BITT POLYTECHNIC, RANCHI

DEPARTMENT OF CIVIL ENGINEERING

Question Set-2 Transportation Engineering

Date:-31/03/2020

A. Objectives Questions:

1. The camber for drainage of the surface was first introduced by
   A) Telford. B) Tresaguet. C) Sully. D) Macadam
2. The highest point on the road surface is called
   A) crown. B) camber. C) gradient. D) berm
3. The total annual cost (A) of Highway transportation is given by
   A) A=B-CN. B) A= B+CN. C). A= B/CN. D). A= CN/B
   Where, B is is annual cost of highway
   C is is annual cost of vehicle operation
   N is total number of vehicle on road per year.
4. When the bearing capacity of soil is poor intensity of traffic is high, an additional layer is provided between the soling and subgrade which is called
   A). Wearing layer. B). Wearing course. C). Road surfacing. D). Any one of these
5. The thickness of road surface depends upon the
   A). Types of traffic. B). Intensity of traffic. C). Type of material. D). All of these
6. The camber of road should be approximately equal to_____ the longitudinal gradient
   A). One half. B). 2 times. C). 3 times. D). 4 times
7. The rate of change of radial acceleration governs the
   A). Length of transition curve B). Extra width of payment
   C). Length of the tangent. D). All of the above
8. Transition curve cannot be a
   A). True spiral. B). Cubic spiral. C). Compound curve. D). Cubic parabola
9. Shape of a vertical curve is
   A). Parabola. B). Spiral. C). Elliptical. D). Any one of these
10. The minimum length of valley curve should be such that the headlight beam side distance is
    A). Stopping sight distance. B) passing sight distance
    C). Braking distance. D). None of these

B. Short Answer Types Questions:

1. Discuss the special care to be taken while aligning Hill road?
2. What are the object of Highway geometric design. List the various geometrical elements to be considered in highway design?
3. Write short note on
   a) Kerbs
   b) road margins
   c) shoulders
4. What are the factor on which stopping sight distance depends?
5. Calculate the stopping sight distance for a design speed of 100 kmph. Take the total reaction time 2.5 second and coefficient of friction 0.35?
6. Why overtaking zones are provided?
7. Design the superelevation required at horizontal curve of radius 300 metre for speed of 60 kmph?
8. List various type of transition curve used in highway?
9. Discuss the requirement of summit curve and it shapes?
10. Calculate the absolute minimum radius of original curve for a design speed of 80 kmph

C. Long Answer Types Questions:

1. Calculate the length of transition curve for a design speed of 65kmph at radius of 220 m?
2. Why should the psychological widening be added in the mechanical widening?
3. What is off tracking explain with sketch?
4. Radius of 500m has to be provided at a locality due to site instruction international highway with design speed of 100 kmph. Design the superelevation
5. The properties of the soil subgrade are given below
   Liquid limit is 75%
   Plastic limit is 55%
   Passing number 200 sieve is 70%
   Determine the group index and classify the soil?

Solutions:

A. Objectives Questions:

1. B 2. A 3. C 4. B 5. D 6. A 7. A. 8. C. 9. A. 10. A

B. Short Answer Types Questions

1. The special consideration while aligning the road on hilly areas are stability-- common problem in Hill road is that of land slide. The cutting and filling of the Earth affect the stability, drainage- number of cross drainage structure should be minimum, geometric standard of Hill road- the root should enable the ruling gradient in most of the length minimising steep gradient and needless rise and fall, and resisting length.

2. The geometric of the highway should be designed to provide optimal efficiency in traffic operation with maximum safety iits at reasonable cost.

Geometric design of highway deals with the following elements

a. Cross section element

b. Sight distance consideration

c. Horizontal alignment details

d. Vertical alignment details

e. Intersection elements

3 a) kerb- it indicate the boundary between pavement and shoulder and sometime island aur footpath aur parking space.

b) road margins- the various element included in the road margin are are shoulders, parking lane, frontage road, driveway, cycle track, footpath, guardrail and embankment slope.

c) shoulders- shoulder provided along the road edge Tushar was emergency lane for vehicle compelled to be taken out to the roadway. It also act as a service lane for the vehicle that have broken down.

4. the factor on which the stopping sight distance depend are

a. Features of the road ahead

b. Height of the driver eyes above the road surface

c. Height of the object above the road surface.

