ASSESSMENT OF ENVIRONMENTAL IMPACT OF TRAFFIC ON GANDHI ROAD, DEHRADUN

A DISSERTATION

submitted in partial fulfilment of the
requirements for the award of the degree
of
MASTER OF URBAN AND RURAL PLANNING

By

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JANUARY, 1994

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in dissertation entitled "ASSESSMENT OF ENVIRONMENTAL IMPACTS ON CANDHI ROAD, DHARAVI" in partial fulfilment of the requirement for the award of the degree of MASTER OF URBAN AND RURAL PLANNING submitted in the Department of Architecture and Planning, University of Roorkee, Roorkee is an authentic record of my own carried out for a period of six months from August 1993 to January 1994 under the supervision of Dr. R. Sankar, Reader, Department of Architecture and Planning, University of Roorkee, Roorkee, India.

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

Dated: JANUARY 31, 1994 (AJAY KUMAR GUPTA)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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[illegible] involves a [illegible] This dissertation [illegible] a result of sincere efforts, co-operation and help of [illegible] individuals besides, the supreme power "THE GOD". I [illegible] this opportunity to thank all of them at this moment.

First of all, I would like to extend my [illegible] heartiest thanks to my [illegible] R. Sankar, Reader, [illegible] constant source of inspiration and invaluable guidance [illegible] moral support had been available at every moment of my dissertation work.

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PREFACE

Dehradun is a very important city of Utter Pradesh. It is a gateway to Uttara Khand. The economic development of hilly region of Utter Pradesh is closely associated with the development of Dehradun City. Dehradun has emerged as the most vital service centre within the hilly region of Uttar Pradesh. A number of civil and defence institutions of national level such as Rashtriya Indian Military College, the survey of India, Forest Research Institute, Indian Photo interpretation Institute, Indian Institute of Petroleum, and ONGC have given it a special status. The city deserves a special mention with regard to tourism also. It is the reilhead for the queen of hill station Mussoorie. A number of tourist resorts are located with in the city it self which attract a large number of tourists every year.

Due to its special status and location, Dehradun has grown at a very fast pace in the last couple of decades. Along with the resident population increase, there has been a rapid expansion of urbanised area also. Consequent to this fast urban growth there is an increase in traffic on some of the main roads of Dehradun particularly in the central area.

This in turn has caused problems of air pollution, noise pollution, accidents, imopediments to smooth flow of traffic inconvenience to people etc. It is also observed that the

problem of air pollution and traffic consestion is very acute particularly in Gandhi Road. The poor air quality poses various health problem such as anemia, fatigue, headache, asthma and dizziness etc. where as, high—prevailing noise levels cause annoyance, partial deafness etc.

Thus keeping in view the existing levels of congestion and alarmingly high rate of environmental decay, there is a need to study in detail the environmental impacts of operating the highway transport system on selected road in Dehradun so that its natural beauty and environmental condition may be preserved and improved.

This report consists of Seven Chapters. The first chapter describes the Introduction including, aims, objectives, methodology, scope and limitations of the study. The second chapter presents a general over view as well as the abstracts of the extensive literature survey under taken by the author. Chapter three gives the brief introduction to Dehradun city and selected study area. Chapter four deals with the studies. Surveys and observations done in the study area to assess the traffic Characteristics. Chapter five deals with the analysis, findings, results and studies of environmental impact of traffic on study area. Chapter six introduces some planning parameters. Chapter seven concludes the thesis presenting the proposals, recommendation and conclusion of the study. Finally, bibliography, Photographic study and appendices have been included for more details and further information.

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CHAPTER 1

CHAPTER 1

INTRODUCTION:

1.1 GENERAL:

The rapid urbanization throughout the world has brought in very serious problems to be tackled by the society. In India the urban population has been increasing very rapidly and is expected to be about 325 million (32% of total population of India) by 2001 A.D. The growth rate of population in uruban areas between 1971-1991 varied from 3 to 5.5 % per anum.

Due to the rapid urbanization, the vehicular traffic volume has also increased at a much faster rate over the last two decades. Increased vehicular traffic has resulted in many environmental problems especially in urban areas. The trend to have personal transport due to inadequate public transport has added to the problems of increased traffic and congestion in the urban areas leading to noisy and highly polluted envionment.

Until the environmental revolution came up in early 70's the main aspects taken in to consideration while planning,designing and operating the transport system,were those of economy and safety of traffic flow and very little or no consideration was given for the environmental changes and ecological disturbances caused.

The environmental consequences or impacts range from noise created by transport vehicles, emission of exhaust gases, dust, nuisance and social burden of those killed or maimed in accidents in addition to disturbances or damages caused to the

natural environment and the existing eco- system. It is also necessary to examine the means available for evaluating the environmental impact.

1.2 NEED OF THE STUDY:

Dehradun is a very important city of Uttar Pradesh. It is a gateway to Uttara Khand. The economic development of hilly region of Uttar Pradesh is closely associated with the development of Dehradun city. Dehradun has emerged as the most vital service centre within the hilly region of Uttar Pradesh. A number of civil and defence institutions of national level such as Rashtriya Indian Military College, the survey of India, Forest Research Institute, Indian Photo interpretation Institute, Indian Institute of Petroleum, and ONGC have given it a special status. The city deserves a special mention with regard to tourism also. It is the railhead for the queen of hill station Mussoorie. A number of tourist resorts are located with in the city it self which attract a large number of tourists every year.

Due to its special status and location, Dehradun has gvown at a very fast pace in the last couple of decades. Along with the resident population increase, there has been a rapid expansion of urbanised area also. Consequent to this fast urban growth there is an increase in traffic on some of the main roads of Dehradun particularly in the central area.

This in turn has caused problems of air pollution, noise pollution, accidents, impediments to smooth flow of traffic inconvenience to people etc. It is also observed that the problem of air pollution and traffic congestion is very acute

particularly in Gandhi Road. The poor air quality poses various health problem such as anemia, fatigue, headache, asthma, and dizziness etc. where as, high prevailing noise levels cause annoyance, partial deafness etc.

Thus keeping in view the existing levels of congestion and alarmingly high rate of environmental decay, there is a further need to study in detail the environmental impacts of operating the highway transport system on the stretch of selected road in Dehradun so that its natural beauty and environmental condition may be preserved and improved.

1.3 AIMS AND OBJECTIVES:

The proposed thesis is aimed at :

i. Studying the extent and intensity of problems caused by traffic on selected stretch of main road.

ii. To analysing the causes and effects (impacts) of traffic problems.

iii. To propose the remedial measures.

1.4 SCOPE AND LIMITATION OF THE STUDY:

This study when completed will help in understanding the problems faced by people, road users etc. due to traffic on the Gandhi Road in Dehradun. More or less the contents of this study could be used in formulating appropriate planning measures for bringing out the essential improvement in the study area in particular and in other towns. This study would also help the planners to face their task in a more realistic way. This study when completed will surely depict some of the major problems due to traffic in Dehradun. The scope of this project is limited

to studies based on available informations from secondary sources and informations drived from field survey on selected aspects. The study is sevierly limited by the non-availability of quantitative data of various traffic aspects on Gandhi Road, time and other resources.

1.5 METHODOLOGY:

The salient steps of the methodology followed in this study are presented as follows:

i) Objective formulation:

ii) Literature Survey:

An extensive and intensive literature survey is primarly done to under stand what exactly the effect of automobiles and traffic on environment of a city.

iii) Collection of Planning Data From Second Resources:

All relevant planning data from secondary sources is callected along with photography survey and general survey of all the informal activities taking place on Gandhi Road.

iv) Data From Field Survey:

It is performed by interview of the experts officers their opinion and respons to ideas generated. After having defined informal activities for operational purpose, work programmes, survey schedules, questionnaire are prepared to undertake field survey and detailed study.

v) Analysis of Data:

Analysis of the collected data is done by various methods including statistical and graphical methods.

vi) **Assessments of Environmental Impact:**

After analysis of data collected from field survey, an comparative study is made between collecting datas and standard, datas to assess the extent of environmental pollution and impect in study area.

vii) **Proposals:**

Various methods ideas and proposals are made to improve the present condition of study area.

CHAPTER 2

CHAPTER 2

LITERATURE REVIEW

2.1 URBAN TRAFFIC PATTERN:

2.1.1 Pattern of movement:

The basic unit of movement is a trip. Trip is defined as "the one way travel from one point to another for a particular purpose". The two end points of a trip are usually referred to as the origin and the destination of that trip. For convenience, trips are often split into two groups;

a. **Home-based trips**: Such trips have one trip-end at the home of the person making the trip, which may be either the origin or the destination of the given trip.

b. **Non- home-based trips**; these have neither origin nor destination trip-end at the home of the person making the trip.

Like wise land uses from which trips radiate are called trip generators and land uses to which trips converge are called trip attractions.

2.1.2 Purpose of Movement:

There are seven broad categories into which various journey purposes are grouped:

a. **Work** most important journey purpose for employed persons. In this context, 'work' would apply to the place where the person is normally employed.

b. **Firm's business**- journeys made during the course of one's work as distinct from a precise journey to one's place of work.

c. **Education** - journeys which are made by school children, students etc., for the purpose of receiving instruction or being educated.

d. **Shopping and Personal Business** - such as going to the super market, hairdressers or to receive other services; these are of a semi-regular or intermittent nature.

e. **Social and Entertainment** - such as visiting friends and relatives, going to the place of entertainment or even going for a joy ride in the car.

f. **To reach home** - for most persons over 40 percent of all journeys they make are for the sole purpose of reaching or getting back home.

g. There are some journeys for which there is no specific purpose other than to be with or assisst some other person; for example, driving some one to the station or taking children to school.

2.1.3 Parking in Traffic Planning:

Proper parking provision is an essential element in a good traffic system. In the short run, parking policies and good traffic management are widely recognised as the best means of coping with the present and imminent growth of urban traffic. in the longer term, parking policies are an indispensable part of the land use and transport plan for urban settlements.

a. Effect of Parking on Traffic:

Without control, on-street parking can lead to dangerous traffic conditions, and to the loss of road space needed for moving traffic. The amount and type of parking space provided both on and off street affects the amount of traffic entering

central areas. Uncontrolled street parking impedes loading and unloading and encourages double banking. Vehicles are often parked too close together, making it difficult for vehicles to enter or leave the parking spaces;

b. **Effect of Parking on Environment:**

The presence of parked vehicles in urban areas has a sharp impact on urban character. Noise and fumes associated with cars stopping and starting, visual intrusion of vehicles crammed into every available space, vehicles loading and unloading goods on to the pavement in peak hours; all these debase the quality of the environment.

2.1.4 Urban Traffic Congestion:

Buchanan was the first person to identify clearly the conflicting desires of vehicle and pedestrian movement in urban areas by defining accessibility and environment. There are two main requirements for good accessibility.

a. Vehicle users should be able to move from one part of a town to another or beyond, in safety and with reasonable speed, directness and pleasantness from the driver's eye view.

b. On arrival in the vicinity of his destination, the driver should be able to penetrate without delay close to his final destination and to stop there without restriction.

Poor accessibility is not the whole of the traffic problem by any means. The penetration of motor vehicles throughout urban areas has brought its own peculiar penalties of accident, anxiety, intimidation by large or fast vehicles that are out of

scale with the surroundings, noise, fumes, vibration, dirt and visual intrusion on a vast scale. closely associated with the quality of the environment is freedom of pedestrian movement. The simple act of walking plays an indispensable part in the transport system of any town.

In addition to social costs, congestion increases the travel time and travel costs of both people and goods. Delay is experienced by private vehicles and public transport and by freight movement and pedestrian crossing the road. In a congested traffic stream it is common to find a number of private vehicles with one occupant to each vehicle apparently delaying a double-decker bus with perhaps fifty passengers. The immediate objective solution to this problem must surely be to prohibit private vehicles, transfer the private vehicle occupants to public transport, and overnight, public transport would have increased patronage and dramatically reduced journey times in the peak periods while traffic congestion has disappeared.

The success or failure of an urban centre must be based on the level of business activity. Unless the shops, commercial offices, restaurants, theatres etc. are making good profits the business activity will decline. The level of profit must relate to patronage and patronage must relate to accessibilty. From bitter experience developers know that the success of, say, a city stor depends on the level of accessibility for the private car. A good public transport system certainly encourages business but without provision for the private vehicale business activity would not prosper.

2.1.5 Comprehensive Traffic Management:

Limitations in financial resources will preclude the provision of extensive new road networks in most towns for the foreseeable future. Even with limited financial resources such networks would not now be acceptable. Urban traffic solutions cannot therefore depend on the provision of new roads although some new roads and road improvements will be essential to enable any action to be taken. The alternative solution to the problem is to manage the use of existing road networks with the intentions of achieving a compromise between the following goals:

a. Give priority to public transport.
b. Protect and encourage the cycle.
c. Restrain and control the car.
d. protect and aid the pedestrian.
e. control parking.
f. Direct and control the lorry.
g. Protect and enhance the environment.

2.2 TRAFFIC AND THE ENVIRONMENT:

The transportation system in cities have become one of the most important factor for achieving the high standard of living of people. But in recent year, the enormous growth of vehicle population and the latest development in Highway system have created many problems by its side effects. Some of these problems habe direct impact on the environment in which the people live. Much have been written on 'Environmental Problems' with least implementation effected. Unless and until the environment is kept healthy and sate by applying suitable corrective measures, there is a danger that the motor vehicle which is hailed as a boon to mankind, might turn out to be the worst offender in defiling nature and its beauty. The detrimental side effects of traffic on the environment are as follows:

1. Air Pollution
2. Noise Pollution
3. Visual Pollution

The three aspects of pollution namely air pollution, noise pollution and visual pollution has been discussed as follows:

2.3.1 AIR POLLUTION:

(i) Definition

Engineers joint council (U.S.A.) defines Air pollution as "Air Pollution means the presence in the out door atmosphere of one or more contaminations, such as dust, fumes, gas, mist, odour, smoke or vapour in quantities, characteristics and of duration such as to be injurious to human, plant or animal life or to property or which unreasonable interferes with the comfortable enjoyment of life and property".

(ii) Air Pollution Due to Transportation:

Fast moving and heavy traffic movements on highways and railway tracks lift the dust and other particles from the ground which get suspended in the atmosphere due to turbulence created in the air. Thus particles of various size and nature remain suspended in and around traffic lanes as the air is always in turbulent condition there. This reduces visibility on the roads and near by thus causing problems for drivers and others. Apart from this these dust particle get into respiratory systems of people and causing breathing troubles, eye irritation and skin problems. These particle also cover all surfaces of near by

property, clothes, vehicles, plants etc. and degrade their surface by attrition and some times ruin them in combination with acidic gases and moisture.

Transportation related pollution has accounted for an average of 60 percent of the total pollutants in the atmosphere for the major metropolitan areas in general.The major air pollutant due to transportation are as follows:

a. Carbon Monoxide (Co)

b. Hydrocarbons (Hc)

c. Nitrogen Oxide (NOx)

d. Suspended Particulates (SPM)

e. Sulpher Di Oxide (So_2)

(iii) **Effects of Air Pollution: (Due to Transportation)**

a) **Carbon Monoxide**: The major portion of Carbon Monoxide present in the atmosphere is due to transportation services. Out of this the gasoline (petrol) engine contributes more than 90 per cent increase in 'Co' concentration can produce toxie effects alike breathing of air of lower oxygen concentration.

b) **Hydrocarbon**: Hydrocarbon can produce photochemical smoke in which state it may affect one's visibility and cause extreme irritation to the eyes. Ethylene (HC component) also has toxic effects and it will damage sensitive plants.

c) **Nitric Oxide** (No) and nitrogen di-Oxide: At high concentration these oxides are toxic and have caused death of many persons.

d) **Particulates**: It causes respiratory diseases.

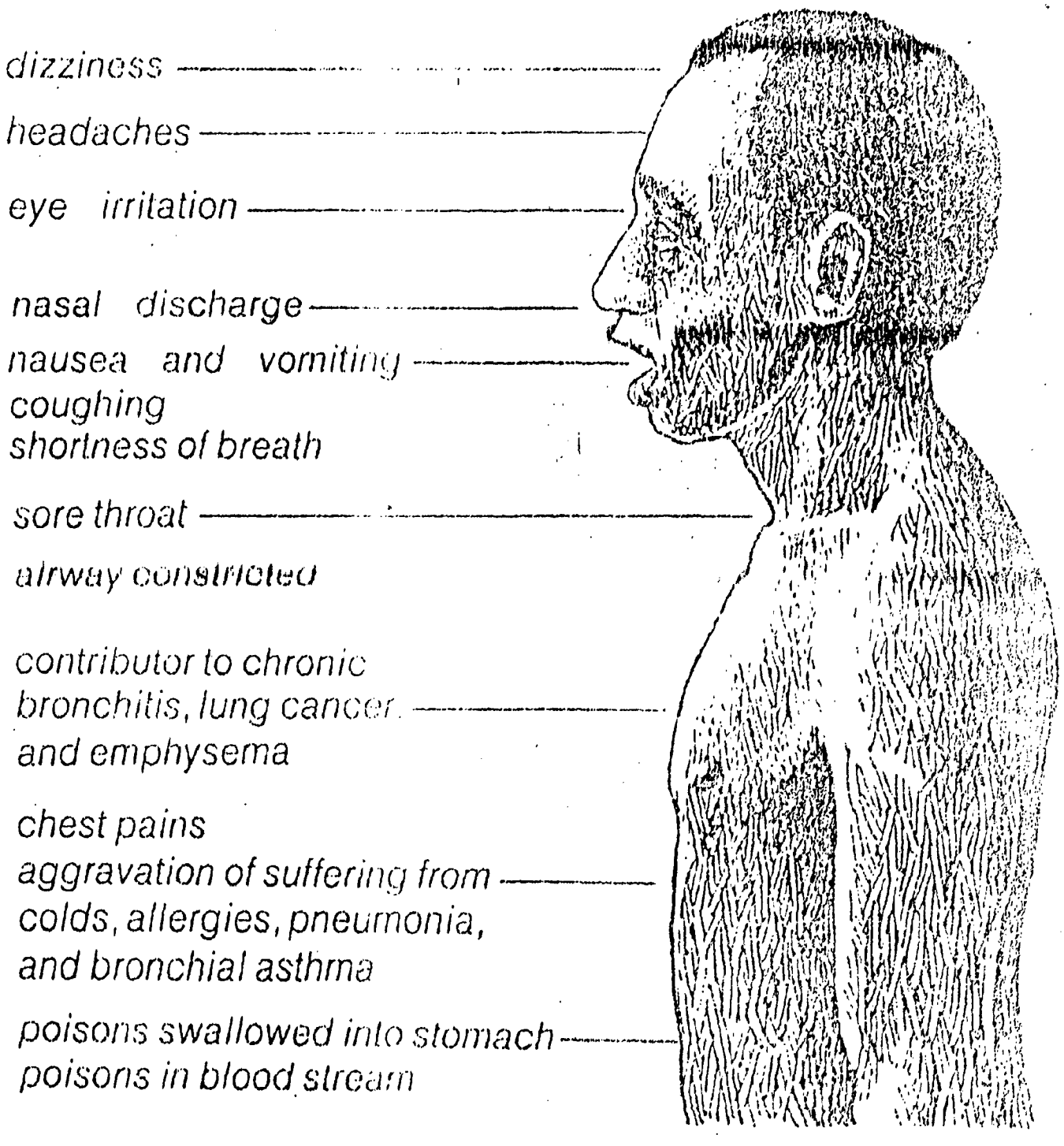


FIG NO 1. *Some possible effects of air pollution on the human body.*

(iv) Effects of Air Pollution on Materials:

Air pollution also has considerable economic and asthetic effects upon materials. According to Parker, materials may be damaged directly by air pollutants. The damage may be due to direct chemical attack on materials such as tarnishing of silver or etching of a metallic surface by an acid mist. The effect of major air pollutants due to traffic on materials can be summerised in the following table:

Table No.1

Pollutant	Type of Effect	Materials affected
Carbon-Dioxide	Deterioration caused by combination of Co and moisture to form carbonic acid.	Building stone
Nitrogen oxides	cause dyes to fade and whites to turn yellow	Textiles
Particulates	Abrasion and corrosion when combined with other gaseous pollutants.	Most metals, Paints textiles.
Sulfur oxides	Corrosion	Steel, zinc, Electrical equipments, limestone, roofing state, mortar, statues, textiles, leather.
	Electrochemical deterioration	Iron, aluminium, copper, silver, building materials.

2.3.2 NOISE POLLUTION:

(i) General:

Noise can be described in the simplest meaning as unwanted sound. Noise generally has three sources namely:

a) Transportation noise.

b) Occupational (or) Industrial noise.

c) community background noise.

In an urban area transportation noise is one of the most prevailing sources of sound. And many transportation noise sources are between 80 dBA and 100 dBA.

(ii) Transportation noise:

Noise from moter vehicles in motion comes from two major souces, namely (i) From the Vehicles (ii) From the Tyre road way system.

Elements that contribute to vehicle noise are:

a. Engine
b. Inlet
c. Exhaust
d. Propulsion and transmission, including gears etc.
e. Brakes
f. Horns
g. Chassis
h. body structures
i. Loads in the vehicle
j. Door rattling

The tyre road way interaction produces a sound primarily attributable to the pattern and depth of tyre tread, roughness of the road surface, wetness, tyre stiffness, tyre loading and suspension system of the vehicles.

(iii) Intersection and Noise Production:

The loudest sounds are generated at intersection areas by stopping and starting the vehicles. These noise source consist of (a) Braking noise, (b) Tyre road way and brake system (primarily in deceleration) and (c) tyre road way interaction (Primarily in acceleration)

(iv) Effects of Noise:

The following are the detrimental effects of traffic noise, it creates disturbance annoyance, dissatisfaction, discomfort, interference in speech and disturbance to mental activities. Noise contribute to the development of Cardiovascular problems like heart disease and high blood pressure. Noise also affects the central nerves system of man. Noise also disturb the man from his deep sleep making him fatigure and frustrated. When depth and quality of sleep is reduced, physical and mental health is affected.

2.3.3. VISUAL POLLUTION:

(i) General:

The pulic judges the road, mostly on the basis of visual concept. But unfortunately, most of our higway imporvements have not been given due considerations for visual appearance and to the existing environmental conditions. In arterials, the motor vehicles has been competing for space for movement and appears that buildings seem to rise from a plinth of cars. Our arterials are crowded corridors, where automobiles and pedestrians are intermingled and in addition, the ugly, unplanned and uncoordinated street furniture created a visual pollution. The

following aspects contribute to the visual pollution of an arterials.

a. Traffic signs
b. Street Furnitures
c. landscaping and architecture.

(ii) Traffic Signs:

To attract the attention of motorists, numerous signs, signals and bill Boards have been displayed all along the streets, which mar the beauty of the sorrounding landscape, historical land marks and architectural works. In fact the lot of traffic signs and signals, especially at intersection not only confuses the motorists, but also provide a visual pollution. At the same time many of the signs are not necessarily contributing to the efficient flow of traffic. Also sign boards are not designed unformly to suit the environment. They are not properly maintained. The unmaintained sign boards completes the visual pollution. The lack of control of bill boards not only causes traffic hazards but also cause serious detriment to environment and general aesthetic characteristic of a neighbouhood.

(iii) Steet Furnitures:

The telephone posts, lamp posts and the connecting wires, the abanodoned telegraphic post unmaintained ugly dust pins, the unmaintained handrails, old type of post boxes, telephone cable boxes, service stations and petrol bunks which are not designed to suit the environment causes adverse visual impact in almost every city in India. The traffic signs, street signs, lettering outside and inside of buildings all show a non uniformity in form and colour in most of the cities.

(iv) Landscaping and Architecture:

Major Highway improvements have not always been designed with that impact on the total urban environment in mind, Any improvement to the existing road, should be integrated with the architecture and landscape of the area so as to achieve visual perfection.

CHAPTER 3

CHAPTER 3

INTRODUCTION TO THE CITY AND SELECTED STUDY AREA:

3.1 LOCATION:

Dehradun, the headquarters of Dehradun district, is situated in Dun Valley on the western edge of westen pargana of the district at 30 19' north latitude and 78 20' east longitude. The city is surrounded by river song on the east, river tons on the west, Himalayan ranges on the north and Sal forest in the south. Musoorie, queen of hill stations overlooks in the north. It is the largest city of the hilly region of Uttar Pradesh and is well connected by rail and road transport. It is the terminus of Northern Railway. The distance from Dehradun to Delhi, Haridwar, Saharanpur, Chakrata and Mussoorie, by road is 255 km., 57km., 61 km., 83 km., and 31 km. respectively. It is at a distance of 545 km. from the State capital, Lucknow.

3.2 Physiography:

The city is located at an altitude of 640 meters above mean sea level. The lowest altitude is 600 meters in the southern part, whereas highest altitude is 1000 meters on the northern part. The site of the city slopes gently from north to south and south west having a gradient of 1:37.5 and is heavily dissected by a number of seasonal streams and nallas which are locally known as Khalas. The drainage of the city is borne by two rivers namely Bindal and Rispana Rao. The direction of flow of streams and nallas in the eastern part in north to south and in the western part it is north to south-west. Dense patches of forests exist along the outer limits of regulated area.

3.3 Climate :

The climatic conditions of the city are nearly similar to those in the plains. In general, the climate is temperate. The year may be divided into four seasons. The period from about the middle of November to February is the cold season. The hot season which follows, continues upto about the end of June. The monsoon season is from July to about the third week of September. The following period, till the middle of November, is the post-monsoon or transition season.

a. Temperature: The maximum degree of average temperature is 36 6' C and the minimum is 5 2' C. In summers, maximum temperature is 36 6' C and minimum is 16 7' C whereas in winters it is 23 4' c and 5 2' c respectively. In summers, heat is often intense and on individual days, the maximum temperature rises to over 42 C. January is generally the coldest month and the minimum temperature sometimes falls down to about a degree below the freezing point of water. Inversion of temperature is a conspicuous phenomenon, owing to the location of the city in the velley.

b. Rainfall : The average annual rainfall of Dehardun city is 2183.5 milimeters. About 87 percent of the rainfall is through monsoon and is received during the months from June to September, July and August being the rainiest.

c. Humidity: The relative humidity is high during the monsoon season normally exceeding 70 percent on an average. The mornings are generally more humid than the afternoons. The driest part of the year is during the summer season, with the relative humidity becoming less than 45 percent.

