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A Dissertation on

Design and Analysis of Foot Over Bridge using STADD Pro

Submitted in partial fulfillment of the requirement for the award of the degree

of

MASTER OF TECHNOLOGY

In

STRUCTURAL ENGINEERING

Submitted by

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CANDIDATE DECLARATION

We hereby affirm that the project report "DESIGN AND ANALYSIS OF FOOT OVER BRIDGE USING STADD PRO," which is being submitted in partial fulfillment of the requirement for the award of a degree of Master of Technology in Structural Engineering, is an authentic record of my work completed during the period of 2021 to 2023 under the supervision and guidance of Miss Swati Dhiman Assistant Professor, Department of Civil Engineering, Roorkee I did not submit the subject matter contained in this report for any other degree award.

Aman Kumar
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Date:

Place: Dehradun

This is to confirm that, to the best of our knowledge, the candidate's above statement is accurate.

Approved By:

Miss Swati Dhiman

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CERTIFICATE

This is to certify that Mr. Aman kumar (210240714002) has worked under my supervision on "DESIGN AND ANALYSIS OF FOOT OVER BRIDGE USING STADD PRO" for her Degree of Master of Technology in Structural Engineering and Construction at Roorkee Institute of Technology, Roorkee, Uttarakhand, India. She fulfils the eligibility criteria for submitting her M.Tech. thesis as per research rules & regulations of the Institute / University / UGC.

It is also certified that the candidate has incorporated the suggestions given in the pre-submission presentation. I recommend the thesis for evaluation for the award of the Degree of Master of Technology of Roorkee Institute of Technology, Roorkee, Uttarakhand, India.

(External Examiner)

(Internal Examiner)

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(210240714002)

ABSTRACT

Foot Over bridges are necessary when need to offer a clear path for people to cross a highway and another physical impediment. They typically need a structure that is quite lightweight because they transport are relatively low when compared to the toll highways or railroad bridges. But since they typically have to offer a lengthy clear span, stiffness starts to matter. The advent warrants careful consideration because bridges are typically anticipated to be practically visible to the public. All requirements for a footbridge are met by the economically advantageous and aesthetically appealing designs made of steel. Due to the quick and extensive installation of foot over bridge.

Now Numerous bridges constructed in seismic zones are not sufficiently earthquake resistant. To meet the needs of these enhanced tourists on the constrained land, the length of the bridge will be increased through medium to large size. The weakest parts of the building start to fall apart during an earthquake. Typically, weak points are caused by form stiffness, mass discontinuities, and geometry. With this project, we can design the best foot over bridge, including connection details, calculation of structural components, and foundation detailing for the foot over bridge construction.

The main goal of this project is to comprehend how to assess and construct a Truss using STAAD Pro. An effective structural engineer is crucial in today's market, which is expanding quickly and becoming more competitive. As a follow-up, an effort is made to evaluate and build a Truss using the STAAD pro program. The design is finished using manual load calculations and STAAD Pro analysis. Structures were subjected to their own weight in addition to dead and live loads, wind pressure, and other factors using the load case data from STAAD Pro. According to the specifications of IS 875, STAAD Pro estimated wind loads at various heights while accounting for the provided wind strengths. We are attempting to examine the steel construction utilizing the trial-and-error approach while employing various sizes and forms of steel pieces.and Staad Pro program to analyze the structure. Buildings must take into account minimum design loads such as dead loads, imposed loads, as well as other outside loads in order to comply with their fundamental structural safety standards. It is envisaged that strict respect to the loading criteria established in this code will guarantee the structural integrity of constructions that are currently being developed.

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CHAPTER ONE

INTRODUCTION

A steel truss bridge is to be designed and analyzed before being constructed to connect the two zones of a particular place that are separated by an obstruction. the obstruction may be a road, railway, or any other physical obstruction to avoid it. in the past centuries, the bridges are designed by manual calculations and then by the advent of powerful and helpful software the designing And Analyzing

For distances between 10 and 20 meters, and maybe up to 25 meters, a steel truss footbridge was determined to be the optimum option when building wharfs for temporary backings for pillar-style footbridges is impractical. Furthermore, docks should be considered at ranges greater than 10 meters where they are an option. Considered to be the points of interest are:

The necessary steel sections should be available at major asset hubs. The segments are likely to be more consistent in fit and size than timber segments, allowing for the easy production of standard truss layouts. -Joints are easier to create than they are in timber trusses.

A conventional outline should be able to be created in a medium-sized workshop and then transported to the site in advantageously calculated pieces. Darting the components together and installing a wood deck are tasks that may be completed on-site under the guidance of a KNowledgeable expert by local artisans and other people who are skilled with their hands.

The scaffold may be divided into 3 segments for transportation at each level:

- Individuals who are transported and propelled together after being predrilled at a workshop. For this circumstance, each piece must be transported 24 kilometers, beginning on a rocky terrain and ending at the location of the footbridge. This method calls for careful gathering on site and comprehensive, accurate probing of workshop apertures.
- In the workshop, Boards are made from the cut and welded steel parts, which are then pierced for assembly into catapults. Boards are delivered to the site and assembled using darts there. This drastically reduces the need for pre-penetrating and group work. Boards can weigh as much as 100 kg.
- In the workshop, boards are put together to form modules that are then delivered to the site. On site, the modules are recorded all at once. This will demand the smallest amount of neighboring gathering labor. Modules will likely weigh between 300 and 400 kg, making them extremely heavy to carry. Only if trucks have direct access to the footbridge site is this method likely to be practical.

The quantitative and qualitative accident analysis evidence as well as other supporting data are summarized in risk-based roadway planning.Future volume traffic buildup is taken into account since available road space is a finite resource. Future traffic levels may be predicted, and suitable junctions are suggested.

Construction and management of lights at various crossroads are part of physical traffic control, and they are done according to the amount of traffic and the best time for that intersection.

Signal control at junctions provides information on the Green Period, which considers the count fortraffic volume each junction every Fifteen minutes, as well as the various signal design strategies.

The weight-age analysis technique, in which the accident cost ratio is utilized to establish road safety, is Known as road safety management.

A. THE PROJECT'S SCOPE

- To construct pedestrian overpasses in urban areas in order to ease traffic congestion.
- I proposed an area to reduce the number of accidents.
- To make it easier for pedestrians to cross the highways in a busy location securely and easily.

B. THE AIMS OF F.O.B.

- Utilizing Stadd Pro to simulate steel truss bridge design.
- Create a steel truss bridge that is accessible locally.
- To create a steel truss bridge that is affordable, safe, and easy to install for pedestrian crossing purposes.
- Using AutoCAD, create plans, elevations, and sections.
- Create a steel truss bridge that is accessible locally.

C. ADVANTAGES

There are various benefits of Foot over Bridge, some of which are listed Below.

- The most affordable Foot over Bridge
- simple to put up and maintain
- A side that is safer than other bridges
- They have a very flexible design and structural concept.

CHAPTER TWO

BRIDGES

A. INTRODUCTION TO BRIDGES

A bridge is a building constructed to span a dip, gap, or obstruction like a river, channel, canyon, valley, road, or railway with vehicles, trains, or other moving goods. The type of bridge is chosen to satisfy the demand based on the objective and the obstruction. A bridge is referred to as a highway bridge if it was built to carry cars, and a railway bridge if it was used to carry trains. Aqueduct bridges are bridges used to transport canals and pipe lines, and foot bridges are bridges built specifically to carry people, bicycles, and animals.

B. BRIDGE CLASSIFICATION

➢ *Based on structural parts moving.*

A bridge can be stationary or moveable. A bridge that can be moved is one that can be opened vertically or horizontally to allow river or channel traffic to pass. A bridge that is fixed is one that is anchored firmly in one place. In situations where the conventional headway is insufficient for passing vehicles, these bridges are constructed across navigable waterways.

➢ *Based On Resting*

A bridge can be either a deck or a through kind. In contrast to deck-type bridges, which place the surface of the road or railroad over the underlying support structure, From bridges place it at the bottom of the main load bearing component.

➢ *Based on Constructions Material*

Different materials, including steel, concrete, brick masonry, and wood masonry, are used to construct bridges. Timber bridges are only built for temporary use across extremely tiny spans and to handle modest weights. Shorter-span masonry bridges can also be built. To bear a variety of loads, pre-stressed cement concrete and reinforced cement concrete are both used in the construction of concrete bridges with moderate to high spans. Like how steel bridges are built across moderate to high spans and for large traffic loads, concrete arch bridges with spans up to 200 meters have also been built.

C. STEEL BRIDGE

The strength and longevity of structural steel above other building materials are its key advantages. When compared to concrete, it gives a better compression strength to cost ratio. Steel has a significantly higher stiffness to weight ratio than concrete. Thus, the use of structural steel in bridge construction is effective and cost-effective.

➢ *STEELS USED IN BRIDES*

The following categories can be used to classify steel used in bridge construction:

- Carbon steel: This is the most affordable steel on the market right now for structural uses where stiffness is more crucial than strength.
- High strength steels: Due of their high strength and other attributes required to add alloying components, these are chosen. These are also referred to as weathering steels in Europe.

The strongest steels are made of carbon steel that has undergone heat treatment. After rolling, they undergo heat treatments called normalizing, quenching, or tampering to increase their strength.

For structural steel to be used in bridge building, it must have certain physical characteristics, including strength, ductility, brittle fracture resistance, weldability, and weather resistance. These characteristics are dependent on the alloying of the steel.

➢ *STEEL BRIDGE CLASSIFICATION*

The following factors can be used to classify steel bridges:

- Classification based on different structural arrangement.
- Categorization based on structural action.
- Classification based on the different kinds of connections.

➢ *CLASSIFICATION BASED ON THE DIFFERENT TYPES OF STRUCTURAL ARRANGEMENTS*

According to this specification, the following kinds of steel bridges are acceptable:

- GRIDER BRIDGES: may serve as the primary load-bearing components of girder bridges when the span is modest. For I-sections with broad flanges are employed for this purpose. I-sections are utilized in these kinds of structural structures, although their maximum size has some restrictions.
- PLATE GIRDER BRIDGE: In order to fulfill Built-up plate girder sections are used for long spans since the section modulus must meet the applied loads. Plate girder bridges are quite common in the railway industry.

  In addition, they are employed for road bridges.
- TRUSS GIRDER BRIDGE: When the depth of the girder is more important for structural reasons than other load-bearing elements. Spans of 20 to 200 meters are frequently covered by truss girder bridges.
- SUSPENSION BRIDGE: A suspension bridge made of high-strength steel cables may be offered for even larger spans.

➢ *CLASSIFICATION ACCORDING TO TYPE OF CONNECTION*

Bridges can be any of the following categories depending on how the joints are connected:

- RIVETED BRIDGE: Historically, riveted bridges have been employed for most welding connections.
- WELDED BRIDGES: Steel bridges are now frequently constructed with welded connections. Apart from the primary joints, welded connections are increasingly more frequently employed for built-up sections and bracing components, particularly in highway bridges, because it is not entirely understood how welded connections behave under impact and vibration.
- BOLTED BRIDGES: Some of the older pin-connected bridges were built, but because they are less rigid and require ongoing care, their construction was abandoned.

D. FOOT OVER BRIDGE

Foot over bridges are used to cross busy streets where it is difficult for pedestrians to do so and to lessen the amount of fatal accidents that take place in high-traffic areas. For pedestrian safety movements, most Indian towns have adopted foot over bridges.

E. DECK SLAB

Depending on their location and required size, steel pedestrian footbridge designs change. Longer spans frequently require a simple beam bridge; however, in this project, the beam's span is greater.

F. STEEL TRUSS

Steel trusses are extensively employed to construct bridges of all sizes throughout the world. It is a beneficial ingredient that provides quick-acting and durable remedies. Steel has long been recognized as the cheapest material for a range of bridges.

It predominates in long span bridges, railway bridges, footbridges, and medium span highway bridges. Highway buildings with shorter spans are now doing the same.

