[5154]-15
B.E. (Civil)
TRANSPORTATION ENGINEERING
(2008 Course)
Solution/Scheme of Marking

SECTION I

Q.3 (a) (i) Length of transion curve Ls based on rate of change of centrifugal acceleration $= \frac{0.0215V^3}{CR}$

Rate of change of centrifugal accⁿ $C = \left(\frac{80}{75+V}\right)$

$= \frac{80}{(75+65)} = 0.57$ m/sec³ < 0.8 ∴ o.k.

$Ls = \frac{0.0215 V^3}{CR}$ (kmph) or $\frac{v^3}{CR}$ (m/sec)

$= \frac{0.0215 \times (65)^3}{0.57 \times 220} = 47.1$ m

(ii) Ls by allowable rate of introduction of S.E. $= \frac{EN}{2} = Ls$

$e = \frac{V^2}{225R} = \frac{(65)^2}{225 \times 220} = 0.085 > 0.07$

∴ $f = \frac{V^2}{127R} - 0.07 = \frac{(65)^2}{127 \times 220} - 0.07 = 0.08 < .15$ ∴ ok

(ii) $Ls = \frac{EN}{2} = \frac{B.e.N}{2} = \frac{7.5 \times 0.07 \times 150}{2}$

$= 39$ m

(iii) Mini. value of Ls as per IRC for plain & Rolling terrain

$Ls = \frac{2.7V^2}{R} = \frac{2.7 \times (65)^2}{220} = 51.9$ m

Adopt highest value of the three ie- 51.9 m as the design length of transition curve

(iv) shift of Curve $(S) = \frac{Ls^2}{24R} = \frac{(52)^2}{24 \times 220} = 0.51$ m

Q.4 (c)

Ruling Minimum Radius

$$e+f = \frac{V^2}{127R} \text{ (kmph)} \quad \text{or} \quad e+f = \frac{v^2}{gR} \text{ (m/sec)}$$

$$\therefore R = \frac{V^2}{127(e+f)} \quad \text{or} \quad R = \frac{v^2}{(e+f)g}$$

Assume rate of superelevation = 7.0% ie 0.07 = e
coefficient of friction in lateral direction = 0.15 = f

$$\therefore R = \frac{(100)^2}{127(0.07+0.15)} = 357.9 \text{ m} \simeq 360 \text{ m}$$

Q.5 (b)

Cummulative standard Axles Ns in msa

$$Ns = \frac{365A\left((1+r)^n - 1\right)}{r} \times LDF \times VDF$$

A = Traffic after completion of construction = 500
r = rate of growth of traffic = 7.5%
n = Design life of pavement = 15 yrs
LDF = Lane Distribution Factor = 0.75
VDF = Vehicle Damage Factor = 1.9

$$Ns = \frac{365 \times 500\left[(1+0.075)^{15} - 1\right]}{0.075 \times 10^6} \times 0.75 \times 1.9$$

= 6.792 million standard axles ie. msa

SECTION II

Q.9 (a) Rational Formula

$Q = 100\, p f A I_c$ $m^3/hour$

OR

$Q = 0.028\, p f A I_c$ m^3/sec

Q = Design Discharge or Runoff m^3/sec

p = Coeffi to account for absorption

f = coeffi. to account for variation of rainfall in space

A = Catchment Area in Hectares

I_c = Critical Intensity of Rainfall cm/hour

Time of Concentration $(T_c) = \left[0.89 \times \frac{L^3}{H}\right]^{0.385}$

$= \left[0.89 \times \frac{(4)^3}{25}\right]^{0.385}$

$= 1.37$ Hours.

~~One Ho.~~

~~Critical Inten.~~

One Hour Rainfall $(I_0) = \frac{F}{T}\left[\frac{T+1}{2}\right]$ cm/hour

$= \frac{16}{2}\left[\frac{2+1}{2}\right]$

$= 12$ cm/hour

Critical Intensity of Rainfall

$I_c = \left[\frac{2 I_0}{T_c+1}\right] = \left[\frac{2\times 12}{1.37+1}\right] = 10.12$ cm/hour

Runoff (Q) $= 100 \times 0.3 \times 0.97 \times 1000 \times 10.12$

$=$ ~~296820 m³/hr.~~ 294492 m^3/~~hour~~

$=$ ~~82.45 m³/sec.~~ 81.80 m^3/sec.

Note: **1 Hect. = 10^4 m^2**

$\therefore$ $10\ km^2 = \frac{10 \times 1000 \times 1000\ m^2}{10^4} = 1000$ Hectares.

$\therefore$ A = 1000 Hectares.

Q.10 (a)

Constant of variation 'a' for various spans

For 4 m Span, $a_1 = 1700/16 = 106.25$

8 m Span, $a_2 = 7000/64 = 109.37$

12 m Span, $a_3 = 16000/144 = 111.11$

15 m Span, $a_4 = 24500/225 =$ ~~109.0~~ 108.88

Avg. value of constant of variation 'a'

$$= \frac{106.2 + 109.37 + 111.11 + 108.88}{4}$$

$= $ ~~108.875~~ 108.89

The Avg. Cost of pier,

$$P = \frac{22,200 + 23,200 + 23,000 + 23,600}{4}$$

$= 23,000$

Economic Span, $l = \sqrt{P/a}$

$$= \sqrt{\frac{23,000}{108.89}}$$

$= \underline{\underline{14.53}}$ m

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