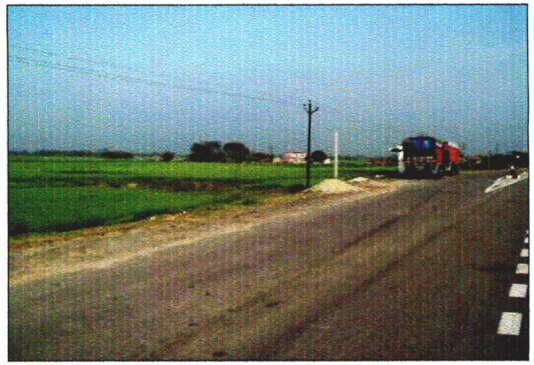
13.5 KM TO 14.8 KM



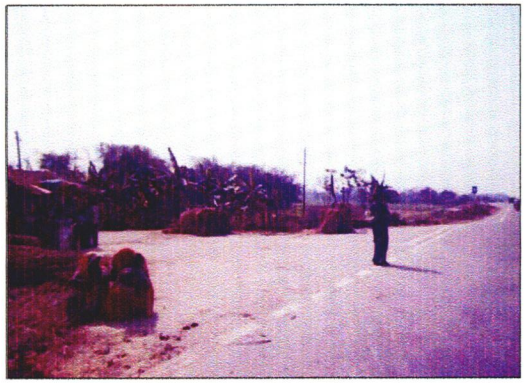
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

