Section -5

RAILWAY BRIDGE ENGINEERING

CHAPTER 1

Bridge Terminology

Bridge terminology, in alphabetical order, is given below to facilitate students in searching of the desired terminology easily. It is possible that some of the terminology might not be explained in details in the following chapters, due to its being of complicated nature, yet the same has been included here to brief them in simplified way.

A.

(1) ABUTMENT

In multi span bridge, it is the end supporting structure of substructure. In single span bridge, since there is no middle support i.e. pier, both the end supports are called abutments.

(2) AFFLUX

It is the rise in water level of water carrying body due to obstruction created by reducing the width. Due to width reduction, water level rises up. This additional rise in water level is called afflux, which has to be considered while fixing the vertical clearance. Width reduction might be either due to construction of pier or due to other consideration of passing water channel in restricted width.

(3) ALLUVIAL REACH

It is one of the various reaches of the river where river flows in plain area, after hilly and submontane reaches. Final reach of the river is called tidal reach, in case river joins the sea.

(4) ANCHORAGE

In suspension bridges, it is the mass concrete which fix the cables, at both the ends of the bridge. In PSC girder it is the anchoring system to hold the pre-stressing tables. In general, it is the anchoring system which anchor the bridge part, which needs anchorage.

(5) ANEMOMETER

An instrument used in measuring the wind velocity.

(6) AUGUR BORING

A terminology normally used in pile foundation, for boring purpose, in which boring is done with specially designed augurs.

(7) APPROACH SLAB

It is an assisting bridge to the main bridge provided at both ends of the main bridge. It consists of one span of RCC slab of about 3.5m span, one end of which rests on the abutment and other end on shallow foundation. Purpose of approach slab is to relieve abutment from live load surcharge, getting relief in earth pressure on abutment and most importantly factor is to bring gradual change in the structure i.e. approach structure to bridge structure. Now a days, both railway rules and highway rules stress regarding provision of approach slab at least on major bridges.

(8) APRON

It is a protective work. For details please see launching apron.

(9) AREA VELOCITY METHOD

It is the direct method of computing the discharge in a river by calculating area and velocity. Since velocity is not uniform in whole cross section, area is divided into parts and multiplied by the corresponding velocity. Total sum of multiplication of area and velocity gives the total discharge.

(10) ARCH BRIDGE

A bridge which transfers the load by arching action. An Arch bridge may be either of masonry, concrete or steel.

(11) ASSISTED CUTOFF

It is one of the method of river training where, as per requirement, water course of the river is changed from meandering to straight flow.

B.

1. BALANCED CANTILEVER BRIDGE

A type of bridge used in large spans where part moment is balanced by the end cantilever. On the end cantilevers, suspended span of simply supported nature is placed.

2. BASCULE

It is a type of bridge, which is of cantilever type, supported by hinge joint at the end, which can be lifted to give passage to ships.

3. BASE PRESSURE

Reaction of the earth at the base of the foundation is known as base pressure.

4. BATTER

Side slope in vertical direction in pier and abutment is known as batter.

5 BEARINGS

Bearing is that component of the bridge which receives the load from the super structure and then transfers the same to substructure. Various types of bearings will be discussed in their specific name.

6. BEARING CAPACITY OF THE SOIL

It indicates the capacity of the soil to bear the load.

7. BED BLOCK

Bed block is a bed, preferably of R.C.C. on which the girder is seated through bearings.

8. BAILEY BRIDGE

Name after Sir Bailey, inventor of such a bridge. This is temporary bridge, which can be assembled and launched with prefabricated unit, in a short time. Mostly such bridges are used for army movements.

9. BENTONITE

A type of clay, normally used in bored piles to stabilize the side earth of the bore hole to avoid cave in.

10. BRI

Short form of Bridge inspector – An inspector exclusively deputed for inspection of bridges and bridge works. He now adays designated as Section Engineer/ Senior section Engineer (SE/SSE) Bridges.

11. BRIDGE RULE

It is a book containing guideline and loading standards for desidning Railway bridges.

12. BRIDGE STRENGTHENING

When the bridge becomes weak on certain account, its strengthening is required to restore the structure to normal strength to carry design load. This is called bridge strengthening.

