

"Design And Analysis of a Double-Stage Flyover Considering Various Load Conditions and Design Challenges Using SAP2000"

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OBJECTIVE

- The main objective of designing of Fly-over Bridge on major junction to avoid excessive traffic.
- To study and to make the suggestion and improvement in transportation by providing fly-over bridge for excessive traffic.
- The project area is having very high density of traffic flow. The public felt inconvenient to cross the busy four roads' highways & therefore the flyover is essentially required at the junction.
- For Smooth traffic flow of industrial goods and Agricultural goods without traffic congestion flyover is essential to overcome the traffic congestion required.
- The Pier is designed for the axial dead load and live load from the slab, girders, deck beam. Foundation designed as footing for the safe load bearing in the soil.
- Design and analyze the flyover using software SAP 2000
- To minimize the traffic delay due to heavy traffic & to suggest the fly-over with good Aesthetic and Architectural view.

ABSTRACT

The primary goal of this project is to use SAP2000 to design and study a six-lane flyover. The fly past is 15 metres long and 15.5 metres wide. The pier has a diameter of around 2.5 metres, and the beams have an I-section. The 4.2 m tall columns are rather impressive. The Flyover has a total width of 15.5 metres, with six lanes, and a median width of 0.5 metres. In addition, a two-meter-wide walkway is a part of the package. The post-processing step, which included structural work and an examination of bending moment and shear force values, followed the design phase.

Since flyovers are common in cities, people associate them with constructions above highways or trains to handle traffic. Unfilled holes allow other operations under the building, making it more usable. Human overloading may damage high-rises. Shaky substructures collapse construction flyovers. New ones may hurt the economy. It's crucial to repair and maintain damaged structures and build long-lasting ones.

Location and purpose classify flyovers. Flyovers connect inaccessible regions across valleys, rivers, seas, and other natural gaps. Flyovers span busy intersections. Flyovers bypass barriers. Highways, railways, and valleys need cuts. Safe, inexpensive flyovers require innovation. Design principles require a building to withstand all stress over its anticipated lifespan. The building must survive extreme conditions and last as designed.

India's steel fly past-history is long. Long-distance flyovers cross highways, lowlands, or crossings. Steel flyovers and flybridges can manage vast spans, mountainous terrain, and other challenges. Short-term flyovers. Steel-concrete buildings are increasing. India has 100-year-old steel flyovers. Most Indian cities are overpopulated, generating traffic.

metropolitan areas. Build flyovers. Slow, disruptive, and seismically unreliable R.C.C flyovers. Steel flyovers are costly but prevent these difficulties. Fly pasts are three-part. The substructure's columns and abutments support the flyover. Flyovers and roads need abutments.

PROBLEM STATEMENT

“By studying different examinations like road survey and traffic analysis that the problem at city by pass road 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.”

Analysis and design of single pier double decker flyover by using sap2000

- In Two Lane Rigid or Flexible pavement road of national highway the structure is design for 4-lane as per IRC SP 84.
- Flyovers are design on two separate piers for three lanes.
- We are going to design a Flyover on single pier

INTRODUCTION

Types of Flyovers

1. Railway crossing
2. Road crossing

Parts of Flyover

1. Super structure
2. Sub structure Super structure

The superstructure consists of the components that span the obstacle the bridge is intended to cross and includes the following

- Bridge deck
- Structural members
- Parapets (bridge railings), hand rails, side walk, lighting and some drainage features.

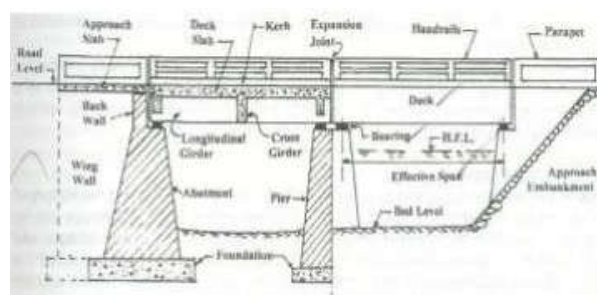


Fig1.1: Cross-section of fly over Loads on Flyover

and four lanes having deck slab with of 20 mtr.

- We are going to take this location in congested city area.
- Total length of structure will be 450 mtr having span of 35 mtr, it will consist of 1 no. obligatory span, 9 nos. of pier of dia. 4 mtr to 15 mtr. And 2 nos. of abutment.
- The foundation type will be open foundation and pile foundation.
- Superstructure will be of segmental type consist of precast wing and precast spine beam, wearing coat.
- There will be also curve section span in flyover.

