Design of double stage flyover with different types of load and problems occur in design with SAP2000

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Abstract— the principle objective of this project is to design and analysis Six lane flyover using SAP2000. The flyover is of 15m lengthwith width of 15.5m. The diameter of the pier is about 2.5m and theBeams are of I-section. The height of the columns is 4.2m. The Flyoverhas a road width of 15.5m (6lanes), in which 0.5m is of median. It also consists of footpath of 2m width. In the post processing mode after completion of the design we have worked on the structure and studied the bending moment and shear force values.

Key Words: Fly over, design parameters, bending moment shear force, post processing, SAP2000

INTRODUCTION

It is generally assumed that the flyover is related to the Flyover constructed over road or railway tracks as how they are often couldbe seen in order to deal with heavy traffic. The construction is not limited to that alone, rather it is advantageous to conduct other activities under the construction if the spaces also as they are left empty. High-rise structures might get damaged due to over man- made loads. There are flyover collapses occurring while construction, due to the instability of the substructure. Construction of newer ones in the place of previous ones may lead to economic loss. Repairing/maintaining the damaged structure, though essential, building of such structures with longer life span is also unavoidable.

The difference between Flyover and Flyover is based on the purpose of its usage and the location where it is built. Flyovers are built to connect two points separated by a naturally occurring region like valley, river, sea or any other water bodies, etc. Flyoveris built to connect two points in congested areas or roads and intersection of roads. Flyover and flyovers are structures providing passage over an obstacle without closing the way beneath. The required passage may be for a road, railway or a valley. Flyover design is a complex problem, calling a creativity and practicability,while satisfying the basic requirement of safety and economy. The basic design philosophy governing the design is that a structure should be designed to sustain, with a defined probability, all action likely to occur within its intended life span. In addition, the structure should maintain stability during unprecedented action and should have the adequate durability during its life span.

India has a rich history of steel Flyovers and flyovers. These are generally road flyover over low terrains or roads or intersection joining long distance through single span or multiple span constructions. Steel Flyover and flyover are ideal solution for long spans, construction in hilly areas or terrain conditions. For the short and medium span Flyovers and flyovers Steel – concrete composite construction is gaining popularity. Some of steel Flyovers in India are about 100 years old and yet going steady, demonstrating the long life performance of steel Flyovers. In India due to high population density, most of the cities are saturated and traffic congestion is one of the major problems faced by these cities. Construction of flyovers is a solution to this problem. But construction of flyovers using R.C.C is time consuming, and will affect existing traffic and it has low seismic resistance. Construction of flyovers using steel sections can overcome these disadvantages, even though its initial cost is high. A flyover and Flyover has three main elements. First, the substructure (foundation) transfers the loaded weight of the Flyover and flyover to the ground; it consists of components such as columns (also called piers) and abutments. An abutment is the connection between the end of the Flyover and road carried by earth; it provides support for the end sections of the Flyover and flyover.

Types of Flyover

1. Railway crossing
2. Road crossing

Parts of Flyover
1.Super structure
2.Sub structure Super structure
The superstructure consists of the components that actually spanthe 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.

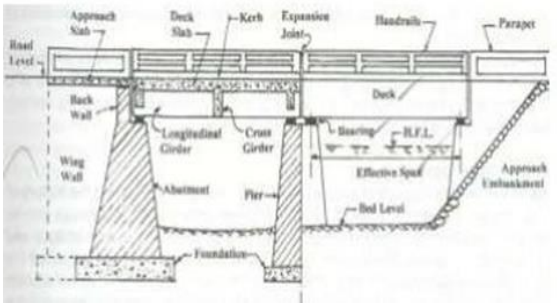


Fig1.1: Cross-section of fly overLoads on Flyover

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 whichpermanent 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 ClassA Loading. It is also necessary to eliminate the over Flyovers that remain futileand which pose a threat to the environment. The fact is that, their roles are productive at the beginning stage and as days go on, they lose their originality in the sense of reduction in their structural stability. In the construction of over Flyovers, loop/ square topologies were addressed to help in concluding which one suits more.

Proper planning is the most important thing and only after sufficient testing, the built structures must be left for service. Occurrence of problems is common when considering the oversized trucks into account. Smart systems were introduced which deliberately alarm when oversized vehicles head to the flyover. In this case, these vehicles are stopped for a while to pave way for other vehicles to leave from the Flyover in-order to avoid collision. Since this approach is costlier, computer aided mechanism replaces the previous one. Still, this system delays the vehicles and makes them wait.

So, an ideal flyover construction must be built that is strong enough to hold any number of huge vehicles that passes by. Vibro pile construction is elaborated where 318 piles are considered for analysis. It is stated that this type of pile foundation could be preferred for low-volume overpasses. Continuous flight auger piling system was used which is highly recommended in areas where the water table volume is more. Extensive studies and experiments are essential to verify its structural integrity by ensuring apt auger rotation. Furthermore, by economic means, it is not suitable for low budget constructions.