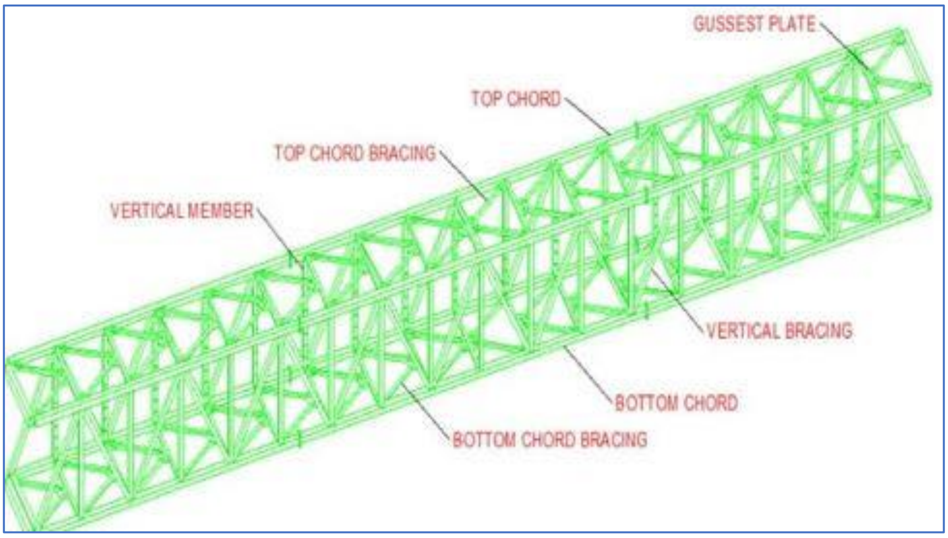

Fig. 2.1: Steel Truss Bridge

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CHAPTER THREE

LITERATURE REVIEW

- A technical analysis and design for a 50-meter-long steel-truss railway bridge were offered by Shubhank Gupta et al. in 2017. To find the least expensive and most stable part, the bridge with equal train applied loads of 32.5 tons was previously divided into several types of truss segments. Design and analysis are carried out using the tool staad pro to compare and pick the best stable pieces for each segment. The structural components of each truss were created in accordance with the Indian Roads Congress Code and Indian Railway Standard Code.
- J. Blanchard, B. L. Davies, J. W. Smith [1, This research suggests a cap on the permissible increasing rate of the footbridge deck, shaking beneath person on foot stacking, based on early investigations of human resistance. The maximum vertical acceleration of a footbridge caused by the linked dynamic stack of a moving man may be calculated using a formula. Finally, computational results demonstrated that the safety of this stacking would be consistently guaranteed by static stacking conditions. Here, wind-related vibration is disregarded.
- Goyal, Pradeep K., and Kumar, Ramesh The design for a steel arch bridge in Jaipur was depicted using Staad Pro by Dhaka in 2017. The 350-meter span, 13.3-meter width, and mean height of 29.977 meter of the research's proposed arch bridge are its dimensions. Wind loads, seismic stress, live loads, and dead loads are all taken into consideration when designing arch bridges. To finalize the design, Staad Pro's structure evaluation and planning tools are combined with Indian requirements.
- The Rochefort-Martrou Transporter Bridge crosses the Charente River.FerdinandArnodin built the Rochefort-Martrou transporter bridge to across the Charente River; it went into operation on July 8th, 1900, and cost 586599 French francs. Its height is 59 meters, and its breadth is 139.916 meters. Between 1933 and 1934, the deck beams and suspension were changed and upgraded. The bridge was suspended by a nearby vertical lift bridge in 1967, putting a stop to its use. It was designated as a historic monument on March 30, 1976, and it underwent renovation in 1996. It is a popular tourist destination and is still in operation.

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CHAPTER FOUR

METHODOLOGY

This project's goal is to outline a foot over scaffold, along with association and foundation areas of interest, and to dissect it. Below these basic requirements are taken into consideration.

Broad writing reviews that referenced books and specialist articles failed to understand the subject's central premise.

- Choosing an appropriate foot over scaffold model.
- Calculating loads and selecting preliminary cross-segments of various auxiliary people.
- Geometrical demonstration and a fundamental analysis of the foot over scaffold for various stacking scenarios in accordance with IS Codal arrangements.
- Results interpretation. For reaching the Aforementioned locations, the following exploration must be finished:
- Using STADD, a foot over bridge is now displayed and examined as a three-dimensional construction.
- STAAD Pro contains cutting-edge restricted component (FEM) and dynamic examination capabilities in addition to cutting-edge UI, perception devices, competent investigation, and plan motors. STAAD genius is the industry standard for everything from show time, investigation, and configuration to representation and outcome validation. Internationally recognized engineers practiced developing STAAD experts. It has been created for more than 20 years and complies with ISO 9001 standards. (STAAD.Pro) or STAAD an auxiliary investigation and outline PC program, was created for the first time in 1997 by Research Engineers International in Yorba Linda, California. Iowa State University uses STAAD-III for Windows, a more seasoned version that Research Engineers International acquired in late 2005, to instruct common and fundamental specialists. It wasutilized for the DOS-Window architecture at first. The corporate version of STAAD Pro is one of the basic research and planning systems that is most frequently utilized. It supports a few restrictions for the configuration of steel, cement, and wood.
- **Arrangement of Foot Over Bridge**
  A 43-meter-high footbridge is studied and planned. The tower's configuration is as follows:
  Bridge span is 43 meters.
  Bridge height is 7.5 meters.
  Walkway width: 3 meters
  Each truss has a 3 m separation.

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CHAPTER FIVE

ANALYSIS AND DESIGN

Staad Pro is utilized during the analysis and design processes.

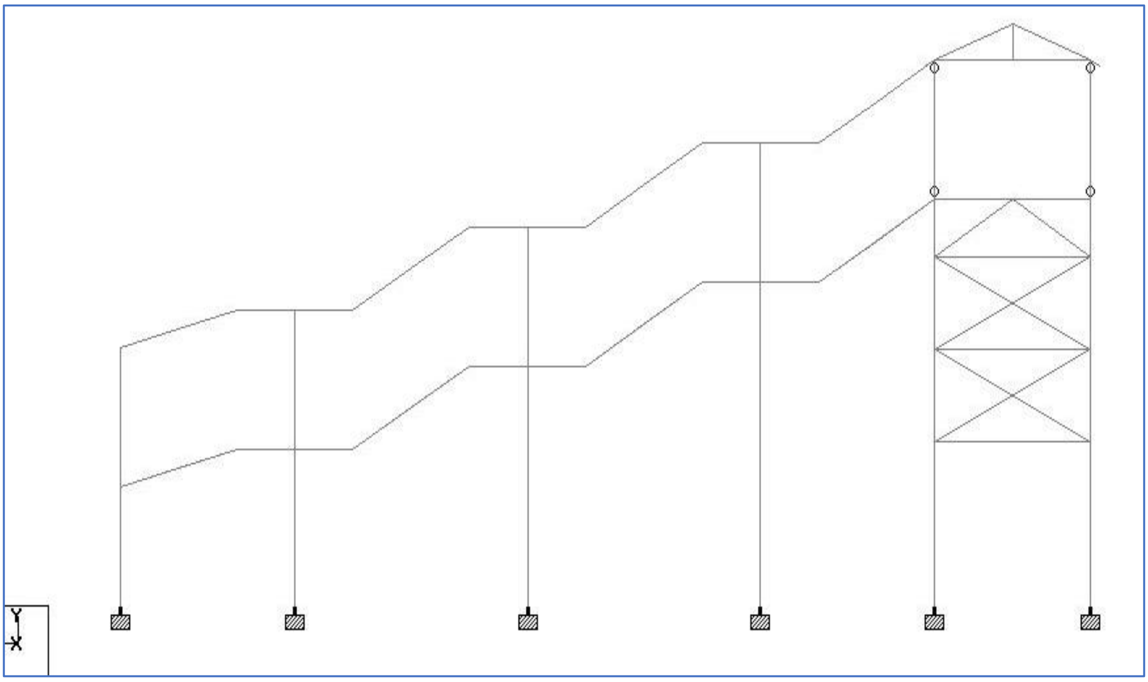

Fig. 5.1: Side View Of Foot Over Bridge

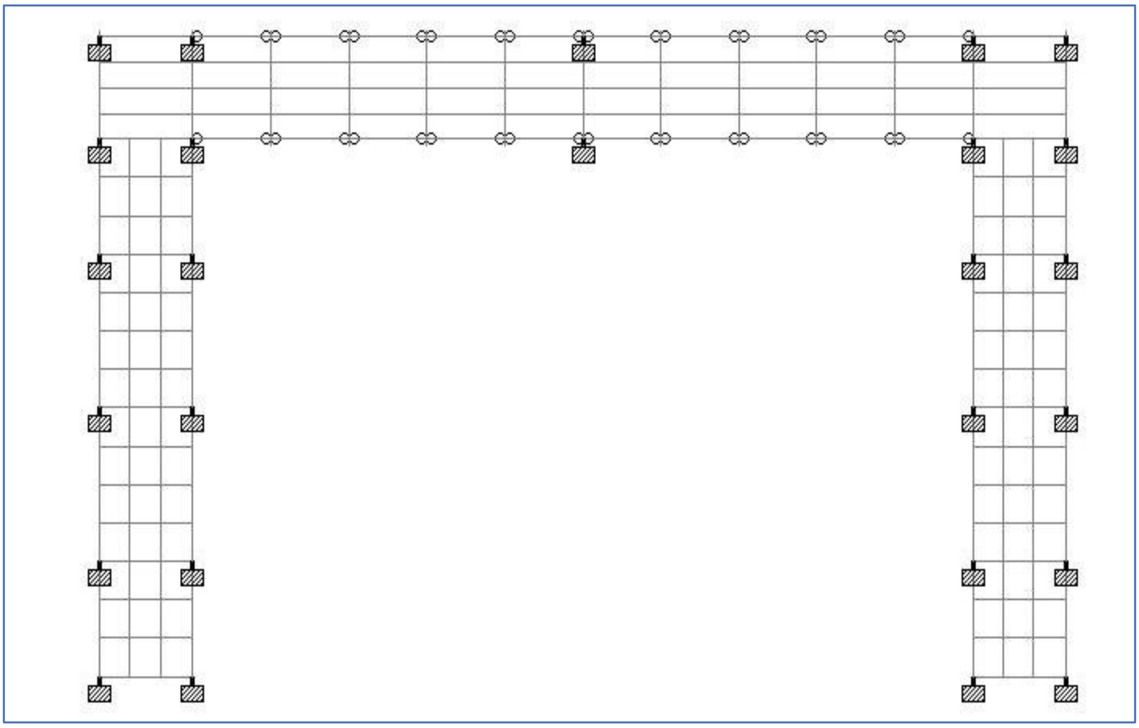

Fig. 5.2: Top View Of Foot Over Bridge

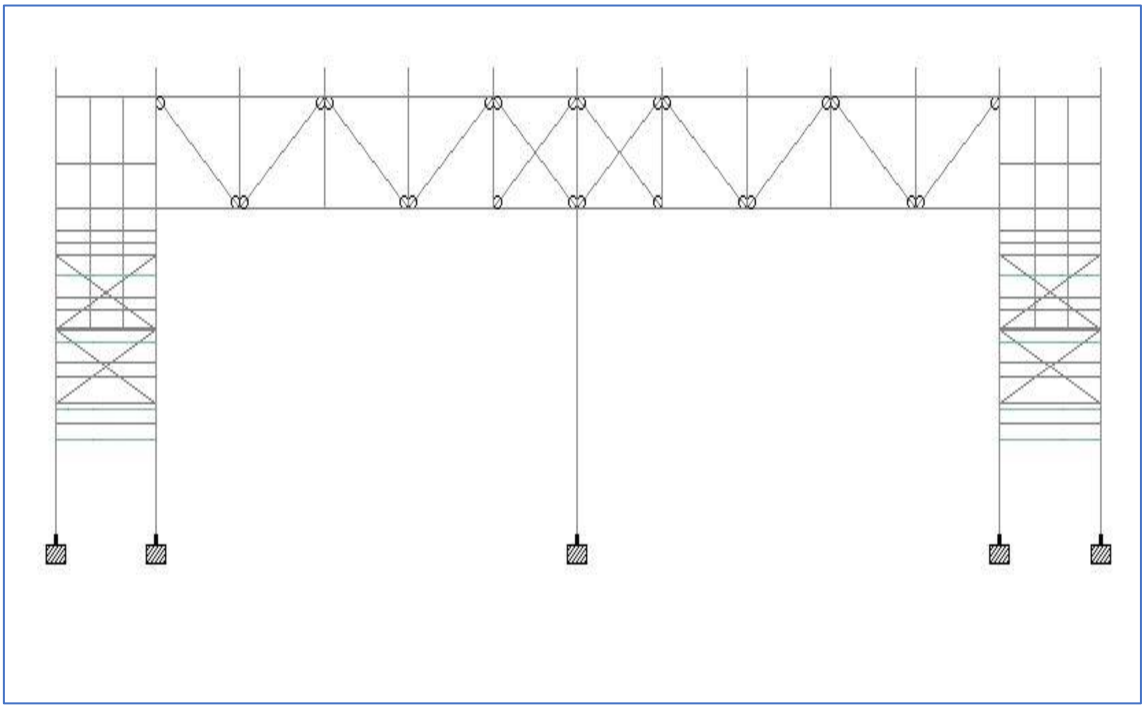

Fig. 5.3: Front View of Foot over Bridge

Staad Pro was used to make a model of the Foot over Bridge, and the distance between the nodes is shown by the lines linking them.

