The Effect of Varying Span on Design of Short Span Reinforced Concrete T-Beam Bridge Deck

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Abstract - **Bridge is an important part of overall transportation system. T-beam Bridge is mainly used by designer for small span bridge. This paper describes the design of 4-lane Reinforced Concrete T-beam Bridge deck considering IRC Class-AA tracked loading with span varying from10 to 25m. In this paper shows after computing manually and software that dead load bending moment with increasing span increases almost square of span.**

Keywords: Reinforced Concrete Bridge, T-beam Bridge deck, longitudinal girder, cross girder, kerb.

I. INTRODUCTION

A Bridge is a structure carrying a road, path, railway, pedestrian etc. across a river, road, valley or other obstacle without closing the way beneath. According to the material of construction of Superstructure Bridge are classified as timber, masonry, iron, steel, reinforced concrete, pre-stressed concrete, composite or Aluminum Bridge.

Reinforced concrete is well suited for the construction of highway bridges in the small span range. Reinforced Concrete Bridge is a bridge with reinforced concrete spans and concrete or reinforced-concrete abutments. The types of Reinforced Concrete Bridge are slab bridge, T-beam bridge, hollow girder bridge, balanced cantilever bridge, rigid frame bridge, arch bridge and bow string girder bridge.

In T-beam bridge, the main longitudinal girders are designed as T-beams integral with part of the deck slab, which is cast monolithically with the girders.

Main components of T-beam Bridge

The RC T-beam superstructure consists of the following components:

i) Deck slab

ii) Cantilever slab portion

iii) Footpaths, if provided, kerbs and handrails or crash barriers.

iv) Wearing coat

v) Longitudinal girders, considered in design to be of T-section

vi) Cross girders or diaphragms, intermediate and end ones.

II. METHODOLOGY

A. Bridge Data/ Description

In this paper, all the varying span of 4-lane T-beam bridge deck are designed for IRC class AA tracked load having 80mm thickness of wearing coat, 600mm x300mm kerb width and depth. The considered materials for all Reinforced concrete bridges are M30 grade concrete and Fe415 grade High Yield Strength Deformed (HYSD) bars.

B. Methods

The design and analyses of all bridge deck are done by STAAD.Pro and manually considering as per Indian Standard IS: 456-2000, IRC: 6-2000 and IRC: 21-2000. This conventional method is widely used with design steps as given in several text books on bridge engineering (Victor 2007, Krishna Raju 2004, Rajagopalan 2006).

III. RESULTS AND DISCUSSION

The paper presents the design of RC T-beam bridge deck four cases considered with varying span.

A. Summary of data for RC T-beam bridge deck

This section describes the data adopted for all the four 4-lane RC T-beam bridges with clear carriageway width of 14.5 m which were used in the parametric study in STAAD analysis as well as conventional method of design and analysis on design of RC T- beam bridges. For all the bridges material properties provided are for M30 grade of concrete and Fe 415 grade of steel.

Table- 1: Summary of data considered for four cases

Span (m)	Slab thickness t (mm)	Overall depth of Longitudinal Girder (mm)	No. of L.G.	c/c Distance of L.G. (m)	Overall depth of Cross Girder (mm)	No. of C.G.	c/c Distance of C.G. (m)
10	200	1600	5	2.9	1400	3	5
15	200	1600	5	2.9	1400	5	3.75
20	200	1600	5	2.9	1400	5	5
25	200	1600	5	2.9	1400	7	4.17

The above thickness of slab and section for cross girders and longitudinal girders have been adopted after design of the bridge decks using the EXCEL spreadsheet developed in the study. For the above sectional properties, the bridges were analysed in STAAD.Pro and the results obtained are presented below.

B. Summary for Design loads

The Design dead load, live load and total load, as obtained from STAAD analysis are presented below. The support reactions have also been computed using the conventional method of design developed as an EXCEL spreadsheet program.

Table-2: Comparison of design Shear force from both the methods

Span (m)	STAAD. Pro analysis			Conventional method of Analysis		
	DLSF (KN)	LLSF (KN)	Total SF (KN)	DLSF (KN)	LLSF (KN)	Total SF (KN)
10	177.296	369.05	546.346	205.168	408.2328	613.4008
15	277.35	384.7	662.05	285.828	438.1034	723.9314
20	332.2	397.8	730	366.488	453.0388	819.5268
25	397.3	400.11	797.41	447.148	462	909.148

C. Summary for bending moment

The Design bending moments, as obtained from STAAD analysis are presented below. The Bending moments have also been computed using the conventional method of design developed as an EXCEL spreadsheet program.