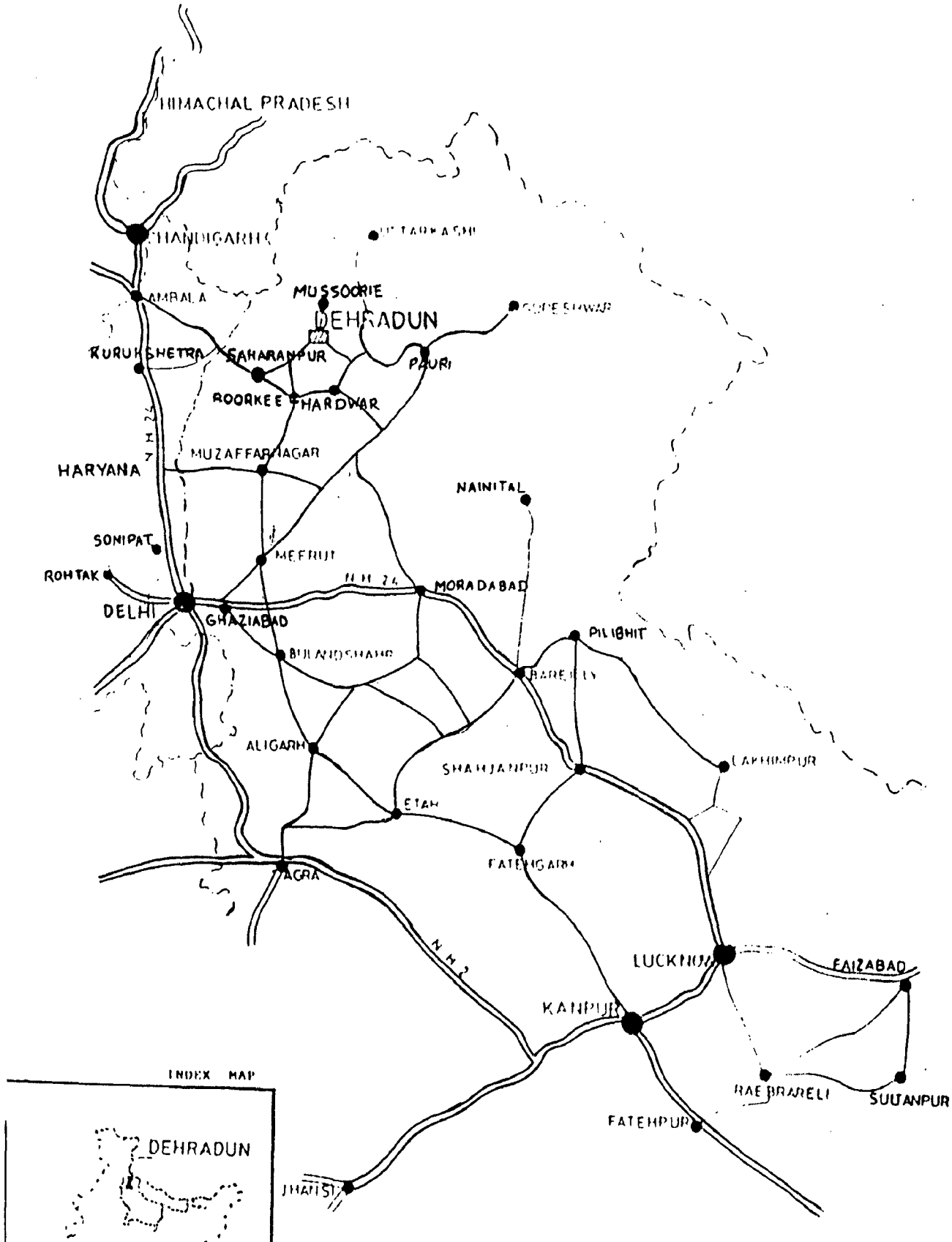


Fig.-1
REGIONAL SETTING-DEHRADUN

d. Prevailing Winds: The winds are mostly from dir between south-west and north-west throughout the year in October and November. The annual mean wind speed is 5.- kilomiters per hour. Mountain and valley winds are common throughout the year.

3.4 POPULATION SIZE AND GROWTH:

Dehradun is twelfth largest city among class- I of Uttar Pradesh according to size of population. the total population of Dehradun urban agglomeration is 2,53,628 persons and that of municipal area is 2,11,838 persons according to 1981 provisional census figures. The total population of the regulated area is 4,16,340 persons as per 1981 census. The following tables show the absolute figurs of population, increase of population and the percentage increase for each decade from 1901 to 1991 for Urban Agglomeration and the Municipal Area.

Table No. 2

YEAR	POPULATION	INCREASE OF POPULATION	PERCENTAGE INCREASE
1901	30,995	-	-
1911	42,568	+11,573	+37.34
1921	50,858	+ 8,290	+19.47
1931	43,206	- 7,652	-15.05
1941	59,535	+16,329	+37.79
1951	1,16,404	+56,869	+95.52
1961	1,26,918	+10,514	+ 9.03
1971	1,66,073	+39,155	+30.85
1981	2,11,838	+55,765	+33.58
1991	2,70,028	+59,180	+40.4

Source: Census of India

3.3 MAJOR CITY FUNCTIONS:

Cities are attached with intangible values like status, character and function. Activities of the city dwellers which emerge from the 'city function' are manufested in the physical development of the city. A harmonious integration of the function and the activity leads to a healthy and orderly development of the city. The major functions of Dehradun are described below.

a. Administrative:

Dehradun being the district headquarters and headquarters of a number of all India organisations, administration is one of its important function. It is, therefore, necessary to give due consideration to this function while preparing the Master Plan.

b. Educational and Institutional:

Besides city and regional level colleges and other technical institutes, Dehradun has institutes of national level such as Forest Research Institute, India Institute of Petorleum and Indian Photo-Interpretation Institute. These institutions occupy large spaces at different locations in Dehradun. An endeavour has to be made to integrate them with the city fabric.

c. Commercial:

Dehradun is the largest service centre within the hilly region of Uttar Pradesh. It meets the trade and commerce requirements of its region. With the establishment of national level institutes and offices and the expansion of cantonment area, the commercial activity has gained momentum. It is likely to increase more and more with the coming up of a number of large and small-scale industries and improved linkages with the surrounding areas.

d. **Industrial:**

Establishment of industries based mainly on lime stone and forests, have attaracted ancilary industrial units and other industries. Development of industries is likely to play a vital role in building a sound economic base of the city.

e. **Tourism:**

Dehradun is endowed with immense potentialities to be a place of tourist attraction besides being gateway to Mussoorie. There are a number of tourist places and recreational spots within short distance of the city, which if developed and landscaped, would be more picturesque for tourist attractions.

f. **Defence:**

Dehradun is the headquarter of Indian Military Academy. A number of other defence establishments viz. Cantonment, Clement Town, Ordinance Factory, Indo-Tibet Border Police, President's Body-Guard etc. are also located at Dehradun. The defence function has played a vital role in shaping the development of the city and it will influence the future development pattern and economy of to town too.

3.6 LAND USE PATTERN:

The quality of urban life and functional efficiency of a city is dependent on proper disposition of activities, the inter-relationship it establishes between the work centres, living areas, community facilities and recreational areas. In order to conduct a systematic analysis of the problems regarding disposition of various activities expressed as land use, analysis has been done in respect of municipal area and the regulated area.

TABLE NO. 4

PUBLIC AND SEMI-PUBLIC FACILTIES AND SERVICES

S.NO.	FACILITIES/SERVICE	NO.
1.	Education:	
	a. Primary School	105
	b. Junior High School	34
	c. High School	9
	d. Intermediate College	19
	e. Degree College	4
2.	Health:	
	a. Hospital	1
	b. Dispensary	3
	c. Maternity & Child Walfare Centre	1
	d. T.B. Clinic	1
	e. Family Planning Center	2
	f. Department Hospital	3
	g. Leprosy Hospital	1
	h. L.C.T.C. hospital	1
	i. Coronation Hospital	1
		14
3.	Recreational:	
	a. Cinema Hall	14

S.NO.	FACILITIES/SERVICE	NO.
	b. Auditorium	1
	c. Stadia/auditoria	7
	d. Public Library	5
4.	Other:	
	a. Banks	48
	b. Fire Fighting Station	2
	c. Head Post Office	1

Sourse: District Information Centre, Dehradun

The total area within municipal limits is 3108 hectares out of which 2398 hectares (77 per cent) is developed area. 655 hectares (21 per cent) is undeveloped in the form of streams, forests, agricultural land, vacant land , etc. and about 55 hectares (2 per cent) is under undefined use. The following table gives analysis of landuses within the developed area:

Table No. 3

Sl. No.	Land Use	Area in hectares	% to Total
1.	Residential	1053	43.90
2.	Commercial	81	3.38
3.	Industrial	36	1.55
4.	Public & Semi-Public	127	5.30
5.	Govt. and Semi-Govt.	293	12.27
6.	Parks, Open spaces & orchards	156	6.50
7.	Circulation	652	27.10
	Total	2398	100.00

Source: Field surveys conducted by Town and Country Planning Department, U.P.

3.7 TRAFFIC AND TRANSPORTATION:

Transportation system plays a key role in developing the socio-economic and cultural life of a city. Dehradun is well connected by rail and road network with all parts of the country. However, there is no civil airport at Dehradun. The nearest airport is Delhi which is about 255 km. from Dehradun.

TABLE NO. 5

CITY AREA CHARACTERISTICS (DEHRADUN)

S.NO.	DESCRIPTION		INDICATORS
1.	Functional Characteristics Stauts Character Rank in class -I cities		 District headquarter Services, Institutions 7th in U.P. state
2.	Urban Agglomeration area	1981 2001	3803 (Hec.) 7045 (Hec.)
3.	Population Size (lacs)	1971 1981 1991	2.03 2.94 4.26
4.	Decadal Population growth	1971-81	44.31%
5.	Sex ratio (Females/1000males	1981	852
6.	Density (persons/hec.)		88
7.	Average household size	1981	5.0
8.	Workforce participation rate	1971	29.39%
9.	Network patter		Radial
10.	Road length under Municipal Board	Metalled Non-"	132.0 km. 19.2 km.
11.	Landuse under transport	1981 2001	5.35% 5.68%
12.	Public transport		Poor
13.	Traffic pattern		Mixed
14.	Transport nagar		Proposed
15.	Resources		Minerals, forests and tourists

Source: 1. Master Plan, Dehradun.
2. Census of India.

a. **Rail Transport:**

Dehradun is the terminal of Northern Railway. The distance between Delhi and Dehradun by rail is 340 km. Dehradun - Amritsar 488 km., Dehardun - Lucknow 545 km. and Dehradun - Allahabad 783 km. During the summer season the number of rail passengers increases enormously due to the tourist visiting Mussoorie and other railgious places of Uttarakhand.

b. **Road Transport:**

Dehradun is connected by motorable roads with various places like Delhi, Rishikesh, Haridwar, Mussoorie and Chakrata, Within the city bus servies are available on six routes from Dehradun to Rajpur, Premnagar, Clement Town, Sahastradhara, Jhanjhara and Harrawala.

Under district service regular bus services are available from Dehradun to other places like Aligarh, Meerut, Mathura, Moradabad as well as to other regional centres such as Rishikesh, Haridwar, Saharanpur, chakrata and Tehri, etc.

c. **Circulation Pattern:**

The Intra-city circulation pattern of Dehradun is radial where all regional roads converge in the centre of the city. The major roads are described below.

d. **State Highways:**

Delhi - Mussoorie road and Dehradun - Rishikesh road.

Other roads:

a. Dehradun - Chakrata

b. Dehradun - Sahastradhara

c. Dehradun - Raipur

Dehradun Municipal Board mantains 132 km. of metalled road and 19.2 km. of un-metalled roads within the city. Majority of the city roads are narrow and lesser in width ranging between 6 to 8 metre. Roads in areas between E.C. Road and Rispana Rao river are comparatively wider (i.e. 8 to 10 metres) than roads of old built up areas of the city such as Khurbura, Dhamanwala, Paltan Bazar, etc.

Width of the regional roads within the town limits varies from place to place. The width of the regional roadsd are as follows:

i.	Dehradun - Saharanpur	21 to 30 metres
ii.	Dehradun-chakrata	9 to 32 metres
iii.	Dehradun-Mussoorie	25 to 33 metres
iv.	Dehradun-Haridwar	12 to 30 metres

3.8 Introduction to Selected Area:

The Study area is selected along the main road running from **Arat Bazar to Clock Tower**, generally known as **Gandhi Road.**

The Gandhi Road is very important in Dehradun as most of the commercial areas of the city have developed along the above mentioned road. The plying of heavy vehicles, truck parking, unplanned crossings and encroachments over this road have aggraviated the trafffic and transportation problems of the city.

Dehradun being a transit point and an important transportation head, the exchange of goods between the hills and the plains take palce here. This results in movement of heavy traffic through this particular road which brings many problems in its wake. Due to overall paucity of paces for vehicular

LOCATIONAL MAP OF STUDY AREA

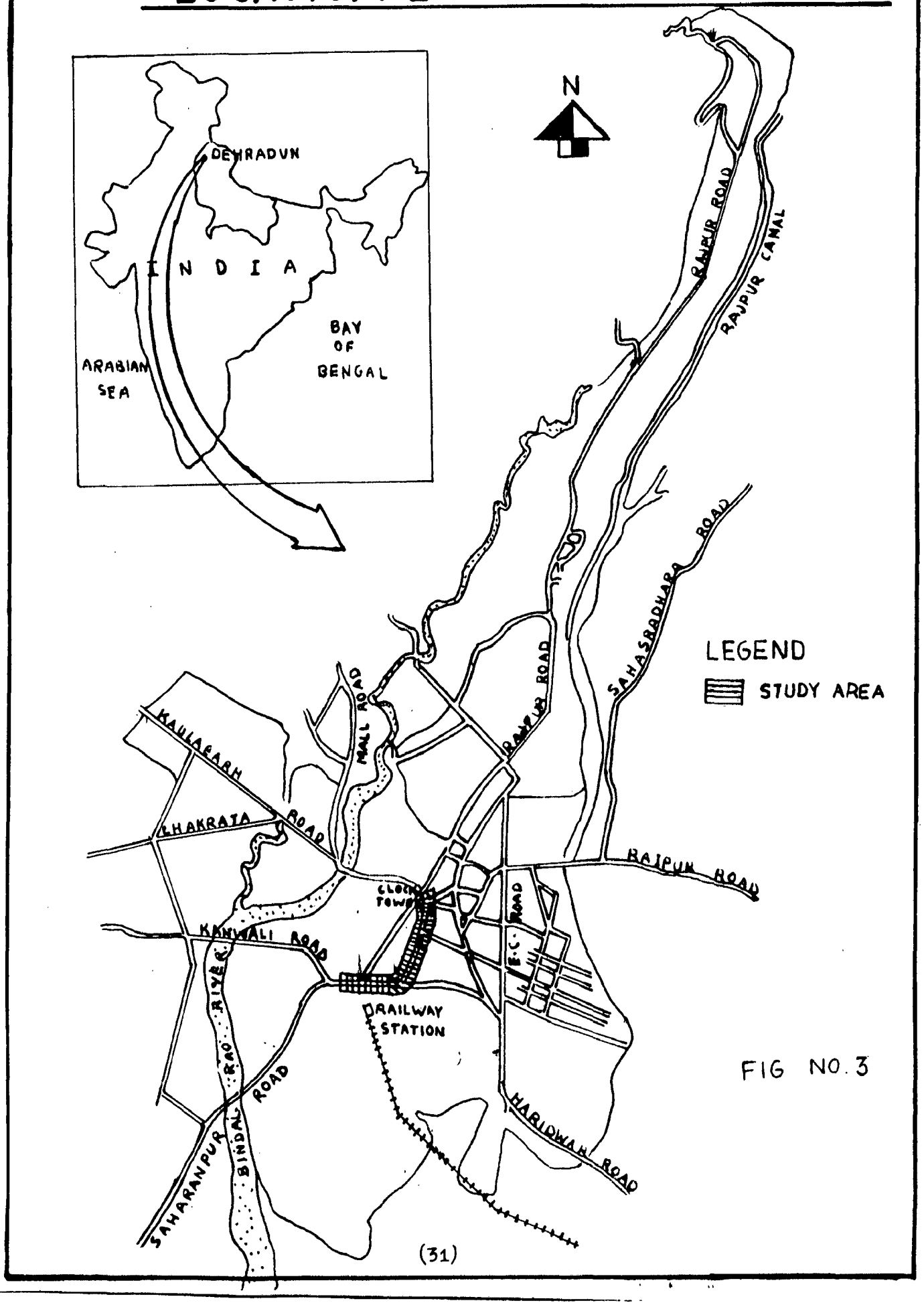
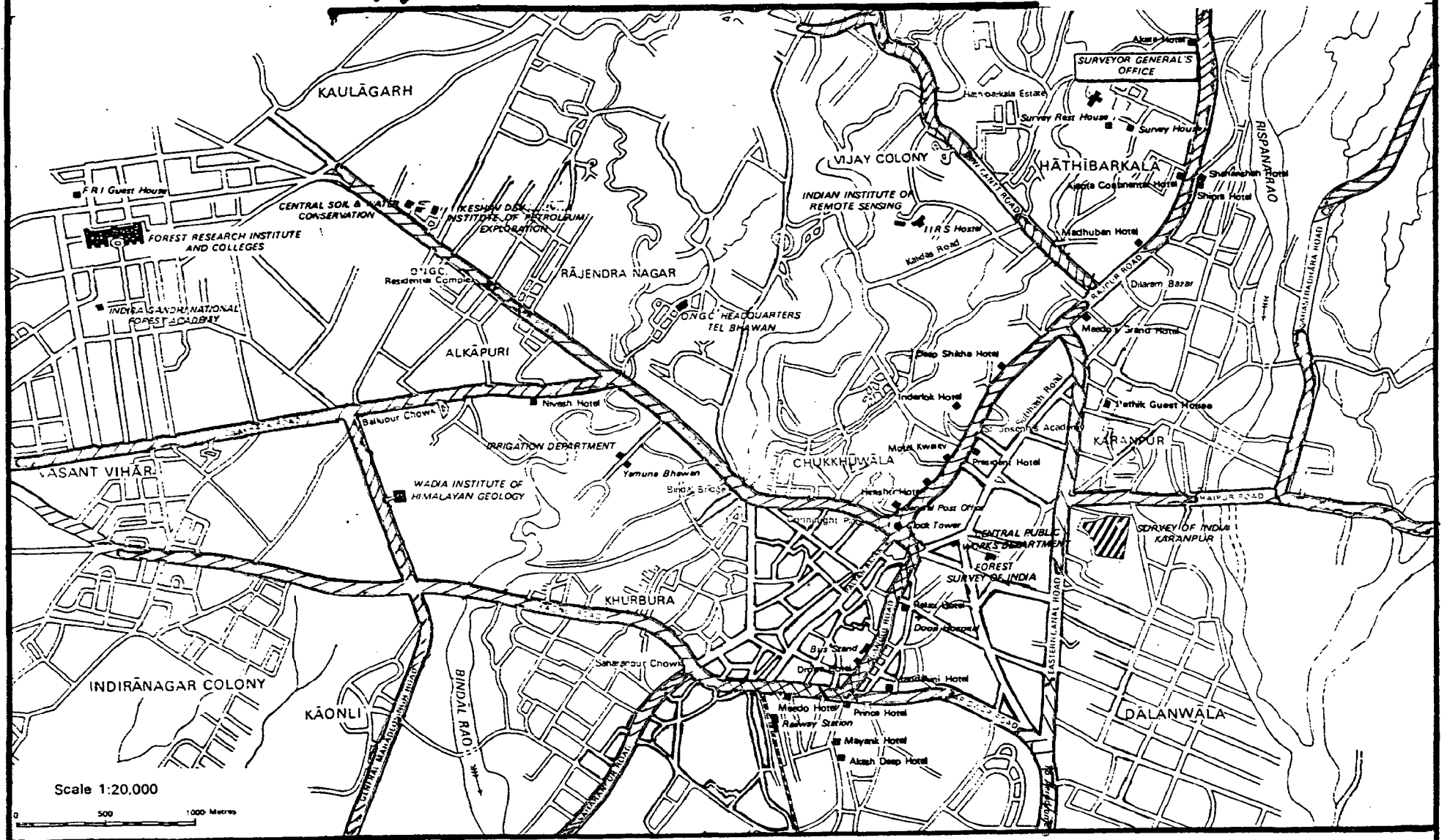


FIG NO. 3

ROAD NET-WORK



parking and taxi-stands, vehicles and taxis are parked on the road itself in front of bus-stand on Gandi Road and near Clock Tower. This creates hindrance for the vehicles moving on the road. The regional roads converged at the centre of city near clock tower leading to mixing of local and regional traffic and resulting into traffice jam at peak hours. Uttar Pradesh Roadways Bus-stand, Railway Station and city bus-stand are located in the congested areas of Gandhi road. Though the movement of trucks and lorries in the city is heavy, yet there is no proper truck stand or lorry stand on Gandhi Road.

Dehradun being a major tourist spot in Nothern India Attracts a lot of tourist through out the year. About 80% tourists coming from plain passes through this particular stretch of road. Thus for the convenience of tourists and development of tourism this road needs a special attention and study.

CHAPTER 4

CHAPTER 4

STUDY OF PHYSICAL AND TRAFFIC CHARACTERISTICS OF "GANDHI ROAD" (THE STUDY AREA)

4.1 Summary

Gandhi Road surrounds the main old urban area of the city. Infact there is a directlink road from Saharanpur Chowk to clock Tower through Paltan Bazar. But this road has been narrowed by uncontrolled aboutting landuses now totally converted into commercial. This has created many bottlenecks and ultimately abundened as shopping area and traffic has been bypassed through the Gandhi Road.

It has been noticed that the CBD area, has a fine road network system and total landuse deveted to circulation is very high (27%) but unfortunately the roads can not be used for traffic as they are drastically encroached by the commercial activities. Even some of the roads have been converted into markets and shopping areas. This has lead to the whole CBD area as mixed landuse with distinctive residential and commercial activities. Thus the area being the original central part of the city converted into commercial activities is delineated as Central Business District (CBD) for the study purpose and the corridors surrounding CBD area is Gandhi Road through which traffic is bypassed.

Gandhi Road from Saharanpur Chowk to Prince Hotel is the most critical part as it changes its alignment at many places and have many constrictions due to extension of abutting landuses. The proposed master plan R.O.W. is 45 m which has been reduced to 15 to 20 m due to encroachment. The section near Dasmesh Bhawan has been constricted to 10 m having carriageway width of 6.5 m only which causes traffic congestion problem through out the day. This section also passes through the whole sale market (Aarat Bazar) which has been using the convensional modes of transport (man carts and bullock carts) and do not fit well with the growing development of the city. Most of the loading and unloading activities are carried on the road itself thereby jamming the main traffic flow. It is also understood that there is no further scope or bypassing traffic to clock tower and therefore this road section cannot be abondened at all.

This section serves railway station in the south side near Lakhi Bagh, mussoorie bus terminal, a local private bus terminal, Hotel Meedow and two large Dharamshalas (Aggarwal and Jain). This has resulted in mushrooming of pety shops abutting the road side thereby creating traffic problems. Also there are many truck and auto repair shops due to which road is encroached by parking of trucks and buses. Consequently, it has created

many traffic hazards and traffic moves at snails speed throughout the day.

Gandhi Road from Prince Hotel to Darshan Lal Chowk is 4 lane road partially divided and has been encroached by commercial activities. It has inter city bus terminal, Hotel Darona and District Cout nearby. This has lead to cropping of many informal activities on road itself. The taxi stand in front of bus stand operating on the road causes tremendous traffic problems. There are frequent median gaps and number of accesses leading to the main alignment. This has certainly caused unsafe travel conditions.

The section from Darshan Lal chowk to clock Tower is 4 lane devided carriageway with commercial activities on the south side only. Darshan Lal Chowk and Clock Tower Junctions are quite complicated and very poorly designed leading to total chaos at times. The total traffic, local as well as through has to pass through this section over - straining the capacity of the roads and junctions.

4.2 Physical Characteristics:

4.2.1 Road Geometry:

The detail section of Gandhi Road has been shown in figure No. 5. The road is 1.925 Km long and having varying cross section at different location.

The R.O.W. of Gandhi Road ranges from 6.5 m to 18 ms. and near places like Dasmesh Bhawn in Aarat Bazar, it is just 6.5 wide.

4.2.2 Building Use:

Gandhi Road is a spinal cord of Dehradun city encircling the CBD area and linking Saharanpur Road to railway station, Haridwar Road, bus stand, Chakrata Road, Rajpur Road and Clock Tower. It passes through densely populated area and shopping areas. The road is having mix building use. From Saharanpur chowk to Railway - Station there are mainly Arati Shops that's why this section of road is called Aarat Bazar. From Railway station to Prince Hotel Chowk there are no. of Hotels, and Dharam Shalas. A lot of Auto repair shops are also there. Form Prince Hotel Crossing to Tehsil Chowk the road is having Hotels, Roadways bus stand, Taxi stand, auto repair shops, Tourism department and various Got. offices. From Tehsil Chowk to clock Tower Crossing it is higly commercialised having different kind of shops.

