ANALYSIS OF METRO BRIDGE BY VARYING COLUMN DISTANCE COMPARISION WITH STAD USING E- TABS

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ABSTRACT

A metro system is a railway transport system in an urban area with a high capacity, frequency and the grade separation from other traffic. Metro System is used in cities, agglomerations, and metropolitan areas to transport large numbers of people. An elevated metro system is more preferred type of metro system due to ease of construction and also it makes urban areas more accessible without any construction difficulty. An elevated metro system has two major elements pier and box girder. The present study focuses on two major elements, pier and box girder, of an elevated metro structural system. Conventionally the pier of a metro bridge is designed using a force based approach. During a seismic loading, the behaviour of a single pier elevated bridge relies mostly on the ductility and the displacement capacity. It is important to check the ductility of such single piers. Force based methods do not explicitly check the displacement capacity during the design. The codes are now moving towards a performance-based (displacement-based) design approach, which consider the design as per the target performances at the design stage. Performance of a pier designed by a Direct Displacement Based Design is compared with that of a force-based designed one. The design of the pier is done by both force based seismic design method and direct displacement based seismic design method in the first part of the study.

Keywords: *Elevated Metro Structure, Bridge Pier, and Box Girder Bridge, Based Seismic Design, Force Based Design.*

1. INTRODUCTION

OVERVIEW:

A metro framework is an electric traveler railroad transport framework in a urban zone with a high limit, recurrence and the level partition from other activity. Metro System is utilized as a part of urban communities, agglomerations, and metropolitan territories to transport huge quantities of individuals at high recurrence. The review division enables the metro to move unreservedly, with less intrusions and at higher general paces. Metro frameworks are regularly situated in underground passages, hoisted viaducts above road level or level isolated at ground level. A hoisted metro auxiliary framework is more favored one because of simplicity of development and furthermore it makes urban territories more open with no development trouble. A raised metro basic framework has the favorable position that it is more financial than an underground metro framework and the development time is considerably shorter.

METRO SYSTEMS:

A metro framework is an electric traveler railroad in a urban zone. Qualities of a metro framework are the high limit and recurrence at which it transports individuals and the review division from other movement. The review division enables the metro to move unreservedly, with less interferences and at higher general rates. Besides, there are less clashes between activity developments, which diminish the quantity of mischances, making it a more secure approach to travel. Level partition for metro frameworks is acknowledged by setting it in underground passages, hoisted above road level or level isolated at ground level. Frequently a metro framework is a mix of these three choices. Next to the conventional metro utilizing electric different units on rails, these days one can discover additionally a few frameworks utilizing attractive levitation or monorails. By changing the limit of the trains, the recurrence and the separation between the stations, minor departure from conventional metros like individuals movers and light metros have showed up. In the meantime, innovative enhancements have permitted new driverless lines and frameworks. With every one of these varieties in metro frameworks it is once in a while hard to decide to what sort a framework has a place. In spite of every one of these varieties, they have in like manner that they are executed increasingly as raised railroads in thick urban territories.The execution evaluation of chose composed wharf demonstrated that, Force Based Design Method may not generally ensure the execution parameter required and in the present case the dock just accomplished the objective required.

The choice between cast-in-situ and precast segmental is reliant of undertaking highlights, site conditions, ecological and open limitations, development time and accessible hardware. Table records the scope of utilizations of some pre focused on box brace connects by traverse length. The high torsional resistance of the case support makes it especially appropriate for bended arrangements.

TABLE 1.1 RANGE OF APPLICATION OF SOME PRE STRESSED BOX GIRDER BRIDGES BY SPAN LENGTH

SPAN (M)	BRIDGE TYPE
30-91	Cast –in-situ post tensioned box grinder
30-91	Pre cast –balanced cantilever segmental constant depth
61-183	Pre cast –balanced cantilever segmental variable depth
61-305	Cast- in – situ cantilever segmental

2. METHODOLOGY

STUDY AREA:

Hyderabad is a umber city that spreads 625 sq. km. of metropolitan organization range and 6852 sq. km. of metropolitan range. It is quick rising as the centre of IT, Biotech, Parma and Tourism area. Its vital geological area, multilingual and cosmopolitan culture, enormous development potential and speculation amicable monetary arrangement are on the whole making it an alluring goal for corporates, business people, academicians and homemakers alike. The expanding weight of the blossoming populace is putting Hyderabad's Transportation System under consistent weight. The need of great importance is a strong framework that is trustworthy, agreeable, reasonable and maintainable. Its populace remains at 8 million and is anticipated to touch 13.64 million by 2021. As of now, more than 2.8 million customized vehicles handle on Hyderabad streets, with an expansion of 0.20 million vehicles consistently. 8 million mechanized excursions are made each day, of which, just around 3.36 million or 42% are made by the Public Transportation System (PTS) i.e., transports and neighbourhood trains. That implies whatever is left of the outings are made by individual vehicles prompting movement bottlenecks, high contamination levels and a lofty increment in fuel utilization.

Hyderabad Metro Rail Limited is the Government Enterprise, which had started the Metro rail venture for Hyderabad. The Project was distributed to L&T organization in Public Private Partnership (PPP) mode. Metro Rail was endorsed for 71.16 km., covering three high thickness activity passages of Hyderabad. The Metro Rail

System has turned out to be the most proficient regarding vitality utilization, space inhabitancy and numbers transported The venture gives a thought regarding the examination and plan of metro Bridge utilizing IRC Loading 70R by E-TABS Here the model is being outlined according to IRC 70R stacking which is appropriate on all streets on which the changeless extensions and ducts can be built. Investigation and Design process by E-TABS decides the execution of Structures. The outlining by the product spares the plan time and by thusly we can check the security of the structure effectively.

TYPES OF BOUNDARY ELEMENTS:

Choosing the best possible limit condition has a vital part in basic examination. Viable displaying of help conditions at direction and development joints requires a watchful thought of congruity of each translational and rotational part of dislodging. For a static examination, it is normal to utilize a less difficult supposition of backings (i.e. settled, stuck, roller) without considering the dirt/establishment framework solidness. However for dynamic examination, speaking to the dirt/establishment solidness is fundamental. Much of the time picking a [6×6] solidness grid is satisfactory. For particular tasks, the nonlinear displaying of the framework can be accomplished by utilizing nonlinear spring/damper. Some Finite Element projects, for example, have more capacity for demonstrating the limit conditions than others.

TYPES OF LOADS:

There are two sorts of burdens in an extension outline: Permanent Loads: Loads and powers that are thought to be either endless supply of development or fluctuating just finished quite a while interim Such loads incorporate the self - weight of structure components, wearing surface, checks, parapets and railings, utilities, secured drive, optional powers from post tensioning, constrain impact because of shrinkage and because of crawl, and weight from earth confinements Transient Loads: Loads and powers that can differ over a brief span interim with respect to the lifetime of the structure Such loads incorporate gravity stacks because of vehicular, railroad and person on foot activity, parallel loads because of wind and water, ice streams, constrain impact because of temperature slope and uniform temperature, and power impact because of settlement and tremors.

Twisted:

On the off chance that the scaffold superstructure can be expected to move as an inflexible body under seismic load, the examination can be streamlined to displaying bents as it were.

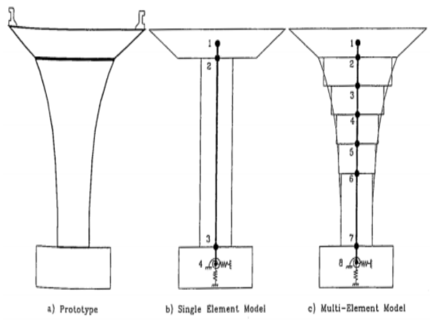


FIGURE 2.1: SINGLE COLUMN BENT MODEL

Outline components, viable twisting firmness, top with extensive torsional and transverse bowing solidness to catch superstructure, and powerful solidness for outriggers ought to be considered. Figure demonstrates single section twisted models.

