Transport facilities on land, sea and air are indispensable for economic progress of a nation. Transport on land may be by road, railways or waterways. Pipelines are also used for transport of bulky liquids or gaseous commodities like petroleum or natural gas. Power transportation (transmission in this case) lines help in transport of power from generating units to consumers. Transport is necessary for the exploitation of our vast natural resources. Many of our natural resources remained untapped in the past because of lack of transport facilities in proper proportion. Transport facilities provide basic infrastructure for the development of agriculture, industry, minerals, forests and fisheries and host of other sectors. Fertilizer, high yielding varieties of seeds and other inputs needed for agriculture are sent (transported) to the villages by utilizing transport facilities. Similarly, food grains and commercial crops are transported to the markets. Often, the development of an industry depends on cheap and efficient cost-effective transport of raw materials, supplements, machineries, work force and finished
products. Transport lines are the life lines of a nation. This becomes more evident in emergencies like wars, floods, famines and other natural and man-induced disasters. For defending the frontiers, as well as for national integration efficient cost-effective transport is a must. Quick and efficient means of transport are essential for moving food grains and other essential commodities for people affected by floods, cyclones, droughts and the like.

The significance of transport is essentially felt in a large country like India with diverse people speaking a number of languages. There are innumerable modes of transport and roads hold a place of pride amongst them. They are flexible, feasible, efficient and cost effective. Flexibility is the hallmark of a good road-network. Economic feasibility often tips the balance in favour of road development first and foremost.

Roads are so old that we are not sure of the origin of the word ‘road’. Most experts think it came from the Middle English word ‘rode’ meaning a ‘mounted journey’. This may have come from the old English ‘rod’ from the word ‘ridden’ meaning to ‘ride’.

In England, hundreds of years ago, certain main roads were higher than the surrounding ground. This was because earth was thrown from the side ditches towards
the centre. Because they were higher, they were called ‘highways’. These roads were under protection of the King’s men and were open to all travellers. Private roads were known as ‘byways’.

The first roads in the world probably followed trails and paths made by animals. These trails and paths led from feeding grounds to watering places. People followed these trails to hunt for animals. People also made their own trails and paths in search for water, food and fuel. Explorers followed these trails as they investigated new lands.

Early roads were built in the near east soon after the wheel was invented. This was about 3000 B.C. As trade developed between villages, towns and cities, other paths or trade routes were made. One such early system of roads was the old Silk Route which ran over 6000 miles (9700 km) built by Romans. They knew how to lay a solid base and how to give the road a pavement of flat stones. The Romans knew that the road must slope slightly from the centre towards both sides to drain off water. This gave the road a ‘crown’. The Roman road builders also knew that there must be ditches along the sides of the road to carry water away. Roman roads were built mainly to get soldiers from one part of the empire to another. This seems to be the prominent function of the
roads throughout the world. This was also the case in India with Grand Trunk Road which also catered to this need. Silk Route was a very important road connecting China with Rome and pre-Christian Europe. Merchants used this ancient route to carry Chinese across Turkistan, India and Persia.

The first road markers were piles of stones at intervals. Trails through forests were marked by blazing trees or cutting a piece from the bark of the tree. These were invented out of necessity to measure the journey. It is human nature to measure, to calibrate the entities and even his efforts and endeavours.

The Egyptians, Carthaginians, and Romans, Etruscans all built roads. But the first really great road Trunk Roads catered mainly and primarily to strategic purposes. To this day these are strategic roads and in the times of crisis work to maximum effect. In wars these roads provides logistical support and are used for troop movement also. Roman roads ran in almost straight lines and passed over hills instead of cutting around them. The Romans built more than 50000 miles (80000 km) of roads in their empire and some of them are still in use. Perhaps this was the reason that it was once said that all roads lead to Rome.
In the middle ages, most roads were merely clearings in the forests. There was little reason to build good roads, because most of the travel was on horseback. The cleared way was sometimes quite wide, so that robbers hiding in the woods could not leap out suddenly upon travellers. Later when more wheeled vehicles, such as wagons, came into use, the roads still remained in poor condition.

A Word about Grand Trunk Road

Discussing development of roads all over the world, it will not be out of place to say a thing or two about the Grand Trunk Road which is the focus of this study. Grand Trunk Road is like a river of life to this country, in the old, old days, when Muhammad-bin-Tughlaq, Sultan of Delhi streamlined the country’s roads, bullock-carts and camel caravans were the chief transporters. In 1333, when Moroccan traveller Ibne Battuta visited India, he was deeply impressed by the Sultan’s road network. Sher Shah Suri, who ruled from 1540 till 1545, made further improvements, especially to the Grand Trunk Road. He built caravanserais and inns for travellers, and planted fine trees along it and other important highways. Horsemen, carts and palanquin – bearers jostled for pride of position, much as our motorist do today. Traffic was slow-moving, and the best way to get ahead was to
mount a horse and canter him from station to station, that is, between 12 and 15 miles a day.