1. Dead load
2. Live load
3. Dynamic load
4. Other loads IRC Class 70R Loading:

This loading is to be normally adopted on all roads on which permanent bridges and culverts are constructed. Bridges designed for Class 70R Loading should be checked for Class A Loading also as under certain conditions, heavier stresses may occur under Class A Loading

Project Comparison

- The comparison will be done for design effect for single pier and two pier flyovers with estimate cost of view, project completion time of view.
- The project cost comparison will be also as per limitation of ROW and land acquisition, as we know construction of highway project land acquisition is a major part which affects the cost of project. Also it affects the project by financially and time lapse.
- We will also discuss the land which is saved due to construction of structure on single pier.
- The project design will be done on SAP2000 and using various guideline of MORT&H, IRC Specification, and procedure for acquisition of land as per government guidelines.

Design & Modelling

- INPUT DATA
FLYOVER DESIGN
- LENGTH 400M
- WIDTH 15.5 M
- IRC CLASS A
TRACK
- IRC CLASS A
WHEEL
- PIER 2.5 m Dia
- NO OF PIER 42
- BEAM 1.5mm x1.5
mm (Longitudinal
Beam Along X- axis)

Analysis of flyover structures with different loads M. Alla Rangaswamy, International Journal of Engineering Sciences & Research Technology, and March 2022

Flyover construction takes time. ONGOLE's 600m, 6.6m-wide flyover. Seismic robustness, lifespan, and lower life cycle costs offset Flyover's greater cost. Bridges avoid bottlenecks. Valley, railway, or road. Bridge design requires creativity, practicability, safety, and economy. Buildings should last. Buildings should last. Flyovers reduce traffic. Fly past style. A pipeline crosses four motorways, generating delays.

Design of Flyover Construction based on Fibre Reinforced Concrete and Timber Pile Foundation J Prakash Arul Jose, International Journal of Applied Engineering Research, 2022

The deck and pile foundations are made of huge wood concrete vertical support through soil and rock strata, making the project unique. Superstructure girders are fiber reinforced concrete. Diagrams show the entire design process. The construction is tested for stability and durability.

Nonlinear Analysis of Reinforced Concrete Flyovers under Earthquakes, Hong-Nan Li, International Conference on Advances in Experimental Structural Engineering, 2019

- BEAM 1200mm x 2
m (Longitudinal
Beam Along Z- axis)
- Deck Slab
Thickness 400mm
- LOADING
- DEAD LOAD

Improved nonlinear static analysis, especially the pushover approach, can predict structural capacity like global drift or inters story drift. Pushover analysis is easier to implement in engineering and takes less computation than nonlinear dynamic analysis.

Design of flyover transverse vertically by using hydraulic jack, M. Hari Sathish Kumar, K. S. Binitha, K. Balaji, International Research Journal of Engineering and Technology (IRJET), 11 Nov 2017

This study discusses Passover in crowded areas. Flyovers now reduce and divert traffic in major cities. Hydraulic jacks allow vertical transverse overpasses. Concrete and steel form the flyover. Pile foundations deepen loads. Deck and pier members are aluminum and steel. This initiative proposes building overpasses in busy, expensive-to-buy neighborhoods. This project analyses and designs flyovers.

Analysis and Design of Skew Flyovers Nikhil V. Deshmukh, International Journal of Science and Research (IJSR) 2018

Flyovers are different. Geometry and loading are both easy. Reinforced concrete flyovers get their live vehicle loads and regular dead loads from flexure, shear, and torsion. Flyovers today are slanted. Traffic makes space smaller. They might need it. The flow of force on skew flyovers is more complex. Skew flyovers need to be modelled by doing a lot of study and using numbers. Flyover software used finite-element methods to model skewed slab flyovers for optimal force reaction under both constant and changing loads.

Flyover Engineering Handbook Superstructure Design, Wai-Fah Chen, Lian Duan, 19 Oct 2021

Determine constructing procedures before segmental flyover design. Unlike other buildings, construction greatly impacts design and tendon configurations. Construction loads affect design, materials, and details.