Flyover pier testing such as core and pull-out/off tests are conducted to determine the basic functionalities including thickness, elastic modulus, structural integrity, surface absorption, etc. From the case study of the T-beam girder made of concrete, it is found that the strength of the piers should have been improved by adding reinforcement or other means. [10] By the inclusion of reinforced concrete, occurrence of disintegration of structures because of beam-column interaction is preventable.

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 resultsin occurrence of accident in different instants of time.”

Aim

“Design of Double stage flyover with different types of load and problems occur in design with SAP2000”

Objectives

- 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 analyse 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.

Analysis and design of single pier double decker flyover byusing sap2000

- In Two Lane Rigid or Flexible pavement road of national highway the structure are 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 and four lane 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 be consist of 1 nos. 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 pilefoundation.
- Superstructure will be of segmental type consist of precastwing and precast spine beam, wearing coat.
- There will be also curve section span in flyover.

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 andtime lapse.
- We will also discuss the land which is saved due toconstruction 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)
- BEAM 1200mm x 2 m (Longitudinal Beam Along Z-axis)
- Deck Slab Thickness 400mm
- LOADING
- DEAD LOAD

4.1 Design of 3D View of Double Decker flyover

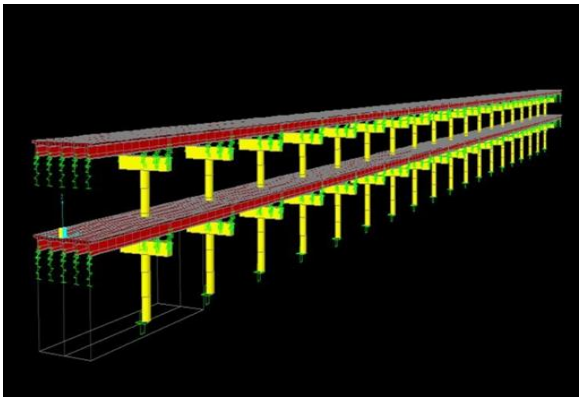


Figure1.1: 3D view of Model

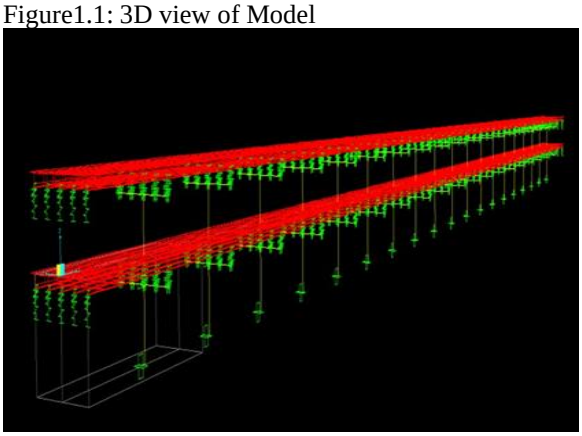


Figure1.2: 3D VIEW BRIDGE MODEL2

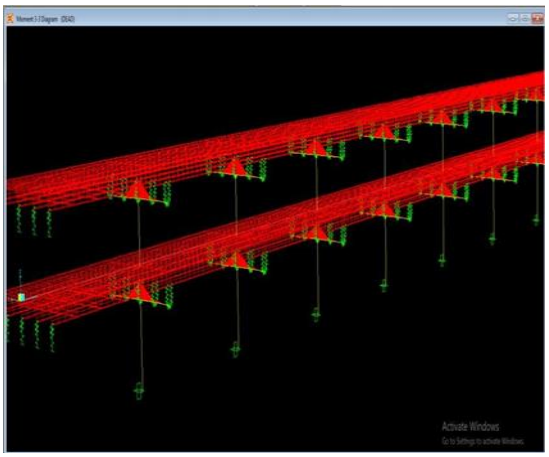


Figure1.3: Bending moment diagram 3D view

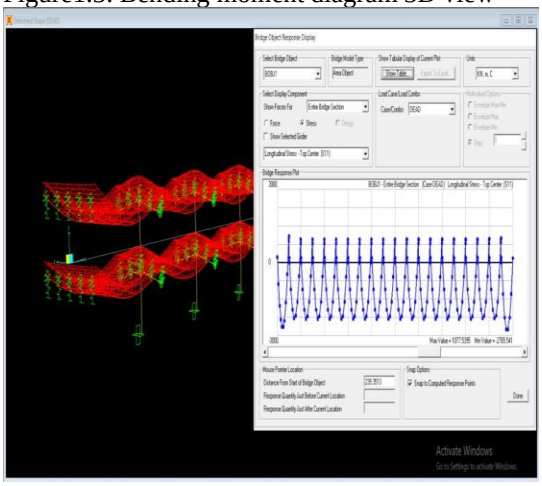


Figure1.4: Bridge response due to loading (longitudinal stressdiagram, max and min)