13. BLOWING OF SAND

It is a problem which often arises while well sinking in sandy strata. In this, all of a sudden, sand along with water rushes inside the well from the outside, due to pressure difference.

14. BOX CULVERT

It is a type of bridge, made of RCC in the shape of square or rectangular cross section of the desired barrel length.

15. BUTTRESS

Sometimes earth retaining structures, including abutments are strengthened by providing extra supporting members, to counter earth pressure are known as buttresses.

C.

1. CABLE STAYED BRIDGE

It is a type of bridge where one end of cable is tried up with deck and other end with supporting tower/ pylon. With the help of various cable, complete deck is supported with supporting tower. 2nd Hooghly bridge at Calcutta is a cable stayed bridge.

2. CAMBER

It is the intentional upward deflection provided in the girders of large spans to take care of secondary stress. Some of this upward deflection is eaten away by dead load by downwards deflection. If camber is not provided, then the girder deflection may pose psychological fear in the mind of passerby, even if the same is in safe limit.

3. CARRIAGE WAY

Width of the bridge for passing of motorized vehicle is known as carriage way. This excludes the footpath width.

4. CAUSEWAY

It is the dip in the Railway track which allows flood water to pass over it. If flood water is of specified depth, traffic can pass over it. It is also known as Irish Bridge.

5. C.C.CRIB

Also known as Christ Church Crib. It is 60 cm X 60 cm X 1.8 m dimension of steel structure, used for temporary support.

6. CENTRALISED BEARING

It is a type of bearing provided in plate girder bridges.

7. C.H.SPAN

Also known as Calendar Hamilton span. It is railway equivalent of the Bailey bridge, in which temporary bridge can be launched with prefabricated components. For train's movement, CH span up to 250' can be launched.

8. CLEARANCE

Both vertical and horizontal clearances are required to be provided in a bridge to have safety zone. In River Bridge some specified vertical clearance should be there above HFL to the bottom of girder.

9. CLOSURE BUND

One or more channels of the river are sometimes required to be closed on certain account. The same is done by closure bunds.

10. COMPOSITE GIRDER

Girder made of Composite material e.g. R.C.C. and steel.

11. CORROSION

Loss of section of steel due to rust formation is known as corrosion. Condition based painting may be required to be done as per specified schedule and in corrosion prone areas the frequency of painting may be increased.

12. CREEP

It is movement of girder in longitudinal direction due to moving effect of vehicle and temperature effects. It should be controlled.

D.

1. DEAD LOAD

It is the self weight of the structure which is permanently available.

2. DECK TYPE BRIDGE.

Those bridges in which track is placed on the top of the girder. Under slung girder bridge is deck type bridge where bank is high and HFL is low such types of bridges are preferred.

3. DEEP FOUNDATION

Foundations, which are having much more depth as compared to its other dimension. It mostly refers to well and pile foundations.

4. DESIGN SCOUR

The scour taken for design of the foundation is known as design scour. Normally it is calculated by multiplying Lacey's scour depth by a factor given in code.

5. DISCHARGE OF RIVER

The quantity of water passing through river is known as its discharge. Design discharge is that discharge taken for design of foundation.

6. DISTORTION OF GIRDER

As the name implies, it is the measure of deviation of the girder from the straight alignment. Time to time, it is measured to ensure safety of the bridge. This is particularly important in case of truss bridges.

7. DIVERSION

Sometimes traffic is to be diverted to complete the work in the original alignment, is known as diversion.

8. DREDGE HOLE

Normally, a term used while sinking of the well for foundation. First activity in sinking is to remove the earth from inside the well, forming a dredge hole.

9. DYNAMIC AUGMENT

Moving load creates additional stress as compared to static load. Increases in the effect of live load, due to its being in dynamic condition is known as dynamic augment or impact factor.

E.

1. EARTH PRESSURE

Pressure exerted by the earth on the earth retaining structure is known as earth pressure.

2. ECONOMICAL SPAN

Economical span is that particular length of span, adoption of which brings economy in construction cost. Concept of economical spans if fulfilled when cost of substructure is equal to cost of superstructure.

3. EFFECTIVE WATER WAY

Total width available for water flow minus width of obstruction provided in the form of piers etc. it called effective water way.

