2/03/2016
CE435 – Railway Engineering
Tutorial #4

Model Answer

Q1: What is the increase in the length of rail of 25.6 m when the rise of the temperature of the track is 30°C and given that $\alpha = 1.15 \times 10^{-5}$ per °C

Answer:

The increase in length due to expansion is given by:

$$\delta l = l * \alpha * t$$

$$\therefore \delta l = 25.6 * 1.15 \times 10^{-5} * 100*30$$

$$\therefore \delta l = 0.8832 \text{ cm or } 8.8832 \text{mm}$$

Q2: What should be the length of track to:

I. Overcome temperature stress if rise in temperature $t = 25\ °C$

II. Prevent creep for equilibrium

Assume 750 kg as resistance to track movement.

Given:

$A=70\ cm^2$, $\alpha = 1.15 \times 10^{-5}$ per, °C and $E = 21.5 \times 10^5$ kg/ cm^2

Answer:

The force required to expansion due to temperature is given by:

$$F = \alpha * t * A * E$$

$$Or\ F = (f) * t * A$$

Where (f) is the stress in rail pre degree rise in temperature = $\alpha * E$

$$So\ F = 1.15 \times 10^{-5} * 25 * 70 * 21.5 \times 10^5 = 43268.75 \text{ kg}$$

I. *Length of track to overcome temperature stress.*

$$L_t = \frac{43268.75}{750} = 57.7 \text{ km}$$

II. *To prevent creep for equilibrium, the length of welded track.*

$$= 2 * L_t$$

$$= 2 * 57.7 = 115.4 \text{ km}$$

Q3: Explain three of rail functions?

Answer:

1. Rails provide a continuous and level surface for the movement of trains.
2. Rails carry out the function of transmitting the load to a large area of the formation through sleepers and the ballast.
3. Rails serve as a lateral guide for the wheels.

Q4: Why theoretically the longer rails are preferred?

Answer:

- Reduces number of joints, so less cost (construction & maintenance)
- Provides smooth and comfortable rides.

Q5: Why the length of a rail is limited ?

Answer:

- Lack of facilities for transport of longer rails, particularly on curves.
- Difficulties in manufacturing very long rails.
- Difficulties in acquiring bigger expansion joints for long rails.
- Heavy internal thermal stresses in long rails

Equation sheet

The increase in length due to expansion is given by:

$$\delta l = l * \alpha * t$$

Where:

Let, l = length of the rail in cm.
α = co-efficient of expansion in per °C.
t = the rise in temperature above the temperature at which the track is laid.

$$F.l = \delta l . A . E .$$
$$F.l = l . \alpha . t . A . E . \quad (\text{Where } \delta l = l \times \alpha \times t)$$
$$F = \alpha . t . A . E .$$

Where:

A = Cross-sectional area of a rail in cm^2
E = Modulus of elasticity of steel in kg/cm^2
F = Force in kg. required to prevent likely expansion due to temperature.