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"STRUCTURAL DESIGN AND COMPARATIVE STUDY BETWEEN THE MONOLOTHIC CONCRETE VS PRECAST CONCRETE BRIDGE STRUCTURE BY USING CANTILEVER METHOD"

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Abstract: A bridge management system is a method of managing bridges throughout the design, operation, building, and maintenance phases of the bridge's lifecycle. When funding becomes more difficult to come by, road management authorities all over the world have had to deal with challenges related to bridge management as well as an increase in the number of maintenance requests for large infrastructure assets in their jurisdictions. The system of bridge management assists agencies in achieving objectives such as inventory construction, maintenance planning, bridge inspection, and repair and rehabilitation interventions in the most systematic manner, increasing the safety of bridge users, and optimizing the allocation of financial resources. The most important task associated with bridge management is the collection of inventory data; condition evaluation and strength; inspection, repair, prioritization of funds allocation; and replacement of bridge elements. Moreover, business management is regarded as a method of managing information about a bridge for the aim of designing maintenance programs within the constraints of a budgetary constraint. The business management also includes four parts, including degradation and cost, data storage, analysis and optimization models, and updating functions, amongst things.

***Index Terms*– Bridge, Monolithic, Precast, Staad Pro Connect Software, Operations**

1. Introduction

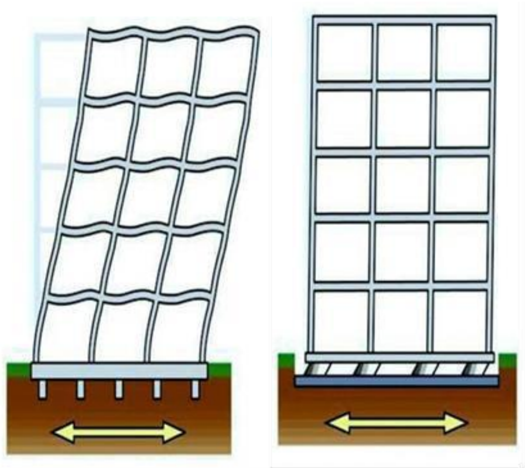
A bridge management system is a way through which bridges are managed in throughout the design, operation, construction, and maintenance of the bridge. When accessibility of funds gets tighter, road management authorities all over the world had to face issues associated with bridge management as well as an increase in maintenance needs of massive infrastructure assets. The system of bridge management support agencies in fulfilling the objectives like constructing inventories, maintenance planning, inspection bridge, interventions of repair and rehabilitation in the most systematic manner, enhancing bridge user's safety and optimization of financial resource allocation.

Concept of base isolation

Base isolation is the separation of the base or substructure from the superstructure. It is also called Seismic isolation. Instinctively, the concept of extrication the superstructure from the substructure to avoid X earthquake damage is relatively simple to understanding. At the time of earthquake, the ground moves X and this ground movement which induces the inertial forces on the structures from both directions which cause most X of the harm to structures. X An airplane flying X over an earthquake X is not affected.

X So, the fundamental theory is quite simple. Separate the superstructure from the substructure. The sub-structure will move X but the structure will X not move. Base X Isolation falls into the overall class of X Passive Energy X Dissipation.

Conventional bridge under ground motion (a) Base isolated bridge under ground motion (b).



The basic principle of base isolation is to transform the response of the bridge so that the ground can move Below the Bridge without transferring these motions into bridge.

The assumption of the ideal system is a complete separation between ground and structure. In actual practice, there is a contact between the structure and the ground surface.

Bridges with a perfectly stiff diaphragm have a nil fundamental natural time period. The ground motion induces acceleration in the structure which will be equivalent to the ground acceleration and there will be nil relative displacements between the structure and the grounds. the structure and substructure move with the same amount. A Bridge with a perfectly stretchy diaphragm will have an immeasurable period. For particular type of structure, when the ground beneath the structure travels there will be zero acceleration induced in the structure and the relative displacement between the structure and ground will be equivalent to the ground displacement. In this case, structure will not change but the substructure will move Incorporation of the isolator into bridge construction:

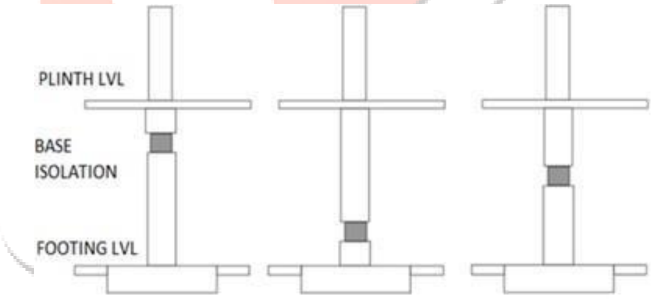
When it comes to earthquake safety, the first issue that comes to mind for a structural engineer is when to use isolation in the bridge. The simple answer is when it gives a more effective and economical alternative to other methods of employ for earthquake safety. In some cases, base isolation may be practicable if the design for earthquake loads necessitates the use of strength or detailing that would otherwise be insufficient for other load circumstances.

The easiest technique to determine whether a structure is suited for isolation when evaluating structures that fit this fundamental condition is to go through a checklist of items that make isolation more or less effective depending on the structure ease isolation system is more efficient for the structures which have heavy masses. To effective isolation can be achieved with the help of the long period of the response. As we know the period is an inherent property of the structure which is relative to the square root of the mass M and contrariwise proportional to the square root of the stiffness K. To achieve an effective isolated time period, a heavy mass must be associated with a low stiffness. Devices that are used for isolation do not have an infinite range of stiffness. For example, elastomeric bearings need to have a minimum diameter to ensure that they remain stable under seismic displacements. This minimum plan size sets a smallest practical stiffness

Sliding systems do not have time period restraint and so low weight bridges may be intelligent to be isolated with sliding systems. However, even these incline not to be cost-effective for light bridges for different reasons. Regardless of the weight of the bridge, the movement is the same for a given effective period and so the size of the slide plates, the most expensive part of sliding bearings, is the same for a heavy or a light structure. In real terms, this usually makes the isolators more expensive as a proportion of the first cost for light bridges. There have been systems proposed to isolate light bridges. However, the fact remains that there are few instances of successful isolation of light structures such as detached residential dwellings.

