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Design and Survey of a Railway Over Bridge (ROB)

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I. Introduction:

A bridge, quite an important structure which is only construction when there's necessity felt by people and later on conveyed by representatives or when Government realises the importance of it. As a result of traffic growth which is caused by many reasons, main cities, important roads, tourist place, pilgrimage centre, industries et-cetera which results in decision of constructing of bridge by Government at a location. Bridge is a structure that crosses over water-bodies, heavy traffic or any obstacle, by allowing even and secured passage of vehicles. In transportation engineering, bridge is a structure built over something so people can cross such as water, a low place, or a railroad. But many structures are certainly taken as highway bridges in which an Overhead is a structure which carries a highway over any railroad while an Underpass is a structure allowing passage of a highway below a railroad. Coming to an Over-crossing which is a structure which carries a country road or city street above a state highway while an Under-crossing is another structure which allows country road or a city street passing below a state highway.

II. Definition:

Bridge, a structure which carries a roadway over an obstacle such as river, railway track, canal or even a pipeline. The passage may be constructed for a railway, a road, pedestrians et-cetera, or simply we can say as per google, "a structure carrying a road, path, railway, et cetera, across a river, road, or any other obstacle".

III. Importance:

A bridge is a structure which connects island to the mainland.

As our topic is about Railway Over Bridge, a ROB is constructed for the passage of road traffic over a railway track/line.

Designing and Construction of a railway over bridge is considered and certainly is the major construction in roadways and railways. Main reason behind the ROB construction is to bring down the traffic volume and travelling time on road and for trains too while increasing the speed of traffic. Another reason is to avoid road traffic when train is passing.

IV. Classification of Bridge:

Classification of bridge is done on various ways,

1. On the basis of "Type of Super-structure",
   a. Slab bridge
   b. Beam bridge
   c. Truss bridge
   d. Arch bridge
   e. Cable stayed of suspension bridge
2. On the basis of Inter-Span relation,
   a. Simple Bridge
   b. Continuous Bridge
   c. Cantilever Bridge
3. On the basis of material of construction,
   a. Timber Bridge
   b. Masonry Bridge
   c. Iron Bridge
   d. Steel Bridge
   e. Reinforced Concrete Bridge
   f. Prestressed Concrete Bridge

g. Composite of Aluminium Bridge

On the basis of Function,

a. Aqueduct
b. Viaduct
c. Pedestrian Bridge
d. Highway Bridge
e. Railway Over Bridge
f. Road-cum-rail Bridge
g. Pipeline Bridge

V. Important Terms:

i) Bridge: Bridge, a structure which carries a roadway over an obstacle such as river, railway track, canal or even a pipeline. The passage may be constructed for a railway, a road, pedestrians et-cetera.

ii) Length of Bridge: Length of a bridge is calculated as overall length measured through the center line of bridge between inner faces of dirt wall while this criterion classifies bridges as,

Small Bridge: Overall length = 30 m and Individual Span ≤ 10 m

Minor Bridge: Total length up to 60 m

Major Bridge: Total Length > 60 m

iii) Bearings: The bearing is a component of superstructure which impart an interface between the superstructure and substructure. This interface plays an essential role because superstructure tends to go dimensional changes and deformations due to many reasons.

1. Sliding Bearings: Sliding movement is permitted.
2. Rocker Bearing: Allows rotational with no sliding movement.
3. Laminated Bearing: Consists of alternate layer of elastomeric and laminates integrally bonded during vulcanization.
4. Elastomeric Bearing: Bearing having one or more internal layers of elastomeric with internal steel laminates with a process of vulcanization which plays important role in elastic deformation.

iv) Safety Kerb: A safety kerb or roadway kerb, usually provided for pedestrian traffic and even safety purposes.

v) Substructure: Structures such as pier, abutment and foundation which supports superstructure.

VI. Foundations:

A foundation which is a structure that supports superstructure and connects to ground and transfers load to soil/ground.

