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Analysis of Pre-Stressed Flyover Elements

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ABSTRACT: Flyover construction today has achieved a worldwide level of importance. Flyovers are the key elements in any road network. Use pre-stressed concrete flyover is gaining popularity in bridge engineering fraternity because of its better stability, serviceability, economy, aesthetic appearance and structural efficiency.

We have chosen L.B.NAGAR junction fly over each girder to be placed on the flyover measures up to 30 meters in length, and weighs 50 tonnes. We are going to analyze the flyover elements like Deck, Girder and Pier. The flyover which is being constructed near Kamineni Hospitals will require 44 such girders on both sides of the road. Completion of the project, with 940-meter flyovers on each side, will ease traffic by 85%.

We are analyzing the fly over elements using STAAD PRO V.8.i.

KEYWORDS: Flyover, bridge, road, pre-stress force, bridge, efficiency, STAAD PRO V.8.i.

I. INTRODUCTION

Transport in the Republic of India is an important part of the nation's economy. The State of Telangana is situated in the Southern India. Road transport is a dominant mode in the State for the transport of goods and movement of passengers. Hyderabad is the capital and largest city of the southern Indian state of Telangana and is situated on the Deccan plateau at an average elevation of 550m above mean sea level. The Greater Hyderabad Municipal Corporation (GHMC) covers 625sq.km in area.

The existing major road network system in Hyderabad city is faced with numerous problems associated with inadequate carriageway width, improper drainage facilities and pedestrian footpaths, traffic management, lack of efficient mass transport system etc., This has resulted in increasing pressure on the exiting road network and it is the time for taking up the proper study technically and scientifically to assess the adequacy of the structural strength of existing road and to take up the necessary strengthening and improvement measures to cope up for the future traffic demand.

The construction of suitable connectivity in form of road/grade separator so as to reduce the traffic congestion on existing road network, improve the mobility & the safety etc., to the road users. For conveying the product materials such as food grains, industrial goods the roads are essential. The roads and bridges are very important for growth of economy of the country. Now our country is being developed by developing roads and bridges. The loss of fuel for combustion and the associated cost resulting from waiting for the signal to change are also estimated, and these are found to be significant. When it rains, it's not just the roads that are water logged all other streets also get full with water so it's easy to travel by flyover to get ease of rain water.

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II. RELATED WORK

Flyover construction today has achieved a worldwide level of importance. Flyovers are the key elements in any road network. Use of PSC Girder has gained popularity in bridge engineering because of its better stability, serviceability, economy, aesthetic appearance and structural efficiency. In the present study a simply supported PSC Girder Bridge of 25m span is analysed for moving loads as per Indian Road Congress codes- IRC: 6 and IRC: 18 specifications.

Design Procedure

- Assume section
- Calculate section properties
- Estimate Bending moment / Shear force
- Select no & size of cables
- Apply pre-stress force
- Estimate pre-stress losses
- Determine stresses in concrete
- Check with permissible stresses
- Check ultimate moment / shear
- Design shear reinforcement
- Design end block

Our project deals with the Design of a grade separator in an intersection. The location is at four roads junction at SALEM town, which is facing major traffic problems due to the construction. We have done a traffic survey and designed all the structural parts for this grade separator.

The grade separator is of 640 m length with 21 spans, 20m per span. It consists of a deck slab, longitudinal girders, cross girders, deck beam, pier and foundation. Structural design of one span was made for all the above components. Slab is designed by working stress method as per the recommendation of IRC: 21-2000, Clause 304.2.1. Cantilever slab is designed for maximum moment due to cantilever action. Longitudinal girders are designed by Courbon's method. Cross girders are designed mainly for stiffness to longitudinal girders. Elastomeric reinforced bearing plate is used.

III. ELEMENTS OF FLYOVER

DECK SLAB

Deck, is the surface of a bridge, and is one structural element of the superstructure of a bridge. It is not to be confused with any deck of a ship. The deck may be constructed of concrete, steel, open grating, or wood. Sometimes the deck is covered with asphalt concrete or other pavement. The concrete deck may be an integral part of the bridge structure (T-beam or double tee (structure) or it may be supported with I-beams or steel girders. When a bridge deck is installed in a through truss, it is sometimes called a floor system. A suspended bridge deck will be suspended from the main structural elements on a suspension or arch bridge. On some bridges, such as a tied-arch or a cable-stayed, the deck is a primary structural element, carrying tension or compression to support the span.

