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Analysis & Design of Flyover by using Staad. Pro v8i

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ABSTRACT

As the population is growing, urbanization is caused which results in increasing of traffic with usage in more number of vehicles for different means of transport.As stated above the growth of population and the usage of vehicles for their different means will automatically result in increase in flow of vehicles which is called as traffic. To overcome the issue of traffic getting jammed (which means having obstacles for free moment or flow at a particular place), there are many different ways implemented to overcome it. When coming to Highways one of the efficient ways of overcoming it is construction of a flyover.Here in this project we are going to a design a flyover at Morampudi Junction located in Rajahmundry Andhra Pradesh along the National Highway 216A as a proposal in order to overcome the issue of traffic jam and also to reduce the rate of accidents occurring at the junction.
By considering all the data collected conducting different examinations I am going to design and analyze the flyover using software STAAD.Pro V8i to study Bending Moment, Shear Force, Nodal Displacement values by considering various types of loads considered are Dead Loads, Live Loads, Wind Loads, Vehicle Load which are taken from Indian Standard Codes IS – 456, IS – 800 & IRC: 6 - 2016.

KEYWORDS: *STAAD.PRO V8i, Shear force, Bending moment,* ***IS – 456, IS – 800 &****IRC: 6-2016*

INTRODUCTION

India is the country with the second largest road network across the world with 5.4 million Km. This road network helps transportation more than 60% of all goods in the country and 85% of passenger traffic in India. Road transportation system has gradually increased over yearswith the improvement in connectivity between cities, towns and villages across thecountry. One of the major components of roadways if Flyover's.

1.1. Introduction to Flyover

Flyover may be referred as an overpass, a h igh-level road bridge that crosses over a highway interchange or intersection.

It is a construction that is built over physical obstacles such as water bodies, valleys and roads which are provided for passage over the obstacle. Designs of flyover vary depending on the requirements and functionalities of the flyover, the nature of the soil where the flyover is constructed, the material that are used for construction and the funds available to build it.

1.2. History Flyover

The first flyover in the world was constructed and started in the year 1843 by the London and Croydon Railway department at Norwood Junction

railway station to carry its atmospheric railway vehicles over the Brighton Main Line.
In India the first flyover was constructed and allowed to access from 14 April 1965 in Kemps Corner in Mumbai. The length of the bridge was 48' (foot) which was constructed in about seven months by Shirish Patel with the expenditure of 17.5 lacks.
A flyover consists of, number of spans with columns (piers), deck, and foundation etc. To construct a flyover all these elements are to be designed properly after analyzing. For large construction the process of designing and analyzing for the structure becomes complicated when done manually, it consumes lot of time and may lead to commencement of errors also, in order to meet the requirements of the proposed construction and complete the task without any problems, software's are used for efficient work.
The software's are used to perform analysis and designing with less effort and no errors with in short period of time, by which the designing of complex flyovers become easier using different software's.
Some of the software's which are generally used for analysis and designing of structures are ETABS, ROBOT STRUCTUREL ANALYSIS, STAAD.Pro V8i.
A flyover has three main elements. First the substructure, which is known as foundation, that which absorbs and transfers the load and weight of the bridge to the ground. It consists of components such as columns (also called piers) and abutments. An abutment is the connection between end of the bridge and the road carried by the earth; it provides support for the end sections of the flyover. Secondly, the superstructure of the flyover is the horizontal platform that spans the space between columns. Finally it comes to the deck of the bridge.

1.3. Scope

The investigation was performed on High Strength Grade ie., M60 grade concrete by using glass fibers and GGBS as mineral admixture The OPC was replaced by GGBS in the proportions of 0,10%, 20% ,30%,40% and glass fibers in the range of 0.5%,1%,1.5%,2% with a SP dosage of 1.5% by weight of cement for mix along with 10%,20%,30% and 40% pumice stone as replacement to coarse aggregate.Mixes were prepared, cured and tested for identifying the mechanical strength characteristics of concrete after 28 days of conventional curing.

Why flyover?

As the usage of number of vehicles on the road is increasing and we don't have any area for extension on both sides, thus the only option left is to go with the third dimension and that is construction of a flyover.

1.4. Components of Flyover

The components of flyover is divided into two categories they are
1. Sub Structure.
2. Super Structure.

Based on the type of construction few parts get added and subtracted for better stability of the structure as-well to support the distribution process of loads applied on the structure.