The loading vehicle details are given:

Design Code = IRCChapter 3

Loading Class = Class 70R Loading

Max. Effect = 9.39626m

Unit of Length = m

Unit of Force = kN

Combination Factor =1

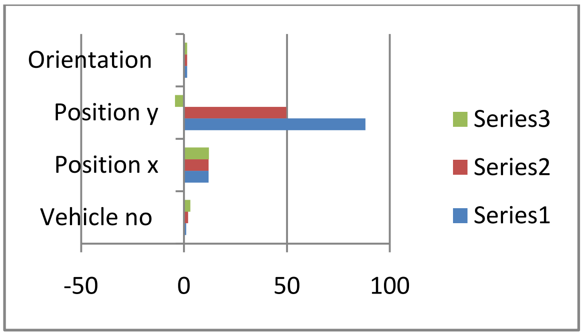
No. of Traffic Lanes = 6

TRAFFIC LANE NUMBER 1

Lane Factor = 1
The loading vehicle details are
Width = 2900
Front Clearance = 31675
Rear Clearance = 31675
No. of Axles = 3
Vehicles travel in the roadway direction
End Lane
Traffic Lane No. 2
End Lane
Traffic Lane No. 3
Lane Factor 1
The loading vehicle details are
Width = 2900
Front Clearance = 31675
Rear Clearance = 31675
No. of Axles = 3

TABLE 2.1 VEHICLES TRAVEL IN THE ROADWAY DIRECTION-1

Vehicle no	Position x	Position y	Orientation
1	3.9501	99.728	1.5708
2	3.95005	49.689	1.5708
3	4.05	0.650844	1.5708

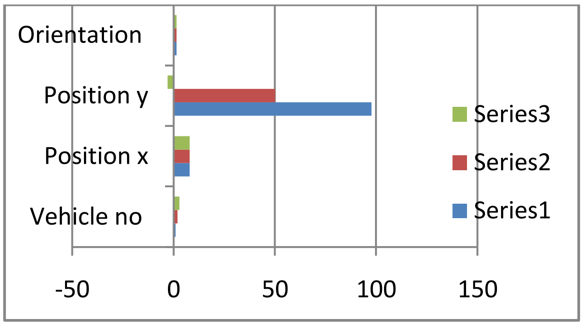


GRAPH 2.1: VEHICLES TRAVEL IN THE ROADWAY DIRECTION

End Lane
Traffic Lane No. 4
Lane Factor 1
The loading vehicle details are
Width = 2900
Front Clearance = 31675
Rear Clearance = 31675
No. of Axles = 3

TABLE 2.2: VEHICLES TRAVEL IN THE ROADWAY DIRECTION-2

Vehicle no	Position x	Position y	Orientation
1	8.0501	97.7264	1.5708
2	8.05005	50.1894	1.5708
3	7.95	-2.85188	1.5708

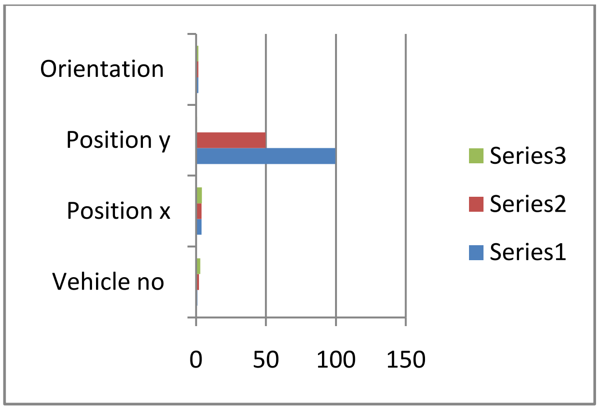


GRAPH 2.2 VEHICLES TRAVEL IN THE ROADWAY DIRECTION

End Lane
Traffic Lane No. 5
Lane Factor 1
The loading vehicle details are
Width = 2900
Front Clearance = 31675
Rear Clearance = 31675
No. of Axles = 3
Vehicles travel in the roadway direction
End Lane
Traffic Lane No. 6
Lane Factor 1

TABLE 2.3 VEHICLES TRAVEL IN THE ROADWAY DIRECTION-3

Vehicle no	Position x	Position y	Orientation
1	3.9501	99.728	1.5708
2	3.95005	49.689	1.5708
3	4.05	0.650844	1.5708



GRAPH 2.3 VEHICLES TRAVEL IN THE ROADWAY DIRECTION-3

It cuts time and gives safe esteems required for its outline. By this approach of outline, most extreme burdens made by E-TABSbeava are moved into E-TABS. furthermore, the examination and configuration is then completed.

Max Bending Moment or Axial Force, diversion, plate stresses, minute about neighborhood x-hub, y-pivot z-hub of the plate (Mx,My,Mz),load positions.