Depth of Foundation: Depth should be taken by considering safety and protection against scour. In addition with this, bearing capacity, settlement, stability and suitability of strata should also be considered for the foundation while providing sufficient depth.

Types of Foundation:

1. Shallow Foundation: Raft and Open foundation
2. Deep Foundation: Pile foundation

VII. Superstructure:

Arches, Concrete Cement, RCC Girders and deck slab, Masonry, RCC T-Beam slab, RCC Box Beam, Solid slab, Voided Slab, PSC Two Girder, Three Girder, Multi Girder, Box Girder, simply supported continuous Cantilever, balance cantilever, hammer head, Bow String girder, cable stated suspension, composite const., all these are types of Superstructures.

Selection of proper Superstructure:

1. Span up to 10 m RCC Solid Slab.
2. Spans 10 to 15 m RCC slab/Ribbed slab.
3. Spans 15 to 20 m RCC Multi-girder slab system.
4. Spans 20 to 30 m PSC Girder/Box type superstructure.
5. Span 30 to 60m PSC Box Girder.

VIII. Surveying:

There are various steps in surveying,

1. Reconnaissance Survey: This is survey is carried out just before the meeting of examine the general characteristics of Project is started. This includes Topography of area, Terrain and soil conditions, Climate and Rainfall, Drainage Characteristics, Traffic patterns, Railway lines, land use, environmental factors, availability of materials with some more useful information.

2. Topographic Surveys: This survey is being carried out along the proposed alignment to get more details about topography, nature and man-made features present within the Right of Way. It is only done after establishing horizontal and vertical grids.

3. Total Station Traverse: A closed traverse is done for established 200-250m apart while connecting pillars constructed along the route.

4. Bench Mark: Located as far as possible, with the proposed right of way boundaries at an interval of 250m by mentioning BM No. with red paint on it.

5. Detailed Survey: Then detailed survey is carried out using the horizontal and vertical control points to establish accurate data of the site.

6. Geotechnical Investigations and Hydrological Investigations are also carried out for the entire project.

IX. Traffic Design: Capacity standards for Railway Over Bridge have been adopted as per Bridge Guidelines. Capacity analysis is really important for planning, design and operation of roads with other things too like determining the width of carriageway at any point in a road network with respect to volume and composition of traffic. In addition to this valuable tool for evaluation of the investments which are needed for future road construction and improvements.

Equivalency Factors: Expressing capacity in passenger car units leads to many studies for establishing appropriate passenger car equivalency (PCE) value for different types of vehicles.

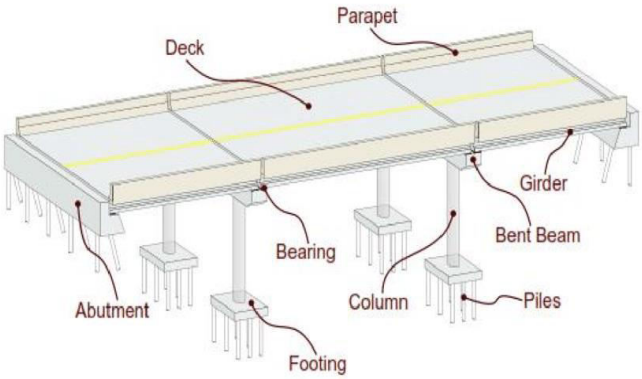
Equivalency factor, a factor which convert the mixed flow oof traffic in to single unit to express the capacity of road.

