

Type of Railway Bridge and Their construction

WHAT ARE THE BRIDGES

- ANY structure which allows more than one type of movement unobstructed is known as bridge.

Basic parts of Bridge

- Superstructure

(a) Deck

(b) Main structural system which supports the deck and spans between the superstructure units.

- Sub Structure and Foundation

(a) Abutment

(b) Pier

(c) Guide Bund

(d) Marginal Bund

(e) Apron

Types of Bridges

- According to Railway Bridges sub structure code.
 - (a) Important Bridge
 - (b) Major Bridge
 - (c) Minor Bridge

Types of Bridge according to materials of construction

- Masonry Bridge
- Concrete Bridge
- Steel Bridge

Types of Bridge according to load distribution

- Beam Bridge
- Arch Bridge
- Suspension Bridge
- Movable Bridge
 - (a) Swing Bridge
 - (b) Lift Bridge

Types of Bridge according to opening

- Box Culverts
- Rcc Slab Culverts
- Hume pipe
- Girder Bridge
 - (a) Solid web girder
 - (b) Open web girder

BRIDGE TERMINOLOGY

- Afflux
- Cause way
- Viaduct
- Grade separation
- Road over Bridge
- Road under Bridge
- Skew Bridge

- Deck Bridge
- Through Bridge
- Semi-Through Bridge
- Span
 - (a) Clear span
 - (b) Effective Span
 - (c) Overall span

Bridge Terminology

- Water way
- Linear water way
- Total water way
- Highest Flood Level (H.F.L)
- Low water Level (L.W.L)
- Scour Depth
- Free Board
- Design Flood Discharge

Numbering of pier and abutment

- In the direction of increasing Kilometers

Design load for Bridges

- Dead Load
- Live Load
- Dynamic Effect
- Forces due to Curvature or eccentricity of track
- Forces and effect of temperature
- Forces and effect due to earthquake
- Frictional Resistance of expansion of bearings
- Longitudinal Forces(Tractive Effort, breaking force effect

Construction of Bridge with temporary arrangements

- Preliminary arrangements
 - (a) CRS sanction
 - (b) Green notice
 - (c) Speed Restriction Boards
 - (d)Lightening Arrangements
 - (f) Posting watchman
- Sleeper Crib
- Service Girder 45',60' or 87'
- Putting service girder in track
- Construction of foundation, Substructure, back filling, Bed Blocks
- Removing temporary arrangements and placing permanent Girder

Re girdering

- Due to serious defect in girder
- Old Girder being of early steel Girder requiring replaement

THE CONNECTION BETWEEN STEEL MEMBERS

- Hinged or Pinned Joints
- Rivets and Bolts
- Welding

OPENING OF THE BRIDGE FOR TRAFFIC

- By CRS
- Visual inspection
- Assessing speed of traffic
- Measuring deflection of Bridge Girder
- Filling Performa giving general data, Specifications of Bridge, Deflection at mid point as well as at the ends at various incremental speeds

INSPECTION OF BRIDGES

- Why inspection is necessary ?
 - (a) To confirm that the bridge is in fit condition to carry the designed load.
 - (b) To plan its maintenance.
- With passage of time , some wear and tear of the elements of the bridge structure does take place and its maintenance and repairs have to planned.

Factors for wear and tear

- Settlement of foundation.
- Cracks in superstructure and bed blocks.
- Blockage of weep holes.
- Scour under piers and abutments.
- Change in the direction of flow of water.
- Corrosion in steel girder.
- Looseness of rivets and bolts due to elongation or ovality of holes.
- Fatigue cracks in girder caused due to reversal of stresses
- Movement of bridge elements caused by creep. Damaged due to accident.

Who inspects the bridge,

- ADEN-Once a year immediately after monsoon.
- IOW-Sub structure of bridge once a year before monsoon.
- PWI-Condition of girders, bearings, approach track, clearance of water ways, once a year before monsoon.
- BRI-All steel bridges of 12.2 m span and above once in five years.

Technical inspection of girder bridge.

- Creep-longitudinal movement of girder.
- Camber-The negative deflection provided at the time of fabrication of girder.
- Distortion-The offset of the various panel pints of the girder from their alignment.
- Seating of bearings
- Condition of bed blocks and holding down bolts, loose rivets.

Technical inspection of girder bridge.

- Lateral bracings.
- Position and level of track.
- Corrosion and painting,
- Drain holes and smoke plates.
- Structural condition of different members.
- Any serious defect requiring immediate attention.