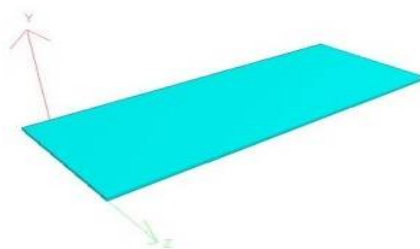


Fig No 1: Deck Slab Model

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GIRDER

It is the main horizontal support of a structure which supports smaller beams. Girders often have an I-beam cross section composed of two load-bearing flanges separated by a stabilizing web, but may also have a box shape, Z shape and other forms. A girder is commonly used to build bridges.

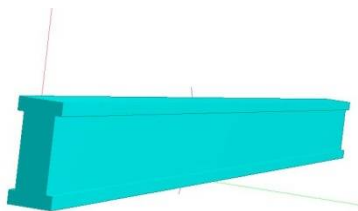


Fig No 2: Girder Model

BEARING

A bridge bearing is a component of a bridge which typically provides a resting surface between bridge piers and the bridge deck. The purpose of a bearing is to allow controlled movement and thereby reduce the stresses involved. Movement could be thermal expansion or contraction, or movement from other sources such as seismic activity. There are several different types of bridge bearings which are used depending on a number of different factors including the bridge span.

PIER/ABUTMENT

A pier is a raised structure typically supported by foundation. Bridges, buildings, and walkways may all be supported by piers. Their open structure allows tides and currents to flow relatively unhindered, whereas the more solid foundations of a quay or the closely spaced piles of a wharf can act as a breakwater, and are consequently more liable to silting. Piers can range in size and complexity from a simple lightweight wooden structure to major structures extended over 1600 meters.

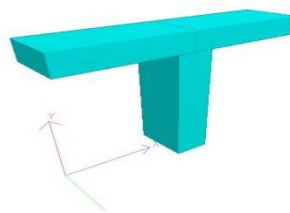


Fig. No 3: Pier Model

IV. TRAFFIC VOLUME STUDY

Analysis of the traffic survey data brings out the Average Daily Traffic (ADT) of the project corridor and the existing junctions peak hour turning movement along the project stretch.

S.No	Section	Average Traffic (Veh/Day)	Average Traffic (PCU/Day)
1	Kamineni X Roads to LB Nagar Junction	73013	80576

Table No 1: Average Daily Traffic

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The summary of Peak hour traffic volume for major junctions along the project corridor is represented in the table below. Further, the traffic growth of 3% per annum is adopted with reference to CTS study report and the traffic projections for the future traffic.

S.No	Junction/ Area	Type	Peak Hr Vol (Veh)	Peak Hr Vol (PCU)
1.	Mansoorabad	T	8786	6359
2.	Towards DSNR	T	6376	4751
3.	LB Nagar	+	50560	57600
4.	Nagole	+	36202	41324

Table No 2: Average traffic projections

S.No.	Section	Peak Hr Vol (PCU)	2020-21 (PCU)	2025-26 (PCU)	2030-31 (PCU)	2035-36 (PCU)
1.	Nagole to LB Nagar	5890	6828	7923	9181	10637
	Lane Requirement	4	5	5	6	7

Table No 3: Projected peak hour traffic

V. LOAD ANALYSIS

DEAD LOAD

Dead loads are the load due to self weight of structure or structural members. Dead loads and static loads remain reasonably constant throughout the life of a structure. The unit weight of different materials may be taken from IS-1343-2000 code of practice for pre-stressed concrete.

DEAD SUPER IMPOSED LOAD

Usually means a load that is in addition to the dead weight of the bar joists and bridging. The part of the total load sustained by a structure or member thereof that is applied to it after erection. Or any load which a structure must sustain, other than the weight of the structure itself.

LIVE LOAD

Live loads are loads which are not steady unlike the dead loads they can change their magnitudes. Live loads are taken according to type of vehicle. Live load is comprehensively described in table 1 and 2 IRC: 21-2000 part 2 imposed loads. The live load taken in the project is H-20.