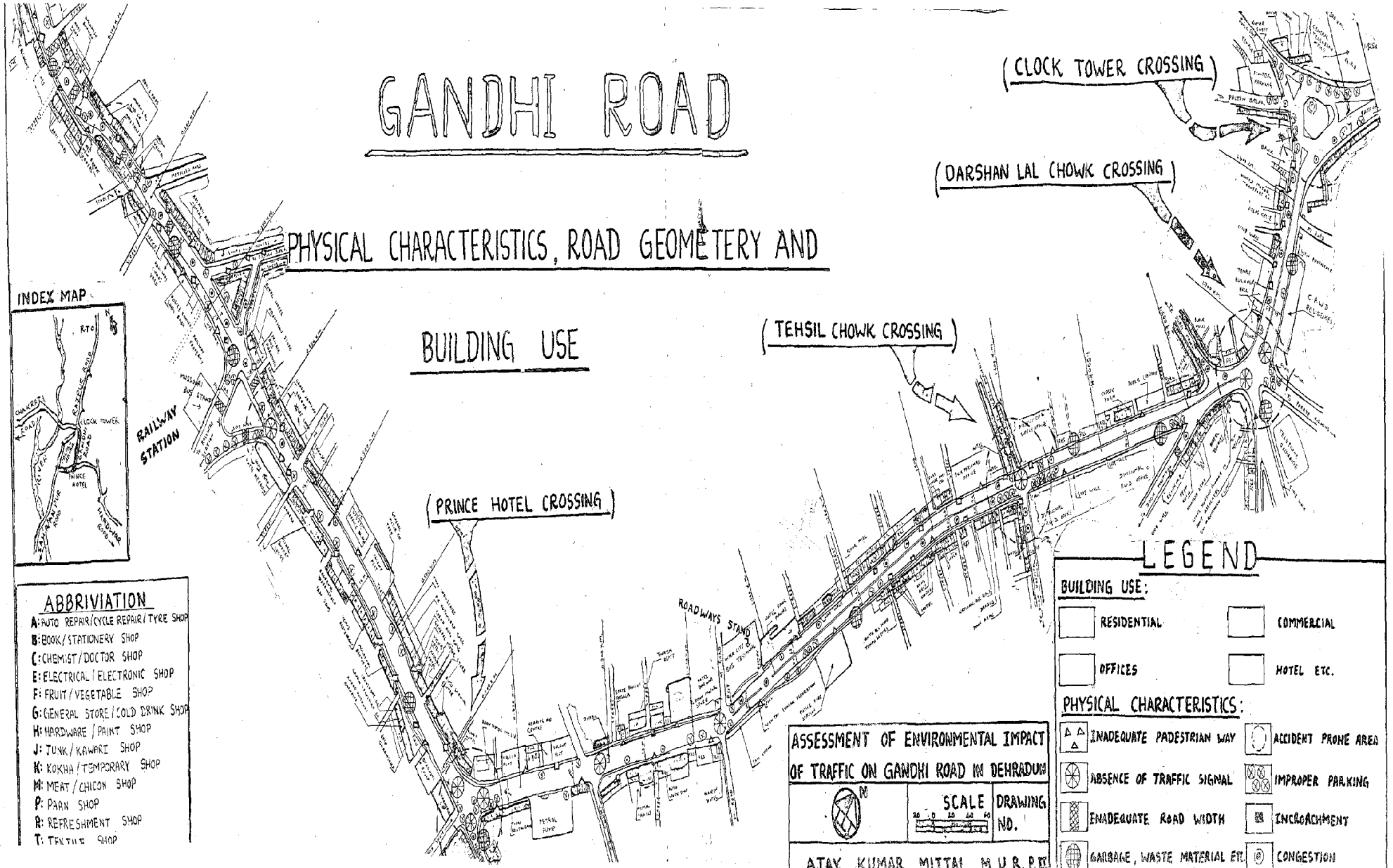
The following table No. 6 and drawing No. 5 shows clearly different type of building use on Gandhi Road.

4.2.3 General Traffic Problems:

As Gandhi Road passes through densely populated

GANDHI ROAD

PHYSICAL CHARACTERISTICS, ROAD GEOMETERY AND BUILDING USE



INDEX MAP

ABBRIVIATION

A: AUTO REPAIR/CYCLE REPAIR/TYRE SHOP
B: BOOK/STATIONERY SHOP
C: CHEMIST/DOCTOR SHOP
E: ELECTRICAL/ELECTRONIC SHOP
F: FRUIT/VEGETABLE SHOP
G: GENERAL STORE/COLD DRINK SHOP
H: HARDWARE/PAINT SHOP
J: JUNK/KAWARI SHOP
K: KOKHA/TEMPORARY SHOP
M: MEAT/CHICON SHOP
P: PAAN SHOP
R: REFRESHMENT SHOP
T: TEXTILE SHOP

LEGEND

BUILDING USE:

- RESIDENTIAL
- COMMERCIAL
- OFFICES
- HOTEL ETC.

PHYSICAL CHARACTERISTICS:

- INADEQUATE PADESTRIAN WAY
- ACCIDENT PRONE AREA
- ABSENCE OF TRAFFIC SIGNAL
- IMPROPER PARKING
- INADEQUATE ROAD WIDTH
- INCROACHMENT
- GARBAGE, WASTE MATERIAL ETC.
- CONGESTION

ASSESSMENT OF ENVIRONMENTAL IMPACT OF TRAFFIC ON GANDHI ROAD IN DEHRADUN

N

SCALE 20 0 10 20 40

DRAWING NO.

AJAY KUMAR MITTAL M.U.R.P.IV

TABLE NO 6

DETAILS OF SHOPPING FACILITIES ON GANDHI ROAD

S.NO.	TYPE OF SHOP	PUCCA SHOP	KUTCHA SHOP	MOBILE SHOP	TOTAL
	A) GOODS				
1.	Paan Shops	5	10	-	15
2.	Teastall/Restaurant/Dhaba	25	15	5	45
3.	Others				
4.	Vegetable & Fruit	5	3	15	23
5.	General/Provision store	8	-	-	8
6.	Whole sale arti shop	30	10	-	40
7.	Stationery shop	3	-	-	3
8.	Confectionery/Bakery	4	-	-	4
9.	Vacant	-	-	-	-
10.	Cloth Merchant	3	1	-	4
11.	Electrical/Electronics Store	4	-	-	4
12.	Ready made Garment	5	-	-	5
13.	Meat shop	2	1	-	3
14.	Arm House	5	-	-	5
15.	Photo studio	3	-	-	3
16.	Foot wear store	2	-	-	2
17.	Opticals	1	-	-	1
	B. SERVICES:				
18.	Cycle Repair shop	1	5	10	16

S.NO.	TYPE OF SHOP	PUCCA SHOP	KUTCHA SHOP	MOBILE SHOP	TOTAL
19.	Auto Repair/Auto part shop	15	7	-	22
20.	Barber shop	3	5	-	8
21.	M.C./Scooter repair	10	4	-	14
22.	Washerman/Ironing	-	-	-	-
23.	Tailoring	3	-	-	3
24.	Dry Cleaners	2	-	-	2
25.	Floor Mills	-	-	-	-
26.	Shoe Repairer	-	-	8	8
27.	Stove Repairer	-	5	-	5
	TOTAL	139	66	38	243

Source : Field Survey.

areas and shopping areas, the road users faces various traffic problems which can be summerised as follows.

1. Inadequate padestrian Path.
2. Mental Egony, Journey Delay & Great Inconvenience.
3. Improper Parking
4. Encroachment due to road side parking
5. Congestion due to mobils shops etc.
6. Absence of traffic signal at different Junctions and crossing.
7. Inadequate Road width.
8. Garbage waste material causing pollution etc.
9. Traffic Jam.
10. Encroachment by Arati Shops in Arat Bazar.

The different location on Gandhi Road affected from all these above problems have been shown in the figure No. 5.

In general it is observed that the whole section of Gandhi Road except near Clock Tower is lacking from adequate Pedestrian Path, proper parking facilities and adequate road width. That is why the problem of Traffic Jam, congestion, encroachment, mental egony and delay occurs frequently. The no. of private vehicles are increasing day by day which is also one of the most important reason of all these problems. (Table No.7)

TABLE NO. 7(i)

NUMBER OF MOTOR VEHICLES REGISTERED IN DEHRADOON (1992)

YEAR	2-WHEELERS	3-WHEELERS	CARS+JEEP	BUSES	TRUCKS	OTHERS	TOTAL
1986	27064	990	5040	530	1390	1321	36335
1987	30117	1090	5804	548	1521	1350	40430
1988	41549	1190	7656	548	1760	1600	54303
1989	46147	112	7793	553	2284	1889	59788
1990	50605	1137	8138	556	2398	1887	64721
1991	54042	1152	8557	607	2717	1920	68995

Source: R.T.O. Office, Dehradun.

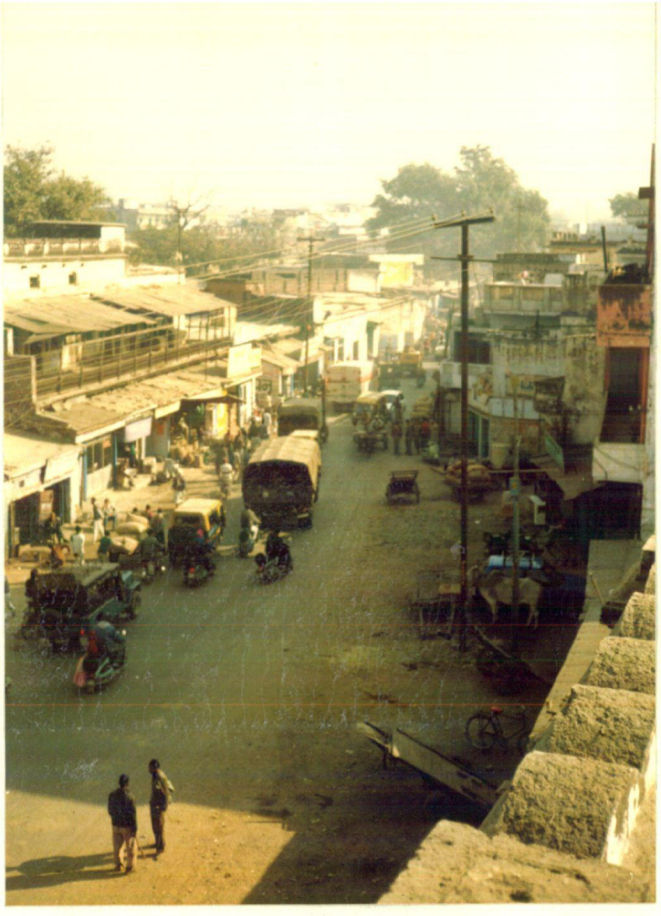
TABLE NO. 7 (ii)

FREQUENCY OF BUSES ON DIFFERENT ROADS IN DEHRADUN

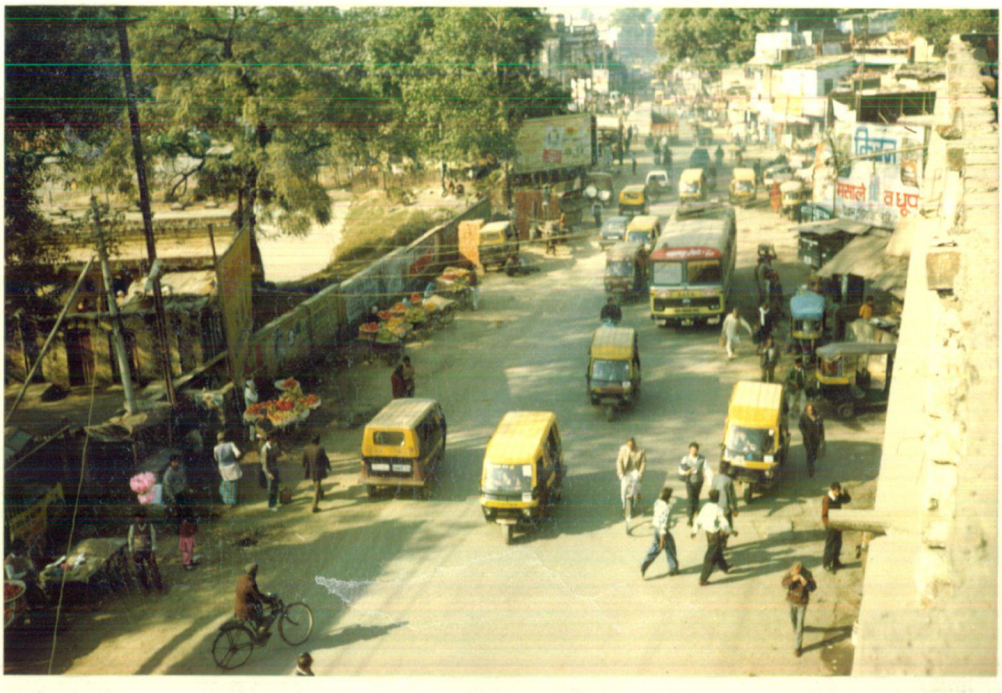
S.NO.	NAME OF THE ROAD	FREQUENCY OF BUSES PER DAY	PERCENTAGE TO THE TOTAL
1.	Dehradun-Saharanpur Road	99	34.25
2.	Dehradun-Haridwar Road	52	17.90
3.	Dehradun-Rishikesh Road	61	21.10
4.	Dehradun-Mussoorie Road	33	11.40
5.	Dehradun-Chakrata Road	44	15.30

Sourse: U.P.S.R.T.C. Office, Dehradun

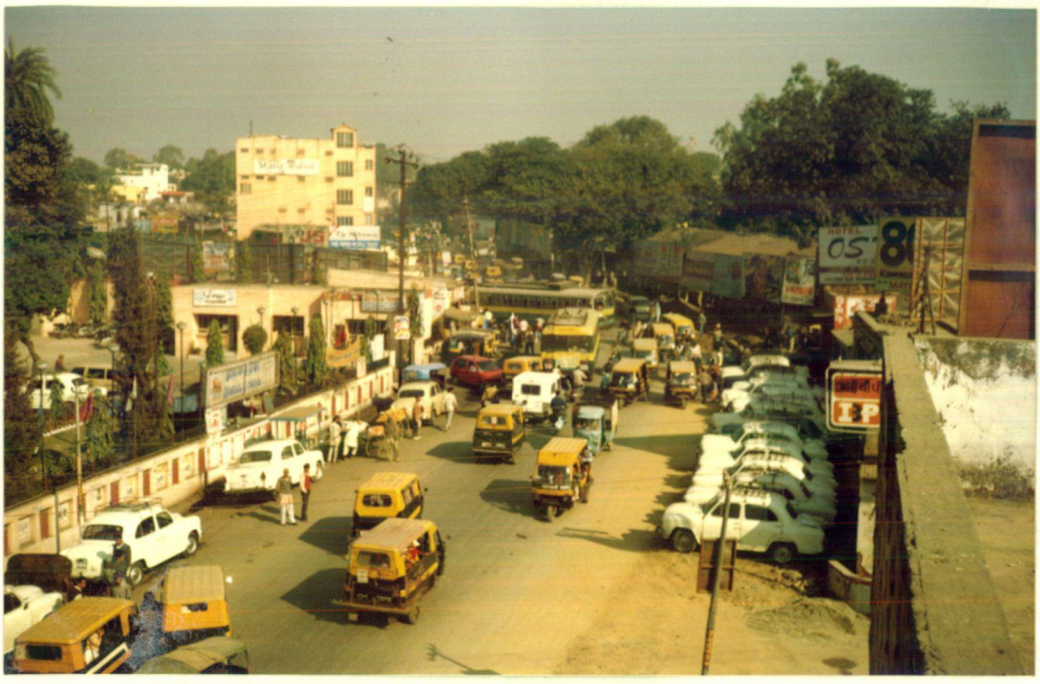
Encroachment by 'Arti Shops': Arat Bazar



Inadequate Pedestrian Path : ARAT BAZAR



Inadequate Pedestrian path : Opposite lakhibag Police Station



Encroachment due to Road Side Parking : Opposite to Roadways Bus-Stand

Encroachment due to Road Side Parking : Infront of P.W.D. Office

Encroachment due to Road Side Parking : Near Tehsil Chowk

Improper Parking: Prince Hotel Crossing

Congestion Due to Mobile Shops: Opposite to Mussoorie Bus-Stand

Absence of Traffic Signal at Crossing: Tehsil Chowk Crossing

Inadequate Road Width: Infront of Lakhibag Police Station

Inadequate Road Width: Infornt of Bus Stand

Inadequate Road Width: Darshan Lal Chowk Crossing

Garbage Waste material Dumping: Tnfront of Lakhibag Police Station

Traffic Jam Condition: Prince Hotel Crossing

4.3 Traffic Characteristics:

4.3.1 Traffic Volume:

The collected data from secondary sources have been compiled, collated and analysed. The analysis of traffic volume is recorded on hourly variation sheets which have been further accumulated to obtain the average daily traffic volume for each direction. The average daily traffic volume is further converted to passenger car Urite (PCU). The peak hour traffic volume has also been arrived. The analysis of traffic volume survey is presented in tabular form under following sub heading.

4.3.1.1 Average daily Traffic Volume:

The analysis of traffic volume has reflected that average daily traffic volume is around 35,000 PCUS on Gandhi Road and around 40000 PCUs on approaches of Clock Tower Junction. The trafic volume in the CBD area ranges from 33,000 to 43, 000 PCUs. The data regarding average daily traffic volume have been collected from Mussoorie Dehradun Development authority and are prsented in tabular form in Appendix III.

4.3.1.2 Traffic Composition:

The composition of traffic volume of fast and slow vehicles is presented in Appendix III. In general it

TABLE NO. 8

TOURIST STATISTICS FOR MUSSOORIE

YEAR	NO. OF TOURIST	
1958	1,15,065	
1959	1,85,806	
1960	2,07,770	
1961	2,18,833	
1962	2,23,512	
1963	2,26,947	
1964	2,49,711	
1965	2,84,282	
1966	3,06,185	
1967	2,95,220	
1968	3,43,463	
1969	3,78,007	
1970	3,55,737	
1971	2,75,677	
1972	4,37,683	
1973	4,38,183	
1974	5,07,965	
1975	4,62,003	
1976	5,13,638	
1977	5,16,561	
1978	5,67,377	
1979	6,08,739	
1980	6,58,808	
1981	7,17,135	
1982	7,70,753	
1983	8,27,319	
1984	8,71,835	
1985	9,46,117	
1986	10,52,054	
1987	11,35,414	
1988	12,25,344	
1989	15,17,930	
1990	13,97,000	
1991	16,00,000	(Approximate)
1992	17,50,000	(Approximate)

Source: Tourism Department Dehradun

ranges from 60 to 63% as fast vehicle because of high number of fast vehicle operation on Gandhi Road. Man carts, bullock carts auto rickshow Vikram etc. comprises of slow vehicle. It is also noticed that city does not have cycle rickshows due to the terrain conditions but bullock carts and man carts are large in number (13- 16%) due to operation of whole sale markets.

4.3.1.3 Peak Hour Traffic Volume:

The analysis has indicated that there is not much variation in traffic volume from 8 AM to 7 PM. Traffic starts to building up at 7 AM. and Continues upto 7 PM. The peak hours of traffic are normally 9 AM to 10 AM and 5 PM - 6 PM as at this time the people working in offices returns to their home. The data regarding Peak hour volume collected from M.D.D.A. has been shown in appendix 2.

4.3.2. Journey Speed and Delay Studies:

The Gandhi Road is having so many traffic problems, bottlenecks etc, that most of the time there is traffic Jam condition. The people going to Musoorie for tourism purpse suffer a lot of delay.

Speed and delay analysis ha been presented in a tabular form after collecting data from M.D.D.A. in table No. 9.

SPEED AND DELAY ANALYSIS

TABLE 9.

NAME OF ROAD ,GANDHI.ROAD.....

SECTION	DIRECTION	DISTANCE (m)	JOURNEY SPEED (KPH)	RUNNING SPEED (KPH)	DELAYS TIME(Secs)	DELAYS CAUSE
SAHARANPUR CHOWK TO PRINCE HOTEL CROSSING	UP	857.8	9.191	11.431	65.83	Congestion
	DN		11.902	12.332	9.00	,,
	AVG.		**10.546**	**11.882**	37.42	
PRINCE HOTEL CROSSING TO CLOCK TOWER	UP	1118.5	15.496	16.182	11.00	Bus Stand
	DN		13.177	16.047	54.66	,,
	AVG.		**14.336**	**16.114**	32.83	
	UP					
	DN					
	AVG.					
	UP					
	DN					
	AVG.					
	UP					
	DN					
	AVG.					
WEIGHTED AVERAGE			12.691	14.277	34.82	

UP : Saharanpur Chowk to Clock Tower
DN : Clock Tower to Saharanpur Chowk

SOURCE : Traffic surveys, BY M.D.D.A.

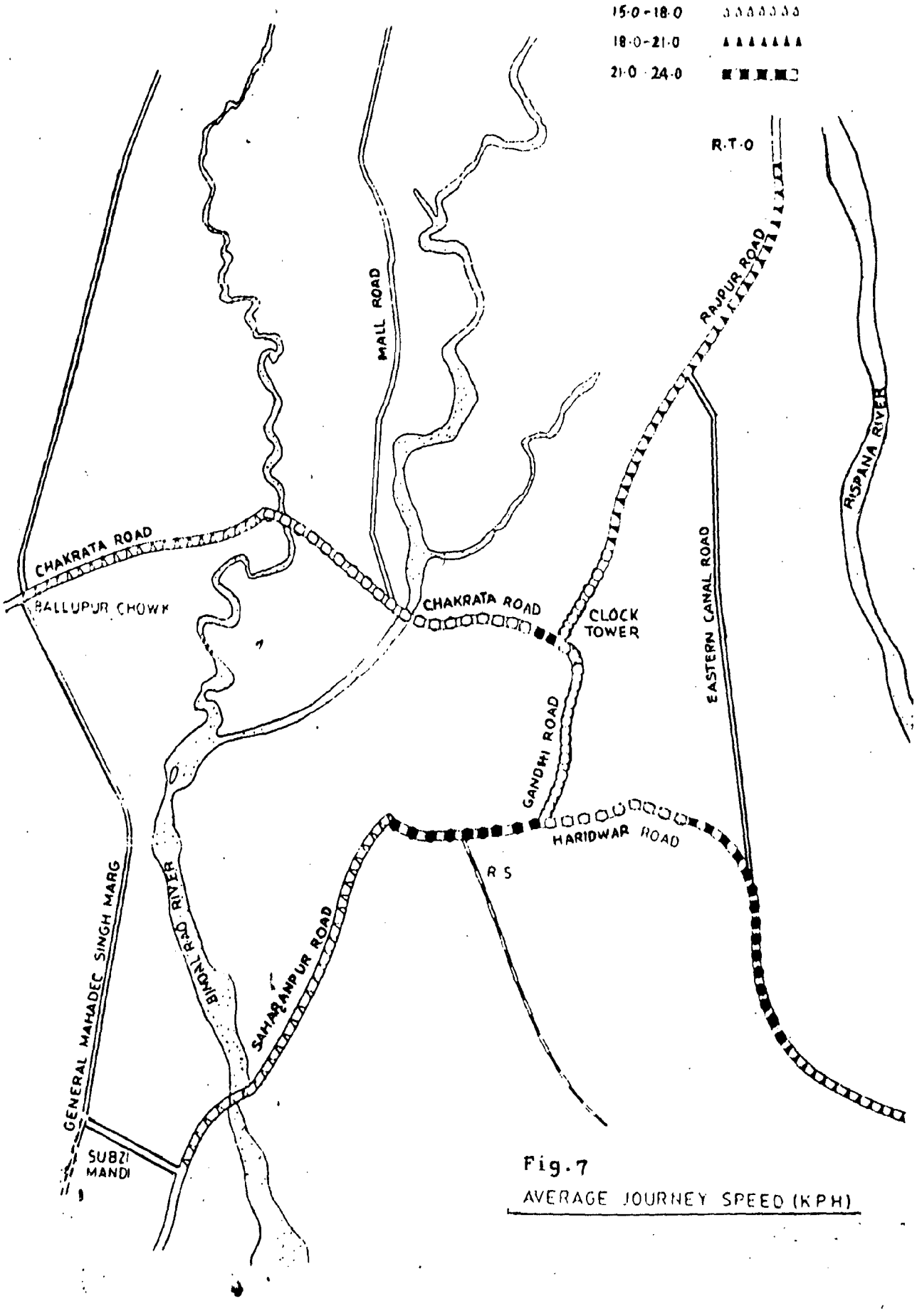


Fig.7
AVERAGE JOURNEY SPEED (KPH)

4.3.3 Parking Studies:

Parking plays a very predominent role in making the transportation system very efficient and problem free. But on Gandhi Road after survey it is found that there is no provision of parking facilities. Any vehicle can stop any where, and this create the condition of traffic Jam frequently. There are no stands etc. for vikram due to which these vikram generally park on crossing like Prince Hotel crossing and Tehsil Crossing, which create congestion and traffic problems. Like wise in Aarat Bazar heavy vehicle like truck etc. stand any where which makes the road very congested and nerrow which is already having a very acute and inadequate cross section in Aarat Bazar. The photographse clearly tells about inadequate parking on Gandhi Road.

4.3.4 Pedestrian Behaviour:

The pedestrian and road users plays the key role in making road full efficient. As the Gandhi Road is lacking proper pedestrian path through out its section the pedestrian use the road on their will. They do not follow traffic rule. The padestrian path is encroached by Kokhas and mobile shops due to which they are forced to use the carriage way of the Road. Due to lack of local Bus stops people force the vikram and local Buses to stop

any where they want which creates the traffic Jam frequently in crowdy area of Gandhi Road. The photographic studies clearly tells about padestrian behavier and inadequate padestrian path through out the road.

4.4 The Push and Pull forces Creating Traffic Movement on Gandhi Road

The Gandhi Road is a spinal cord of Dehradun city encircling the CBD area and linking various institution to residential areas. There are various Push and Pull forces which force people to come and Go out of Gandhi Road. People cross this road for various purpose which can be summerised as follows:

Work:

Approximately 40% of road users of Gandhi Road are employee which go to various offices. Almost all the offices are situated in north and north west side of Dehradun while the residential areas are situdated in south, south - west and south - east direction i.e. on the other side of the road. This large distance between work and place force the employee to cross this Gandhi Road in morning and evening.