4. ELASTOMERIC BEARING

It is made of elastomer. For smaller span, unreinforced bearings are used. For bigger spans elastomers are reinforced by steel plates and called reinforced elastomeric bearings.

5. EPOXY GROUTING

Grouting done for repair work with the help of epoxy material is known as epoxy grouting. Epoxy is having property of early setting. It provides good binding.

6. ERECTION OF GIRDER

Placement of girder in its proper position by suitable scheme is known as Erection of girder.

7. EUDL

Stand for equivalent uniformly distributed load, producing the same effect as that of standard loading configuration.

8. EXPANSION JOINT

A gapping joint provided for free movement of the girder due to temperature variation i.e. expansion and contraction.

F.

1. FACTOR OF SAFETY

It is the ratio of ultimate stress to the allowable stress.

2. FLAT BEARING

It is the simplest type of bearing, having wide base to distribute the load over a wider area on the bad block.

3. FORCES ON THE BRIDGE

Various types of the forces acting on the bridge e.g. centrifugal force, frictional force, horizontal force, longitudinal force, raking force, seismic force etc.

4. FREE BOARD

It is the difference between HFL and top of the approach, embankment, dam or protective work e.g. guide bund, marginal bund etc. Normally it is kept not less than 1.0 m.

5. FRICTION PILE

A type of pile which transfers the load by the way of skin friction developed between the pile surface and soil, is known as friction pile.

G.

1. GAUGE

In Railway terminology, it refers to inside distance between the two parallel rail e.g. BG, MG, NG. In other sense it refers to measuring instrument e.g. rain gauge, screw gauge etc.

2. GRADE SPARATION

When two traffic routes, either of similar type or of different type cross each other at different level to facilitate unobstructed movement of each other, is known as grade separations.

3. GROYNS OR SPUR

It is also a river training work either of deflecting or attracting type to mould the flow of water in desired direction.

4. GUARD RAIL ON BRIDGES

In addition to the left rail and right rail, which forms gauge of the track, two more rails, adjacent to the left rail and right rail, both on inside the track area provided on bridges to guard the vehicle from falling, in case it derails. These two additional rails are known as guard rails.

5. GUNNITING

It is a repair technique where cement sand mortar is deposited under pressure to repair the damaged portion.

6. GUIDE BUND

It is river training work to regulate the flow of water to pass through a specific area, otherwise river water will be spread causing damage to the structure.

H.

1. H.D.BOLT

A HD Bolt stands for holding down bolt. It is special bolt one end of which is fixed in the concrete mass and other end is projected outside to hold the structure eg. girder, base of the FOB etc.

2. HOOK BOLT

It is special type of bolt which holds the sleeper with the girder.

3. HFL

It is the highest flood level which had occurred in the past in that particular river.

4. HUME PIPE BRIDGES

These are simply RCC pipes of suitable diameter. For small discharge, such type of bridges are very convenient.

5. HYDRAULIC DATA

Data related to hydraulics of the river eg discharge, width, slope of the river bed, scour depth etc. are known as hydraulic data.

6. HYDROLOGY

It is a science of study of rainfall and related discharge in the rivers.

I.

1. IMPACT LOAD

It is a same as dynamic augment.

2. IRS

Indian Railway Standard.

3. IRC CODE

Code issued by Indian Road Congress for road bridge.

4. IMPORTANT BRIDGE

Those bridges having linear water way of 300m or more or total waterway of 1000 sqm or more or classified by Chief Engineer as important bridge, are important bridges.

J.

1. JACKETING

It is a strengthening work where pier or abutment is jacketed by adding extra width, ensuring proper fixing arrangement with the original structure.

L.

1. LACEY'S FORMULA

Various formulae derived by Lacey, which are used in calculation of waterway, scour depth, slope of the water carrying body etc.

2. LAUNCHING APRON

An arrangement for automatic launching during severe flood to protect the main structure like guide bund. It consist of boulders properly provided in the river bed.

3. LAUNCHING OF GIRDER

Broadly refers to the placement of girder at the appropriate place by suitable scheme.

4. LINEAR WATERWAY

It refers to the width of the river, naturally available or required in normal condition.