5. SSD = vt + v^2/(2gf)

= (27.78* 2.5) + (27.78^2/(2*9.81*0.35)) = 181.82m

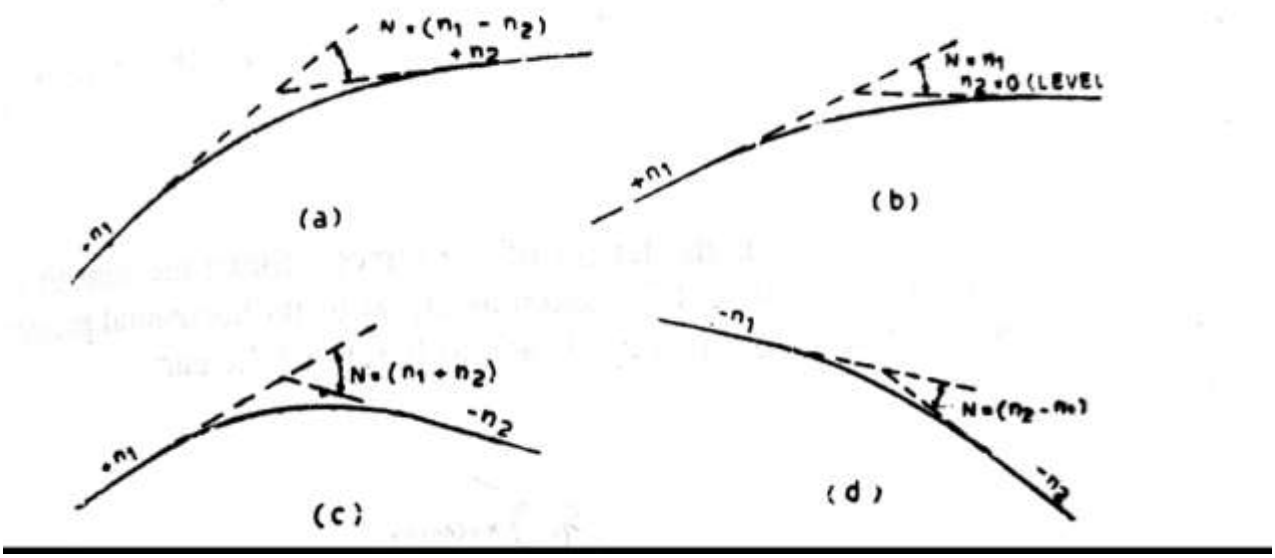
6. Overtaking zones provided at a suitable to provide opportunity for a fast moving vehicle to move or overtake slower moving vehicle safely. The distance may be equal to d1+d2 & the overtaking zone length is 3-5(OSD).

7. e= V^2/127*R = (60^2/127*300) = 0.09 = 9%

8. The various type of transition curve use din highway are are as follow

a. Spiral curve. b. Lemniscate. c. Cubic parabola

9. Due to change in the grade vertical alignment of highway it is necessary to introduce vertical curve at the intersection of different grade. Summit curve with convexity upwards is a common type of curve and is shown below:



10. e+f= V^2/127*R

R= V^2/127*(e+f)

= 80^2/127*(0.07+0.15) = 229m

C. Long Answer Types Questions:

1.

(a) Length of transition curve L_s as per allowable rate of centrifugal acceleration C :

Allowable rate of change of centrifugal acceleration as per Eq. 4.21,

$$C = \frac{80}{(75+V)} = \frac{80}{(75+65)} = 0.57, \text{ m/sec}^3$$

This value is between 0.5 and 0.8 and hence accepted.

$$L_s = \frac{0.0215\ V^3}{C\,R} = \frac{0.0215 \times 65^3}{0.57 \times 220} = 47.1 \text{ m}$$

2. Extra width of the payment is also provided what psychological reason such as to provide for greater meneuverability of steering at higher speed, to allow for extra space requirement for the overhanging of vehicle and to provide greater clearance for crossing and overtaking vehicle on the curve. It is given by.

$$W_{ps} = \frac{V}{9.5\sqrt{R}}$$

Hence the total widening We, m required on a horizontal curve is given by

$$W_e = W_m + W_{ps}$$

i.e.,

$$W_e = \frac{n l^2}{2R} + \frac{V}{9.5\sqrt{R}}$$

3.

The widening required to account for the off-tracking due to the rigidity of wheel based is called *mechanical widening* (W_m) and may be calculated as given below. Refer Fig. 4.25.

R_1 = radius of the path traversed by the outer rear wheel, m

R_2 = radius of the path traverse by the outer front wheel, m

W_m = off-tracking or the mechanical widening, m

l = length of wheel base, m

$$W_m = OC - OA = OB - OA = R_2 - R_1$$

From ΔOAB, $OA^2 = OB^2 - BA^2$

$$R_1^2 = R_2^2 - l^2$$

But $R_1 = R_2 - W_m$

$$(R_2 - W_m)^2 = R_2^2 - l^2$$

i.e., $$R_2^2 - 2 R_2 W_m + W_m^2 = R_2^2 - l^2$$

$$l^2 = W_m (2 R_2 - W_m)$$

$$W_m = \frac{l^3}{2R_2 - W_m}$$

$$= \frac{l^2}{2R} \text{ (approximately)}$$

4.

Solution

For mixed traffic conditions, superelevation is given by Eq. 4.9.

$$e = \frac{V^2}{225 R}$$

V = 100 kmph

R = 500 m

$$e = \frac{100^2}{225 \times 500} = 0.089$$

As the value is greater than the maximum superelevation of 0.07, the actual superelevation to be provided is restricted to 0.07.

Check for coefficient of lateral friction developed for full speed using Eq. 4.10.

$$f = \frac{V^2}{127 R} - 0.07 = \frac{100^2}{127 \times 500} - 0.07$$

$$= 0.157 - 0.07 = 0.087$$

As the value is less than 0.15, the design is safe with a superelevation of 0.07.

5

LL = 75%

P.L = 55%

P.I = LL - P.L

= 75 - 55 = 20

Passing 200 sieve = 70%

$\therefore G.I = 0.2a + 0.005ac + 0.01bd$

a = 70 - 35 = 35

b = 70 - 15 = 55

c = 75 - 40 = 35

d = 20 - 10 = 10

$\therefore G.I = 0.2 \times 35 + 0.005 \times 35 \times 35 + 0.01 \times 55 \times 10$

= 18.625