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COMPARATIVE STUDY FOR THE SKEW BRIDGE USING INDIAN STANDARD METHOD AND AASHTO LRFD

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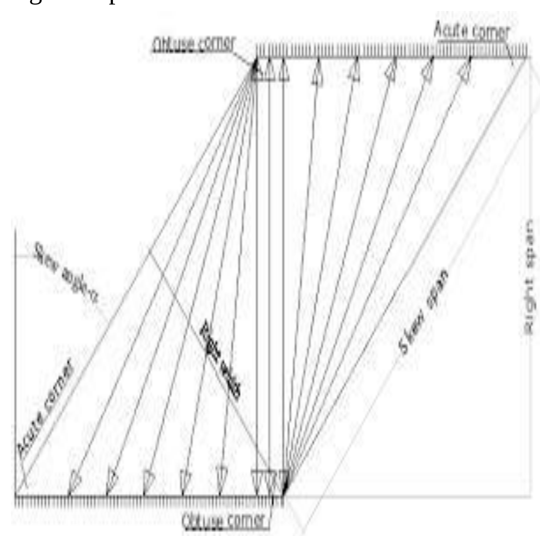
***Abstract*— Bridge is very special type of structures. They are characterised by their simplicity in geometry and loading condition. The simple form of bridge is single-span beam or slab which is simply supported at its ends. Presently constructed bridge is often skew. This is due to space constrains in congested urban areas. The configuration of such a structure is the result of natural or man made obstacles such as, complex intersection, space limitation, and mountainous terrains. For this study, Dead Load, Impact Load, Vehicular Live Load and Lane Load along with load combination according to IRC & AASHTO are considered. Reinforced concrete T – Beam girder of various skew angle (0°, 15°, 30°, 45°, 60°) and different span (16 m, 18 m , 20 m & 24 m) with 2 lane carriage way is considered. The analysis is done using STAAD Pro Software. The skew angle is taken at interval of 15° starting from 0° up to maximum of 60°. The analysis result is present in teams of bending moment, torsion moment, shear force and deflection for T – Beam girder. After end of study conclusion will be made that comparison of skew bridge with normal bridge. Key Words: IRC: 6, IRC: 112, AASHTO LRFD, STAAD Pro, T – Beam Girder.**

I. INTRODUCTION

Newly designed bridge is often skew. This is due to space construction in congested urban area. Skew bridge allows a large variety of solution in roadway alignments. This contribution to a small environments impact for new road construction project. It can also be needed due to geographical constraints such as mountainous terrains. However, the force flow in skew bridge is much more complicated than right bridge. Analysis calculation alone does not provide sufficient accuracy for structural design.

Numerical analysis needs to be performed in which a skew bridge can be modelled in several ways with different degree of sophistication.

In right – angle Bridge the load path goes straight towards the support in the direction of the span. In solid slab skew bridge the load tends to take a short cut to the obtuse corner of the bridge as shown in Fig 1.2. In bridge decks supported by longitudinal girder this effect occurs too, although less pronounced.



[FIG.1.1 Load Path in skew bridge]

II. LITERATURE SURVEY

- The detailed review of literature related to Skew Bridge is carried out in this chapter. All the main researches are discussed with appropriate description. Their adaptability's are also discussed.

- The researcher research on study of skew bridge comparing with the normal bridge for skew angle.
- Deflection decreases with increase in skew angle in two or three span skew slab.

- straight and skewed slab bridges were model using grillage and finite element models to characterize their behaviour under uniform and moving loads with the objective of determining the most appropriate modelling approach for design.

III. OBJECTIVES OF THE STUDY

- To give some idea on the effect of skewness on the general behaviour of bridges.
- To evaluate the Indian Road Congress (IRC) requirements for live load for T - Girder Bridge of 16, 18, 20 and 24 m span length of Reinforced Concrete Bridge.
- To evaluate the American Association of State Highway and Transportation Officials (AASHTO) requirements for live load and lane load for T - Girder Bridge of 16, 18, 20 and 24 m span length of Reinforced Concrete Bridge.

IV. GEOMETRICAL DATA OF RCC DECK SLAB

1) Finding Pt% by Keeping Effective Depth Constant

Example Data:-

Width of RCC deck = 1000 mm

Effective Depth = 170 mm

Bending Moment = 100 kN-m

Design Bending Momen t= 150 kN-m

WSM = Working Stress Method as Per IRC: 21 – 2000

LSM = Limit State Method as Per IRC: 112 – 2011

2) Finding Pt% by Increasing Effective Depth

Example Data:-

Width of RCC deck = 1000 mm

Bending Moment = 100 kN-m

Design Bending Moment = 150 kN-m

WSM = Working Stress Method as Per IRC: 21 – 2000

LSM = Limit State Method as Per IRC: 112 – 2011

V. RESULT AND ANALYSIS

1) For constant effective depth

Provided P_t%						
	FE – 250		FE – 415		FE - 500	
M	WSM	LSM	WSM	LSM	WSM	LSM
15	3.10	3.50	1.90	2.00	1.60	1.70
20	3.20	3.50	1.90	2.00	1.60	1.70
25	3.20	3.50	2.00	2.00	1.60	1.70
30	3.30	3.30	2.00	2.00	1.60	1.70
35	3.30	3.10	2.00	1.90	1.70	1.60
40	3.40	3.00	2.00	1.80	1.70	1.50
45	3.40	2.90	2.10	1.80	1.70	1.50
50	3.50	2.80	2.10	1.70	1.70	1.40
55	3.50	2.80	2.10	1.70	1.70	1.40
60	3.50	2.70	2.10	1.70	1.70	1.40