5. LIVE LOAD

It is that maximum temporary load which may occur on the structure.

6. LOADING STANDARD

Loading has been standarised into various types, which are known as loading standard e.g. BGML, RBG, MBG, 25T in Railways, class A, class AA, 70R loading for highway.

7. LONGITUDINAL FORCES

Forces which act in longitudinal direction e.g. braking force, acceleration/deceleration force etc.

8. LOOSE RIVET

In riveted connection, sometimes rivets become loose, in due course of time. Scattered loose rivets are not a matters of concern but loose rivets in close vicinity are a matter of concern and area to be replaced by sound rivets.

9. LOSS OF CAMBER

When measured camber is less than the designed camber, it is said to be loss of camber. Camber is to be measured from time to time to know the behaviour of the girder and to ensure safety.

10. LWL

Stands for low water level. It is the highest water level available in the river during the dry weather/lean period.

M.

1. MAJOR BRIDGE

Those bridges which are having either linear waterway of 18 m or more or having clear opening of 12 m or more in any of the spans.

2. MARGINAL BUND

Bund provided to contain spread of water in more and more area. Normally it is provided away from the active area of the river.

3. MEANDERING RIVER

In curved reaches, sometimes river goes on adopting sharper and sharper curve. Such pattern of river is known as meandering river.

4. METALLISING

Surface protection by spraying molten metal (e.g. Aluminum) is known as metallising.

5. MINOR BRIDGE

Those bridges which are having linear water way of less than 18m or clear opening of less than 12m.

6. MOVABLE BRIDGE

A bridge which can be either lifted, turned or raised from its normal position to facilitate movement of ships is known as movable bridge.

N.

1. NEOPRENE BEARING

This is brand name of elastomeric bearings.

2. NUMERICAL RATING SYSTEM OF BRIDGE INSPECTION

It is a usual inspection of bridge when number system is used to represent the condition of the bridge.

O.

1. OIL BATH BEARING

For important bridges, rollers and rockers are placed in a box filled up with oil. Such bearing are known as Oil Bath Bearing.

2. OILING AND GREASING OF BEARING

Some types of the bearings are required to be properly oiled and greased at interval of 3 years for proper behaviour. These are to be done and recorded in bridge register as well as painted on the bridge.

3. OPEN FOUNDATION

Foundation which are provided by opening of the earth and then after construction of the foundation. Normally shallow foundation are open foundation.

P.

1. PARAPET WALL

Provided at the end of the bridge, parallel to the track, to avoid falling of anything down below.

2. PHOSPHOR BRONZE BEARING

A type of bearing where bed plate has phosphor bronze surface. This surface has very low coefficient of friction and hence reduce the horizontal force appreciably. Greasing is not required.

3. PIER

In multi span bridges, except the end supports (which are called abutment) all other supports are known as piers.

4. PILE FOUNDATION

A type of deep foundation, constructed either of timber, steel or concrete. These are slender members and are mostly provided in groups joined and covered by a pile cap.

5. PIPE CULVERT

It is the same as Hume pipe bridges.

6. PLATE GIRDER.

It is a built up girder made of plates, angles and channels. RDSO standard drawings of plate girders are available for railway bridges, up to 100 feet span (30.5 m span)

7. PONTOON BRIDGE

It is a temporary bridge, made of big sizes of specially designed empty drums. Such bridges are constructed after the monsoon and dismantled before on set of monsoon.

8. PSC GIRDER

Prestressed concrete girder.

9. PTFE BEARING.

PTFE stand for poly tetra floro ethylene. Coefficient of friction between PTFE and steel is very low. This type of bearing is placed in a suitable box type arrangement.

R.

1. REGIRDERING

When foundation and substructure are strong but girders become week on certain account needing replacement of the same, then girder replacement is called regirdering.

2. REHABILITATION OF BRIDGES

Refers to the weakened bridge whose strength is restored to normal either by heavy repair or replacement of some of the part or complete rebuilding of the bridge.

3. RIVER TRAINING

River training works are those works which are constructed to guide the river flow to the desired fashion.

4. ROAD OVER BRIDGE

When road is passing over the railway track, it is a road over bridge (ROB)

5. ROAD UNDER BRIDGE

When the road passes under the railway track it is called a road under bridge (RUB).

