A COMPARATIVE DESIGN OF REINFORCED CONCRETE SOLID SLAB BRIDGE FOR DIFFERENT SPANS

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ABSTRACT

A Bridge is a structure to be constructed where canal crossing the main road. Bridge is playing important role for traffic flow without interference from canal crossing and to improve the road safety. The design of Bridge should follow the standard design practices mentioned in the IRC and IS codes.

Solid Slab bridges are horizontal beams supported at each end by substructure units and can be either simply supported when the beams only connect across a single span, or continuous when the beams are connected across two or more spans. When there are multiple spans, the intermediate supports are known as piers. The earliest beam bridges were simple logs that sat across streams and similar simple structures. In modern times, beam bridges can range from small, wooden beams to large, steel boxes. The vertical force on the bridge becomes a shear and flexural load on the beam which is transferred down its length to the substructures on either side they are typically made of steel, concrete or wood. Beam bridge spans rarely exceed 250 feet (76 m) long, as the flexural stresses increase proportional to the square of the length (and deflection increases proportional to the 4th power of the length). However, the main span of the Rio-Niteroi Bridge, a box girder bridge, is 300 metres (980 ft).

In this present engineering technology Durable and sustainable bridges play an important role for the socio-economic development of the nation. Owners and designers have long recognized the low initial cost, low maintenance needs and long life expectancy of concrete bridges.. This growth continues very rapidly, not only for bridges in the short span range, but also for long spans in excess of length which, here therefore, has been nearly the exclusive domain of structural steel. Many bridge designers are surprised to learn that precast, pre-stressed concrete bridges are usually lower in first cost than all other types of bridges coupled with savings in maintenance, precast bridges offer maximum economy. The precast bridge system offered two principal advantages: it is economical and it provides minimum downtime for construction.

Keywords: *Solid Slab Bridge, Abutment, IRC: 1343-2012, IRC: 5-1998, IRC: 6-2000, IRC: 18-2000, IRC: 21-2000, IS: 6006-1980*

1. INTRODUCTION

Bridge is life line of road network, both in urban and rural areas. With rapid technology growth the conventional bridge has been replaced by innovative cost effective structural system. One of these solutions present a structural PSC system that is T-Beam.

Bridge design is an important as well as complex approach of structural engineer. As in case of bridge design, span length and live load are always important factor. These factors affect the conceptualization stage of design. The effect of live load for various span are varied. In shorter spans track load govern whereas on larger span wheel load govern. Selection of structural system for span is always a scope for research. Structure systems adopted are influence by factor like economy and complexity in construction. The 24 m span as selected for this study, these two factor are important aspects. In 24 m span, codal provision allows as to choose a structural system i.e. PSC T- beam. This study investigates the structural systems for span 24 m and detail design has been carried out with IRC loadings and IS code books. The choice of economical and constructible structural system is depending on the result.

2. BASIC CONCEPTS OF BRIDGES

Solid Slab Bridges are basically concrete in which internal stresses of a suitable magnitude and distribution are introduced so that the stresses resulting from external loads are counteracted to a desired degree. In reinforced concrete members, the pre-stress is commonly introduced by tensioning the steel reinforcement.

The earliest examples of wooden barrel construction by force-fitting of metal bands and metal tyres on wooden wheels indicate that the art of pre-stressing has been practiced from ancient times. The tensile strength of plain concrete is only a fraction of its compressive strength and the problem of it being deficient in tensile strength appears to have been the diving factor in the development of the composite material known as "reinforced concrete".

The development of early cracks in reinforced concrete due to incompatibility in the strains of steel and concrete was perhaps the starting point in the development of a new material like The application of permanent compressive stress to a material like concrete, which is strong in compression but weak in tension, increases the apparent tensile strength of that material, because the subsequent application of tensile stress must first nullify the compressive strength

3. REINFORCED CONCRETE BRIDGES

The first reinforced concrete bridge was built by Adair in 871 across the Waveney in England spanning 15 m1. The adaptability of reinforced concrete in architectural form was demonstrated by Maillart in Switzerland in building arched bridges using reinforced concrete, utilizing the integrated structural action of thin arch slabs with monolithically cast stiffening beams. Salginatobel and Schwanadbach Bridges built by Maillart in 1930 and 1933 respectively are classical examples of aesthetically, beautiful and efficient use of materials coupled with economy in bridge construction. Reinforced concrete was

Preferred to steel as a suitable material for short and medium span bridges likely due to the added advantage of durability against aggressive environmental conditions in comparison with steel.