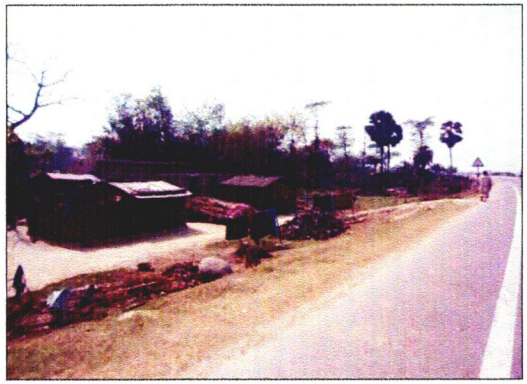
CAMERA 45



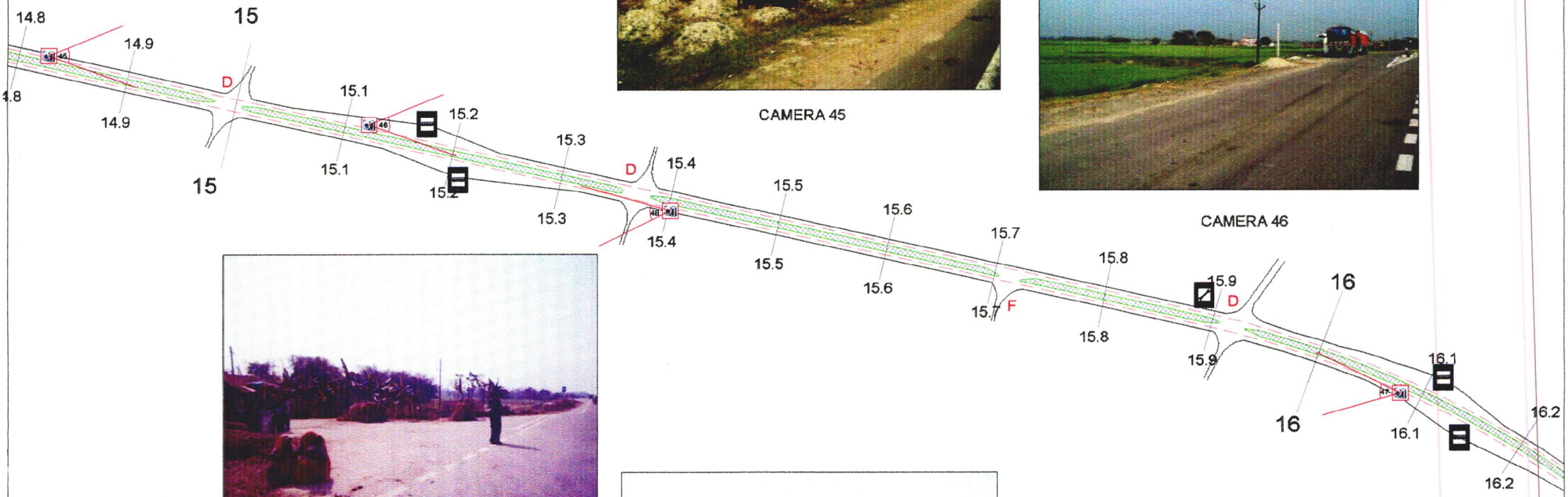
CAMERA 46



CAMERA 48



CAMERA 47

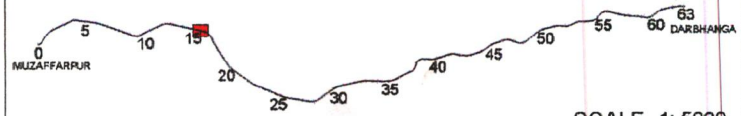


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

14.8 KM TO 16.2 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

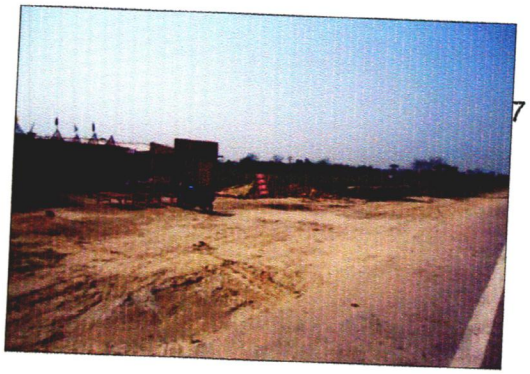
16

16.1 16.2 16.2 16.3 16.3 16.4 16.4 16.5 16.5 16.6 16.6 D 16.7 16.7 16.8 16.8 16.9 16.9 17 17.1 17.1 17.2 17.2 17.3

CAMERA 49

CAMERA 52

CAMERA 50



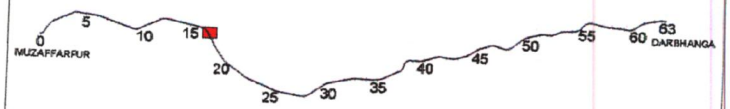
CAMERA 51

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

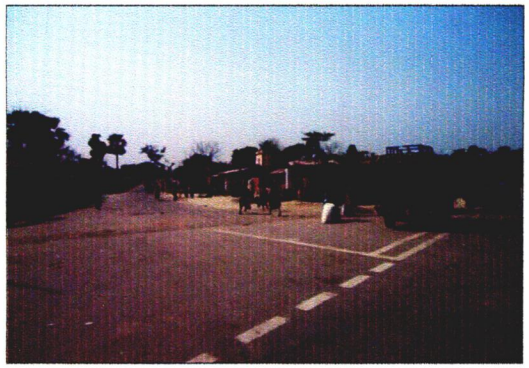
KEY PLAN

16.2 KM TO 17.3 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

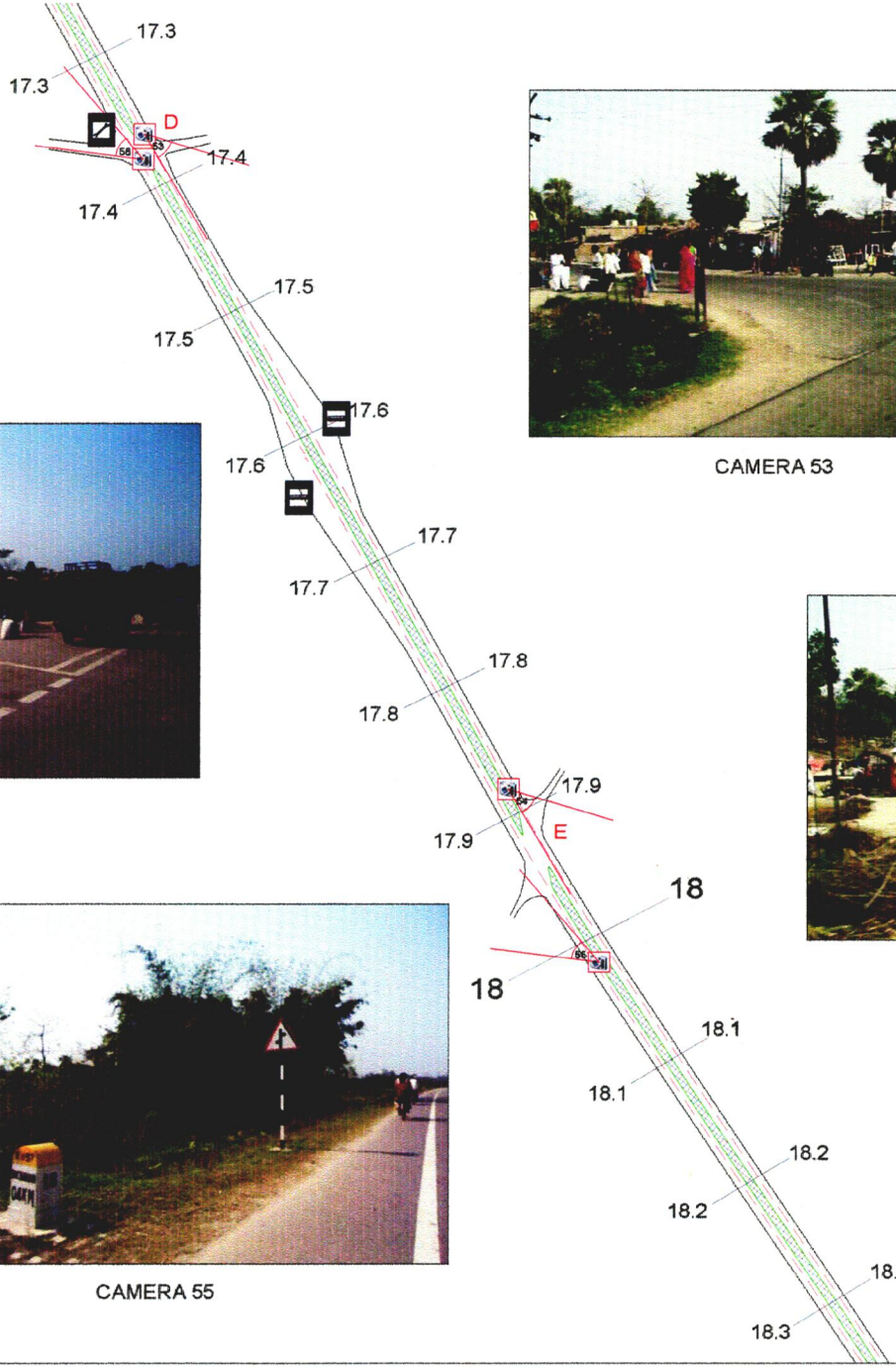


CAMERA 56

CAMERA 53

CAMERA 54

CAMERA 55



LEGEND

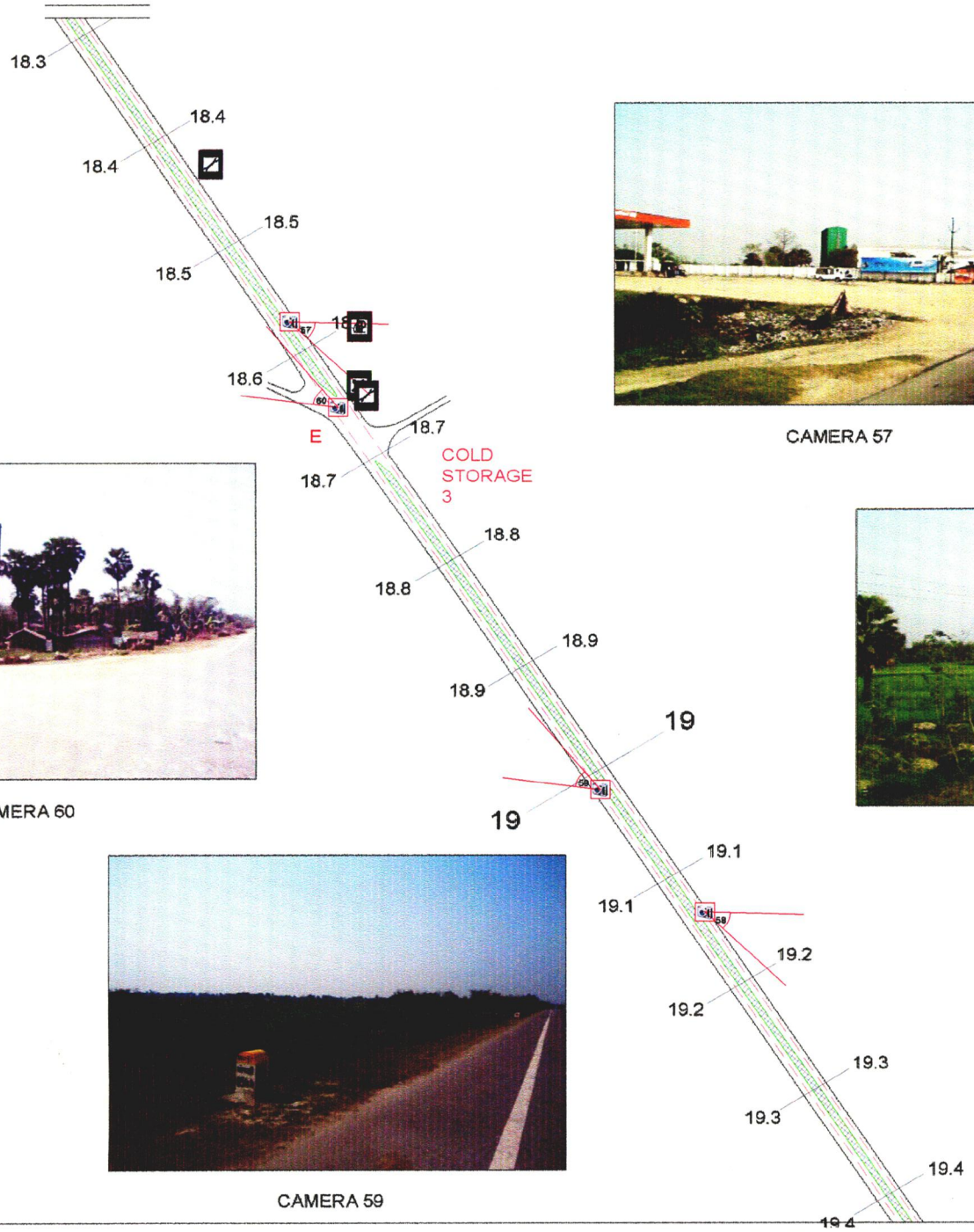
- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

17.3 KM TO 18.3 KM

SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 60

CAMERA 57

CAMERA 58

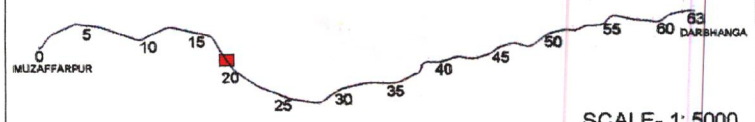
CAMERA 59

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

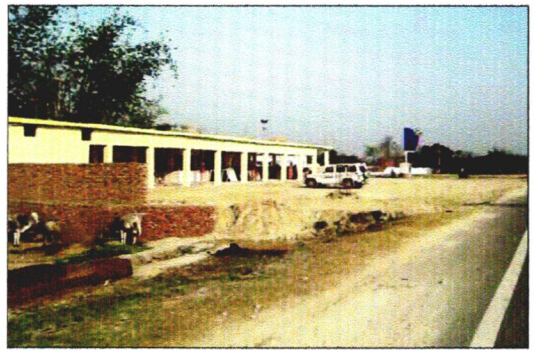
18.3 KM TO 19.4 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 61



CAMERA 62

CAMERA 64

CAMERA 63

LEGEND

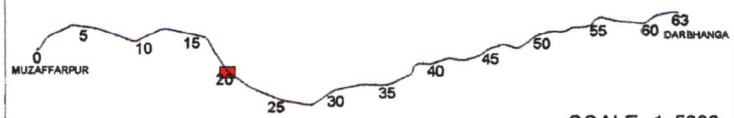
- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

19.4 19.5 19.6 19.7 19.8 19.9 20 20.1 20.2 20.3 20.4 20.5 20.6 20.7 20.8

E E D

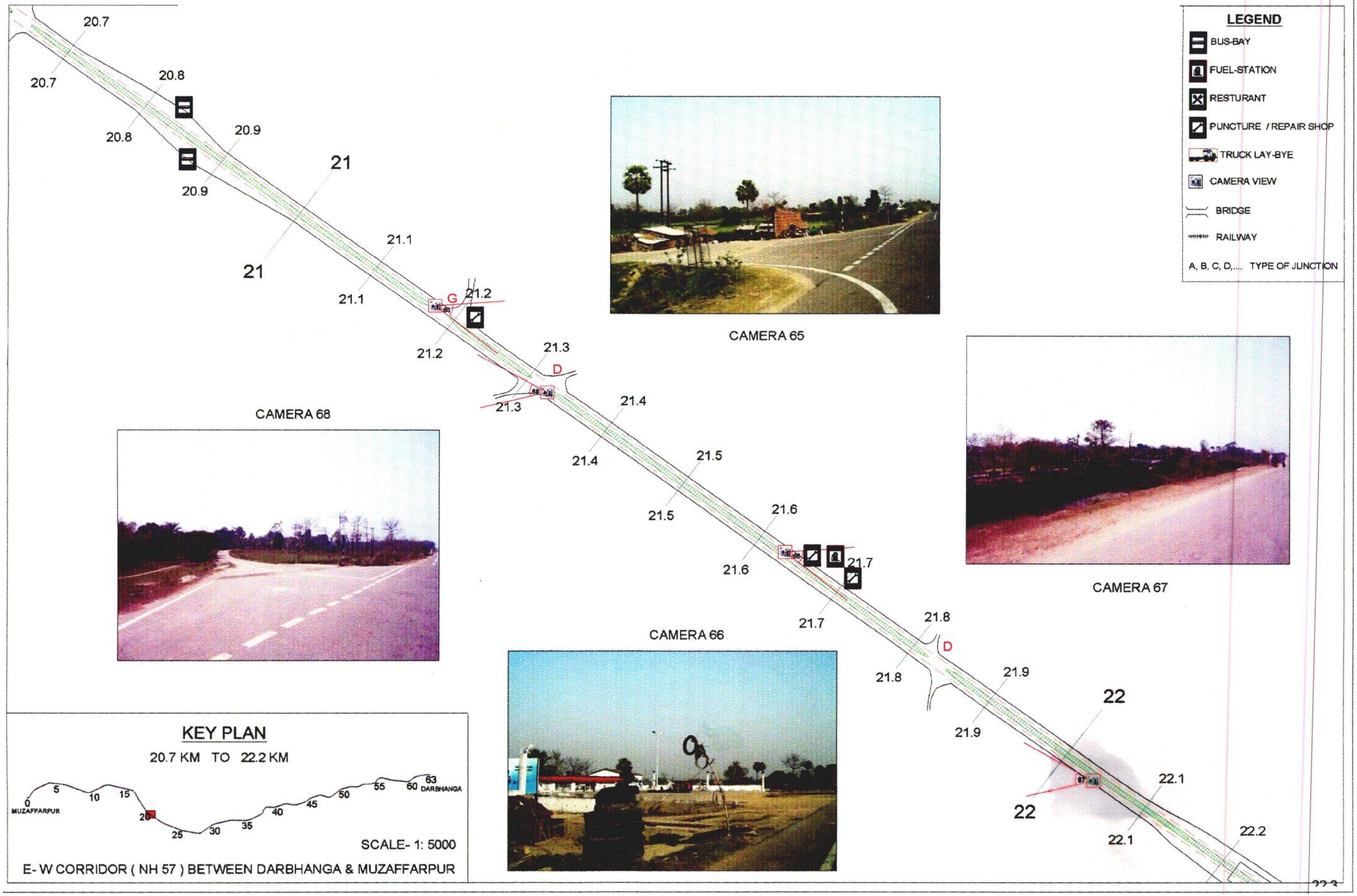
KEY PLAN

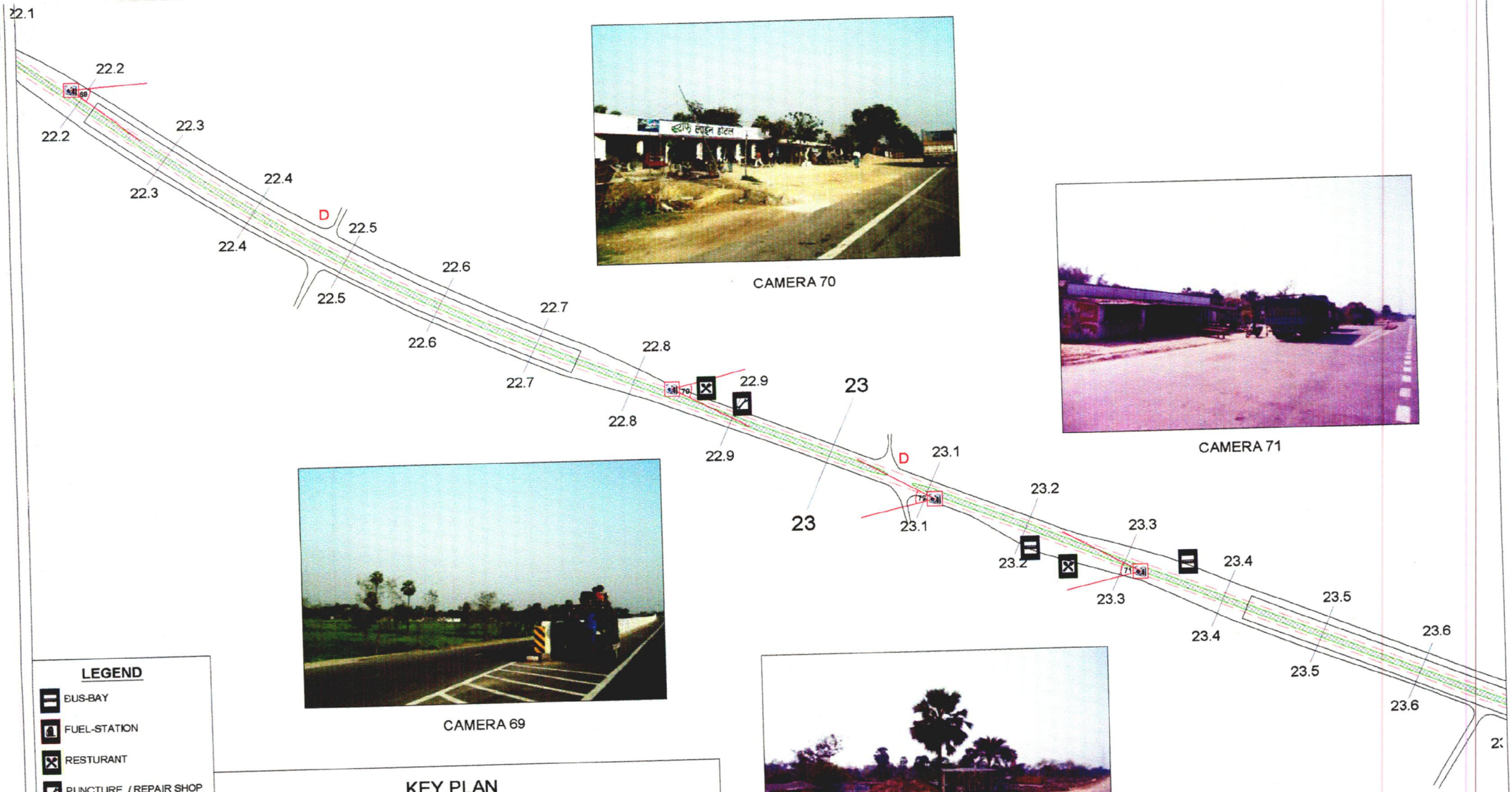
19.4 KM TO 20.7 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR


20.7
20.7
20.8
20.8
20.9
20.9
21
21
21.1
21.1
G
21.2
21.2
21.3
D
21.3
21.4
21.4
21.5
21.5
21.6
21.6
21.7
21.7
21.8
D
21.8
21.9
21.9
22
22
22.1
22.1
22.2
CAMERA 65
CAMERA 68
CAMERA 67
CAMERA 66
LEGEND
BUS-BAY
FUEL-STATION
RESTURANT
PUNCTURE / REPAIR SHOP
TRUCK LAY-BYE
CAMERA VIEW
BRIDGE
RAILWAY
A, B, C, D,.... TYPE OF JUNCTION
KEY PLAN
20.7 KM TO 22.2 KM
0
MUZAFFARPUR
5
10
15
20
25
30
35
40
45
50
55
60
63
DARBHANGA
SCALE- 1: 5000
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

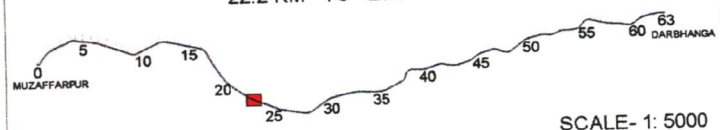


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

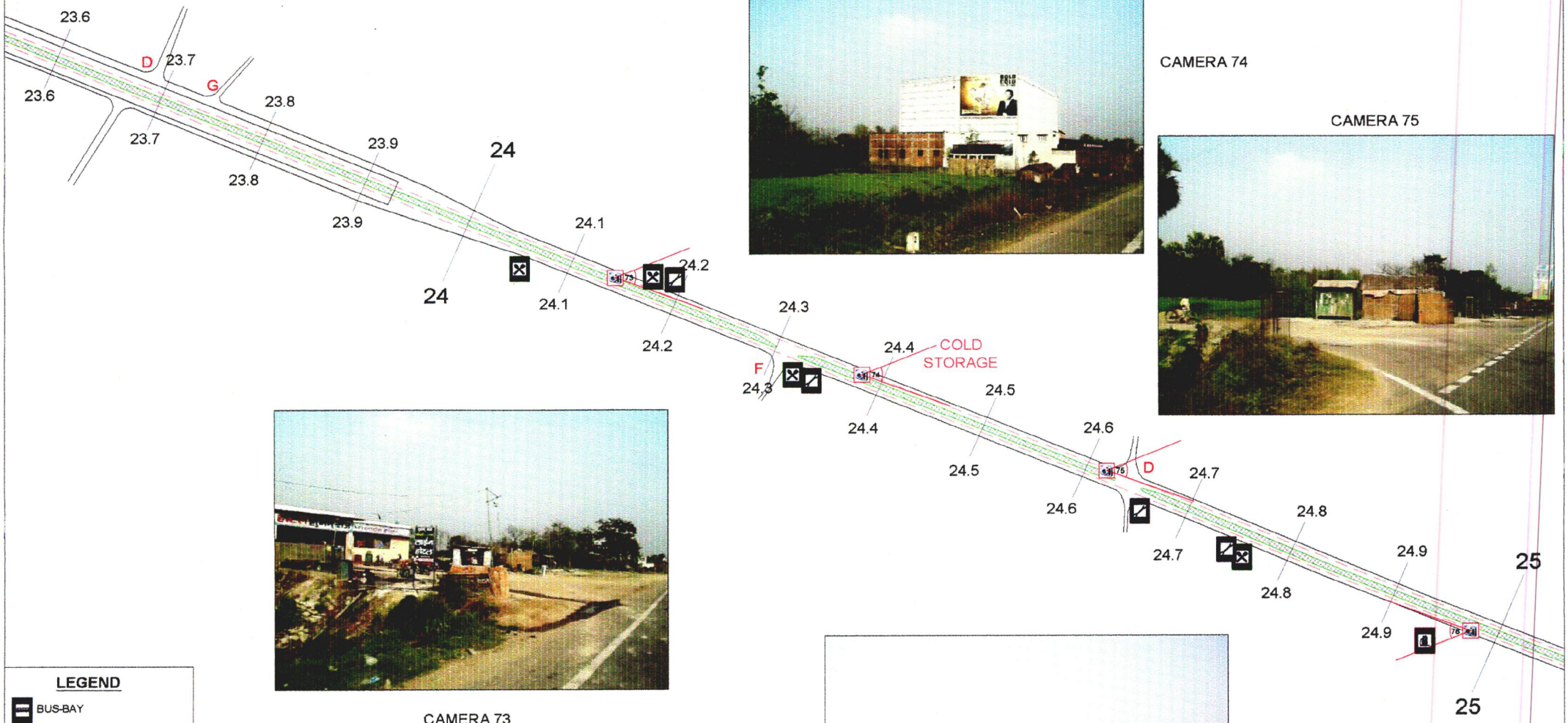
KEY PLAN

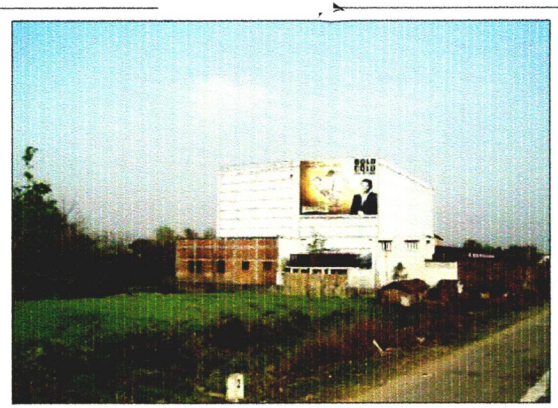
22.2 KM TO 23.6 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR





CAMERA 74

CAMERA 75

CAMERA 73

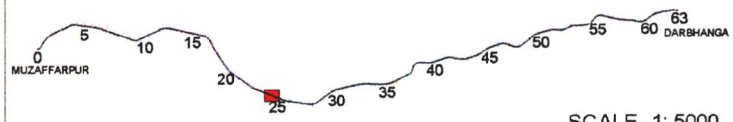
CAMERA 76

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

23.6 KM TO 25.0 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 77

CAMERA 79

CAMERA 80

CAMERA 78

25 25.1 25.2 25.3 25.4 25.5 25.6 25.7 25.8 25.9 26 26.1 26.2 26.3 26.4

COLD STORAGE

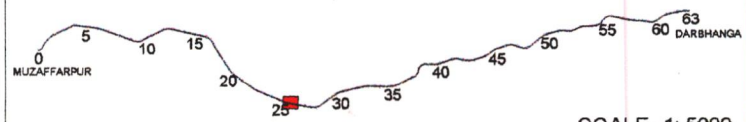
TOLL PLAZA

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

25.0 KM TO 26.4 KM

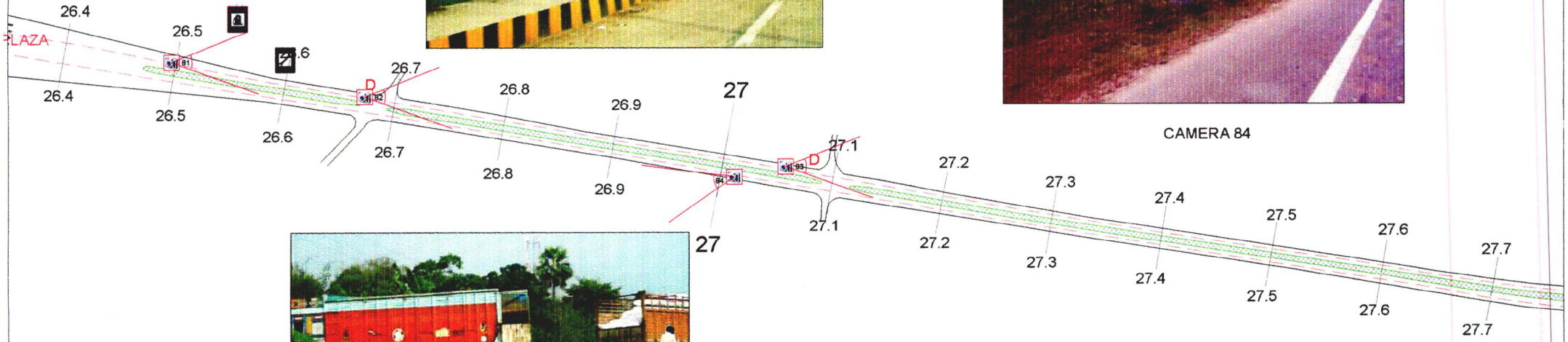


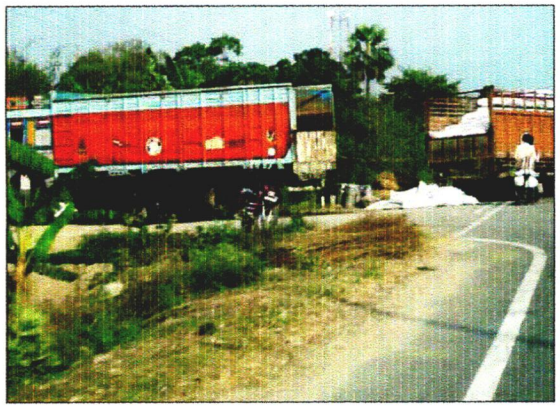
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 81

CAMERA 84





CAMERA 82

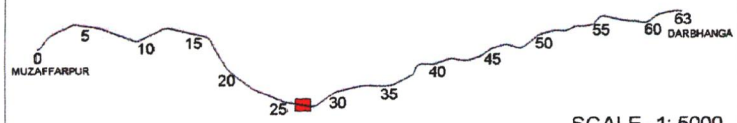
CAMERA 83

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

26.4 KM TO 27.7 KM



SCALE- 1: 5000

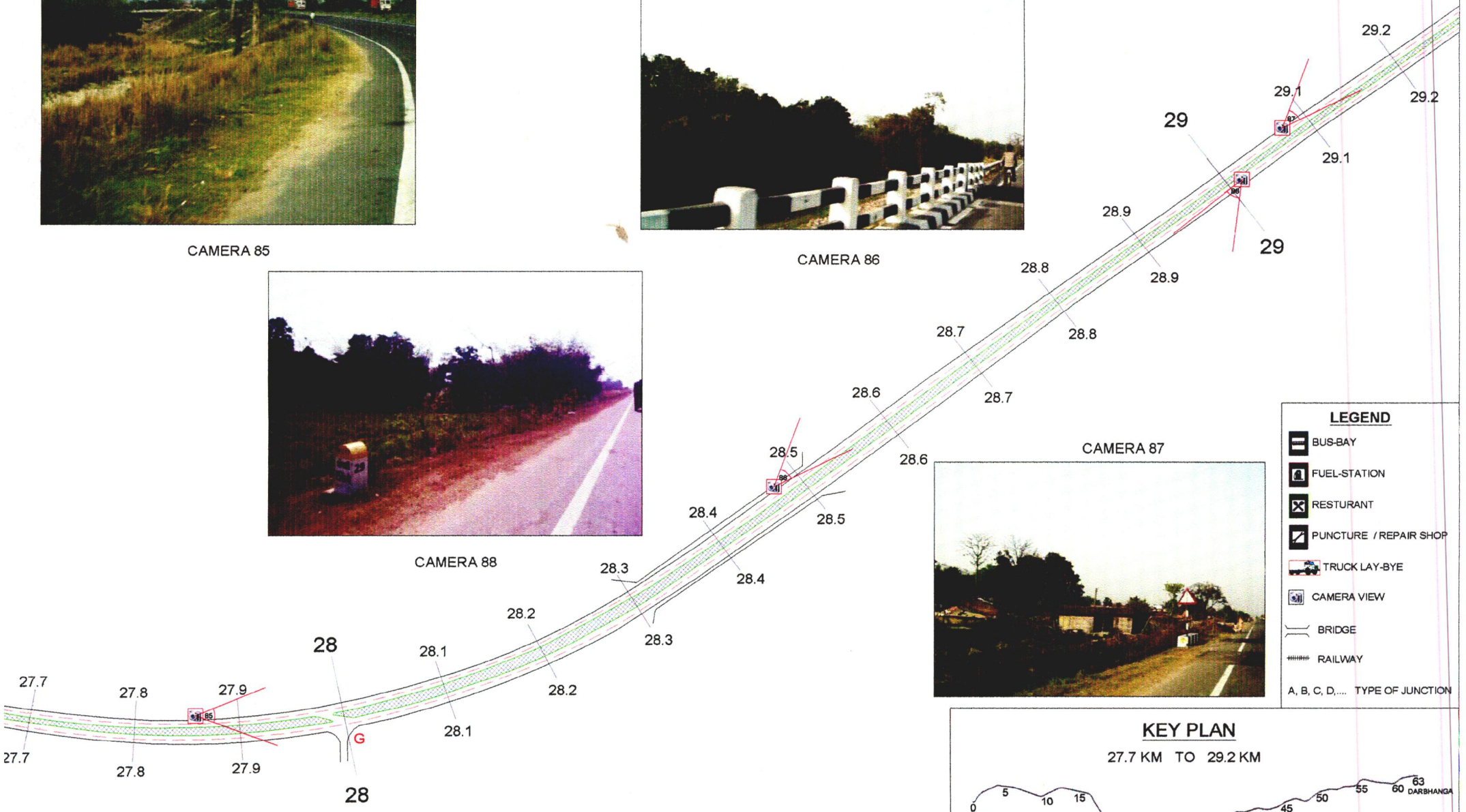
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 85

