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RESEARCH ARTICLE OPEN ACCESS

Study of Box Girder Bridge and Relevant IS Code

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ABSTRACT
In this project around eighteen papers were reviewed & from literature it was realize that Box Girder Configuration is the best one for long span RCC Bridge. For the design of long span RCC Bridges IRC specification were carefully studied, (IRC:6-2000,IRC:21-2000,IRC:78-2000,IRC:18-2000). The Indian Road Congress has drafted the specifications resulting in simplified approach of design of box girder bridges. To begin with 50m span, box girder bridge was design as per specifications & it was found that following parameters are significant in the analysis & design of box girder bridges(Depth of Web, DLBM & LLBM at mid span section, DLBM & LLBM at mid support section, Prestressing Force, Eccentricity, Quantity of Steel & Concrete).Accordingly 60m & 70m span bridges were designed

KEYWORDS – box girder, DLBM, LLBM, Prestressing

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I. INTRODUCTION

A box girder bridge is a bridge in which main beam comprise girders in the shape of a hollow box. The box girder normally comprises either prestressed concrete, structural steel, or a composite of and reinforced concrete. The box is typically rectangular or trapezoidal in cross-section. The box girder bridges are commonly used for highway flyovers and for modern elevated structures of light rail transport. Although normally the box girder bridge is a form of beam bridge box girders may also used on cable-stayed bridges and other forms.

Compared to I-beam girders, box girders have a number of key advantages and disadvantages. Box girders have better resistance to torsion, which is particularly of benefit if the bridge deck is curved in plan. Additionally, larger girders can be constructed, because the presence of two webs allows wider and hence stronger flanges to be used. This in turn allows longer spans.

II. IS CODE PROVISION

2.1 Standard Specification and Code of Practice for Road Bridges(section:II)

a. IRC class AA Loading: This loading is to be adopted within certain municipal limits,in certain existing or contemplated industrial areas,in other specified areas,and along certain specified highways.Bridges desiged for class AA loading should be checked for class A loading also,as under certain conditions,heavier stresses may be obtained under class A loading.

b. IRC class A Loading: This loading is normally adopted on all roads on which permanent bridges and culverts are constructed.

c. IRC class B Loading: This loading is normally adopted for temporary structure and bridges in specified areas.

Clause 207.1.1. For bridge classified under the clause 201.1,the designed live load shall consist of standard wheeled or tracked vehicles or train of vehicles.

Clause 207.1.2.Within the kerb to kerb width of roadway, the standard vehicle or train shall be assumed to parallel to the length of bridge, and to occupy any position which will produce maximum stresses provided that minimum clearances two passing or crossing vehicle.

Clause 207.1.3 For each standard vehicle or train, all the axles of a unit of vehicle shall be considered as acting simultaneously in position causing maximum stresses.

Clause 207.1.4 Vehicle in adjacent lanes shall be taken as headed in the direction producing maximum stresses.

Clause 207.1.5 The spaces on carriageway left uncovered by the standard train of vehicles shall not be assumed as subject to any additional live load unless otherwise specified in table.

Clause 207.3 Dispersion of load through Fill of Arch Bridges
The dispersion of load through the fills above the arch shall be assumed at 45 degrees both along and perpendicular to the span in the case of arch bridges.
Clause 207.4 combination of Live load
This clause shall be read in conjunction with clause 112.1 of IRC:5-1998.The carriageway live load combination shall be considered for the design as shown in table below.

III. ANALYSIS & DESIGN OF BRIDGES

One fifty m span bridge is analysed and designed as per specifications. The details are presented below.
Data:
Span=50m,
Cross-section=multicelled box girder, cell dimension=2x2,
Road width=7.5m,
footpaths=0.6m wide on either side of roadway,
Wearing coat=80mm,
thickness of web=300 to27K-15 Freyssinet type anchorages (27 strands of 15.2mm diameter in 110mm diameter cables)

- Thickness of Top & Bottom Slab=300mm
- Concrete grade M-60
- Loss ratio=0.8
- Type of Tendons high tensile strands of 15.2mm diameter conforming to IRC:6006-2000
- Type of supplementary r/f:Fe415 HYSD bars

IV. RESULTS AND DISCUSSION

After preparation of an excel sheets for the span 50, 55,60, 65,70,75 & 80m span, we are finding the results are as follows.

Table 1. Variations in the height of web for different grades of concrete with different span:

Grade of	Span	Height of Web
M-40	50	1.9
M-40	55	2.3
M-40	60	2.6
M-40	65	3
M-40	70	3.3
M-40	75	3.8
M-40	80	4.4
M-50	50	1.5
M-50	55	1.8
M-50	60	2
M-50	65	2.4
M-50	70	2.7
M-50	75	3.2
M-50	80	4.1
M-60	50	1.3
M-60	55	1.6
M-60	60	1.7
M-60	65	2.1
M-60	70	2.6
M-60	75	3
M-60	80	3.4

Table 2. Variation in Bending Moments at Mid Span Section with different grade of concrete with different span.