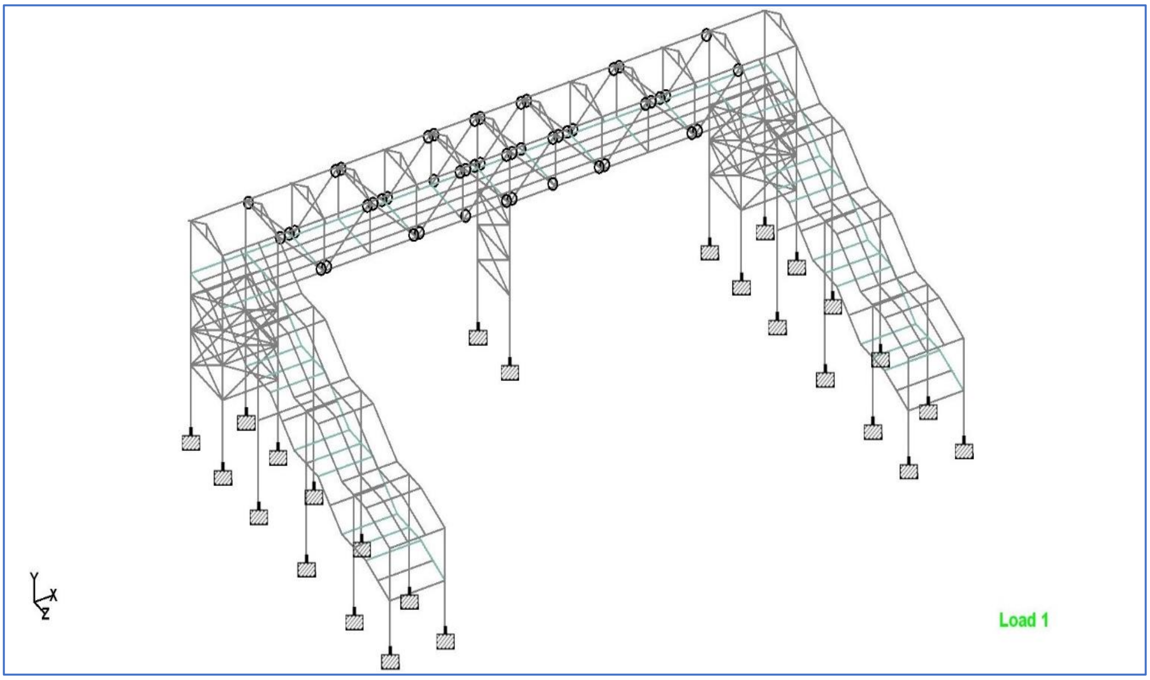

Fig. 5.4: Structural Modal

STAAD Pro software was used to draw the structure model displayed in the previous illustration. In order to properly execute the nodes, the software's X, Y, and Z axes are used to create the nodes. Once the nodes have been coordinated, they are connected using the "Add Beam" option in the toolbar. By choosing this, you can join the nodes to form a beam or column element. This structure has beencreated using a series of nodes.

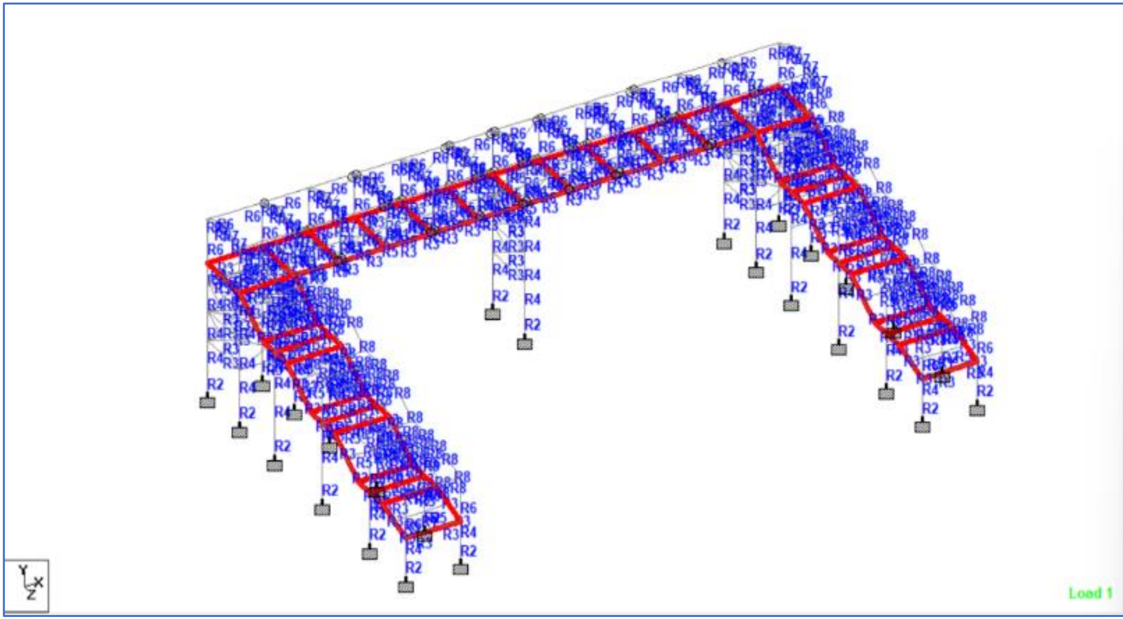

Figure – 5.5 (Show Loading of Structure)

Supports

Node	X (kip/in)	Y (kip/in)	Z (kip/in)	rX (kip ft/deg)	rY (kip ft/deg)	rZ (kip ft/deg)
37	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
38	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
39	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
40	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
41	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
42	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
43	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
44	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
45	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
46	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
47	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
48	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
50	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
51	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
52	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
53	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
55	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
56	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
57	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
58	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
60	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
61	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
62	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
65	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
66	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
83	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

Table 5.1: (Type of Support)

As diverse steel structural sections and other characteristics can be observed in the 3D rendering view in the Staad pro software. The Following Elements Make Up the Model.

Total Number of Nodes	637
Total Number of Beams	1110
Total Number of Plates	868

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In this case, steel plates with a 2 mm thicKNess are utilized as a floor to support the area loads and movement loads on the bridge, according to the specifications set to the construction by the staad pro software.

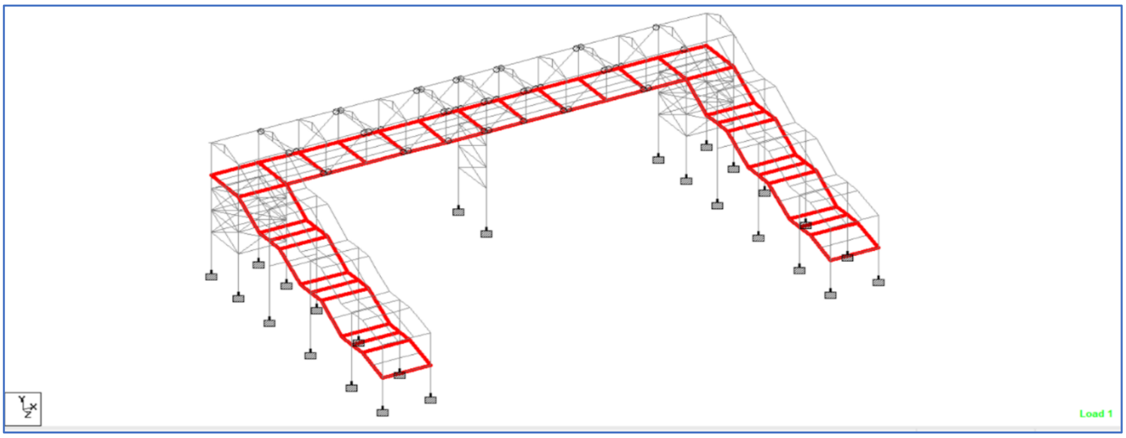

Fig. 5.6: (Base Plate)

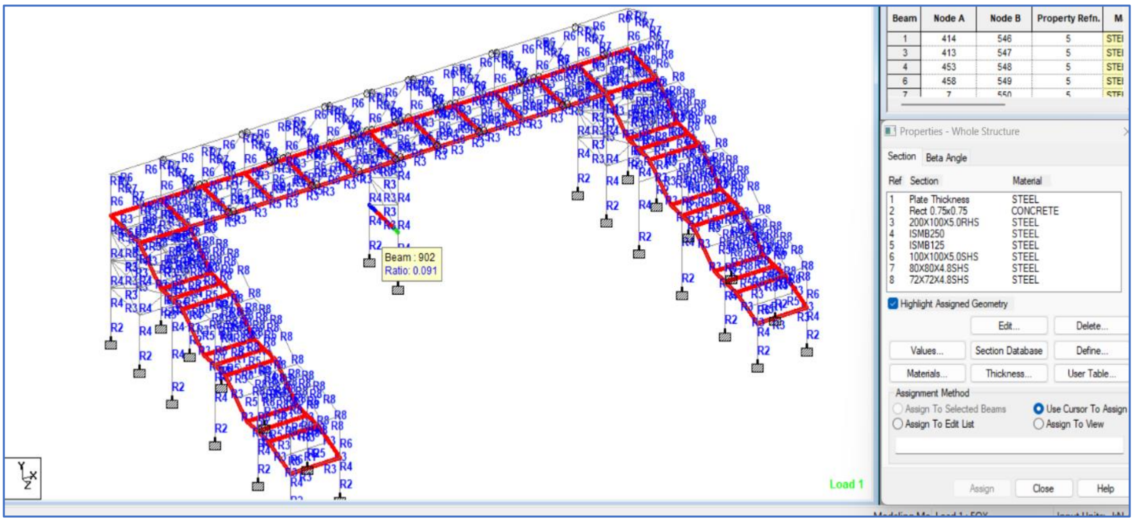

Fig. 5.7: (Property of Steel)

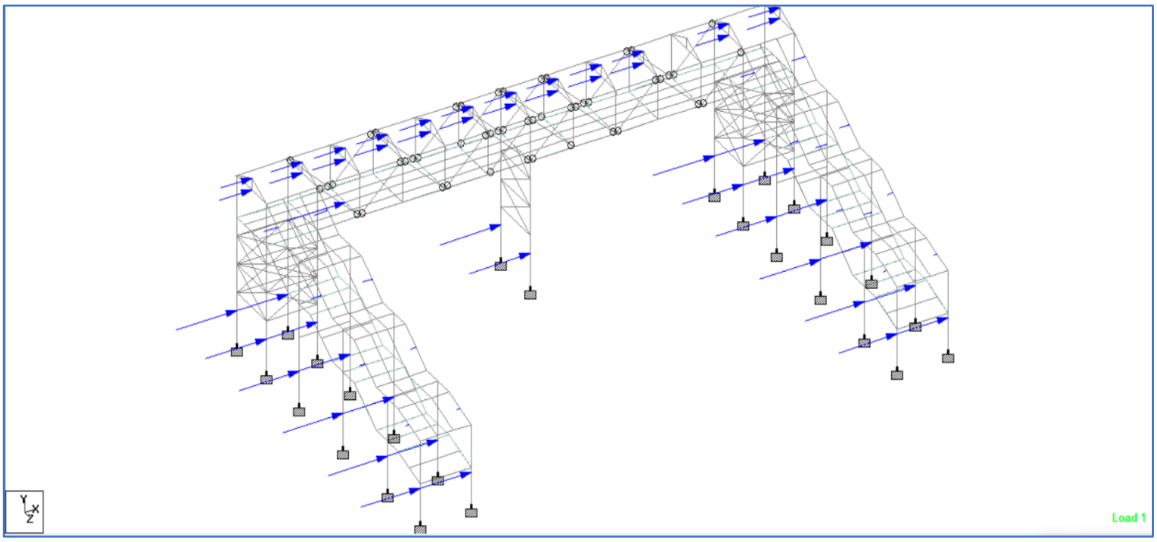

Fig. 5.8: (Seismic Direction)