Location of the isolator in bridges

The paramount requirement for installation of a base isolation system is that the bridge is able to move horizontally relative to the ground, usually at leastX100 mm and in some instances up toX1 meter. A plane of separation must is selected to permit this movement. Final variety of the location of this plane depends on the structure but there are a few things to consider in the process. The most common configuration is to install a diaphragm immediately overhead the isolators. This permits earthquake loads to be spread to the isolator's according to their stiffness. For a bridge without a basement, the isolators are mounted on foundation pads and the structure constructed above them, as shown in Figure.



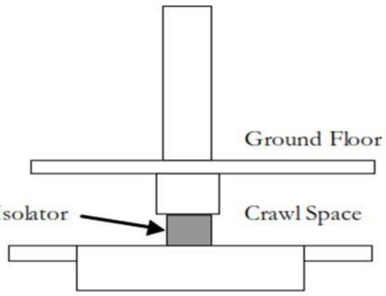


Figure1.2: Isolation in bridge with no basement

Uncertainty the bridge has a basement then the options are to install the isolators at the top, bottom or mid- height of the basements columns and walls, as shown in Figure.

FIGURE1.3: ISOLATION IN THE BASEMENT

For the options at the top or bottom of the column/wall then the element will need to be designed for the cantilever moment developed from the maximum isolator shear force. This wills often require substantial column sizes and may require pilasters in the walls to resist the face loading..

2.METHODOLGY

- Study of literature review survey
- Problem identification and research gap
- Structural study of existing structure by research papers, books, some field works
- Study of precast and monolithic concrete technology, background and current scenario
- Selection of method and technique
- Design and implementation of precast construction of bridge in india
- Result and discussion
- Conclusion

3.DESIGN AND MODELING

Design a bridge to span a given distance while supporting a maximum load and study various parameters such as deck slab, pier, I section beam, isolated footing etc.

Methodology

- Bridge span= 12 m
- Roadway= 12 m
- Single Pier
- Pier dia= 2m
- Trapezoidal section of beam
- Upper portion= 10m x 1.5m
- Bottom portion= 1.8m x 1.2m
- Plate Girder of
- Longitudinal Beam (X-Dir 1mx1m)
- Longitudinal Beam (Z-Dir 1mx1m)
- Tapered Section (1.2 mx1.6 m)
- Deck Slab= 400 mm
- Bearing size 0.8m x 0.8mx0.75 m
- Height- 8 m
- Width-8 m
- Loading:
- Dead Load
- Earthquake Load as per 1893:2002

Geometry Creation

Bridge model geometry is analyzed by using different sketching and modeling tools available. The slab cross section is sketched on one of the planes and dimensioned it as per the bridge model slab cross section dimension.

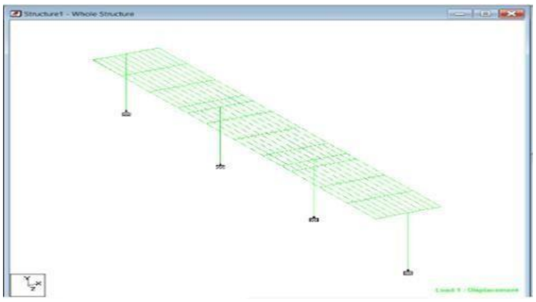
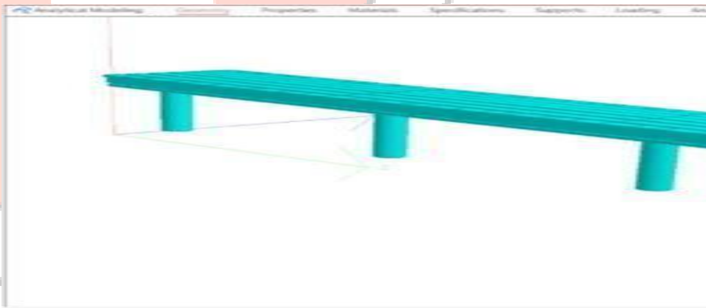