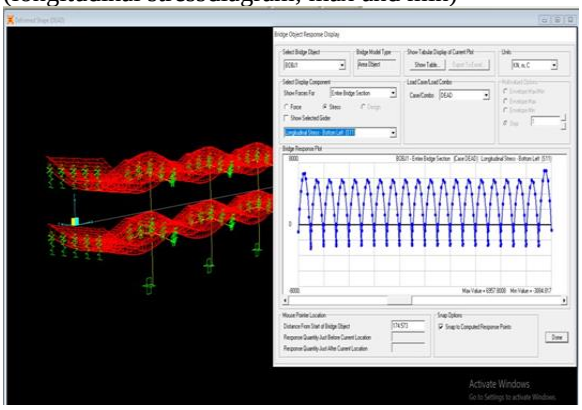


Figure1.5: Bridge response due to loading (longitudinal stressat bottom left side, max and min)

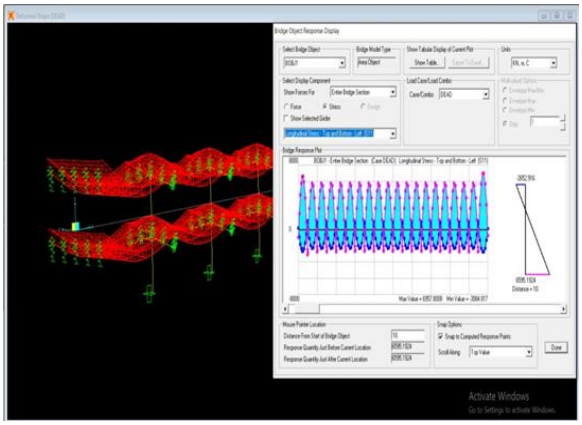


Figure1.6: bridge response due to loading (longitudinal stressat top and bottom left side, max and min)

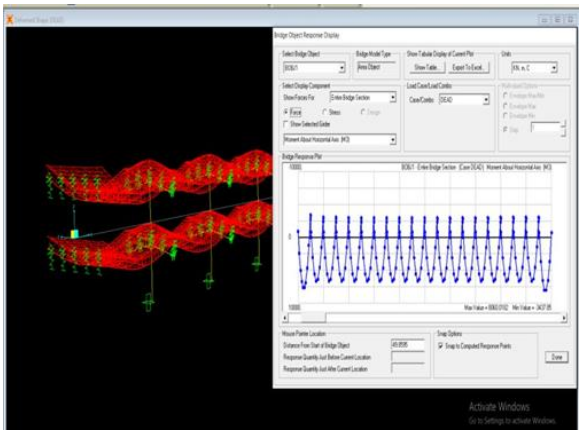


Figure1.7: bridge response due to loading (moment abouthorizontal axis diagram, max and min)

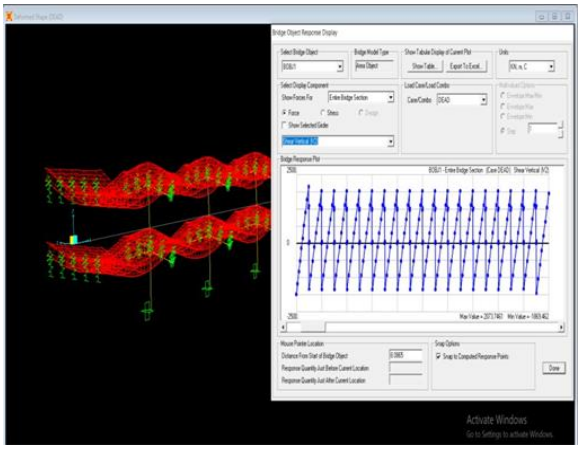


Figure1.8: Bridge response due to loading (Shear verticaldiagram, max and min)

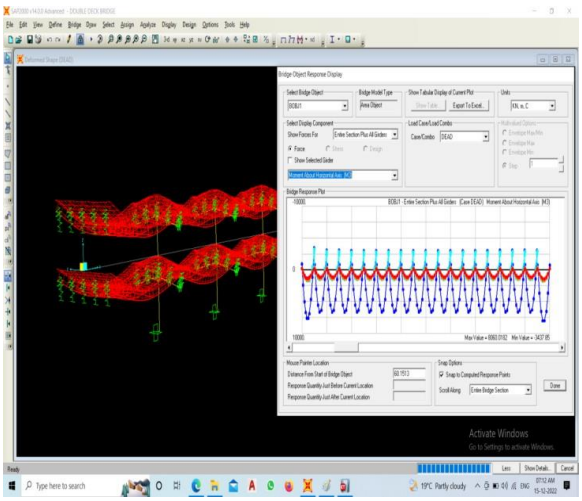


Figure1.9: Bridge response due to loading entire section plusall girder (moment about horizontal axis, max and min)

