SOLUTION FOR IAT-1

HIGHWAY ENGINEERING (15CV63)

1. **(a) What is Jayakar committee and what are its recommendations ?**

Ans:- The first World war period and that immediately following it found a rapid growth in motor transport. So need for better roads became a necessity. For that, the Government of India appointed a committee called Road development Committee with Mr. M.R. Jayakar as the chairman. This committee came to be known as Jayakar committee. In 1927 Jayakar committee for Indian road development was appointed. The major recommendations and the resulting implementations were:

• Committee found that the road development of the country has become beyond the capacity of local governments and suggested that Central government should take the proper charge considering it as a matter of national interest.

• They gave more stress on long term planning programme, for a period of 20 years (hence called twenty year plan) that is to formulate plans and implement those plans within the next 20 years.

• One of the recommendations was the holding of periodic road conferences to discuss about road construction and development. This paved the way for the establishment of a semi-official technical body called Indian Road Congress (IRC) in 1934.

• The committee suggested imposition of additional taxation on motor transport which includes duty on motor spirit, vehicle taxation, license fees for vehicles plying for hire This led to the introduction of a development fund called Central road fund in 1929. This fund was intended for road development.

(b) With neat sketches, explain different road patterns.

Ans:- Road network can be laid in various patterns. These patterns in which the road network is laid could be

1) Rectangular or Block pattern: In this pattern, the whole area is divided into rectangular blocks of plots, with streets intersecting at right angles. The main road which passes through the center of the area should be sufficiently wide and other branch roads may be comparatively narrow. The main road is provided a direct approach to outside the city. Eg:- Chandigarth has rectangular pattern

2) Radial or Star and block Pattern: In this pattern, the entire area is divided into a network of roads radiating from the business outwardly. In between radiating main roads, the built-up area may be planned with rectangular block.
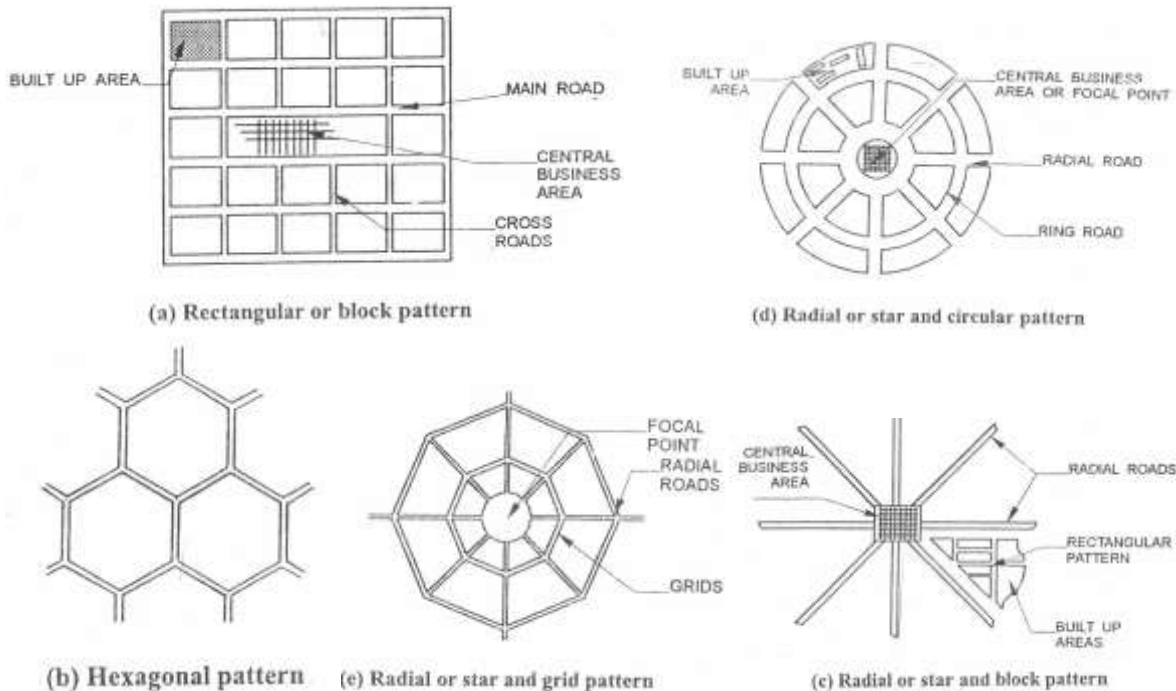
3) Radial or Star and Circular Pattern: In this system, the main radial roads radiating from central business area are connected together with concentric roads. In these areas, boundary by adjacent radial roads and corresponding circular roads, the built-up area is planned with a curved block system.

4) Radial or Star and Grid Pattern : Though the network is entirely interconnected, north-south movement becomes circuitous, indirect, and inconvenient, making driving an unlikely choice and vividly illustrating that interconnectedness by itself is insufficient to facilitate movement. Eg: The Nagpur road plan formulae were prepared on the assumption of Grid pattern.