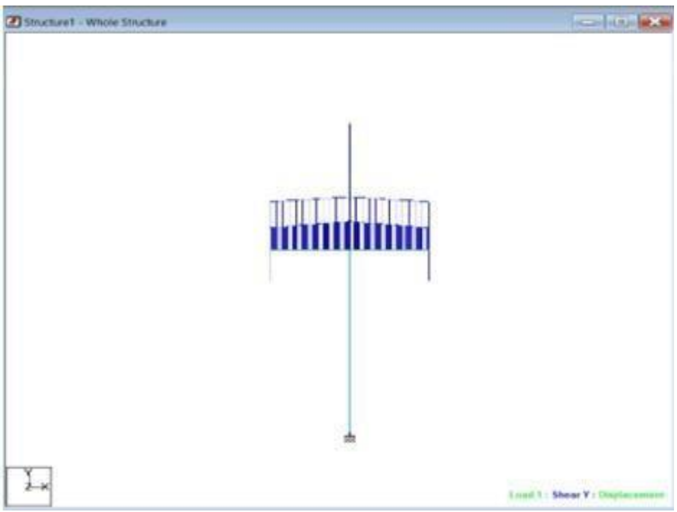
FIGURE 1.2: BRIDGE SECTION

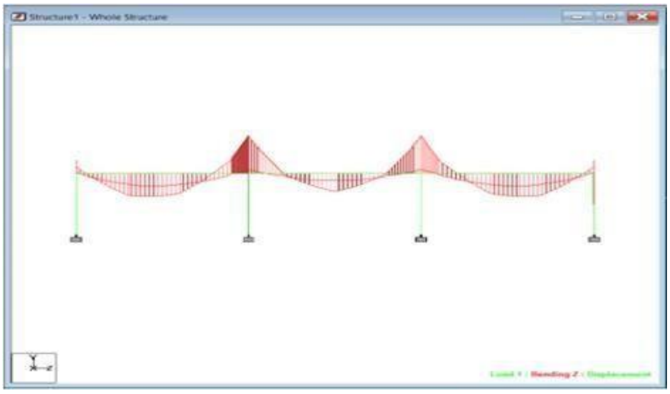
Then slab cross section is extruded in the normal direction to the sketching plane for the required length. On the lower surface of the modeling, a cross section on column of bridge is sketched and is extruded normal to the slab surface for the required column length. The Linear pattern is used to make the multiple copies of the column by specifying the number of copies and spacing between each column. On the lower surface of the column foundation block cross section sketch is created and by using extrude command material is added in the normal direction for the required length. Multiple copies of the foundation blocks are created by using the linear pattern command. Defining the Physical properties of Bridge slab section / Applying the material. Concrete material behavior for the bridge material, the properties of which are as below,

The following are the basic steps required to perform the analysis,

- Set the analysis preference.
- Create or import model.
- Define element attributes (element types, real constants, and material properties)
- Mesh the model.
- Specify the analysis type, analysis options, and the loads to be applied.
- Solve the analysis problem.
- Post process the result.







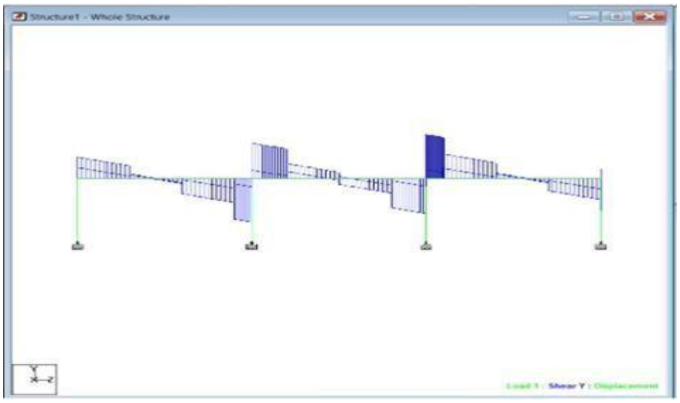
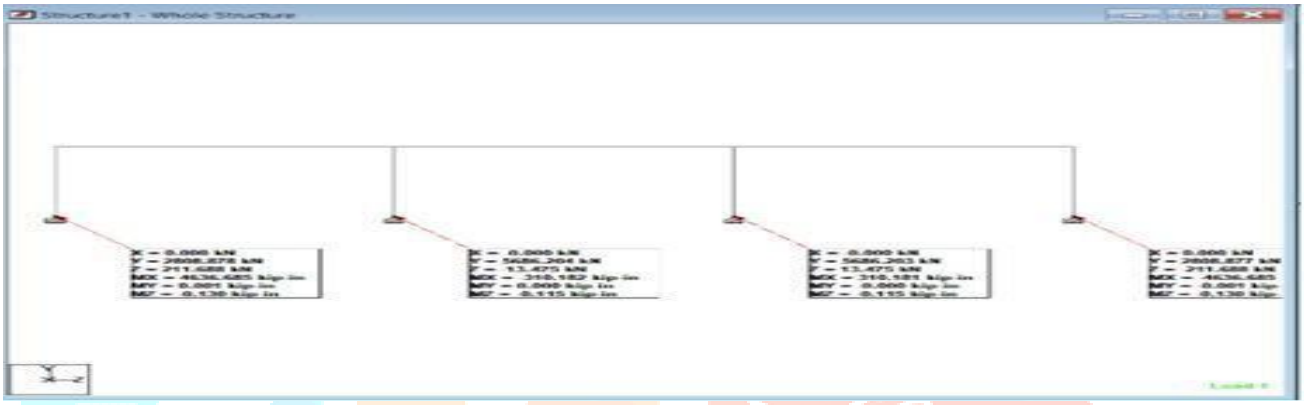
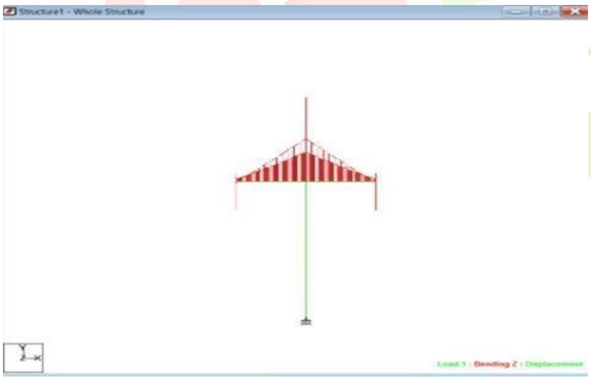
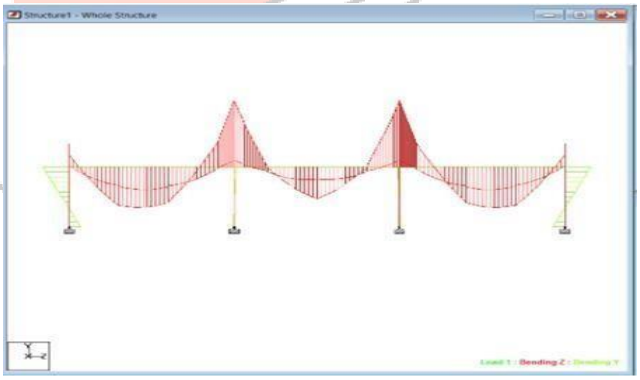