Social impact assessment of road infrastructure projects Ms. Nirali Shukla & Dr. H. J. Jani, (January-February, 2018)

The main objectives of the Social Assessment exercises are to assess the Social Impact of the project, identify issues and assess consequent risk to the project due to positive and negative impact, measures to mitigate the negative impacts and risk due to the road interventions

Comparative analysis of t-beam flyover by rational method and staad pro praful n k , balaso hanumant, International Journal Of Engineering Sciences & Research Technology, 2021

The finite element technique is a general structural analysis method that approximates a continuum mechanics problem by examining an assemblage of finite elements interconnected at a finite number of nodal points and representing the solution domain. I.R.C. loadings analyzed a one-dimensional T-beam Flyover. The same T-beam Flyover was examined as a three-dimensional structure in STAAD ProV8i for spans of 16m, 20m and 24m.

Analysis and Design of Foot Flyover Connecting (2nd Floors) of Block A and Block B of MIET, Jammu Akhil Sharma, Ashwani Kumar, Sunil Sharma, Arun Singh Chib, International Journal of Engineering Research & Technology (IJERT), May-2020

This project focuses on manual and software flyover design. QGIS and Theodolite survey the site using AutoCAD. STAAD.pro connect edition designs and analyses foot Flyovers.

Design and Analysis of Flyover, Bismi M Buhari International Journal of Engineering Research & Technology (IJERT), July-2021

Our project deals with design and analysis of flyover. The manual design of flyover consists of deck slab, longitudinal girder, cross girder, pier, pier cap, abutment, pile cap and pile based on code such as IS: 456-2000 and IRC: 21- 2000. Here the structural analysis is carried out by using STAAD Pro V8i software.

DESIGN AND ANALYSIS

Rectangular column having axial force (1.5mX1.5m) 4323.8 KN and Round Column (2.5M dia) Axial force 5204.8KN So for double deck bridge rectangular column fail due to for shear reinforcement so we can used round shape column instead of rectangular column.

Bending moment and Shear force value is nearly same on frame structure for IRC loading.

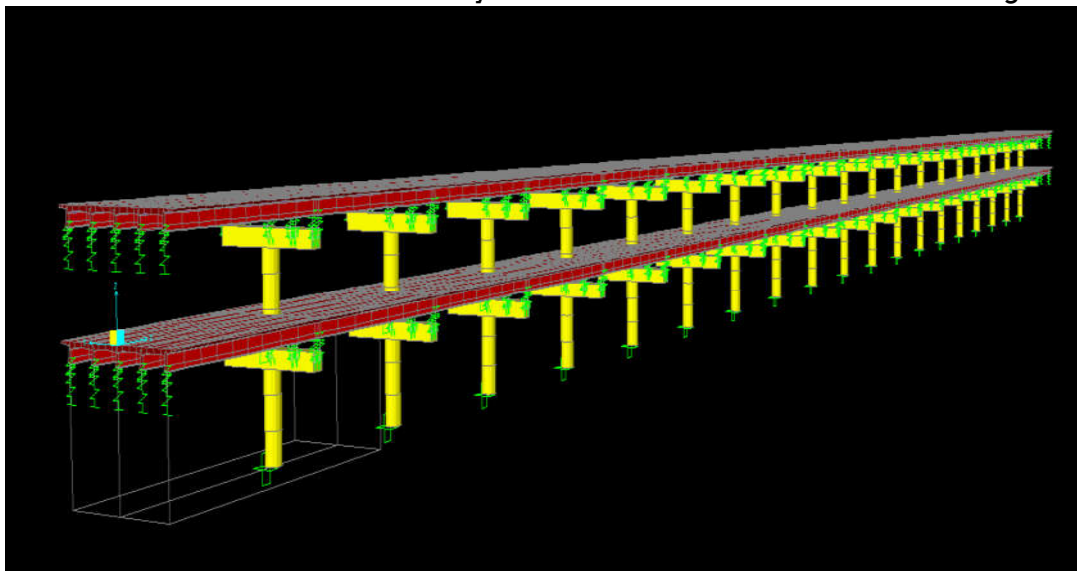


Figure1.2: 3D View Model of Flyover

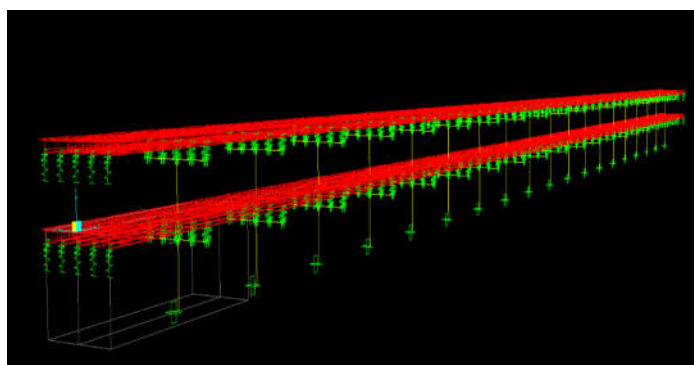


Figure1.3: 3D View Bridge Model with reactions applied

The program was tested in a case study. A first 3D model of the bridge was created, followed by several possible alternative solutions. The initial solution is a solid slab cross section with constant height, and the alternative options are as follows:



A slab cross section with longitudinal linear height variation and parabolic height variation;
T-beam cross section with constant height, longitudinal linear height variation and longitudinal parabolic height variation.

The programmed lets engineers consider any longitudinal or transverse pile form. The program's adaptability aids aesthetic research. Parametric computer programming swiftly generates the overpass's 3D model and several different solutions. Thus, it helps users assess the aesthetics of overpasses, compare options, and choose the best one. Starting with a global study of all possible answers, eliminating some of them, and then examining a smaller set of alternatives in more depth should be the modelling process. This lets you choose the solution that gives the structure a good rhythm and continuity.

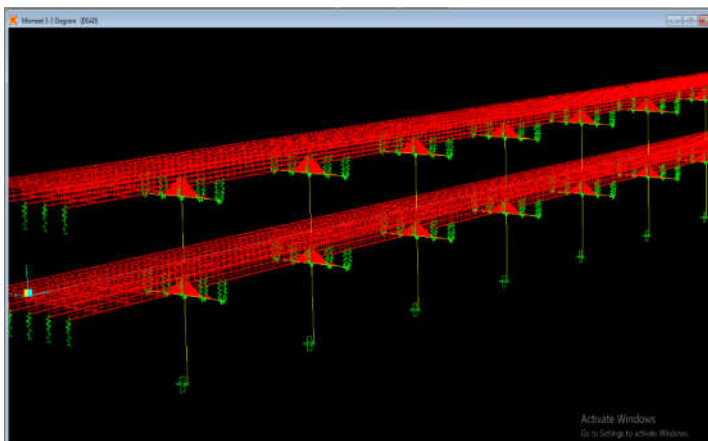


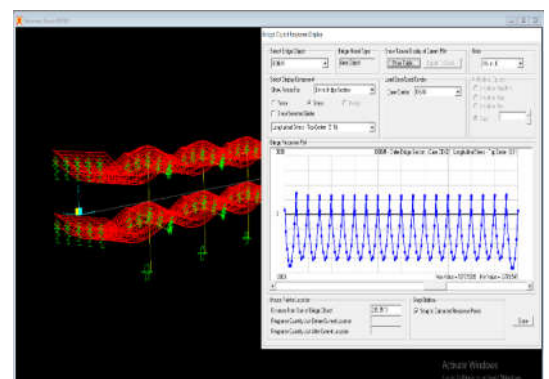
Figure1.4: Bending moment diagram 3D view

Under the action of the prestressed CFRP plate, the bending moment of a simply supported girder bridge is uniformly distributed between the anchor points of each span and the bending moment

$$M = M_c ,$$

the reinforcing of each span will not interact, as shown in Fig.

The vehicle is modelled as a moving concentrated load, and vibration caused by the vehicle is analyzed using numerical simulation. The girder's longitudinal displacement response characteristic is then determined, revealing the mechanical process behind the suspension bridge's girder's longitudinal movement brought on by moving load. However, because the effects of vehicle-bridge coupling and random vehicle flow are disregarded, the numerical results cannot be directly transferred to practical projects. In light of this, future research will focus on more trustworthy girder longitudinal



displacement.

(longitudinal stress diagram, max and min)