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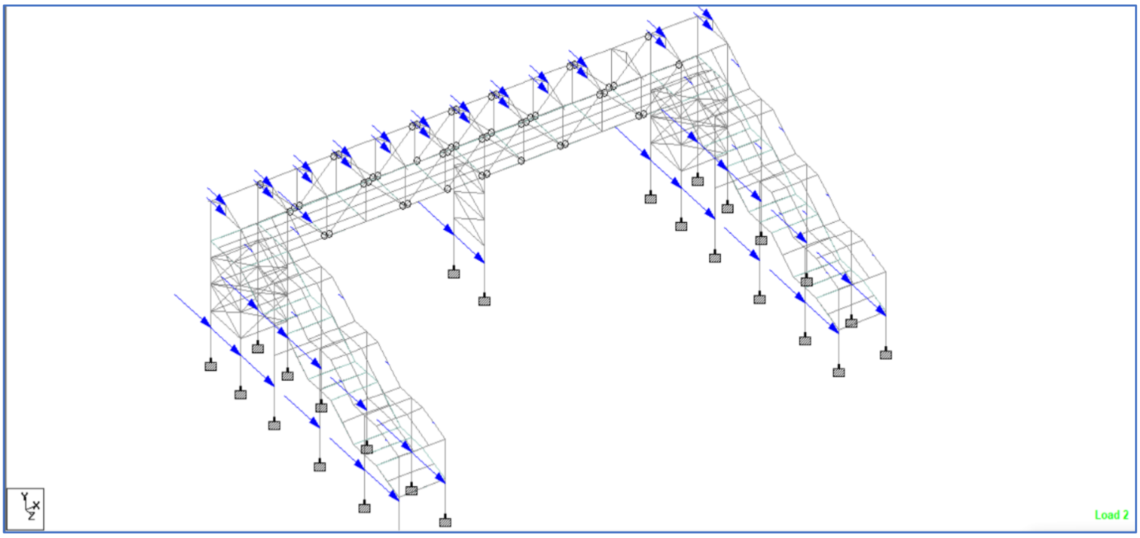

Fig. 5.9: (Seismic Direction)

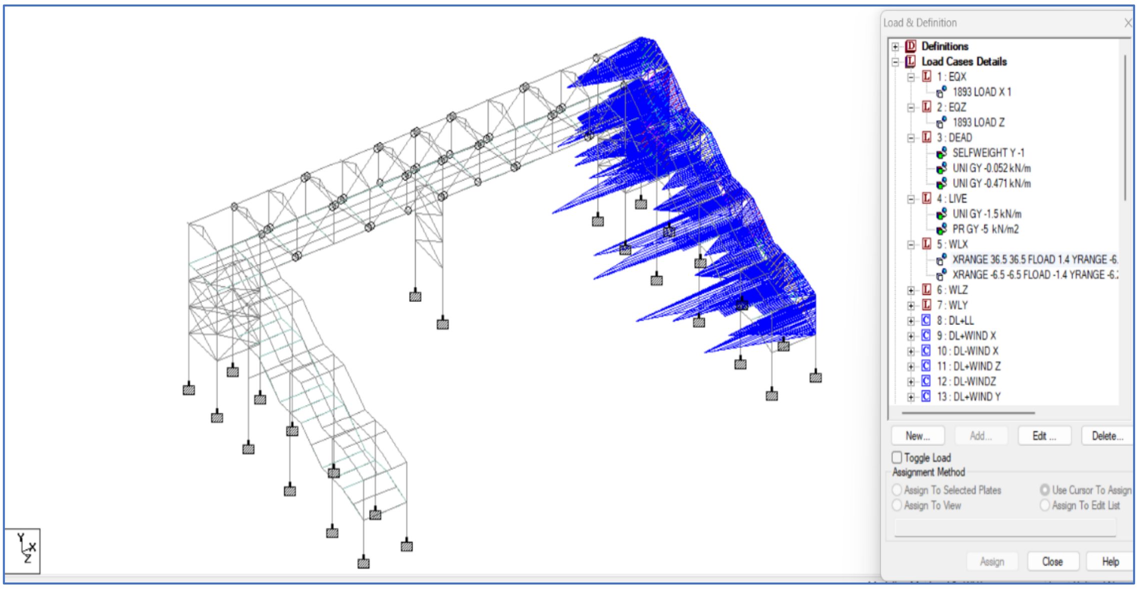

Fig. 5.10: (Wind Loading)

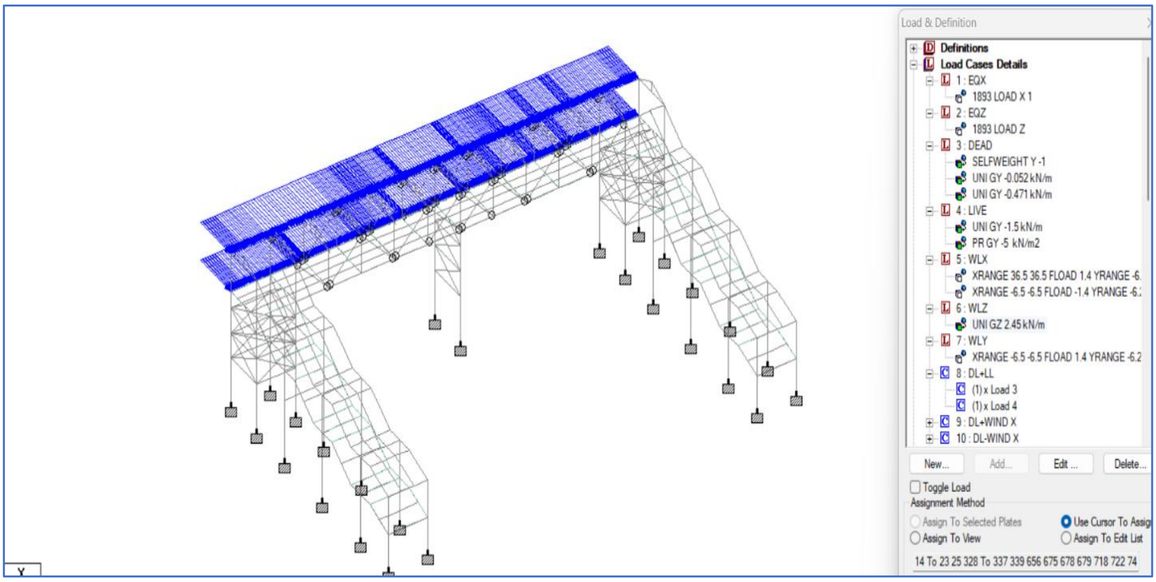

Fig. 5.11: (Wind Loading)

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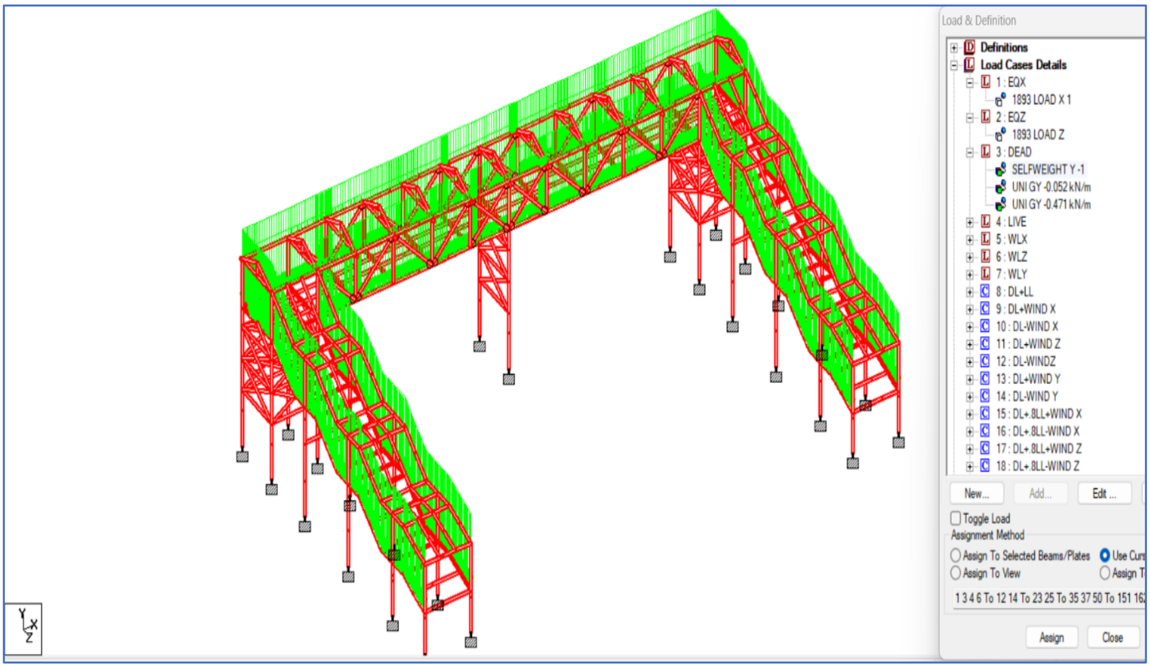

Fig. 5.12: (Dead Load On Structure)

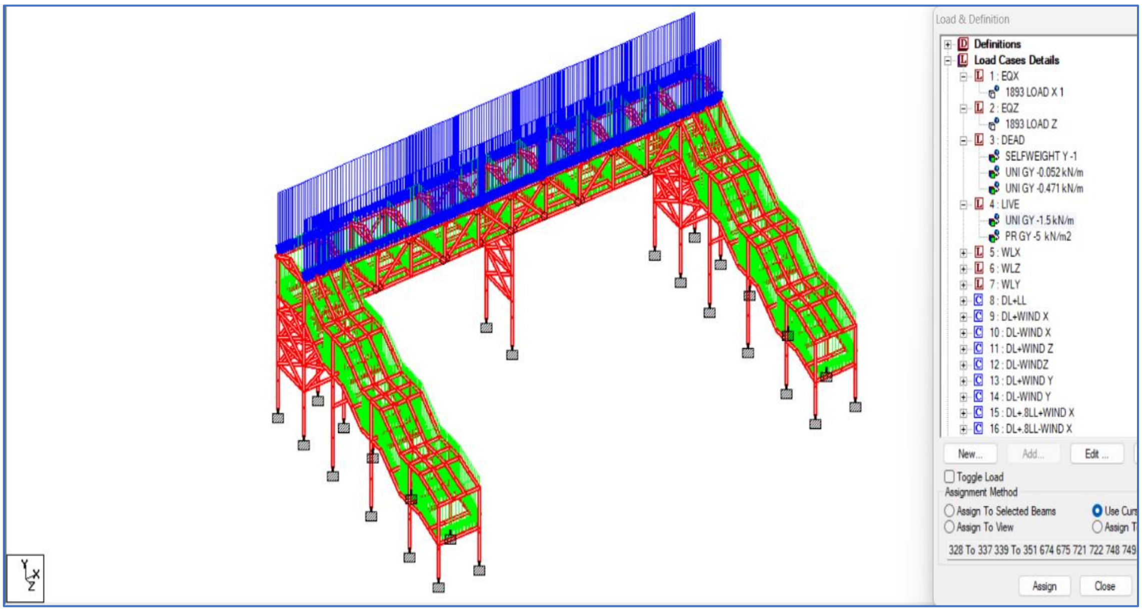

Fig. 5.13: (All Loads)

The red lines in this illustration depict the steel beams and column bending moments that were determined through structural analysis. The process of building a structural model begins with the creation of the model, followed by the assignment of its properties, loading conditions, and analysis to be used in the post-processing and designing of the structure.

When the analysis is finished, the software provides an output file with the results, detailing each member's stress and strain reactions and whether it is safe to proceed with additional design work on that member. From there, the analysis moves on to the next stage.