Table 5-1 Table of Pt% for fixed effective depth

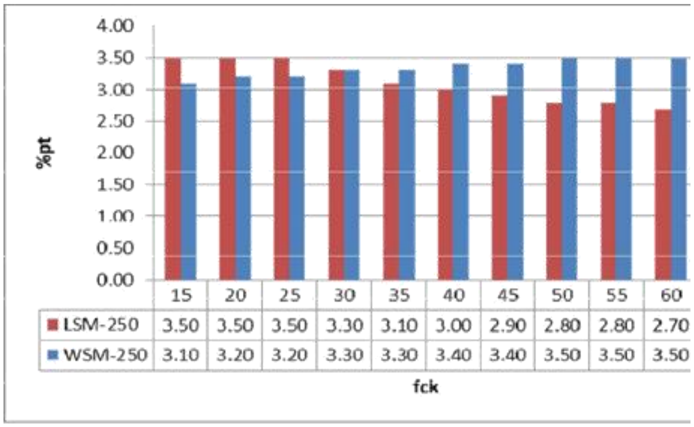


Figure 5-1 Pt % vs.fck for fy = 250 N/mm²

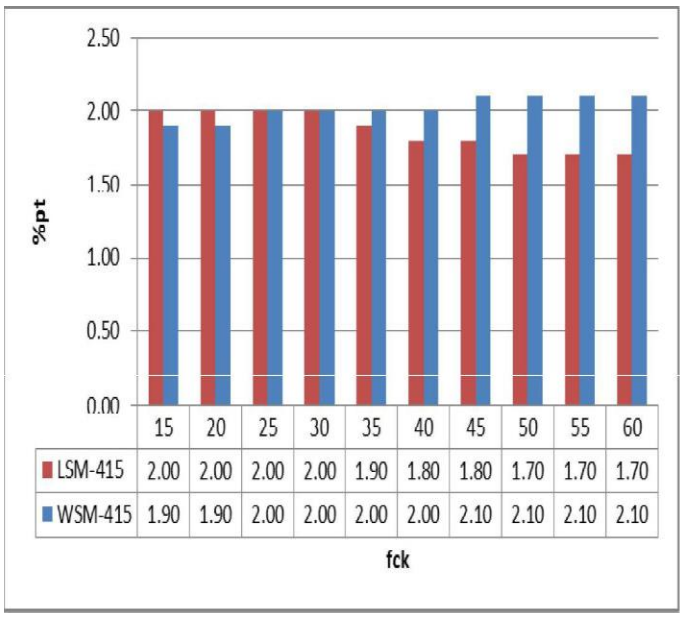


Figure 5-2 P_t % vs.fck for fy = 415 N/mm²

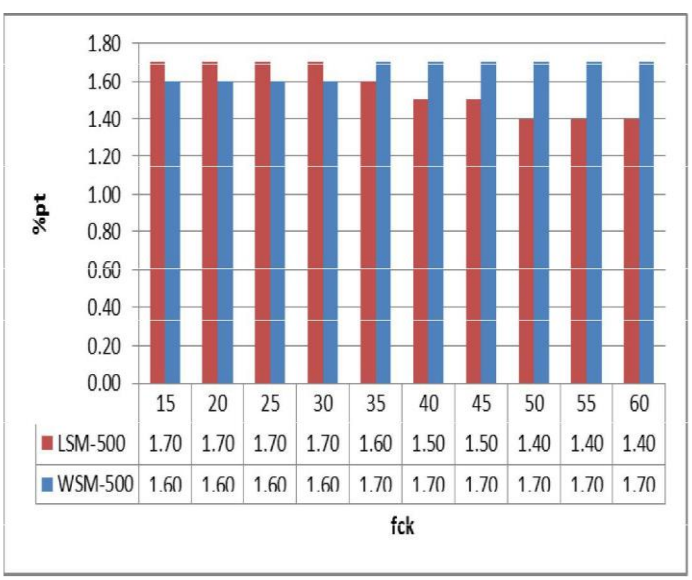


Figure 5-3 P_t % vs.fck for fy = 500 N/mm²

2) For Increasing Effective Depth

Provided P_t%						
fck - fy	30-250		30-415		30-500	
Depth	WSM	LSM	WSM	LSM	WSM	LSM
150	4.18	4.50	2.51	2.56	2.06	2.07
200	3.14	2.10	1.89	1.19	1.55	1.05
250	2.51	1.24	1.51	0.75	1.24	0.63
300	2.10	0.83	1.26	0.51	1.04	0.42
350	1.80	0.60	1.08	0.37	0.89	0.31
400	1.58	0.46	0.95	0.28	0.78	0.24
450	1.40	0.36	0.84	0.22	0.69	0.19
500	1.26	0.29	0.76	0.18	0.63	0.15
550	1.15	0.24	0.69	0.15	0.57	0.13
600	1.05	0.20	0.64	0.13	0.52	0.11