Education:

The Girls degree college is situated near Tehsil crossing

like wise other degree college and various educational institution are situated near by Gandhi Road. Thus the students living in Dalan wala, Indira Colony, Dhamawala, Subash Nagar and Saharanpur road use to come on Gandhi road which makes the increase of vikram and local taraffic.

Shopping and Personal Business:

Gandhi Road incercles the main CBD of Dehradun. The retail and whole sale market is situated in Paltan Bazar. There are lacking of sub CBD areas in other parts of city that is why people living far away from Gandhi Road use to come to paltan Bazar and Aarat Bazar for their shopping and personal Business activities.

Social and Entertainment:

The Gandhi Park, Parade Ground, Paltan Bazar, Cinema Talkies on chakrata road near clock Tower etc. are some sources of social and entertainment purpose of visit to Gandhi Road.

Journey to Outside the City:

The main road ways Bus stand and Railway station are situated on this road. Dehradun is Gateway to hilly area of Uttar Paradesh and Mussoorie Bus stand from where Busses go to hilly area is also there on Gandhi Road near Railway station. Thus the people who want to go out side

the city use to come on this road.

Tourism:

Approximate 20% of road users of Gandhi Road are Tourist which go to Mussoorie and other hilly station for tourism purpose. Thus this through traffic also passes through this road.

Other purpose:

There are also various other purpose for which people move on this road, for example:

(i) People going to court and municipility Board for their cases and problem use to cross this road as the district court and municiple Board are situated on this road.

(ii) People coming to Doon Hospital for medical facilities have to corss this road.

(iii) People going to main post office, P.W.D. office, Banks and Jila Parishad office use to cross the Gandhi Road.

(iv) People going to Railway station or Bus stand to see off or recieve their guests use this road.

CHAPTER 5

CHAPTER 5

ASSESSMENT OF ENVIRONMENTAL IMPACT OF TRAFFIC

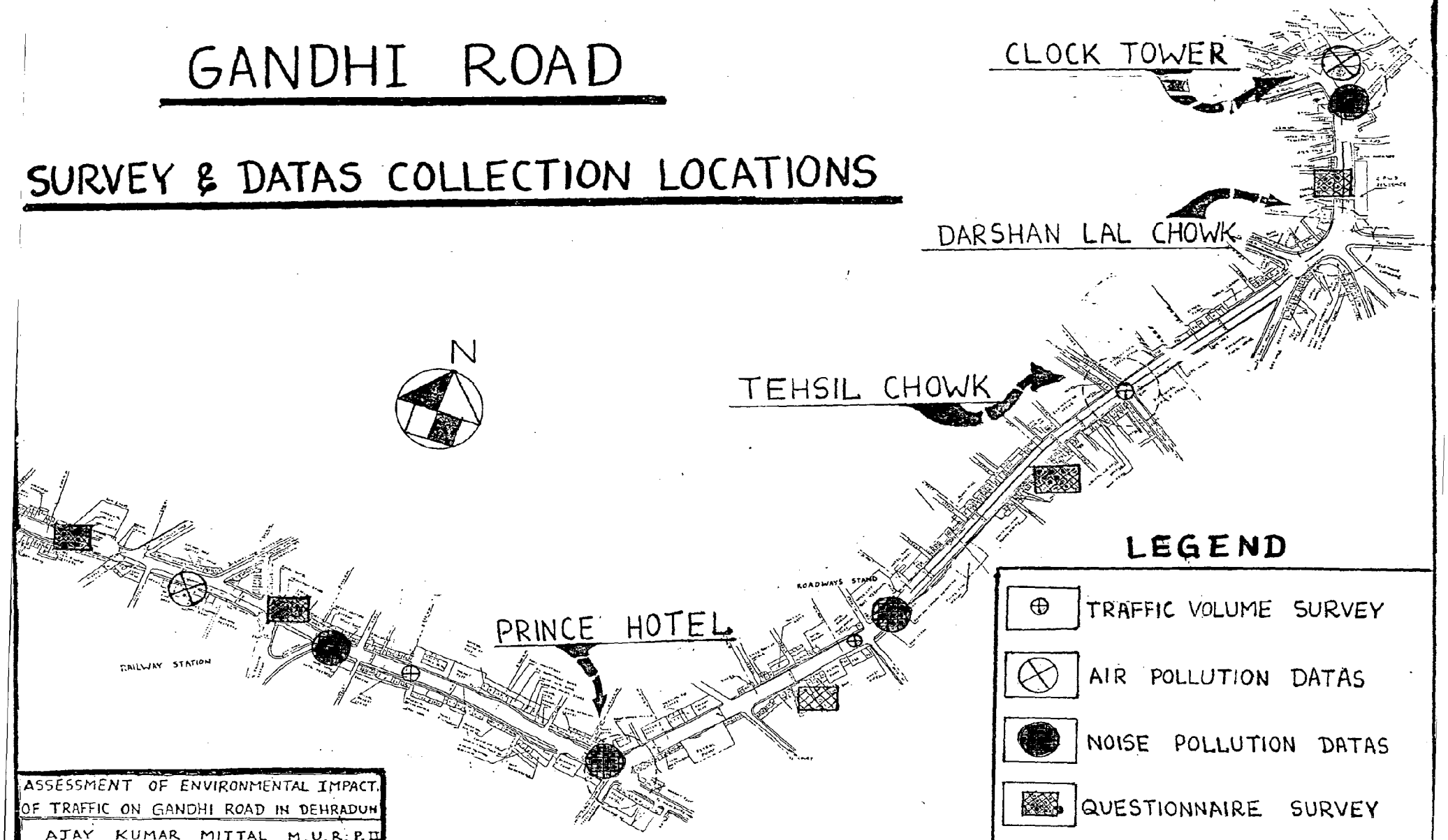
5.1 Analysis of Air Pollution:

The Urban environment is highly integrated system of both natural and man made environment in various mixes. The rapid development of transport activities have resulted in multi dimentional environmental problems. The combustion of fuel by vehicles have been continuously degrading the quality of Urban environment.

The petrol vehicles emit carbon monoxide, unburnt hydro carbons, nitrogen oxides and lead particles. The diesal vehicles emit smoke and nitrogen oxide. These pollutant produce photochemical smog in the city, causing harm to human and vegetation. So is known to cause respirtory problems, irritation in the eyes, asthma, breathlessness etc. Like wise SPM (suspended particulate) matter including dust is equally harmful. These are small particles that absorb, reflect and scatter sunlight, thus obscuring visibility. These SPM are produced mainly due to combusion of fuil from vehicle and very toxic in nature for human health, carbon monoxide produced due to traffic movement may lead to heart and lung weakness. The effect of air pollution are generally

GANDHI ROAD

SURVEY & DATAS COLLECTION LOCATIONS



ASSESSMENT OF ENVIRONMENTAL IMPACT OF TRAFFIC ON GANDHI ROAD IN DEHRADUN

AJAY KUMAR MITTAL M.U.R.P.II

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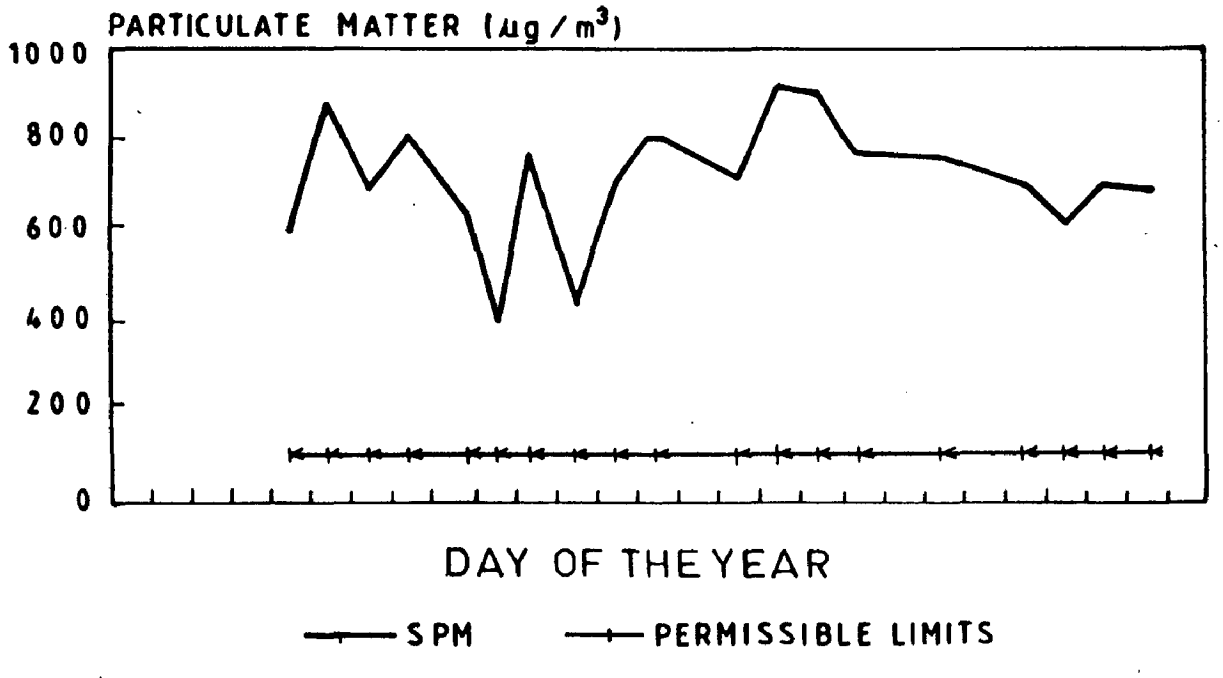
long term and show up only after several years when it becomes difficult to pin point exact cause of the diseases because of so many other factors.

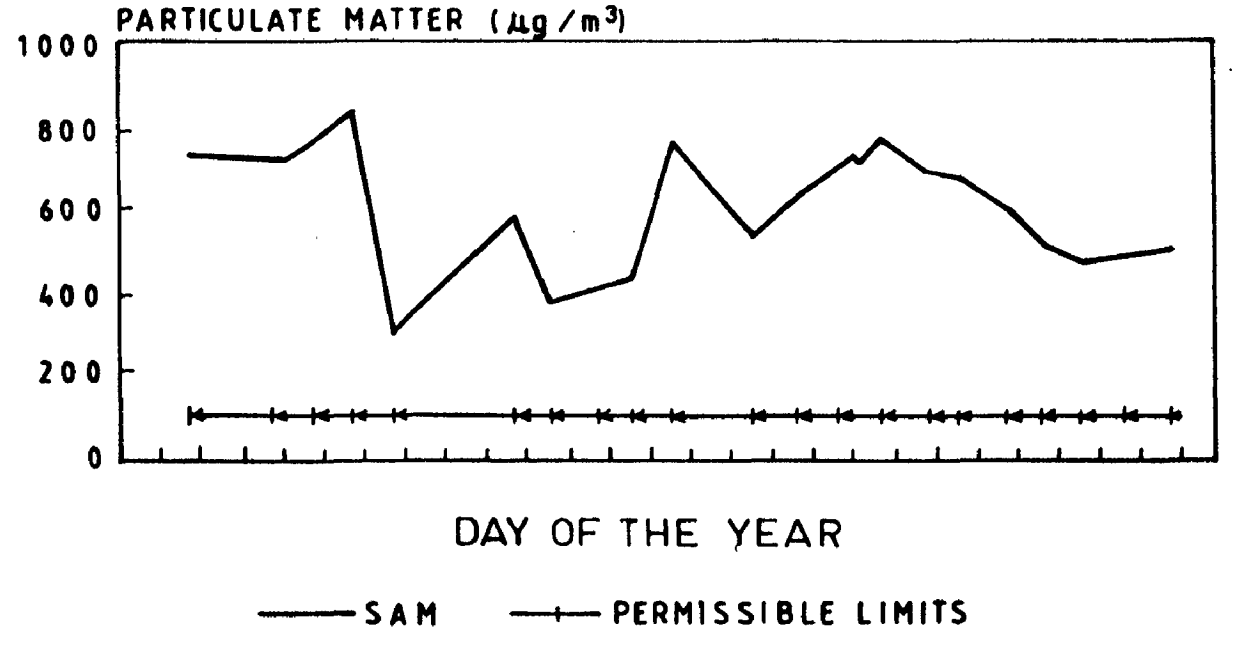
A non Government organisation named people Science Institute is engaged in collecting and analysing the air pollution data in Dehradun. The air pollution data are collected with the help of very sophisticated instrument at clock tower and Lakhibag police Chowky on Gandhi Road as these location are most airly polluted. The data collected from P.S.I. are compiled and presented in Graphical form which clearly shows that the suspended paticulatc matters are much more then permissible limit on Gandhi Road. As earlier stated SPM is responsible for creating irritation in breathing, respirotory discases, asthama and lungs and hearts problems. This is the reason why the people living in this area are very much affected with all these diseases.

A study was conducted by Indian Institute of Petrolium (I.I.P.) to measure the emission from Petrol and Diesal Vehicles. The over all mode wise emission in gms/km/veh. is given in table 10.

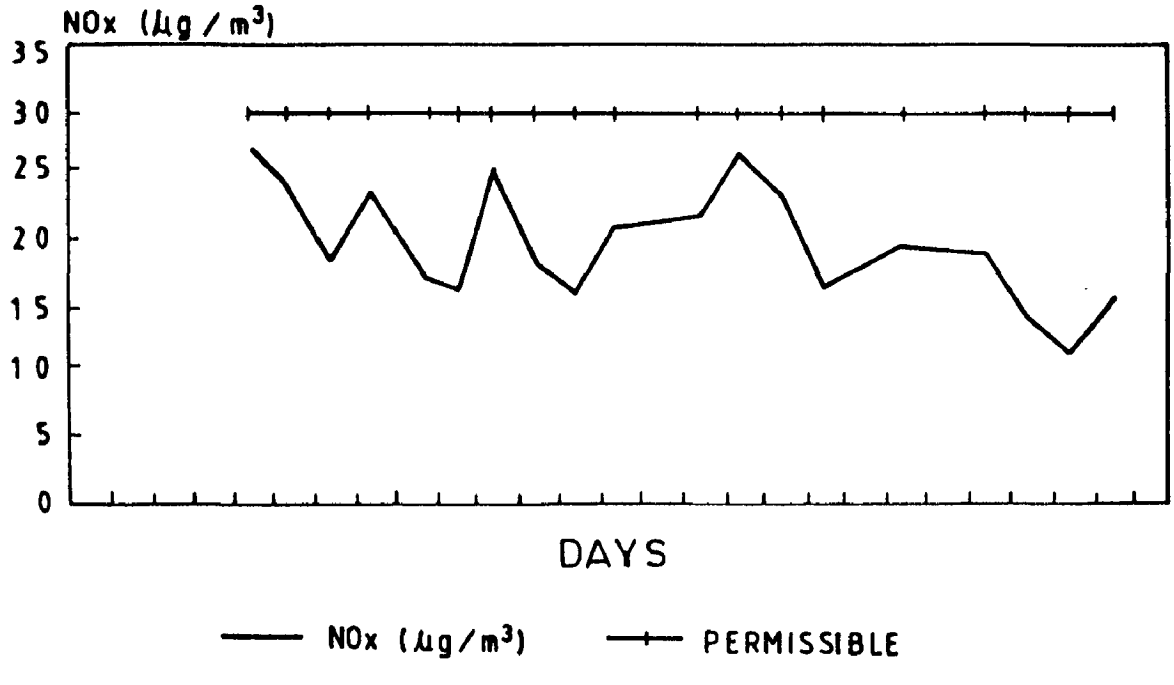
SPM VS DAY
LAKHIBAGH P.S.



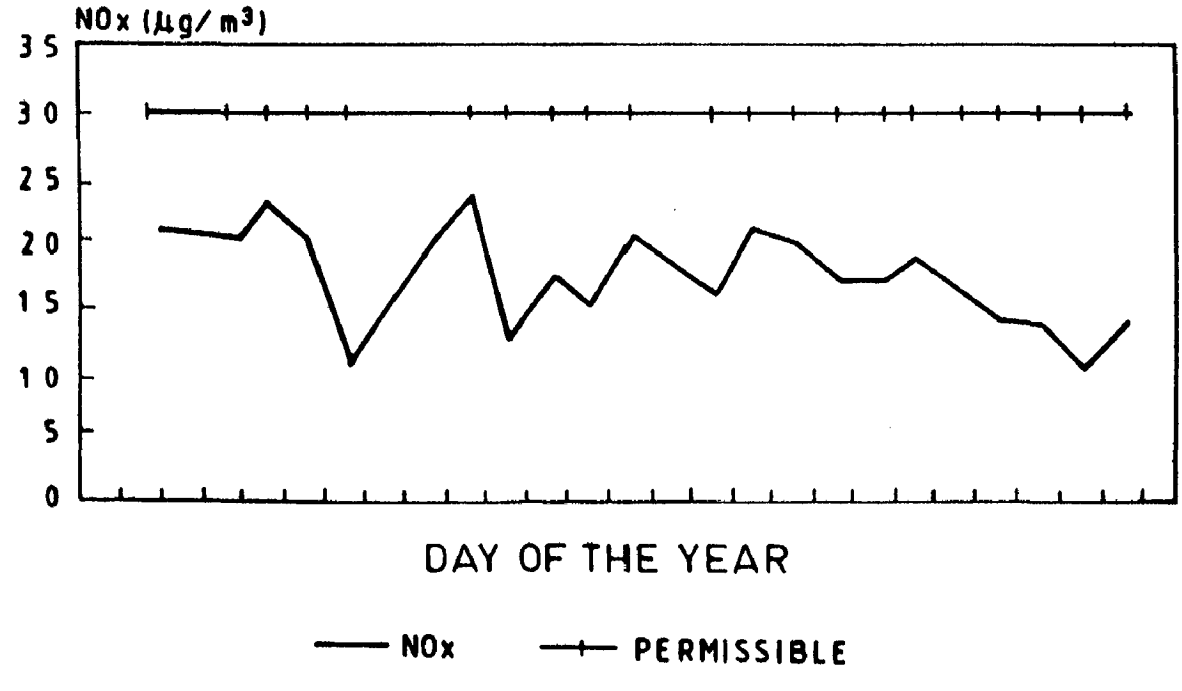
SPM VS DAY
CLOCK TOWER



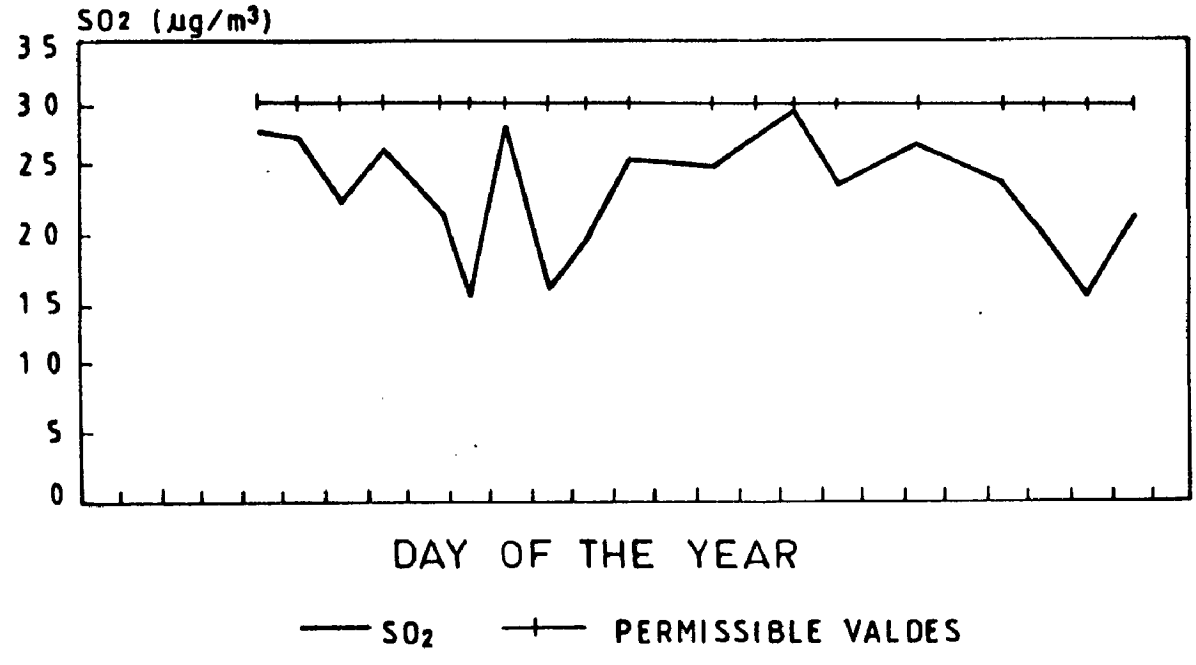
NOx VS DAY
LAKHIBAGH



NOx VS DAY
CLOCK TOWER



SO2 VS DAY
LAKHIBAGH P. S.



SO2 VS DAY
CLOCK TOWER

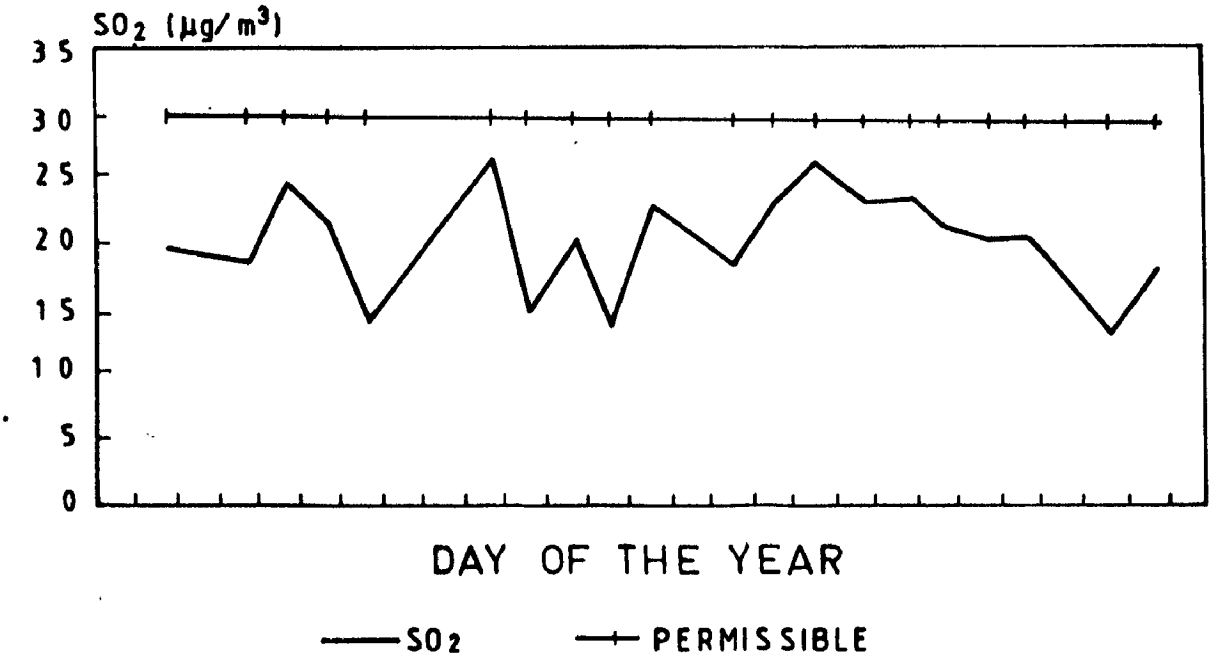


TABLE NO. 10

Travel Mode	Pollution Emission gms/km/veh.
Two Wheeler	13.48
Auto Rickshaw	26.96
Car	29.17
Bus	87.20

An attempt has been made to analyse the environmental factors under various conditions indicating the total quantity of pollutants emitted by various transport modes.

The number of vehicles in different travel modes on Gandhi Road Per day have been estimated . The number of vehicles has been multiplied to distance covenred in order to get vehicle utilisation level. Then total vehicle kilometers is multiplied with the emission rate and total emission of pollutants on Gandhi Road have beenn estimated. (Table No. 11)

It is found that on Gandhi Road the total emission of pollution is approx.1.38 tonn every day. Three whelers and two wheelers are emitting the highest amount of emission in the city due to their large number and continuous movement through out the day on Gandhi Road.

TABLE NO. 11

IMPACT OF TRAFFIC ON ENVIRONMENT

Type of Mode	Emission rate Gm/km/veh.	Vehicle	Gandhi Rd. Length (Km)	Vehicle*km	Emission (Tons)
Bus	87.20	1315	1.9	2498.5	0.218
Truck	87.20	1801	1.9	3421.9	0.29
Car	29.17	3820	1.9	7258	0.212
Van	29.17	332	1.9	630	0.018
3-Wheeler	26.96	6424	1.9	12205.6	0.33
2-Wheeler	13.48	12182	1.9	23145	0.312
Total					1.38

Note: 1. Traval modes are Average daily Traffic Volume on Gandhi Road, surveyed by M.D.D.A.

2. Emission rate is taken from I.I.P., Dehradun.

for example there are around 50 vikrams which run on Gandhi Road from clock Tower to subash Nagar,out of these 50 vikrams. Each vikram generally makes 30 trips on Gandhi road from morning till evening. Thus there are around 1500 trips of vikram only on Gandhi road in a singly day.

This indicates that the present transport scenario is very hazardous for the city and resideots. This necessitates to improve the travel conditions by providing a balanced and suitable transport system.

5.2 Analysis of Noise Pollution:

Noise pollution is a silent killer and a growing menace on the Gandhi Road. It is said that prolonged exposure to noise may even lead to permanent hearing loss. The other health hazards of noise are headache, nervous tension and high blood pressure. In extreme cases, it also leads to death. Noise is not only unwanted intruder but also distrubs the level of back ground stimulation necessary for efficient functioning. It may cause a psychological harm to a human. A noise may interfere the task by having irritability, anxiety, speech - communication interruption, frustration fatiguoe, annoyance and mental stress.