The live load is taken as per IRC class AA loading, self weight is taken from the software and the dead super imposed load calculated is 2.315kN/m (girder), 9.26kN/m (deck), 23kN/m (pier)

AXLE LOAD SURVEY

The Vehicle Damaging Factor (VDF) of each commercial vehicle & their axle load band /distribution and expected damage on pavement and extent of over loading are estimated and presented in table:

S. No	Vehicle Category	Recommended VDF
1.	Standard Buses	4.065
2.	Mini Bus	0.923
3.	Two Axle Trucks	4.065
4.	Three Axle Trucks	6.202
5.	4 - 6 Axle Trucks	12.100
6.	7 or More Axle Trucks	12.100
7.	LCV (Light Commercial Vehicles)	0.923

Table No 4: Vehicle Damage Factors (VDF)

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VI.ANALYSIS REPORT OF ELEMENTS

DECK SLAB

S. No	Load Combinations	Negative/ positive shear forces	Distance mm	Mz K-Nm	Distance mm	My K-Nm
1	1 DL	Max +ve	0.000	1.27233E6	0.000	0.000
		Max -ve	30000.000	-1.27233E6	0.000	0.000
	2 LL	Max +ve	0.000	306.00006E	0.000	0.000
		Max -ve	30000.000	-306.00006E	0.000	0.000
	3 SIDL	Max +ve	0.000	34725.006	0.000	0.000
		Max -ve	30000.000	-34725.006	0.000	0.000
	4 DL+SIDL+L	Max +ve	0.000	1.93566E6	0.000	0.000
		Max -ve	30000.000	-1.93566E6	0.000	0.000

Table No 5: Max. Shear Force Values of deck

S.No	Load Combinations	Negative/positive bending moments	Distance mm	Mz K-Nm	Distance mm	My K-Nm
1	1 DL	Max +ve	0.000	0.000	0.000	0.000
		Max -ve	15000.000	-9542.449	0.000	0.000
	2 LL	Max +ve	30000.000	0.000	0.000	0.000
		Max -ve	15000.000	-2295.001	0.000	0.000
	3 SIDL	Max +ve	0.000	0.000	0.000	0.000
		Max -ve	15000.000	-260.438	0.000	0.000
	4 DL+SIDL+L	Max +ve	30000.000	0.000	0.000	0.000
		Max -ve	15000.000	-14517.466	0.000	0.000

Table No 6: Max. Bending Moment Values of deck

(*All dimensions are in mm)

Load case	Dead Load	Dead Super Imposed Load	Live Load	Pre-stressing force
Deflection (at mid span)15000	22.5	18.22	27.89	-12.52

Table No 7: Deflection values of Deck

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GIRDER

Member	Load selection	Axial	Bend-Y	Bend-Z	Combined	Shear-Y	Shear-Z
1	1	0.0	0.0	0.0	0.0	400.5	0.0
		0.0 C	0.0	0.0	0.0	400.5	0.0
	2	0.0	0.0	0.0	0.0	79.7	0.0
		0.0 C	0.0	0.0	0.0	79.7	0.0
	3	0.0	0.0	0.0	0.0	36.2	0.0
		0.0 C	0.0	0.0	0.0	36.2	0.0
	4	0.0	0.0	0.0	0.0	619.7	0.0
		0.0 C	0.0	0.0	0.0	619.7	0.0

Table No 8: Member stresses values of Girder

6.3 PIER

Member	Load selection	Axial	Bend-Y	Bend-Z	Combined	Shear-Y	Shear-Z
1	1	.0	55.8 C	0.0	0.0	0.0	0.0
		1.0	55.8 C	0.0	1658.1	185.5	0.0
	2	.0	0.0	0.0	0.0	0.0	0.0
		1.0	0.0 C	0.0	551.0	61.7	0.0
	3	.0	0.0	0.0	0.0	0.0	0.0
		1.0	0.0	0.0	1497.3	167.6	0.0
	4	.0	67.0 C	0.0	0.0	0.0	0.0
		1.0	67.0 C	0.0	4447.6	497.7	0.0
2	1	.0	55.8 C	0.0	1658.1	185.5	0.0
		1.0	55.8 C	0.0	0.0	0.0	0.0
	2	.0	0.0 C	0.0	551.0	61.7	0.0
		1.0	0.0 C	0.0	0.0	0.0	0.0
	3	.0	0.0 C	0.0	1497.3	167.6	0.0
		1.0	0.0 C	0.0	0.0	0.0	0.0
	4	.0	67.0 C	0.0	4447.6	497.7	0.0
		1.0	67.0 C	0.0	0.0	0.0	0.0