1.4.1 Sub Structure:

This is the base supportive structure of the construction. Following are the parts which come under sub structure.
a) Foundation
b) Pier / Abutment
c) Bead Block
d) Bearing

1.4.2 Super Structure:

This is the structure which distributes the loads transferred by the vehicles moving on the construction. Following are the parts which come under sub structure.
a) Girder / Slab
b) Pavement
c) Railing / Parapet wall / Barrier

1.5. Objectives:

1. The main objective of this study is to know the reasons for variations in traffic flow at different times and occurrence of accidents at Morampudi junction and design a flyover as a solution for it. To provide free flow of traffic and enhances safe driving.
2. To study average density of traffic flow per day at Morampudi Junction on NH 216A.
3. To study and calculated Vehicle moving capacity at Morampudi Junction.
4. To know the effect of different load types i.e. Dead loads, Live loads, Wind loads, Vehicle loadwhichmay be taken considering codes as reference.

5.To know the effect of design parameters on the structure i.e. bending moment, Shear force and Nodal Displacement.
6.To know the maximum load capacity of the flyover

RELATED WORK

Design of Flyover Bridge in TRICHY, in this paper the study deals with the problems occurring in high traffic area in Trichy. The analysis influences traffic behavior of both the structural components of highway and fly over bridge systems. Additionally, it is also demonstrated that beneficial effect on the superstructure response and sometimes produce detrimental effects on the system behavior and is dependent on the characteristics of the high volume of vehicle movement intensity. Here I consider the place to be from Trichy to Chennai Highway because there are more traffic problems especially in peak hours. It is an overpass and underpass together form a grade separation. Stack interchanges are made up of many over passes. For Pedestrians crossing over busy road without impacting traffic.

Design of Flyover By Uing Staad Pro The objective of this project is to do designing and analysis of flyover using Staad.Pro. The location of the flyover is at Velagapudi Ramakrishna Siddhartha Engineering College (KANURU-VIJAYAWADA), which is facing major traffic problems. Completion of the flyover work is expected to ease traffic movement on the Bandar Road. The flyover is a part of the 3.3-km new Pantakaluva Road that connects Autonagar's 100 ft. road and Tadigadapa- Enikepadu Road via Sanath Nagar, Kanuru Vijayawada Andhra Pradesh. The road follows the defunct irrigation stream (pantakaluva). The flyover is 204 m length with 12 spans, 17m of each span. The diameter of the pier is about 1.6 m and the Beams are of I-section. The height of the columns is 4.2 m .The Flyover has a road width of 8m (2lanes), in which 0.5 m is of median. It also consists of footpath of 2 m width. In the post processing mode of the design we have worked on the structure and studied the bending moment and shear force values.

Analysis And Design of Integral Flyover In general Flyovers/Bridges are built with conventional method. In conventional method various elements like Bearings; Expansion joints need regular inspection and maintenance. The expansion bearings and joints, by virtue of their functions and sources of weakness in the bridge and there are many examples of distress in bridges, due to poor performance of these two elements primarily. This can be avoided by adopting Integral type of structures. Integral Bridges are the structures without joints. Integral bridges are characterized by monolithic connection between the deck and the substructure (piers and abutments). They span from one abutment, over intermediate support to the other abutment, without any joint in the deck. Integral bridges have been constructed all over the world including India. The work includes analysis and design of Integral structure by using STADD PRO software and manual analysis for simply supported structure.

Vikash Khatri et., at (2012) in this paper describesGrillage analysis is the most common method used inthe bridge analysis. In this method the deck isrepresented by an equivalent grillage of beams. Thefiner grillage mesh, provide more accurate results. Itwas found that the results obtained from grillageanalysis compared with experiments and morerigorous methods are accurate enough for designpurpose. The finite element method is a well-knowntool for the solution of complicated structuralengineering problems, as it is capable ofaccommodating many complexities in the solution. Inthis method, the actual continuum is replaced by anequivalent idealized structure composed of discreteelements, referred to as finite element, connectedtogether at a number of nodes.

Dr. Maher Qaqish et., al. (2008) this method is usually used for analysis of bridges based on the consideration of the bridge deck as an elastic continuum in the form of an orthogonally anisotropic plate. Using the stiffness method of structural analysis, it became possible to analyse the bridge deck structure as an assembly of elastic structural members connected together at discrete nodes. There are four distinct techniques which have been found useful by bridge engineers: grillage and space frame analysis, folded plate method, finite element method and finite strip method .The grillage analogy method involves a plane grillage of discrete interconnected beams.