(Bridge response due to loading

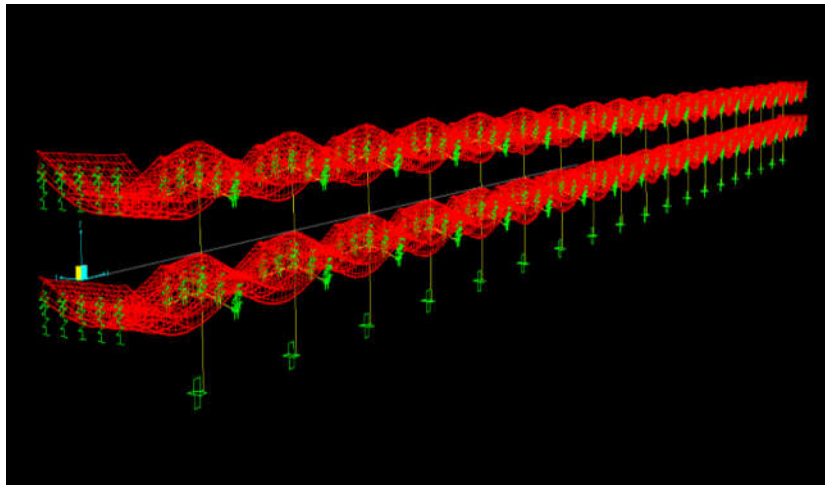


Figure1.5: Displacement due to all Loading

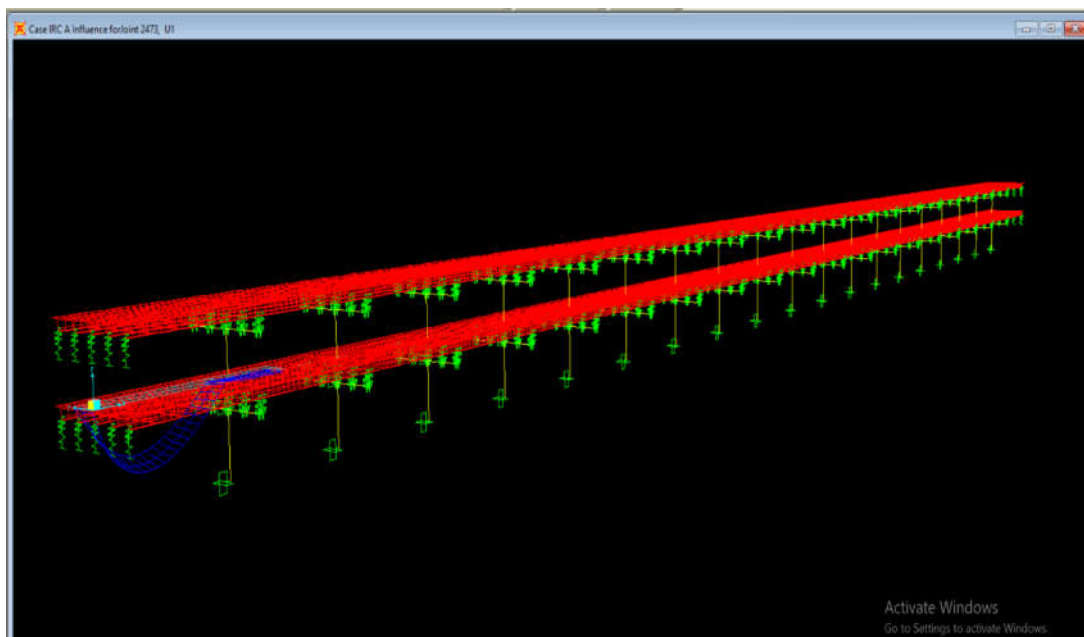


Figure1.6: Influence line diagram for Gider Flyover

Bridge decking supports static and moving loads. Worst-case bridge members must be built. Live loads create disasters. Member critical roles vary. "Influence lines" determine severe loading conditions.

An influence line shows a section or girder member's shear force or bending moment as a unit load passes over the span. The structure's ordinate of influence line shows that function with unit load. Influence lines calculate load force, moment, and shear in a structure.

Statically determinate structures have straight influence lines. Indeterminate structures don't. Shear or bending moment diagrams demonstrate structure-wide variation for fixed loads. Shear or moment impact lines indicate how a unit load travelling from end to end affects that reaction at one segment. Next, static influence lines are assessed.

A unit force is placed at various locations and the shear force at sections 1-1 is obtained for each position of the unit load. These values give the ordinates of influence line with which the influence line diagram for

shear force at sections 1-1 can be constructed. Note that the slope of the influence line for shear on the left of the section is equal to the slope of the influence line on the right of the section. This information is useful in drawing shear force influence line in all cases.