Width = 2900

Front Clearance = 31675

Rear Clearance = 31675

No. of Axles = 3

End Lane

MATERIAL PROPERTY:

The material property considered for the present pier analysis for concrete and reinforcementsteel are given in Table 3.4.

TABLE 2.4: MATERIAL PROPERTIES

S.NO	MATERIAL	E(KN/MM^2)	V	DENSITY(Kg/m^2)	α(l^{0}c)
1	STEEL	205.000	0.300	7.83E+3	12E-6
2	STAIN LESS STEEL	197.930	0.300	7.83E+3	18E-6
3	ALUMINUM	68.948	0.330	2.71E+3	23E-6
4	CONCRETE	21.718	0.170	2.4E+3	10E-6

TABLE 2.5: STRUCTURE TYPES

NUMBER OF LOADS	1728	HIGHEST NODE	1728
NUMBER OF ELEMENTS	590	HIGHEST BEAM	2188
NUMBER OF PLATES	1600	HIGHEST PLATE	2190

LOAD CASES

load of basic load cases	3
number of combination load	0

SUPPORTS:

s.no	nodes	X(KN/MM)	Y(KN/MM)	Z(KN/MM)	rX	rY	rZ
1	fixed	fixed	fixed	-	-	-	-
2	fixed	fixed	fixed	-	-	-	-
3	fixed	fixed	fixed	-	-	-	-
4	fixed	fixed	fixed	-	-	-	-
5	fixed	fixed	fixed	-	-	-	-
6	fixed	fixed	fixed	-	-	-	-
7	fixed	fixed	fixed	-	-	-	-

SECTION PROPERTIES

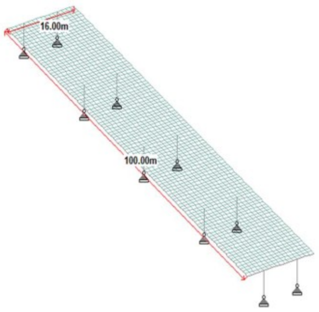
S.NO	PROP	SECTION	AREA	LM	FM	MATERIAL
1	6	Cir 2.000	31.4E+6	785E+6	157E+6	CONCRETE
2	7	Rec 1.00	8.33E+6	8.33E+6	14.1E+6	CONCRETE
3	8	Rect 1.00	8.33E+6	8.33E+6	14.1E+6	CONCRETE
4	9	Rect 0.500	521E+3	521E+3	879E+3	CONCRETE

PLATE THICKNESS

PROPE	NODE A	NODE B	NODE C	NODE D	MATERIAL
1	30.00	30.00	30.00	30.00	CONCRETE
2	30.00	30.00	30.00	30.00	CONCRETE
3	30.00	30.00	30.00	30.00	CONCRETE
4	30.00	30.00	30.00	30.00	CONCRETE
5	30.00	30.00	30.00	30.00	CONCRETE

SELF WEIGHT:1DL

DIRECTION	FACTOR
Y	-1000



FIGS 2.2 INE-TABS

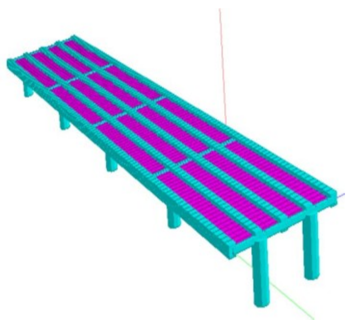
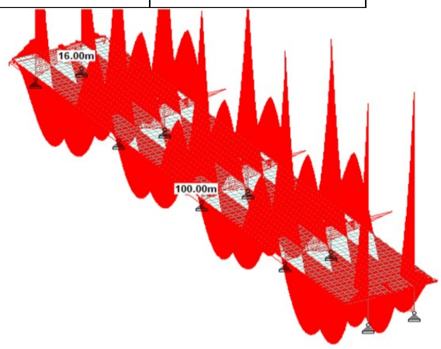


