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Introduction :-

In the modern world, speed has become the measure of economic development of a nation and indication of speed can be judged only from the means of transport available in different parts of the country. In a village, life moves at a slow pace, but in a city, everything appears to be dynamic. The bigger the city, the greater the rush. Aeroplanes, railway trains, automobiles, boats and steamers, which are symbols of activity and hence of speed, indicate that people are being engaged in creating wealth.

History and Importance of Highways

- An effective system of transport is therefore, essential, for economic prosperity and industrial development.
- In fact, transport facilities in a country can be rightly compared to arteries in human body.
- Just as arteries maintain man's health by enabling circulation of blood, means of transport increase a nation's health by keeping people and goods in moving.
- Unless the roads are there, the railways can serve no more than a fractional portion of territory.

Characteristics of Road Transport

- i) Roads are used by various types of road vehicles, like passenger cars, buses, trucks, two and three wheeled automobiles, pedal cycles and animal drawn vehicles.
- ii) Road transport requires a relatively small investment for the government. Motor vehicles are much cheaper than others. Carries like rail locomotives and wagons, water and air carriers.
- iii) Road transport offers a complete freedom to road users to transfer the vehicle from one lane to another and from one road to another, according to the need and convenience.
- iv) In particular, for short distance travel, road transport saves time. Trains stop at junctions and main stations for comparatively longer time.
- v) Speed of movement is directly related with the severity of accident. The road safety decreases with increasing dispersion in speed.
- vi) Road transport is the only means of transport that offers itself to the whole community alike.

Current road Development plans in India

Road Development Plan Vision 2021

IRC published the 'Road development' Plan Vision 2021 in the year 2007. The major thrust areas covered in this vision document relate to mobility in respect of main roads and accessibility in respect of rural roads to connect all the villages in the country. In a time bound programme

1. Connecting major ports, industrial complexes, important growth nodes, pilgrimage and tourist centres.
2. Filling up the grid of 100km square side, in pockets of pockets of various regions without a NH.
3. Providing linkages with adjoining countries.
4. connecting capitals of the states being carved out now or likely in future.

* It was further proposed that the State Highways be increased from 124300 km by 2001 to 160,000 km by 2021; keeping in view the following factors.

1. providing linkage with minor ports, industrial towns, pilgrimage and tourist centres.
2. connecting the remaining towns with population 5000 and above.
3. connecting the capitals of newly carved out states with the district head quarters.

→ By the end of 2000, Only 54% of villages in the country were connected by roads. The goal set for village roads was to connect all villages with a population below 500 by the end of 2010. The work of further improvement of village roads and additional links, where necessary, was proposed to be taken up in the subsequent decade (2011-2021)

Present status of Roads in India

Indian Roads are one of the largest road networks in the world. The total length of roads in the country is estimated to be around 38.41 lakh kms.

→ The length of National highways, also termed

primary roads, is 76818 km at the end of 11th five year's plan (March 31, 2011). This constitutes about 22% of the total length of roads, but caters to 40% of the total road traffic. Out of the total of 76818 kms, of NH, 30537 kms were constructed by the National Highway Authority of India [NHAI] Under the National highway development program [NHDPP], 4982 kms constructed by the states.

NHDP and the remaining 3798 kms by the border roads organisation (BRO). At present, out of 76818 kms of NH, about 23% length is of 4 lanes and above standard, 54% length is of two lanes standard and 23% length is of single and intermediate standard. Despite the progress in NH, only 23% of whose total length is wider than two lanes, leading to heavy congestions. Short falls in the construction of Bypasses, inadequate capacity, insufficient pavement thickness and weak, narrow and distressed bridges / culverts are some of the other deficiencies.

Highway Development in India

Roads in Ancient India

The excavation of Mohenjo-Daro and Harappa have revealed the existence of roads in India. As early as 25 to 35 centuries BC. Old records reveal that in Early Periods, the roads were considered indispensable for administrative and military purposes.

Roads in Mughal Period

During the Pathan and Mughal Periods, the roads of India were greatly improved. Some of the highways either built or maintained by Mughals received great appreciation from the foreign visitors, who visited India during that period. Roads were built running from North West to the Eastern areas through the Gangetic planes, linking also the coastal and Central Point.

Roads in Nineteenth Century

At the beginning of British rule, the conditions of roads deteriorated. The economic and political shifts cause main damage to the great extent in the maintenance of road transportation. The fall of mughal emperor lead therefore, to the scant attention to the communication. In fact, these roads connected important military & business centres.

Highway Planning

The first attempt were for proper planning of the highway development program in India on a long term basis was made at the Nagpur Conference in 1943, as indicated in art. After the completion of Nagpur Road Plan, targets, the second 20 years plan was drawn for the

Period of 1961, to 1981. The Third 20 years development Plan for the period 1981-2001 was apprved only by the year 1984.

Highway Alignment

The position or the layout of the centre line on the highway on the ground is called the Alignment. The horizontal alignment includes the straight path and the horizontal deviations and curves. changes in gradient and vertical curves are covered under vertical alignment of the roads.