M.A.Sobhan, A.F.M.Saiful Amin, the point of this paper is to upgrade and further invigorate the diverse controls of structural engineering and design that can enhance the execution and monetary return of a bridge over the long haul. To this end, the paper takes a note of current pattern of bridge engineering in Bangladesh and endeavors to give an advanced vision to improvement in the coming decades by keeping a match with the financial improvement status of the nation.

Narabodee Salatoom1, Pichai Taneerananon, suggested that to lessen traffic blockage at an at-grade crossing point close to a major city, one technique is construction a flyover bridge at the old junction in two bearings on one of the principle interstates. The flyover encourages the traffic stream in the bearings of the bridge, however the framework can't completely take care of the majority of the issues particularly on the optional road. Under the bridge, despite the fact that it mitigates the traffic blockage at the crossing point; the traffic flag still uses an indistinguishable control from the "before" circumstance, that is the settled time control plan. With the flyover bridge set up, it was found that around 30-35% of all traffic volumes occupied to the bridges, and time delay reduced by 30% over a similar period.

Kavitha.N, Jaya kumari.R, Jeeva.K, Bavithra.K, Kokila.K, project manages the Design of a grade separator in a convergence. The area is at four roads junction at SALEM town, which is confronting real traffic issues because of 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 ranges, 20m for every traverse. It comprises of a deck slab, longitudinal braces, cross supports, deck pillar, wharf and establishment. Structural design of one traverse was made for all the above segments.

Anuj Dubey Tajammul Sayed, this paper underscores on the utilization of software's for scheduling purposes in Project Management. In India, dreary and tedious regular strategies are as yet utilized for project management as opposed to utilizing present day software instruments. The Hadapsar-Saswad Bridge in Pune is selected for construction booking as a contextual analysis. In this project the exercises were drilled down, amounts were evaluated, assets were assigned and henceforth a calendar was made. A few proposals were made on the site to beat the obstructions on the site without influencing the project's duration and furthermore not hampering excessively with the cost.

EXPERIMENTAL STUDY METHODOLOGY

The objective of the project is to design a flyover at Morampudi Junction located in Rajahmundry Andhra Pradesh along the National Highway 216A to overcome the issue of traffic jam and also to reduce the rate of accidents occurring at the junction.

3.0 Problem statement

By conducting different examinations like road survey and traffic analysis we came to a conclusion that the problem at Morampudi junction on NH 216A is due to insufficiency of road space for the vehicles to pass through the junction at different instants of time in a day which is effecting the free flow of traffic, and improper movement of traffic also results in occurrence of accident in different instants of time

3.1 Survey

Survey is a method of research used for collection of data from different sources to execute the project efficiently.

In order to execute the project I have conducted survey to obtain the density of traffic flow and to determine the density of traffic flow in instants of time at Morampudi Junction on NH 216A.

Here by I have surveyed regarding density of vehicles at Morampudi Junction on NH 216A at different time intervals to obtain adequate results at that particular junction. I also have noticed that there are many different types of vehicles that are passing through Morampudi junction on NH 216A at different instants of time. There is variation in vehicles that pass through this junction, I here have noted down the density of traffic follow which passes through Morampudi Junction and came up with the conclusion of choosing the path along with the National Highway 216A for the construction of the flyover by taking necessary considerations.

4.0 Test Results and Discussion

Table 1: **Average density of traffic flow per day at Morampudi Junction on NH 216A**

Number of Days	Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8	Hour 9	Hour 10	Hour 11	Hour 12	Hour 13	Hour 14	Hour 15	Average Density
Day 1	98	109	263	251	150	132	102	122	134	102	116	185	194	164	128	2.5
Day 2	74	86	284	267	195	127	108	130	107	95	86	193	230	180	159	2.58
Day 3	81	94	270	259	173	143	119	126	128	117	106	218	210	173	145	2.63
Day 4	98	109	263	251	150	132	102	122	134	95	86	193	230	180	159	2.56
Day 5	74	86	284	267	195	127	108	130	107	102	116	185	194	173	145	2.55
Day 6	85	118	269	237	198	152	173	183	196	137	119	162	235	251	176	3
Day 7	96	138	153	168	142	175	196	175	168	127	130	175	283	267	195	2.89