4. THE SCOPE OF THE DESIGN OF BRIDGE INVOLVES

- Collection of Topo data.
- Collection of crossing canal data including velocity of flow, clearance, width of water way etc.
- Collection of Geotechnical data.
- Design of Bridge Superstructure by using **STAAD** software and **Excel** sheets.
- Design of Solid slab.
- Design of Bridge Foundation and Substructure by using **Excel** sheets.
- Design of Abutment foundations.
- Design of Abutment walls.
- Design of Abutment caps.
- Design of Dirt walls.
- Calculation of Quantities by using **Excel** sheets.
- Preparation of Drawings by using **Auto-Cad** software

5. DESIGN OF SOLID SLAB

S.No	**Description**	**Dimensions**
1.	Span C/C of Expansion Joint	11000 mm
2.	Distance B/w Exp. Joint to Bearing	220 mm
3.	Effective Span (c/c Brg.)	10560 mm
4.	Width of Slab	12900 mm
5.	Width of Carriage way	10500 mm
6.	Width of Crash and safety Barrier	1200 mm
7.	Thickness of Wearing	65 mm

	Coat	
8.	Slope of Carriageway	2.50 %
9.	Depth of Slab	800 mm
10.	Effective Depth	748 mm
11.	Clear Cover	40 mm
12.	Main Reinforcement	25 mm
13.	Top Reinforcement	12 mm
14.	Distribution Reinforcement	12 mm
DESIGN CONSTANTS		
15.	Grade of Concrete	M 35
16.	Modular Ratio, ***m***	10
17.	Neutral Axis Constant, ***n***	0.327
18.	Grade of Steel	Fe 500
19.	Lever Arm Constant, ***j***	0.891
20.	Moment of Resistant constant, ***Q***	1.700
21.	Density of Concrete	2500
22.	Density of Wearing Coat	2200

5.1 Live Load Forces

a) Class - 70R Track, Bending Moment

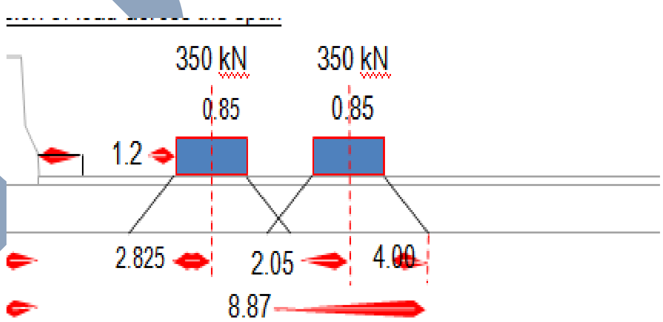


Fig: 5.1 Dispersion of load across the span

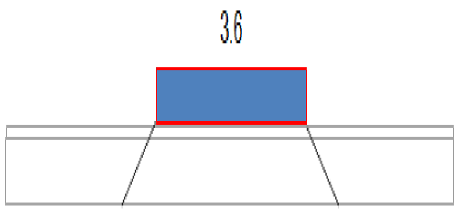
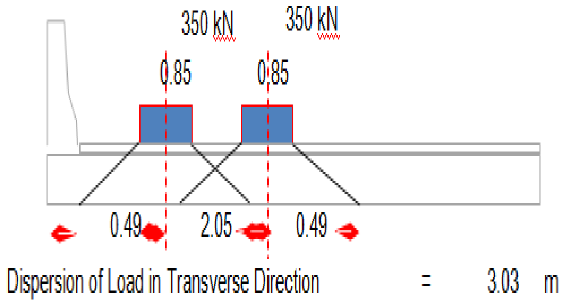
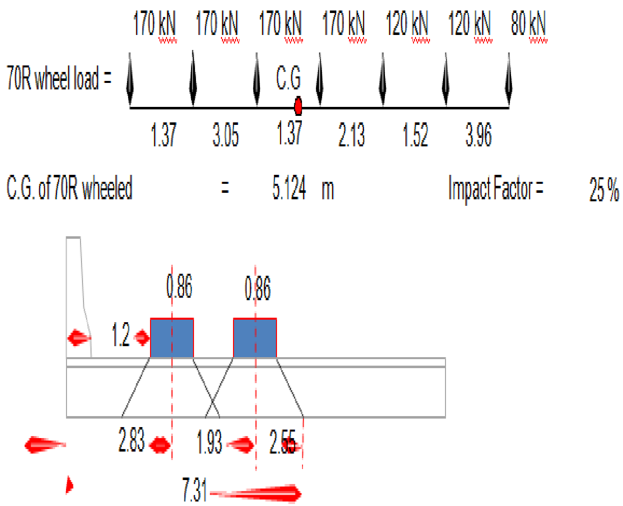