6. ROCKER BEARING

Pin jointed bearing which allows rotation but do not permit horizontal movement.

7. ROLLER BEARING

Free end of the girder with bearing which rolls to and fro to facilitate expansion and contraction.

S.

1. SCOUR

During flood period, water erodes the river bed. Bed erosion due to water flow is known as scour.

2. SEMI THROUGH BRIDGE

Those bridges, floor level of which are supported at some intermediate level of super structures are called semi through bridges.

3. SERVICE SPAN/GIRDER

Temporary girder placed in the track as a temporary bridge, for doing some work eg. Construction of new bridges, is known as service span/girder.

4. SHALLOW FOUNDATION

Foundation whose depth is normally about 2m and which can be constructed by opening the earth is known as shallow foundation.

5. SHIFT OF A BRIDGE FOUNDATION

Normally in case of well foundation, at the time of sinking, some dislocation takes place. It is known as shift of the well, which should preferably be within 15cm on either direction, otherwise design is to be checked.

6. SHOTCRETING

It is another name of Gunniting.

7. SIDE SLEWING

This terminology, mainly used while girder launching in which girder is placed by the side of the original girder at the same level and then after shifting the original girder placed at proper location by side slewing.

8. SILTING

Deposition of silt in the river bed is known as silting of river.

9. SKEW BRIDGE

When alignment of the bridge is not at right angle to the track, it is said to be skew bridge. Skew bridge angle should preferably be restricted to 30 degress.

10. SLAB BRIDGE

That bridge whose super structure is either RCC or PSC slab is known as slab bridge.

11. SLEEPER CRIB

Temporary support made of released wooden sleepers, normally for placement of service span is known as sleeper crib.

12. SOUNDING

Measuring depth of river bed, particularly during flood time is known as sounding of river. It is done to know the scour depth to ascertain safety of foundation.

13. SPAN

a. Clear span

Clear distance between the two supports is called clear span.

b. Effective span

Centre to centre distance of bearings of a girder is known as effective span.

c. Over all span

Overall length of the girder denotes overall span.

d. Total span

In multi span bridges, total length of bridge, from one end to other is known as total span.

14. SPUR

It is another name for groyns.

15. STEEL BRIDGE

That bridge, whose super structure is made of steel, is known as steel bridge.

16. SUB MONTANE REACH OF THE RIVER

It is the 2_{nd} reach of the river, in between the hilly and plain reach. River is still in turbulent flow stage. Mainly this reach is at the foothills.

17. SUBSTRUCTURE

Bridge portion below bearing is known as sub structure.

18. SUPER STRUCTURE

Bridge portion above bearing is known as super structure.

19. SYPHON BRIDGE

Bridge in which water passes through symphonic action are known as Siphon Bridge. Mostly these are canal bridges.

T.

1. TELL TALES

To study the crack pattern, whether the same are increasing or not, dated marks-put on plaster cast at the extremities of the crack, is known as tell tales.

2. THROUGH BRIDGE

In such bridge, floor system to lay the track is supported at the bottom of the super structure. At the top, sway and lateral bracing are there. Movement of vehicle is there in the opening created by bottom, sides and top of the bridges structure and hence such bridge is known as through bridge.

3. TIDAL REACH OF THE RIVER

It is the last stage of river before meeting the sea. River is mostly divided into many channels forming deltas.

4. TILT

At the time of well sinking, sometimes it tilts, which is known as tilt of the well. It should not be more than 1 in 100.

U.

1. UPPER REACHES OF THE RIVER

Mostly hilly and sub montane reaches of the river combined, is known as upper reaches of the river.

W.

1. WATER WAY

Denotes width of the water body i.e.river, nala etc.

2. WELDED GIRDER

Those steel girders, various members of which are having welded connections, are known as welded girders.

3. WELL FOUNDATION

A type of deep foundation, shaped and sunk like a well, mostly provided in river bridges.

4. WELL STEINING

Thickness of the wall of the well in well foundation is known as well steining.

5. WIND LOAD

Load exerted by the wind is known as wind load.

6. WING WALL

Splayed wall at both the ends of the bridge, which guide the flow, as well as retain the backfill of the earth is known as wing wall.