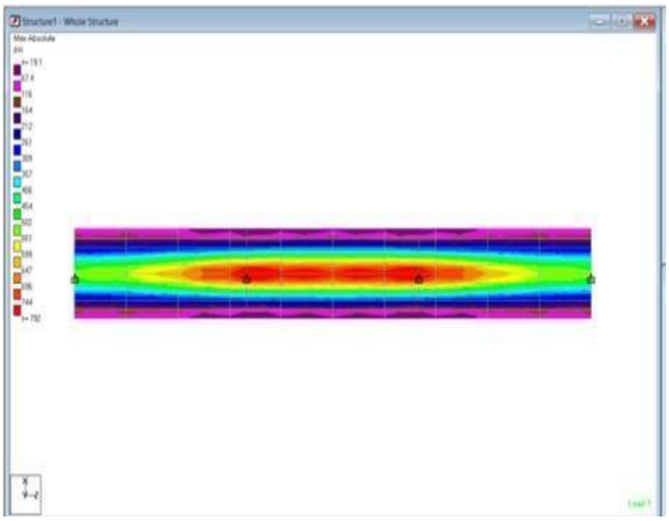
Fig 3.1 3DView of Model



4.RESULT AND DISCUSSION







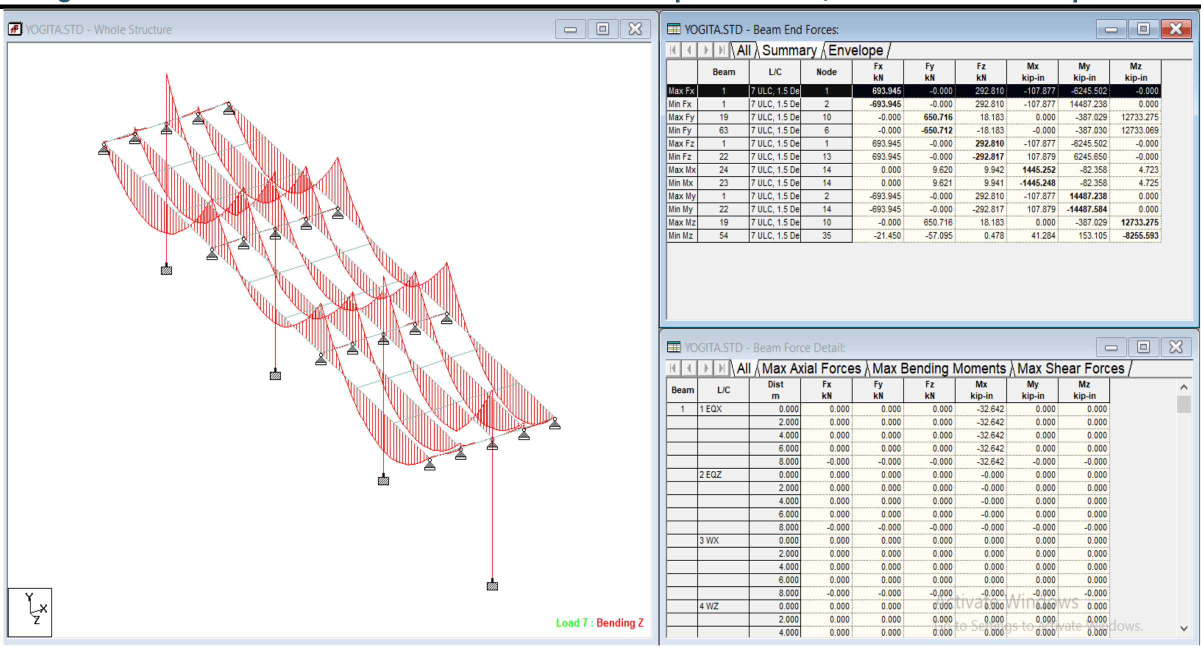


Figure4.1: BEAM BMD COL BMD

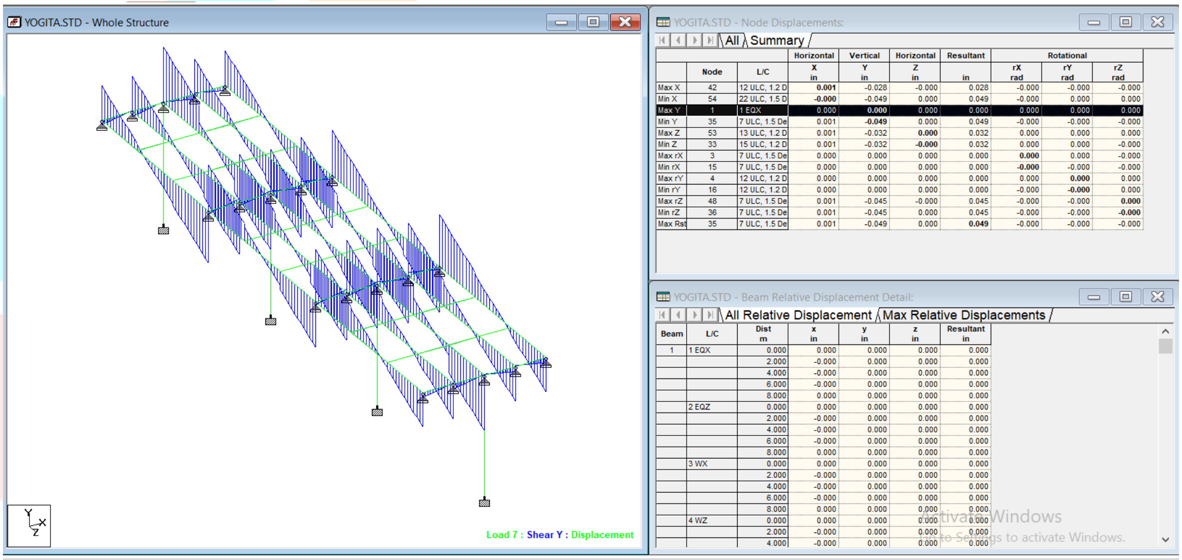
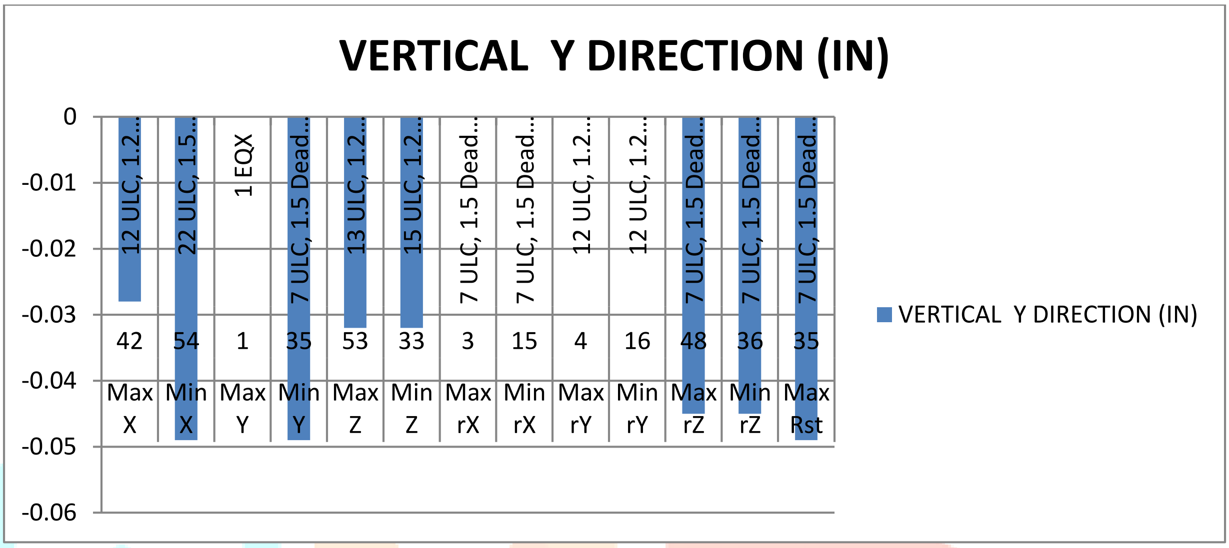