If the member fails, the output of such elements is not visible on the modeling view, but the given deflection and bending moments are shown in the output file. The given bending moment is given in millimeters in both the figure and the output report.

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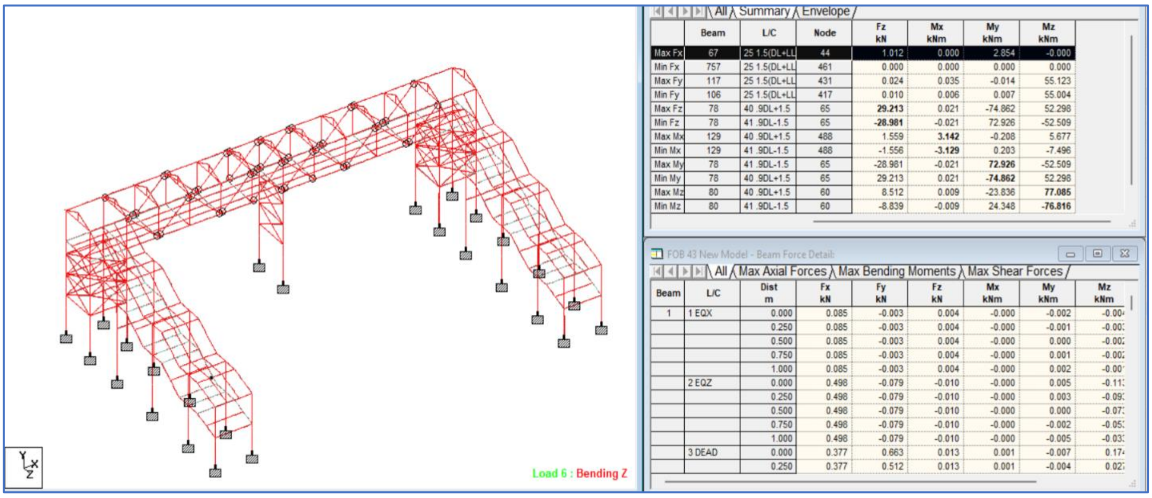


	Beam	L/C	Node	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	67	25 1.5(DL+LL	44	1.012	0.000	2.854	-0.000
Min Fx	757	25 1.5(DL+LL	461	0.000	0.000	0.000	0.000
Max Fy	117	25 1.5(DL+LL	431	0.024	0.035	-0.014	55.123
Min Fy	106	25 1.5(DL+LL	417	0.010	0.006	0.007	55.004
Max Fz	78	40 .9DL+1.5	65	29.213	0.021	-74.862	52.298
Min Fz	78	41 .9DL-1.5	65	-28.981	-0.021	72.926	-52.509
Max Mx	129	40 .9DL+1.5	488	1.559	3.142	-0.208	5.677
Min Mx	129	41 .9DL-1.5	488	-1.556	-3.129	0.203	-7.496
Max My	78	41 .9DL-1.5	65	-28.981	-0.021	72.926	-52.509
Min My	78	40 .9DL+1.5	65	29.213	0.021	-74.862	52.298
Max Mz	80	40 .9DL+1.5	60	8.512	0.009	-23.836	77.085
Min Mz	80	41 .9DL-1.5	60	-8.839	-0.009	24.348	-76.816

Beam	L/C	Dist m	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	1 EQX	0.000	0.085	-0.003	0.004	-0.000	-0.002	-0.00
		0.250	0.085	-0.003	0.004	-0.000	-0.001	-0.00
		0.500	0.085	-0.003	0.004	-0.000	0.000	-0.00
		0.750	0.085	-0.003	0.004	-0.000	0.001	-0.00
		1.000	0.085	-0.003	0.004	-0.000	0.002	-0.00
	2 EQZ	0.000	0.498	-0.079	-0.010	-0.000	0.005	-0.11
		0.250	0.498	-0.079	-0.010	-0.000	0.003	-0.09
		0.500	0.498	-0.079	-0.010	-0.000	0.000	-0.07
		0.750	0.498	-0.079	-0.010	-0.000	-0.002	-0.05
		1.000	0.498	-0.079	-0.010	-0.000	-0.005	-0.03
	3 DEAD	0.000	0.377	0.663	0.013	0.001	-0.007	0.17
		0.250	0.377	0.512	0.013	0.001	-0.004	0.02

Fig. 5.14: (Bending Moment)

In the picture above, member displacements are presented after the structure has been loaded and evaluated. The findings are then displayed in accordance with the loading on the structure, and more displacements are shown on the structure. Particularly, each and every member can be examined by selecting the member, and each element's properties and deflection are KNown. If a member fails, we can change its member properties and add more properties from the section database to increase its strength. Therefore, this result demonstrates the displacement of the members and may be corrected by being aware of the output results.

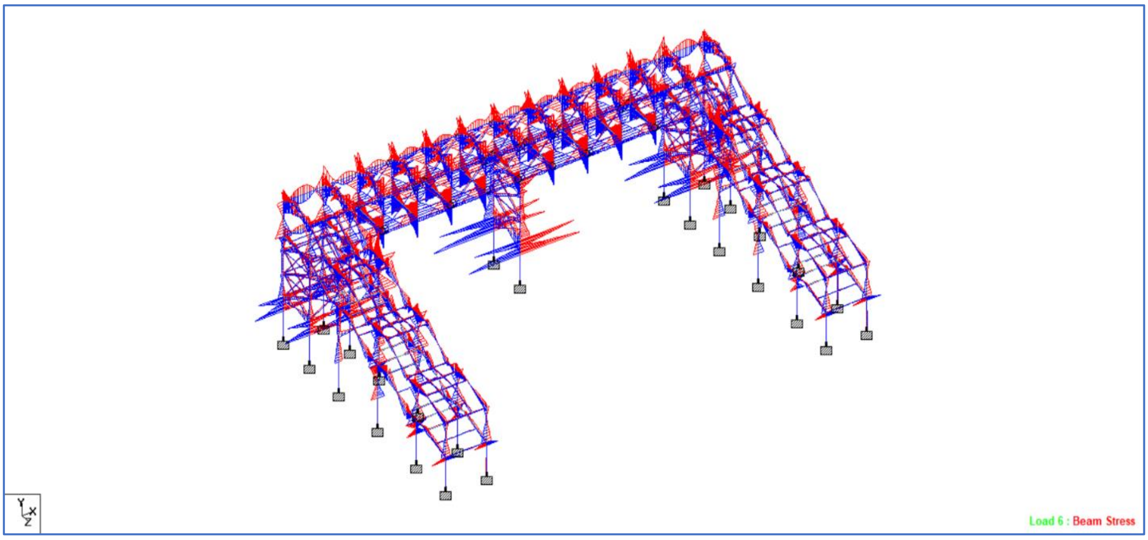


Fig. 5.15: (Beam Stress Graph)

Figure depicts the stresses placed on each beam during the analysis of the structure; the figure's output depicts how each beam responded to the loads. The beams of the staircase are the most affected element in this diagram, where the red lines indicate negative stressand the blue lines indicate positive bending stress. The pattern formed according to the strains placed on the member; the greater the rise, the greater the stress placed on that member; hence, by being aware of this, additional analysis and design processes are initiated.

Every single member can be shown with its stresses clearly in the modeling view, allowing us to understand how the load is acting.on that specific member, we can either utilize this to improve or adjust the member's attributes and lessen the stresses that are imposed on the member, or we may use the staad pro program to shorten the clear span of the model.

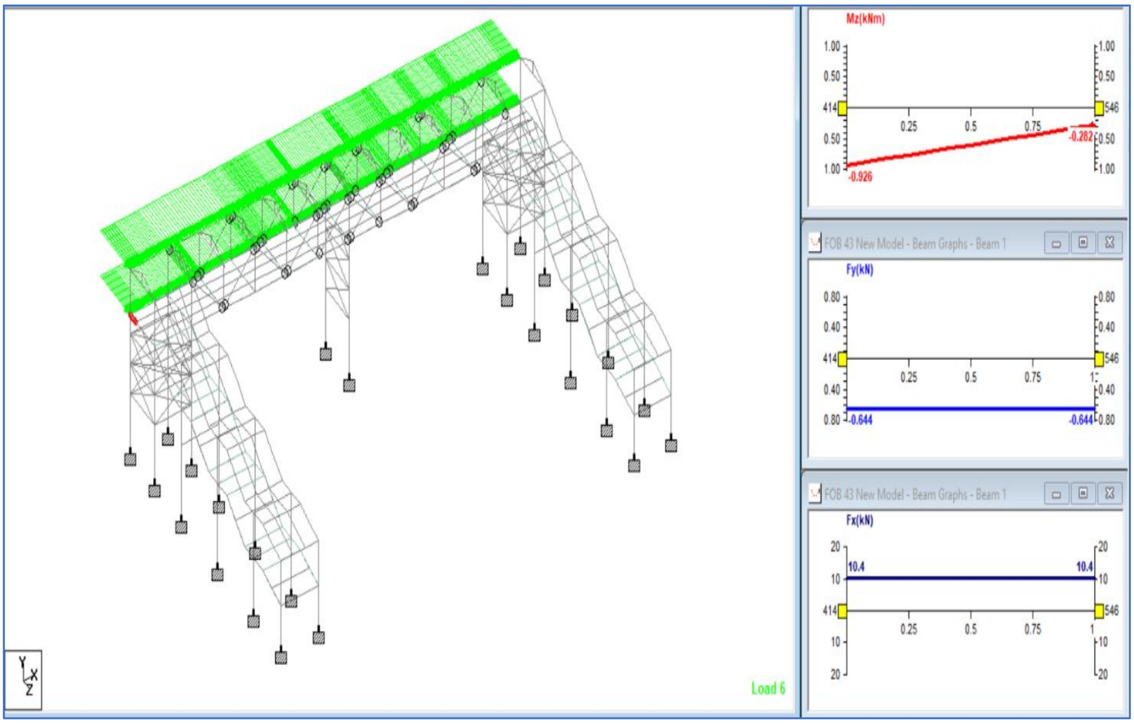
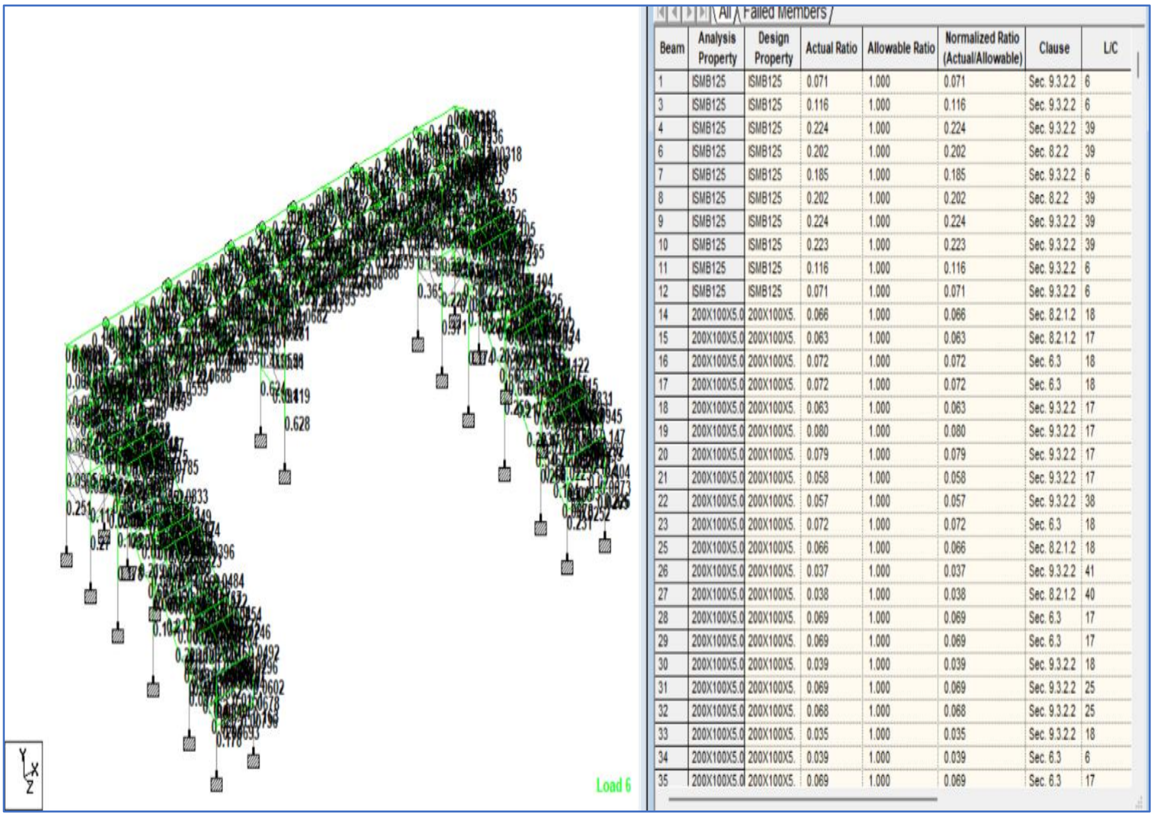


