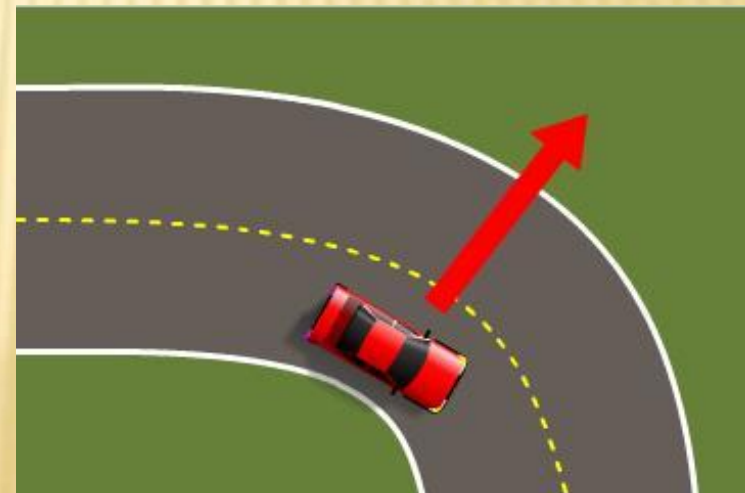
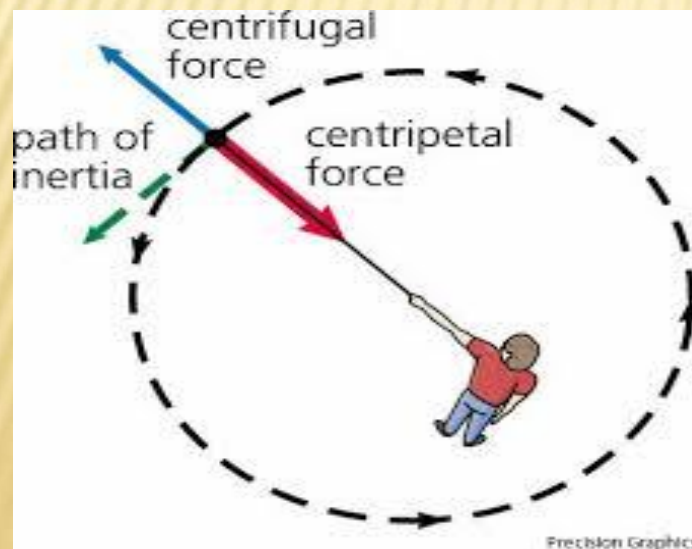


SUPERELEVATION



CENTRIFUGAL FORCE

- ✦ **When a body moves on a circular curve, it has a tendency to move in a straight direction tangential to the curve. This tendency of the body is due to the fact that the body is subjected to a constant radial acceleration.**



DEGREE OF CURVES

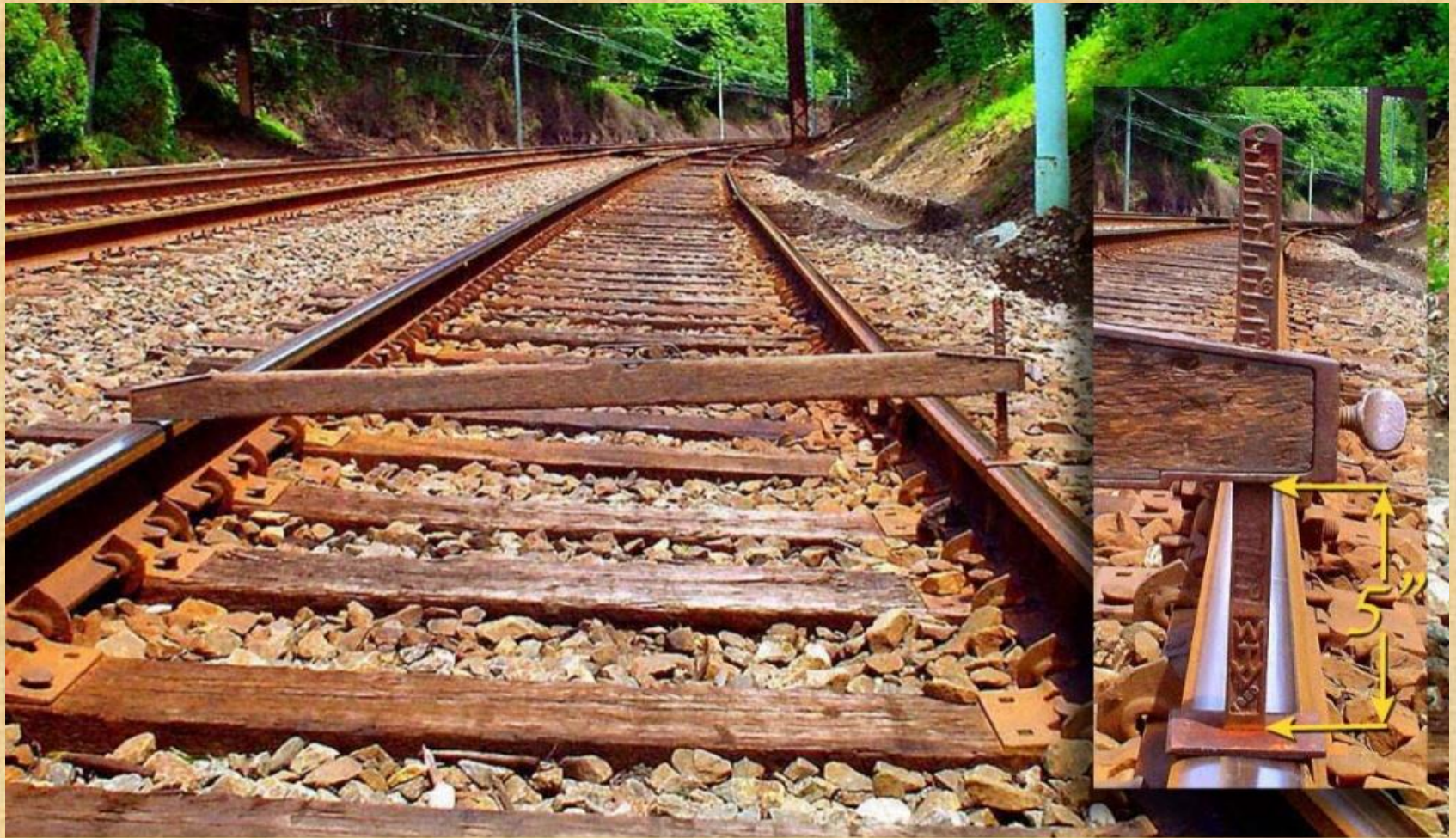
- × **A curve is defined by its degree or radius. The degree of a curve is the angle subtended at the center by a chord of 100 feet or 30.48m.**
- × **If R is the radius of curve,**
- × **• Circumference of the curve = $2 \pi R$**
- × **• Angle subtended at the center by the circle = 360 degree**
- × **• Angle subtended by the arc of 30.48m = $1750/R$**
- × **Thus, a 1 degree curve has a radius of 1750 m**