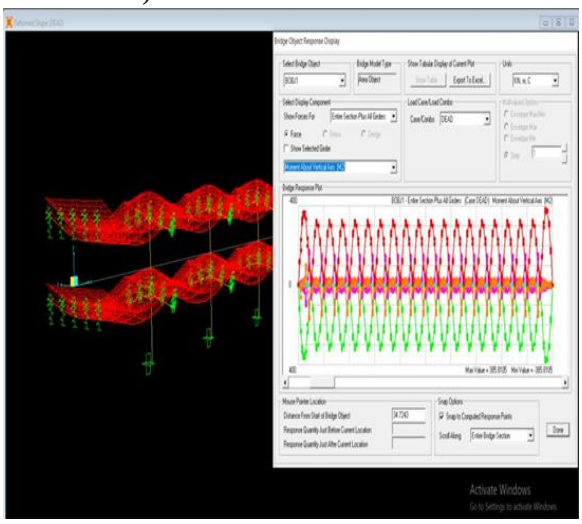


Figure1.10: Bridge response due to loading entire section plusall girders (moment about shear vertical, max and min)

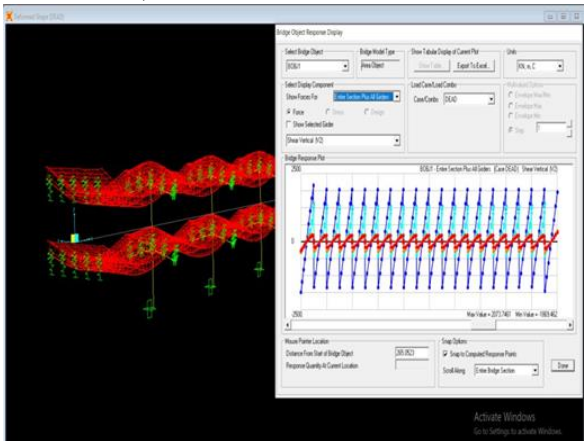


Figure1.11: Bridge response due to loading entire section plusall girder (shear vertical, max and min)