When the British consolidated their power in India, they found the Grand Trunk Road, stretching as it did from Calcutta to Peshawar, a great line of communication. Regiment marching down the Grand Trunk Road was a common enough sight throughout the 19th century. During the 1857 uprising, after the British were ousted from Delhi, their relieving army assembled at Ambala and come marching down the G.T.Road to lay siege to the walled city of Delhi. A junior officer, recalling the march, wrote- The stars were bright in the dark deep sky and the fireflies flashed from bush to bush. Along the road came the heavy roll of guns, mixed with the jangling of bits and the clanking of the scabbards of the cavalry. The infantry marched behind with a deep, dull treat Camels and bullock-carts, with innumerable camp servants, toiled away for miles in the rear, while gigantic elephants pulling the heavy guns, and came lumbering down the road.

Invading armies had, of course, made use of the road long before the British gained control of northern India. On this same stretch of road, the Persian invader Nadir Shah defeated the mogul emperor in 1739. In a battle lasting two hours, over 20000 of the emperor's
soldier’s were killed. The next day Nadir Shah marched to Delhi, to sack the city and massacre its inhabitants. The treasure houses of Delhi were fair game for acquisitive kings and warlords.

Some thirty years after the 1857 uprising came the Afghan wars, and the G.T.Road became an all important route for the British army proceeding towards Peshawar and Khyber Pass. Those were the days of military manoeuvres all over north India. Wives and children followed the regiment wherever it was sent, and military camps and cantonments sprang up everywhere.

Notable English poet Kipling immortalized the road in Kim and Barrack-Room ballads (he had a strong empathy with the common soldier), and but for him, few outside of India would have heard of the Grand Trunk Road. But Kipling would not recognize the road today. Cars, buses, trucks, tractors, all thunder down the highway, and even the bullock carts are equipped with heavy tyres. It is a very democratic mix! Perhaps nowhere else in the world are you likely to find such a variety of traffic, or so many impediments to vehicular progress—cows, cart-horses, buffaloes, cyclists, stray hens, stray villagers, stray policemen.

"Proceed At Your Own Risk" one could call this the motto of the road, a motto vividly illustrated by overturned
lorries lying in ditches, buses upended against trees or
dangling over culverts, fancy cars crushed into concertina
shapes, squashed cats and dogs, mangled drivers and
passengers. These are common sights, along with the
endless panorama of field, factory, village or township.

For the towns and cities grow bigger by the day;
they spread octopus-like over the rural landscape, and the
traffic spills out in an endless, honking procession of
humankind on wheels. "O.K. TATA", proclaims the truck in
front of you, and it would be wise to keep your distance.

The Grand Trunk Road may not be sacred as the
Ganga, which it greets at Kanpur and Varanasi, but it is
just as permanent. It’s a river of life, a meandering stream
of humanity going places, intent on arriving and getting
these most of the time.

**Road Development in Earlier Times**

Realizing the importance of land transport, the
ancient Hindu and Moslem rulers laid great emphasis to the
construction of highways linking the far corners of their
empires. Some of the roads may be traced back to the
medieval periods and they were laid for movement of
troops. Villages were linked with one another and with a
market town by cart tracts. Animal drawn carts and horses
were the only mode of travel. These cart tracts could be
used only in the dry season as they become slushy during
the rainy season. Absence of bridges across rivers also made the roads impossible during the rainy season. Volume of traffic was small at each region but relatively self sufficient. There was no regional specialization then as has developed at the present time.

Roads provide the most fundamental mode of transport in a modern society. The railways and airways reach only places of considerable regional importance, whereas the feeder service is done by the road which connects countless number of towns and villages, factories, farms, mines and even the remote areas. A considerable amount of surface transport is carried out by roads. Although the history of road construction in India goes back to the 4th century B.C., when Emperor Asoka built a network of roads in his Empire, the present road system in the country is quite inadequate and primitive when compared to the advanced countries of the world.

Road Development in India

Transport plays a very significant role in human society. It is the de facto barometer of economic, social and commercial progress, and carries ideas and inventions to the people and has considerably contributed to the evolution of civilization (Ogburn, W.F., 1964). It has also greatly helped nations in the spread of urbanization. There
are various modes of transport but road transport is certainly one of the most important.