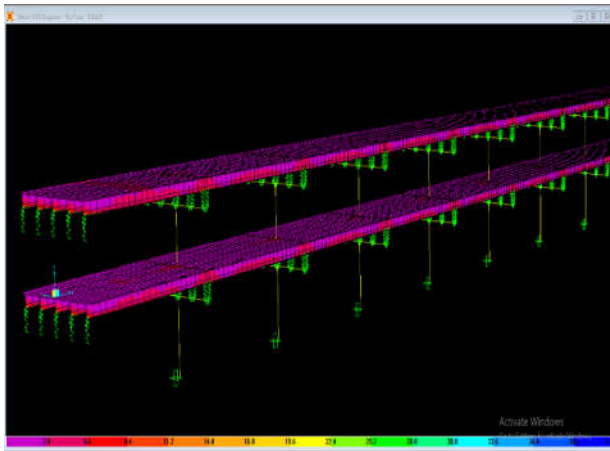


Figure 1.7: Shear Stress on Plate Girder

The maximum shear force is found as 362 KN at section 1, which is placed at the distance of 0.15m from face of girder. The maximum bending moment is found as 2350 KN-m at section 11, which is placed at a distance of 14.25m from the face of the girder

RESULTS AND DISCUSSION

Auto-Seismic – IS1893:2002

Table 1.1: Auto Seismic - IS1893:2002							
Load Pat	Dir	Z Code	Soil Type	I	R	T-Used	Base Shear
Text	Text	Text	Text	Unitless	Unitless	Sec	KN
EX	X	0.36	II	1	5	0.5948	15455.706
EY	X	0.36	II	1	5	0.5948	15455.706

Table 1.2: Base Reactions			
Output-Case	Step-Type	Global-FZ	Global-MY
Text	Text	KN	KN-m
DEAD		187764.593	-37488753
IRC A	Max	5040	0
IRC A	Min	0	-146186.656
IRC	Max	554	0
IRC	Min	0	-12445.0489

Table 1.3: Modal Periods and Frequencies				
StepNum	Period	Frequency	CircFreq	Eigenvalue
Unitless	Sec	Cyc/sec	rad/sec	rad2/sec2
1	0.826176	1.2104	7.6051	57.838

2	0.813783	1.2288	7.721	59.613
3	0.792242	1.2622	7.9309	62.899
4	0.761076	1.3139	8.2557	68.156
5	0.720841	1.3873	8.7165	75.977
6	0.673431	1.4849	9.3301	87.051
7	0.621736	1.6084	10.106	102.13
8	0.594794	1.6813	10.564	111.59
9	0.568896	1.7578	11.045	121.98
10	0.549593	1.8195	11.432	130.7
11	0.51759	1.932	12.139	147.36
12	0.493494	2.0264	12.732	162.1

force act on entire section plus all girders				
Bridge object response Display (due to loading)				
1	Maximum Shear Vertical			2074.74
2	Maximum longitudinal stress (Top centre)			1077.54
3	Maximum Longitudinal stress (Bottom left)			6957.8
4	Max moment about horizontal axis			8060.01
5	max moment about vertical axis			385.81

CONCLUSION

- This structure will be reducing the traffic control and enhances the safe driving.
- The structure will be designed as per IRC class loading.
- This project helps to improve the urbanization of rural areas
- Also facilitate the connection of various system of road such as village road, state highway, national highway etc.
- This project concludes with planning, design, and analysis of a fly over.
- Based on study area flyover construction is best and economically low cost which is essential at National Highway NH which is always busy with traffic moment. Located at Solapur junction in Hyderabad Naka, Maharashtra, India.
- The maximum flow of traffic is along National Highway NH64 which includes transportation of agricultural goods and industrial goods, so path chosen for the execution of flyover is along at National Highway NH65.
- Construction of this structure at that junction results in the traffic control and enhances safe driving.

- Analysis of proposal of Prestressed concrete bridges are carried out using relevant IRC codes and IS codes
- For self-weight of girder condition: The maximum shear vertical force is found as 3315.51 KN at U Girder Bridge. The maximum bending moment is found as 6831.26 KN-m from the face of the girder.
- For self-weight of girder condition: The maximum
- shear vertical force is found as 2074.74KN at I Girder Bridge. The maximum bending moment is found as 8060.01 KN-m from the face of the girder.
- Maximum Longitudinal Stress at top in I girder 1077.54 and U girder 607.54 mpa and at bottom side 6957.8 and 2962.67 mpa which show that in I girder more stress due to loading as compare.
- Structure is designed based on IRC class A and IRC 70R loading. IRC Loading is only applied for justification of bridge girder analysis.
- Amount of steel provided in U Girder Bridge as comparative to I girder the structure is economic.
- In this comparative analysis it is clearly stated that u Girder Bridge is more stable in resisting load. But it is also concluded that in terms of cost U girder is more costly comparative to I girder.

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