CMR
INSTITUTE OF
TECHNOLOGY

Internal Assessment Test 2 – May 2017
Solutions

Sub: Transportation Engineering II **Code:** 10CV63

Sem: VI **Branch:** CIVIL

1. $n = 4$ $\quad w = 24$ tonnes

$V = 75$ kmph.

B.G. track

$W = ?$

Gradient = 1 in 150

curve = 3°

$\mu = 0.166$

Hauling capacity = $\mu \times W$

$= 0.166 \times 4 \times 24$

$= 16$ tonnes

case (i) straight level track – $RT_2 = 0$

$H.C = RT_1$

$16 = 0.0016W + 0.00008WV + 0.0000006WV^2$

$16 = 0.0016W + 0.00008 \times W \times 75 + 0.0000006 \times W \times 75^2$

$16 = 0.010975\ W$

$W = 1457.86 \approx 1450$ tonnes

case (ii) R_g (1 in 150)

$16 = 0.0016 \times 1450 + 0.00008 \times 1450 \times V + 0.0000006 \times 1450 \times V^2 + 1450 \times \frac{1}{150}$

$13.67 = 0.11648\ V + 8.736 \times 10^{-4} \times V^2 + 1450 \times \frac{1}{150}$

~~V = 18 V = 75~~ $V_1 = 28.5$ kmph

Reduction in speed $75 - 29 = $ **46 kmph**

case (iii)

$16 = 0.0016 \times 1450 + 0.00008 \times 1450 \times V + 0.0000006 \times 1450 \times V^2 + 1450 \times \frac{1}{150}$

$+ 0.0004 \times 1450 \times 3$

$V_2 = 17$ kmph (16.54)