0.00 1.00 2.00 3.00 4.00 5.00

Table 5-2 Table of Pt% for different effective depth

Figure 5-4 Effective Depthvs. Pt% for fck = 30 N/mm² and fy = 250 N/mm²

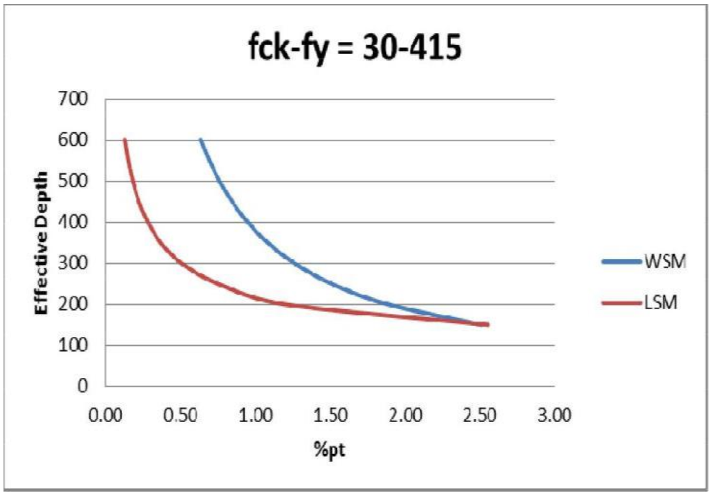


Figure 5-5 Effective Depthvs.Pt% for fck = 30 N/mm² and fy = 415 N/mm²

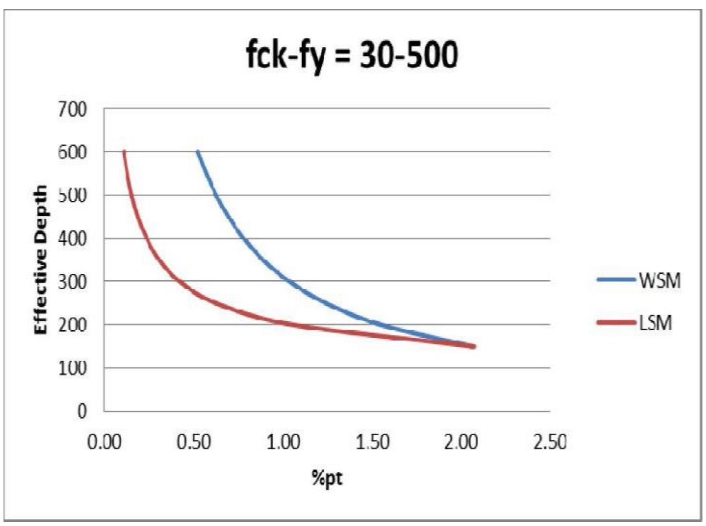


Figure 5-6 Effective Depthvs.Pt% for fck = 30 N/mm² and fy = 500 N/mm²

VI. CONCLUSIONS

- From Figure 5-1, Figure 5-2 and Figure 5-3, it can be seen that provided Pt % is increase for LSM as grade of concrete up to 25 N/mm² and than increase after 30 N/mm² - 60 N/mm² while, it is increases for WSM as grade of concrete increases from 30 N/mm² to 60 N/mm².
- From Figure 5-1, Figure 5-2 and Figure 5-3, it can be seen that provided Pt % is decreases for LSM and WSM both as grade of steel increases from 250 N/mm² to 500N/mm².
- From Figure 5-4, Figure 5-5 and Figure 5-6, it can be seen that provided Pt % is decreases as effective depth increases but LSM consumes more percent of steel compare to WSM for constant grade of concrete fck = 15 N/mm².
- From Figure 5-4, Figure 5-5 and Figure 5-6, it can be seen that provided Pt % is decreases as effective depth increases but WSM consumes more percent of steel compare to LSM as grade of steel increases from 250 N/mm² to 500 N/mm².
- Form Figure 5-7, it can be seen that for a given data the required shear reinforcement for LSM is quite lesser than WSM. Thus, LSM consumes lesser quantity of shear reinforcement compare to WSM for a given data.
- From above conclusion, it can be said that the new code IRC: 112 gives economical and safe design compare to old code IRC: 21.

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