Fig. 5.16: (Graph of B/M & S/F)



Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Normalized Ratio (Actual/Allowable)	Clause	L/C
1	ISMB125	ISMB125	0.071	1.000	0.071	Sec. 9.3.2.2	6
3	ISMB125	ISMB125	0.116	1.000	0.116	Sec. 9.3.2.2	6
4	ISMB125	ISMB125	0.224	1.000	0.224	Sec. 9.3.2.2	39
6	ISMB125	ISMB125	0.202	1.000	0.202	Sec. 8.2.2	39
7	ISMB125	ISMB125	0.185	1.000	0.185	Sec. 9.3.2.2	6
8	ISMB125	ISMB125	0.202	1.000	0.202	Sec. 8.2.2	39
9	ISMB125	ISMB125	0.224	1.000	0.224	Sec. 9.3.2.2	39
10	ISMB125	ISMB125	0.223	1.000	0.223	Sec. 9.3.2.2	39
11	ISMB125	ISMB125	0.116	1.000	0.116	Sec. 9.3.2.2	6
12	ISMB125	ISMB125	0.071	1.000	0.071	Sec. 9.3.2.2	6
14	200X100X5.0	200X100X5.	0.066	1.000	0.066	Sec. 8.2.1.2	18
15	200X100X5.0	200X100X5.	0.063	1.000	0.063	Sec. 8.2.1.2	17
16	200X100X5.0	200X100X5.	0.072	1.000	0.072	Sec. 6.3	18
17	200X100X5.0	200X100X5.	0.072	1.000	0.072	Sec. 6.3	18
18	200X100X5.0	200X100X5.	0.063	1.000	0.063	Sec. 9.3.2.2	17
19	200X100X5.0	200X100X5.	0.080	1.000	0.080	Sec. 9.3.2.2	17
20	200X100X5.0	200X100X5.	0.079	1.000	0.079	Sec. 9.3.2.2	17
21	200X100X5.0	200X100X5.	0.058	1.000	0.058	Sec. 9.3.2.2	17
22	200X100X5.0	200X100X5.	0.057	1.000	0.057	Sec. 9.3.2.2	38
23	200X100X5.0	200X100X5.	0.072	1.000	0.072	Sec. 6.3	18
25	200X100X5.0	200X100X5.	0.066	1.000	0.066	Sec. 8.2.1.2	18
26	200X100X5.0	200X100X5.	0.037	1.000	0.037	Sec. 9.3.2.2	41
27	200X100X5.0	200X100X5.	0.038	1.000	0.038	Sec. 8.2.1.2	40
28	200X100X5.0	200X100X5.	0.069	1.000	0.069	Sec. 6.3	17
29	200X100X5.0	200X100X5.	0.069	1.000	0.069	Sec. 6.3	17
30	200X100X5.0	200X100X5.	0.039	1.000	0.039	Sec. 9.3.2.2	18
31	200X100X5.0	200X100X5.	0.069	1.000	0.069	Sec. 9.3.2.2	25
32	200X100X5.0	200X100X5.	0.068	1.000	0.068	Sec. 9.3.2.2	25
33	200X100X5.0	200X100X5.	0.035	1.000	0.035	Sec. 9.3.2.2	18
34	200X100X5.0	200X100X5.	0.039	1.000	0.039	Sec. 6.3	6
35	200X100X5.0	200X100X5.	0.069	1.000	0.069	Sec. 6.3	17

Fig. 5.17 (Utility Check)

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Table 5.2: (Loading Summary)

L/C		Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	Loads	20.368	0.000	0.000	0.000	167.451	60.413
	Reactions	-20.368	0.000	-0.000	0.000	-167.451	-60.413
	Difference	0.000	0.000	-0.000	0.000	0.000	-0.000
2	Loads	0.000	0.000	20.368	-60.413	-310.158	0.000
	Reactions	0.000	-0.000	-20.368	60.413	310.158	-0.000
	Difference	0.000	-0.000	0.000	0.000	-0.000	-0.000
3	Loads	0.000	-1310.662	-0.000	12615.106	0.000	-20578.080
	Reactions	-0.000	1310.662	0.000	-12615.106	-0.000	20578.080
	Difference	-0.000	0.000	-0.000	-0.000	0.000	0.000
4	Loads	0.000	-1860.821	0.000	14880.162	0.000	-29214.882
	Reactions	-0.000	1860.821	-0.000	-14880.162	0.000	29214.882
	Difference	-0.000	-0.000	-0.000	-0.000	0.000	0.000
5	Loads	147.840	0.000	0.000	0.000	1389.178	256.640
	Reactions	-147.840	0.000	-0.000	0.000	-1389.178	-256.640
	Difference	0.000	0.000	-0.000	0.000	0.000	-0.001
6	Loads	0.000	0.000	203.840	305.760	-3200.289	0.000
	Reactions	0.000	-0.000	-203.840	-305.760	3200.289	-0.000
	Difference	0.000	-0.000	0.000	-0.000	0.000	-0.000
7	Loads	0.000	0.000	0.000	0.000	0.000	0.000
	Reactions	0.000	0.000	0.000	0.000	0.000	0.000
	Difference	0.000	0.000	0.000	0.000	0.000	0.000

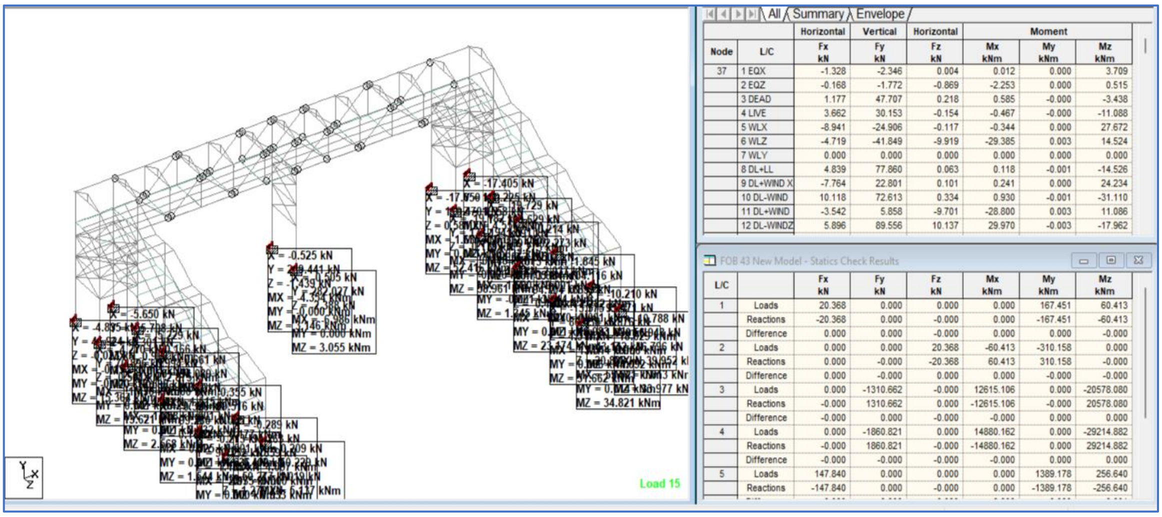

Fig. 5.18: (Reaction on Support)

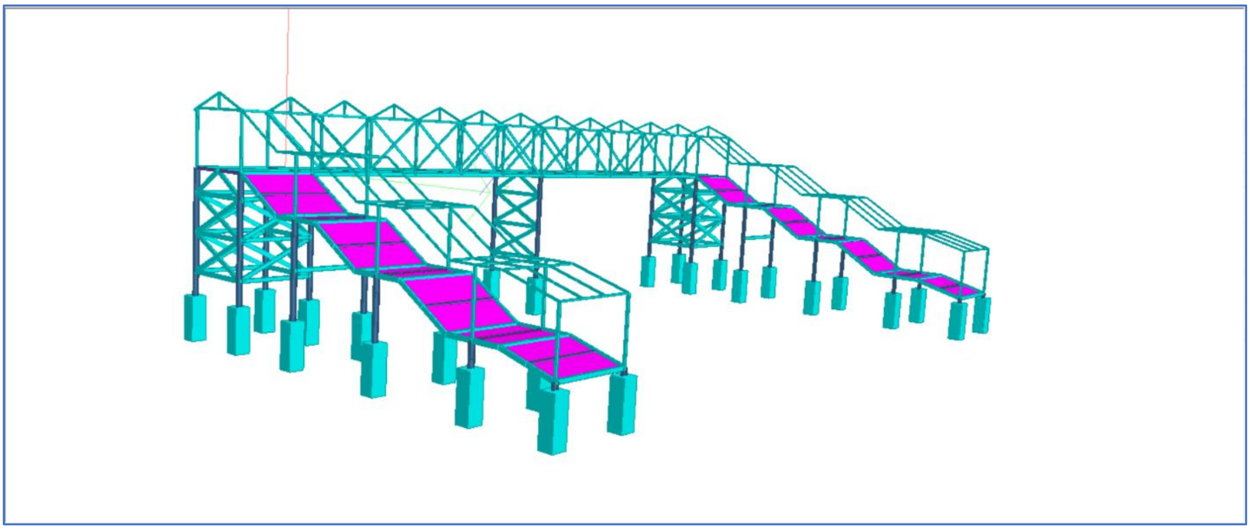

Fig. 5.19: (3D Modal)

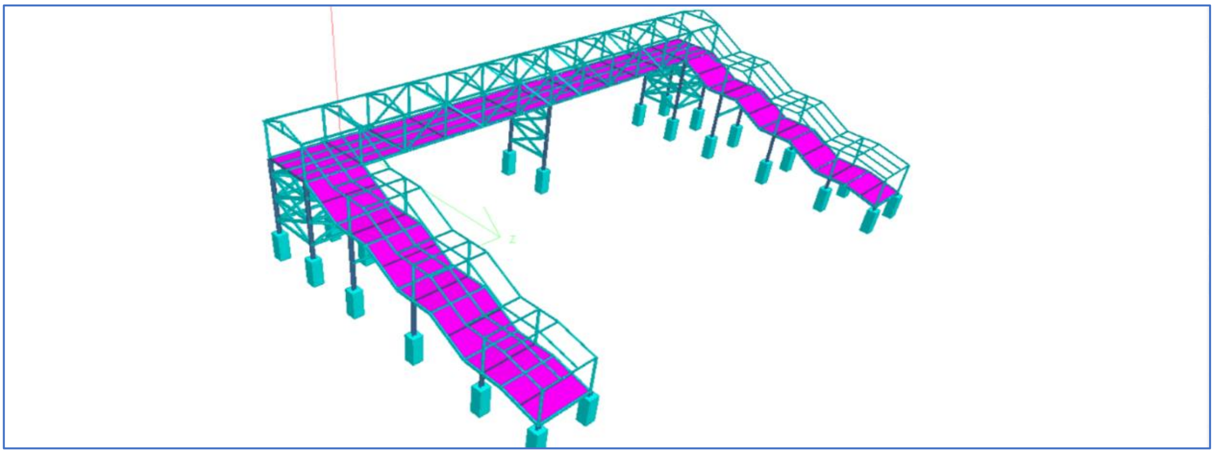

Fig. 5.20: (Side View of 3d Modal)

