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Analysis and Design of Flyover by using Staad Pro

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Abstract - *The principle objective of this project is to design 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 of 204m length with 12 spans, 17m per each span. The diameter of the pier is about 1.6m and the Beams are of I-section. The height of the columns is 4.2m .The Flyover has a road width of 8m (2lanes), 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: **Staa.pro, Fly over , post processing**

1. INTRODUCTION

The world's first flyover was constructed and started in 1843 by the London and Croydon Railway at Norwood Junction railway station to carry its atmospheric railway vehicles over the Brighton Main Line. The first flyover in India was allowed access on 14 April 1965 at Kemps Corner in Mumbai. The 48-foot-long bridge was constructed in about seven months by Shirish Patel at a cost of ₹17.5 lakh.

A flyover is a construction built to span physical obstacles such as a body of water, valley, or road, for the purpose of providing passage over the obstacle. Designs of flyover vary depending on the function of the flyover, the nature of the terrain where the flyover is constructed, the material used for construction and the funds available to build it.

The flyover consists of number of spans with columns (piers), deck, and foundation etc. In order to construct a flyover all these elements are to be analysis and designed properly. For large construction this process of designing and analyzing become complicated when done manually time taking and sometimes lead to errors so in order to meet these problems software's are used. The computer software's are the ones which can perform this action of analysis and designing with minimum errors with in short period of time such that the designing of complex flyover become easier while using software's. Some of the famous software's which are generally used for analysis and designing of structure are ETABS, ROBOT STRUCTUREL ANALYSIS, STAADPRO.

A flyover has three main elements. First the substructure i. e foundation transfers the loaded 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 the end of the bridge and the road carried by the earth; it provides support for the end sections of the flyover. Second, the superstructure of the flyover is the horizontal platform that spans the space between columns. Finally, the deck of the bridge.

1.1 TYPES OF FLYOVER

1. Railway crossing
2. Road crossing

1.2 PARTS OF FLYOVER

1. Super structure
2. Sub structure

Super structure

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

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

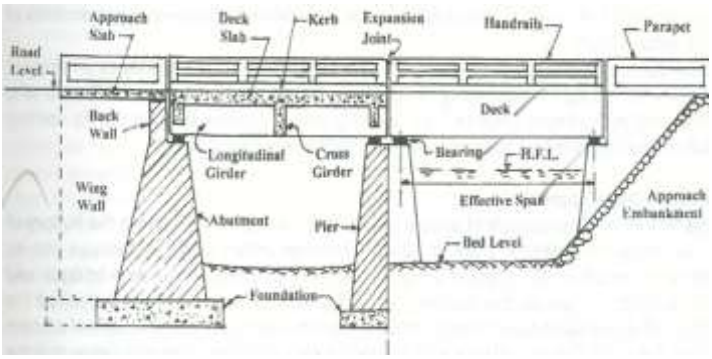

Fig -1: Cross-section of fly over

2. Parts of Fly over

APPROACH SLAB:

The approach slab provides a transition between roadway pavement and the flyover. The approach slab behaves as an intermediate flyover to span the portion of embankment directly behind the abutment/back wall which was excavated to construct the abutment/back wall

DECK SLAB:

A deck is the surface of a flyover sometimes the deck is covered a railroad bed and track, asphalt concrete, or other form of pavement for ease of vehicle crossing. A concrete deck may be an integral part of the flyover structure (T-beam or double tee structure) or it may be supported with I-beams or steel girders.

KERB:

Kerb is a component of a city road. A kerb (also termed as curb) is a vertical or sloping member provided along the edge of a pavement or Shoulder to give strength and protect the edge of pavement. It indicates the boundary between the pavement and shoulder or sometimes island or footpath or car parking space

HANDRAILS:

A handrail is designed to grasp by the hand so as to provide stability or support. Handrails are commonly used while ascending or descending stairways and escalators in order to prevent injurious falls. Handrails supported by posts or mounted directly to walls.

BACK WALL:

Back walls are the vertical walls at the ends of most flyover that extend up from the abutment seats and support the expansion joint. Back walls are small retaining walls which also support the approach slabs and hold back the embankment under the approach slabs.

WING WALL:

In a flyover the wing walls are adjacent to the abutments and act as retaining walls. The wing walls are generally constructed of the same material as those of abutments. The wing walls may be independent or can be attached to abutment.

LONGITUDINAL GIRDER:

A girder bridge uses girders for supporting the girder. Because of the properties of inertia, the height of a girder is the most significant factor to affect its load capacity.

BRIDGE BEARING:

A bridge bearing is a component of a flyover which typically provides a resting surface between flyover piers and the bridge deck. Bearing is provided to control movement and thereby reduce the stresses involved.

3. TYPES OF BRIDGE DECKS:

1. Solid Slab deck
2. Beam deck
3. Voided slab deck
4. Cellular deck
5. Discrete box deck

Beam and slab composite deck

SOLID SLAB DECK:

This type of bridge deck is the most cost efficient for shorter span less than20 meters. Bridge deck can be built with or without cantilever Bridge deck with cantilever has less weight with less reduction on second moment of area. Solid deck can be simply constructed in-situ concrete and pre-cast concrete form.