CAMERA 86

CAMERA 88

CAMERA 87

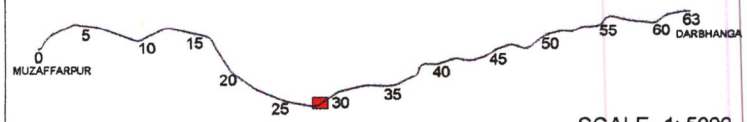


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

27.7 KM TO 29.2 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 91

CAMERA 89

CAMERA 92

CAMERA 90

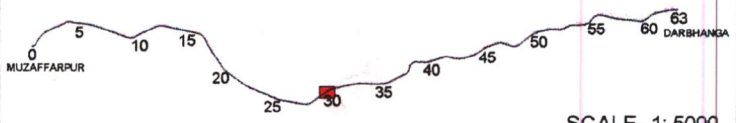
29.1
29.2
29.3 E
29.3
29.4
29.5
29.6
29.7
29.8
29.9
30
30.1
30.2
30.3 G
30.4
30.5
30.6
30.7

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

29.2 KM TO 30.7 KM



SCALE- 1: 5000

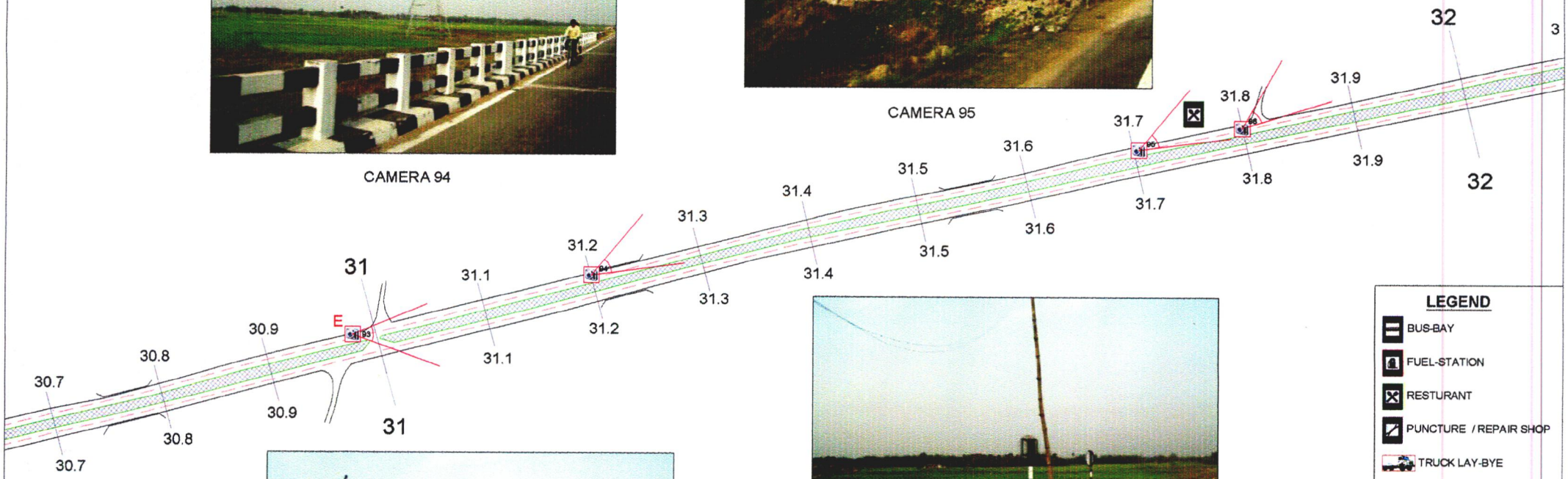
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 94

CAMERA 95

CAMERA 93

CAMERA 96

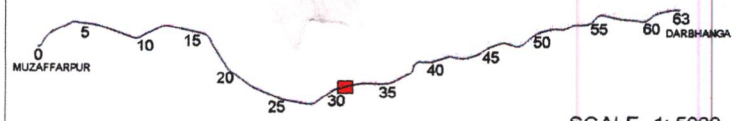


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

30.7 KM TO 32.0 KM

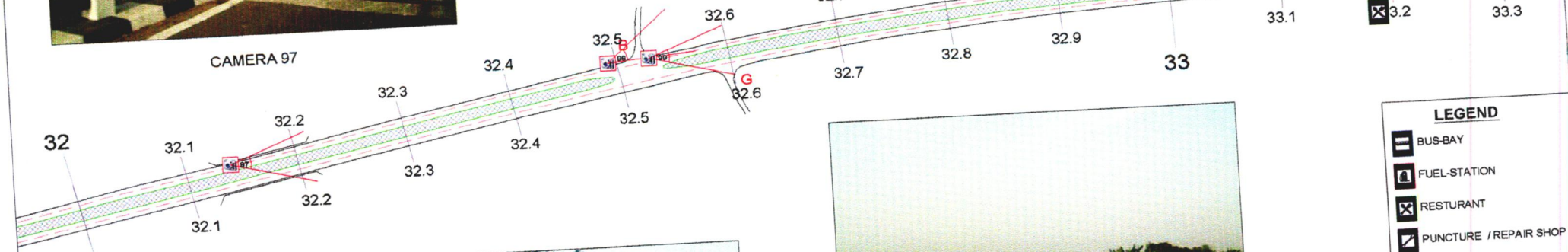


SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 97

CAMERA 98



CAMERA 99

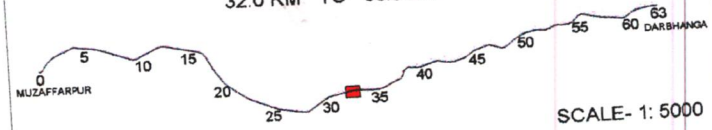
CAMERA 100

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

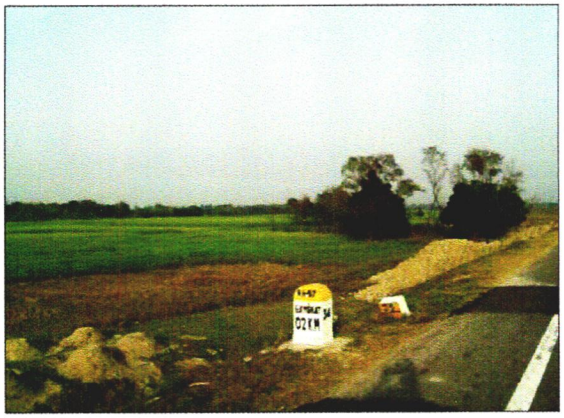
32.0 KM TO 33.3 KM



SCALE- 1: 5000

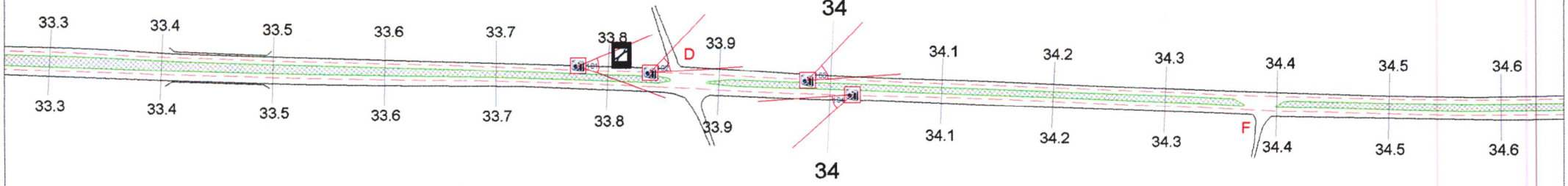
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

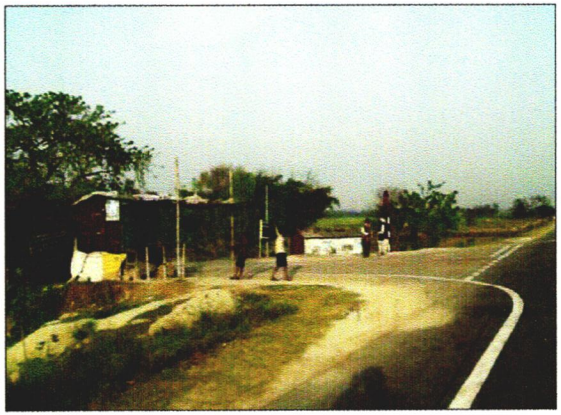
CAMERA 101



CAMERA 103

CAMERA 104





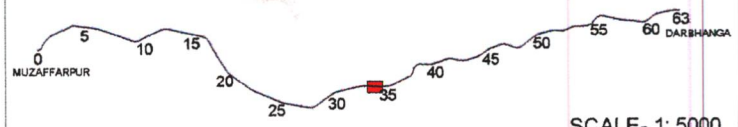
CAMERA 102

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

33.3 KM TO 34.6 KM



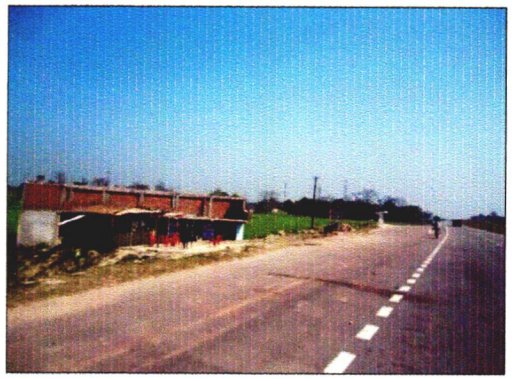
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