FIG 2.3 3D RENDERING VIEW



2.4 BENDING Z

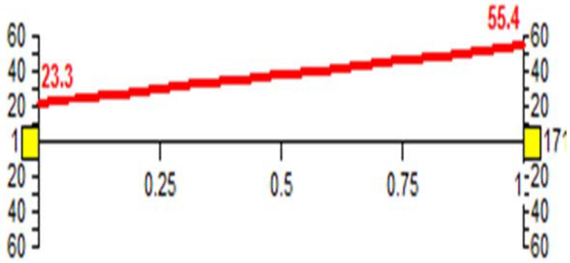
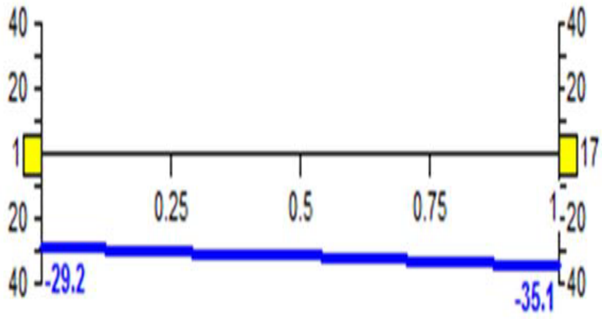
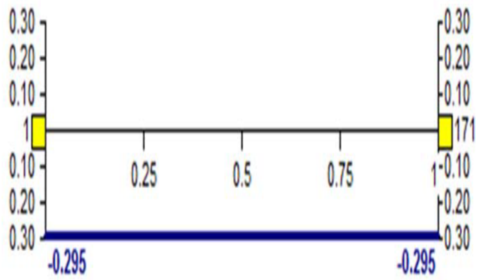


FIG 2.5 MZ (KNM) BEAM GRAPH



2.4 FY(KN) BEAM GRAPH



GRAPH 2.5 FX(KN) BEAM

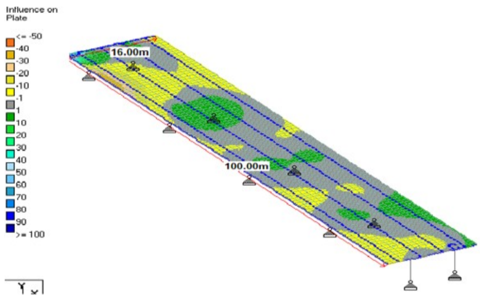


FIG 2.6 PLATE STRESSES

3. RESULTS AND DISCUSSIONS OVERVIEW

The yield information for the IRC Class 70R Bridge loadings are considered which incorporate nodal removal, nodal dislodging rundown, pillar powers, shaft end relocations, bar end uprooting outline, responses, response synopsis, hub powers, bar minutes, live load impact and numerous more by E-TABSAs every one of them can't be portrayed in this venture, the information result tables being expansive, a portion of the look at the yield brings about the forbidden structures is given in this beneath