Table 1: Indian road network of 33 lakh Km. is second largest in the world and consists of:

<table>
<thead>
<tr>
<th>Type</th>
<th>Length (In Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressways</td>
<td>200</td>
</tr>
<tr>
<td>National Highways</td>
<td>66,590</td>
</tr>
<tr>
<td>State Highways</td>
<td>1,31,899</td>
</tr>
<tr>
<td>Major District Roads</td>
<td>4,67,763</td>
</tr>
<tr>
<td>Rural and Other Roads</td>
<td>26,50,000</td>
</tr>
<tr>
<td>Total Length</td>
<td>33 Lakhs Km (Approx)</td>
</tr>
</tbody>
</table>

*Source: website of National Highway Authority of India, [www.nhai.org](http://www.nhai.org)

The modern period of road development in India begins with the submission of the Jayaker Committee Report when the Government of India accepted the responsibility of road construction. A concrete step was taken in 1943 when the famous Nagpur Plan was prepared (Ogburn, W.F., 1964). According to this plan, roads were classified into National Highways, Provincial Highways (now state highways), major district roads, minor district roads and village roads.

A special feature of post-independence era is the construction of *kachcha* (non-metalled and approach roads.
under the Community Development and other programs similar to it linking thousand of villages with each other and with other roads leading towards the towns. Following are some figures and tables showing the progress of road construction and growth of traffic since 1951.

Table 2: Progress of Road Construction (length in 000 km)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metalled</td>
<td>157</td>
<td>263</td>
<td>407</td>
<td>724</td>
<td>888</td>
</tr>
<tr>
<td>Non-Metalled</td>
<td>243</td>
<td>264</td>
<td>880</td>
<td>1010</td>
<td>955</td>
</tr>
<tr>
<td>Total</td>
<td>400</td>
<td>527</td>
<td>1287</td>
<td>1734</td>
<td>1843</td>
</tr>
</tbody>
</table>

Though India had roads linking major regions with one another, these roads, did not have a strong smooth surface for automobiles. The British were content with the development of railway network and they did not take steps to build modern roads except those of strategic value for movement of troops. Realising the importance of roads for economic development, a 10 year road development scheme called the Nagpur plan was prepared. It aimed at increasing the road length in India from 265000 km in 1944 to 400000 km in 1954. This plan adopted for the first time a systematic classification of roads on a functional basis as:
(a) National Highways

(b) State Highways

(c) District Roads

(d) Village Roads

The *Nagpur plan* was a very good plan and a completion it would here transformed the road network but could not be implemented owing to the paucity of funds. To this day it is relevant due to being first methodical approach and having functional and systematic classification of roads.

Major development in road construction took place during the five year plan periods. Adequate funds were provided in the plans for improving the existing roads and laying new roads by central and state governments. During the first three five year plans and the three annual plans a total outlay of Rs. 1104 crores was spent on road development. The expenditure during the IV, V and VI plan (outlay) on road development were Rs. 862 crores, Rs. 1353 crores and Rs. 3439 crores respectively. The outlay for road development in VII plan was Rs. 5200 crores comprising Rs. 1019.75 crores in central sector, Rs. 3666.98 crores in union territories sector. A twenty year road plan was prepared in 1961. It was planned for increasing road length from 656000 km to 1060000 km during the twenty year period. The plan envisaged the
completion of two lane carriage way on all the national highways. The other objectives of the plan were:

(a) To bring every village in a developed agricultural area within 6.4 km of metalled road and 2.4 km of any other road.

(b) To bring every village in a semi-developed area within 12.8 km of a metalled road, and

(c) To bring every village in an undeveloped and uncultured area within 19.2 km of a metalled road and 8 km of any other road. The total cost of twenty year plan was estimated to be about Rs. 5200 crores. This plan has been implemented in most parts of the country.

The preceding table shows that the maximum growth has occurred after 1961. The length of the surfaced roads has increased by 465% and the length of non-metalled roads has grown by 338% during the period 1950-51 to 1982-83.

Road transport plays an important role in the economy of the country and is particularly suitable for short and medium distances. It offers flexibility, reliability, speed and door-to-door service. For short and medium distance it often proves to be cheaper mode of transport. Road-transport forms an indispensable element of the national transportation system.
About 65% of freight and 80% passenger traffic is carried by the roads.

National Highways constitute only about 2% of the road network but carry about 40% of the total road traffic. Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years. It is in this backdrop that the government has embarked on a programme to widen and strengthen them at a cost of over Rs. 185873 crores.