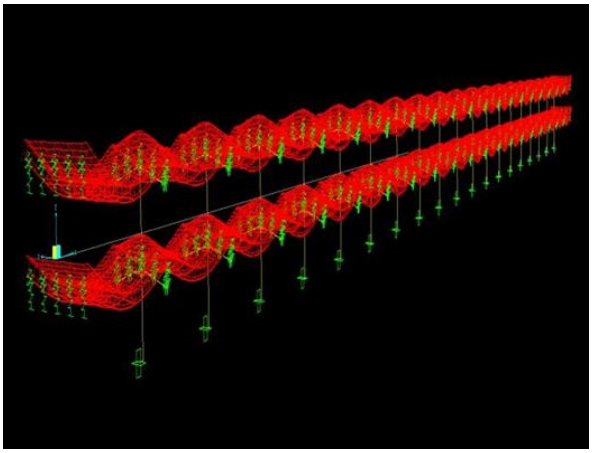


Figure1.12: Displacement due to all loading

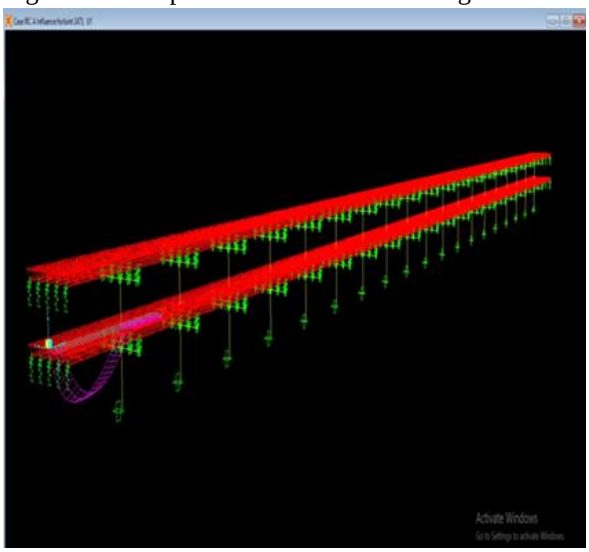


Figure1.13: Influence line diagram on frame due to moment

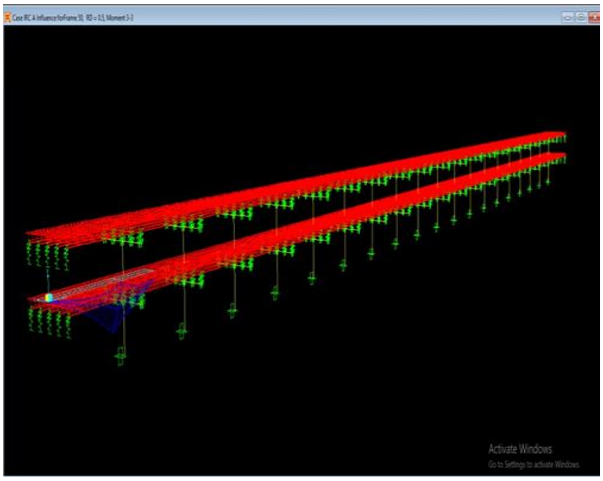


Figure1.14: Influence line diagram on frame

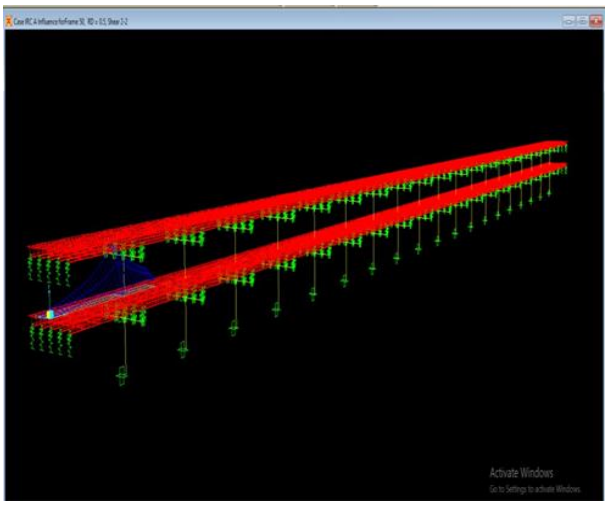


Figure1.15: Influence line diagram on shell due to IRCA loading

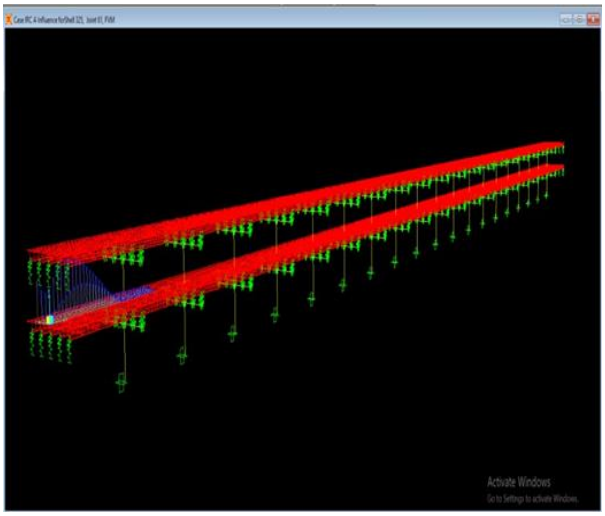


Figure1.16: Influence line diagram