A new road should be aligned very carefully as improper alignment would result in one or more of the following disadvantages.

- a) Increase in Construction cost
- b) Increase in maintenance cost
- c) Increase in vehicle operation cost
- d) Increase in accident rate.

Engineering Survey for highway alignment

Before a highway alignment is finalised in highway project, the engineering surveys have to be carried out. The surveys may be completed in four stages. The first three stages consider all possible alternate alignment keeping in view the various requirements of highway alignment as discussed in Art 3.1.2.

The fourth stage is meant for the detailed survey of the selected alignment

The stages of the engineering surveys are

(a) Map study

(b) Reconnaissance

(c) Preliminary surveys

(d) Final location & detailed surveys.

(a) Map Study:-

If the topographic map of the area is available, it is possible to suggest the likely routes of the road. The probable alignment can be located on the map from the following details available on the map:

(a) Alignment avoiding valleys, ponds or lakes

(b) When the road has to cross a row of hills, possibility of crossing through a mountain pass.

(c) Approximate location of bridge site for crossing rivers, avoiding bend of the river, if any.

(b) Reconnaissance

The second stage of survey for highway location is the reconnaissance to examine the general character of the area for deciding the most feasible route for detailed studies. A field survey party may be inspect a fairly broad sketch of land along the proposed alternative routes of the map in the field. Only very simple instruments like Abney level, tangent clinometer, barometer etc. -

Preliminary Survey

The main Objectives of the Preliminary survey are:

- i, TO Survey the various alternate alignment proposed after the reconnaissance and to collect all the necessary physical information and details of topography (damage and soi)
- ii, TO Compose the different proposals in view of the requirements of a good alignment
- iii, TO estimate Quantity of earthwork Materials and other construction aspects and to workout the cost of alternate proposals
- iv, TO finalise the best alignment from all considerations

* The preliminary survey is carried out to collect all the physical information which are necessary in connection with the proposed highway alignment. The Preliminary survey carried out by any one of the following methods:-

- (a) Conventional Approach, in which a survey party carries out surveys using the require field equipment, taking measurements, collecting topographical and other data and carrying out soil survey.
- (b) Modern Rapid Approach by serial survey taking the require aerial photograph and, by photogrammetric method and photo-interpretation techniques.

Final location and Detailed Survey

Location

The centre line of the road finalised in the drawings is to be translated on the ground during the location survey. This is done using a transit theodolite and by staking of the centre line. The location of the centre line should follow, as closely as practicable, the alignment finalised after the preliminary survey. Major and minor control points are established on the ground and centre pegs are driven, checking the geometric design requirement.

Detailed Survey

Temporary benchmarks are fixed at intervals of about 250metre and at all drainage and underpass structures. Levels along the final centre line should be taken at all staked points. Levelling work is of great importance as the vertical alignment, earthwork calculations and drainage details are to be worked out from the level notes.

Highway Project

General

In a new highway project, the engineer has to plan, design and construct either a network of new roads or a road link. There are also projects requiring re-design and re-alignment of existing roads or upgrading the geometric design standards.

New Highway Project

The New highway project work may be divided into the following stages:

- i, selection of route, finalisation of highway alignment and geometric design details.
- ii, collection of materials and testing of subgrade soil and other construction materials mix design of pavement materials and design details of Pavement layers.
- iii, construction stages including Quality Control

Route Selection

The Selection of route is made keeping in view the requirements of alignment and the geological, topographical and other features of the locality as explained in Art 3.2. After the alignment is finalised, the plans and working drawings are prepared.

Materials and design

The Soil samples collected from the selected route during the Soil surveys are tested in the laboratory in order to design the pavement thickness required and the design of embankment and cut slopes.

The basic construction materials such as selected soil, aggregates etc. are collected from the nearest barrow pits and quarries and stacked along the road's alignment after subjecting

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these materials to the specified laboratory tests. In order design the mixes for the pavement component layers and to specify Quality control test values during road construction, mix design tests are carried out in the laboratory.

Construction

The construction of the road may be divided into two stages viz; (i) Earthwork (ii), Pavement construction. The earthwork consists of excavation and construction of the embankments. During the excavation for highway cuts, the earth slopes, their protection and construction of drainage network are taken care of. Highway embankment may be best constructed by rolled-fill method by compacting the soil in layers under controlled moisture and density using suitable rollers.

Highway drawings and Reports

The following drawings are usually prepared in a highway project

- i, Key map
- ii, Index map
- iii, Preliminary Survey Plans
- iv, Detailed Plan and Longitudinal section.
- v, Detailed cross-section
- vi, Land Acquisition plans
- vii, Drawings of cross drainage & Other retaining structures

viii, Drawings of road intersections
ix, Land Plans showing quarries etc.

Key map:- Should show the proposed and existing roads, and important places to be connected.

Index map:- Should show the general topography of the area. The details are symbolically represented.