The sound level has benn measured with the help of pocket noise level meter. This noise level meter is very easy to operate and to carry as it can be put in the pocket easily. The different sites where the sound level data are recorded are shown in the drawing No.9.

Noise is commonly measured as pressure, which is the ratio (multiplied by 20) between particular noise pressure and a standard low pressure which represents the approximate limit of human audibility (0.0002 dyne / cm^2). This measure is called sound pressure level and usually measured in decibal i.e. dB. This pocket noise level meter measure the sound level direct in decibals. The data recorded at different sites are presented in Table No.12.

The Bureau of Indian Standards has recommended the acceptable noise level under different situation. The acceptable noise level are given in Appendix No.IV. After analysing the collected data it is evedent that on Gandhi Road the sound level is more then acceptable limit. The site near Lakhibag police chowky is most polluted from noise pollution. The sound level at this site preveils with in 85 to 95 dB through out the day which is much higher then permissible limit. The reason of such a high sound level is Traffic Jam which frequently occur at this location and the different vehicle blow horns

TABLE NO. 12

MEASUREMENT OF NOISE LEVEL ON GANDHI ROAD

S.NO.	LOCATION	NOISE LEVEL IN dB
1.	Lakhi Bag Police Chowky	84.2 - 96.1
2.	Prince Hotel Crossing	78.4 - 86.3
3.	Road way Bus stand	79.2 - 88.7
4.	Clock Tower	83.4 - 92.5

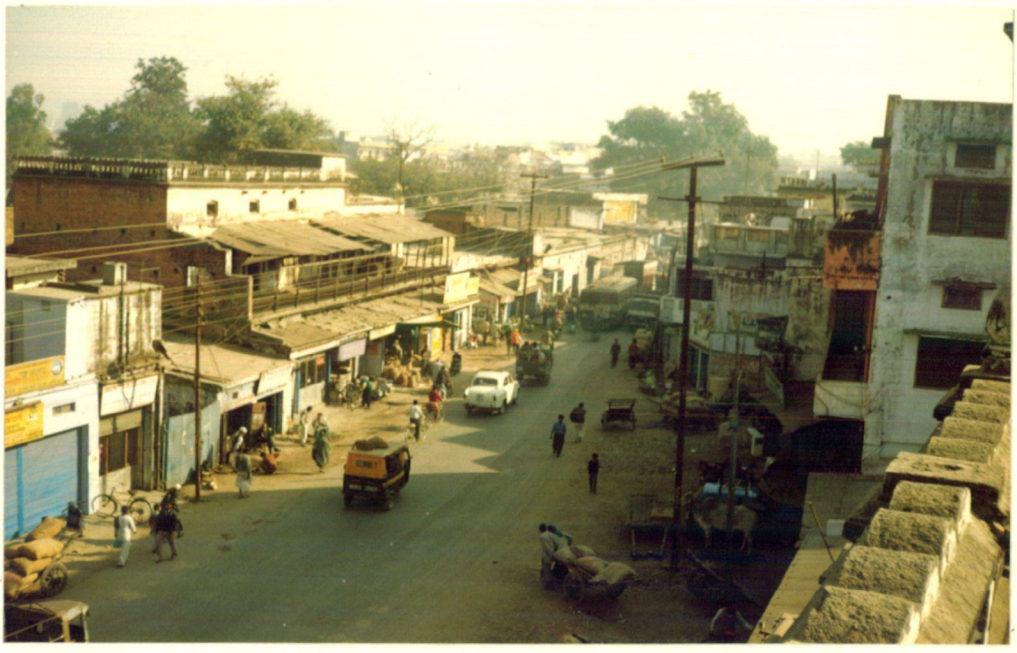
Source: Field Survey.

causing high sound level,like wise the site near Bus stand and clock tower are affected by noise pollution very much due to highly congested areas.

5.3 Analysis of Visual Pollution:

The public judges the road, mostly on the basis of visual concept. But unfortunately the Gandhi Road has not been given due considerations for visual appearance and to the existing environmental condition. On Gandhi Road where automobiles and pedstrions are inter mingled and in addition, the ugly, unplanned and uncoordinatied street furniture created a visual pollution.

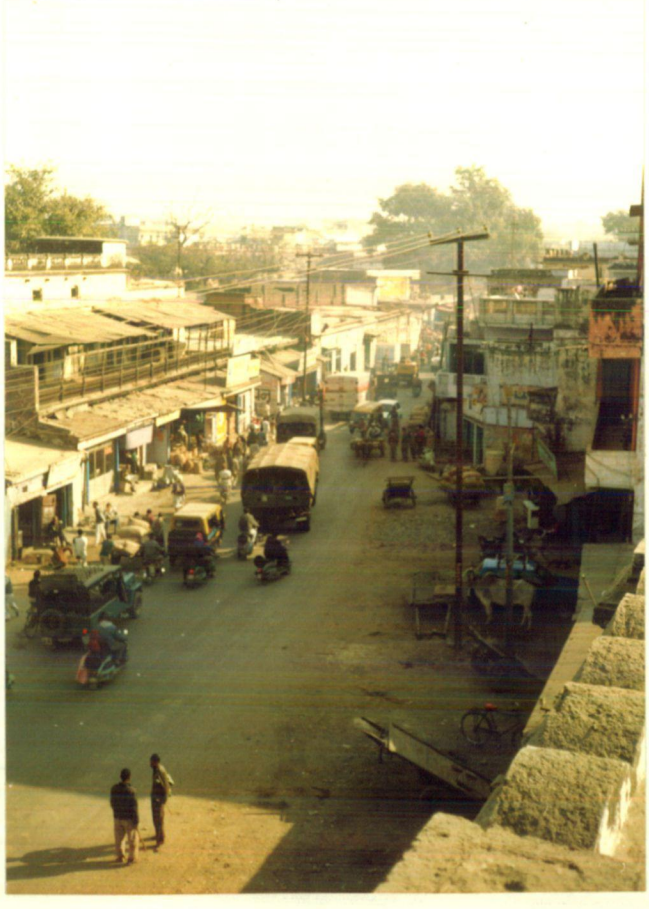
An extensive photographic study has been conducted to get the idea about visual pollution. It is clear from the photographs that the various sign boards are not designed uniformly to suit the environment. They are not properly maintained. The unmaintained sign boards at Aarat Bazar, Lakhibagh, apposite to Road ways Bus stand, Thesil crossing and clock tower cause visual pollution. Similarly the telephone posts, lamp posts and the connecting wires, the abanodoned telegraphic post unmaintained ugly dust pins, the unmaintained service station, petrol pumps etc. are not designed to suit the environment causes adverse visual impact on Gandhi Road.



Building Condition in Arat Bazar.

Improper Street Furniture, Bad Condition of building at Arat Bazar.

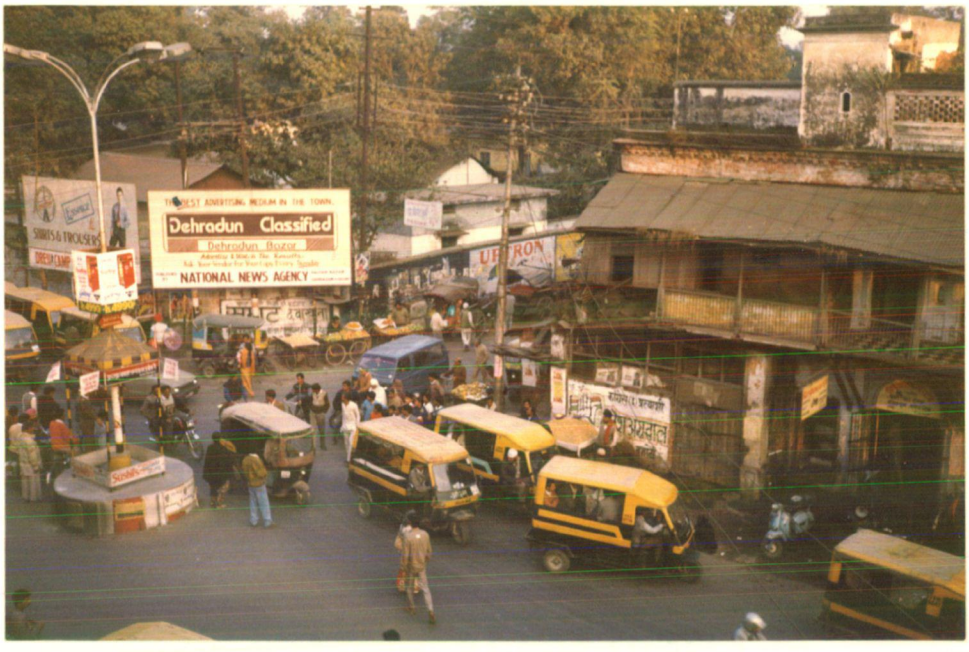
Encroachment due to Road side Parking and Arti Shops.



Improper maintenence of pedestrian facilities in Arat Bazar.

Garbage dumping by the Road side infront of Lakhibag Police Chowky.

Road side construction work, Improper maintenence, Improper Parking facilities and pedestrian facilities at Prince Hotel Crossing causing visual Pollution



Improper Road signboard, Bad Condition of buildings, Congestion at Tehsil Chowk Crossing.

The old type of building in Aarat Bazar and their bad condition also cause visual pollution.

5.4 Analysis of Land Use Survey:

The extensive survey of Land Use on Gandhi Road has indicated the details of abutting land uses pointing out the category of land use, nature of activity, frontage area etc. The landuse activities have been devided in to different categories and same have been marked on base drawings. This has indicated the sections of commercial, residential or some other land uses. It shows the problematic landuses creating serious interferences with traffic and tansportation system and warrants the action to control their hazardus nature.

The problematic landuses like on-road vegetable market near sabzi mandi, Arat Bazar, Vegetable market on Amrit Kaur Road, wood market on Saharnpur road have abutting both sides of the road. Their activities are extended on the road causing mis - utilisation of road space. Section from Dashmesh Bhawan to Prince Hotel has highly commercialised building of whole sale Arati shops and various hotels. Dharamshale etc. Two big Dharmashala (Jain and Agarwal) causes the problem of congestion. Road side kokhas mobile shops are cropping at a very fast space. A new multistory shopping complex is corpping at

prince Hotel crossing with out providing any parking space. Section form Agarwal Dharmshala to Tehsil choks has various Kutcha and pacca auto mobile shops. These shops are encroaching the road as the vehicles to be repaired are standing on the road side. Section from Prince Hotel to Darshan Lal Chowk crossing has a very highly mix land use, as there are residential buildings, commercial buildings, offices. Roadways Bus stand, Hotel, Police fire station, etc.

In general the land use pattern on Gandhi Road is causing following problems:

(i) Encroachment

(ii) Congestion

(iii) Inconvenience to road users.

The most critical problem of this road is Arat Bazar and truck repair shops which certainly need strict control. Clock Tower area is the central commercial place in Dehradun city.

5.5 Analysis of Accident Data:

Accidents is another area which can be exploited through data collection from secondary sources. The accident data has been collected to know the level of safety on roads.

TABLE NO.13

ACCIDENT IN DEHRADUN CITY (1992)

S.NO.	NAME OF ROAD	SECTION	ACCID. IN ONE YEAR			NO OF ACCID./KM	
			FATAL	NON-FATAL	TOTAL	FATAL	TOTAL
1.	Saharanpur Rd.	Sabzi Mandi to Reetha Mandi Rd.	8	9	17	4.4	8.8
		Reetha Mandi Rd. to Saharanpur Chowk	6	5	11	9.1	16.4
2.	Gandhi Road	Saharanpur Chowk to Prince Hotel	5	6	11	2.3	5.8
		Prince Hotel to Clock Tower	3	4	7	1.8	4.5
3.	Haridwar Road	Prince Hotel to Race Course	-	1	1	-	1.1
		Race Course to Aragha	-	1	1	-	1.6
		Araghar to DCM Toyota	-	1	1	-	1.5
		DCM Toyota to Rispna Bridge	-	1	1	-	0.9
4.	Chakrata Road	Clock Tower to Prabhath Cinema	-	1	1	-	3.8
		Prabhath Cinema to Cantt. Road	2	2	4	2.8	5.6
		Cantt. Road to Krishan Ngr. Chowk	-	1	1	-	1.2
		Krishan Ngr. to Ballupur Chowk	-	-	-	-	-
5.	Rajpur Road	Clock Tower to Astley Hall	2	4	6	3.9	11.6
		Astley Hall to R.T.O.	4	3	7	1.8	3.1
TOTAL			30	39	69	1.7	4.0

Source: Office of Superintendent of Police, Dehradun

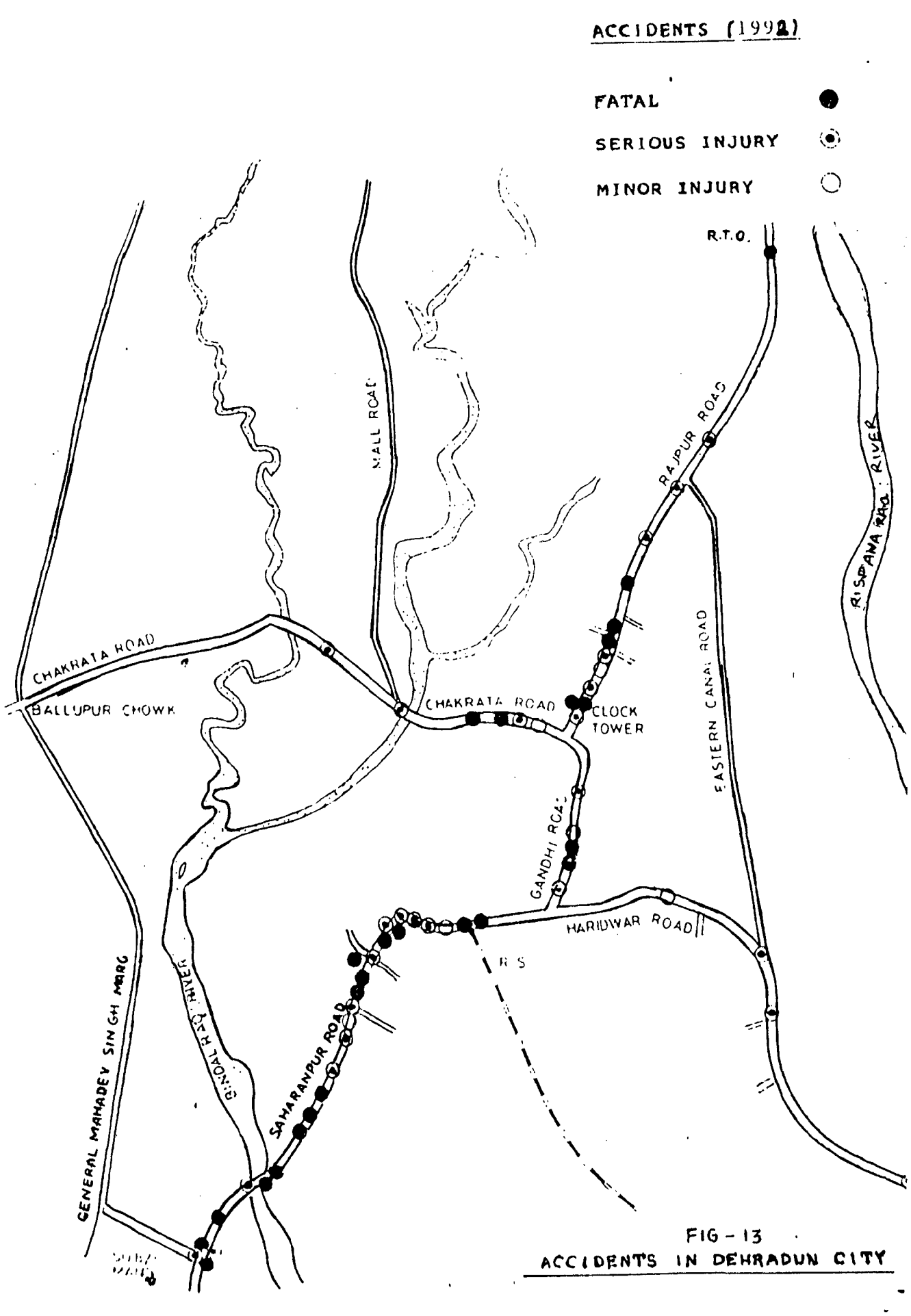


FIG - 13
ACCIDENTS IN DEHRADUN CITY

It has been found that total 68 accidents occured on the major roads during the year of 1992, 32 are fatal. The analysis indicates that Saharanpur Road from Reetha mandi to arat Bazar is the most dangerous road having the highest accident rate of 16.4 accidents/km. The visual occurence of accidents is shown in figure No. . over all the analysis indicates that the Saharanpur road and Gandhi Road have high rate of accidents and there are many strategic unsafe points. Most of the victims are cyclists and padestrians. The movement of pedestrians and cyclists has to be given serious thought. Allowing cyclists and pedestrians on the main road without any seperate lane and mixing with the fast vehicles means more accidents, show speed and constrained capacity which is going on at present at a very fast rate on Gandhi Road.

5.6 Analysis of Effect on Human Health Due to Environmental Pollution:

A questionnaire was prepared and extensive survey was conducted. Total Five sites are taken. The persons wre interviewed for their reactions about the high noise exposure in general and some specific aspects in particular, as given in the questionnaire. The persons interviewed were of mixed lot of different age,

qualification, health and work experience in shop (in years.)

Subjective responses about noise from 180 persons were collected by asking them different cross questions keeping in view their educational background, service life and physical condition.

During the questionnoise survey, it was felt that many persons could not express their views regarding noise exposure due to lack of knowledge about the noise pollution. The result are shown in graphical form.

In general, from the result it is evedent that mild headach occasionally occur to 30 % people on Gandhi Road. Horn of the Vehicle is the most inportant source of disturbance. The most annoying vehicle is vikram. Generally 15% people report memory loss occasionally while at site No. 2 and 5, 5% people reported frequent memory loss. In general 30 to 50 % people reported sleep interference due to noise pollution. 50% people were found having moderate annoyance while 8 to 20 % people were having high annoyance sinilarly 20 t 30 % people reported increase in Blood pressure. Thus after analysing the effects on human health due to environmental pollution it can be stated that people are not enjoying a healthy and peaceful life on Gandhi Road.

