Railway & Bridge Engg.

Geometric Design of Track :-

The geometric design of a railway track includes all those parameters which determine or affect the geometry of the track. These parameters are as follows :-

→ Gradients in the track, including grade, compensation, rising gradient & falling gradient.

→ Curvature of the track, including horizontal & vertical curves, transition curves, sharpness of the curve in terms of radius or degree of the curve, cant or superelevation on curves etc.

Necessity for Geometric Design :-

The need for proper geometric design of a track arises of the following considerations :-

→ To ensure the smooth & safe running of trains.

→ To achieve maximum speeds.

→ To carry heavy axle loads

→ To avoid accidents & derailments due to a defective permanent way.

→ To ensure that the track requires least maintenance.

Details of Geometric Design of Track :-

The geometric design of railway track deals with the following aspects :-

→ **Alignment of Railway Lines :-**

It refers to the direction & position given to the centre line of the railway track on the ground in the horizontal & vertical planes.

Curve & Superelevation on a Railway Track :-

The curves are introduced on a railway track to bypass obstacles to provide longer & easily traversed gradients & to pass a railway line through obligatory or desirable locations.

Gradients :-

These are provided to negotiate the rise or fall in the level of the railway track.

Points & Crossings

Points and crossing are peculiar arrangement used in permanent way to guide the vehicle for directional change. Broadly point & crossing assembly consists of three main components namely point, lead & crossing element. The track portion betn point & crossing is called lead.

Constituents of the Points & Crossing :-

The switch assembly the crossing assembly & the lead portion beyond the turnout, turn-in-curve is also important assembly.

Turnout :-

The term denotes points & crossing with the lead rails.

Tongue rail :-

It is tapered moveable rail; connected at its thickest end to running rail.

Stock rail :-

It is the running rail, against which a tongue rail functions.

Switch :-

A pair of tongue with stock rail with necessary connections & fittings.

Points :-

A pair of tongue rail with their stock rails are termed as points.

Crossing :-

A crossing is a device introduced at the junction where 2 rails cross to permit the wheel flange of railway vehicle to pass from one track to another.

Heel of switch :-

It is an imaginary point on the gauge line midway betn the end of lead rail & the tongue rail in case of loose heel switches. In case of fixed heel switches it is a point on the gauge line of tongue rail opposite the centre of heel block.

Lead :-

The track portion betn heels of switch to the beginning of crossing assembly is called lead.

Station & yard station

At a station on railway line traffic is booked & authority to proceed is given to the trains. These are following types :-

i) Flag station is not meant to control the trains movement. It deals with traffic only.

ii) Block station deals with control of movement of the train without dealing the traffic.

station may be further classified into 3 categories
(i) wayside station
(ii) Junction
(iii) Terminals.

Yard :-

It is a system of tracks laid within definite limits for various purposes such as storing of vehicles making up trains, dispatches the vehicles. etc.

yards may be classified as

(i) passenger yard facilitates movement of passengers
(ii) In good yards the goods are received loaded & unloaded.

(iii) **marshalling yard :-**

It stores & distributes empty as well as loaded wagons. as & when received from other stations.

(iv) **Locomotive yard :-**

It is meant for maintenance repairing & overhaul of locomotives.

Signalling :-

safety to the traffic movement on rails may be ascertained by signalling. It facilitates smooth traffic flow & shunting operations. It may be classified as

(i) semaphore type signals
(ii) warner signals
(iii) Disc or ground signals
(iv) coloured light signals.

Interlocking :-

The mechanical systems, levers & cables etc which are essential in the operation of signal mechanism are K.a. interlocking

The methods for interlocking are
(i) Tappets & locks systems
(ii) Key system
(iii) Route relay system

Key system is the simplest method of interlocking.

Maintenance of Track :-

(a) Gauge maintenance uniformity of the gauge should be properly maintained. Gauge may be disturbed due to following reasons.
(i) The loosening of track fittings
(ii) The irregularity of the track gauge increases with the passenger of time.

(b) Joints maintenance :-

→ A joint in the railway track is the weakest part Proper attention should be paid for this maintenance

⇒ Riding, blowing & pumping are the defects which occur due to faulty maintenance of the rail joints & its surface.

(c) Packing of ballast :-

Due to heavy loads & vibrations caused by running trains, the ballast under the sleepers get loose.