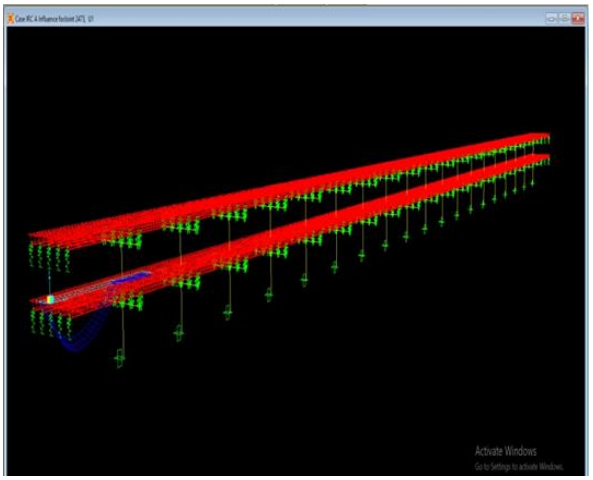


Figure1.17: Influence line diagram2

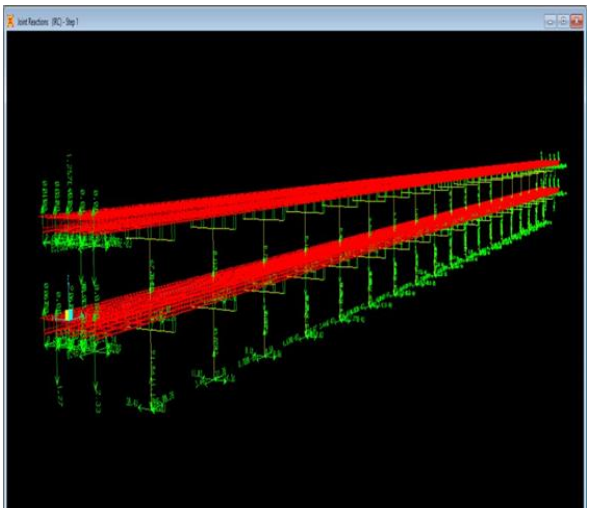


Figure1.18: Joint reaction due to IRC loading

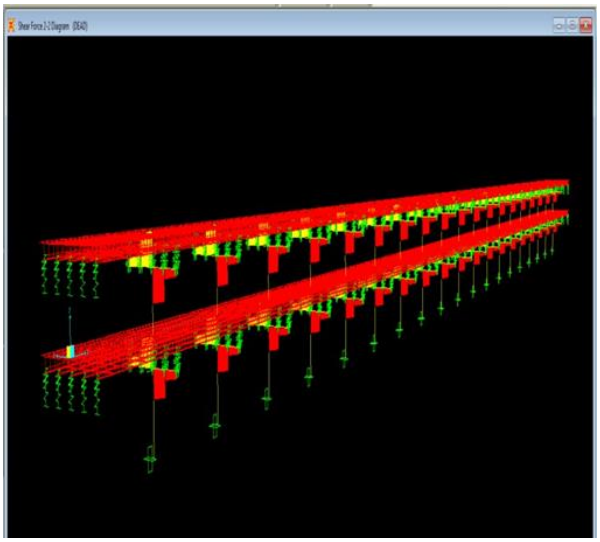


Figure1.19: Shear force diagram 3D view

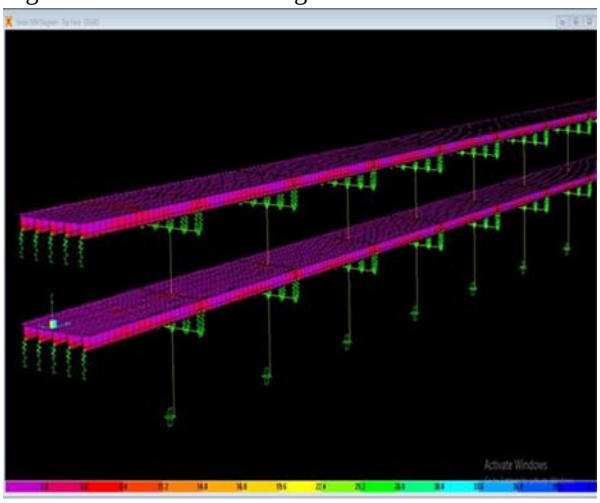


Figure1.20: Shear stress on plane (max and min value shown)diagram 3D view

SQUARE COLUMN RESULTS

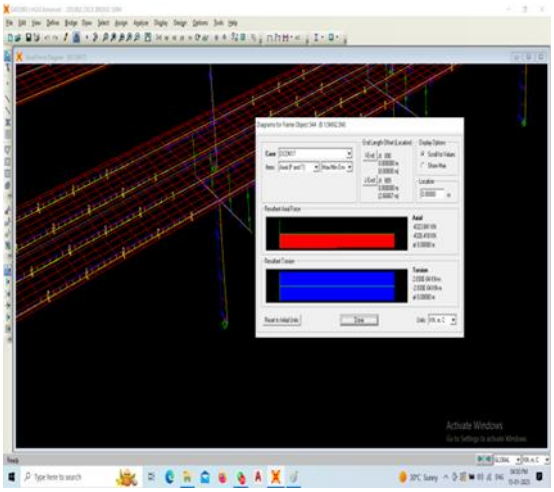