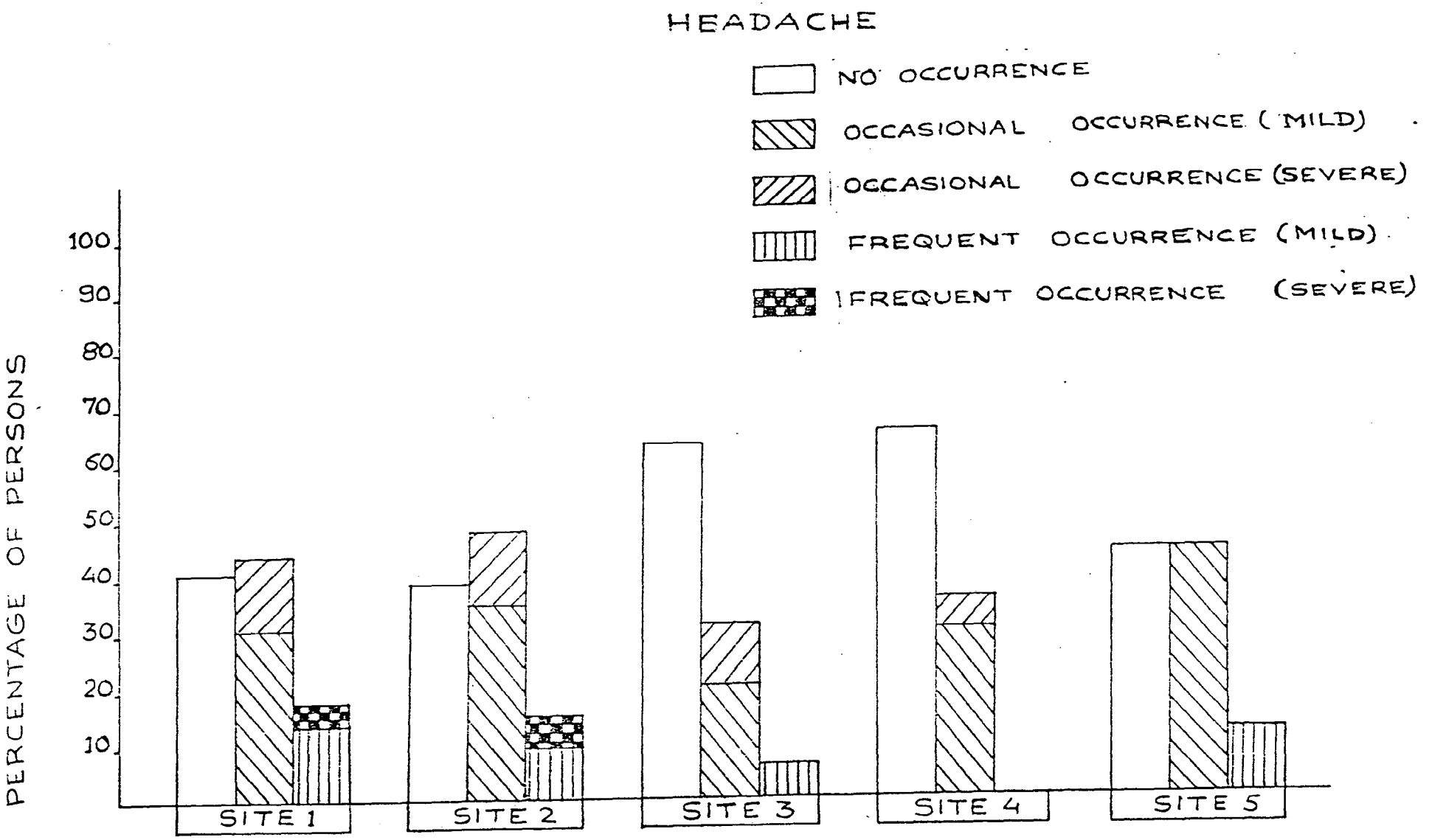


FIG NO. 14 PERCENTAGE OF PERSONS Vs OCCURRENCE OF HEADACHE

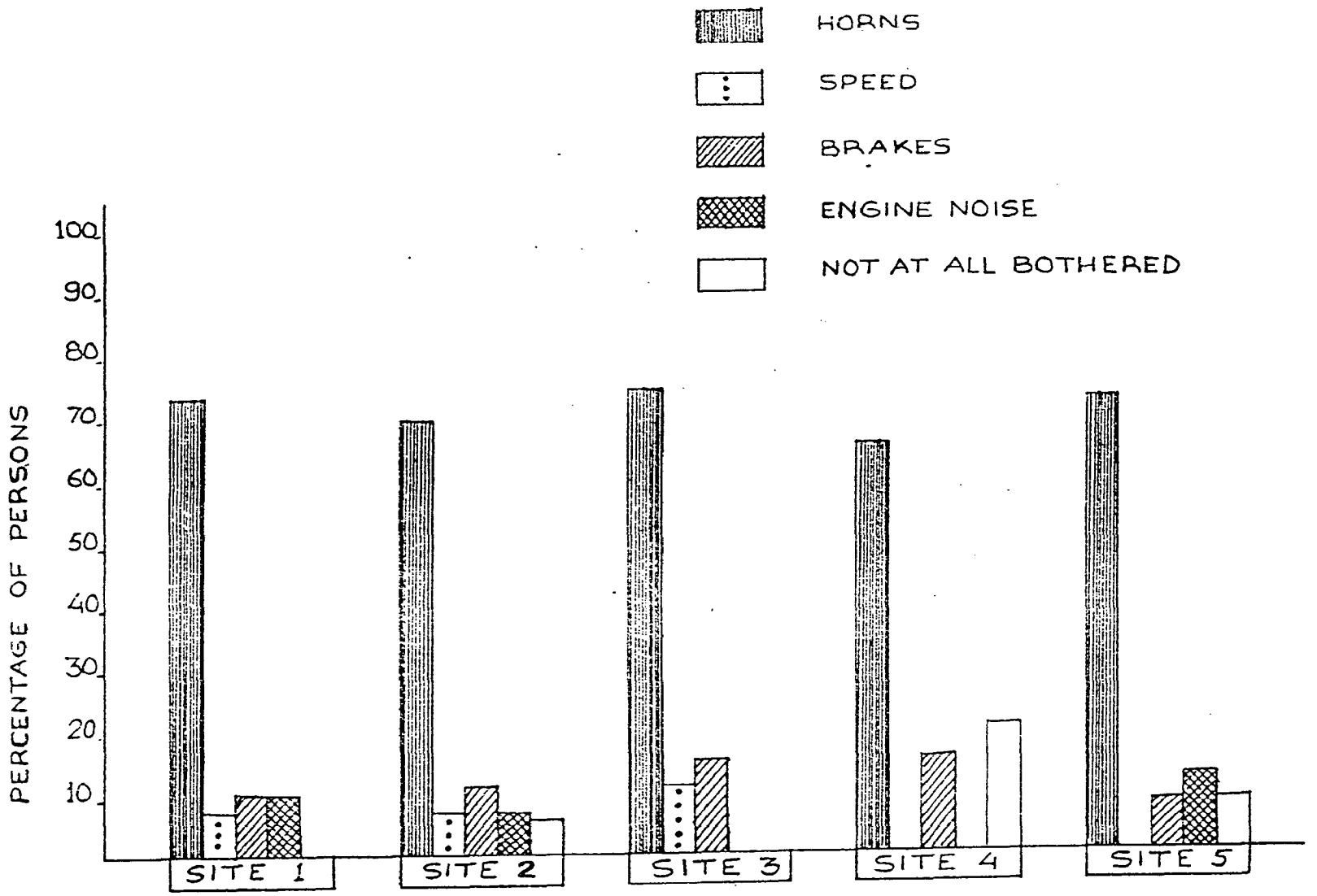


FIG NO. 15 PERCENTAGE OF PERSONS Vs SOURCES OF DISTURBANCE

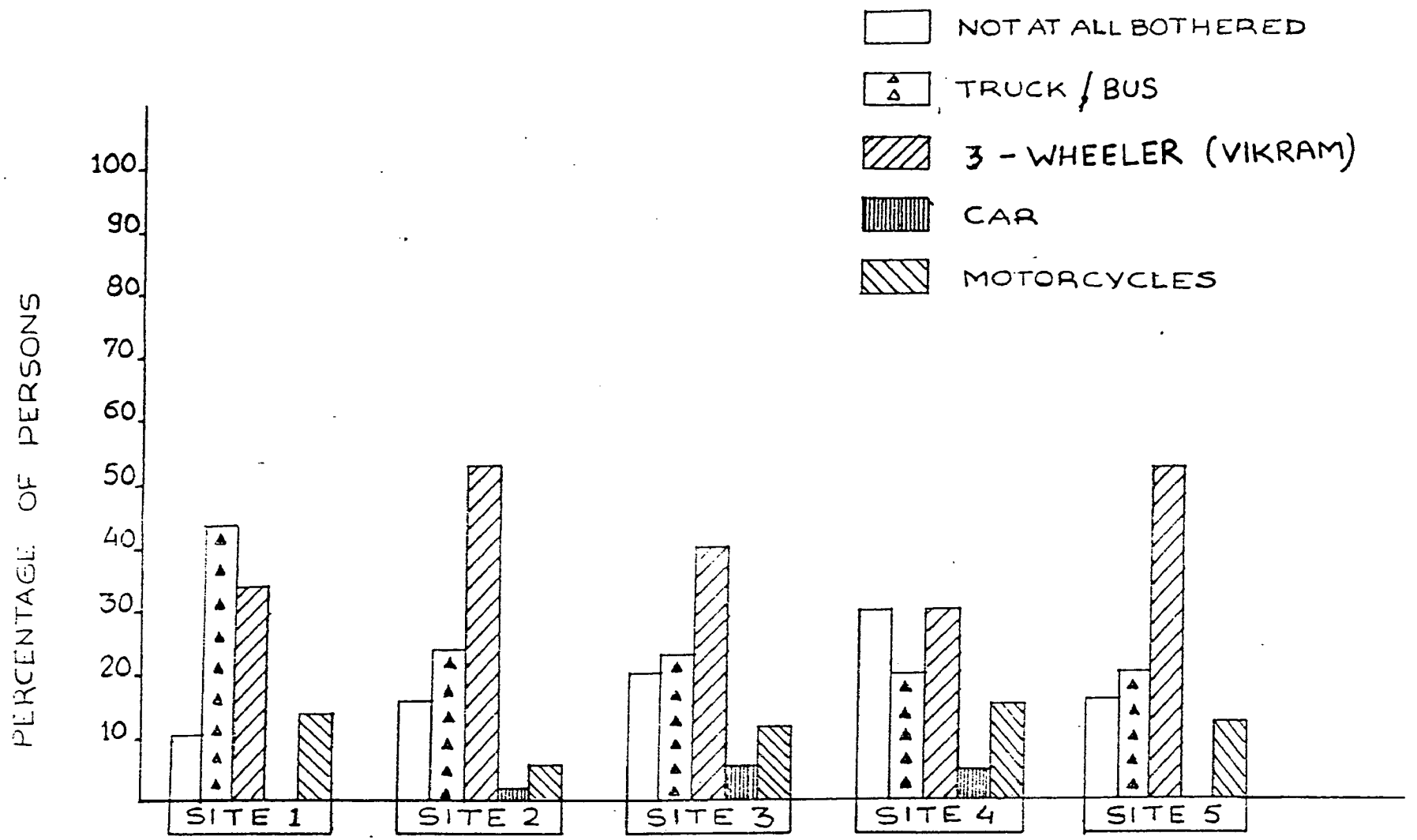


FIG 16. PERCENTAGE OF PERSONS Vs MOST ANNOYING VEHICLE

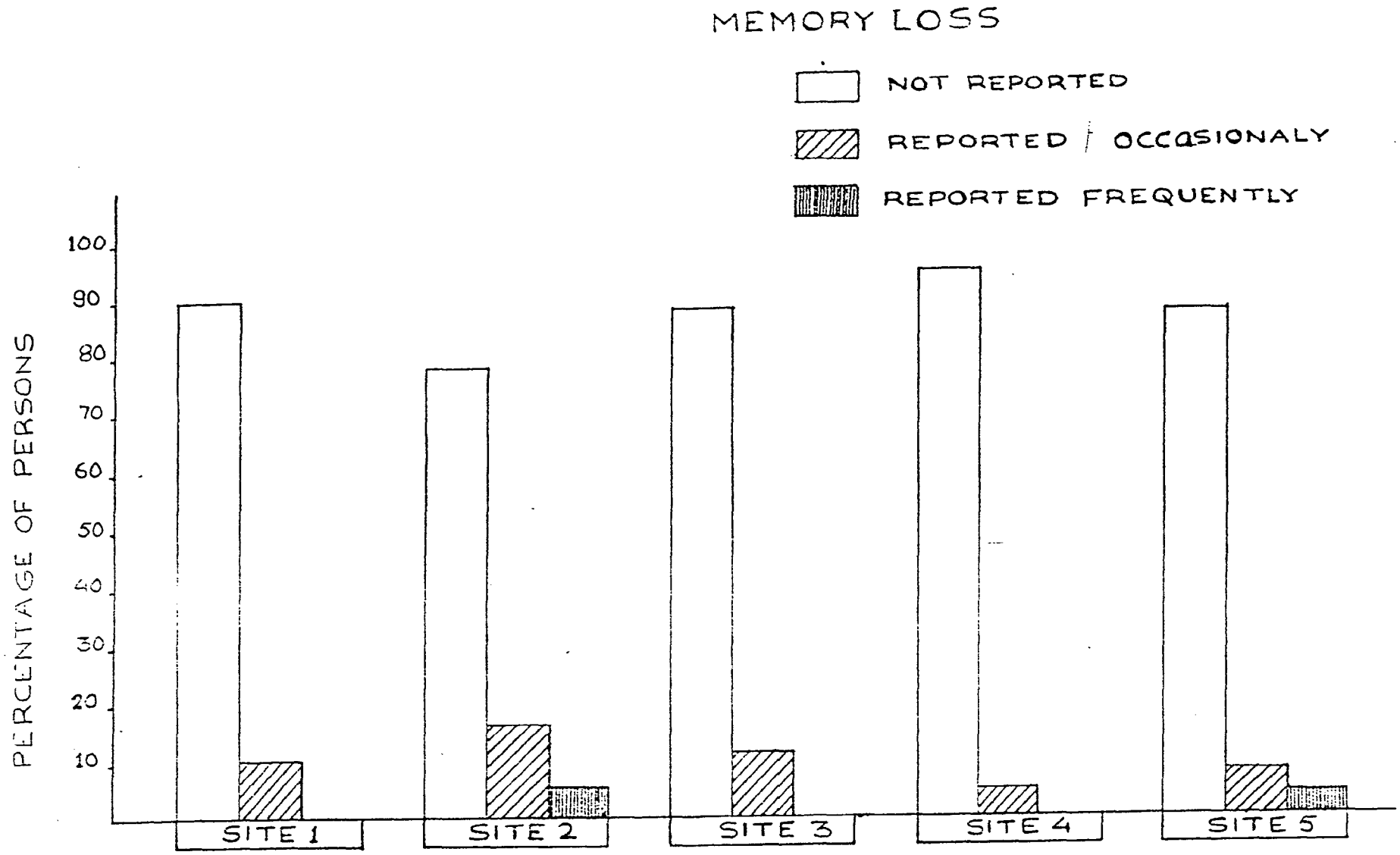


FIG 17. PERCENTAGE OF PERSONS Vs MEMORY LOSS

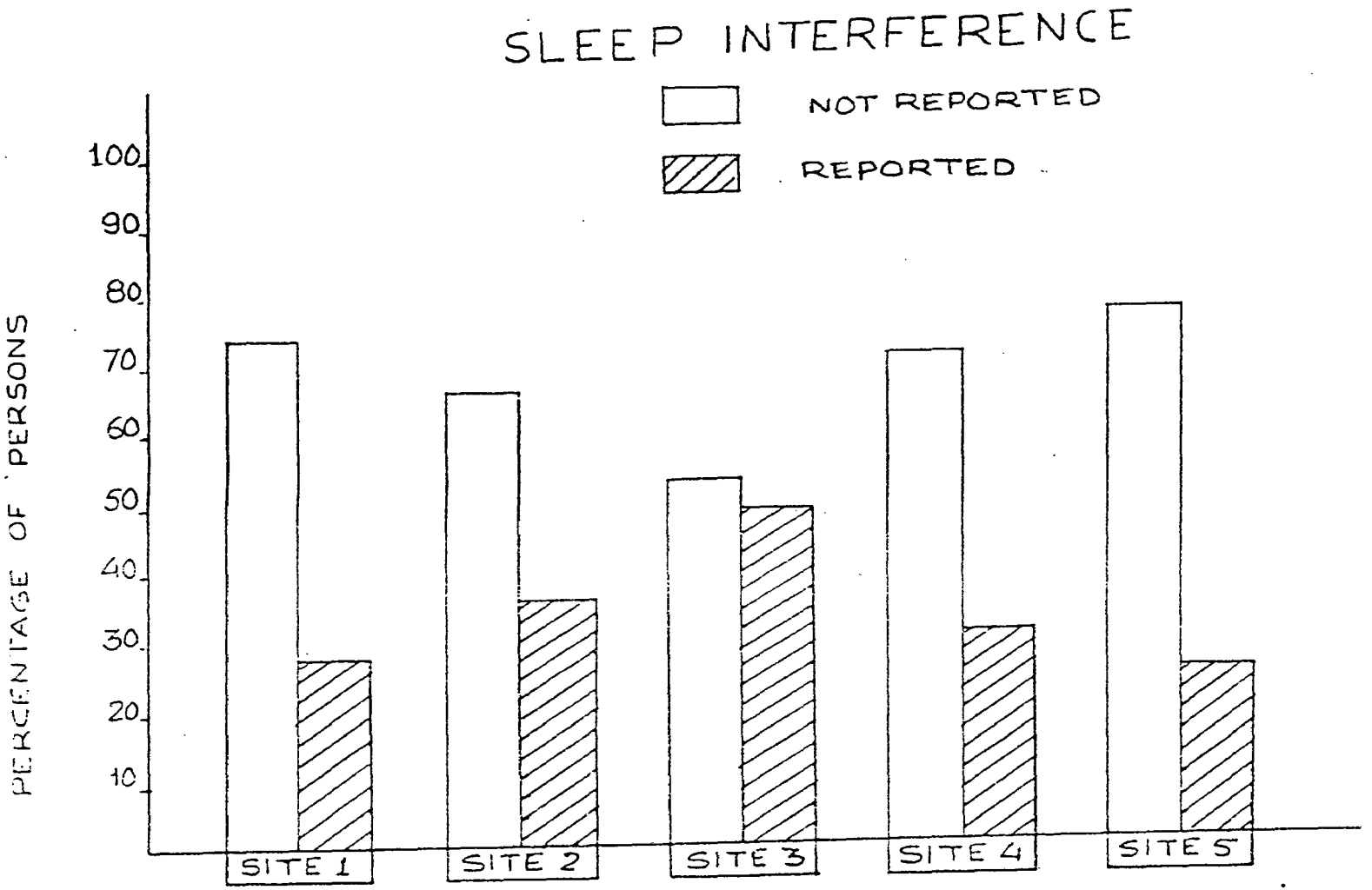


FIG 18. PERCENTAGE OF PERSONS Vs SLEEP INTERFERENCE

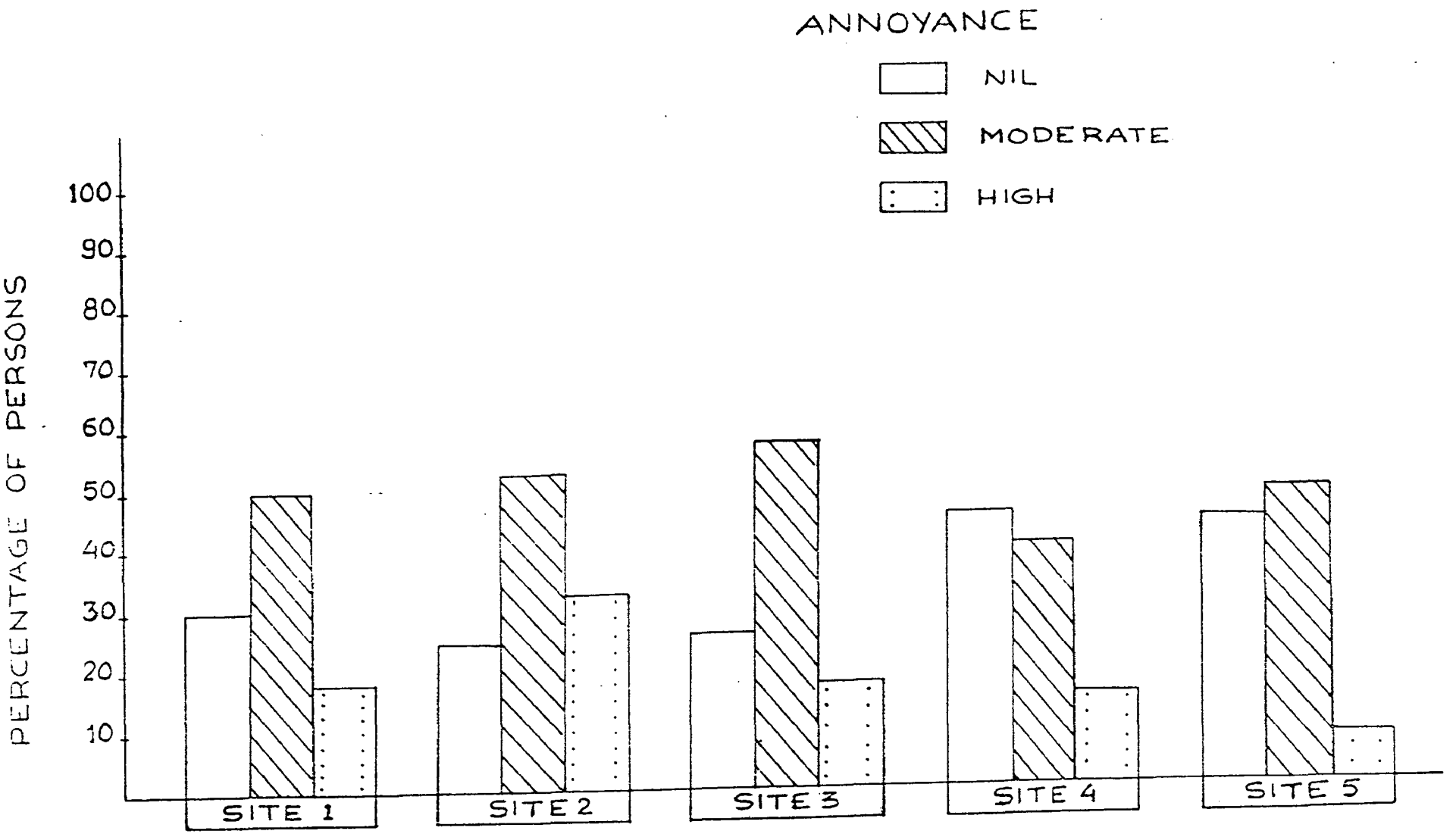


FIG 19. PERCENTAGE OF PERSONS Vs ANNOYANCE

5.7 Analysis of Causes and Effects of Various Traffic Proplems, on Gandhi Road:

Cause No. 1: Presence of Arat Bazar:

Loading and unloading of goods takes part on the road side causes congestion, Traffic Jam. Encroachment of Pedestrian Path, Mushrooming of various mobile and Kutcha Auto/Truck Repair shops.

Cause No. 2: Lacking of Bye Pass:

The through traffic going to hilly area, Haridwar, Chakrata etc. is forced to come on this Road causing the increase in Traffic volume, Accidents, Journey Delay and other problems to be likely.

Cause No.3: Lacking of a Proper Transport Nagar:

This causes Trucks/ Heavy vehicles to park on the road side it self again creating congestion, empediment to traffic flow.

Cause No. 4: Lacking of other Sub CBD Area:

Due to this reason people living in remote area are forced to come Gandhi Road for their shopping and Business.

Cause No. 5: Presence of Regional Bus Stand and Railway Station:

Increase in Traffic volume as 285 Buses come in dehradun

daily according to U.P.R.T.C. Information. Buses causes great pollution, congestion and Traffic Jam condition.

Cause No. 6: Lacking of Proper Public Transport System:

This causes increase in number of Private vehicles. Further Poor Public Transport System like Vikram is eating city environment. Their improper maintenance, causes great environment pollution. The middle class people are forced to bear with this kind of poor public Transport System.

Cause No. 7: Presence of Various Public/ Semi Public Utilities and Services.

Presence of Degree College, Doon Hospital, Municipal Board, District Court and Head Quarter, P.W.D. office, Fire Fighting Station, Head Post Office, Parade Ground, Cinema Hall, Public Library, various Banks, Telegraph and Telephone exchange etc. causes the movement of great crowd on this Road causing mental agony, Incovenicnce, annoyence, over crowding, delay, congestion, uncontrolled pedestrian movement etc.

Cause No. 8: Lacking of Proper Traffic Regulating Measures:

Absence of traffic control signs on crossing, pedestrian path, Parking facilities etc. causes Accident, congestion, encroachment etc.

Cause No. 9: Existance of Work Place Far Away From Residence Place:

This is the major reason causing employee to cross this road which creates the problem of over crowding, noise pollution, delay, accident, Traffic Que and Jam condition.

Cause No. 10: Existance of Mix. Land use on the Road:

As the Hotels, Residences, Commercial activities, offices, utilities, services etc are going on the road, this creates the mix. traffic flow, resulting various traffic problems.

Cause No. 11: Lacking of Strict Control on Building use and Development:

Causing the mushrooming of mobile shops, kutcha shops, Market complex with out providing adequate parking facilities, Development of mix land use.

Cause No. 12: Lacking of Strict Measures to Pollution Control:

Causes visual, Air, Noise Pollution. Vikram etc. with out proper checking are creating the environment most polluting.

Cause No. 13: Lacking of Proper Management and coordination Betewwn Various Authorities:

Delay in execution of proposals to improve the environment.

CHAPTER 6

CHAPTER 6

PLANNING PARAMETERS

6.1 Traffic Projection:

Based on the existing travel characteristics, the traffic volume has been projected to 2001 through trend projection method (Table No. 14, 15, 16, 17). The traffic volume of each mid block location has been projected at the rate of 3% per annum and then 10% of the projected traffic volume has been considered as peak hour volume. The final figures are adjusted incorporating the composition changes.

In general, the projections indicate that the average daily traffic volume in 2011 is very high and peak hour volume ranges from 6000 PCUs to 7500 PCUs. It is also noticed that fast vehicles are approximately 5000 during the peak hour. This is very critical situation to contain the traffic volume.

The directional trafic volume at junctions has been projected to the years of 2001 and 2011 on the basis of assumptions as mentioned earlier. It has indicated that the average daily traffic volume on project road junctions in CBD area will increase to 60 -70 thousand

TABLE NO. 14

PROJECTION OF TRAFFIC VOLUME PCUs (GANDHI ROAD)

NAME OF ROAD LOCATION	Traffic Volume in 1991 (%)			Traffic Volume in 2001			Traffic Volume in 2011		
	Total	Fast	Slow	Total	Fast	Slow	Total	Fast	Slow
Agarwal Dharmshala	37787	27516	10271	50782	40626	10156	68247	54598	13649
	(100.00)	(72.82)	(27.18)						
Darona Hotel	35186	27660	7526	47287	37830	9457	63550	50840	12710
	(100.00)	(78.61)	(21.39)						
Tehsil	31261	25915	5346	42012	33610	8402	56461	45169	11292
	(100.00)	(82.90)	(17.10)						
Sriman-Srimati	40430	29774	10656	54334	43467	10867	73021	58417	14604
	(100.00)	(73.64)	(26.36)						

Assumptions: 1. Traffic Volume has been projected at the rate of 3% per annum.

2. Traffic composition will change as city grows in its size.

3. 10% of average daily traffic volume is considered for peak hour traffic volume.

TABLE NO. 15

JUNCTIONWISE DIRECTIONAL TRAFFIC VOLUME PROJECTION

S. NO.	NAME OF INTERSECTION	DIRECTION FROM	PEAK HOUR TRAFFIC VOLUME (PCUs)		
			1991	2001	2011
1.	Prince Hotel Crossing	Saharanpur Chowk	1456	1957	2630
		Clock Tower	1472	1978	2658
		Dharampur	1201	1614	2169
		Tyagi Road	325	437	587
2.	Tehsil `T' Junction	Prince Hotel	1856	2494	3352
		Clock Tower	1447	1945	2613
		Doon Hospital	421	566	760
3.	Darshan Lan Chowk	Prince Hotel	1714	2303	3096
		Clock Tower	2054	2760	3709
		Parade Ground	928	1247	1676
		Telephone Exch.	702	943	1268
4.	Clock Tower Chowk	Gandhi Road	2246	3018	4056
		Chakrata Road	1514	2035	2734
		Rajpur Road	1400	1881	2528

Source: Direction traffic volume survey, Conducted by M.D.D.A.

PCUs in 2001 and 80 -95 thousand PCUs in 2011.

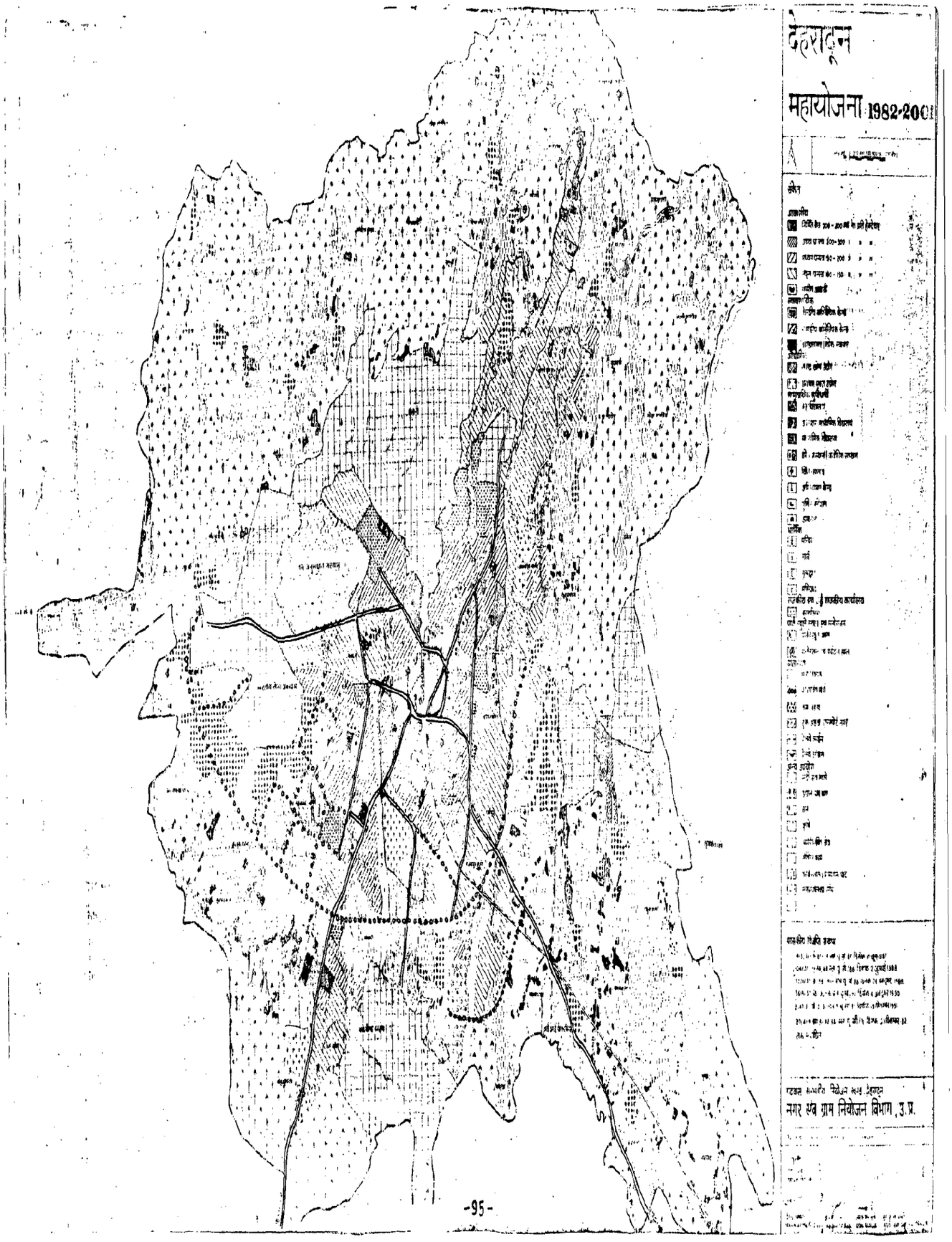
Clock Tower chowk and Darshanlal chowk will have the maximum traffic volume of 71582 PCUs and 69,870 PCUs in 2001 (Table No. 15). It is also understood that 10% of the total traffic is peak hour volume which indicates that besides the maximum updation of the road junctions, traffic management and control measures have to play a crucial role in solving the problems.

