

POSTAL Book Package

2023

CIVIL ENGINEERING

Highway Engineering

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Highway Development & Planning

Q1 Briefly describe the factors which are considered in the planning and decision making process for a highway.

Solution:

Factors which are considered during decision making process of highway are as following:

- (i) **Social factor:** Factors such as population growth, current population, land use, congestion, travel patterns, existing transport facilities etc. are considered during decision making process of highway planning.
- (ii) **Historical factor:** Factors such as preservation of historical sites and building during highway construction are also considered.
- (iii) **Economic factors:** During highway planning total cost, current funds, alternate options, benefits, internal rate of return, utility of roads per unit length, commercial benefit and other economic advantages and disadvantages are also considered.
- (iv) **Geographical factor:** Topography, geology, highway location, cost of right of way are also considered.
- (v) **Environmental factor:** Effect of environment due to highway project both during construction and operations, and methods to mitigate the hazardous effect on environment also considered.
- (vi) **Traffic factor:** Factors such as trip purpose, orientation, parking availability, peak per hour volume, safety, freight movement are also considered.
- (vii) **Code and legal factors:** Factors such as building codes, zoning ordinances, regulations, other laws affecting the highway project are also considered.

Q2 Briefly describe planning surveys for highways. How are these used and interpreted?

Solution:

Highway planning phase includes:

- (i) Assessment of road length requirement for an area.
- (ii) Preparation of master plan showing the phasing of plan in annual and or five year plans.

The planning surveys consists of following studies, the details are as follows:

(a) Economic studies

In order to estimate the economics involved and to give economic justification for each plan, economic studies are to be undertaken. Details to be collected include:

- (i) Population and its distribution.
- (ii) Trend of population growth.
- (iii) Agricultural and industrial products, areawise.
- (iv) Existing communication, recreation and education facilities.
- (v) Per capita income.

(b) Financial studies

Financial studies are essential to study the financial aspects like sources of income and manner in which funds for the project may be mobilized. Following details should be collected:

- Sources of income and estimated revenue from taxation on road transport.
- Living standards.
- Resources at local level, toll taxes, vehicle registration and fines etc.
- Future trends in financial aspects.

(c) Traffic or road use studies

Traffic surveys should be carried out in order to collect the following details:

- Traffic volume in vehicle per day, annual average daily traffic, peak and design hourly traffic volume.
- Origin and destination studies.
- Traffic flow patterns.
- Mass transportation facilities.
- Accident analysis.
- Future trends and growth in traffic

(d) Engineering studies

The studies include:

- Topographic surveys.
- Soil surveys.
- Location and classification of existing roads.
- Road life studies.
- Traffic studies.
- Special problems in drainage, construction and maintenance of roads.

Q3 Enumerate the major policies and objectives of the 3rd twenty-year road development plan (1981-2001) of India.**Solution:**

The 3rd twenty year road development plan (1981-2001) was prepared by the road using of the ministry of shipping and transport with the active co-operation from a number of organisations and other Highway Engineering experts. This document was released in 1985 at Lucknow so called 'Lucknow Road Plan'.

The major policies and objectives of this road plan are as under:

1. The road network should be developed so as to preserve the rural oriented economy and to develop small towns with all essential facilities. All the villages with population over 500 should be connected by all weather roads by the end of this century.
2. The future road development should be based on the new road system consisting of primary, secondary and tertiary road systems.
3. The overall road density in the country should be increased to 82 km per 100 sq. km area by the year 2001. The corresponding values of planned road densities are 40 for hill areas of altitude upto 2100 mtr. above MSL and 15 km per sq. km area for altitude above 2100 meter.
4. The National Highway network should be expanded to form square grids of 100 km sides so that no part of the country is more than 50 km away from a NH.
5. The lengths of SH and MDR required in a state or region should be decided based on both areas and number of towns with population above 5000 in the state or region.
6. Expressways should be constructed along major traffic corridors to provide fast and easy travel. Total length of 2000 km is targeted.
7. All the towns and villages with population over 1500 should be connected by major district roads and the villages with population 1000 to 1500 by other district roads. There should be a road within a distance of

- 3 km in plains and 5 km in hilly terrain connecting all villages or groups of villages with population less than 500.
8. Roads should also be built in less industrialized areas to attract the growth of industries.
 9. Long term master plans for road development should be prepared at various levels i.e. Gram Panchayat, district, state and national levels. The road network should be scientifically and technologically decided to provide maximum utility.
 10. The existing roads should be improved by rectifying the defects in the road, geometrics, widening of pavements, improving the riding quality of the pavement surface and strengthening of the pavement structure to save vehicle operation cost and thus to conservation of energy.
 11. There should be improvements in environmental quality and road safety.
 12. The plan has set the target length of NH to be completed by the end of seventh, eighth and ninth five year plan periods.