Figure4.2: Displacement due Load Combination

Table 4.1 Max displacement for load combination

MAX / MIN	NODE	LOAD COMBINATION	VERTICAL Y DIRECTION (IN)
Max X	42	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	-0.028
Min X	54	22 ULC, 1.5 Dead + -1.5 Seismic (1)	-0.049
Max Y	1	1 EQX	0
Min Y	35	7 ULC, 1.5 Dead + 1.5 Live	-0.049
Max Z	53	13 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (2)	-0.032
Min Z	33	15 ULC, 1.2 Dead + 1.2 Live + -1.2 Seismic (2)	-0.032
Max rX	3	7 ULC, 1.5 Dead + 1.5 Live	0

Min rX	15	7 ULC, 1.5 Dead + 1.5 Live	0
Max rY	4	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	0
Min rY	16	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	0
Max rZ	48	7 ULC, 1.5 Dead + 1.5 Live	-0.045
Min rZ	36	7 ULC, 1.5 Dead + 1.5 Live	-0.045
Max Rst	35	7 ULC, 1.5 Dead + 1.5 Live	-0.049



Graph4.1: Max Displacement for Load Combination in Bridge

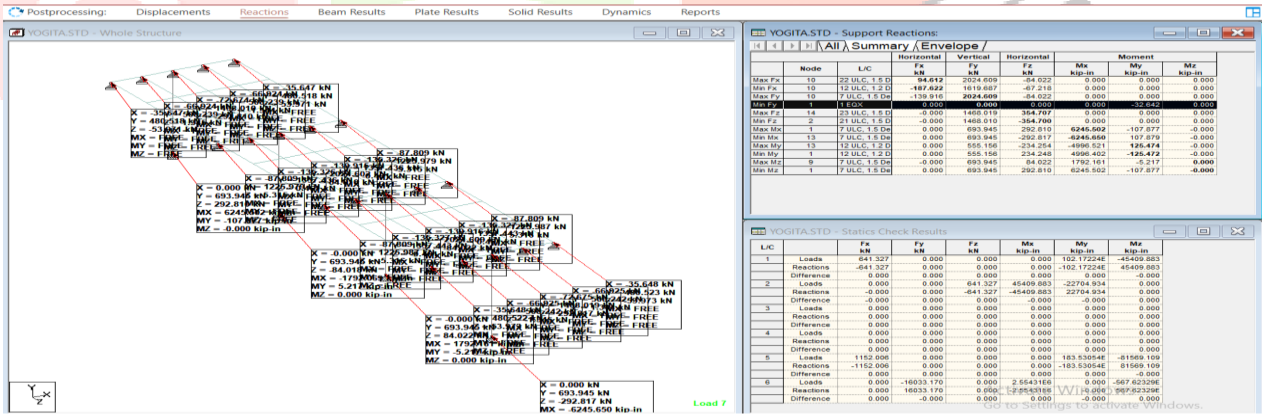


Figure4.2: Displacement due Load Combination

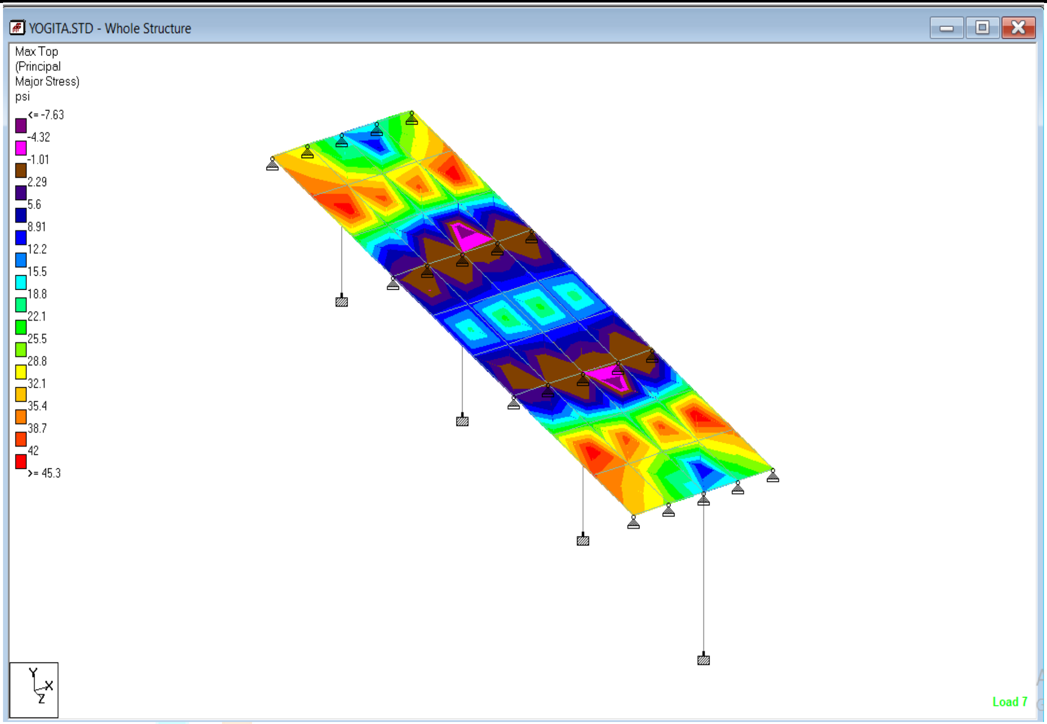


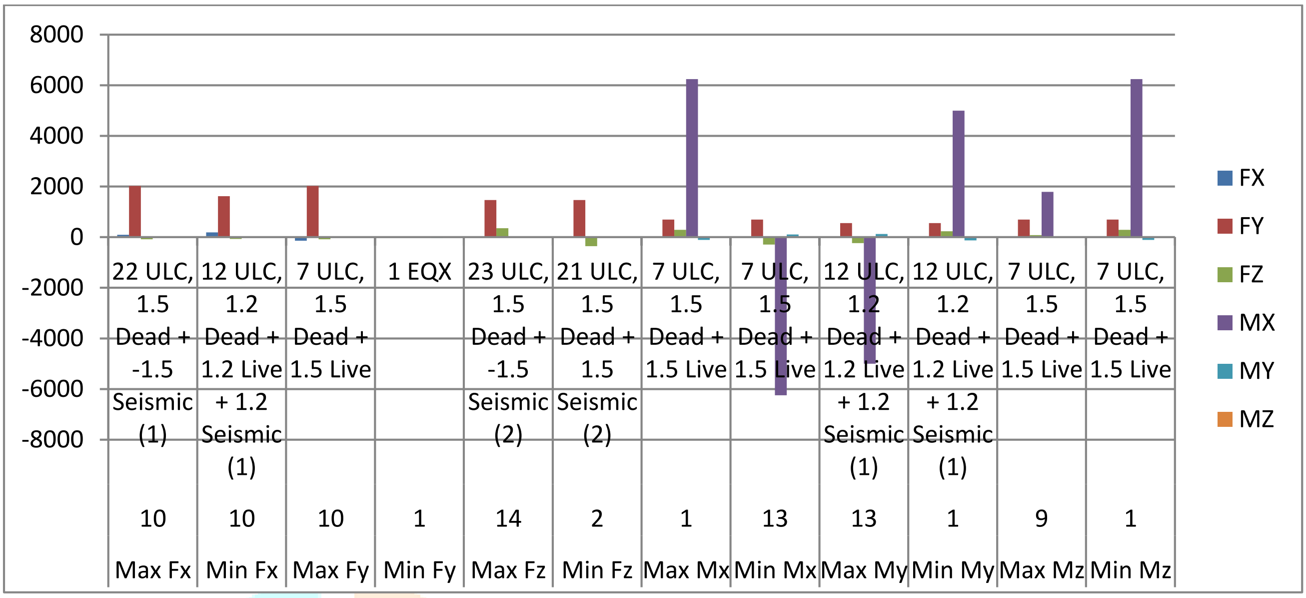