National Highways are the major roads linking state capitals, major ports and cities and towns of national importance. Under the National Highway Act 1956, the central government is directly responsible for the construction and maintenance of National Highways. A total length of national highways was 33612 km on 31\textsuperscript{st} March 1986, 4581 km of missing road links including diversions were constructed, 22995 km of roads were improved so as to reduce their gradient, 23933 km of roads were widened and strengthened to make it a two lane highway and 427 major bridges were constructed. Thus the national highways ensure smooth flow of traffic along the major trunk routes. Though the national highways constitute only 2% of the total road length, they carry nearly 33% of the volume of road traffic, thus indicating their importance. Though in terms of total length
of roads, India is one of the leading countries, yet the position in relation to total area or total population is not satisfactory when compared to other nations of the world. India has 50 km of roads per 100 sq. km. of area. Japan has 270 km, Belgium 300 km and UK 146 km per 100 sq. km of area. In terms of population India has 200 km of road per 100,000 of population. Japan has 970 km, Belgium 950 km, UK 641 km, USA 2900 km per 100,000 of population. Thus the existing road network is inadequate both in terms of area and in terms of population.

**Golden Quadrilateral**

The Golden Quadrilateral (GQ) is the largest express highway project in India. It is the first phase of the National Highways Development Project (NHDP), and consists of building 5,846 kilometres of four/six lane express highways connecting Delhi, Mumbai, Kolkata and Chennai (thus forming a quadrilateral of sorts), at a cost of Rs. 60,000 crores (US$ 12.317 billion) (at 1999 prices) (Rs 580 billion). The National Highways Authority of India has produced statistics to indicate that, as of September 2007, 96% of the entire work has been completed. However, these statistics appear to be misleading: in practice, road works are still a major feature of certain sections of the Golden Quadrilateral. For example, the statistics indicate
that the Delhi to Mumbai section is 100% complete, whereas in reality there are a number of sections which are still single carriageway and in very poor repair (for

Fig. 2
example the stretch to Ahmedabad in Gujarat). The whole project is a few years behind schedule, due mainly to issues with the various states about giving up land for the national highway and the termination of several contracts which take 6 months to be issued. In January, 2008 it was announced that the project will now be expanded to cover 6,500 kilometres, some portions of which will developed into eight lanes.

Source: NHAI website  Fig. 3
Chapter II Settlement Development and Highways

The GQ project is managed by the National Highways Authority of India (NHAI) under the Ministry of Road, Transport and Highways. The Mumbai-Pune Expressway, the first controlled-access toll road to be built in India is a part of the GQ Project though not funded by NHAI. Infrastructure Leasing & Financial Services (IL&FS) has been one of the major contributors to the infrastructural development activity in the GQ project.

The Golden Quadrilateral project envisages four-laning of 5846 km of roads connecting the four metros of the country has been completed to the extent of 87 percent. About 5079 km of roads have already been four laned.

The Delhi-Mumbai corridor, with a total length of 1419 km, has been fully completed. On the Mumbai-Chennai section 1145 km has been four laned out of the total length of 1290 km. On the Chennai-Kolkata section 1462 km has been four-laned out of a total length of 1684 km. On the Kolkata-Delhi section 1071 Km of roads have been four-laned out of a total of 1453 km.

Under agreements reached with Social Commission on Asia and Pacific (ESCAP), important national highways have been linked with the capitals of adjoining countries like Pakistan, Nepal, Bhutan, Bangladesh and Burma.
These links have been financed by World Bank. The World Bank has also financed major arterial roads such as Agra-Mumbai Road, Delhi-Multan Road, Bangalore-Chennai Road and Golaghat-Laos Road.

**Table 3: Status of National Highways on February 28, 2007**

<table>
<thead>
<tr>
<th>Type of Highway</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Lane/ Intermediate Lane</td>
<td>35%</td>
</tr>
<tr>
<td>Double Lane</td>
<td>55%</td>
</tr>
<tr>
<td>Four or More Lane Highways</td>
<td>10%</td>
</tr>
</tbody>
</table>

In India roads carry about 80% of passenger traffic and 60% of total freight traffic. The main problem in road traffic is the poor condition of roads in most states. Maintenance of roads is also not satisfactory. In rainy season, roads cannot be used at all specially in the Great Northern Plain. The bar diagram shows that the growth of road network is not commensurate with vehicle growth (growth in number of vehicles). Another figure shows that there has been a major shift in transportation made from Railways towards the Road sector. So the pressure on road network has increased both due to growth in number of vehicles and due to modal shift from railways to road-sector.
### Table 4: Total Length of Highways in India