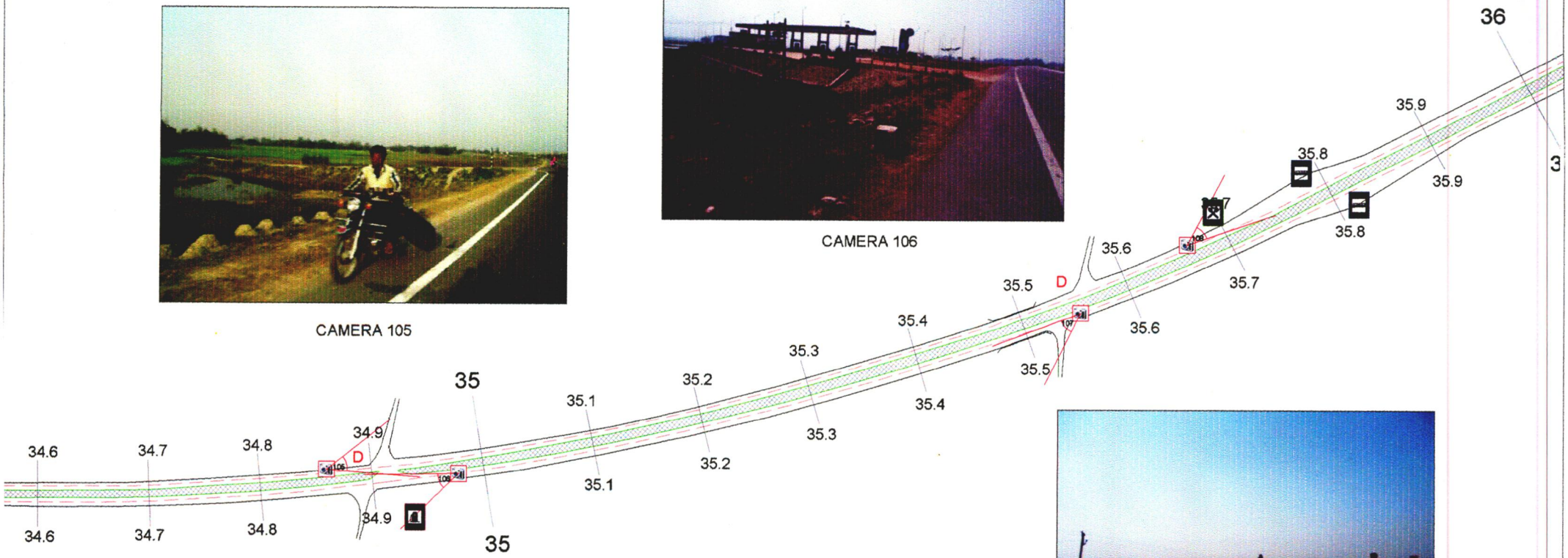
CAMERA 105

CAMERA 106

CAMERA 107



CAMERA 108

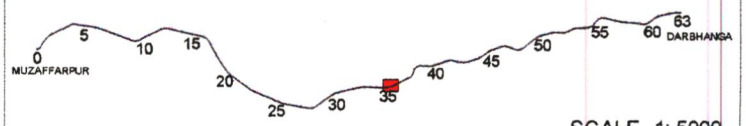


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

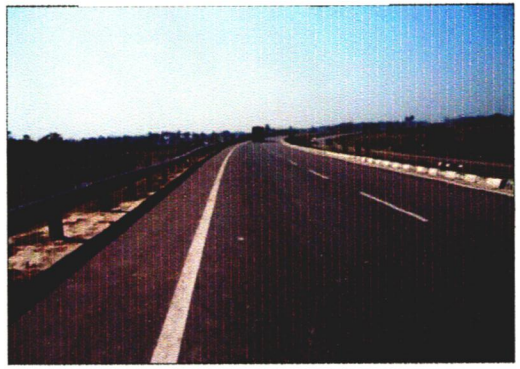
KEY PLAN

34.6 KM TO 36.0 KM



SCALE- 1: 5000

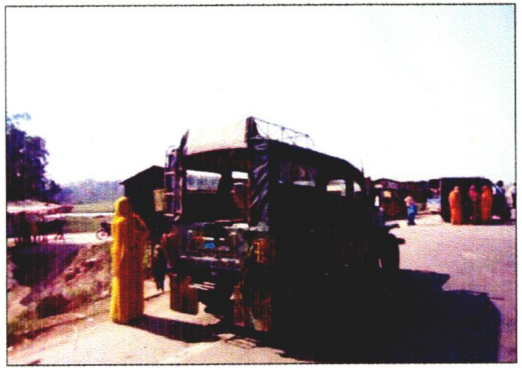
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 110

CAMERA 109

CAMERA 111



CAMERA 112

36 36.1 36.2 36.3 36.4 36.5 36.6 36.7 36.8 36.9 37 37.1 37.2 37.3 37.4 37.5

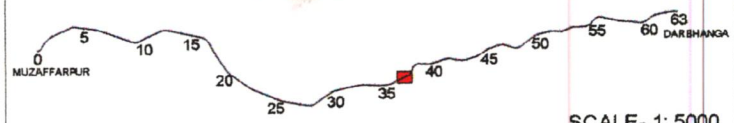
D

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

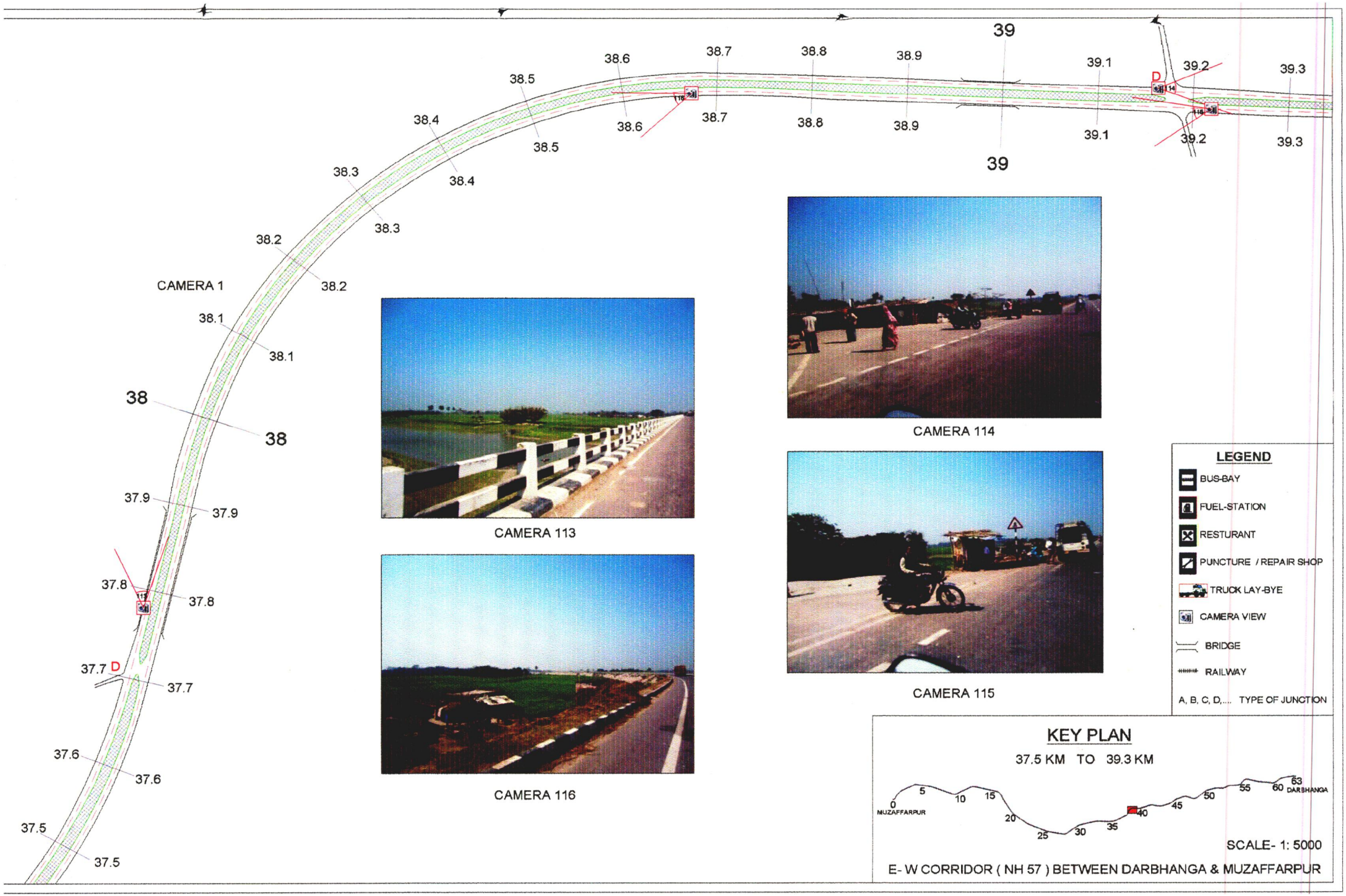
KEY PLAN

36.0 KM TO 37.5 KM



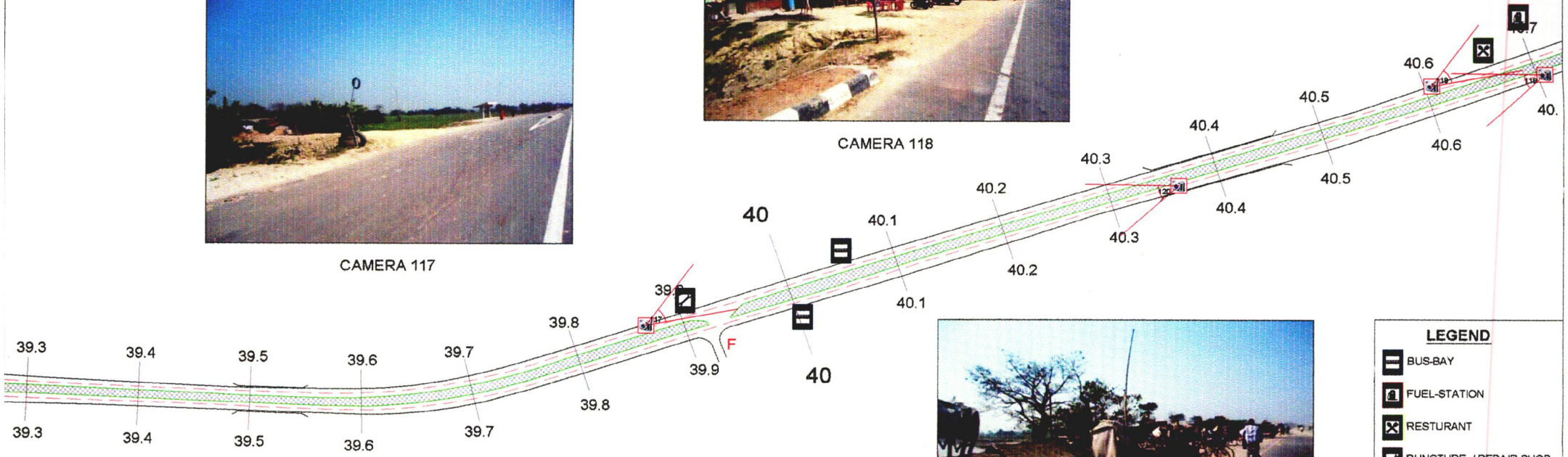
SCALE- 1: 5000

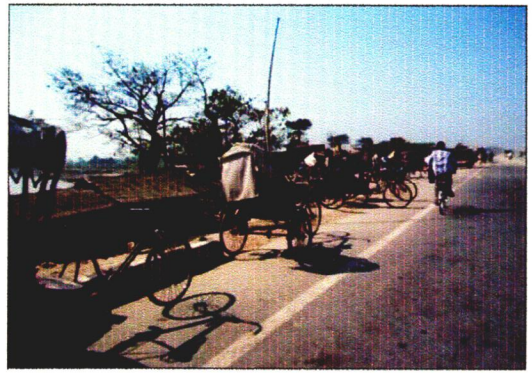
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR


39
38.6
38.7
38.8
38.9
39.1
39.2
39.3
38.5
38.4
38.3
38.2
CAMERA 1
38.1
38
37.9
37.8
37.7
37.6
37.5
D
38.6
38.7
38.8
38.9
39.1
39.2
39.3
38.5
38.4
38.3
38.2
38.1
38
37.9
37.8
37.7
37.6
37.5
D
CAMERA 113
CAMERA 114
CAMERA 115
CAMERA 116
LEGEND
BUS-BAY
FUEL-STATION
RESTURANT
PUNCTURE / REPAIR SHOP
TRUCK LAY-BYE
CAMERA VIEW
BRIDGE
RAILWAY
A, B, C, D,.... TYPE OF JUNCTION
KEY PLAN
37.5 KM TO 39.3 KM
0
MUZAFFARPUR
5
10
15
20
25
30
35
40
45
50
55
60
63
DARBHANGA
SCALE- 1: 5000
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 117

CAMERA 118





CAMERA 119

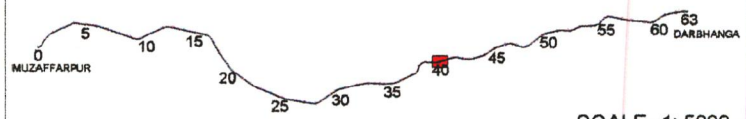
CAMERA 120

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

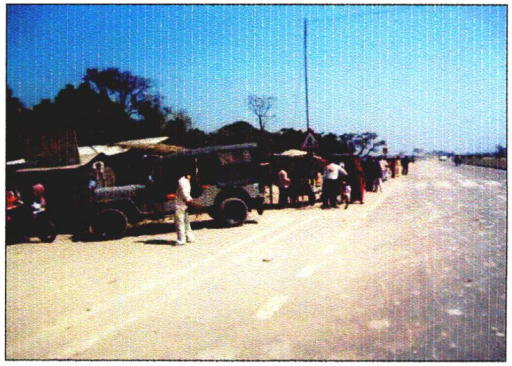
39.3 KM TO 40.7 KM



SCALE- 1: 5000

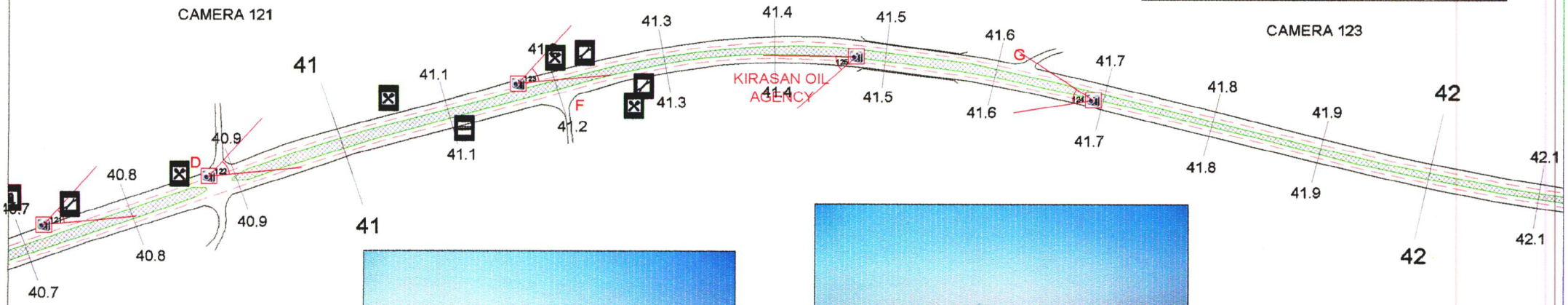
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 121