Figure4.3: Stresses due to Load Combinations

4.2 MAX AND MIN SUPPORT REACTIONS AT JOINTS

Table4.2: Max and Min Support Reactions at Joints

MAX/MIN	NODE	LOAD COMBINATION	FX	FY	FZ	MX	MY	MZ
Max Fx	10	22 ULC, 1.5 Dead + -1.5 Seismic (1)	94.612	2024.609	-84.022	0	0	0
Min Fx	10	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	187.622	1619.687	-67.218	0	0	0
Max Fy	10	7 ULC, 1.5 Dead + 1.5 Live	-139.916	2024.609	-84.022	0	0	0
Min Fy	1	1 EQX	0	0	0	0	-32.642	0
Max Fz	14	23 ULC, 1.5 Dead + -1.5 Seismic (2)	0	1468.019	354.707	0	0	0
Min Fz	2	21 ULC, 1.5 Dead + 1.5 Seismic (2)	0	1468.01	-354.7	0	0	0
Max Mx	1	7 ULC, 1.5 Dead + 1.5 Live	0	693.945	292.81	6245.502	-107.877	0
Min Mx	13	7 ULC, 1.5 Dead + 1.5 Live	0	693.945	-292.817	-6245.65	107.879	0
Max My	13	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	0	555.156	-234.254	-4996.52	125.474	0
Min My	1	12 ULC, 1.2 Dead + 1.2 Live + 1.2 Seismic (1)	0	555.156	234.248	4996.402	-125.472	0
Max Mz	9	7 ULC, 1.5 Dead + 1.5 Live	0	693.945	84.022	1792.161	-5.217	0

