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Design and Analysis of Pre-Stressed I-Girders by Midas Civil Software

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ABSTRACT

Today the construction of bridges has gained worldwide importance. Bridges are an important feature of all road networks and the use of pre-stressed bridges is increasingly popular in the construction of bridges due to their better stability, service friendliness, economy and durability, beauty and appearance of the building. Reinforced concrete construction, steel or steel construction using composite construction. In the case of high spaces, reinforced concrete construction makes no money due to the large space. cross-section is used more effectively than cross-section of reinforced concrete. Prefabricated concrete is used for long bridges with a length of more than 10 meters. Typically, when bridges are calculated, the superstructure and substructure are analyzed separately. The supernatural structure is usually a grid made of large strips, a shortcut membrane and a desk slab. vertical grid Columns of large girders with anchors. The superstructure is tested according to IRC: 62014 and according to IRC: 182000 with unimaginable gravity loads and loads of moving vehicles. Reduced stress and deviation rates compared to a straightforward tender profile.

KEYWORDS: *Pre-tensioning, Pre-stressing, I Girder, Bridge, Tendons, mechanical jacks*

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I. INTRODUCTION

Pre-Stressing phenomenon occurs to happen before the casting of the concrete. This is done by placing of high tensile steel tendons in a desired profile through its appropriate span in which the concrete is to be cast. When the concrete had reached the required strength, the tendons are released to introduce a compressive force to the concrete.The concrete will then be in a permanent state of maintaining pre-stressed strength.

Pre-Stressing

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CASE1: (PLAIN CEMENT CONCRETE BEAM ON LOADS)

Consider a Plain Cement Concrete (PCC) beam subjected to loads as shown in the Fig. The beam bends and cracks are developed in the tensile zone when subjected to loads as shown in the figure. This shows that the concrete is very weak in tension and excellent in compression.

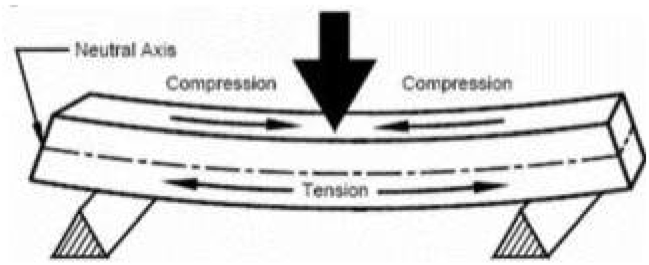


Figure 1 Point load on a simple beam

CASE2: (REINFORCEMENT CEMENT CONCRETE ON LOADS)

In order to over come these cracks reinforcement steel are provided in the tensile zone which can take the tensile loads as shown in the fig and prevent the member from cracking.

Concrete with steel act as a composite member where concrete's poor tensile strength and ductility are countered by the reinforcement steel which have a high tensile strength and ductility.

Materials for prestress concrete members:

1. Cement: The cement used should be any of the following

A. Ordinary Portland cement conforming to IS269
B. Portland slag cement conforming to IS: 455. But the slag content should not be more than 50%.
C. Rapid hardening Portland cement conforming to IS: 8041.
D. High strength ordinary Portland cement conforming to IS: 8112.

One of the major advancements in bridge construction in the United States in the second half of the twentieth century was the development and use of prestressed concrete. Prestressed concrete bridges offer a broad range of engineering solutions and a variety of aesthetic opportunities. The objective of this Manual is to provide guidance to individuals involved in the design, installation, grouting and inspection of post-tensioning tendons for prestressed concrete bridges.