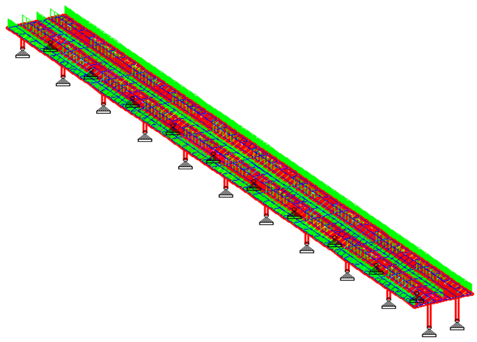

Fig.1Dead Load

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	12.1
6	7 or More Axle Trucks	12.1
7	LCV (Light Commercial Vehicles)	0.923

Fig.2 Vehicle Damaging Factor

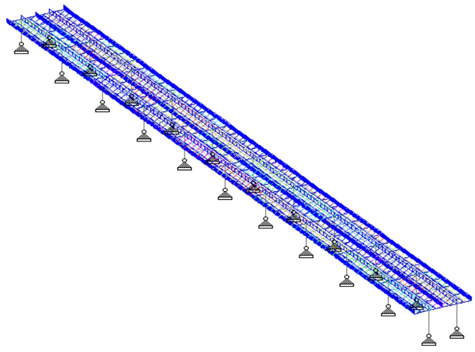

Fig.3 Live Load

Zone	Basic wind speed (m/sec)
I	33
II	39
III	44
IV	47
V	50
VI	55

Table.2 Zone wise basic wind speed in m/s

	Total no. of records	Available number of years of maximum gust wind speed	Raw hourly gust statistics (Figure 1)				Up-cross peak statistics (Figure 2)			
			W_{max} kmph	Wemean kmph	Westd kmph	Extreme kmph	Number of peaks	EP-mean kmph	EP-Std kmph	ExtremeP kmph
IMD station	Count	A	B	D_m	D_{std}	D_{peak}	Count	E_m	E_{std}	E_{peak}
HASHIMARA	2882	9	125	31	13	72	1386	24	15	68
MADRAS_HARBOUR	6177	20	150	42	13	81	3045	35	17	85
TUTICORIN_HP	5275	15	140	51	14	94	2833	47	16	95
MANGALORE_HP	1451	4	91	38	13	76	761	35	12	70
AMRITSAR	11099	32	190	37	19	94	5921	31	17	82
PALAM_A	12626	35	199	39	15	85	6792	34	14	78
NEWDELHI_SAFRJG	12310	34	152	35	15	79	6457	30	14	71
CHABUA_A	395	2	72	28	12	65	155	16	15	60
JAIPUR_SANGANER	11697	38	181	32	15	76	6148	27	14	70
LUCKNOW_AMAUSI	7160	18	170	39	16	87	3637	33	16	81
BAGHOGRA_A	2921	9	102	31	13	70	1448	24	15	68
ALLAHABAD_BAMHRAULI	863	3	131	31	14	73	452	27	13	65
VARANASI_BABATPUR	539	2	67	25	9	52	277	21	9	49
GAYA	2207	7	120	34	16	83	1163	29	16	76
NEW_KANDLA	7407	22	132	47	15	91	3989	43	15	88
AHMEDABAD	9652	29	150	35	11	69	5019	31	12	68
BHOPAL_BAIRAGARH	7784	22	125	42	14	83	4158	38	13	78
JAMNAGAR_A	4328	15	182	44	13	83	2209	38	16	86
BARODA	7564	22	155	35	13	72	4052	31	13	70
INDORE	6959	21	136	52	13	91	3704	47	15	92
JAMSHEDPUR_PB	1395	4	118	34	18	89	730	29	16	78
JAMSHEDPUR	1284	4	122	36	17	87	646	30	17	79
KALAIKUNDA_A	2536	8	142	40	17	91	1283	33	18	87
CALCUTTA	6074	18	143	40	16	88	3133	35	16	82
CALCUTTA_DUMDUM	9966	29	200	34	17	83	5272	29	15	75
NAGPUR_ONEGAON	9348	26	132	36	15	81	5013	32	14	74
RAIPUR	6442	22	112	28	13	67	3443	24	12	61
JHARSUGUDA	1216	4	120	37	17	89	657	32	16	80
SAGAR_ISLAND	6603	19	163	31	16	79	3458	26	15	73
VERAVAL	4427	16	150	40	12	77	2341	35	14	77
BOMBAY_SANTACRUZ	13616	38	200	36	10	67	7262	33	10	64
AURANGABAD_CHIKATHA	394	2	52	32	8	56	117	15	16	64
JAGDALPUR	3438	11	125	33	13	73	1764	28	13	67
GOPALPUR	3764	11	140	43	15	89	1999	39	15	83
BOMBAY	12530	36	103	37	12	74	6649	34	13	72
PUNE	13410	38	165	34	10	66	7116	31	11	64
PUNE_ALOHAGAON	4253	14	130	46	13	85	2210	41	16	88
BIDAR_A	3321	10	137	46	15	90	1557	36	20	96
HYDERABD_A	9291	28	140	37	13	77	4845	34	13	73
HAKIMPET_A	4161	12	114	44	14	87	2146	39	15	83
VISHAKHAPATNAM_A	6211	18	196	43	14	85	3198	39	14	79
VIZG_RSRW	3754	13	140	34	13	72	2079	31	12	68
MORMUGAO	12549	37	190	35	14	77	6542	31	14	74
YELAHANKA_A	1332	4	124	43	18	96	674	36	20	95
MADRAS	761	3	98	32	10	61	396	30	9	57
MADRAS_MINAMBAKKAM	14098	41	160	38	13	77	7374	33	14	75
MANGALORE_HP_PANBUR	9875	28	110	31	12	67	4818	25	14	66
BANGALORE	11319	32	106	38	10	69	5965	34	12	70
NAMGALORE_A	10969	32	125	41	11	75	5738	37	12	74
TAMBARAM_A	4844	5	104	45	12	79	1677	24	23	92
PORT_BLAIR	10253	29	170	40	17	89	5575	36	16	84
KODAIKANAL	13183	37	190	40	12	76	6453	33	16	81
TIRUCHIRAPALLI_A	13261	37	167	50	15	95	6928	46	15	92
COCHIN_NAS	9418	29	180	36	12	72	4929	32	13	70
TRIVANDRUM_TIRUAN	9908	29	108	29	11	61	5655	27	11	60
TRIVANDRUM_A	7976	25	92	30	11	64	4387	27	12	63
TUTICORIN	7761	23	146	49	13	87	4111	45	13	84
OZAR	2825	7	102	42	15	86	1494	37	16	87