Figure1.21: Axial Force for Square Column

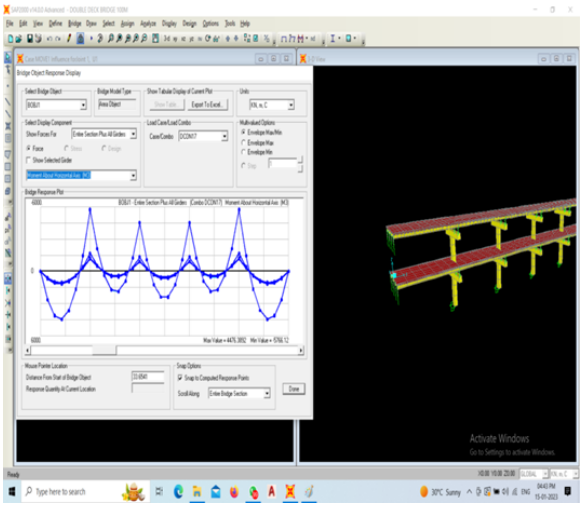


Figure1.22: Bending Moment for Square Column

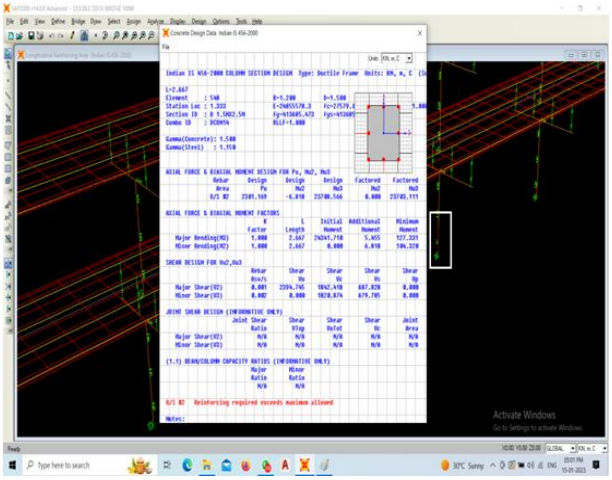


Figure1.23: Column Fail for Square Column

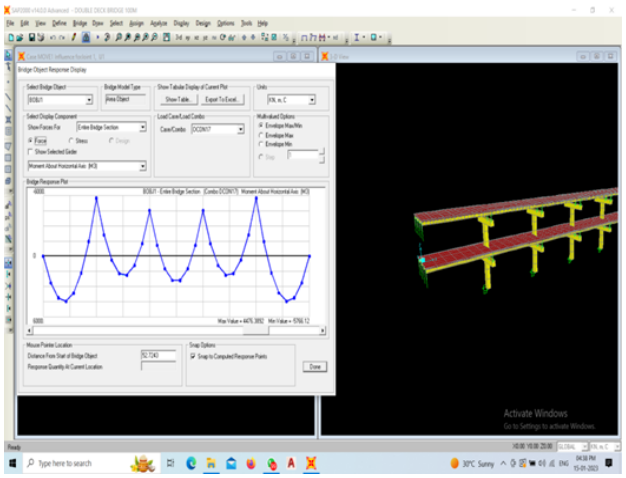


Figure1.24: Force for Square Column

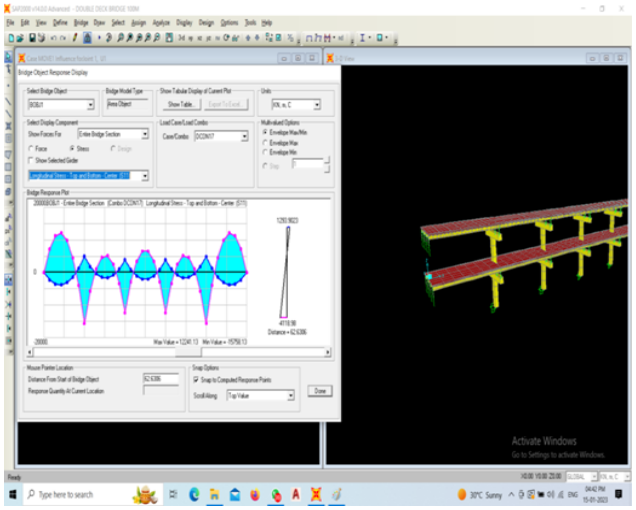


Figure1.25: Longitudinal Stress Top and Bottom

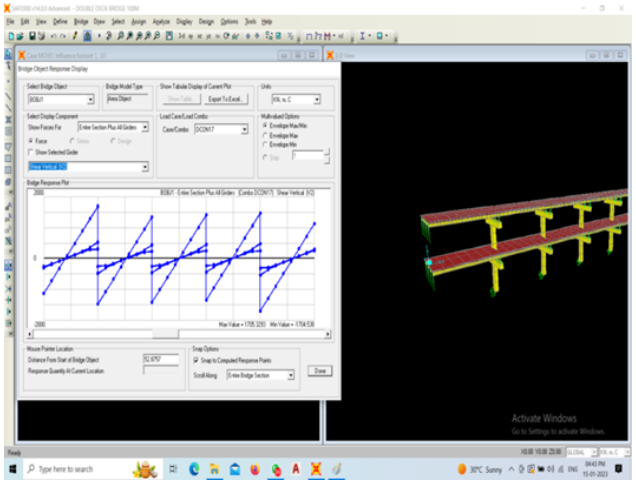
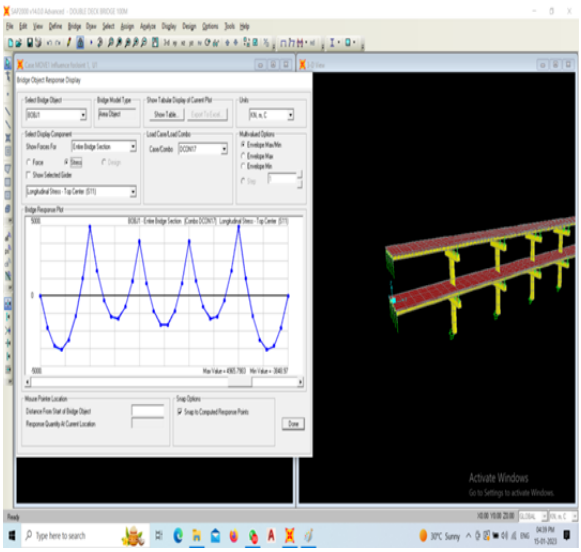