Grade of Concrete	Span	Mid Span Section(D) (kN-m)			
		D.L.B.M.	L.L.B.M.	Tot. BM	Ultimate BM
M-40	50	8165.00	4298.5	12463.5	22993.81
M-40	55	10490.0	4728.3	15218.4	27556.04
M-40	60	12968.3	5158.2	18126.5	32348.08
M-40	65	16198.6	5588.0	21786.7	38268.18
M-40	70	19482.4	6017.9	25500.3	44268.44
M-40	75	23868.5	6447.7	30316.3	51922.26
M-40	80	29081.6	6877.6	35959.2	60816.5
M-50	50	7632.50	4298.5	11931.0	22195.06
M-50	55	9711.56	4728.3	14439.9	26388.29
M-50	60	11957.6	5158.2	17115.8	30832.03
M-50	65	14780.5	5588.0	20368.6	36141.09
M-50	70	18090.8	6017.9	24108.7	42181.04
M-50	75	21965.6	6447.7	28413.4	49067.91
M-50	80	28119.3	6877.6	34996.9	59373.11
M-60	50	7336.66	4298.5	11635.1	21751.31
M-60	55	9415.73	4728.3	14144.1	25944.55
M-60	60	11403.6	5158.2	16561.9	30001.11
M-60	65	14248.8	5588.0	19836.8	35343.43
M-60	70	17711.2	6017.9	23729.2	41611.75
M-60	75	21452.1	6447.7	27899.9	48297.68
M-60	80	25809.9	6877.6	32687.5	55908.98

V. GRAPHS & MATHEMATICAL MODELS

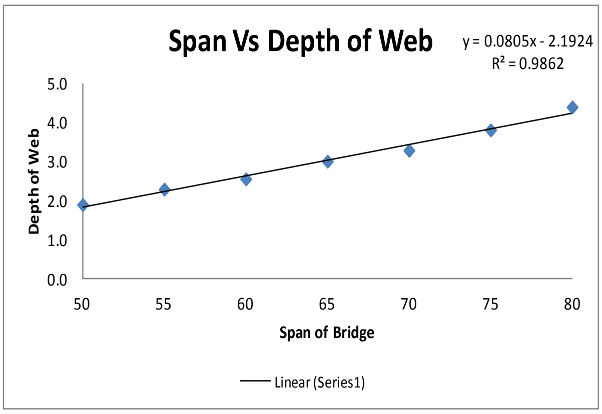

Fig 1. Variation in Depth of Web

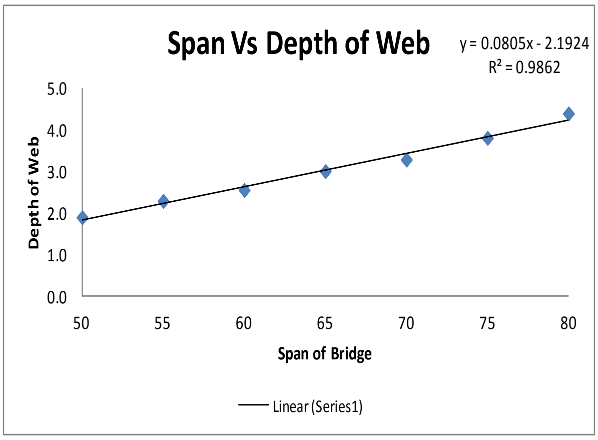

Fig 2. Variation in Depth of Web

VI. INTERPRETATION OF RESULTS

Table 3 %Error of Actual value & Predicted value for Web

Grade of Concrete	Span	Height of Web		
	m	m	Predicted	%
M 40	50	1.90	1.91	-0.77
M 40	55	2.29	2.20	4.28
M 40	60	2.56	2.52	1.34
M 40	65	3.01	2.90	3.84
M 40	70	3.29	3.31	-0.72
M 40	75	3.81	3.77	0.98
M 40	80	4.40	4.28	2.69
M 50	50	1.48	1.48	0.36
M 50	55	1.79	1.74	3.13
M 50	60	2.01	2.04	-1.43
M 50	65	2.35	2.39	-1.59
M 50	70	2.73	2.81	-2.75
M 50	75	3.15	3.30	-4.68
M 50	80	4.11	3.87	5.71
M 60	50	1.25	1.19	4.93
M 60	55	1.60	1.42	11.49
M 60	60	1.71	1.69	1.21
M 60	65	2.11	2.00	4.99
M 60	70	2.58	2.36	8.43
M 60	75	2.97	2.77	6.78
M 60	80	3.40	3.22	5.26

VII. CONCLUSION

a. The IRC6-2000, IRC21-2000, IRC78-2000 gives detailed provisions for the design of RCC Bridges.
b. Excel sheets developed can give design output for any long Span Box Girder Bridge
c. The analysis & design of Box Girder Bridges for any Span can be obtained from the mathematical models without doing lengthy calculations.
d. In the mathematical models by simply putting the values of span we can obtain analysis & design parameters of any long span Box girder RCC bridge.

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