In this project we used solid slab deck

SUB STRUCTURE:

The sub structure consists of all of the parts that are mentioned above that support the super structure. The main components are abutments, Piers, footings and piling.

ABUTMENTS:

In engineering, abutment refers to the substructure at the ends of a bridge span or dam whereon the structure's superstructure rests or contacts.

PIERS:

A pier is a raised structure in a body of water, typically supported by well-spaced piles or pillars.

4. LOADS 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 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

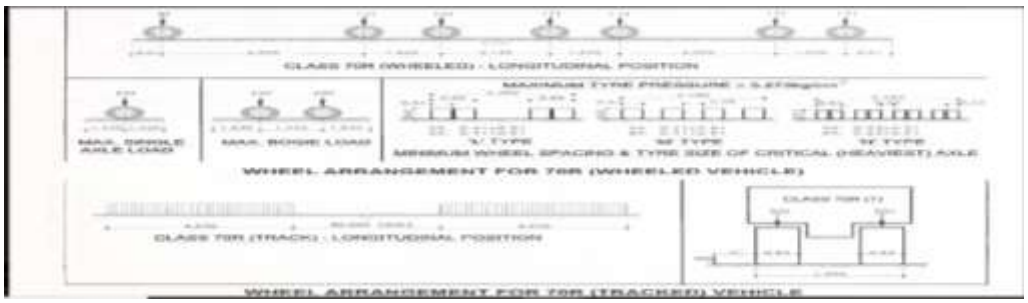

Fig -2: Wheel Arrangement For 70R (Tracked) Vehicle

5. List of software's used:

1. STAAD.pro (v8i) 2. STAAD. Beava 3. STAAD .Foundation

6. Design:

6.1DESCRIPTION OF PLAN:

The flyover is of 204m length with 12 spans, 17m per each span. The diameter of the pier is about 1.6m and the Beams are of I-section. The height of the columns is 4.2m .The Flyover has a road width of 8m (2lanes), in which 0.5m is of median. It also consists of footpath of 2m width. The location of the project is at velagapudi Ramakrishna Siddhartha Engineering College (KANURU- VIJAYAWADA), which is facing major traffic problems.

6.2STATEMENT OF PROJECT:

Length of flyover	: 204m
Number of spans	: 12 spans
Number of girders	: 4 longitudinal girders and 2 end girders in each span
Types of foundation	: open foundation
Footings	: isolated footing
Type of wall	: earthen wall
Length of each span	: 17m
Diameter of pier	: 1.6m

6.3Materials:

Concrete grade	: M30 (for slabs)
	: M40 (isolated footing)
Grade of steel	: Fe 500

6.4GEOMETRY:

Fig -3: GEOMETRY

6.5BRIDGE DECK:

Fig -4: BRIDGE DECK

6.6 DESIGN PROCEDURE:

The combination of STAAD.pro and STAAD.beava can make our bridge design and analysis easier. By using STAAD.pro construction of bridge geometry is done and by using STAAD.beava AASHTO 2002 load positions can create the maximum load response.

The max load response could be any one of the following:

1. Max plate stresses, moment about the local x axis of a plate (Mx), moment about the local y axis of a plate (My) etc. are used for design of concrete deck reinforcement.
2. Max support reactions to design isolated, pile cap, and open foundations.
3. Max bending moment or axial force in a member used to design members as per the AASHTO code.
4. Maximum deflection at mid span.

These loads that create the maximum load responses can be transferred into STAAD.pro as load cases to load combinations for further analysis and design. Figure shows the bridge design procedure discussed above.