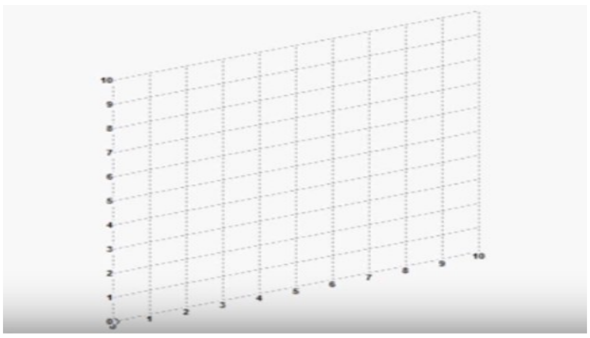


FIGURE 3.1 BASE VIEW OF BRIDGE

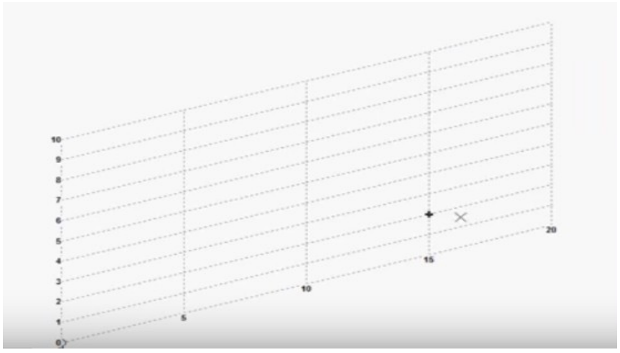


FIGURE 3.2 BASE STRUCTURE OF HORIZONTAL VIEW

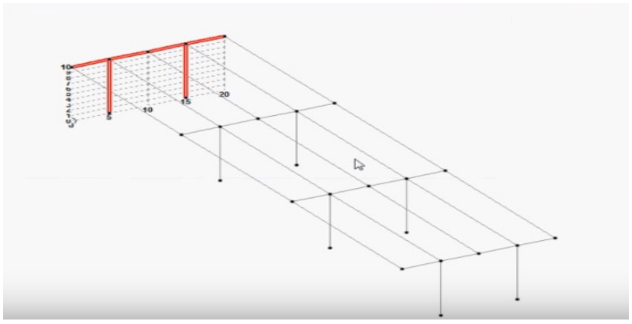


FIGURE 3.3 HOLE STRUCTURE METRO BRIDGE

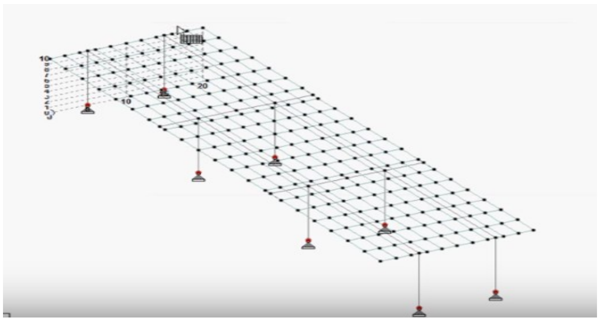


FIGURE 3.4 LINER GRIDE MODEL OF THE BRIDGE MODEL

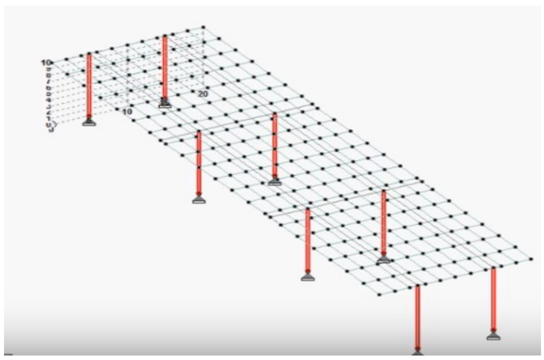


FIGURE 3.5 SELECTED BEAMS OF WHOLE STRUCTURE

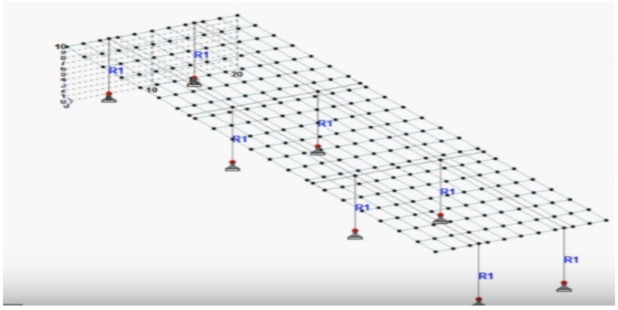


FIGURE 3.6 SHOWS THAT NODE MODEL

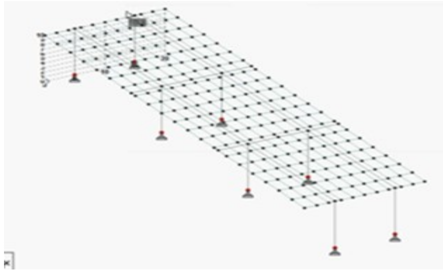


FIGURE 2.10 SHOWS NODE POINTS FOR DECK PREPARATION

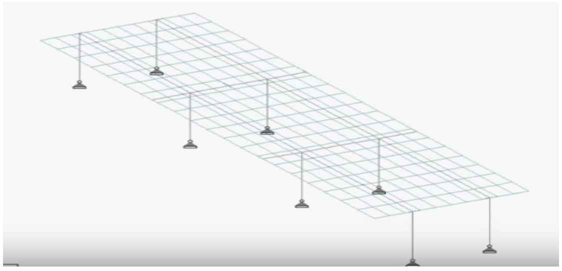


FIGURE 3.7 SELF WEIGHT OF THE WHOLE STRUCTURE

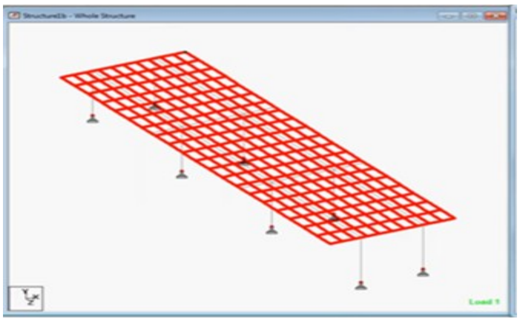


FIG 2.11 LOAD IMPACT OF THE WHOLE STRUCTURE

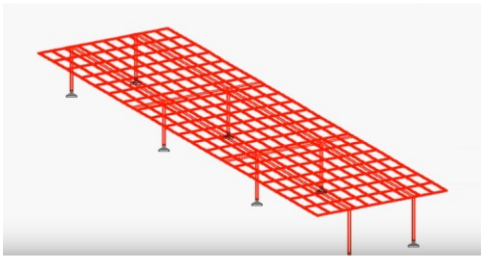


FIGURE 3.8 WHOLE STRUCTURE INITIAL LOADS

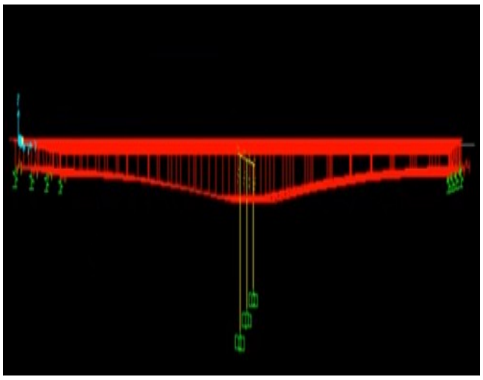


FIGURE 3.12 3D VIEW OF BRIDGE STRUCTURE

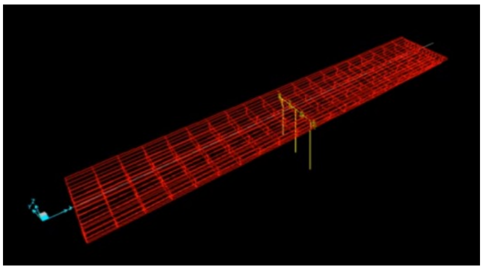


FIGURE 3.9SHOWS THE BSIC VIEW OF BOX GRINDER BRIDGE

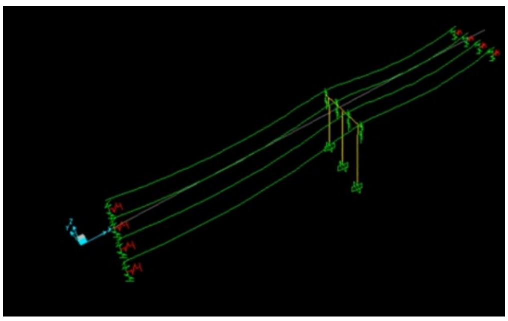


FIGURE 3.13. PRE STRESSED LOADS OF BRIDGE STRUCTURE