INSPECTION EQUIPMENTS

- Pocket tape
- Plumb bob.
- Chipping hammer.
- Straight edge.
- 30 m steel tape.
- Feeler gauge.
- Long lime withweight
- Thermometer

INSPECTION EQUIPMENTS

- Elcometer
- Wire brush
- Magnifying glass
- Center punch
- Torch light
- Screw driver
- Paint and brush
- Gauge cum level

INSPECTION EQUIPMENTS

- Nylon chord
- Inspection hammer
- Rivet testing hammer

Bridge Register data

- Bridge No.
- Spans
- Material of construction
- Type of bearings
- Depth of cushion
- Previous history
- Class of structure
- Type of girder & strength of girder.

Important Levels to be maintained in bridge.

- Rail Level (If not available assume 100.00m)
- Bottom of girder/ slab
- Danger level
- H.F.L/F.S.L (With year)

Defects in Bridges

- Cracks in masonry or bed block. These are repaired by
- Cement grouting under pressure.
- Epoxy grouting
- Guniting
- Jacketing

Defects in Bridges

- Replacing loose rivets
- Loss of camber it is due to (a) Heavy overstressing of members beyond elastic limit.(b) Over stressing of joint rivets(c) Play between rivet holes and rivet shank because of faulty riveting
- Repairs to cracks in steel work and buckling and bending of members
- Repairs to steel girder members.

Maintenance of steel girders

- Oiling- Greasing of bearings
- Technical inspection of bridge girders
- Painting of steel work of girder

corrosion

- Corrosion of steel structure takes place when steel comes in contact with oxygen and moisture. Corrosion has to be avoided as it eats away into the section of steel and reduces the strength of the structure. Oxidation of iron in presence of moisture and air forms ferric oxide, known as rust.

Numerical Rating of bridges

- Condition Rating Number (CRN): It indicates the condition of Bridge elements.
- Unique Rating Number (URN): It is eight digit number assigned to bridge based on CRN
- Over All Rating Number : It is one digit number depicting over all condition of bridge. Based on ORN, planning of bridge repair is decided.

CRN

- Bridge Components:
 1. Foundation and flooring
 2. Masonry / Concrete in sub structure
 3. Training and protection works
 4. Bed Block
 5. Bearing and expansion arrangements
 6. Super structure, Girder, Arch, pipe , Slab etc
 7. Track structure

CRN

- CRN is allotted to every element as under based on its condition as under
 1. A condition which warrants immediate re-building/re-habilitation of bridge
 2. A condition which requires re-building/ re-habilitation of bridge on programme basis
 3. Condition which requires major /special repair
 4. A condition which require routine maintenance
 5. A sound condition
 6. Not applied
 - 0 . Not inspected
- If there is not any component in the bridge, CRN 6 is allotted to it.

URN

- Eight digit number given to bridge. First digit indicating the ORN and the remaining seven digits the CRNs of each of the seven components.23443244

ORN

- It is the lowest of the seven CRNs allotted to different components of the Bridge.

Bearings

- Flat bearings
- Centralized Bearings
- Roller Bearings
- Oil Bath bearings
- Phosphor Bronze Bearings
- Oil Bath Bearings
- P.T.F.E bearings
- Elastomeric bearings

Painting Schedule of steel girder Bridges

- Schedule A- for areas where corrosion is not severe
- Schedule B- for areas where corrosion is severe

Watch Man on bridge

- Two red flags, one green flag, Two hand signal lamps, 10 detonators & Flair signals
- Whistle & match Box
- Keying and spiking hammer as well as fish Bolt spanner
- A gauge cum level
- A staff to exhibit flag lamp
- A powerful torch & a probing rod if required.

Duties of watchman

- To watch the flood whether the same is exceeding the danger level
- Any type of crack or seepage in approach bank/embankment/various types of Bunds
- Whether any type of obstruction is there in the water way or not

In case of danger, he has to stop the traffic and communicate the same to appropriate authority for further necessary action

RAILWAY AFFECTING WORKS

- There are so many works near to Railway Track, which may effect to safety of the Railway track, if not properly maintained or in case of failure of the same

Types of Railway affecting works

- Irrigation and water supply tank or reservoir
- Canal embankment and river bund
- Road embankment with adequate water way for drainage situated up stream and down stream of the Railway
- Temporary channel cut for irrigation or other purposes from bed of active river
- Other works or operations which might alter or impede the natural course of flood flow or cause an increase in volume of such flow. These may be new irrigation projects, new townships, new forest belts, large scale deforestation etc.