SUPER ELEVATION OF CURVE

- x Superelevation on Curves (Cant)**
- x Cant is defined as the difference in height between the inner and outer rails on the curve. It is provided by gradually raising the outer rail above the inner rail level. The inner rail is considered as the reference rail and normally is maintained at its original level. The inner rail is known as the gradient rail.**
- x Function of superelevation:**
 - x – Neutralizes the effect of lateral force.**
 - x – It provides better load distribution on the two rails.**
 - x – It reduces wear and tear of rails and rolling stock.**
 - x – It provides smooth running of trains and comforts to the passengers.**



Curve with superelevation



Superelevation between the inside and outside rails

SUPERELEVATION

- In metric system

$$e = GV^2/127R$$

where e = superelevation in mm, V = speed in kmph, R = radius of curvature in metres, G = dynamic gauge in mm, which is gauge in mm + width of rail head in mm. This is 1750mm for BG and 1058mm for MG

- In fps units

$e = GV^2/1.25R$ where e = superelevation in inches, G = gauge in ft, V = speed in mph, R = radius of curve in feet.

EQUILIBRIUM SPEED

- The equilibrium speed is the speed at which the effect of centrifugal force is exactly balanced by the cant provided.

MAXIMUM PERMISSIBLE SPEED

- This is the highest speed which may be permitted on a curve taking into consideration the radius of curvature, actual cant, cant deficiency, cant excess and length of transition.

CANT DEFICIENCY

- Cant deficiency occurs when a train travels around a curve at a speed higher than the equilibrium speed. It is the difference between the theoretical cant required for such higher speed and the actual cant provided.

CANT EXCESS

- Cant excess occurs when a train travels around a curve at a speed lower than the equilibrium speed. It is the difference between the actual cant provided and the theoretical cant required for such lower speed .

CANT GRADIENT AND CANT DEFICIENCY GRADIENT

- These indicate the amount by which cant or deficiency of cant is increased or reduced in a given length of transition.
- A gradient of 1 in 1000 means that cant or deficiency of cant of 1 mm is attained or lost in every 1000 mm transition length.

RATE OF CHANGE OF CANT OR CANT DEFICIENCY

- This is the rate at which cant –deficiency is increased while passing over the transition curve .
- 35 mm per second means that a vehicle when travelling at a maximum speed permitted will experience a change in cant or cant deficiency of 35 mm in each second of travel over the transition.

MAXIMUM VALUE OF SUPERELEVATION

GAUGE	GROUP	NORMAL (mm)	SPECIAL (mm)
BG	A	165	185
BG	B & C	165	
BG	D & E	140	
MG		90	100
NG		65	75

MAXIMUM DEGREE OF CURVE

GAUGE	ON PLANE TRACK		ON TURN OUT	
	MAX DEGREE	MIN RADIUS	MAX DEGREE	MIN RADIUS
BG	10	175 M	8	218 M
MG	16	109 M	15	116 M
NG	40	44 M	17	103 M

Limiting value of various parameters

ITEM	LIMITING VALUES	
	BG	MG
Max degree	10 degree	16 degree
Max cant	165 mm	90 mm
Max cant deficiency	75 mm In special case 100mm with permission of CE	50 mm
Cant excess	75 mm	65 mm
Max cant gradient	1 in 720 In exceptional cases 1 in 360 with permission of CE	1 in 720
Rate of change of cant or cant deficiency	Desirable: 35 mm/sec Maximum: 55 mm/sec	Desirable: 35 mm/sec Maximum: 35 mm/sec
Max cant deficiency in turn out	75mm	50 mm

Thank You