Railway Design Project

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The records of the existing curve with transition curve:
R = 510 m
m = 95 mm
AE=104+13.00
AV=IE 104+91.00
IV=AV 106+11.00
AE 106+89.00
α 48°17'35.63"
Designed velocity: V =120 km/h

$R := 510\ m$ $v_e := 120\ \frac{km}{h}$ $m := 95\ mm$

$\alpha := 45.55°$

$L := 10491.00 - 10413.00 = 78\ m$

Investigation DYNAMICAL MOVEMENT

Lateral Accerelation $a_{max} := 0.65\ \frac{m}{s^2}$**:**

$a := \frac{v_e^{\ 2}}{12.96 \cdot R} - \frac{m}{152.905} = 1.557\ \frac{m}{s^2}$ $0.604 < 0.65$ **GOOD**

Changing of the lateral Accerelation $a_{max} := 0.65\ \frac{m}{s^2}$

$h := \frac{v_e^{\ 3}}{23 \cdot R \cdot L} = 1.889\ \frac{m}{s^2}$ $0.797 > 0.65$ **NOT GOOD**

Maximum Speed In the Curve:

$V_a := 3.6 \cdot \sqrt{R \cdot \left(a + \frac{m}{152.905}\right)} = 120\ \frac{km}{h}$

Maximum Speed In the Transition Curve:

$v_h := \sqrt[3]{23 \cdot R \cdot L \cdot h} = 120\ \frac{km}{h}$

Maximum Velocity:

$$V_{max} := min\left(V_a, v_h\right) = 120\frac{km}{h}$$

Determination of minimum values of R and L

$$a_{max} := 0.65$$

$$R_{mn} := \frac{{v_e}^2}{12.96 \cdot \left(a_{max} + \frac{m}{152.905}\right)} = 873.995 \ \ m$$

$$L_{min} := \frac{{v_e}^3}{23 \cdot R \cdot h} = 78 \quad m$$

Length of transition curve has to be increased

DATA OF THE EXISTING AND NEW CURVE

$$\tau := \frac{L}{2 \cdot R} = 0.076 \ rad$$

$$x := L - \frac{L^3}{40 \cdot R^2} + \frac{L^5}{3456 \cdot R^4} - \frac{L^7}{599040 \cdot R^6} = 77.954 \quad m \text{ distance along tangent}$$

$$y := \frac{L^2}{6 \cdot R} - \frac{L^4}{336 \cdot R^3} + \frac{L^6}{42240 \cdot R^5} - \frac{L^8}{9676800 \cdot R^7} = 1.987 \ m \text{ right angle distance from tangent}$$

$$x_o := x - R \cdot \sin\left(\tau\right) = 38.992 \quad m$$ Distance along tagent to the point at right angle to f

$$f := y - R \cdot \left(1 - \cos\left(\tau\right)\right) = 0.497 \ \ m$$ length of the radius to tangent

$$Thm := x_o + \left(R + f\right) \cdot \tan\left(\frac{\alpha}{2}\right) = 253.324 \quad m \text{ spiral length}$$

$$ih := R \cdot \left(\alpha - 2 \cdot \tau\right) = 327.45 \quad m$$ length of the curve

$$SK := \left(R + f\right) \cdot sec\left(\frac{\alpha}{2}\right) - R = 43.665m$$ Points of Intersection of curve tangents

Determination of data Existing and new curve

$R := 1100$

$l := 110$

Lateral Accerelation :

$$a_o := \frac{v_e^{\,2}}{12.96 \cdot R} - \frac{m}{152.905} = 0.389 \quad < \quad 0.65 \ \frac{m}{s^2}$$

Changing of the lateral Accerelation :

$$h := \frac{v_e^{\,3}}{23 \cdot R \cdot l} = 0.621 \quad < \quad 0.65 \ \frac{m}{s^2}$$

Adequate

The Data Of New Curve

$$\tau := \frac{l}{2 \cdot R} = 0.05 \quad rad$$

$$x := l - \frac{l^3}{40 \cdot R^2} + \frac{l^5}{3456 \cdot R^4} - \frac{l^7}{599040 \cdot R^6} = 109.973 \, m$$ distance along tangent

$$y := \frac{l^2}{6 \cdot R} - \frac{l^4}{336 \cdot R^3} + \frac{l^6}{42240 \cdot R^5} - \frac{l^8}{9676800 \cdot R^7} = 1.833 \ m$$ right angle distance from tangent

$x_o := x - R \cdot \sin(\tau) = 54.995 \quad m$ Distance along tagent to the point at right angle to f

$f := y - R \cdot (1 - \cos(\tau)) = 0.458 \quad m$ length of the radius to tangent

$$Th := x_o + (R + f) \cdot \tan\left(\frac{\alpha}{2}\right) = 517.021 \quad m$$ spiral length

$ih := R \cdot (\alpha - 2 \cdot \tau) = 764.5 \quad m$ length of the curve

$$SK := (R + f) \cdot sec\left(\frac{\alpha}{2}\right) - R = 93.514 m$$ Points of Intersection of curve tangents

Determination of the main points of new curve

AE=AE+THm-TH= $303 + 82.00 + 242.731 - 517.021 = 301 + 07.71$

AV=IE=AE+L = $301 + 07.71 + 110 = 304 + 17.71$

IV-AV=AV-IE+ih= $304 + 17.71 + 764.5 = 311 + 82.21$

AE=IV=AV+L= $311 + 82.21 + 110.000 = 312 + 92.21$