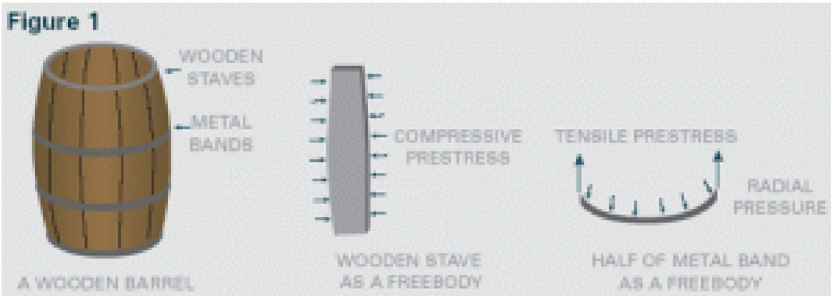


Figure 2 Expansion of Pre-stressing from Barrel

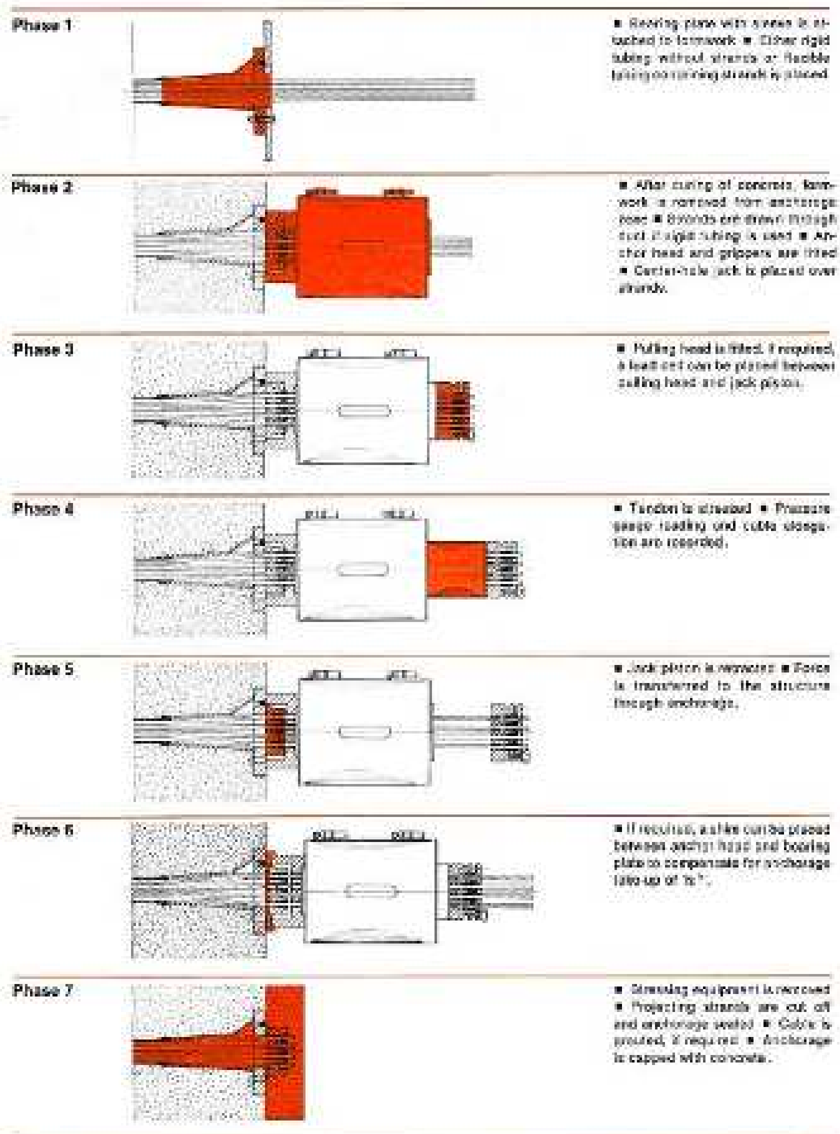


Figure 3 Prestressing Operation

II. LITRATURE REVIEW:

Ramyasri.N and Rangarao. V (2017)-Objectives: To determine whether soil type affects PSC design parameters Bridge and study the tendency to bend per minute, shear force and mass deviation once pier center in various loads. Methods / Analysis: In this paper a pre-pressed concrete bridge is analyzed using STAAD-Beava by processing the base of the pile in the middle at the end it is considered correct. Here, the two models are compared one to the soil mix with the other without soil contact. Live load, dead load, shipping loads are used. Shipping is available provided with 3 loading cases eg class-A, 70R tracked, 70R Wheels loadings. Findings: The structure of the soil structure is an integrated study that includes geotechnical and civil engineering. Replace the earth material around the piles and under abutment it does not affect the performance of the main structure. Building construction, Foundation construction calculated without regard to soil hardness. In design, ignoring the effects of communication between the ground and the bridge there may be consequences whether it is unsafe or expensive.

Kai et al. (2018) - The behavior of reinforced concrete (PC) beam-column sub assemblages responsible for the loss of the middle column is investigated experimentally. The impact of unpaid cables (UPS) with curves resembling the behavior of reinforced concrete (RC) that are independent of continuous falls is also measured. Test results have shown that UPS has little effect on yield load and initially large independent load to withstand continuous fall. However, the UPS can significantly increase the final capacity of the frame because stretching the strands can provide more resistance to vertical suspension. The UPS will cover the damage to the beams near the middle column, or it may release damage to the side of the beams near the side column. In addition, the UPS can change the load resistance of the RC framework. No reliable arch action has been performed on PC beams to withstand a continuous fall because the UPS reversed the pressure distribution distribution along the beams.