Min Mz	1	7 ULC, 1.5 Dead + 1.5 Live	0	693.945	292.81	6245.502	-107.877	0



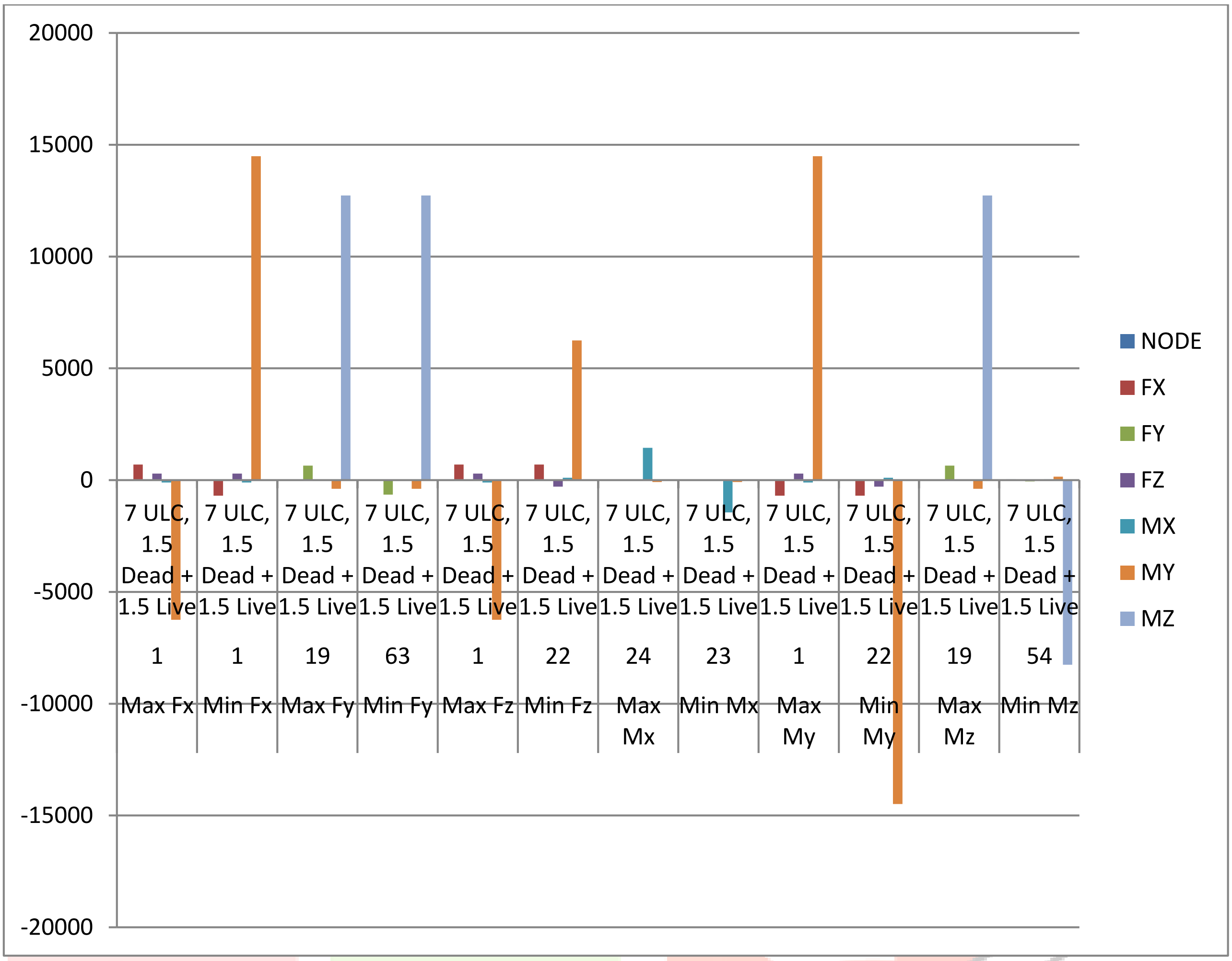
Graph4.2: Max and Min Support Reactions at Joints

4.3 MAX AND MIN BEAM REACTION ON THE BRDIGE

Table4.3: Max and Min Beam Reaction On The Bridge

MAX/MIN	BEAM	LOAD COMBINATION	NODE	FX	FY	FZ	MX	MY	MZ
Max Fx	1	7 ULC, 1.5 Dead + 1.5 Live	1	693.945	0	292.81	-107.877	-6245.5	0
Min Fx	1	7 ULC, 1.5 Dead + 1.5 Live	2	-693.945	0	292.81	-107.877	14487.24	0
Max Fy	19	7 ULC, 1.5 Dead + 1.5 Live	10	0	650.716	18.183	0	-387.029	12733.28
Min Fy	63	7 ULC, 1.5 Dead + 1.5 Live	6	0	-650.712	-18.183	0	-387.03	12733.07
Max Fz	1	7 ULC, 1.5 Dead + 1.5 Live	1	693.945	0	292.81	-107.877	-6245.5	0
Min Fz	22	7 ULC, 1.5 Dead + 1.5 Live	13	693.945	0	-292.817	107.879	6245.65	0
Max Mx	24	7 ULC, 1.5 Dead + 1.5 Live	14	0	9.62	9.942	1445.252	-82.358	4.723
Min Mx	23	7 ULC, 1.5 Dead + 1.5 Live	14	0	9.621	9.941	-1445.25	-82.358	4.725
Max My	1	7 ULC, 1.5 Dead + 1.5 Live	2	-693.945	0	292.81	-107.877	14487.24	0
Min My	22	7 ULC, 1.5 Dead + 1.5 Live	14	-693.945	0	-292.817	107.879	-14487.6	0
Max Mz	19	7 ULC, 1.5 Dead + 1.5 Live	10	0	650.716	18.183	0	-387.029	12733.28

Min Mz	54	7 ULC, 1.5 Dead + 1.5 Live	35	-21.45	-57.095	0.478	41.284	153.105	-8255.59