Table No 9: Member stresses values of Pier

VII. CONCLUSION

1. The live load is taken as per irc class aa loading, self weight is taken from the software and the dead super imposed load is 2.315 kn/m^2 (girder), 9.26 kn/m^2 (deck), 23 kn/m^2 (pier) and the pre-stressed force is 16.484 kn.
2. It has been observed that the maximum shear force at a span of 30000mm is 34.725kn and bending moment is at a span of 15000mm 14517kn-m in deck.
3. It has been observed that the maximum shear force at a span of 30000mm is 497.7kn and bending moment is 67.0kn-m in girder
4. As per the calculations in the project the maximum bending moment value in the pier is 4447.6kn-m.

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5. The deflection values in the deck slab due to dead, dead super imposed, live and pre-stressing forces are 22.5mm, 18.22mm, 27.89mm and -12.52mm respectively which are within the safety limits.

REFERENCES

- [1] **Kavitha.N¹, Jayakumari.R²**, "ANALYSIS AND DESIGN OF FLY OVER", Assistant professor in Department of Civil Engineering, Bharathiyar Institute of Engineering for Women, Deviyakurichi, Salem.
- [2] **Prabu.M¹, Tamizhazhagan.T²**, "DESIGN OF FLY OVER BRIDGE IN TRICHY" * Post Graduate Student, M.Tech., Structural Engineering, Prist University, Trichy-Thanjavur Highway, Vallam, Thanjavur, Tamilnadu, India-613403
- [3] **Konda Pradeep kumar¹, A, B.Shankar², P.Madhusudhan rao³**, "EVALUATION AND DESIGN OF FLY OVER USING STAAD PRO".M.Tech(Structural Engineering), Department of Civil Engineering, Kommuri Pratap Reddy Institute of Technology, Village Ghanapur, Mandal Ghatkesar, District Rangareddy, Telangana, India.
- [4] **K.S.RAKSHIT**, Design and construction of **HIGHWAY BRIDGES** in New Central Book Agency, KOLKATA.
- [5] JAYARAM, T. R. JAGADEESH and M.A. DESIGN OF BRIDGE STRCUTRES PRENTICE HALL of India Pvt.ltd. NEW DELHI.
- [6] Trilok Gupta, Anurag misra (2007), "Effect on support reaction of skew bridges", Journal of bridge engineering, ARPN. Vol. 2, No. 1.
- [7] **Shreedhar, R., Rashmikharde**, (2009), "Effect of skew bridge for moving loads", International journal of scientific & engineering research, vol -4, issue feb-2013, ISSN 2229-5518.
- [8] **Vikash Khatri, P.R., Maiti. P.K., Singh and Ansumankar**, (2010), "Analysis of Skew bridge computational methods, /ISSN: 2250-3005" Bnars Hindu university varnasi.
- [9] T. Pramod Kumar et al., (2015) 'ANALYSIS AND DESIGN OF SUPER STRUCTURE OF ROAD CUM RAILWAY BRIDGE ACROSS KRISHNA RIVER', International Journal of Engineering & Science Research, Vol-5, pp.830-838
- [10] Karthiga, P et al., (2014) 'A COMPARISON OF ROAD OVER BRIDGE AND RAIL OVER BRIDGE', pp.23-28
- [11] **Monteiro, R et al.**, (2008) 'Pushover ANALYSIS OF RC BRIDGES USING FIBER MODELS OR PLASTIC HINGES', The 14th World Conference on Earthquake Engineering, pp.1-8 [8] Chao Li et al., (2014) 'Life-Cycle Seismic Response Analysis'
- [12] **Vikash Khatri, P.R., Maiti. P.K., Singh and Ansumankar**, (2010), "Analysis of Skew bridge computational methods", /ISSN: 2250-3005" Bnars Hindu university varanasi.