Ravikant and Chand (2019)- Bridges are a major route or a route beyond the obstacle without changing the alignment of the lower road. The present study looks at the formation of bridge girders for both longitudinal girders and cross girders. The duration of the bridge is considered to be 25m where the belts are built. The size of the longitudinal belts is considered to be 2000x500 mm and the cross girders are 1500x250 mm. There are three longitudinal girders considered to be spaces of 2600 mm c / c and cross girders are considered to be 5000mm c / c. The design of the girders is done using the STAAD Pro software. In this bridge girder design study, three identical models were modified in STAAD pro and modified uploads according to IRC codes, Euro codes and AASHTO definitions respectively. According to this unique loading we found the shaving force, the bending shape and the location of the metal in the longitudinal girder and cross girder. The analysis was performed in STAAD Pro and the analysis results were compared with tables and graphs.

Gangwar et al. (2020) - Girder is a structural component that basically forms a loaded beam because the cutting and filtering power is applied to the lateral and axial cross section. The main difference between a reinforced concrete girder and a prestressed concrete girder is the fact that reinforced concrete binds concrete and steel bars by simply joining them and allowing them to work together naturally. On the other hand, pre-compressed concrete combines high-strength concrete with high-strength steel obtained by tightening the metal and holding it to the concrete, thus placing the concrete under pressure.

Jaiswal and Naik (2021) - Comparative study of RCC girder and prestressed girder road bridge 30 m long. Analysis and formation of girder 30 m span extracted from loading IRC Class AA Vehicle according to IRC 6. Distribution of live load between longitudinal girders was determined using Courbon's Method as it is widely accepted due to its simplicity. By designing both RCC and prestressed girder the process of manual construction is adopted. This study included the construction and estimation of the required values in the RCC girder and prestressed girder. The emphasis was on the long girder. The amount of concrete and steel required according to the design of the longitudinal girder of both structure and similar comparisons.

III. EXPERIMENTAL PROGRAM:

1. Analysis of both models i.e., Indian and American Standard has been analysed by keeping same sectional properties of the I Girder.
2. As midas is worked on FEM based modelling so it gives much accurates results regardless of following any of the standards taken into consideration.
3. In both the cases whether it is manual or software analysis the Loading are guided on the track taking the Vehicles Smanual into consideration.
4. Procedure involved in the analysis is taken into consideration as maximum moment resisted by the element is taken into consideration for the analysis that will make the whole superstructure ultimately safe for the upcoming.