Figure1.26: Shear Force for Square Column



Figur1.27: Stress for Square Column

ROUND COLUMN ANALYSIS RESULTS

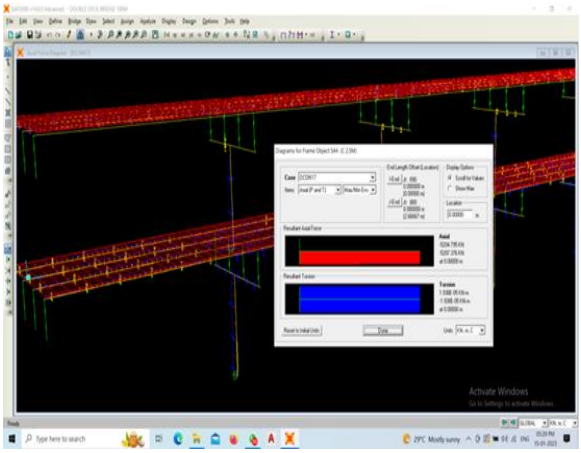


Figure1.28: Axial Force of round Column

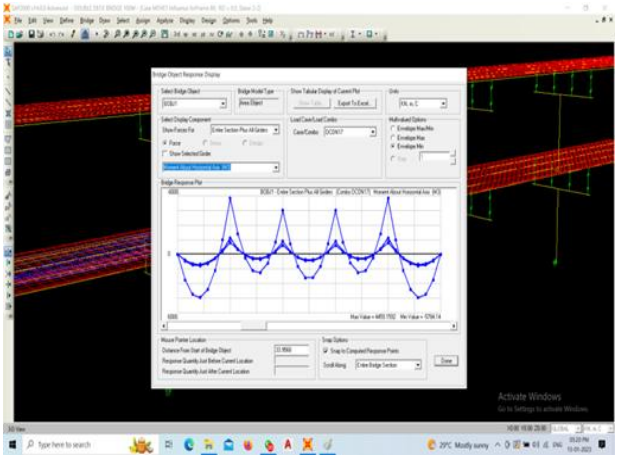


Figure1.29: Maximum Bending Moment

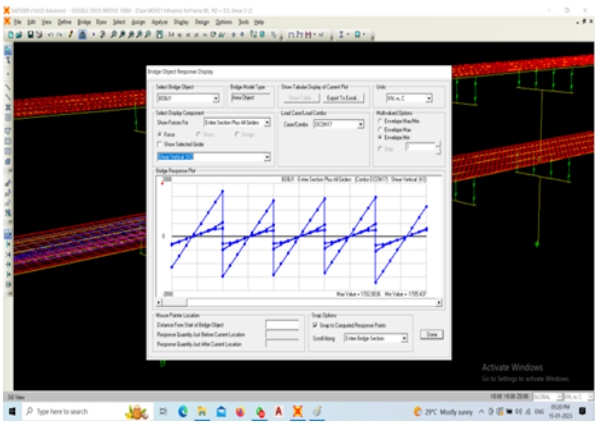


Figure1.30: Maximum Shear Force

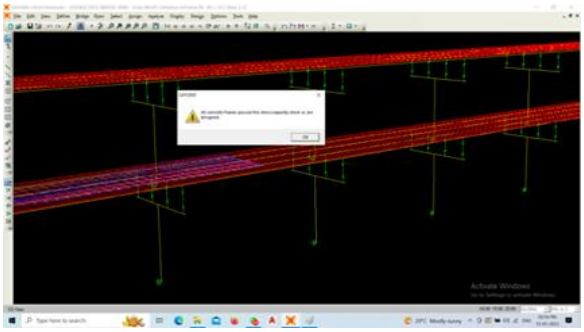


Figure1.31: All Column Passed of Round Column of Double Decker

CONCLUSION

- This project concludes the planning, analysis and design of flyover structures.
- This structure will be reduces the traffic control and enhancesthe 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 NH64which 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.

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