(d) Track drainage :-

The sources of moisture in a railway track are surface water, seepage water & hydroscopic water. The pressure of excessive water reduces the track stability erodes the banks of the embankments & in some cases may even result in accidents.

Bridges :-

Definations :-

Bridge is a structure built to span a physical obstacle, such as a body of water, valley or road without closing the way underneath.

or

A bridge is a structure that is built over a railway river, or road so that people or vehicles can cross from one side to the other.

Components of a bridge :-

The bridge structure consists consists of the following components :-

1. superstructure or decking component
2. Bearings
3. substructure components

superstructure components of Bridges :-

The structure consists of deck slab, grider, truss etc. These components vary based on the type of bridge. superstructure of the bridge bears the load passing over it. This helps in transmitting the forces formed by the loads to the below substructures.

Decks :-

The decking is considered as the road or the rail surface of the Bridge. The decks are supported by the girders or the

huge beams that is in turn supported by the Piers.

Substructure components of Bridges :-

It involved in substructure of bridges are
1. Piers
2. Abutments
3. Wing walls & the Returns
4. Foundation.

Piers :-

The Piers are vertical structures used to support deck or the bearings. Provided for load transmission to underground soil through foundation

The structure has mainly 2 functions :-
1 - Load transmission to the foundation
2 - Resistance to the horizontal forces.

Abutments :-

Abutments are vertical structures used to retain the earth behind the structure. The dead & the live loads from the bridge superstructure is supported by the bridge abutments.

Wing walls & Returns :-

Structures constructed as an extension of the abutments to retain the earth present in the approach will otherwise have a natural angle of repose. These are retaining walls constructed adjacent to the abutments. This wall can be constructed either integrally or independent with the abutment wall.

Foundation of Bridges :-

The structures are constructed to transmit the load from the piers, abutments, wing walls & the returns evenly on the strata

→ The foundation provided for bridge structures are deep in sufficient manner to avoid scouring due to the water movement or to reduce the chances of undermining

Classification of Bridges :-

There are many types of bridges & they can be classified in many different ways:-

By structure they are classified as

Beam bridges:-

main structural element of a beam bridge is a horizontal beam that is supported at each end. They can be simply supported when the beams only connect across a single span or continuous when the beams are connected across two or more spans

Truss brige :-

It is a bridge whose load-bearing superstructure is composed of a truss - a structure of connected elements forming triangular units; They are one of the oldest types of modern bridges

Cantilever bridge :-

It is built using cantilevers, structural elements that are supported on only one end & that, from there, project horizontally into space. They are usually made from a pair of

continuous spans that extended from opposite side

Arch bridge :-

It has abutments at each end which hold the weight of the bridge.

Suspension bridges :-

It hold weight of the bridge with cables. In ancient times these bridges were made from ropes or vine Today are use steel.

Cable - stayed bridges :-

These bridges are similar to suspension bridge & also use cables but their form is different they have fewer cables & towers that hold cables are much higher.

Requirement of an ideal bridge :-

→ Bridges are required to connect big towns & cities.

→ It provides communication bet^n two cities & provide business aspects. It also helps in the war time for the mobility of the Army

→ Bridges are required in the road or rail projects where large numbers of accuracy are required.

→ These projects take longer time for completing & required more accuracy & large number of planning & consideration

→ The economy of bridges depends upon the material used at the time of construction

Site selection :-

Keep the following points in your mind while you are selecting a site for the bridge construction

- → connected with roads
- → strong embankments on both sides
- → Type of foundation
- → Requirement of material & labour
- → Flow of water
- → straight stretch of river
- → Flow of river
- → width of river

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Determination of flood discharge :-

(i) Dicken's formula

$$Q = CA^{(3/4)}$$

where Q = Maximum flood discharge in cumec
A = Area of catchment in square kilometer
C = coefficient

(ii) RYVE's formula

$$Q = CA^{(2/3)}$$

where Q = Flood discharge in cumec.
A = catchment area of basin in sq.m.
C = Flood co-efficient

Constant C depends upon the catchment & may be obtained from table

Location of catchment	C
Area within 24 Km from the coast	6.75
Area within 24 Km to 160 Km from the coast	8.45
Limited area near hills.	10.1