CHAPTER SIX

DESIGN OF FOOTING

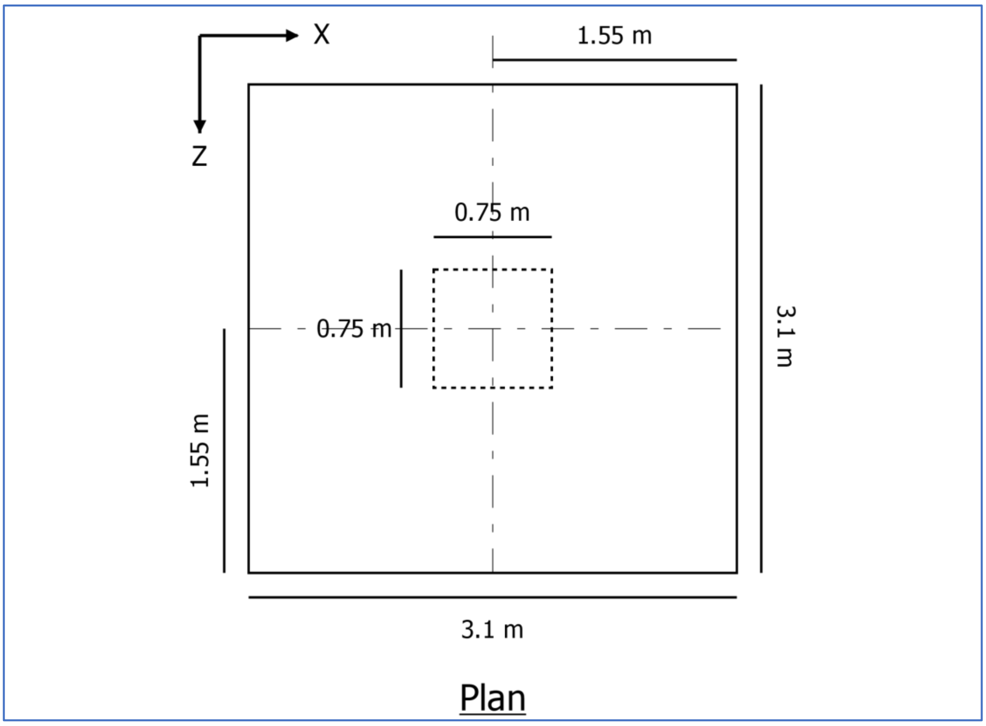

Fig. 6.1

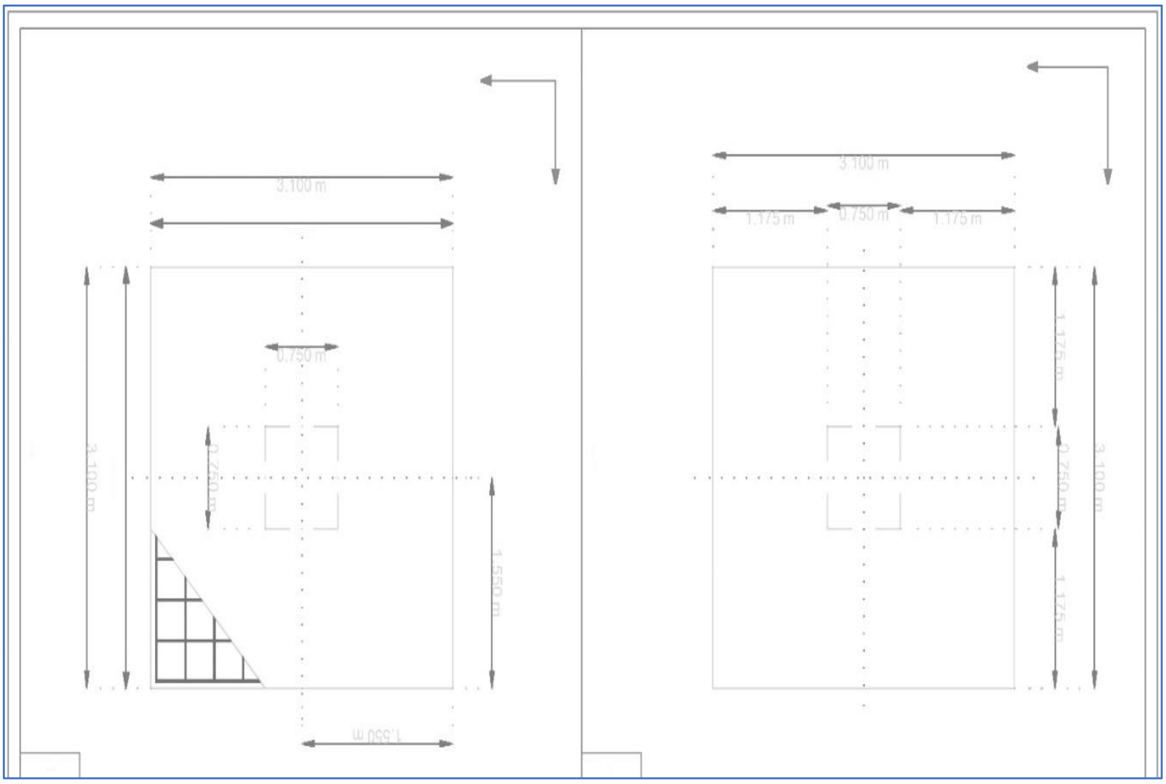

Fig. 6.2: Section of Footing

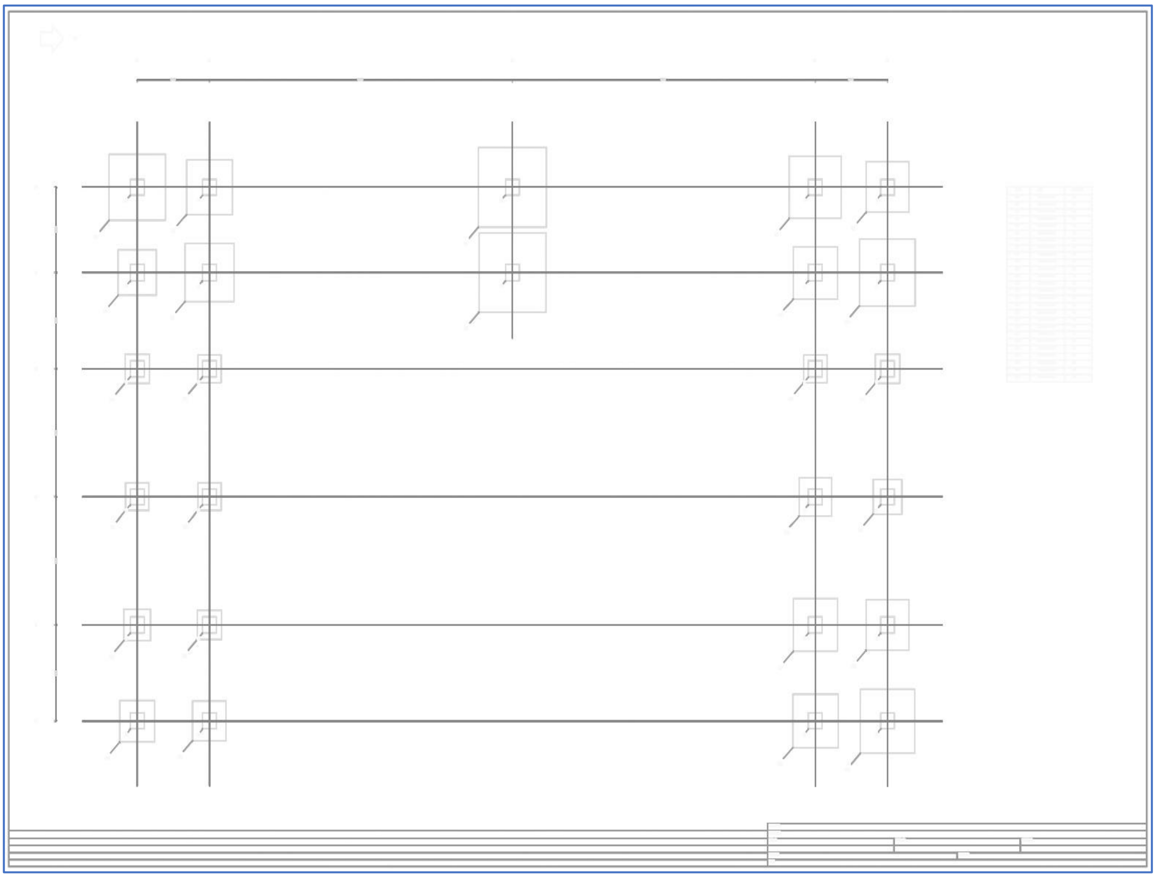

Fig. 6.3: Footing Plan

A. Input Data

footing geometry type minimums as a starting point	=	calculate dimensions using user-specified
The Minimum Footing WidthZ (Fw)	=	900 mm
the minimum footing length (X(Fl))	=	900 mm
the minimum footing Thickness (in mm)	=	305 mm
eccentricity along X	=	0.00 mm
eccentricity along z	=	0.00 mm
Dimensions of Column		
Shape of Column	=	Rectangular
Length of Column	=	.75 M
Width Of Column	=	.75 m
Pedestal		
Pedestal Include	=	No
Design Parameter		
Concrete and Rebar Property		
Unit Weight of Concrete	=	23.60KN/M3
Concrete Strength	=	28 N/MM2
Steel Yield Strength	=	415 N/MM2
Minimum Size of Bar	=	12 mm
Maximum Size of Bar	=	60 mm

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Minimum Size of Pedestal Bar	=	6 mm
Maximum Size of Pedestal Bar	=	32 mm
Minimum Spacing Of Bar	=	50 mm
Maximum Spacing of Bar	=	450 mm
Clear Cover Of pedestal	=	50 mm
Clear cover of footing	=	50 mm

Soil Properties

Type Of Soil	=	Cohesive
Unit Weight of Soil	=	17.60 KN/M3
Bearing Capacity of Soil	=	120.00 kPa
ultimate loads For bearing capacity of soil	=	2.00
Type Bearing Capacity of Soil	=	Gross Bearing Capacity
Soil Surcharge	=	0.00 KN/M2
Height of Soil	=	500.00 mm
Depth Type	=	Fixed
Top Cohesion	=	0.00 KN/M2

Minimum Slab Area in Contact for Service Loads Percentage	=	0.00
Minimum Slab Area in Contact for Ultimate Loads Percentage	=	0.00

B. OVERTURNING AND SLIDING

Friction Coefficient	=	0.5
Safety Factor Against Sliding	=	1.5
factor of safety against overturning	=	1.5

C. FINAL FOOTING MEASURMENT

Footing Weight + Pedestal	=	69.17KN
Soil Weight above footing	=	79.62KN
Buoyancy Uplift Force	=	0KN
Effect of adhesion	=	0KN

Critical Load case and governing safety factor for tipping and sliding in the X direction.

Length	=	3.1 MTR
Width	=	3.1 MTR
Depth	=	.3 MTR
Area	=	9.61 M2

The Ultimate Load Case controls depth.