Q4 Following five alternate road plan development proposals with particulars as mentioned below are available:

Proposal	Number of towns and villages served along with population range					Total industrial products in thousand tonnes
	<2000	2001-5000	5001-10000	10001-20000	> 20000	
A	80	10	25	5	1	60
B	115	120	30	10	2	370
C	340	230	25	20	4	350
D	150	200	100	35	6	750
E	200	90	70	60	3	500

If the total road length of proposals A, B, C, D and E are respectively 200 km, 380 km, 605 km, 700 km and 400 km, calculate the utility rate per unit length of each road proposal and indicate the priority based on saturation system. Assume the utility units as follows:

For population :

Range	Unit
< 2000	: 0.25
2001 to 5000	: 0.50
5001 to 10000	: 1.00
10001 to 20000	: 2.00
> 20000	: 3.00

For products :

One unit for 1000 tonnes.

Solution:

Proposal A:

$$\begin{aligned}\text{Population units} &= (80 \times 0.25 + 10 \times 0.50 + 25 \times 1.00 + 5 \times 2.00 + 1 \times 3.00) \\ &= (20 + 5 + 25 + 10 + 3) = 63\end{aligned}$$

$$\text{Product units} = (60 \times 1) = 60$$

$$\therefore \text{Total utility units} = (63 + 60) = 123$$

$$\text{Utility rate} = \frac{123}{200} = 0.615$$

Proposal B:

$$\begin{aligned}\text{Population units} &= (115 \times 0.25 + 120 \times 0.50 + 30 \times 1.00 + 10 \times 2.00 + 2 \times 3.00) \\ &= (28.75 + 60 + 30 + 20 + 6) = 144.75\end{aligned}$$

$$\begin{aligned}\therefore \text{Product units} &= (370 \times 1) = 370 \\ \text{Total utility units} &= (144.75 + 370) = 514.75 \\ \text{Utility rate} &= \frac{514.75}{380} = 1.355\end{aligned}$$

Proposal C:

$$\begin{aligned}\text{Population units} &= (340 \times 0.25 + 230 \times 0.50 + 25 \times 1.00 + 20 \times 2.00 + 4 \times 3.00) \\ &= (85 + 115 + 25 + 40 + 12) = 277 \\ \text{Product units} &= (350 \times 1) = 350 \\ \therefore \text{Total utility units} &= (277 + 350) = 627 \\ \text{Utility rate} &= \frac{627}{605} = 1.036\end{aligned}$$

Proposal D:

$$\begin{aligned}\text{Population units} &= (150 \times 0.25 + 200 \times 0.50 + 100 \times 1.00 + 35 \times 2.00 + 6 \times 3.00) \\ &= (37.50 + 100 + 100 + 70 + 18) = 325.50 \\ \text{Product units} &= (750 \times 1) = 750 \\ \therefore \text{Total utility units} &= (325.50 + 750) = 1075.50 \\ \text{Utility rate} &= \frac{1075.50}{700} = 1.536\end{aligned}$$

Proposal E:

$$\begin{aligned}\text{Population units} &= (200 \times 0.25 + 90 \times 0.50 + 70 \times 1.00 + 60 \times 2.00 + 3 \times 3.00) \\ &= (50 + 45 + 70 + 120 + 9) = 294 \\ \text{Product units} &= (500 \times 1) = 500 \\ \therefore \text{Total utility units} &= (294 + 500) = 794 \\ \text{Utility rate} &= \frac{794}{400} = 1.985\end{aligned}$$

The priority of road proposals based on saturation system will then be as follows:

Road Proposal	Utility rate	Priority order
A	0.615	V
B	1.355	III
C	1.036	IV
D	1.536	II
E	1.985	I