CAMERA 122

CAMERA 123



CAMERA 125

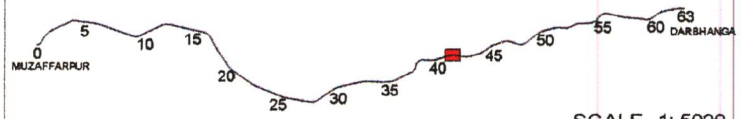
CAMERA 124

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

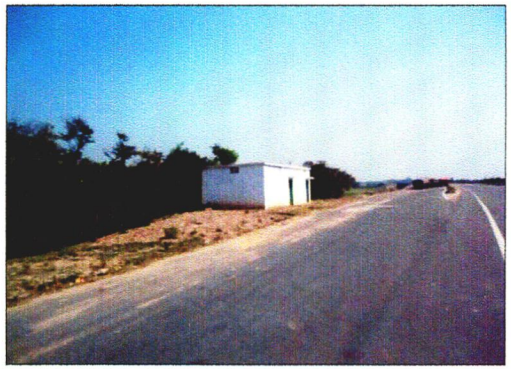
40.7 KM TO 42.1 KM



SCALE- 1: 5000

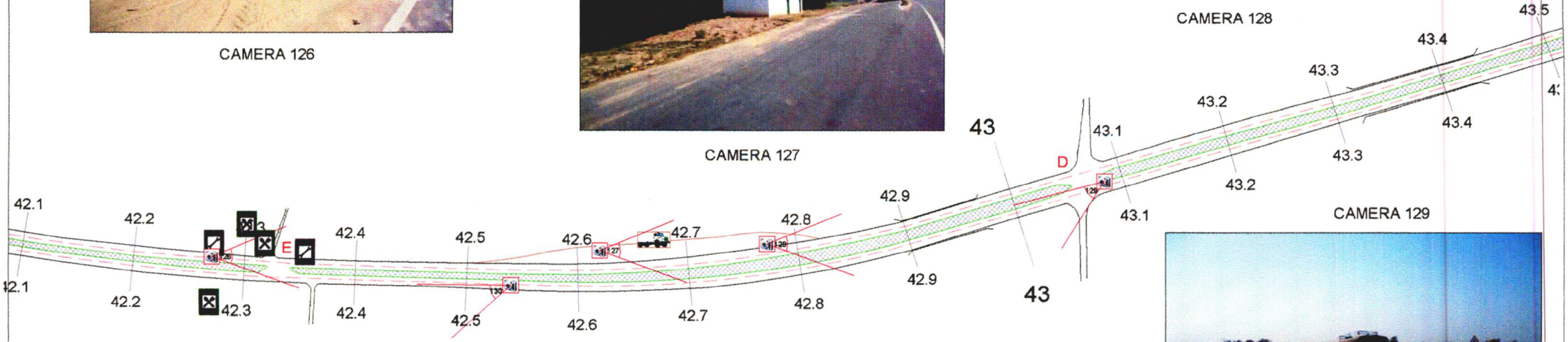
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 126



CAMERA 127

CAMERA 128



CAMERA 129

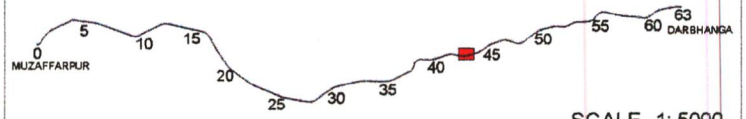
CAMERA 130

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

42.1 KM TO 43.5 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 134

CAMERA 133

CAMERA 131

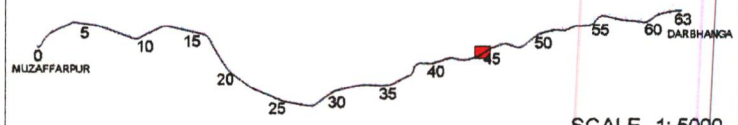
CAMERA 132

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

43.5 KM TO 45.0 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 136

CAMERA 135

CAMERA 137

CAMERA 138

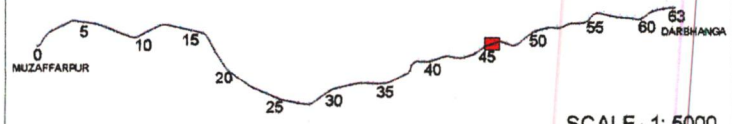
45 45.1 45.2 45.3 45.4 45.5 D 45.6 45.7 45.8 45.9 46 46.1 46.2 46.3 46.4

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

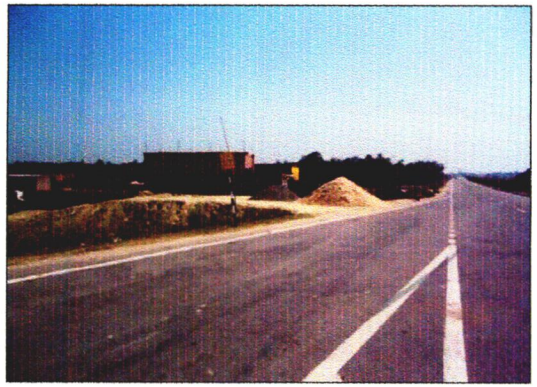
45.0 KM TO 46.4 KM



SCALE- 1: 5000

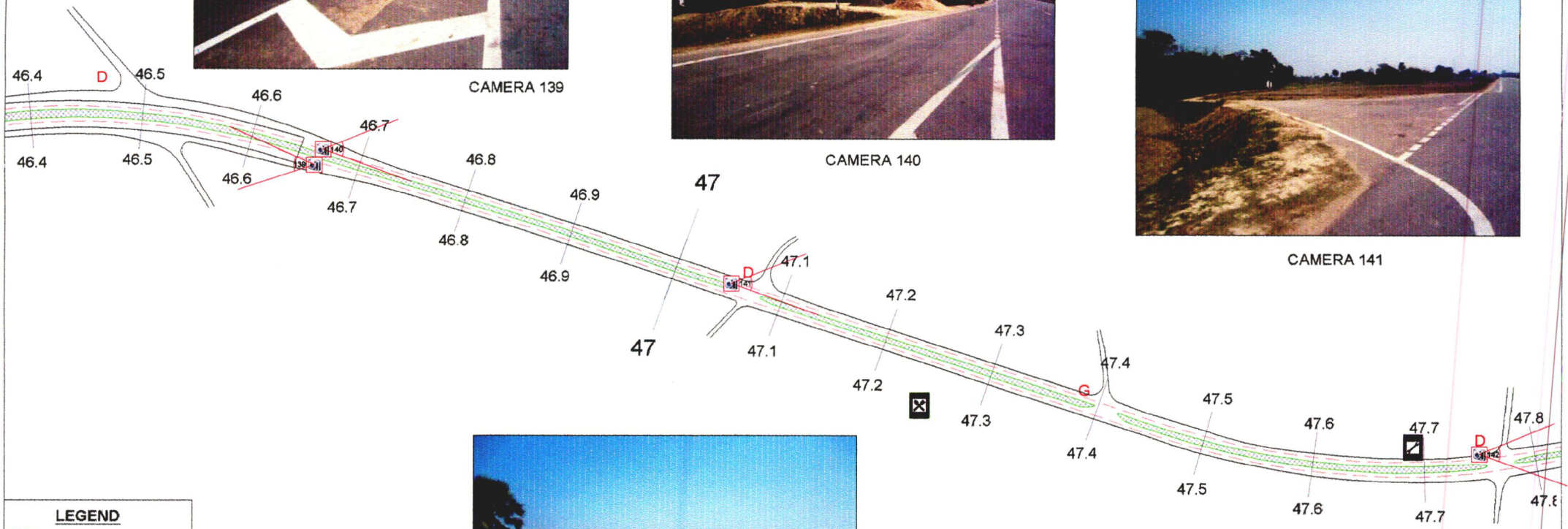
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 139



CAMERA 140

CAMERA 141



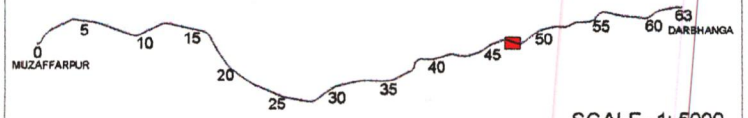
CAMERA 142

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

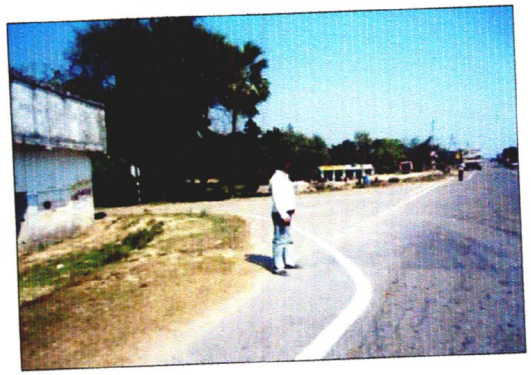
KEY PLAN

46.4 KM TO 47.8 KM



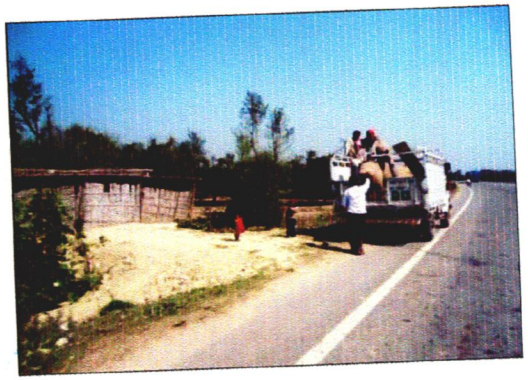
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 144

CAMERA 145



CAMERA 143

CAMERA 146

47.8 47.9 48 48.1 48.2 48.3 48.4 48.5 48.6 48.7 48.8 48.9 49 49.1 49.2 49.3

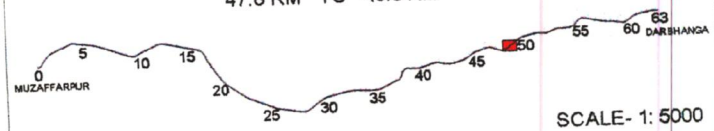
D G

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D.... TYPE OF JUNCTION

KEY PLAN

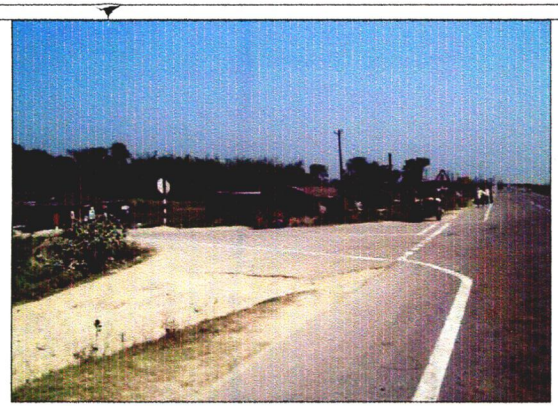
47.8 KM TO 49.3 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

