

CE 353
PRINCIPLES OF TRANSPORTATION AND TRAFFIC ENGINEERING

Example Problem on Superelevation:

The plan and the cross-section of a two lane highway segment are shown below. The road rises at a uniform grade of 2.5% from A to B. The design speed (V) is 90 km/hr. The radius (R) of the circular curve is 500 m.

Prepare superelevation table to show superelevations of each travel lane and the elevations of CL, OE, IE at 10 m even stations starting from the beginning of L_t distance up to end of L_s .

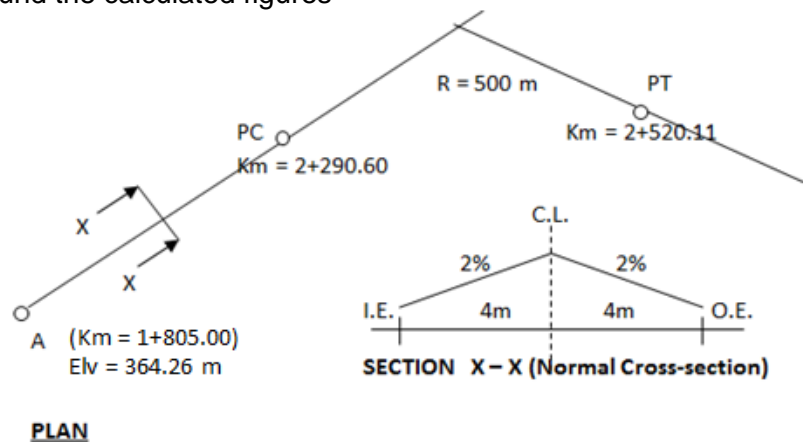
Notes: 1) Apply S.E. by rotating around CL

2) Add critical stations (End L_t /Start L_s , PC) to superelevation tables,

3) Draw SE diagram

4) (max $e = 0.08$, take $S_r = 1/200$, $b_w = 0.75$ for $n = 2$)

5) Do not round the calculated figures



Solution:

$$e = 0.00443 \cdot 90 \cdot 90 / 500 = 0.072 < 0.08 \text{ OK (according to Turkish practice)}$$

$$L_s = 0.0354 \cdot 90 \cdot 90 \cdot 90 / 500 = 51.61 \text{ m (according to Turkish practice)}$$

$$L_s = 0.072 \cdot 4.0 / 0.005 = 57.60 \text{ m}$$

$$\text{Take } e_{\max} = 0.072 \text{ and } L_s = 57.60 \text{ m}$$

$$L_t = 0.02 / 0.072 \cdot 57.60 = 16.00 \text{ m}$$

$$\text{St. (End } L_t / \text{Start } L_s) = (2+290.60) - 2/3 L_s = (2+290.60) - 2/3 \cdot 57.60 = 2 + 252.20$$

$$\text{St. (Start } L_t) = (2+252.20) - L_t = (2+252.20) - 16.00 = 2 + 236.20$$

$$\text{St. (End } L_s) = (2+290.60) + 1/3 L_s = (2+290.60) + 1/3 \cdot 57.60 = 2 + 309.80$$

$$\text{Rate of Superelevation } (e_{\text{rate}}) = e_{\max} / L_s = 0.072 / 57.60 = 0.00125 = 0.125\% / \text{m}$$

$$\text{C.L. Elev. (Start } L_t) = (\text{St. Start } L_t - \text{St. A}) \cdot G + \text{Elev (A)} = (236.20 - 1805.00) \cdot 0.025 + 364.26 = 375.04 \text{ m}$$

$$\text{I.E. Elev. (Start } L_t) = \text{O.E. Elev. (Start } L_t) = \text{C.L. Elev. (Start } L_t) - e_o w = 375.04 - 0.02 \cdot 4.00 = 374.96 \text{ m}$$

Table: Superelevation Table by Rotation Around Centerline:

POINT	Km	Distance (m)	Superelevation (%)		Elv. Diff. w.r.t. CL (m)		Elevation (m)		
			Outer lane	Inner lane	Outer edge	Inner edge	Outer edge	Center-Line	inner edge
START L_t	2 + 236.20	0	-2.00	-2.00	-0.08	-0.08	374.96	375.04	374.96
	2 + 240.00	3.80	-1.53	-2.00	-0.06	-0.08	375.07	375.14	375.06
	2 + 250.00	13.80	-0.28	-2.00	-0.01	-0.08	375.37	375.39	375.31
End L_t / Start L_s	2 + 252.20	16.00	0.00	-2.00	0.00	-0.08	375.44	375.44	375.36
	2 + 260.00	23.80	0.97	-2.00	0.04	-0.08	375.67	375.64	375.56
	2 + 268.20	32.00	2.00	-2.00	0.08	-0.08	375.92	375.84	375.76
	2 + 270.00	33.80	2.23	-2.23	0.09	-0.08	375.97	375.89	375.81
	2 + 280.00	43.80	3.48	-3.48	0.14	-0.14	376.27	376.14	376.00
	2 + 290.00	53.80	4.73	-4.73	0.19	-0.19	376.57	376.39	376.20
PC	2 + 290.60	54.40	4.80	-4.80	0.19	-0.19	376.59	376.40	376.21
	2 + 300.00	63.80	5.98	-5.98	0.24	-0.24	376.87	376.64	376.40
END L_s	2 + 309.80	73.60	7.20	-7.20	0.29	-0.29	377.17	376.88	376.59

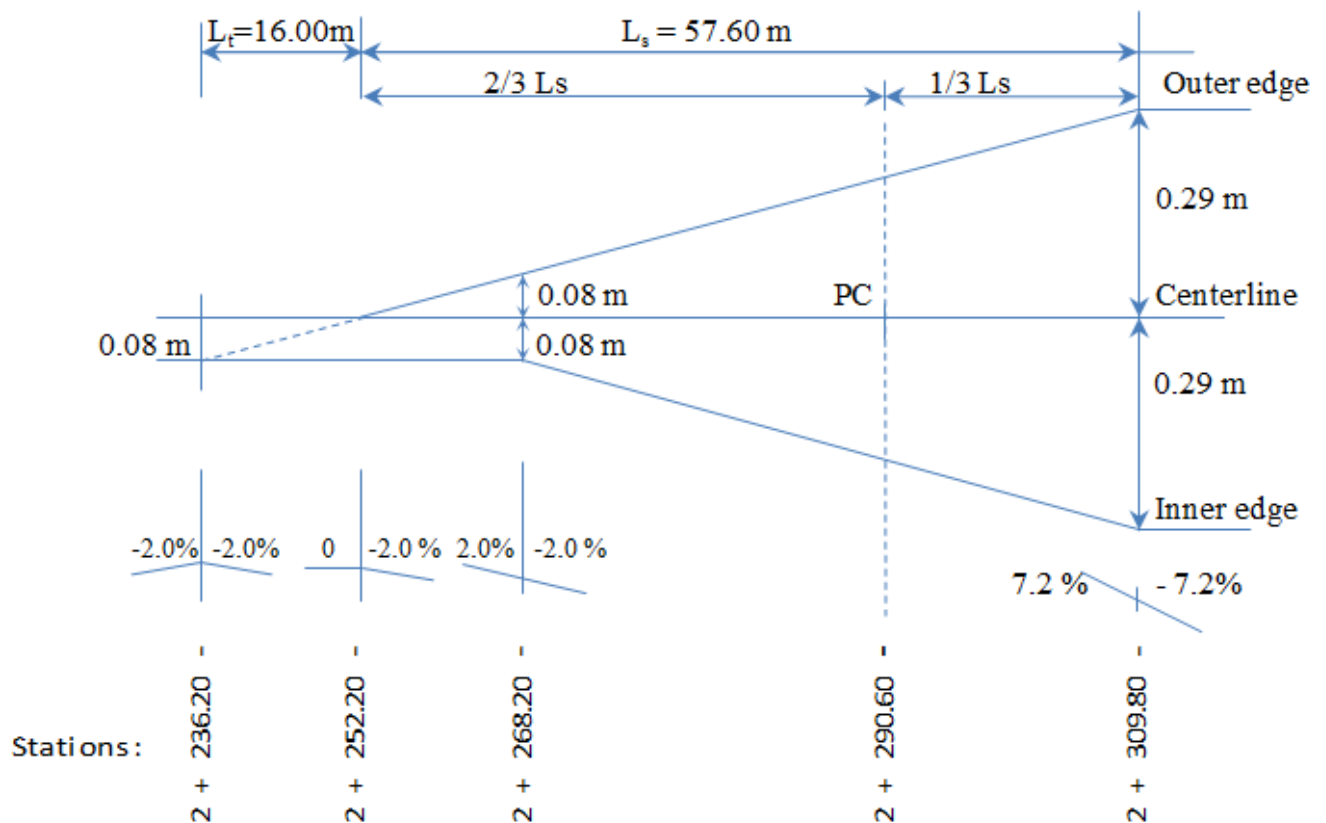


Figure: Superelevation diagram (rotation around CENTERLINE) for part A.