Table-3: Comparison of Bending moment from conventional calculation and STAAD.Pro

Span (m)	STAAD. Pro analysis			Conventional method of Analysis		
	DLBM (KN-m)	LLBM (KN-m)	Total BM (KN-m)	DLBM (KN-m)	LLBM (KN-m)	Total BM (KN-m)
10	487.55	847.53	1335.08	549.46	816.4655	1365.926
15	1046.64	1254.84	2301.48	1126.665	1314.31	2440.975
20	1632.7	1654.2	3286.9	1905.52	1812.155	3717.675
25	2176.1	2062	4238.1	2886.025	2310	5196.025

D. The variation of Bending Moment and Shear Force with span

The variation of dead load SF, live load SF, dead load BM and live load BM are shows as below. It can be observed that as the span is increases the dead load and live load shear and moment are increases.

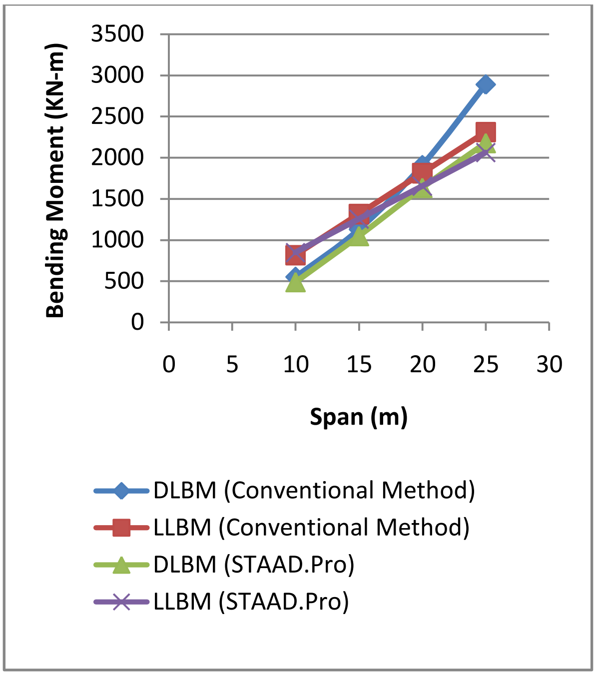

Figure 1: Variation of Bending Moment with Span by STAAD.Pro and Conventional method

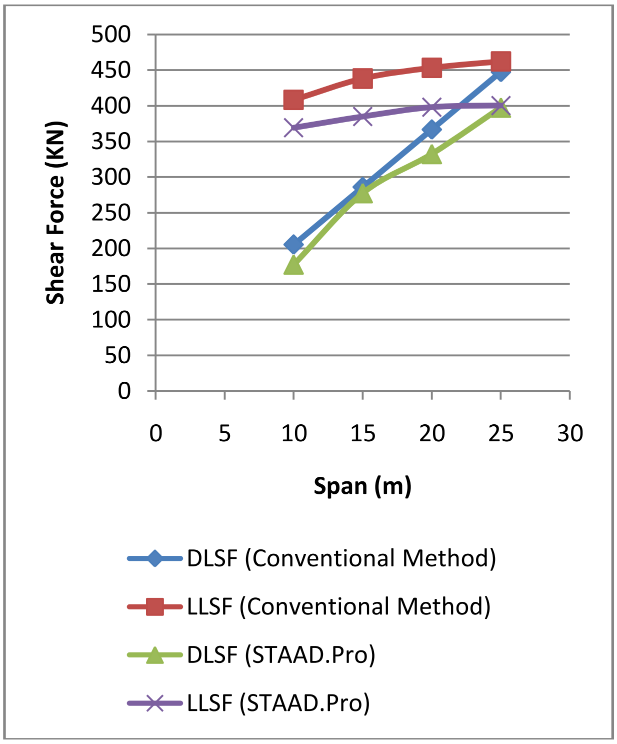

Figure 2: Variation of Shear Force with Span by STAAD.Pro and Conventional method

IV. CONCLUSION

On the basis of design and analysis it was concluded that with increasing span the dead load bending moment increases almost square of the span. This is true that bending moment increases in a parabolic manner with span.

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