Graph4.3: Max and Min Beam Reaction On the Bridge

4.4 PRINCIPLE STRESSES

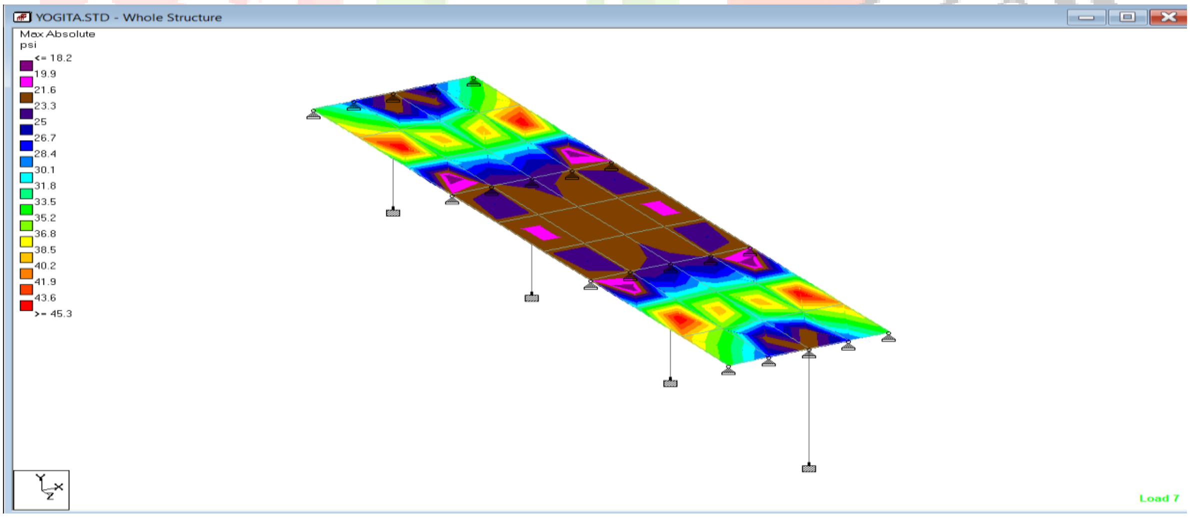
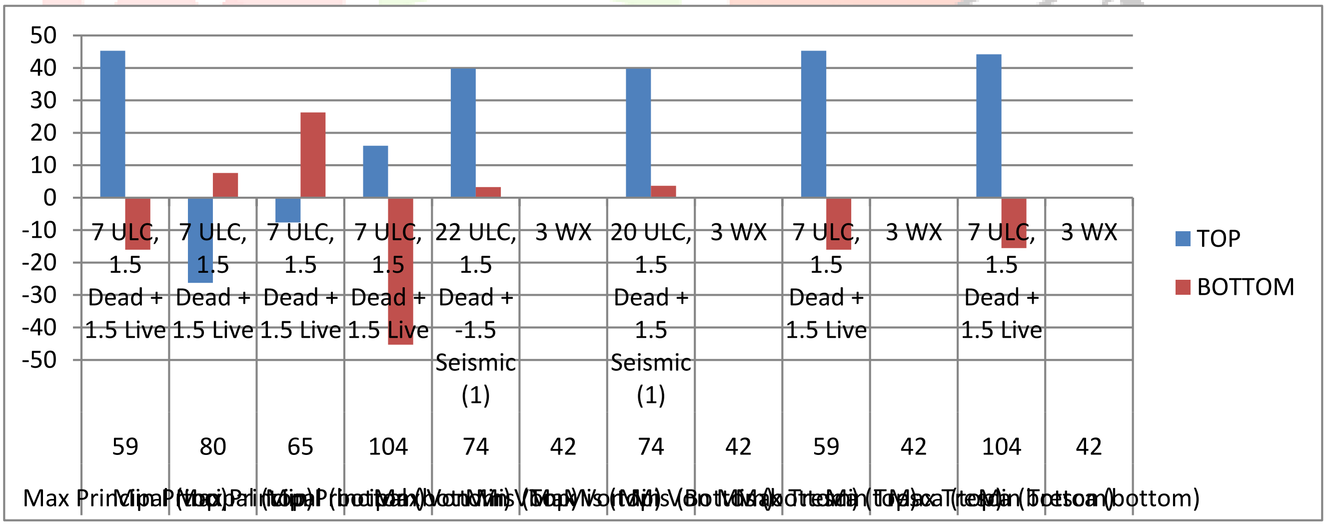


Figure4.4: Maximum Stresses

Table4.4: PRINCIPLE STRESSES

MAX/MIN	PLATE	LOAD COMBINATION	TOP	BOTTOM
Max Principal (top)	59	7 ULC, 1.5 Dead + 1.5 Live	45.306	-16.011
Min Principal (top)	80	7 ULC, 1.5 Dead + 1.5 Live	-26.267	7.631
Max Principal (bottom)	65	7 ULC, 1.5 Dead + 1.5 Live	-7.631	26.267
Min Principal (bottom)	104	7 ULC, 1.5 Dead + 1.5 Live	16.011	-45.306
Max Von Mis (Top)	74	22 ULC, 1.5 Dead + -1.5 Seismic (1)	39.779	3.255
Min Von Mis (top)	42	3 WX	0	0
Max Von Mis (Bottom)	74	20 ULC, 1.5 Dead + 1.5 Seismic (1)	39.765	3.653
Min Von Mis (bottom)	42	3 WX	0	0
Max Tresca (top)	59	7 ULC, 1.5 Dead + 1.5 Live	45.306	-16.011
Min Tresca (top)	42	3 WX	0	0
Max Tresca (bottom)	104	7 ULC, 1.5 Dead + 1.5 Live	44.202	-15.536
Min Tresca (bottom)	42	3 WX	0	0



Graph Principle Stresses

5. CONCLUSION

- The chapter highlights the influence of temperature variation on the structural response of the bridge
- Construction of this structure at that junction Results in the traffic control and enhances safe driving.
- The structure is designed basing codes Wind IS 875 Part III - 1987 and seismic Code 1893 Part 1- 2002.
- The structure is designed basing codes IRC Class 70R and IRC Class A Loading, IRC 6-2016 for designing.
- It has been observed that the maximum support reactions 2024.609 KN and Moment 6245.502KNm is which is safe limit
- The maximum displacement is occurred on column -0.049mm in Y direction is safe.
- The maximum plate stress due to moving vehicle 45.306 KN/m^2 at top

- Designed structure by using software result in obtaining reduction in time of design work and improved the accuracy of the work.

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