Fig.4 Table of wind pressure in different cities & towns

Based on the values given in the table 3.3, vales of zone VISHAKAPATNAM_A are being considered.

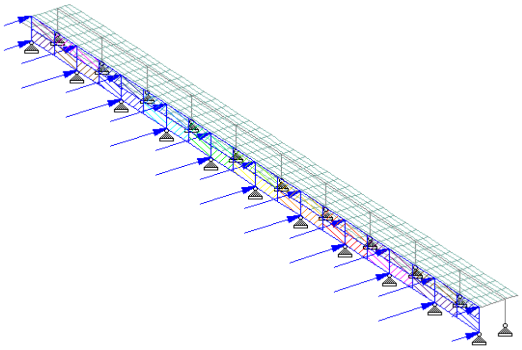

Fig.5 Wind Load

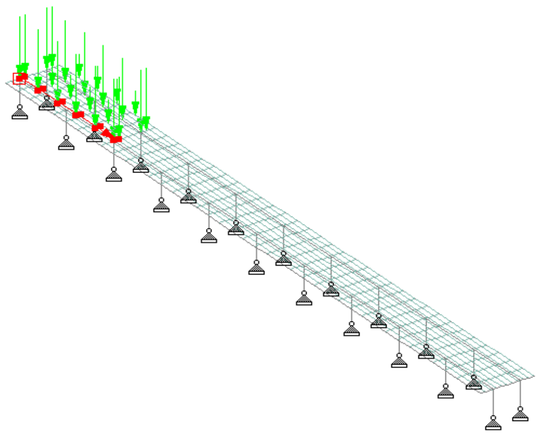

Fig.6 Axial Load

Vehicle impact loads are calculated using IS 875(Part-5)-1987.

Axial loads are calculated using IS 456-2000.