Preliminary survey:- Plans showing details of the various alternate alignments and all informations collected should be normally drawn to scale of 10cm = 1km to 25cm = 1km

Detailed Plans:- Show the ground plan with alignment and the boundaries, contours at intervals of 1 to 2 meters in plain country a scale of 1/2400 and in close country.

Longitudinal Sections:- should be drawn to the same horizontal scale of ground as in detailed plan.

Detailed cross-sections are generally drawn to natural scale of 1cm = 20 to 2.5m, Cross Section should be drawn every 100m or where there are abrupt changes in level.

Land acquisition Plans and Schedules:- Are usually prepared from the Survey drawings for land acquisition details. These Plans show all general details such as buildings, wells, nature of gradient and other details.

Detailed design for cross drainage and masonry structures are usually drawn to scale of 1cm = 1m.

Land plans for quarries where quarries for construction materials are to be acquired for new projects, separate land plans should be prepared.

Detailed Project Report Preparation

The project Report contains documents of the following

1. The Project Report
2. Estimate
3. Drawings.

* The Project Report is an important component of the project documents and it should give a comprehensive idea of the nature of the work involved and an appreciation of the proposal.

→ The Project Report is an information on all aspects of the scheme and should be grouped as indicated below:

1. Preliminary

- * Nature of work and its scope
- * Authoring, Plan provision
- * History, geography, terrain, Climate
- * Necessity.

2. Road features

- * Route selection

- * Alignment

- * Environmental factors

- * traffic

- * cross-sectional elements

3. Road design and specification

- * Geometric design standards

- * Road design

- * Pavement design

- * Masonry works

- * Specifications

4. Drainage facilities

- * General conditions, HFL, water-table, seepage flows

- * surface drainage, catch-water drains, longitudinal drains.

- * sub-surface drainage, blanket courses, sub-drains

- * cross drainage structures

5. Material, labour and plant

- * Sources of construction material, transport

- * labour availability, amenities

- * Equipment

6. Rates

- * Schedule of Rates

- * Justification of rates.

7. Construction Programming.

- * Working season.

* Schedule of completing the work.

8. Miscellaneous

* Rest houses, temporary quarters

* Diversion and haul roads

* Site amenities

* Traffic control device etc--

* Road-side plantation, turfing, landscaping.

9. Economic Appraisal

* Costs and benefits

* Time Horizon

* Interest Rate

* Results of appraisals.

Stages in Project Preparation

Highway project preparation is carried out in the following stages

1. Project Identification / Pre-Feasibility

2. Feasibility

3. Detailed Engineering

4. Preparation of tender documents.

PPP Schemes of Highway development of India

→ The two models of PPP adopted in India for the development of National Highways are BOT (TOI) and BOTC (Annuity).

→ Owing to constraints of public funding, Public private Partnership (PPP) has come to play a

major role in the development of national highways. The National Highways Act, 1956 was amended in 1995 with a view to enabling private investment in development, maintenance and operation of highways.

→ The National Highways, the Government Initiated several other measures in this direction such as declaration of road sector as industry to facilitate borrowing on easy terms and reduction of custom duties on construction equipment.

Models of PPP adopted in India

(a) BOT (TOII) Model:- In the BOT (TOII) model, the concessionaire recovers his investment by charging toll from the users of the road facility. This model reduces the fiscal burden on the government while also allocating the traffic risk to the concessionaire.

(b) BOT (Annuity) model:- Under a BOT annuity model, the concessionaire is assured of a minimum return on his investment in the form of annuity payments. The concessionaire does not bear the traffic risk and the government bears the entire risk with respect to toll income.

Projects awarded under BOT(Toll) and BOT(Annuity)
during Eleventh Five Year Plan

	BOT (Toll)		BOT (Annuity)	
Year	No. of Projects	Length km	No. of Projects	Length km
2007-8	8	1,109	1	36
2008-9	8	643	-	-
2009-10	34	3085	3	192
2010-11	28	3057	20	1577
2011-12	47	6231	2	247
Total	125	14126	26	2032

Government of India Initiatives in developing the highways and expressways in improving the mobility and village road development in improving the accessibility.

- In FY21, 13,298 kms of highway was constructed across India
- The Government aims to construct 65,000 kms of National highways at a cost of ₹35 lakh crore Rupees (US \$741.51 billion) by 2022
- To transform road infrastructure in Punjab, Haryana, and Rajasthan, the Indian Government

has planned to construct roads extending 313kms for Rs. 11,000 Crore (US \$1.43 billion)

→ In October 2021, the government issued a notice related to concessions under the vehicle scrapping Policy (effective from April 2022) to encourage vehicle owners towards discarding old vehicles which have higher fuel consumption costs

→ India has the second-largest road network in the world, spanning a total of 5.89 million kilometers. This road network transports 64.5% of all goods in the country and 90% of India's total passenger traffic use road network to commute.

→ Road transportation has gradually increased over the years with improvement in connectivity between cities, towns and villages in the country.