International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 11 | Nov -2016 www.irjet.net p-ISSN: 2395 -0072

Design of Prestressed Concrete Bridge using Limit State Method

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Abstract –*The bridge should withstand every action, which includes applied induced loads, accidental loads and it should also withstand the loads caused due the action of earthquake without damaging the property or without causing any causative event. Safety, serviceability, durability and economy are the terms which decide the performance of the bridge. Keeping this into account a project has been done based on the national highway standards. The thesis involves construction practice and properties of pre-stressed concrete in comparison with reinforced concrete design. Also, a per-cast post-tensioned continuous beam and slab bridge deck for a national highway crossing of span 80m has been modeled, analyzed and designed with the help of STAAD software.*

Key Words: Prestressed concrete, bridge, limit states, staad , national highway.

1. INTRODUCTION

The structures such as long span bridges, long span roofs, nuclear containment vessels and ocean structures are constructed with pre-stressed concrete are in the trend. The methods of design in pre-stressed concrete has been through reasonable changes during last 50 years .Working stress method of design was introduced many years ago and now it has been replaced with limit state method of designing. The ultimate strength design method was invented in the fifties, but the limit state method overtook this method by gaining the vast acceptance. Pre-stressed concrete is known as the concrete in which the effective internal stresses are artificially induced with steel in tension before the structure is loaded. An example of simple engineering structure those used the principle of pre-stressing from many years is the formation of wooden barrel.

1.1 Modeling of the structure

The thesis is about modeling and designing a prestressed concrete bridge using deck slab for a national highway of span 40m and width of roadway being 7.5 m. The span considered in the thesis ranges between 40 to 80 m i.e. the span may range from 80 to 200 ft therefore we shall consider California wide flange girder for design of the prestressed bridge of specifications are as below.

Modeling of the structure is made via STAAD software by using plate of 80mX0.2m which represents the deck slabs. A tapered main girder of depth 2m and rectangular cross girders of depth 2m are made use to represent the prestressed beams:

1.2 Possible load combinations

According to IRC 006-2014 the minimum nose to tail distance between 70R and class A vehicles are 30m and 18.5 ,clearance of 0.15m and 1.2m from kerb to wheel edge and 1.2 between the overtaking vehicles respectively. Based on this criteria following are the load combinations.

2. Design of slab and beams

The loads and moments so obtained from staad are used in the manual calculations. limit state method of design is used to design and as follows.

Table -1: Moments of beam obtained from staad

Moments		
loads		
dead load	1382	kNm
Live load	6585	kNm
Total load	7967	kNm
Factored load	13145	kNm

Confirming to IRC 600- 1983 select the diameter of the strand of maximum size of 15.2mm with breaking load of 260.7 KN

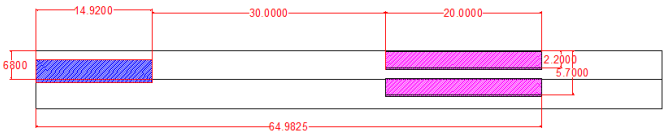

Chart -1: An example of possible load combination

According to IRC to possible load combinations are defined in staad and the moments so obtained in staad are used in the design calculations.

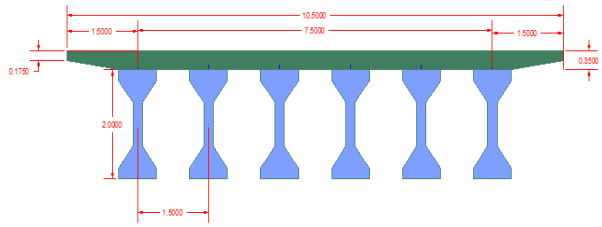

Fig -1: Cross section of the bridge

According to manual calculations and the design the beam consists of the parabolic cable. which has an eccentricity of 750mm at the support section and 350mm at the mid support section.

Also the balance moment which cannot be provided by the prestressing force can be compensated by the reinforcement bars .

3. CONCLUSIONS

By dealing with the tactics of the design various aspects of the designs are understood such as the modulus of the section plays a very important role in the design of prestressed concrete bridge. The depth of the section is one of the most important characteristics which govern the design. Even though the fiber stresses does not seem to be an important aspect it has to be keenly taken care of.
It seems to the edge beams do not takes the live load but the edge beam should take the dead load moments of the cantilever slab. therefore the edge girder should be provided with the same pre-stressing force to that of the middle girder.

ACKNOWLEDGEMENT

I would like to thank my friends who gave me shelter in their home while doing the thesis.

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BIOGRAPHIES

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