Design Process:

Size of column = 600 x 600 cm
Axial load = 750 KN
Safe Bearing Capacity (SBC) = 200 KN/m^2
f_{ck} = 20 N/mm^2
f_y = 415 N/mm^2

a. Size of floating:

Load from the column (P) = 750 KN
Self-weight of footing = 10% of column weight
= 750/10
=75KN
Total load = 750+75
= 825 KN

Area of footing

$A = \frac{\text{Total Load}}{\text{SBC}}$

$= \frac{825}{200}$

= 4.125m^2

As footing is square

$A=B^2$

$B=\sqrt{A}$

$=\sqrt{4.125}$

B= 2.1 m

b. Upward soil pressure:

Factored load = 1.5 x 750
= 1125 KN

Soil pressure at ultimate load (q_u) = $\frac{Pu}{\text{area of footing}}$

$= \frac{1125}{2.1 \times 2.1}$

= 255 KN/m^2

q_u= 0.255 N/m^2

c. Depth of footing

$M_u = M_u \text{ lim}$

$M_u = 0.138\, f_{ck}\, Bd^2$

$M_u = q_u \frac{B(B-b)2}{8}$

$= 0.255 \times \frac{2100(2100-300)2}{8}$

M_u = 216.88 x 10^6N-mm

$d=\sqrt{\frac{Mu}{0.138 \times FckxB}}$

$d=\sqrt{\frac{216.88 \times 106}{0.138 \times 20 \times 2100}}$

d= 193.43mm

Depth required to resist shear in footing is much higher than required for B.M

Let us assume the effective depth is twice the depth required for B.M

d =193.43 x 2

d= 386.86mm ≈ 400mm

D=d+50

D=400+50

D=450mm

B=2100mm

d. Reinforcement (Area of steel)

$M_u = 0.87 f_y \times A_{st} \times d\ [1-\frac{fy \times Ast}{Fck \times Bd}]$

216.88 x 10^6 = 0.87 x 415 x A_{st} x 400 x $[1-\frac{415 \times Ast}{20 \times 2100 \times 400}]$

A_{st} =1561.86 m^2 ≈ 1562m^2

Spacing

$S = \frac{ast}{Ast} \times 2100$

Assuming Ø of bar as 12mm

$= \frac{\frac{\pi (12)2}{4}}{151.86} \times 2100$

S = 152.06 ≈ 152mm

Providing 12mm Ø bars at 152mm C/C

e. Check for shear: ($\tau_c > \tau_v$)

The critical section for one-way shear is at a distance'd' from the face of column [Take value of τ_c from IS 456-2000 from table 19 P. No 73]

$\tau_v = \frac{Vu}{Bd}$

$V_u = q_u \times Bx\ [\frac{(B-b)}{2}]-d$

$= 0.255 \times 2100 \times [\frac{2100-600}{2}]-400$

$V_u = 401.225 \times 10^3$ N

$\tau_v = \frac{267.75 \times 10(3)}{2100 \times 400} = 0.318$ N/mm²

$\tau_c = \frac{Ast}{Bd} \times 100$

$= \frac{1562}{2100 \times 400} \times 100$

$P_t = 0.2\%$

From table no 19 τ_c based on P_t and grade of concrete M_{20} is taken as 0.32 N/mm²

∴$\tau_c > \tau_v$ (Hence safe)

Check for two ways shear:

The critical section is at distance of d/2 from face of column

Perimeter of the section (p) = 4(b + d)

P = 4(600 + 400)

P = 4000mm

Area of cross section (A) = p x d

= 4000 x 400

= 16 x 10^5 mm²

$V_{u2} = q_u$ x (Area of shaded portion)

= 0.255 x [(2100 x 2100) – (700 x 700)]

$V_{u2} = 999.86 \times 10^3$N

Two-way shear $= \frac{Vu2}{A}$

$= \frac{999.86 \times 10(3)}{1.12 \times 10(6)}$

$\tau_{v2} = 0.89$ N/mm²

Permissible punching stress (τ_p)

$\tau_p = 0.25\sqrt{f_{ck}}$

$= 0.25\sqrt{20}$

= 1.12 N/mm²

∴ $\tau_p > \tau_{v2}$ Hence safe

In two-way shear, form claws 26.2.11 P. No 43 based on the grade of Concrete is 1.2

From HYSD or deformed bars the value is increased by 60%

Check for development of length (L_d):