6.2 Review of Master Plan Proposals:

The Master Plan has given various proposals. These proposals can be summerised as follows:

6.2.1 Proposed Circular Pattern:

In the old parts of city, it is very difficult to widen the existing roads, as it will involve mass demolition resulting in heavy economic loss. Therefore, it is proposed to widen those roads only which carry the intra - city traffic, regional traffic and the roads along which major commercial areas have ben proposed. Additional roads have been proposed and decentralisation of activities in the central areas has been envisaged to make improvements in the over all circulation pattern. The following categories of roads have been proposed according to their hierarchy and widths: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(i) Regional Roads and Bye-pass — 45 meters wide

(ii) Major City Roads — 30 meters wide

(iii) Other City Roads — 12 meters to 24 meters wide.

The regional and major city roads which are proposed to be widened are mentioned below alongwith their proposed widths:

S.N.	NAME OF ROAD	EXTENT	PROPOSED WIDTH
1.	Saharanpur Road	Saharanpur Chowk to Shivaji Dharamshala	30m
		Beyond Shivaji Dharamshala	45 m
2.	Haridwar Road	Saharanpur Chowk to Rispana Rao	30 m
		Beyond Rispana Rao	45 m
3.	Chakrata Road	Clock Tower to Prabhat Cinema	18 m
		Prabhat Cinema to Bindal River.	36 m
		Beyond Bindal River	45 m
4.	Raipur Road	Raipur Road to Rispana Rao	24 m
		Beyond Rispana Rao	30 m
5.	Sahastradhara Rd.	Raipur Road to Sahastradhara	30 m
6.	Rajpur Road	Clock Tower to New cantt. Road	30 m
		New Cantt. Road to Mussoorie Diversion Road	36 m
		Beyond Mussoorie Diversion Road	30 m

7.	Mussoorie Byepass	Beyound Diversion Point	36 m
8.	Gandhi Road	Clock Tower to Prince Hotel crossing	30 m
9.	General Mahadeo Singh Road	Chakrata Road to Saharan pur Road	30 m
10.	Kaonli Road	Saharanpur Chowk to Bye-Pass	30 m
11.	Bye-Pass Road	Raipur Road to Chakrata Rd.	45 m

Bye-Pass:

The National Council of Applied Economic Research, New Delhi, conducted a traffic survey of Dehradun during June, 1980. The survey revealed that traffic volume on Haridwar road and Saharanpur road was 8,132 and 9,450 PCUs respecively. On the basis of this survey the Public Works Department proposed 45 meter wide bye-pass road joining Raipur Road with Saharanpur Road. The Town and Country Planning Department has proposed to extend this bye-pass from Saharanpur Road to Chakrata Road. Since the regional roads converge in the centre of Dehradun, hence all sorts of traffic passes through the congested areas of the city and causes traffic hazards. Heavy vehicles carry lime - stone marble chips, lime and cement through the central areas. Similarly, trucks incoming from Saharanpur and Haridwar sides also pass through the central areas of the city.

During the summers, there is a great influx of

tourists especially through Sahranpur road and Haridwar road. As a result, the tourist buses, taxis, etc. go to Mussoorie and Chakrata passing through the congested areas of the city. The bye - pass road will enable the heavy vehicles and all other vehicles which do not intend to got to the city, to avoid delays and bottlenecks caused while passing through the congested areas. Thus, the radial pattern of roads has necessitated the proposal of a ring road which in this case has been.

Bus Station, Truck Terminus and Transport Nagar: The existing bus - station of Uttar Pradesh State Road Transport Corporation located at Gandhi Road has been proposed to be expanded to meet the growing requiremtns of traffic. An area of about 1.4 hectares has been proposed near the inter section of Saharanpur Road and porposed by-pass because the existing bus-station is located in the congested central part of the city. The present city bus stand and the Mussoorie bus-stand have been retained at their present sites because there is a good coordination between the railway station and Mussoorie Bus Stand, City Bus Stand and Roadways bus Stand. A site of about 4 hectares has been earmarked for Chakrata Bus stand near the inter section of Kaonli Road and General Mahadev Singh Road.

For heavy vehicles like truck and lorries a site

measuring 8 hectares has been proposed for truck terminus on Saharanpur Road near the proposed Bye-Pass. Another site covering an area of about 12 hectares has been reserved for Transport Nagar by the side of proposed truck terminus. Transport nagar will help in releasing the congestion of heavy vehicles from the main city, since a number of shops dealing in auto - repairs and spare parts have developed along Haridwar Road in the absence of any separate area for transport.

6.2.2 Government and Semi Government Offices:

The master plan envisages an office complex occupying a commanding location on General mahadeo Singh Road with an area of 42.5 hectares. It will contain the various Central and State Government offices, Semi-Government institutions, public sector undertakings and autonomous bodies. Area under office use has been increased at Kaulagarh road adjoining the existing office of the Oil and Natural Gas Commission of India. Both these locations provide desirable segregation and yet will maintain convenient physical link necessary for efficient functioning of offices. Provision of proper zone for the offices will ultimately eliminate the discordent relationship between the work centres and the living areas both existing as well as proposed. The existing

office complex of Hathibarkala Estate and the district courts have been retained at their present locations. Thus, about 313.52 hectares of total land has been earmarked for office use.

6.2.3 Commercial Areas:

Dehradun being the major city of hilly region, will require adequate space for commercial activities of regional importance. The Master Plan provides for commercial areas of various hierarchy which cover an area of 290 hectares. The nature and hierarchy of commercial activities envisaged in the paln are as under:

i) **Central Commercial Area:**

The highest order of commercial facilities exist in the central core of the city viz. Paltan Bazar, Dhamanwala, Mannuganj, Dandipur, Gandhi Road and Saharanpur Road near Saharanpur Chowk. The master Plan envisages the proposal of 27 hectares of land of for central commercial aea at its existing site with following conditions:

Commercial activity has been proposed along different roads to suit the Indian concept and conditions with following depth of shops beyond the proposed width of roads:

Gandhi Road	18 m . on either sides starting from Hotel Prince Chowk to clock Tower excepting Roadways Bus Stantion and Government use zone.
Haridwar Road	18 m. on either sides starting from Paltan Bazar to Jail.
Platan Bazar	12 m. on either sides starting from clock Tower to Haridwar road crossing.
Chakrata Road	12 m. on either sides starting form clock Tower to prabhat Cinema and 18 m. on either sides upto Bindal River Beyond Prabhat Cinema.
Rajpur Road	30 m. on either sides from Clock Tower to Astley Hall.
Raja Road	9 m. on northern side.
Ansari Road	9 m. on either sides.
Tilak Road	9 m. on either sides.

The area surrounded by Paltan Bazar road, Raja Road, Gandhi Road and Haridwar Road has also been proposed under Central Commercial Area.

ii) **District Centres:**

Four district centres covering 33 hectares of land have been proposed for growth of commercial

activities during the paln period. The district centre proposed between Saharanpur road and General Mahadeo Singh road is the largest one because the bulk of future urbanisable area has been proposed on either sides of these roads. The other district centres have been proposed on Rajpur Road near Mussoorrie diversion road and Sahastradharea Road. The existing market along Karanpur road had been retained and envisaged as district centre upto a width of 9 m. on either sides of Karanpur road starting from E.C. Road crossing upto college road corssing.

iii) **Wholesale Markets:**

The Master Plan envisages two sites for wholesale markets covering an area of about 25 hectares. The present wholesale market located along Saharanpur Road around Saharanpur Chowk has been retained at its present site with the condition that no shop will be located beyond 18 m. on either sides of the road strating from Paltan bazar crossing upto canal on Kaonli Road. Another site measuring about 20 hectares has been earmarked for wholesale market yard along Saharanpur road. All wholesale fruit and vegetable markets located within the congested parts of the city are proposed to be shifted here.

6.2.4 Public and Semi-Public Facilities:

i) Educational Facilities:

There are 4 degree colleges in the city and it will require 2 more additional colleges which have been proposed in the plan. Nearly 12 hectares of land has been earmarked for them near General Mahadeo Singh Road and Rajpur Road.

ii) Research Institutions:

The existing research institutions such as Forest Research Institute and Indian Institute of Petroleum have been retained at their present sites and no incongruous land uses have been proposed near or around them.

iii) Health Facilities:

At present there are 9 hospitals of various types and sizes in Dehradun which are sufficient to fulfil the future requirements. But looking to the needs of beds, there are only 500 beds in all the hospitals, and there is no scope of expansion for existing hospitals. Therefore, two additional general hospitals with an area of about 16 hectares have been earmarked for future health needs on General Mahadeo Singh road and Rajpur road respectively. About 8 hectares of land has been

reserved for leprosy hospital along the left bank of river Riispana Rao.

iv) **Parks, Open Spaces and Recreational Facilities:**

The Master Plan provides hierarchy of recreational spaces and parks. More diversitied and specialised recreational activities would enhance the tourist interest in Dehradun. An area of about 50 hectares has been earmarked at the Sahastradharea picnic spot. A big park covering an area of 12 hectares has been reserved in the west of General mahadeo Singh Road. In addition, the existing picnic spots like Malsi Deer Park, Tapovan, Gandhi Park have been preserved and earmarked for their specialised tourist utility. These picnic spots are proposed to be improved to make them more attractive. The varoious orchards, gardens and tea estates have also been retained in the Master Plan as they are elements of landscape and recreation as well.

CHAPTER 7

CHAPTER 7

PLAN PROPOSALS RECOMMENDATIONS AND CONCLUSION:

7.1 Proposals and Recommendations:

7.1.1 General Physical Improvement of Gandhi Road:

The physical conditions for improvement of Gandhi Road differ in different sections. So various techniques are to be used to improve over all travel conditions. In general the area of improvement involve in following components:

* Widening of Carriage way.
* Provision of Central verge.
* Provision of islands and channelizers.
* Provision of footpath facility.
* Provision of strong railing along footpath.
* Provision of good lighting system.
* Provision of good drainage system.
* Road signs and marking.

For further physical improvement of Gandhi Road the Fallowing components should be considered.

i) Gandhi Road is to be designed to be 4 - lane divided carriageway through out having central verge of 1.0 m. for widening near Dasmesh Bhavan, about 20 shops

have to be removed at chainage 0.130 km and 5 shops at chainage 1.620 km near Darshan Lal Chowk.

ii) Encroachment by Hotel meedow has constrained the provision of footpath. Pedestrians are forced to walk on the carriageway. So the encroachment should be removed or a side walk for pedestrians should be provided by Hotel Meedow.

iii) Prince Hotel crossing should be designed in detail including lighting system and signalisation.

iv) The road in front of inter city bus terminal should be closed for vehicles by raised foot path and bollard on it.

v) Tehsil crossing should be converted into 'T' junction by closing Pritam Kaur Road by raised footpaths and bollards on it.

vi) Darshal Lal Chowk should be designed in detail including lighting system and signalisation. The road going to Doon Hospital should be one way traffic path.

vii) A local Bus stop stand should be constructed at the chainage of 1.55 km near P.W.D. office. Similarly another stop stand should be constructed at 0.7 km chainage, in front of Petrol Pump and vikram should

GANDH

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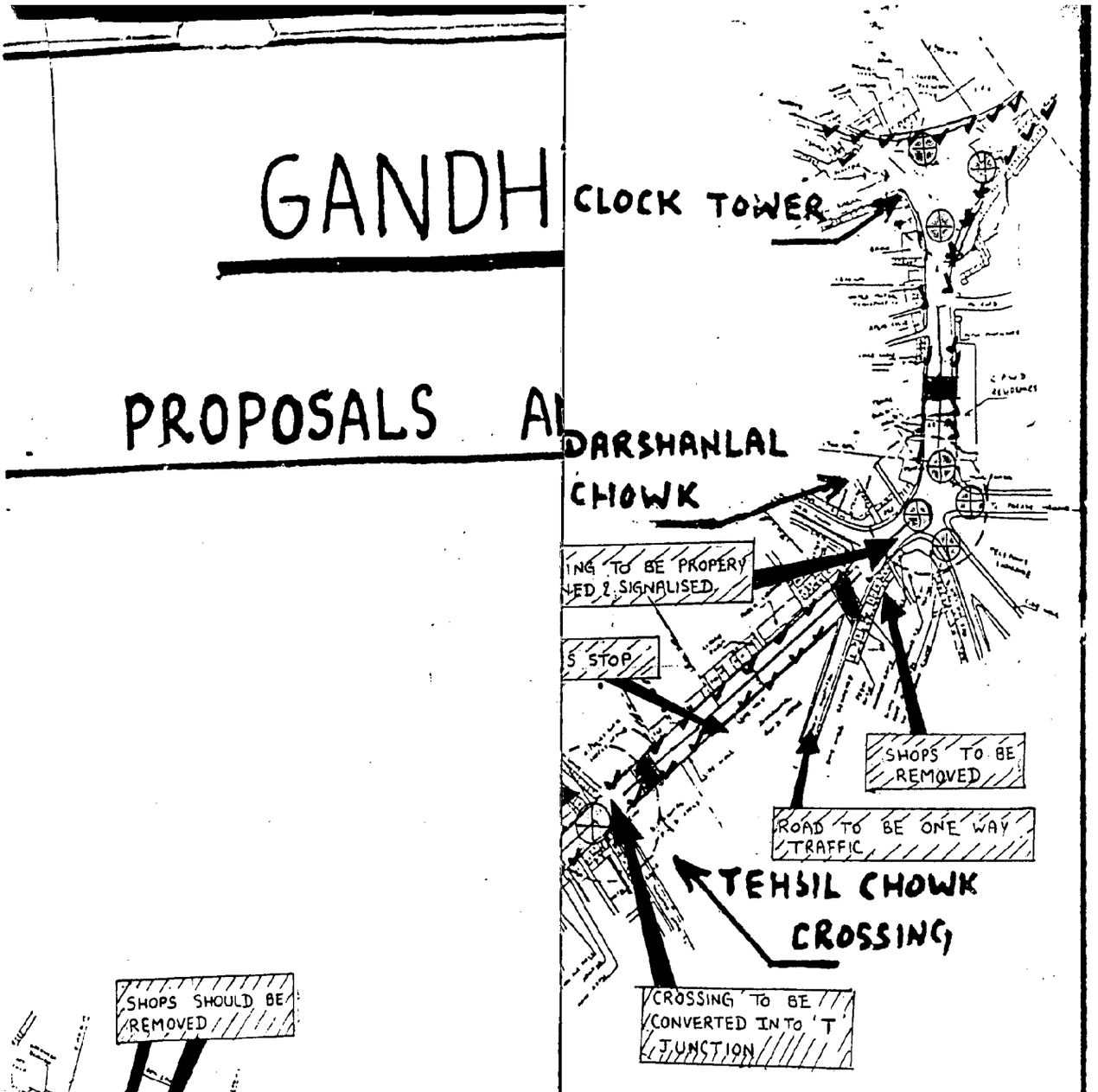


LEGEND

- PROPOSALS
- RECOMMENDATIONS
- PROVISION OF CENTRAL VERGE
- WIDENING OF CARRIAGE WAY
- PROVISION OF STRONG RAILING
- ROAD SIGN AND MARKING

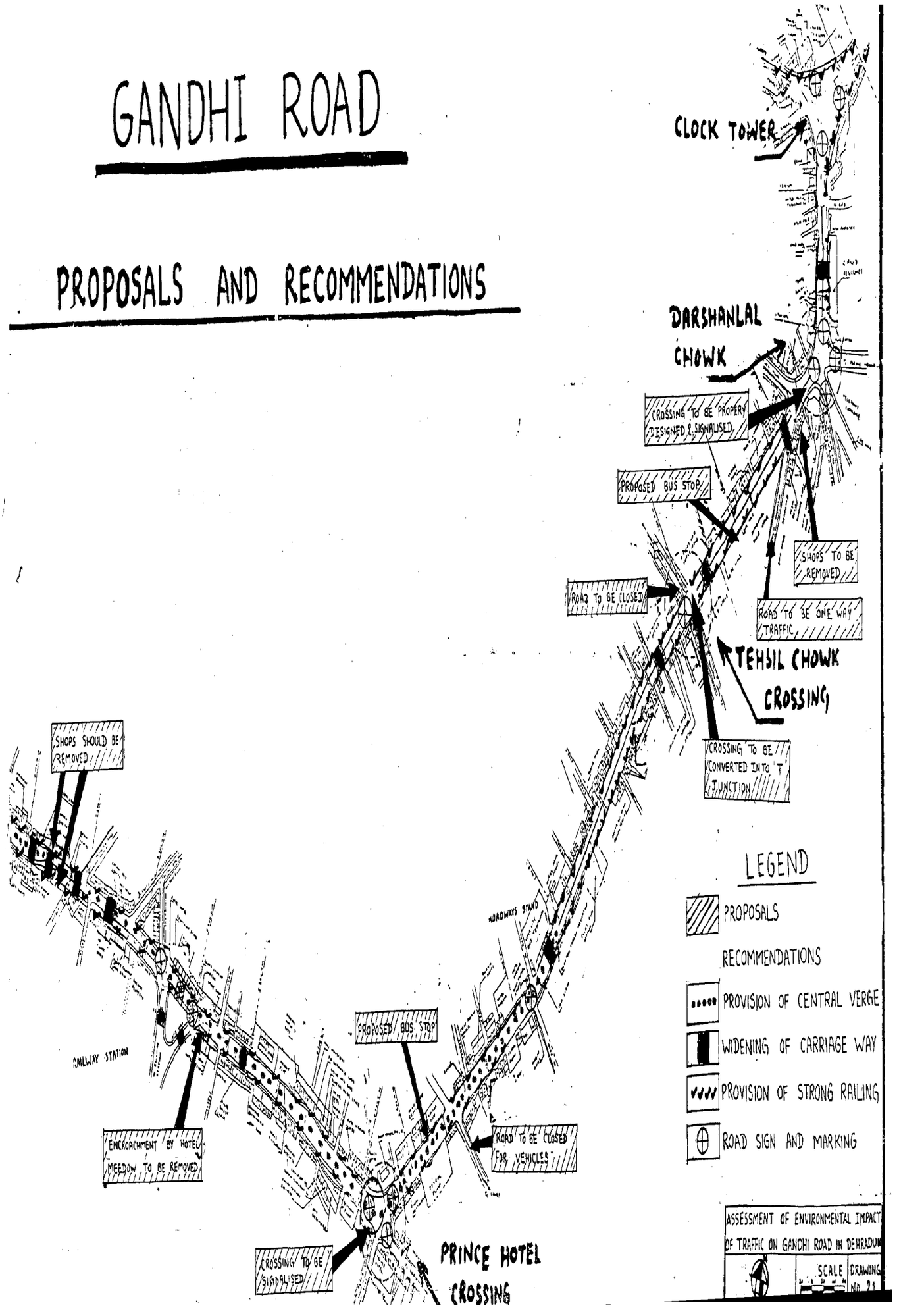
ASSESSMENT OF ENVIRONMENTAL IMPACT OF TRAFFIC ON GANDHI ROAD IN DEHRADUN

SCALE

DRAWING NO. 21

GANDHI ROAD

PROPOSALS AND RECOMMENDATIONS



not be allowed to stop at no other places except the stop stand.

viii) The pedestrian path must be raised above the level of carriage way so that road side parking may be harrased.

7.1.2 **Recommendations Based on Traffic Characteristic:**

i) **Introduction of City Bus Service:**

City bus service is must in order to provide cheep and fast transport services. This will also reduce number of IPT modes on the project corridors thus relieving congestion on the road. So it is recommended that a local bus service consisting of battery operated mini-buses should be operationalised on Gandhi Road.

ii) **Supplementary Role of I.P.T. Modes:**

Intermediate public transport modes are slow speed and low capacity as well as very costly for the general public. So the role of I.P.T. modes as major transport system has to be discouraged by limiting them to supplement the transport needs at dispersal points. This will create an integrated transport system where local bus system will play a major role.

iii) **Restriction on Entry of Slow Vehicles:**

It is evident that design capacity cannot contain the volume of the slow vehicles. They are also causing extensive congestion on the road due to their conventional and irregular operation. So it is recommended that entry of slow vehicles on to the Gandhi Road should be immediately banned.

iv) **Encroachment Control:**

The road corridors in DBD area can be categorically named as critical sections due to significant interference of encroachment problem. This should be solved immediately by providing a strong fencing alogn the road as well as by changing or removing the objectionalbe landuses abutting the road side.

v) **Rerouting and Scheduling of the Vehicles:**

There should be perfect and strict scheduling of different vehicle for passing on Gandhi Road, Similarly alternative routes should be encouraged. For example during peak hour time i.e. 8 to 10 am. and 4 to 5 pm. private cars, heavy vehicles, through traffic should not allow to pass on Gandhi Road, as during this period employee, students etc. use this road to reach their work place. So during this time

period battery operated public mass transport system should be allowed to pass through Gandhi Road, while private cars, heavy vehicles and through traffic should be allowed to use E.C. Road, Hardwar Road and other alternate route as should in Drawing No. 22.

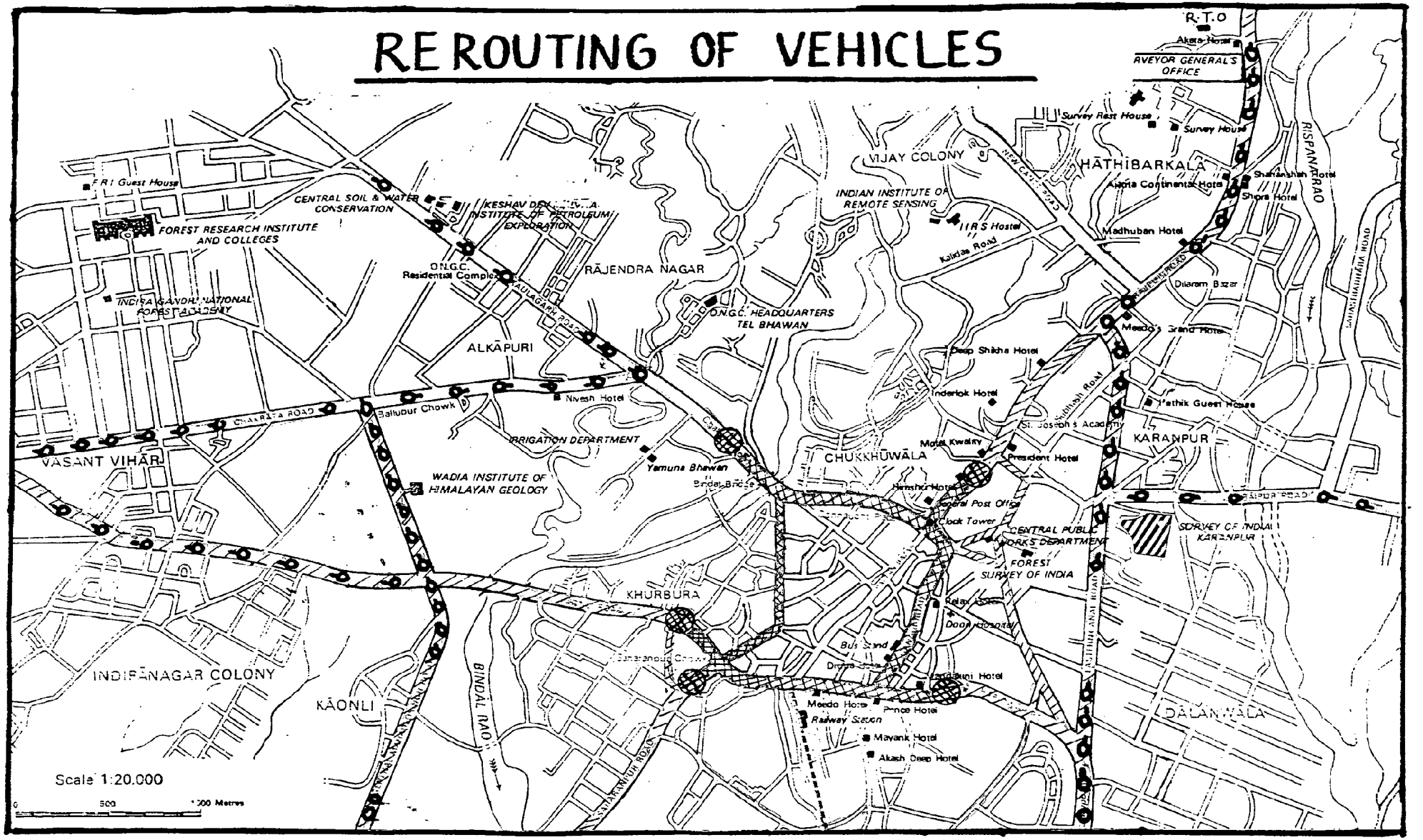
vi) **Pedestrian Facilities:**

The entire project corridor should be provided with foot path facilities along both sides of the road. The critical areas should be further strengthened by strong railing along the footpath in order to discourage the criss-cross movement of pedestrians. The zebra crossing at road junctions should be marked properly. The areas of local markets particularly Paltan Baza abutting the project corridor should be declared pedestrian priority areas.

vii) **Landuse Control:**

The devlopment of multistorey buildings and hazardous landuses should be stopped by enforcing building by - laws. The problematic landuses like on - road vegetable market near Sabzi Mandi, Arat Bazar on Gandhi Road, Vegetable market on Amrit Kaur Road, wood market on Saharanpur Road should be removed or shifted. Many multi-storey shopping as well as

REROUTING OF VEHICLES



ROUTE PROHIBITED FOR VIKRAM

TERMINAL POINT FOR VIKRAM

ROUTE FOR THROUGH TRAFFIC

ROUTE FOR PRIVATE VEHICLE

office complexes like shopping complex on Saharanpur Road, Tula Ram Bazar on Haridwar Road, R.G.M. Plaza on Chakrata Road etc. are cropping in the city without providing any parking space. These type of activities will further aggravate the problem.

viii) **Traffic Education:**

For making the people law abiding and sensitive to the traffic regulation, it is necessary to impart traffic eduction to the citizens through seminars or training programmes to school childern and college students. The on-site demonstrations should be carried out by the traffic police in co-ordination of college students and traffic wardens.

ix) **Strengthening of Traffic Police:**

It is recommended that traffic police should be fully equipped with necessary man power and machinery to regulate the management schemes. They should be authorised to penalise the offenders on the site itself. They should have proper co-ordination with traffic planners and engineers.

x) **Traffic Engineering Cell:**

The administration and traffic police can not function properly without the assistance of traffic

planners. So it is recommended that a separate traffic engineering cell should be engineered to tackle day to day problems of the city or traffic consultants should be retained on some basis.

xi) Other Recommendations:

Besides the above mentioned major recommendations, the other short term recommendations are as follows:

- Tempos (Vikrams) are creating intensive pollution in the city besides their unsafe operation. It is practically eating up the city space and environment. So its operation should be limited under certain policy guide lines and should be totally banned in Gandhi Road. It can be done by making entire Gandhi Road section as Restriction zone for vikram. Vikram must stop before Saharanpur Chowk and beyond Clock tower on rajpur Road. People willing to go to Clock Tower may use Battery operated local Bus or on foot as the distance is walking distance between Saharanpur Chowk and Clock Tower.