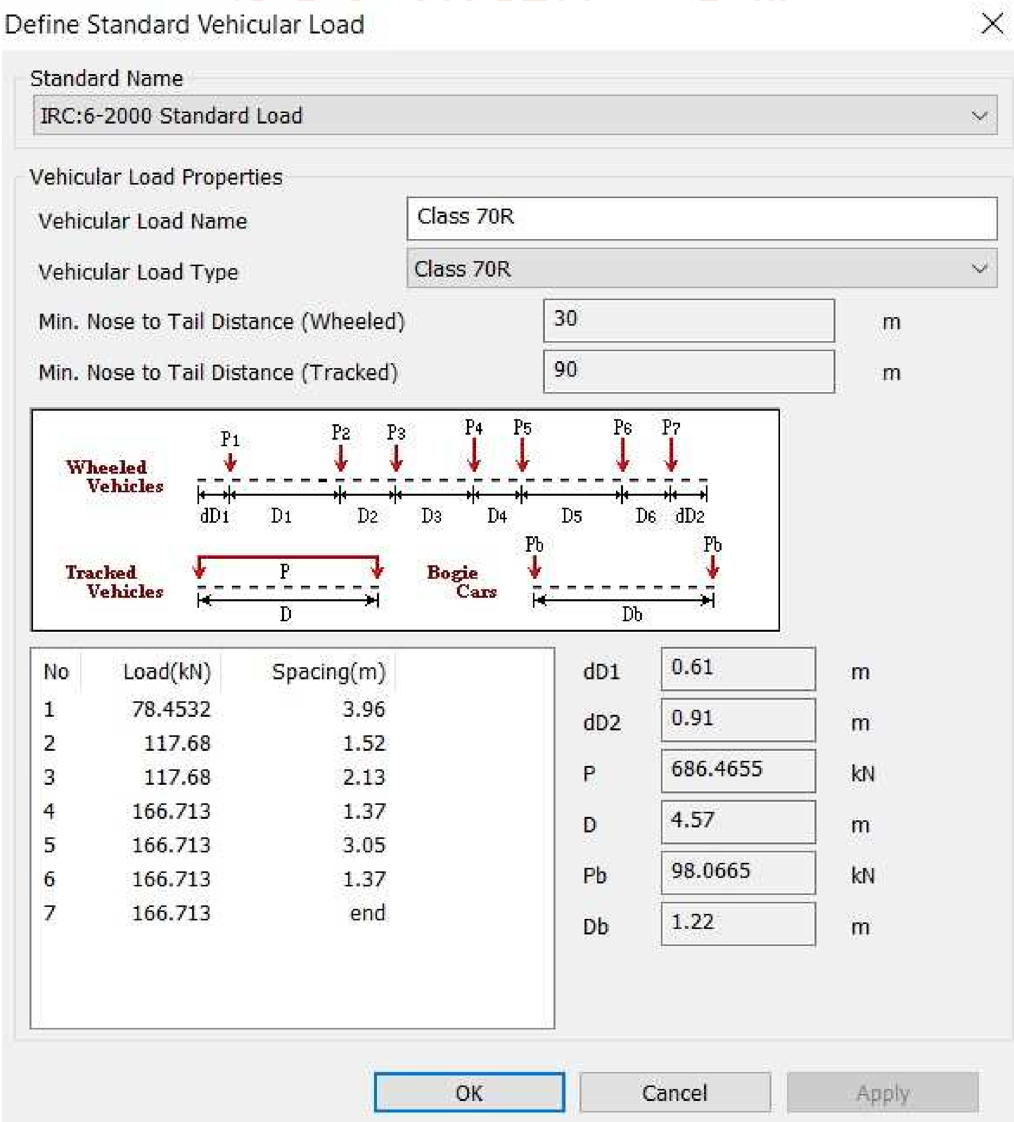
Bridge Type	PSC Composite (Composite I Girder)
Span Length	2-Span @23 m each
Expansion Joint B/W 2 Spans	40 mm
Girder	5 precast, post-tensioned spaced @ 3m c/c
Time Dependent Material	IRC: 112
Loads	Static Loads, Prestress Loads, Moving Loads
Moving Load	IRC 6
Load Combination	IRC 6 (2000)
PSC Design Check	IRC 112-2011

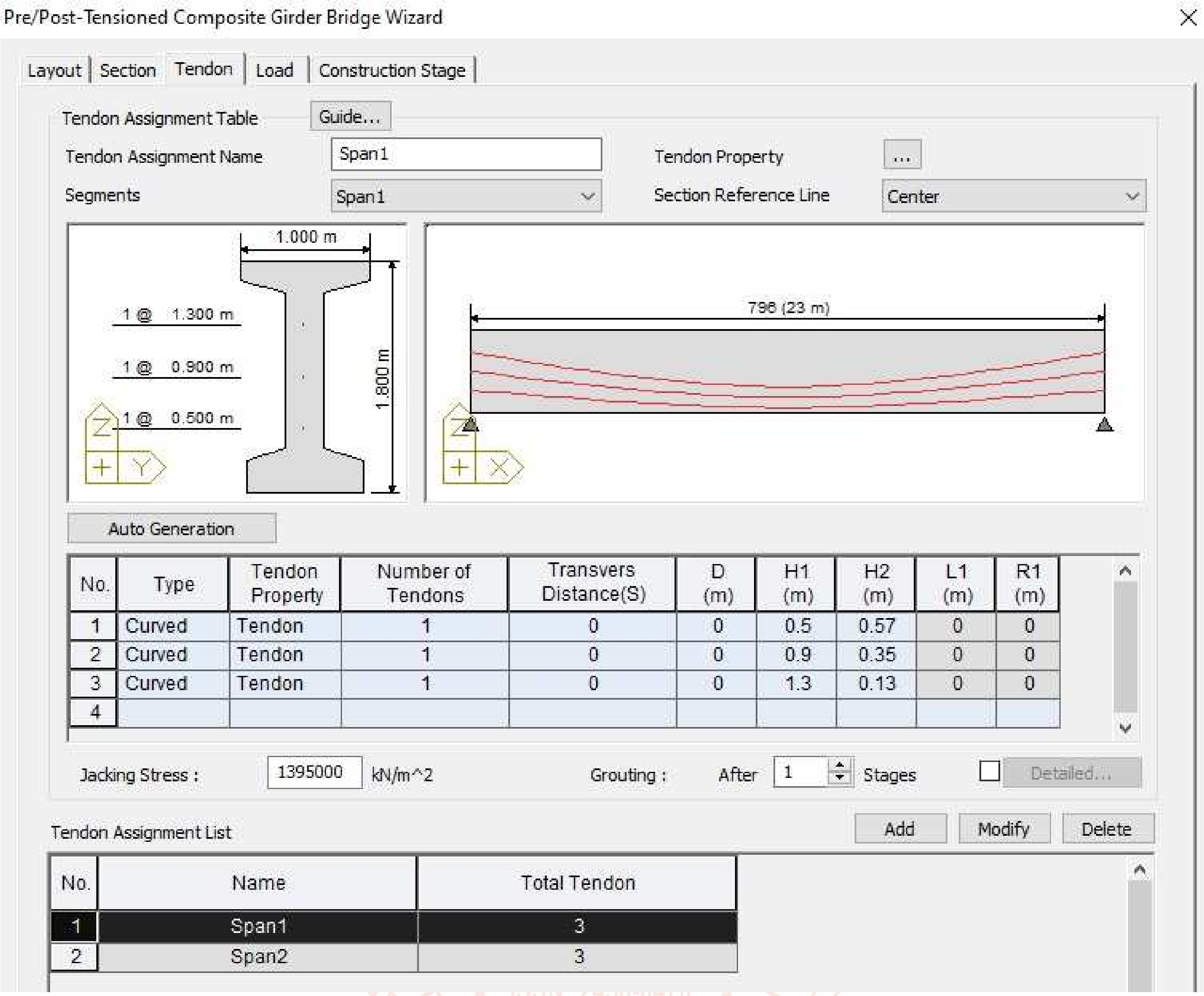
IV. METHODOLOGY:

The post-processor can automatically create load combinations in accordance with specified design standards. Changing the type of display can produce various forms of graphic output. Practically all the results can be animated, namely, mode shapes, time history results of displacements and member forces, dynamic analysis results and static analysis results.

Midas Civil provides various design check and load rating features including: Indian, Eurocode & AASHTO LRFD and many more, Bending, shear & torsional strengths, Composite plate girder design, Member forces & stresses for each construction stage and max & min stress summations, Automatic generation of load combinations in accordance with various design codes.

1. Using Midas Software the Pre-Stressed I girder is been modelled and analysed for the details provided below.
2. In Midas software two type of modelling has been taken into consideration, one modelling is done as per Indian Standard (IRC- 112) and one with American Standard (AASTHO LRFD- 16).
3. Load & Stresses are taken into account as per IRC 6.





V. RESULT AND DISCUSSION

1. After all analysis for both with the basis of Software as well as with the manual analysis the result came as a conclusion that there result in the variation came been seen clearly, first all due to access to different codal variation with respect to the Indian & American standards respectively.
2. As per Indian Standard IRC Loading Class 70R and Class A vehicles and as per American standard Loading vehicle LRFD Trek-16 vehicle is taken into consideration.
3. As per the analysis, the result and final outcome of the analysis is enlisted below.

Result Sheet as per AASTHO LRDF

S. No.	Details	Values
1	+ve Factored Moment	59796.785 Kips-in
2	Flexural Resistance (+ve Moment)	134128.539 Kips-in
3	-ve Factored Moment	0.000 Kips-in
4	Flexural Resistance (-ve Moment)	44791.188 Kips-in
5	Max-Shear Force	14.92 Kips
6	Shear Resisted by Torsional R/f (Max Shear Force)	114.92 Kips
7	Factored Shear Resistance (Max Shear Force)	433.58 Kips
8	Min-Shear Force	8.81 Kips
9	Shear Resisted by Torsional R/f (Min Sear Force)	8.81 Kips
10	Factored Shear Resistance (Max Shear Force)	8.81 Kips
11	Torsional Cracking Moment	6630.84 Kips-in

Table 1 Result as per AASTHO LRFD

VI. CONCLUSION:

Based on results following conclusions are drawn for present study

Application of Pre-stressing in different type of structures i.e., from girders, segmental construction in bridges and its wide range of acceptance in multistory buildings, as well as its use in precast members like sleepers, and lots of its engineering application helps the Engineer make the use of extra edge provided by pre-stressing on load application which advances in technical terms for Design Engineers.

1. As there is lots of prons of pre-stressing over RCC as per the technical aspects and wide range of its usage in the industry by the Engineers, signifies that its application on the field will use uptill far extent with its application on an integration of new structural members with its new technologies Incorporated.
2. Relaxation in the moment generation & Load Carrying capacity provide extra space for designers to work for higher working load on the Structures.

SCOPE FOR FURTHER STUDY

Its future usage for the designers is going to increase in the market and simultaneously the advancement of the software will really help the designers to better understand the phenomenon and work efficiently on further modelling & analysis of different types of structures in future.

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