Fig: 5.2 Dispersion of Load in Longitudinal Direction

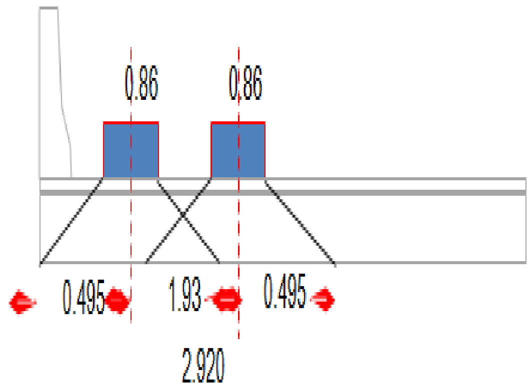
b) Class - 70R Track, Shear Force



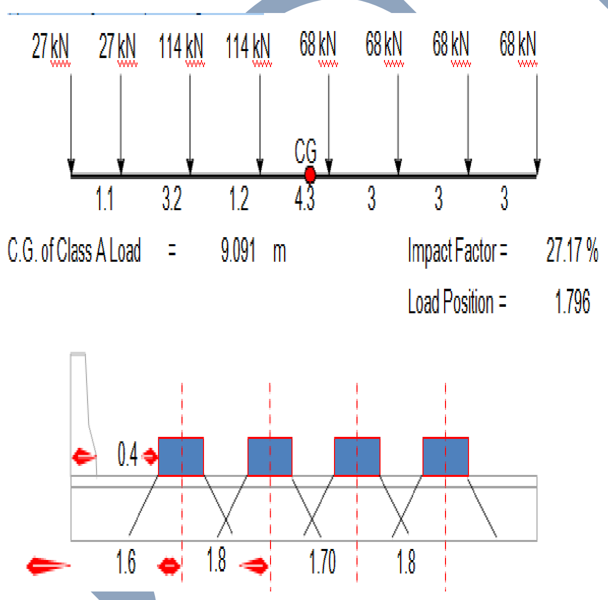
(c) One Lane of Class-70R Wheeled Vehicle, Bending Moment



(d) One Lane of Class-70R Wheeled Vehicle, Shear Force



(e) Two lane of class A, Bending Moment



CONCLUSIONS

1. It is easy to add length in the event of widening of the road.
2. Solid Slab bridge is structurally very strong, rigid and safe.
3. Solid Slab Bridge does not need any elaborate foundation and can easily be placed over soft foundation by increasing base slab projection to retain base pressure within safe bearing capacity of ground soil.
4. Bridge of required size can be placed within the embankment at any elevation by varying cushion. This is not possible in case of slab culvert.
5. Right Slab Thickness can be used for flow of water in skew direction by increasing length or providing edge beam around the box and it is not necessary to design skew box.

6. Easy to construct, practically no maintenance, can have multi-cell to match discharge within smaller height of embankment.
7. Small variation in co-efficient of earth pressure has
8. little influence on the design of box particularly without cushion.
9. considered or distributed over the whole length of box (not restricted within the effective width) the design shall be unsafe.
10. It may be seen that α affects effective width, mainly applicable for the top slab (particularly for slab without cushion) and braking force. As regards bottom slab and top and bottom slabs of box with cushion due to dispersal of loads either through walls or through fills effective width loses its applicability.
11. The design of box with cushion done by STAAD. Pro computer software compares very close to manual design.

REFERENCES

1. Bridge Deck Behavior by E. C. Hambly.
2. Bridge Deck Analysis, Book by Damien L. Keogh and Eugene O'Brien.
3. Bridge Deck behavior Revisited, Doug Jenkins; BSc MEng Sci MIEAust MICE.
4. Bridge Deck Analysis by A. R. Cusens and R. P. Pama.
5. Bridge Analysis Simplified by Baidar Bakht and L. S. Jaeger.
6. Computational Structures by S. Rajasekharan.
7. Computer Aided Design by C. S. Krishnamoorthy and S. Rajeev.
8. Computer Analysis of Structural Frameworks by James A. D. Balfour.
9. Structural Design by Computer by E. W. Wright.
10. Computers in Structural Engineering by J. E. Gibson.
11. Institution of Structural Engineers (1967) Standardization of Input Information for Computer Programs in Structural Engineering.
12. Design of Bridge Structures by T. R. Jagadeesh and M. A. Jayaram.