- The Sabzi Mandi, Rispana River, Ballupur Chowk and R.T.O. office should be created as dispersal points for regional traffic. So the regional bus services should touch these points.

- The entry of trucks and bullock carts should be banned during day time in the CBD area/ sections of the project road corridor.

7.1.3. Long Term Capital Intensive Solutions:

i) **Construction of New Road Links:**

The orbital movement of traffic in the city is almost missing and the total load falls on the radial coridors. It is suggested that the circular corridors should be indentified and constructed in order to strengthen the orbital movement of traffic.

The proposed by-pass is a good solution for by-passing is a good solution for by - passing traffic. It should be further joined to Mussoorie Road along the Rispana Rao River. Similarly Reetha Mandi Road should be connected with Haridwar Road by creating railway underpass. A circular road along river Bindal should also be constructed to join Chakrata Road to Rajpur Road.

ii) **Provision of Transport Nagar:**

All the transport activities of repair and maintenance including loading/unloading of trucks should be shifted to a well planned Transport Nagar.

It will create an environmentally sound transport system on the project road corridors.

iii) **Decentralisation of Activities:**

The central point of the city has densely populated area including commercial and other allied activities. It is recommended that some of the activities should be decentralised in order to reduce congestion in the central part of the city.

The activities to be decentratised can be listed as follows:

i) Govt. institution and offices like court, Bank, Police fire station, Public works department etc.

ii) Taxi stand infornt of Roadways Bus stand.

iii) Petrol Pumps situated near Prince Hotel crossing.

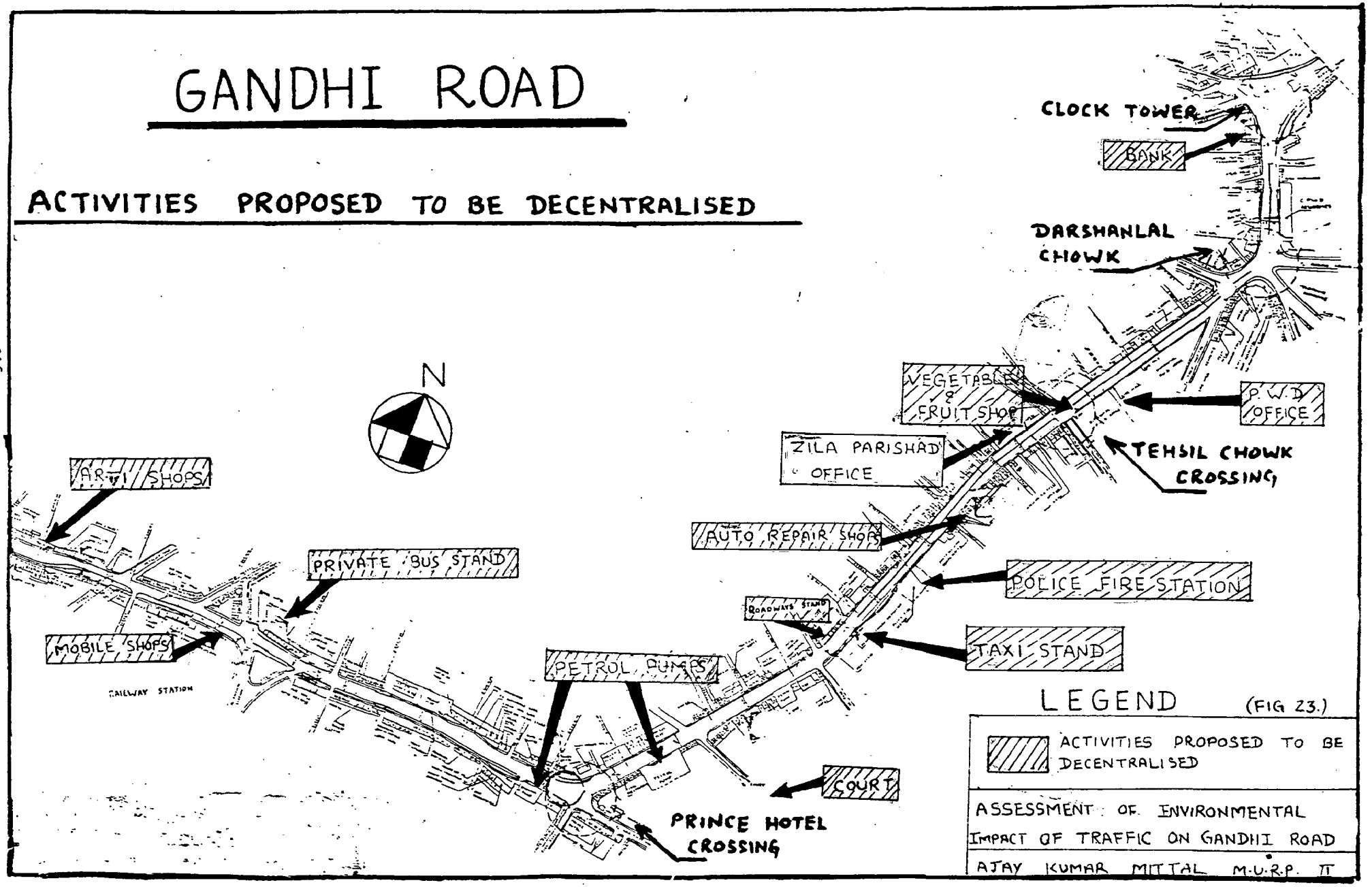
iv) Educational institutions like sadhuram Inter College, Guru Ram Rai School which are located in Paltan Bazar should be shifted.

v) Vegetable and fruit shops situated at tehsil chowk.

vi) Arati shops from Aarat Bazar. There should be a mandi area out side the city on Saharanpur Road so that Arat Bazar may be reshift there.

GANDHI ROAD

ACTIVITIES PROPOSED TO BE DECENTRALISED



iv) **Shifting of Regional Bus Stand:**

The Regional Bus stand is located in the central of the city and all the buses have to pass through the narrow busy roads. It is recommended that the regional bus stend should be shifted to somewhere outskirt near proposed by - pass at Saharanpur Road and the vacated space should be utilised to operate local bus service. It is also suggested that Mussoorie bus stand at railway station is highly problematic and therefore should be shifted to the outskirt of the city somewhere on Rajpur Road.

v) **Self Contained New Townships:**

Dehradun is developing very fast and many new townships are being proposed along the principal corridors. It is suggested that the new townships should be fully self-contained in order to avoid strain to the central part of the city.

vi) **Construction of River Bridges:**

Lal Bridge on Saharanpur Road, and Bindal Bridge on Chakrata Road are the bottle necks for traffic. It is suggested that these bridges should be constructed at the earliest possible. Prabhat Cinema and Krisha Place are opposite to each other and at the release of shows there is total chaos on the

road. First of all they should have disparity in show release time. They should also be enforced to create a common basement under the road in order to seggregate their activities from main traffic flow.

vii) **Construction of Office Complexes:**

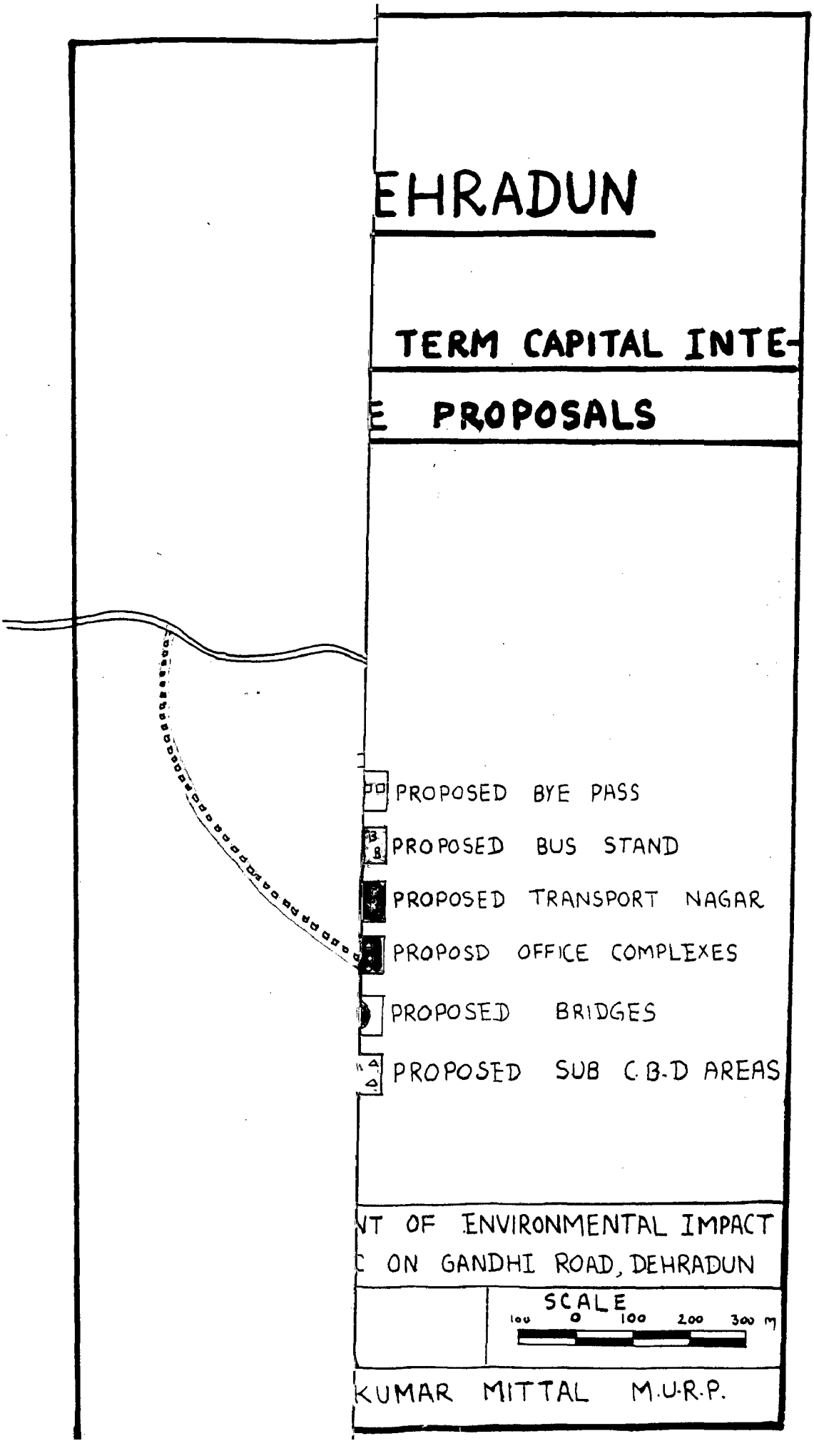
Multistoreyed office complexes should be constructed near residential colonies so that employee may cover small distances and the use of private cars and vehicles may be discourased. A such kind of office complex is proposed in Master Plan of Dehradun by M.D.D.A. on General Mahadeo Singh Road.

viii) **Co-ordination:**

The responsibility of development and maintenance of the project roads and road junctions is divided into many organisations. As the transport system is related to many other activities like electrical lines, telephone lines etc., so it is suggested that there should be an appropriate co-ordination among various organisations during the execution of project as well as afterwards for maintenance of the facilities.

7.2 Conclusion:

a. The fast landuse development as well as physical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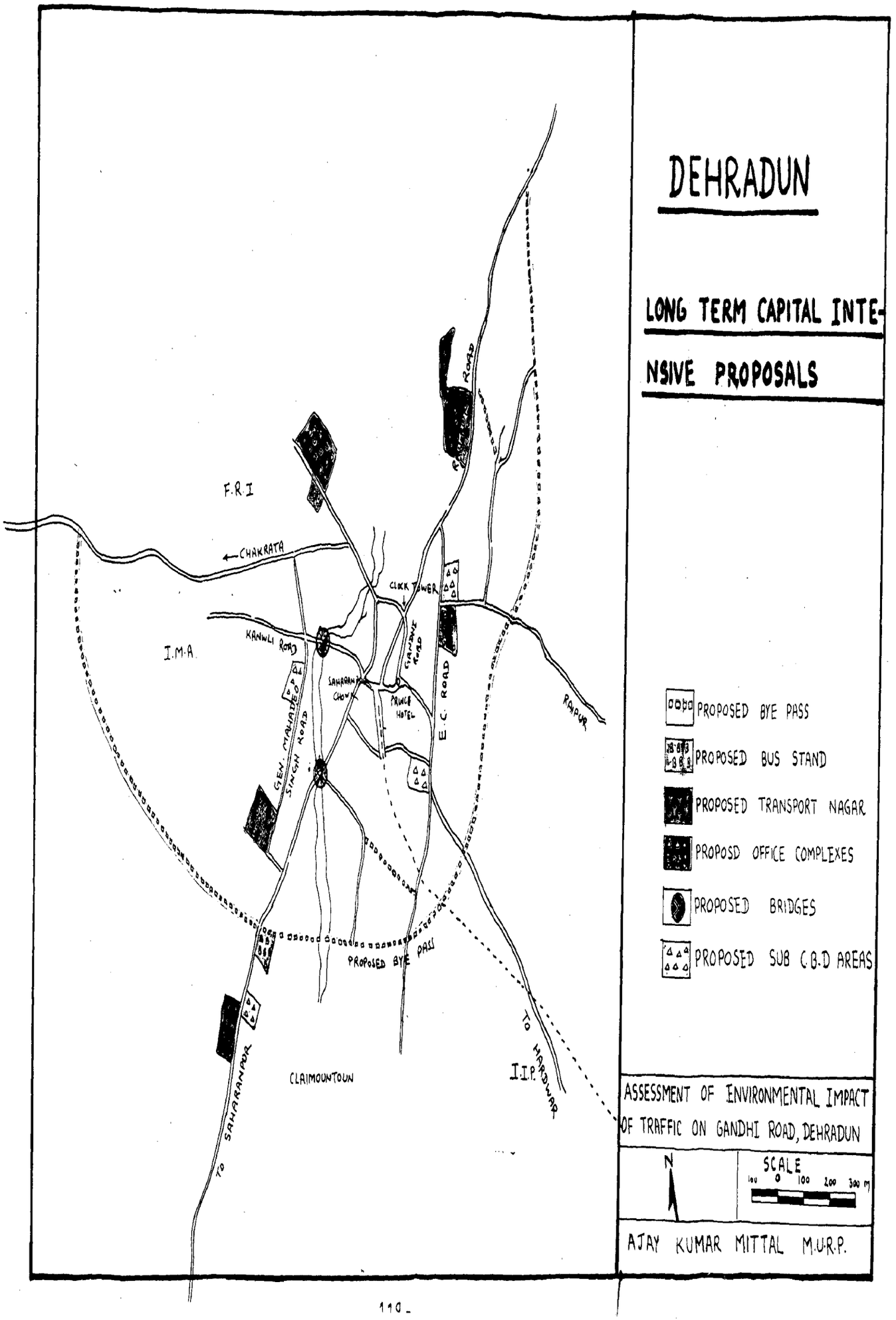
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GEN. MAHADEO SINGH ROAD
E.C. ROAD
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expansion of the city has changed the travel behaviour of the people. The trend projection has indicated that the total population of Dehradun city would be 6.5 lakh by the turn of the century. This is clearly reflecting the anticipated explosive size of the city and thus a complex traffic and transportation system ahead. The ultimate traffic load will strain the existing road network. The surge of population with increased employment opportunities as well as the physical expansion of the city is likely to generate more traffic problems.

b. Considering the physical as well as socio-economic expansion of the city and other travel characteristics, it is anticipated that the traffic growth will be more than normal and also will have a gradual change in its composition. For providing a healthy and environmentally sound transport system in the city, it is necessary to consider a reasonably feasible modal share for satisfying consider a reasonably feasible modal share for satisfying the travel demand by various available modes.

c. Visualising the chaotic traffic conditions, it is desirable to initiate and develop mass transport

system by a gradual shift of modal share from low capacity modes to high capacity modes. Present behaviour of tempoes and autorickshaws is indicative of enforced travel conditions due to lack of public transport system. It is unfortunate that the tempose (Vikrams) are spoiling the city by air pollution and congestion and people are left to bear huge losses unwillingly.

d. Another factor of travel demand scenarios is the use of personalised vehicles which constitute cycles, two-wheelers and cars. Due to lack of reliable public transport system, people are enforced to use personalised modes of transport in the city and this has caused a severe degree of congestion on the roads. The existing road network particularly the project roads are already over-capacitated and causing frequent jamming conditions. So it is highly desirable to discourage the use of personalised modes of transport by various policy measures as well as by improving public transport system. The use of persnalised modes should be re-oriented to supplement the public transport system in the city.

e. Intermediate public transport (IPT) system comprises auto-rickshaws, tempoes and tongas. These are slow speed and low capacity modes and are not suitable in

urban environment particularly on important arterial roads. The IPT modes swqrm every nook and corner of the city causing lot of congestion on the saturated road network. People are forced to use IPT modes as there is no other option or cheaper transport mode available. If the high speed public transport system is developed, the IPT modes on the project roads will automatically be reduced in due course of time. Since the traffic volume on the project corridor is already over - saturated, so it is essentially desirable to discourage the use of IPT modes on project roads. Their operation has to be re-oriented to supplement the public transport system. Also their use can be concentrated in specific areas where they are not a problem but a solution to the transoprt needs of the city.

f. The operation of auto-rickshaws is not regularised and rationalised under any specific norms and standards though their number is very less in the city. This is the most suitable mode of door to door service but the condition of vehicles is very poor and they donot follow fare policy. Due to its fast speed, it is considerable to serve the travel needs but its operation has to be re-oriented under certain policy measures. It is assumed that after

the development of public transport system, its operation has to be limited to supplement the mass transport system. It is further highlighted that its operation should be restricted through proper licensing and fare policy.

Tempoes in the city are large in number comprising 15 -20% of traffic volume. They are exploiting the transportation conditions in the city and currently play the role of public transport modes. Their operation as major public transport modes has to be discouraged.

g. The operation of trucks in the city has created menance in the city. The city being a transit point, the exchange of goods take place. The whole operation is done during day time in the central part of the city. Trucks are parked throughout the day for loading and unloading of the goods in Arat Bazar etc. The entry of Trucks in CBD in day time must be checked.

The above maintioned facts conclude that an appropriate traffic management plan is avitable and an urgency of the city.

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HOURLY TRAFFIC VOLUME

LOCATION : GANDHI ROAD

Appendix I

LOCATION	DIREC.	HOURLY VARIATIONS (VEHS.)																
		6-7	7-8	8-9	9-10	10-11	11-12	12-01	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	TOTAL
AGGARWAL DHARAMSHALA	UP	339	680	1264	1723	1397	1343	1207	1399	1070	1326	1466	1769	1673	1382	772	630	19440
	DN	338	880	1328	1800	1800	1628	1428	1421	1408	1335	1566	1448	1362	993	824	491	20050
	TOTAL	677	1560	2592	3523	3197	2971	2635	2820	2478	2661	3032	3217	3035	2375	1596	1121	39490
DARONA HOTEL	UP	300	618	1221	1307	1391	1452	1216	1059	1196	1378	1374	1783	1773	1291	1007	474	18840
	DN	267	783	1185	1279	1600	1547	1433	1366	1299	1405	1284	1573	1259	1124	580	384	18368
	TOTAL	567	1401	2406	2586	2991	2999	2649	2425	2495	2783	2658	3356	3032	2415	1587	858	37208
TEHSIL	UP	311	499	859	826	1026	1318	1442	1198	1011	1304	1628	1690	1517	1208	764	424	17031
	DN	336	851	1180	1447	1546	1587	1414	1234	949	1030	1176	1308	1159	968	631	303	17119
	TOTAL	647	1350	2039	2273	2572	2903	2856	2432	1960	2334	2814	2998	2676	2174	1391	727	34150

DIRECTION : UP - CLOCK TOWER - SAHARANPUR CHOWK
DN - SAHARANPUR CHOWK - CLOCK TOWER

SOURCE : TRAFFIC SURVEY, BY M.D.D.A.

PEAK HOUR TRAFFIC VOLUME (PCUS)

Appendix II

LOCATION :GANDHI. ROAD . . . . . .

LOCATION	DIRECTION	AVG.DAILY TRAFFIC VOL.			MORNING PEAK HR.VOL.			EVENING PEAK HR. VOL.			PEAK HR.VOLUME AS % OF TOTAL VOLUME	
		FAST	SLOW	TOTAL	FAST	SLOW	TOTAL	FAST	SLOW	TOTAL	MORNING	EVENING
AGGARWAL DHARAMSHALA	UP	13351	5293	18644	1041	601	1642	1069	472	1541	8.81	8.27
	DN	14165	4978	19143	1233	469	1702	1112	395	1507	8.89	7.87
	TOTAL	27516	10271	37787	2274	1070	3344	2181	867	3048	8.85	8.07
		72.82	27.18									
DARONA HOTEL	UP	14073	3711	17784	1072	230	1302	1260	431	1691	7.32	9.51
	DN	13587	3815	17402	1133	390	1523	1129	268	1397	8.75	8.03
	TOTAL	27660	7526	35186	2205	620	2825	2389	699	3088	8.03	8.78
		78.61	21.39									
TEHSIL	UP	12934	2687	15621	896	189	1085	1272	359	1631	6.95	10.44
	DN	12981	2659	15640	1179	257	1436	944	181	1125	9.18	7.19
	TOTAL	25915	5346	31261	2075	446	252	2216	540	2756	8.06	8.82
		82.90	17.10									

DIRECTION : UP - CLOCK TOWER TO SAHARANPUR CHOWK
DN - SAHARANPUR CHOWK TO CLOCK TOWER

SOURCE : Traffic survey, BY. M.D.D.A.

AVERAGE DAILY TRAFFIC VOLUME (6 A.M. - 10 P.M.)

Appendix III

NAME OF ROAD : GANDHI ROAD.....

LOCATION	DIREC.	FAST VEHICLES								SLOW VEHICLES					TOTAL	
		BUS	TRUCK	CAR	VAN	3WHLS	2WHLS	TOTAL VEHS	PCUS	CYCLE	CY.RI	OTHER	TOTAL VEHS	PCUS	GRAND TOTAL VEHS	TOTAL PCUS
AGGARWAL DHARAMSHALA	UP	592	894	1849	229	3111	7407	14082	13351	4859	29	470	5358	5293	19440	18644
	DN	723	907	1971	103	3313	7775	14792	14165	4813	22	423	5258	4978	20050	19143
	TOTAL	1315	1801	3820	332	6424	15182	28874	27516	9672	51	893	10616	10271	39490	37787
DARONA HOTEL	UP	669	687	1902	70	4682	6702	14712	14073	3764	79	285	4128	3711	18840	17784
	DN	696	575	1865	84	4553	6544	14317	13587	3702	29	320	4051	3815	18368	17402
	TOTAL	1365	1262	3767	154	9235	13246	29029	27660	7466	108	605	8179	7526	37208	35186
TEHSIL	UP	459	656	1863	169	5089	4935	13171	12934	3688	42	130	3860	2687	17031	15621
	DN	464	632	2089	68	4980	5111	13344	12981	3620	18	137	3775	2659	17119	15640
	TOTAL	923	1288	3952	257	10069	10046	26515	25915	7308	60	267	7635	5346	34150	31261

DIRECTION : UP - CLOCK TOWER TO SAHARANPUR CHOWK
DN - SAHARANPUR CHOWK TO CLOCK TOWER

SOURCE : Traffic survey, By M.D.D.A.

APPENDIX IV

Table No. 1

SUGGESTED PCU FACTORS BY IRC

S.N.	Vehicle Type	PCU Factor
1.	Passenger Car/Jeep/Van	1.0
2.	Truck	3.0
3.	Bus	3.0
4.	2-Wheeler	0.5
5.	3-Wheeler	1.0
6.	Tractor	1.5
7.	Tractor's Trailor Unit	4.5
8.	Rickshaw	2.0
9.	Cycle	0.5
10.	Horse driven vehicles	4.0
11.	Bullock cart	8.0

Table No. 2

DESIGN NOISE LEVEL/LAND USE RELATIONSHIP

Design Noise Level	Description of land use category
60 dB (Exterior)	Tracts of land in which sensity and quit are of extra ordinary significant & serve an important public need, and where the preservation of those qualities in essential
70 dB (Exterior)	Residences, motels, hotels, public meeting rooms, schools churches, libraries, hospitals.
75 dB	Developed lands
55 dB (Interior)	Residences, motels, hotels.

Appendix V

QUESTIONNAIRE

1. Name of the person
2. Age
3. Location of Shop
4. Work experience in shop (in years)
5. Physilogical status

(a) General Health

Good	Average	below average

(b) (b) Occurance of headache

Not any	Occasional		Frequent	
	Moderate	Severe	Moderat	Severe

(c) Memory loss

No	Yes	
	Occasional	Frequent

6. Annoyance

Nil	Moderate	High

7. Sleep Interference

Reported	Not Reported

8. Speech Interference

Not Reported	Reported

9. Most Annoying Vehicle

Truck	Bus	Car	Motorcycle	Not at all Bothered

VIKRAM

10. Sources of Disturbance of Vehicle

Horns	Speed	Brakes	Engine noise	Not at all Bothered