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the State/Union Territory</th>
<th>Length (km)</th>
<th>Sr.No.</th>
<th>Name of the State/Union Territory</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>4472</td>
<td>16</td>
<td>Madhya Pradesh</td>
<td>5200</td>
</tr>
<tr>
<td>2</td>
<td>Arunanchal Pradesh</td>
<td>392</td>
<td>17</td>
<td>Maharashtra</td>
<td>4176</td>
</tr>
<tr>
<td>3</td>
<td>Assam</td>
<td>2836</td>
<td>18</td>
<td>Manipur</td>
<td>959</td>
</tr>
<tr>
<td>4</td>
<td>Bihar</td>
<td>3537</td>
<td>19</td>
<td>Meghalaya</td>
<td>810</td>
</tr>
<tr>
<td>5</td>
<td>Chandigarh</td>
<td>24</td>
<td>20</td>
<td>Mizoram</td>
<td>927</td>
</tr>
<tr>
<td>6</td>
<td>Chhattisgarh</td>
<td>2184</td>
<td>21</td>
<td>Nagaland</td>
<td>494</td>
</tr>
<tr>
<td>7</td>
<td>Delhi</td>
<td>72</td>
<td>22</td>
<td>Orissa</td>
<td>3704</td>
</tr>
<tr>
<td>8</td>
<td>Goa</td>
<td>269</td>
<td>23</td>
<td>Pondichery</td>
<td>53</td>
</tr>
<tr>
<td>9</td>
<td>Gujarat</td>
<td>2871</td>
<td>24</td>
<td>Punjab</td>
<td>1557</td>
</tr>
<tr>
<td>10</td>
<td>Haryana</td>
<td>1468</td>
<td>25</td>
<td>Rajasthan</td>
<td>5585</td>
</tr>
<tr>
<td>11</td>
<td>Himachal</td>
<td>1208</td>
<td>26</td>
<td>Sikkim</td>
<td>62</td>
</tr>
<tr>
<td>12</td>
<td>Jammu &amp; Kashmir</td>
<td>823</td>
<td>27</td>
<td>Tamil Nadu</td>
<td>4183</td>
</tr>
<tr>
<td>13</td>
<td>Jharkhand</td>
<td>1805</td>
<td>28</td>
<td>Tripura</td>
<td>400</td>
</tr>
<tr>
<td>14</td>
<td>Karnataka</td>
<td>3843</td>
<td>29</td>
<td>Uttar Pradesh</td>
<td>5599</td>
</tr>
<tr>
<td>15</td>
<td>Kerala</td>
<td>1440</td>
<td>30</td>
<td>Uttarakhand</td>
<td>1991</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>31</td>
<td>West Bengal</td>
<td>2325</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>32</td>
<td>Andaman &amp; Nicobar</td>
<td>300</td>
</tr>
</tbody>
</table>

(Source: NHAI Website)
Sustainability Issues in Highway Transportation

Highway transportation affects all four dimensions of sustainability. The issues raised by highway transportation are likely to be intensified in the future as mobility needs increase. Many of those in the 85% of the global population who do not own an automobile are likely to purchase one in the near future (Hawken, P., Lovins, A., & Lovins, L. H. 1999). Forecasts imply a rapid increase in global highway travel, doubling from 1990 to 2020, and then redoubling again by 2050. This increase in mobility will challenge the attainment of long-run sustainability.

The principal ecological problems of road transportation are emissions, noise, and land use. The transportation sector is the fastest-growing and most intractable source of carbon dioxide emissions (Hawken et al., 1999). The emission of gases and particles leads to changes in atmospheric composition, causing harm on local, regional (acid rain, smog), and global (melting polar ice caps and rising sea levels) scales.

The economic dimension of sustainability injects the concept of economic efficiency into sustainability. An efficient economic system corrects for market failures, achieves cost effectiveness, and achieves the highest return on all capital (financial, human, physical, and natural capital). The social costs of highway transportation due to congestion, traffic delays, accidents, roadway
damage, land use, and other side effects have been estimated by (Miller and Moffet, 1993) at more than a trillion dollars. Unless these costs are internalized into production and consumption decisions, they will cause economic inefficiency.

One of the goals of sustainable development can be described as sustaining or improving the quality of life of all people, now and in the future (World Commission on Environment and Development [WCED]. The social equity concerns of highway-related transportation are focused on access, congestion relief, health, and the effects of noise and pollution on various populations—the poor, the disabled, and the powerless. Pollution has particularly adverse effects on children and the elderly, which exacerbates intergenerational equity.