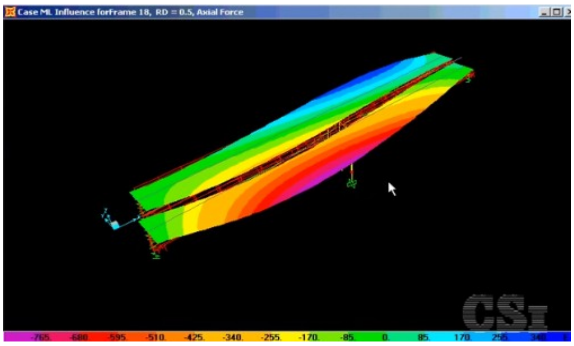


FIGURE 3.14 INFLUNCE OF FORCE FRAME BRIDGE ANALYSIS

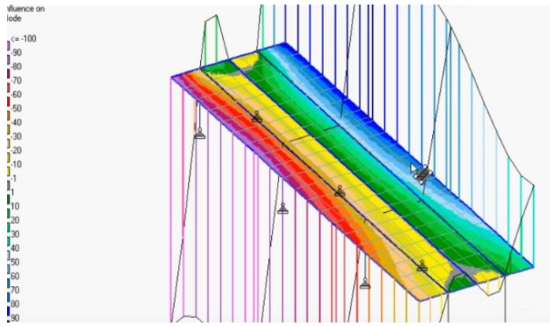


FIGURE 3.15 SHOWS THAT INITIAL DEAD LOADS OF METRO BRIDGE

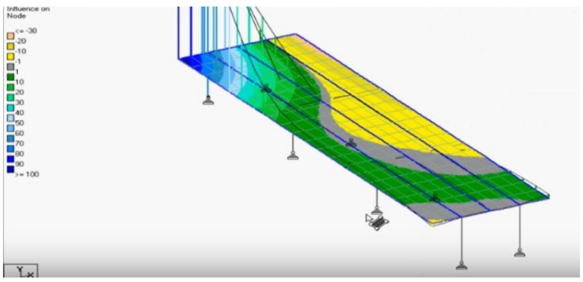


FIGURE 3.16 SHOWS THAT END DEAD LOADS OF METRO BRIDGE

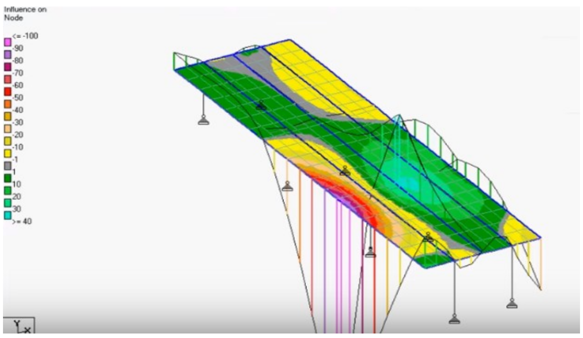
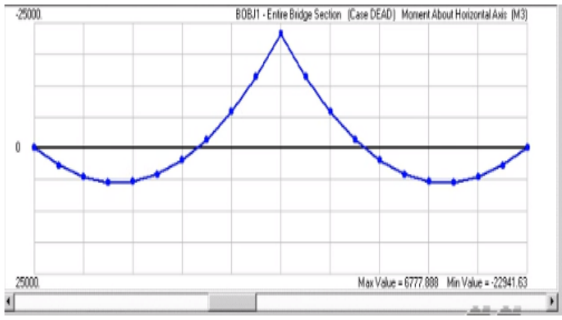
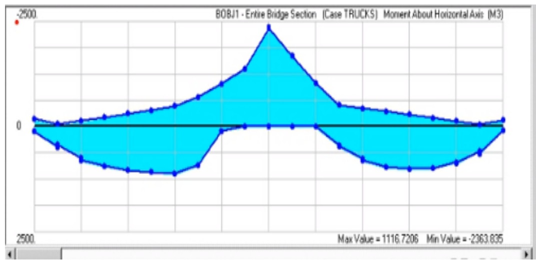


FIGURE 3.17 DIS PLACEMENT MOMENT OF THE METRO BRIDGE



GRAPH 3.1 HORIZONTAL AXIS BRIDGE DESIGN



GRAPH 3.2 MOVING LOADS OF BRIDGE DESIGN

CONCLUSIONS

- Analysis and plan of the lifted Metro Bridge according to IRC codes can be effectively done by E-TABSregarding E-TABS.
- Force Based Design Method may not always guarantee the performance parameter required and in the present case the pier just achieved the target required.
- In case of Direct Displacement Based Design Method, selected pier achieved the behaviour factors more than targeted Values. These conclusions can be considered only for the selected pier. For General conclusions large numbers of case studies are required and it is treated as a scope of future work. The parametric study on behaviour of box girder bridges showed that,

- As the radius of curvature increases, responses parameter longitudinal stresses at the top and bottom, shear, torsion, moment and deflection are decreases for three types of box girder bridges and it shows not much variation for fundamental frequency of three types of box girder bridges due to the constant span length.
- As the span length increases, responses parameter longitudinal stresses at the top and bottom, shear, torsion, moment and deflection are increases for three types of box girder bridges and fundamental frequency decreases for three types of box girder bridges.
- As the span length to the radius of curvature ratio increases responses parameter longitudinal stresses at the top and bottom, shear, torsion, moment and deflection are increases for three types of box girder bridges and as span length to the radius of curvature ratio increases fundamental frequency decreases for three types of box girder bridges.

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