Reduction in speed $75 - 17 = $ **58 kmph**

(2) Length of each rail = 11.89 m

No. of rails per side = $\left(\frac{1000}{11.89}\right) = 84+1 = 86$ nos

For two sides $= (2 \times 86) = 172$

Sleeper density = 1.0936 m + 4

$= 1.0936 \times 11.89 + 4$

$= 17.$

No. of sleepers = $17 \times 86 = 1462$ nos

No. of fish plates = 2 × No of rails per km

$= 2 \times 172 = 344$ nos

No. of fish bolts = 4 × No. of rails per km

$= 4 \times 172 = 688$ nos

Bearing Plates = 2 × No of sleepers = $2 \times 1462 = 2924$ nos ✓

$= 4 \times$ No. of rails $= 4 \times 172 = 688$ nos

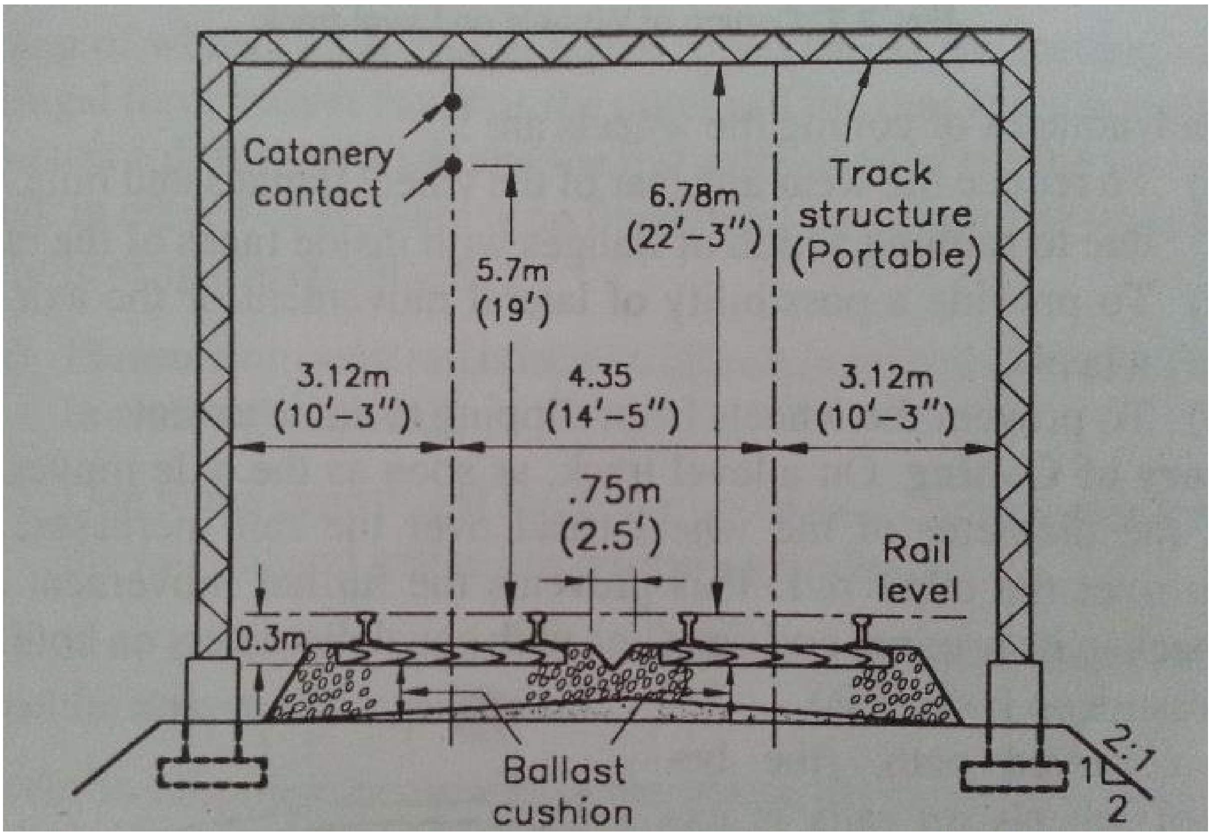
Dog spikes = 4 × No of sleepers

$= 4 \times 1462 = 5848$ nos

Ballast = $1.036\ m^3/m$ length

$= 1036\ m^3$ / km length

3.



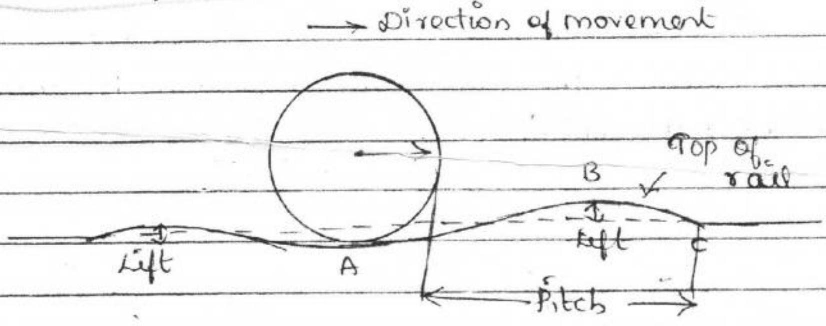
Double Line BG Track With Electric Traction

4. Creep of rails :
Longitudinal movement of rails with respect to the sleepers is known as creep of rails.

Theories of creep :

A) Wave theory
Wave motion is set up by moving loads of wheels. The vertical reverse curve ABC is formed in the rails ahead of the wheels. Resulting from the rail deflection under the load, is the chief cause of creep. The wheels push the wave with a tendency to force the rail in the direction of traffic on a particular rail, the joint action by several wheels causes creep. As the wheels move, the lift in front of the moving load is thus carried forward by the wheels and causes creep.

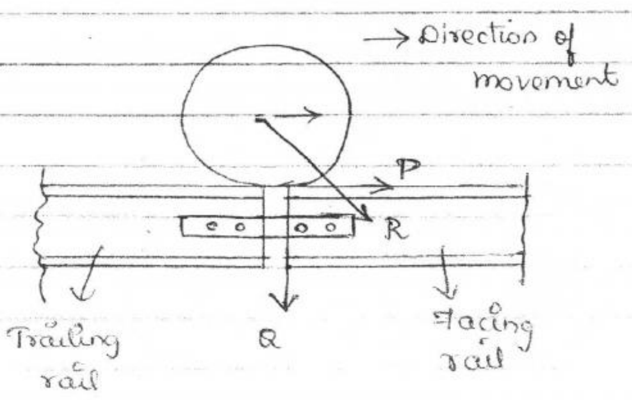
load is thus carried forward by the wheels and causes creep, whereas the lift at the rear of the wheel gets back to its normal position.



② Percussion Theory:

This theory states that the creep is due to impact of wheels at the rail end ahead of joints. The horizontal component of 'P' of 'R' tends to cause creep while the vertical component tends to bend down the rail end vertically. Though the creep is very small in single impact but cumulative effect of number of wheels in quick succession results in sufficient creep. This kind of creep will increase due to

(i) weak and loose fish bolts
ii) Due to worn out fish plates.
iii) Due to loose packing of at joints
(iv) Due to wide expansion gap.
(v) Due to heavy axle loads moving at high speed.



