DESIGN AND ANALYSIS OF PRESTRESSED BRIDGE

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Abstract - *This project "DESIGN AND ANALYSIS OF PRESTRESSED BRIDGE".As in post tensioning prestressed concrete (PSC) technology is being used all over the world in the construction of a wide range of bridge structures. Most of the common used for transportation of a bridge .However in many places though the reinforced concrete bridge constructed.*

The development of the nation is mainly from agricultural and industrial activities, so, it is convert the traditional to facilitate the proper transportation by providing the T Beam Bridge. In order to find out the most suitable section, this project looks on the work of analysis, design and cost comparison of T-Beam and traditional bridge for different spans. The purpose of this study is to identify the suitable section for bridges of different spans. The Prestressed concrete sections have been considered in this case as the spans designed are more than 25 metres for which the Reinforced concrete sections are uneconomical. The aim and objective of the work is to analyse and design the sections for different Indian Road Congress, IRC vehicles. This has been done by analysing the structure by STAAD Pro software and validating with manual results by developing the Working Stress Method and by adopting Courbon's theory. It is found that the IRC 70R vehicle producing maximum effect on the sections. Cost comparison has shown that the T-beam girder is suitable for spans up to 30metre, as we go for higher spans the depth of T-beam girder increases drastically which makes it uneconomical. Therefore span of the bridge deck slab is suitable. The result of this analysis can be used to find the suitable section for respective spans. From the obtained results we can conclude that the software results.

In the project Prestressed concrete T-beam bridge deck comparison with traditional prestressed concrete deck slab.

In the reinforced concrete structure behavior of environment change and shrinkage Crack and developed of early tension and compression crack in reinforced concrete of the super structure. Total span of the bridge 19m width of the road 7.5m footbath 1.5m and thickness of the slab 250mm.

Key Words: T-beam bridge deck, Prestressed Concrete, Courbon's theory,

1. INTRODUCTION

Prestressed concrete (PC) technology is being used all over the world in the construction of awide range of bridge structures. Prestressed concrete is the most recent form of major construction to be introduced to structural engineering. In a relatively short time period, it has become a well- established and common method of construction. For bridge engineers, the development has allowed the design of longer spans in concrete bridges, and more economical solutions for smaller bridges. As a result, the use of prestressed concrete for bridge design has become very common worldwide.

Reinforced concrete bridge structure early crack of the live load and over the compression but Prestressed concrete bridge will be high strength of material used for the structure. Used on high tensile steel and tendon.

2. ANALYSIS

2.1 DESIGN PROCEDURES

The design of prestressed concrete is a complicated, iterative process. The structure is required to simultaneously satisfy a number of different design requirements defined by the Eurocodes. Each of these requirements must be designed for separately, and satisfaction of one does not necessarily guarantee satisfaction of another (Gilbert and Mickleborough, 1990). The Eurocodes separate these requirements into two categories; the serviceability limit states and the ultimate limit states. The serviceability limit states cover stress limitations, crack control, and deflections while the ultimate limit states cover bending moment resistance, shear resistance, and fatigue verifications.

Typically, the design is based on the requirements for the serviceability limit states first, as these account the working conditions of the structure. Then the ultimate limit state criteria are considered (Bungey, Hulse and Mosley 2007). Throughout the design process, many of the Eurocodes must be applied. Of these, the most heavily applied for prestressed concrete bridge design are BS EN 1992-1-1 which covers the general rules and rules for buildings in the design of concrete structures and BS EN 1992-2 which covers concrete bridge design. Due to the complicated stress distributions that occur in prestressed concrete, the design of a composite prestressed concrete beam must be considered at three stages encompassing the full range of loading the member will encounter during its life (Bungey, Hulse and Mosley 2007). The first.

Generally, a procedure is adopted and followed for the design which encompasses all required checks for the serviceability and ultimate limit states along with the basic principles of prestress design. The designer can adjust the sequence of the steps in this process based on his or her preferences, as long as every step is covered. For this dissertation, the sequence of steps illustrated in Figure 5.1 has been adopted. It should be noted that this sequence of steps is not meant to cover every aspect of bridge design. There are several facets in the design which, due to time constraints have been omitted. However, the sequence of steps provides a simplified design procedure which is sufficient for gaining an understanding of the overall design of prestressed concrete bridges.

2.2 PRELIMINARY DESIGN DATA

The first step in any design process is to determine the requirements for the design and how they can be met in a cost effective manner. This is often done by developing a preliminary plan consisting of the collection and analysis of site information, establishment of policies and practices, and consideration of alternatives with cost evaluations. It should also incorporate any requirements set by the client. The preliminary plan essentially lays the groundwork for the final design (Precast/Prestressed Concrete Institute, 1997).

With the bridge site data, a preliminary plan is developed for the bridge, incorporating initial geometric design data for the structure such as the number of spans, span lengths, deck width, beam type, and beam layout, as well as size and type of the foundations and hydraulic analysis. In a true design process, this plan is reported with cost estimates, evaluation of alternatives, drawings, established design methods and limits, and initial design loads. Approval is then sought before beginning the final design (Precast/Prestressed Concrete Institute, 1997)

3. DURABILITY AND FIRE RESISTANCE

3.1 Nominal Cover

The nominal cover is the sum of the minimum cover an allowance for deviations in fabrication. The minimum cover, cmin, is the most un favourable of those determined in the last two sections and 10 millimetres

Table 1 Nominal concrete cover requirements for design example

	Diameter, (mm)	cmin (mm)	Δcdev (mm)	cnom (mm)
Single span				
Reinforcement	25	30	10	40
Pre-tensioned tendons	15.2	38	10	48
Continuous Spans				
Reinforcement	25	30	10	40
Post-tensioned ducts	50	50	10	60

4. ACTIONS ON THE STRUCTURE

Before a prestressed concrete bridge can be designed, the actions on it must be determined. This includes both the permanent actions and the variable actions. The detailed calculation of all applied loads to the structure is a complicated process in itself, requiring a full study that due to time constraints is beyond the scope of this report. Here all loading types are briefly discussed; however, detailed analysis is only given to the self-weight and traffic loads on the structure. These loads will have the most adverse affect on the structure, and will provide enough loading to give an accurate representation of a prestressed concrete bridge design.