5) Hexagonal Pattern :In this pattern, the entire area is provided with a network of roads formatting hexagonal figures. At each corner of the hexagon, three roads meet the built-up area

boundary by the sides of the hexagons is further divided in suitable sizes.

6) Minimum Travel Pattern :In this road pattern, city is contented by sector center, suburban center and neighborhood center by the road which required minimum to connect the city center.

(a) Rectangular or block pattern

(d) Radial or star and circular pattern

(b) Hexagonal pattern (e) Radial or star and grid pattern

(c) Radial or star and block pattern

(c) Determine the lengths of different categories of roads in a state in India by 2001 plan. The total area of the State is 80,000 sq.km and number of towns as per 1981 census is 86. Calculate the length of primary, secondary and tertiary road network.

Ans:-

1. NH in km = 80000/50 = 1600km

2. SH in km

3.   a. By area 80000/25 = 3200km

      b. By area and no of towns = 62.5*86 – 80000/50 = 3775km
        Adopt 3775km

4. MDR in km

   a. By area 80000/12.5 = 6400km

   b. By area and no of towns = 90*86 = 7740km

   Adopt 7740km

5. Total length of road network as per 2001 per 100sqm is

   (NH+SH+MDR+ODR+VR)= 80000*(82/100) = 65600km
   Length of NH+SH+MDR = 1600 + 3775 + 7740 = 13115 km

Length of ODR & VR = 65600 − 13115 = 52485 km
Primary road network = 1600 km

2.a) Explain briefly the contribution of the following in the road development in India: (i) Indian Roads Congress ii) Central Road Research Institute.

Ans:-

(i) **IRC**:- IRC was formed in the year 1934. The main objectives are: (a) to provide forum for regular pooling of experience and ideas on all matters that effect the planning, construction and maintenance f roads in India , and (b) to recommend standard specifications to provide a platform for the expression of professional opinion on matters relating to road engineering.
It played an important role in (a) the formation of three road development programs in India (b) controlling specifications, standardizations and recommendations on materials, design and construction of roads and bridges (c) publishing journals, research publications, standards, specifications, guidelines and other special publications on various aspects of highway engineering. It works in close collaboration with Roads Wing of the Ministry of Transport.
iii) **CRRI** was started at New Delhi in 1950. The main objectives of CRRI are:
  i) To carry out the basic and applied research for investigation, design, construction and maintenance of different types of roads and runways.
  ii) To carry out research on road traffic and transportation, including traffic safety and transport economics.
  iii) To render technical advice and consultancy services to various organizations.
  iv) To arrange for utilization of results of research by extension unit, display centers etc.
  v) To conduct refresher and training courses for staff of other research Institutions, Universities and highway Departments.
  vi) To develop labour intensive methods and manual aids for the construction of low cost allweather roads.

2. **(b) List the factors affecting realignment of a project (highway).**
Ans:- The realignment of existing roads may be necessary in the following cases:
  • Improvement of horizontal alignment design elements such as radius, super elevation, transition curve, clearance on inner side of the curve of shifting the curve to provide adequate sight distance, elimination of reverse curves and undesirable zig-zags etc.
  • Improvement of vertical alignment design elements like steep gradients, changes in summit curves to increase sight distance, correction of undesirable undulations like humps and dips etc.
  • Raising the level of a portion of a road which is subjected to flooding, submergence or waterlogging during monsoons.
  • Re-construction of weak and narrow bridges and culverts and changes in water-ways at locations slightly away from the existing site.
  • Construction of over bridges or under bridges at suitable locations across a railway line in place of level crossing or across another road to provide grade separate intersection.
  • Re-alignment required due to a portion of a road being submerged under water at the reservoir area on account of construction of a new dam.
  • Construction of a bypass to avoid the road running through a city or town.
  • Defence requirements.

2. (c). Explain briefly the functions and objectives of (i) PMGSY

Ans:-

Pradhan Mantri Gram SadakYojana (PMGSY)

➢   Pradhan Mantri Gram SadakYojana (PMGSY) was launched on 25th December, 2000 as a Centrally Sponsored Scheme to provide road connectivity in rural areas of the country.

➢   The primary objective of the Program is to provide connectivity to unconnected habitations in rural areas by means of all-weather roads.

➢   The program envisages connecting all habitations with a population of 500 persons and above in plain areas and 250 persons and above in Hill States, Tribal (Schedule V) areas, the Desert Areas (as identified in Desert Development Program) and in the 60 Left Wing Extremism affected / Integrated Action Plan districts as identified by the Ministry of Home Affairs/Planning Commission.This is to be done in a time frame that habitations with a population of 1000 and above shall be covered in three years, and those with a population of 500-1000 shall be covered by the end of the Tenth Five Year Plan period.