(3) Dragging Theory :

It states that backward thrust on driving wheel of the locomotive of train has got a tendency to push the rail off the track backward while the other wheels of the locomotive and the vehicles push the rail in the direction of travel resulting in creep of rails in the direction of movement of trains.

(4) Starting , Accelerating , slowing down or stopping of train :

When a train is starting or accelerating, the backward thrust of the engine driving wheels tends to push the rails backwards. When it is slowing down or coming to a stop , the braking effect tends to push the rails forward.

(5) Expansion or contraction of Rails due to Temperature.

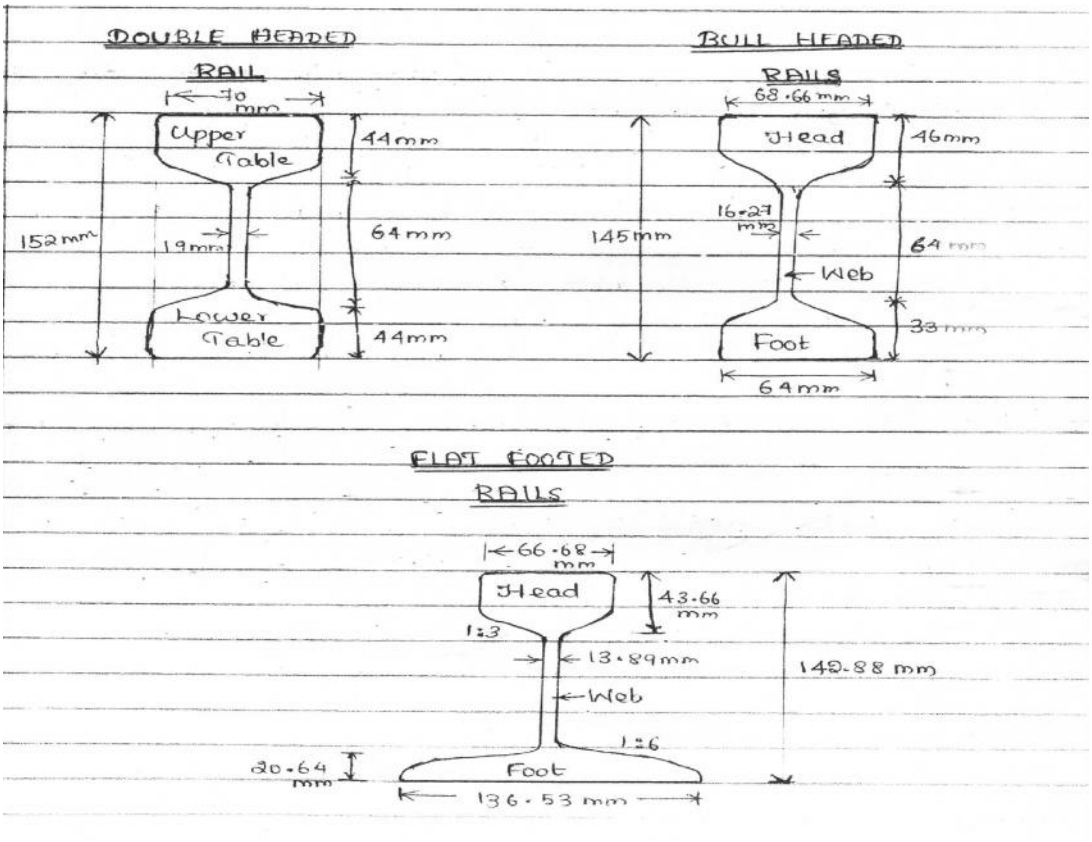
Creep occurs due to variation in temperature.

(6) Unbalanced Traffic :

a) In a single line system, if heavy equal traffic runs in both directions, the creep is almost balanced. Otherwise, heavy traffic in one direction will cause creep.

b) In a double line system, trains on a particular line being unidirectional, creep occurs in both the lines.