4.1 Self-Weight

Clause 5.1(2) of BS EN 1991-1-1 defines the self-weight of a structure to include the structure as well as any non-structural elements. For a bridge, non-structural elements include any fixed services and bridge furniture, as well as the weight of any earth or ballast. Fixed services may consist of cables, pipes, or service ducts which are sometimes located within the deck structure. Bridge furniture may include waterproofing, surfacing, traffic restraint systems, and acoustic or anti-wind screens attached to the structure (Calgaro, Gulvanessian and Tschumi, 2010).

Table 2 Nominal densities for self-weight of design examples

Material	Density, y(kN/m3)	BS EN 1991-1-1
Reinforced/Prestressed	25	Table A.1

Concrete		
Wet Concrete	26	Table A.1
Hot-rolled asphalt	23	Table A.6

Table 3 –Final self-weight for each element in the design examples

	Depth,d (mm)	Variation Factor	Area,A (mm2)	Density,⅟ (kN/m3)	Weight, w (kN/m)
Single span					
Beam	-	-	745153	25	18.63
slab	200	-	400000	25	10
surfacing	60	1.55	120000	23	4.28
Continuous spans					
Beam			735475	25	18.39
Slab	300	-	600000	25	15
Surfacing	60	1.55	120000	23	428

4.2. Snow Loads

There are currently no specifications in BS EN 1991-1-3 for snow loads acting on a bridge. This does not necessarily mean they should be excluded, however, in normal climatic zones significant snow loads cannot act simultaneously with traffic loads on a bridge deck, and the effects of the characteristics values for snow loads are far less important than those for traffic loads. It should be noted that in some Nordic countries, the snow load may be the leading action on the deck for footbridges (Calgaro, Gulvanessian and Tschumi, 2010).

For roofed bridges, a combination of the loads can be defined and should be determined on a national level or specifically for the individual project. The characteristic value for the weight of snow on the roof can be determined using the same methods as those defined for a building roof (Calgaro, Gulvanessian and Tschumi, 2010).

4.3. Wind Actions

Section 8 of BS EN 1991-1-4 provides guidance for determination of the quasi-static effects of wind actions on bridge decks and piers with spans up to two hundred meters. In general, the most significant wind loading will be that due to wind pressures acting parallel to the deck width and perpendicular to the direction of travel. The wind loads acting vertically on the structure should also be considered, as they may cause uplift on the bridge deck. But this report was 19m span, so this is minor bridge deck not consider wind load.

4.4. Traffic Loads

Chapter 4 of BS EN 1991-2 and the corresponding National Annex provide extensive guidance on the application of traffic loads. Consideration is given to vertical load models and corresponding horizontal forces, fatigue load models, and actions for accidental design situations. Due to the complexity of this loading, the explanation has been separated and the full discussion can be found in Chapter 5 of this dissertation. The load models have been combined into groups of traffic loads, which define the global actions of traffic loads that are then included in the combinations of actions. Only four of the groups are considered in the design examples for this dissertation.

5. RESULT AND DISCUSSION

Using Courbon"s theory, the IRC class AA loads are arranged for maximum eccentricity.

Provide 10 mm dia bars at 100 mm centre in the vertical and horizontal directions have been provided at distances of 100 mm and 200 mm respectively.

Solid end blocks are provided at the end supports over a length of 1.5m. Typical equivalent prisms on which the anchorage forces are considered to be effective are detailed in the figure. The bursting tension is computed using the data given in the table.

(ypo/yo)	0.3	0.4	0.5	0.6	0.7
(Fbst/Pk)	0.23	0.20	0.17	0.14	0.11

Provide 10mm diameter bars at 100mm centres in the horizontal direction. In the vertical plane, the ratio of (ypo/yo) being higher the magnitude of bursting tension is smaller. However the same reinforcements are provided in the form of a mesh both in the horizontal and vertical directions.

Wind load is not consider in this report minimum span of the wind load upto 150m. .Height 100m suspension bridge and ribbon bridge computation of design wind load.

6. CONCLUSIONS

- In this project, efforts have been made to analysis, design and detail a PSC- deck slab bridge taking into consideration IRC Class AA tracked and wheeled vehicle loads as specified in IRC 6.
- In view of achieving the aim and objectives of this project the detailed design of two types of deck sections is carried out in manual working stress method and the comparative statement is given as per the results obtained. It gives us idea about the methodology used and the suitable section to be adopted.
- For lower spans the T-beam girder can be adopted which is easy to install and maintain.
- Less than 10 to 15 m Traditional slab deck bridge Upto 15 to 25m T beam bridge deck suitable the spans greater than 30m, box girder is economical overall and is suitable type of section.
- Design and analysis is done.
- Wind load not consider for this report in this minor bridge of the span.

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