Fig -4

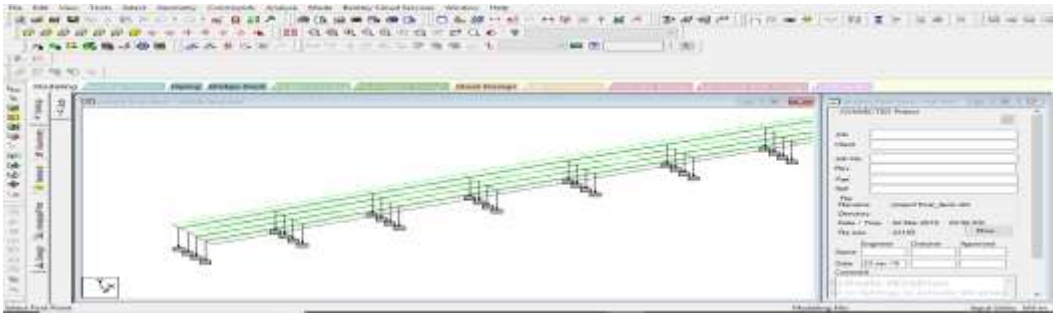

Fig -5

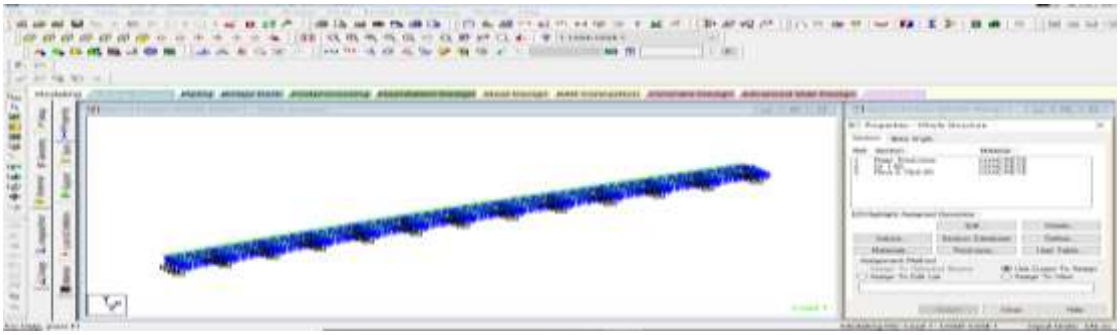

Fig -6

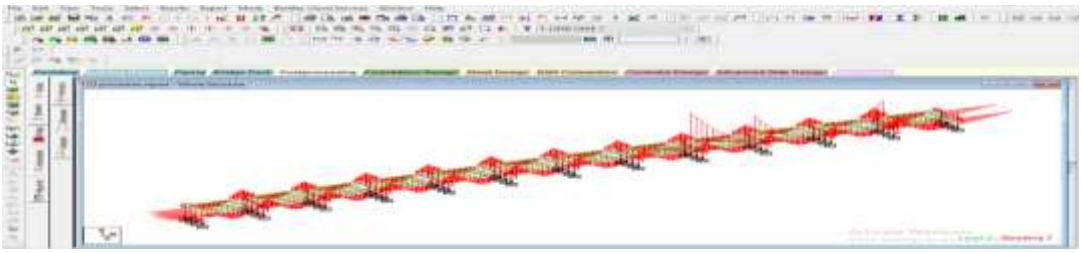

Fig -7

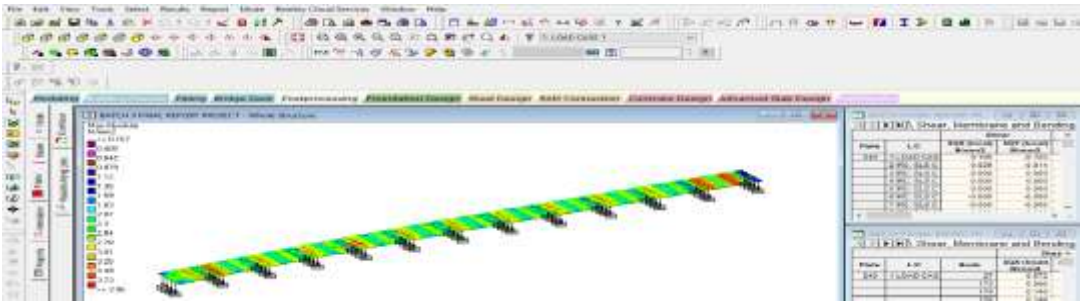

Fig -8

7. FOUNDATION DETAILS:

Foundation is the part constructed under the pier or abutment and over the underlying soil or rock. The loads transmitted by the foundation to the soil must not cause soil shear failure or damaging settlement of the superstructure.

ISOLATED FOOTING: The footings are designed as isolated footings .As isolated footings are meant for single columns.

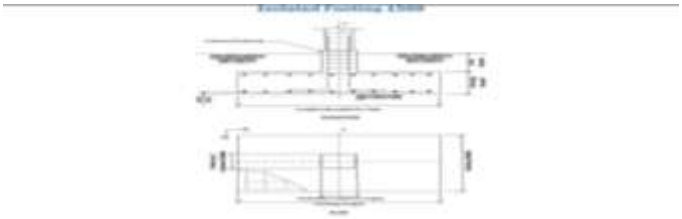

Fig -8 Figure showing the foundation Details

8. CONCLUSIONS:

1. This project concludes the, analysis and design of flyover by using STAAD pro and STAAD. Beava.
2. The location of the flyover is Velagapudi Ramakrishna Siddhartha Engineering College (Kanuru Vijayawada, Andhra Pradesh).
3. STAAD.pro in combination with STAAD.beava can be used to analyze bridges as per the IRC code. By using STAAD.pro construction of bridge geometry is done and by using STAAD.beava AASHTO 2002 load positions can create the maximum load response. .
4. These loads that create the maximum load responses can then be transferred into STAAD.pro as load cases to load combinations for further analysis and design. Similarly we can use this design method for design of concrete members, slab elements and foundations
5. Rectangular cross sections are provided for four longitudinal girders.
6. The structure is designed as per IRC class 70R loading.
7. Isolated footing is done by each pier.

Total volume of concrete = 1137.5 CU.METER
Total amount of steel = 508089 IN NEWTONS

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