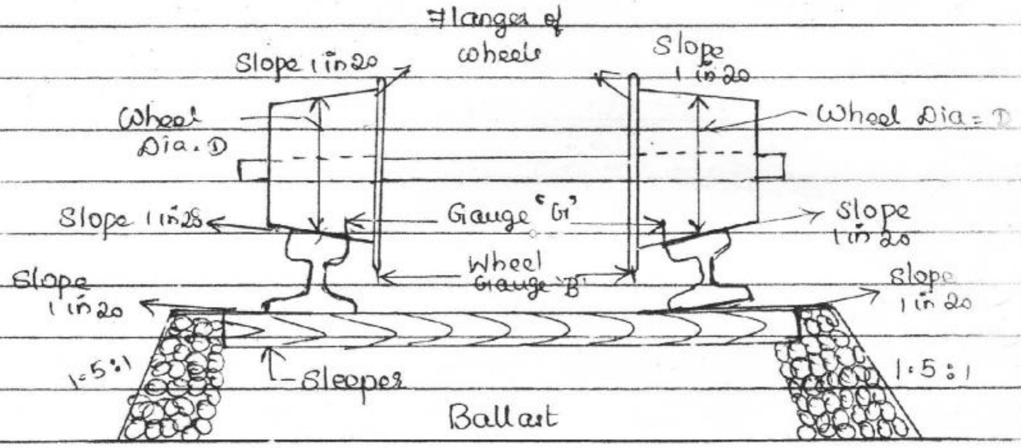
5 a) Rail sections:



b) Coning of wheels

Coning of wheels :-

The distance between the inside edges of wheel flanges is generally kept less than the gauge of the track. So there is a gap between the wheel flanges and running edges of the rails, nearly equal to 1 cm on either side. Normally, the tread of wheels is absolutely dead centre of the head of the rail, as the wheel is coned to keep it in this central position automatically. These wheels are coned at a slope of 1 in 20 as shown in fig.



CONING OF WHEELS ON LEVEL TRACK

The advantages of coning the wheels are:

(i) To reduce the wear and tear of the wheel flanges and rails, which is due to rubbing action of flanges with inside faces of the rail head.

(ii) To provide a possibility of lateral movement of the axle with its wheels

(iii) To prevent the wheels from slipping to some extent

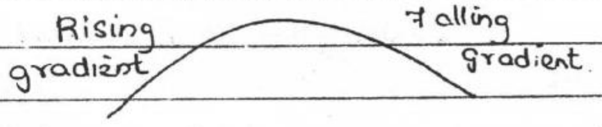
6. a)

1) Ruling gradient
2) Momentum gradient
3) Pusher or Helper gradient
4) Gradients at station yards.

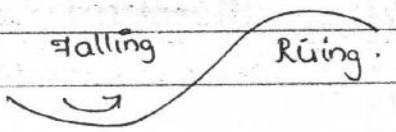
Ruling gradient:

The ruling gradient is defined as the maximum gradient to which a track may be laid in a particular section. It determines the max load that the engine can haul.

Steep gradients require more powerful locomotive, smaller train loads, lower speed and costly haulage. As a rule, rising gradients must be followed by falling gradients. With this the energy which was used up in climbing, is saved in descending.



A train is able to climb a rising gradient more easily if this rising gradient follows a falling gradient as the train can attain high speed over the falling gradient.



Generally for one locomotive train (single engine), the following gradients are adopted.

In Plain terrain 1 in 150 to 1 in 200.
In hilly regions 1 in 100 to 1 in 150.

Rule: NO GRADIENT SHOULD BE GREATER THAN THE RULING GRADIENT.

② Momentum gradient:

A train while coming down a falling gradient acquires sufficient momentum. This momentum gives additional kinetic energy to the moving train which could enable the train to overcome a steeper rising gradient than the ruling gradient for a certain length of the track. This rising gradient is called momentum gradient and in such cases a steeper grade than the ruling grade can be adopted.

③ Pusher or Helper gradient:

The load that the train can carry is decided by the ruling gradient. If a severe grade is concentrated in a specific section such as mountainous section, instead of limiting the train load, it may be operationally easy or even be economical to run the train using an assisting engine (extra) (or pusher engine or a banking engine). Such gradients are known as "Pusher" or "Helper" gradients

Generally a value of 1 in 75 to 1 in 100 is used.

④ Gradients at station yards:

They have to be sufficiently low for the following reasons

(i) To prevent the movement of standing vehicles on the track due to the effect of gravity combined with a strong wind and/or a gentle push.

(ii) To prevent additional resistance due to grade on the starting vehicles, which is about twice ~~the~~ @ the start than vehicle in motion.

Values of gradients @ station yards:

Maximum gradient = 1 in 400.

Minimum gradient = 1 in 1000.

Minimum gradient:

A certain minimum gradient is to be provided for drainage. This is known as minimum gradient.

b) The different types of ballast used in the permanent way are :

- Gravel
- Kankar
- Crushed stone
- Sand
- Ash
- Cinder etc