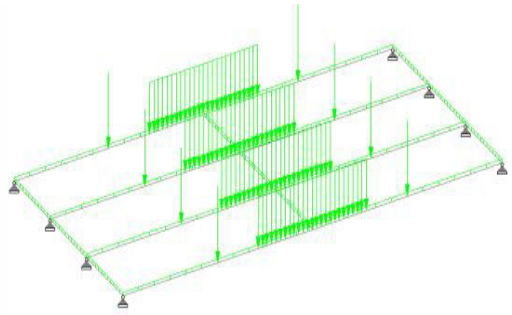
S. No.	Vehicle Type	Equivalency Factors
Fast moving vehicles		
1	Motor cycle or scooter	0.50
2	Passenger car, pick up van or auto-rickshaw	1.00
3	Agricultural tractor, light commercial vehicle	1.50
4	Truck or bus	3.00
5	Truck – trailer, agricultural tractor – trailer	4.50
Slow moving vehicles		
1	Cycle	0.50
2	Cycle rickshaw	2.00
3	Hand cart	3.00
4	Horse drawn vehicle	4.00
5	Bullock cart	8.00

Capacity Analysis for ROB: As per guidelines of ROB, capacity of an ROB is sensitive to the traffic flow characteristics on divided highways. It consists of Free Flow Speed, Factors affecting FFS.

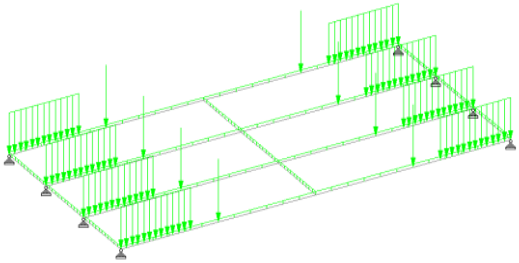
X. Designing Components of Railway Over Bridge:

a) Deck Slab
b) Girders
c) Hammers Headed Bed Block
d) Pier
e) Footing

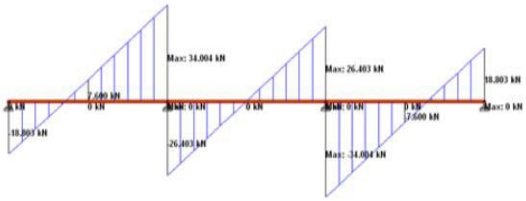




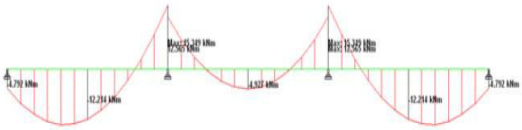
Maximum Bending Moment case I



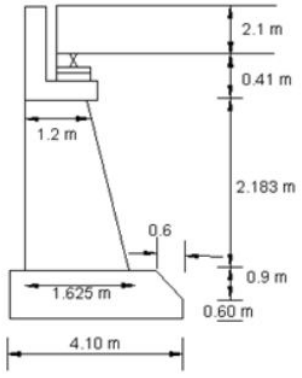
Maximum Shear Force case II



Shear force for cross beam no. 1



Max Bending Moment for first cross beam



Cross-section of Abutment

XI. Design Results:

S. No.	Design as per Code
1.	**Deck Slab** Required RCC at bottom in short span direction is 12mm Ø @ 100mm c/c Required RCC at bottom in short span direction is 10mm Ø @ 230mm c/c
2.	**Cantilever Beam** Required RCC at top in lateral direction is 20mm Ø @ 230 and 12 mm Ø @ 230mm c/c
3.	**Outer Longitudinal Girders** RCC required at bottom of girder is 17#32mm Ø
4.	**Hammer Headed Bed Block** Reinforcement required at top in tensile zone is 19#32mm Ø
5.	**Piers** Required RCC is 26#25mm Ø equality distributed
6.	**Footings** Required RCC is 52#16mm Ø in both direction Require Size of footing is 7m × 7m

XII. Conclusion:

- Reason behind construction of Railway Over Bridge is to control road traffic and reduce travelling time, in other words, ROB construction is to bring down the traffic volume and travelling time on road and for trains too while increasing the speed of traffic. Another reason is to avoid road traffic when train is passing.
- Values are nearly same while doing analysis manually and with Stadd Pro.
- Stadd Pro is really comfortable and accurate design analysis of a bridge.

XII. Reference:

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