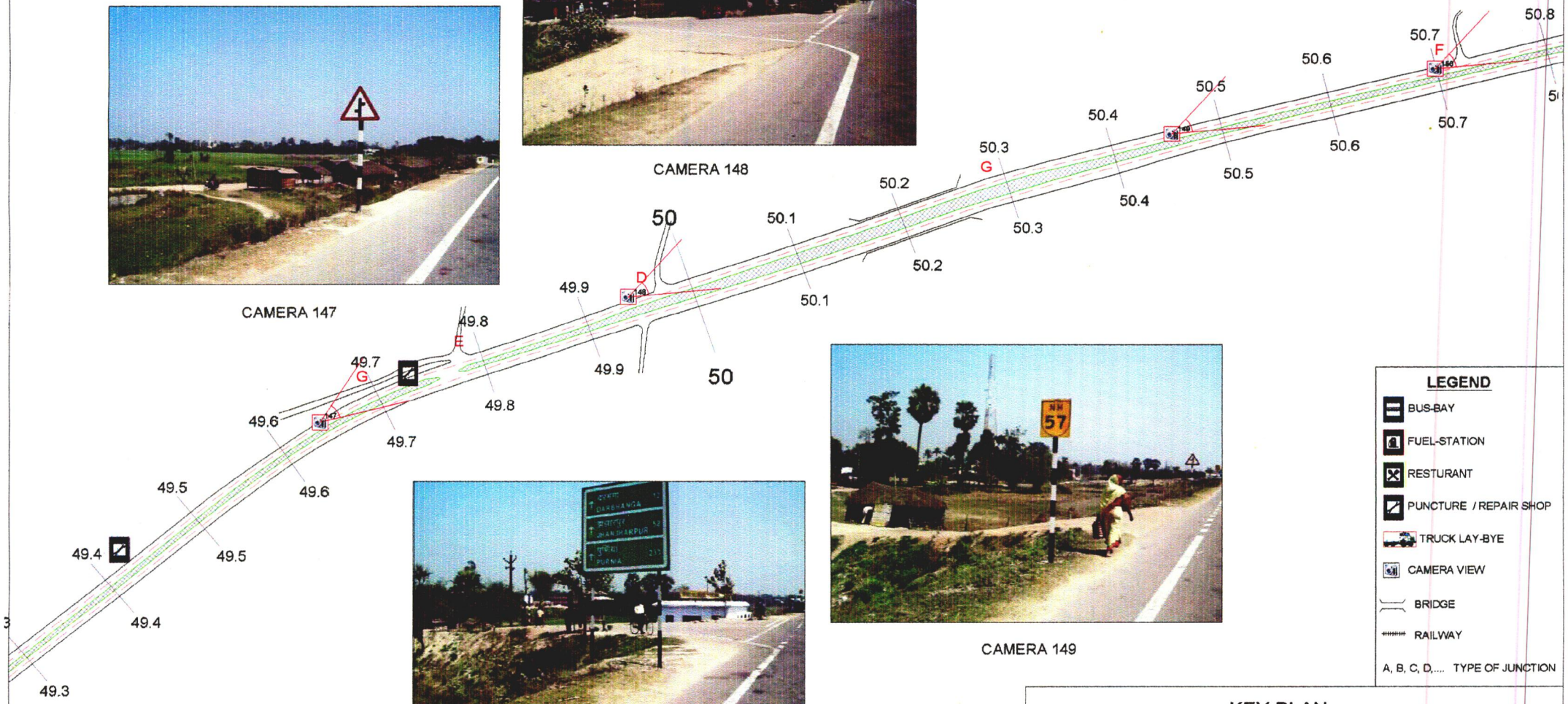
CAMERA 147



CAMERA 148

CAMERA 149

CAMERA 150

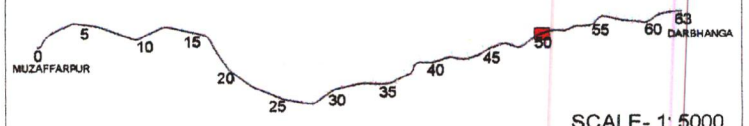


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

49.3 KM TO 50.8 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 151

CAMERA 153

CAMERA 152

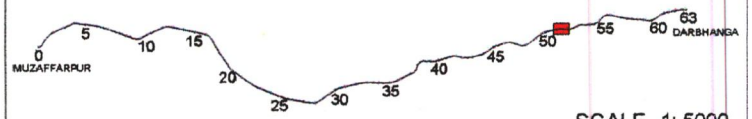
CAMERA 154

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

50.8 KM TO 52.1 KM



SCALE- 1: 5000

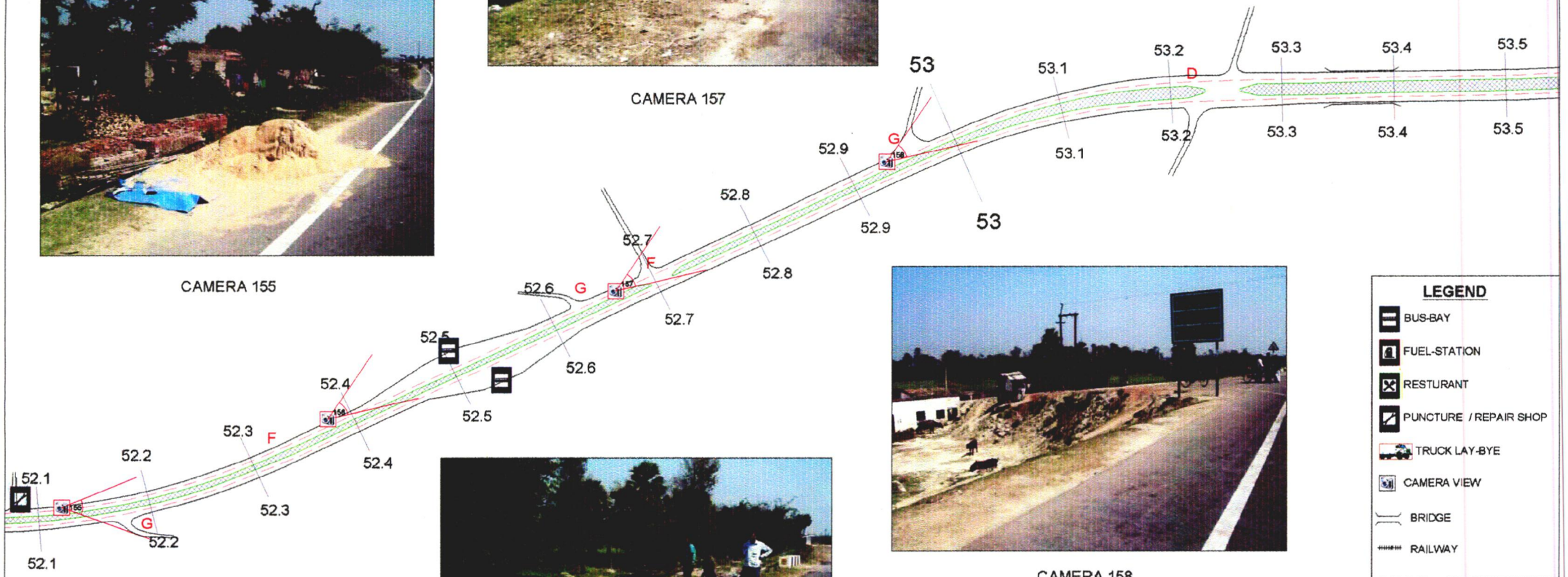
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 155