$L_d = \frac{0.87 \times fy \times Ø}{4 \times \tau d}$

Ø is 12mm of bar

$= \frac{0.87 \times 415 \times 12}{4 \times \tau d \times 1.2 \times 1.6}$

Length available beyond the column is

$\frac{2100-300}{2} = 900$

∴ 900 >564

Table for maximum Shear Force values in x, y, z directions

Beam	Negative/Positive Shear Force	Fx (KN)	Fy (KN)	Fz (KN)
17	Max Fx	2918.121	-120.175	43.631
60	Min Fx	-299.021	149.778	0.135
15	Max Fy	74.49	1450.116	2.675
177	Min Fy	53.098	-1303.46	-0.637
116	Max Fz	1310.072	-59.373	381.051
6	Min Fz	1310.072	-59.373	-381.051
4	Max Mx	92.593	542.852	-149.852
114	Min Mx	92.593	542.851	149.852
6	Max My	1310.072	-59.373	-381.051
116	Min My	1310.072	-59.373	381.051
107	Max Mz	58.226	810.872	-0.011
17	Min Mz	2897.112	-120.175	43.631

Table for maximum Bending Moment values in x, y, z directions

Beam	Negative/Positive Bending Moment	Mx (KNm)	My (KNm)	Mz (KNm)
17	Max Fx	0	0	0
60	Min Fx	0	-0.413	456.523
15	Max Fy	-57.007	-0.604	672.141
177	Min Fy	56.611	-0.245	597.339
116	Max Fz	0	-1161.445	-180.97
6	Min Fz	0	1161.445	-180.97
4	Max Mx	295.598	29.029	367.813
114	Min Mx	-295.598	-29.029	367.813
6	Max My	0	1161.445	-180.97
116	Min My	0	-1161.445	-180.97
107	Max Mz	-0.756	0.052	1122.79
17	Min MZ	0	-132.987	-366.294

Table for summary of Node Displacements

Max & Mim Displacements Chart Area	Node	Horizontal	Vertical	Horizontal	Resultant	Rotational		
		X (mm)	Y (mm)	Z (mm)	Resultant	rX (rad)	rY (rad)	rZ (rad)
Max X	3	29.262	0.144	0.024	29.262	0	0	-0.006
Min X	443	-0.976	0.005	-0.872	1.309	0	0	0
Max Y	107	4.121	7.854	-0.068	8.87	0.001	0	0
Min Y	5	7.164	-70.178	0.56	70.545	-0.003	0	-0.017
Max Z	71	0.966	0.227	2.883	3.049	0	0	0
Min Z	5	7.312	-11.912	-3.211	14.341	-0.009	0	-0.008
Max rX	75	6.979	-14.295	0.855	15.931	0.021	0	0.013
Min rX	493	6.979	-14.295	-0.855	15.931	-0.021	0	0.013
Max rY	90	9.268	-0.16	-1.518	9.393	-0.008	0	-0.001
Min rY	12	9.268	-0.16	1.513	9.392	0.008	0	-0.001
Max rZ	8	7.272	-23.969	0.718	25.058	-0.003	0	0.018
Min rZ	107	7.322	-26.88	0.492	27.864	-0.003	0	-0.019

CONCLUSIONS

This project concludes with planning, design and analysis of a fly over.

1. Based on study area flyover construction is best and economically low cost which is essential at National Highway 216A which is always busy with traffic moment. Located at Morumpudi junction in Rajahmundry, Andhra Pradesh, India.
2. The maximum flow of traffic is along National Highway 216A which includes transportation of agricultural goods and industrial goods, so path chosen for the execution of flyover is along at National Highway 216A.
3. Construction of this structure at that junction results in the traffic control and enhances safe driving.
4. The structure is designed basing codes IRC class AA loading, IRC 6-2016 for designing.
5. The calculated Vehicle moving capacity at Morampudi Junction is $9.8 \times 10^3 KN/m^2$.
6. It has obtained that maximum load capacity of the flyover is 98×10^3 KN.
7. It has been observed that the maximum shear force is 381.051KN and bending moment is 1161.445 KNm which are in safe limit.
8. The maximum nodal displacement is occurred at node 107; 7.164 mm in x, -70.178 mm in y and 0.56 mm in z directions.
9. Design structures using software's like STAAD.Pro V8i, helps in finding failed members and better section is given by the software.
10. Design structure by using software results in obtaining details of each and every member, reduces time of design work, and improved the accuracy of results.

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