➢   The program can provide for the upgradation of the existing roads to prescribed standards. However, it must be noted that upgradation is not a key component of the program and cannot exceed 20 per cent of the allocation of the State. And, in upgradation works, priority should be given to the work of conversion of fair-weather roads to allweather roads.

➢   The program envisages single connectivity. If a habitation is connected to another habitation by an all-weather road, no further work can be taken up under the PMGSY for that habitation.

➢   Each year the list of road works to be taken up under the PMGSY is finalised by the District Panchayat, in accordance with the funds allocated to the district by the State Government.

3.(a)What are the requirements of an ideal alignment?

Ans:- In general given below are the requirements of an ideal highway alignment:

Short: The alignment must be the shortest of the various alternatives available. The shortest path between any two points is a straight line but the topography of the area or other factors may necessitate it do divert and take some other route, but as far as possible it should be kept minimum.

(2) Easy: Alignment should be such that the road must be easy to construct and easy to maintain or repair. If curves are of large radius and the gradient is gentle it would be easy to construct the road, rather than opposite.

(3) Safe: Safety is again the basic requirement of the highway alignment and special care must be taken to align the road in such a way that it must have the safe or minimum Sight distances and Radius of the curves, means the geometrical design features like Sight Distance, Radius of the curves and the gradient of the road must be given special attention.

(4) Economical: Road alignment must be designed to have the initial cost of construction, maintenance cost and the vehicle operation cost to a minimum. Also the locally available materials should be checked before and it may decrease the over all cost. There must be a balance in the cutting and filling on the alignment of the road.

3. (b) Explain obligatory points. With neat sketches discuss how these control the alignment.

Ans:- Obligatory points are the control points governing the alignment of the highways. These control points may be divided in to two categories:

   i) Points through which the alignment is to pass
   ii) Points through which the alignment should not pass.

Obligatory points through which the road alignment has to pass may cause the alignment to often deviate from the shortest (or) easiest path. In fig.1.shows how the straight alignment AB is deviated along the hillside pass, thus avoiding a tunnel (or) heavy cutting. Fig.2.shows that the straight alignment between stations A and B which passes across the river band is to be deviated along the path shown in order to cross the river at a proper bridge location.

ii) Obligatory points through which the road should not pass also may make it necessary to deviate from the proposed shortest alignment. The obligatory points, which should be avoided while aligning a road, include religious places, very costly structures.

However if there is no alternative and the alignment has to be taken across such an area, the construction and maintenance costs are likely to be very high.
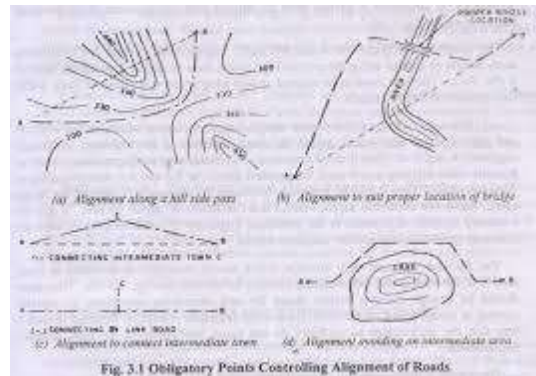

Fig. 3.1 Obligatory Points Controlling Alignment of Roads.

(c).Four new road links are to be constructed during a 5 year plan period. Suggest the order of priority for phasing the road construction program based on maximum utility approach. Assume utility units of 0.5, 1.0 , 2 & 4 for the population ranges & 1 per 1000 tonnes,500 tonnes & 100 tonnes of agricultural, raw material and industrial products respectively.

Road link	Length, Km	No: of villages served with population range				Agricultural productivity served in tonnes		
		<500	501-1000	1001-2000	> 2000	Agricultural	Raw material	Industrial
A	70	30	18	8	3	8000	4000	1000
B	45	11	7	6	3	6000	1000	1600
C	65	23	7	5	5	4500	2000	3200
D	60	38	4	3	3	4000	6000	500

Ans:-

Road link	Length, Km	utility units for population range				utility units for productivity served in tonnes			Utility/length	Priority
		<500	501-1000	1001-2000	> 2000	Agricultural	Raw material	Industrial		
A	70	30 *.5= 15	18*1= 18	8*2= 16	3*4= 12	8000/1000 =8	4000/500 = 8	1000/100 =10	87/ 70= 1.24	3
B	45	11*.5= 5.5	7*1=7	6*2= 12	3*4= 12	6000/1000 =6	1000/500 =2	1600/100 =16	60.5 /45 =1.3 4	2
C	65	23*.5= 11.5	7*1=7	5*2= 10	5*4= 20	4500/1000 =4.5	2000/500 =4	3200/100 =32	89/ 65= 1.36 9	1
D	60	38*.5= 19	4*1=4	3*2=6	3*4= 12	4000/1000 =4	6000/500 =12	500/100= 5	62/ 60= 1.03 3	4