CAMERA 157

CAMERA 158

CAMERA 156

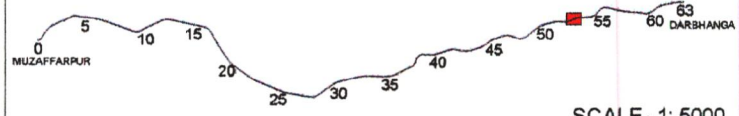


LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

52.1 KM TO 53.5 KM

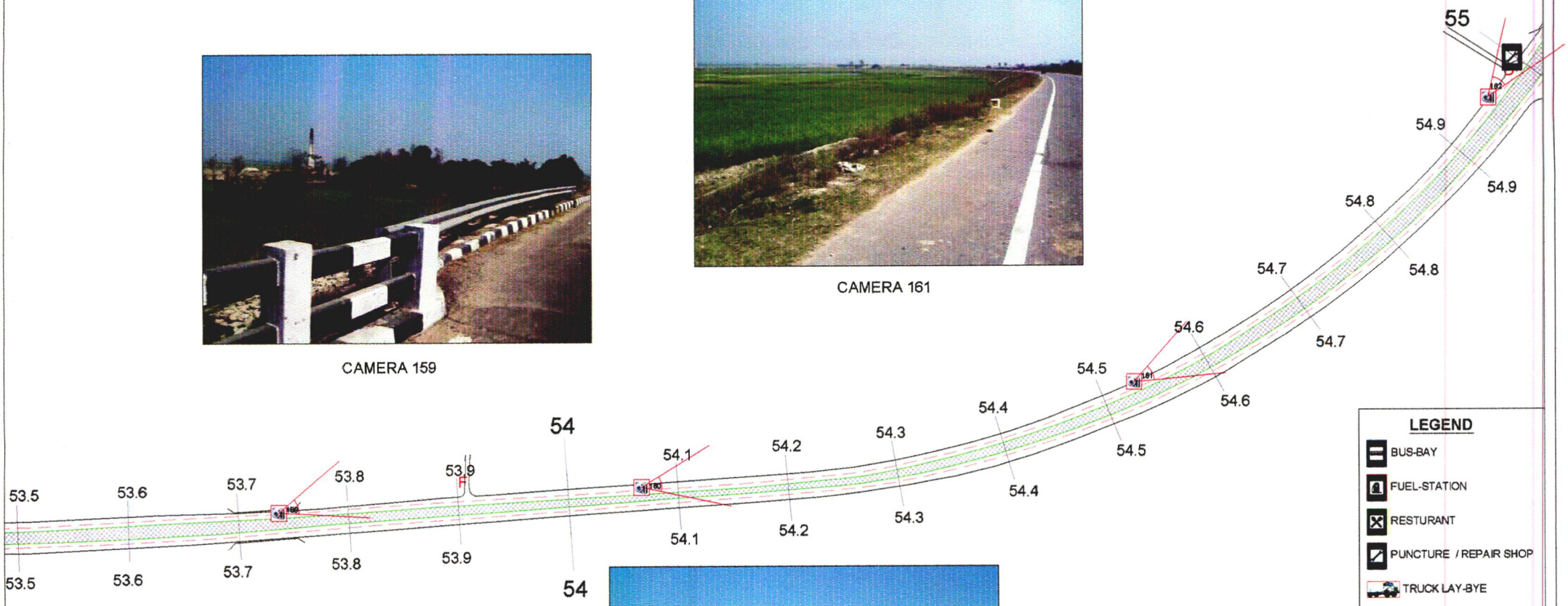


SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 159

CAMERA 161



CAMERA 160

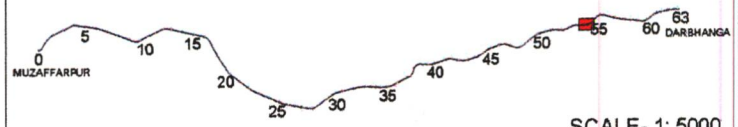
CAMERA 162

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

53.5 KM TO 55.0 KM



SCALE- 1: 5000

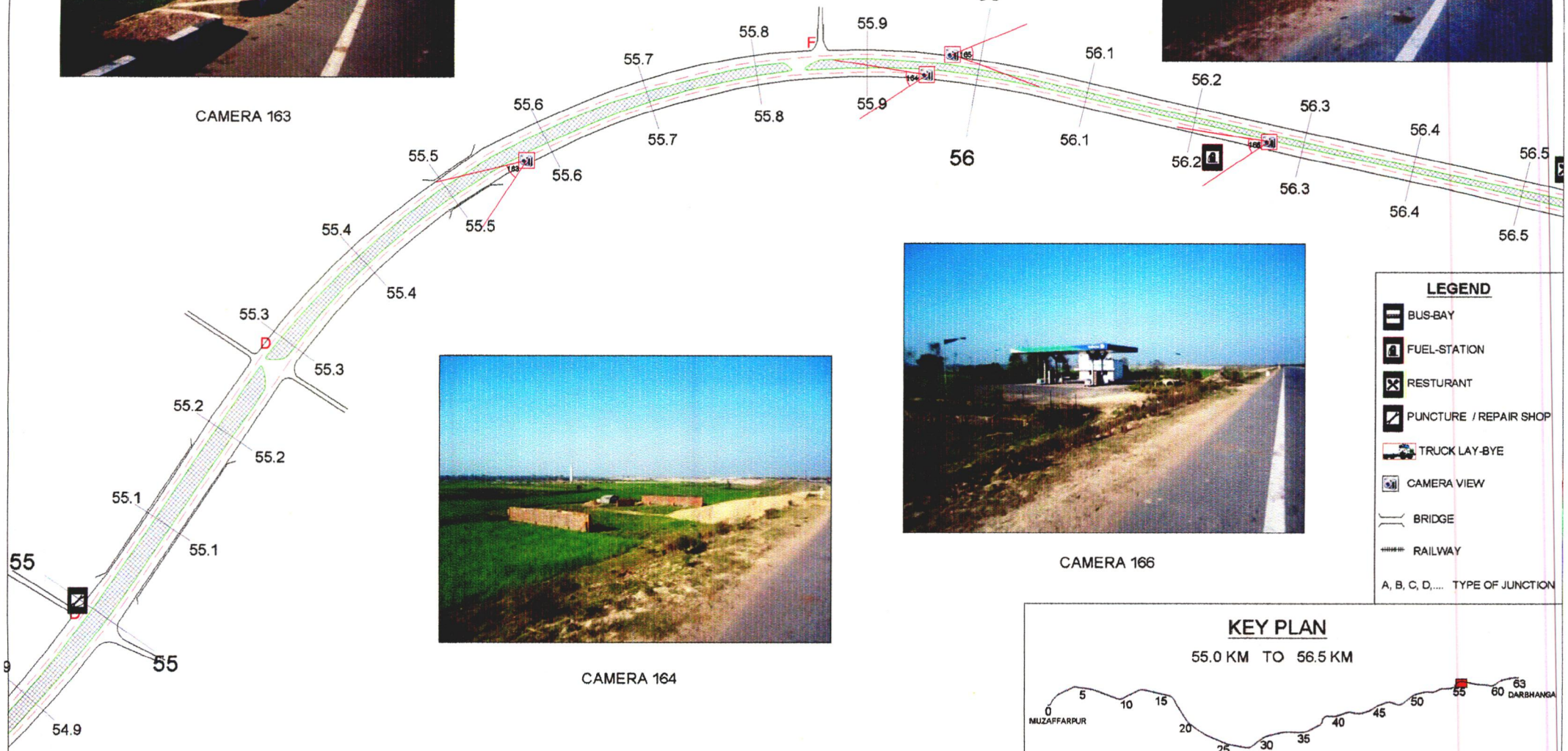
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 163

CAMERA 165

CAMERA 164

CAMERA 166



LEGEND

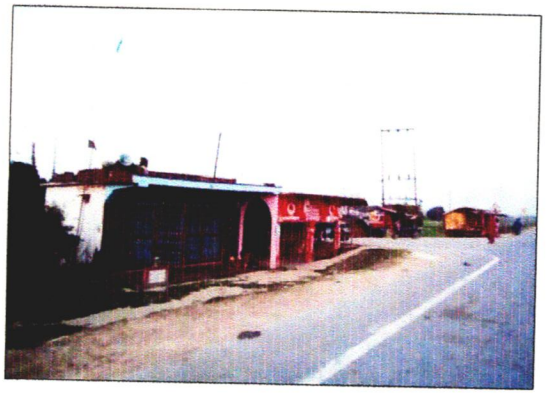
- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

55.0 KM TO 56.5 KM

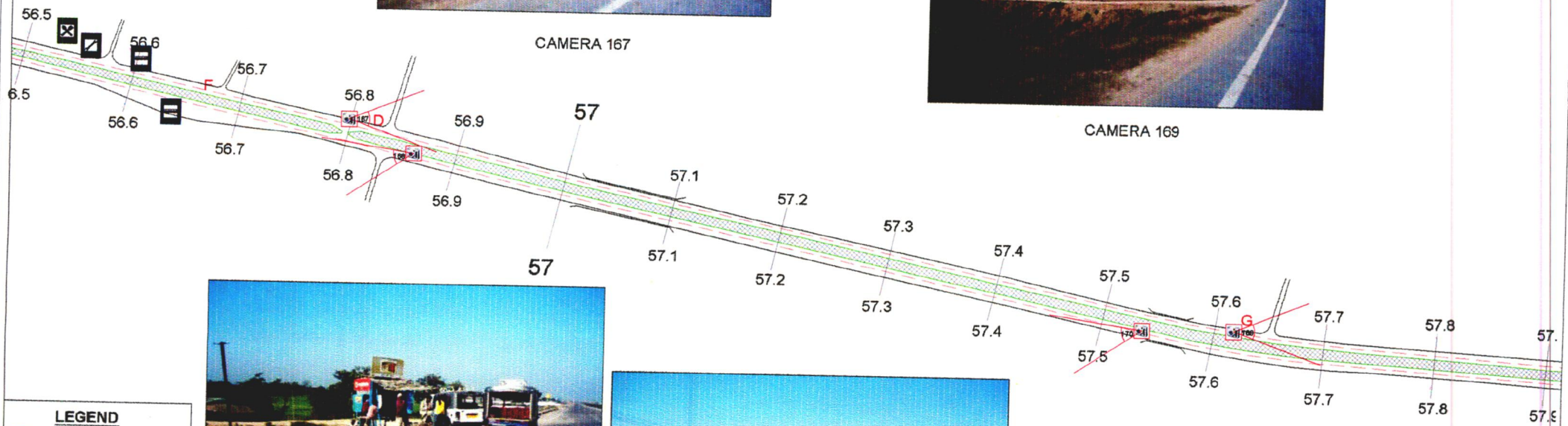
SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR



CAMERA 167

CAMERA 169



CAMERA 168

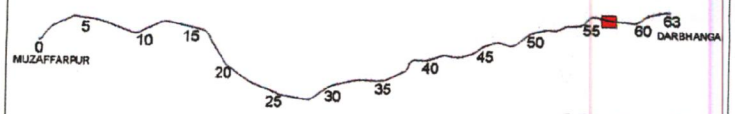
CAMERA 170

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

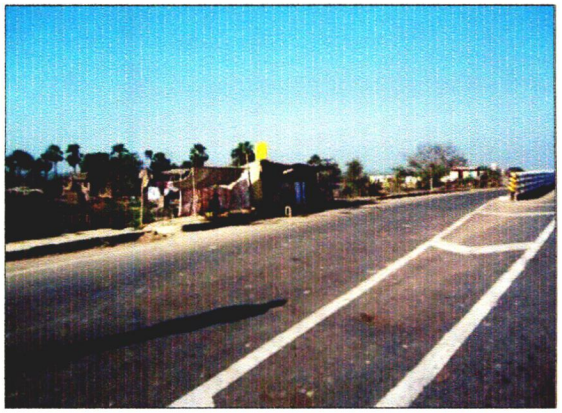
56.5 KM TO 57.9 KM



SCALE- 1: 5000

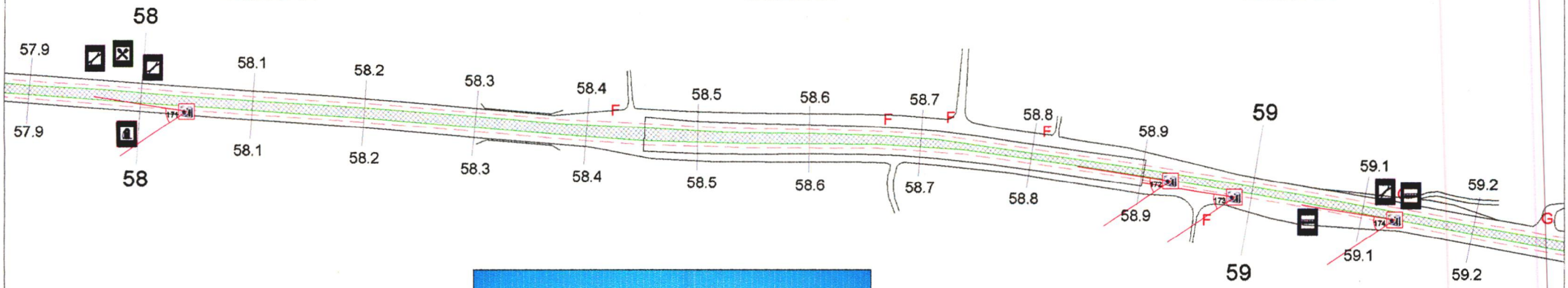
E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

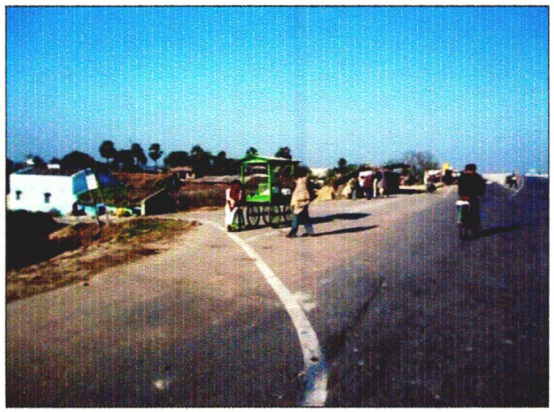
CAMERA 171



CAMERA 172

CAMERA 174





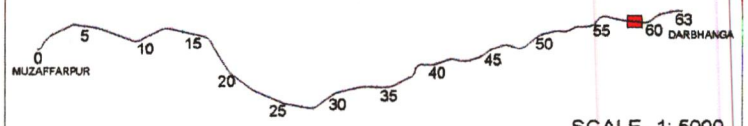
CAMERA 173

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

57.9 KM TO 59.2 KM

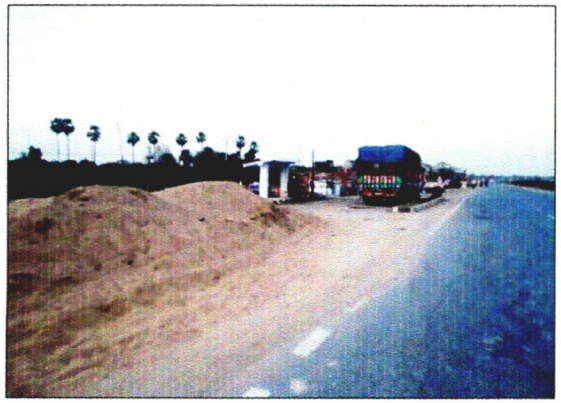


SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 175

CAMERA 178



CAMERA 176

CAMERA 177

59.2 59.3 59.4 59.5 59.6 59.7 59.8 59.9 60 60.1 60.2 60.3 60.4 60.5 60.6 60.7

G D

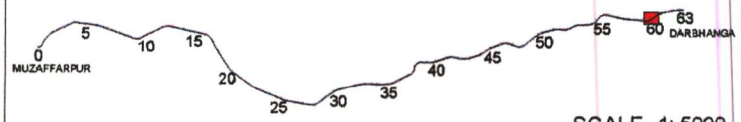
INDUSTRY

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

59.2 KM TO 60.7 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR

CAMERA 179

CAMERA 182

CAMERA 180

CAMERA 181

60.7 60.8 60.9 61 61.1 61.2 61.3 61.4 61.5 61.6 61.7 61.8 61.9 62 62.1

E G D

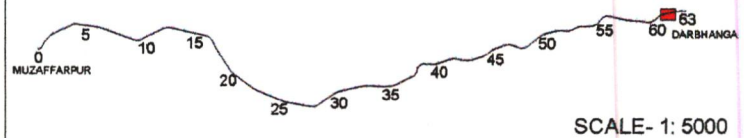
STRY

LEGEND

- BUS-BAY
- FUEL-STATION
- RESTURANT
- PUNCTURE / REPAIR SHOP
- TRUCK LAY-BYE
- CAMERA VIEW
- BRIDGE
- RAILWAY
- A, B, C, D,.... TYPE OF JUNCTION

KEY PLAN

60.7 KM TO 62.1 KM



SCALE- 1: 5000

E- W CORRIDOR (NH 57) BETWEEN DARBHANGA & MUZAFFARPUR