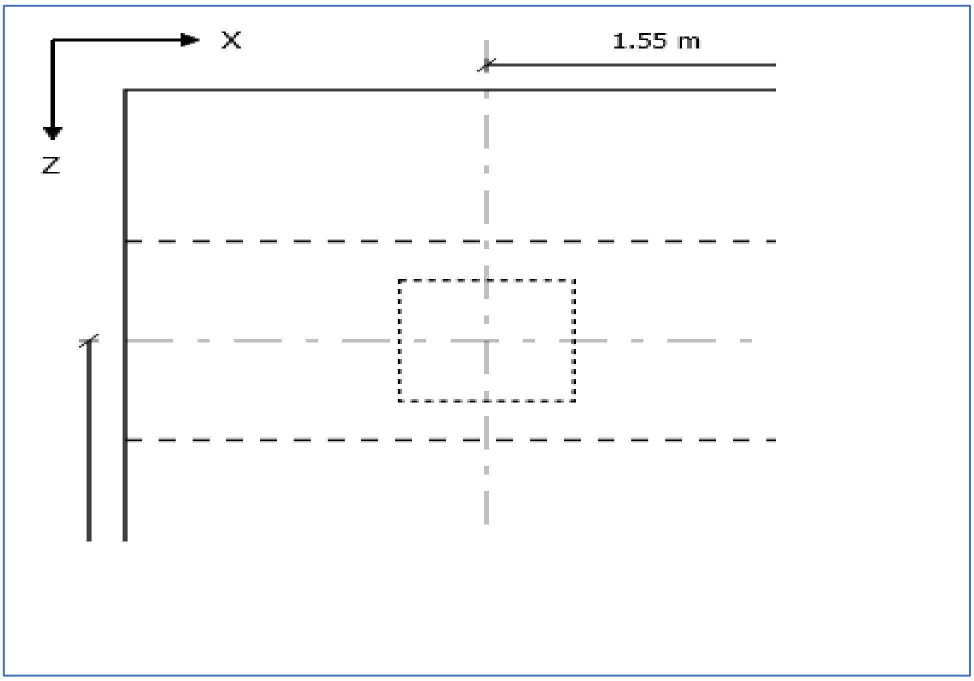
Final Height of soil	=	0.50 meters,
critical load case for sliding along X-direction	=	131 kilograms.
the governing disruptive force	=	12.95 KN
Governing Restoring Force	=	25.57 KN
Sliding Ratio Minimum for the Critical Load Case	=	1.97
the Critical Load Case for Overturning About X-Direction		131
Overturning Governing Moment:	=	32.40 KNm
resisting moment	=	122.16 KNm,
Critical Load Case Minimum Overturning Ratio:	=	3.77

Critical Load Case and the Overturning and Sliding Z Direction Safety Governing Factor

Case of Critical Load for Sliding in the Z-Direction = 131

Disturbing Force in Government	=	9.91KN
Regulation of Restoring Force	=	25.57 KN
For the Critical Load Case, the Minimal Sliding Ratio		2.58
Critical Load Case for Z-Directional Overturning	=	131
The Governing Overturning Moment	=	16.31KN
Minimum Overturning Ratio for the Critical Load Case		1.57
The Governing Resisting Moment	=	25.57 KN

Moment Calculation
Check Depth Again Moment



Critical Load =

Effective Depth = D-(cc+1.5xdb) = .24m

Governing Moment = 72.53KN-M

From IS 456:2000

Limiting factor	=	700(1100+(.87 x fy))	=.48
Limiting factor 2	=	.36 x fck x KUmaxx (.42 x KUmax)	= 3857.61 KN/M2
Resistant of limiting moment	=	RU max x B x d2	=671.69KNM

$M_u <= M_{umax}$ hence, safe

Check Trial Depth against moment (About X Axis)

Effective Depth	=	D-(cc+1.5 × db)	=	0.24
Mu	=		=	60.22

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From IS 456:2000

Limiting factor	=	700(1100+(.87 x fy))	=.48
Limiting factor 2	=	.36 x fck x KUmaxx (.42 x KUmax)	= 3857.61 KN/M2
Resistant of limiting moment	=	RU max x B x d2	=671.69KNM

M_u<= M_{umax} hence, safe

Critical Load no = #215

Critical section's distance along Z and DZ from the top left corner	= .94 m
Shear Stress (Tv)	=107.85 KN/M2
Shear Force (S)	=79.24KN
Steel Content (Pt)	=0.1847

Clause 40 of IS 456 2000, Table 19

Concrete's Shear Strength (Tc) = 321.30KN/M2

According to IS456 -2000 Clause No. 40.5.1, Shear Enhancement Factor (if considered) is applied Tv<(Tc) hence, safe

Critical Case Load = #215

Critical section's distance along X, DX from the top left corner	=	94 m
Shaping Force(S)	=	94.77KN
Steel Content As A Percentage	=	.18
Shear Stress (Tv)	=	128.99KN/M2

According to IS 456 2000 Clause 40 Table 19

Shear Strength of Concrete (Tc) = 321.30 KN/M2

Shear Enhancement Factor (if considered) is added to (Tc), in accordance with IS 456 -2000 Clause No. 40.5.1 and Fig. 24

Tv<Tc, making the structure safe.

Critical Case Load = #215

Critical section's distance along X, DX from the top left corner	=	94 m
Shaping Force(S)	=	94.77KN
Steel Content As A Percentage	=	.18
Shear Stress (Tv)	=	128.99KN/M2

According to IS 456 2000 Clause 40 Table 19

Shear Strength of Concrete (Tc) = 321.30 KN/M2

Shear Enhancement Factor (if considered) is added to (Tc), in accordance with IS 456 -2000 Clause No. 40.5.1 and Fig. 24

Tv<Tc, making the structure safe.

the Critical Load Case = #215

shear force (S) is 173.52 KN

shear stress (Tv) is 179.78 KN/M2.

As stated in IS 456 2000 Clause 31.6.3.1,

Ks is equal to min [0.5+,1] = 1.00.

Shear Strength (Tc) = 0.25×fck = 1322.88 KN/M2

Ks x Tc = 1322.88 KN/M2

Tv<= Ks x Tc hence, safe

Reinforcement Calculation

Determining the maximum bar size

on the X axis

Bar diameter equal to maximum bar size (db): 25 mm

as per Clause 26.2.1 of IS 456 2000

Growth Length(ld) = db×0.87×fy4×bd = 0.95 m

Length Allowed (ldb) = (B-b)2-cc = 1.12 m

Safe since ldb>= ld.

on the Z axis

Bar diameter equal to maximum bar size(db): 25 mm

as per Clause 26.2.1 of IS 456 2000

Growth Length(ld) = db×0.87×fy4×bd = 0.95 m

Length Allowed (ldb) = (H-h)2-cc = 1.12 m

Safe since ldb>= ld.

About X-Axis Flexure

Design for Parallel Z-Axis Bottom Reinforcement 12 - 12XZ

Regarding the X Axis (Mx)

As to Clause 26.5.2.1 of IS 456 2000

Critical Load Case = #215

The Minimum Area of Steel (Astmin) = 1135 mm2

The Calculated Area of Steel (Ast) = 1135 mm2

The Provided Area of Steel (Ast,Provided) = 1357 mm2

If the steel area is acceptable, Astmin=Ast

Size of Selected Bar (DB) = 12

Minimum permitted spacing (Smin) is 50.00 mm.

Selected spacing (S) is 297.84 millimeters.

Smin = S = Smax, and the maximum bar size was chosen. The bolstering is approved.

According to reinforcement spacing increment, the given reinforcement is

12 @ 295mm o.c.

Flexure Regarding Z-Axis

Design for Parallel to X Axis Bottom Reinforcement 12 - 12XZ

For the time being, Z Axis (Mz)

As to Clause 26.5.2.1 of IS 456 2000

Calculation of Crack Width (for Mz)

Concrete's elastic modulus (Ec)	=	26457513.11 KN/M2, according to Clause No. 6.2.3.1
Steel's modulus of elasticity (Es)	=	200000000.00 KN/M2, according to Annexure F.
Neutral axis depth (Xu)	=	0.11 mClause No. G-1.1.a in Annexure G
the effective MOI (Ieff)	=	1651544891.95 mm4
Steel Strain Average at Considered Level (m)	=	0.00 X 10-5
The closest tension rod's distance (acr)	=	0.16 meters.
Annexure F: Crack Width (Wcr)	=	0.00 mm

from Clause No. 35.3.2 of IS 456-2000

Section is uncracked.

Calculation of Crack Width (for Mx)

Concrete's elastic modulus (Ec)	=	26457513.11 KN/M2, according to Clause No. 6.2.3.1
Steel's modulus of elasticity (Es)	=	200000000.00 KN/M2, according to Annexure F.
Neutral axis depth (Xu)	=	0.11 mClause No. G-1.1.a in Annexure G
the effective MOI (Ieff)	=	1651544891.95 mm4
Steel Strain Average at Considered Level (m)	=	0.00 X 10-5
The closest tension rod's distance (acr)	=	0.16 meters.
Annexure F: Crack Width (Wcr)	=	0.00 mm

from Clause No. 35.3.2 of IS 456-2000

Section is uncracked.

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CHAPTER SEVEN

RESULTS

- A 43 m long foot over bridge is studied and designed. The tower's configuration is as follows:
  Span length= 43m
  Height of FOB=7.5m
  Size of pedestal= 300*300
- Using IS: 875(Part 3)1987 and STADD.Pro V8i, wind load is computed.The structure is under a total wind load of 1.4 KN/M2.
- The amount of the wind load acting on pedestrians crossing a bridge will already be quite low.Although the construction is more open and has more apertures, high-intensity winds and earthquakes are the major causes of the towers' demise. Therefore, earthquake and wind loads should be given a high safety factor.

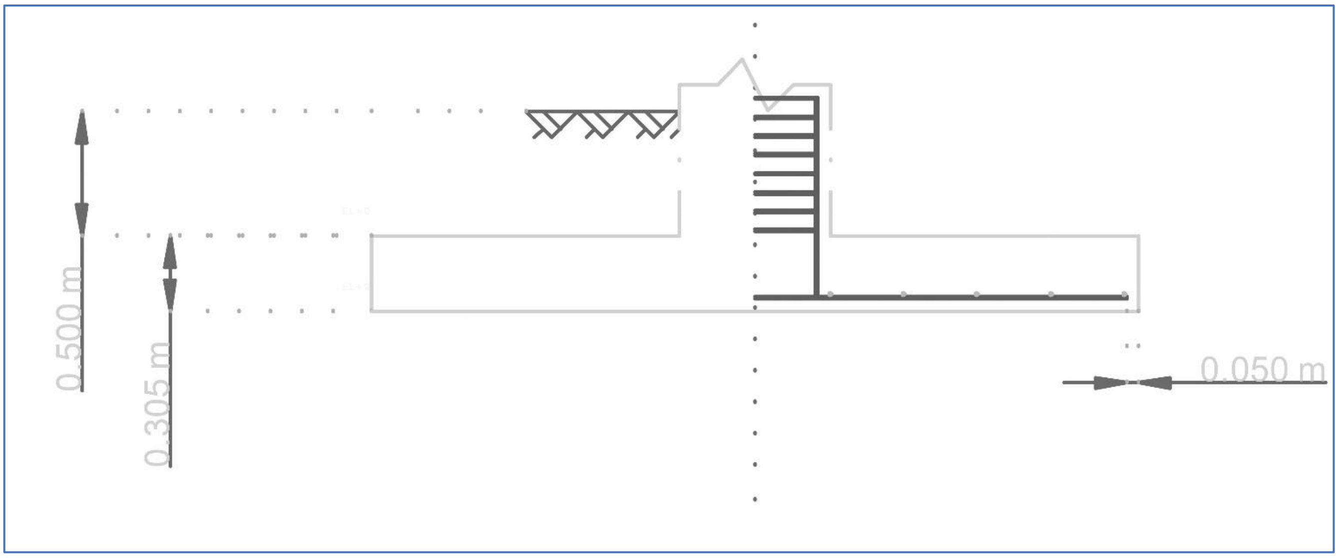

Fig. 7.1: Footing Design

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CHAPTER 8

CONCLUSION

In today's quickly changing construction business, understanding the methods for building, and designing bridges, such as foot over bridge structural components, columns, beams, loadings on foot over bridge, etc., is crucial. So, accurate guesswork is required throughout the footbridge's design and analysis.

If we can discover a way to enhance the existing ineffective design or uneconomical manner of the foot over bridge, there is a lot of potential for cost and resource savings. The truss in the building of the footbridge was historically made of just angle sections, but now days numerous sections are preferred because of their low labor and material costs.

The footbridge will experience less wind stress than the towers since it has more apertures, however towers typically collapse due to earthquakes and strong winds, hence the towers require a high safety factor.

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REFERENCES

[1]. Engström, 2011. Deep beam, plate, and other discontinuity region design and analysis. Chalmers University of Technology's Civil and Environmental Engineering Department, Goteborg
[2]. Lian Duan and W.F. Chen. Bridge Engineering Handbook.CRC Press, New York, 1999. Computers and Structures, Inc.'s CSI Analysis Reference Manual. Berkeley: CSI, 2008. Ivy Tech Community College in Fort Wayne, Crossroads.
[3]. State Highway and Transportation Officials American Association. AASHTO LRFD Movable Highway Bridge Design Specifications Interim Revisions from 2008.2008, Washington, DC: American Association of State Highway and Transportation Officials
[4]. Sustainable Bridges (2007): Reinforced concrete bridges' remaining fatigue life and nonlinear analysis. Future Traffic Demands and Longer Lifespans for Sustainable Bridges: An Assessment
[5]. Section -II (Loads and Stresses) of IRC: 6-2014 Standard Specifications and Code of Practice for Road Bridges.