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Design and Analysis of Steel Foot Bridge Tube Square Hollow Section (SHS) 10.3 m Span to access the passage of passengers form Multilevel Cark Parking to General Bus Stand in Jammu

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Abstract : A Steel footbridge are common means of linking two zones detached by any kind of physical barrier to the pedestrian crossing. In the past century, foot bridges are usually designed manual calculations. With the help of new updated designing software, the designing of the structures has become more precise and less time-consuming. In this paper, complete analysis and design of steel footbridges is conducted using STAAD Pro connect edition designing software, under unpredictive loading, i.e., dead, live, pedestrian, wind and seismic loading. A foot bridge of Tube Square hollow section (SHS) 10.3 m span is designed to access the passage of passengers form multilevel cark parking to general bus stand in Jammu.

***IndexTerms* - Foot Bridge, STAAD Pro, Tube Square hollow section, IS 800: 2007**
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I.INTRODUCTION

Footbridges are needed where a detached pathway has to be provided for public to cross traffic flows or some physical hindrance, such as a river. A footbridge (also a pedestrian bridge, pedestrian flyover, or pedestrian overcrossing) is a bridge designed only for pedestrians. Whereas the prime meaning for a bridge is a structure which links "two points at a height above the ground", such as a track, that allows pedestrians to cross wet areas, delicate, or nallahs. In some cases, a footbridge can be both efficient and give a beautiful appearance.

A foot bridge of Tube Square hollow section (SHS) 10.3 m span is designed to access the passage of passengers form multilevel cark parking to general bus stand. This project mainly contains of the detailed design of such a foot bridge by software. The design and analysis of foot bridge is done using STAAD.pro connect edition. STAAD Pro is the specialist's choice for steel, concrete, aluminum, rolled and cold-formed steel design of low and high-rise buildings, culverts, tunnels, bridges, piles etc. To complete an exact analysis a structural engineer must be aware of dead loads, live loads, floor finish loads, shape, support reactions and conditions and various properties of material used for construction. The results of such an analysis typically include support reactions, stresses and displacements and their diagrams. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behaviour

Technology domain:

The proposed solution i.e. Foot bridge is as per modern trends in civil engineering. It falls under the domain of design of structures. The approach used is analytical by considering manual and software approach.
Types Different types of design footbridges include:
• Timber footbridges
• Steel footbridges
• Concrete footbridge

II RESEARCH METHODOLOGY

Model was designed in staad.pro connect edition where after applying the materials, dimensions, loading conditions, supports etc. run and final analysis report and various calculations obtained from staad.pro was interpreted and members which are fail were redesigned until we got a stable structure. The steel tubular footbridge under consideration is designed to have the following specifications: -

2.1. Specifications of Foot Bridge:

1) Span = 10.3 meter.
2) Clear carriage way = 1.8 meter.
3) Clear Height of Bridge= 1.5 m.
4) No of Panels = 6 of 1.717m
5) Top Chord, Bottom Chord = TUB 150 x150 x6mm
6) Diagonals TUB 100 x 100 x 4 mm
7) Stringers ISMC 75
8) Gusset Plate = 16 mm thick
9) Flooring = 5 mm CHQ. Plate
10) Site location = J&K (Earthquake zone V)

Earthquake loading as per IS 1893:2016.
“As per IS 800:2007 clause no. 2.2.4.1
Unit mass of steel, p = 7850 kg/m³
Modulus of elasticity, E = 2.0 x 10^5 N/m^2

2.2. Load Calculations:

1. Dead loading as per IS 875 Part 1.
2. Live loading = 4KN/m^2

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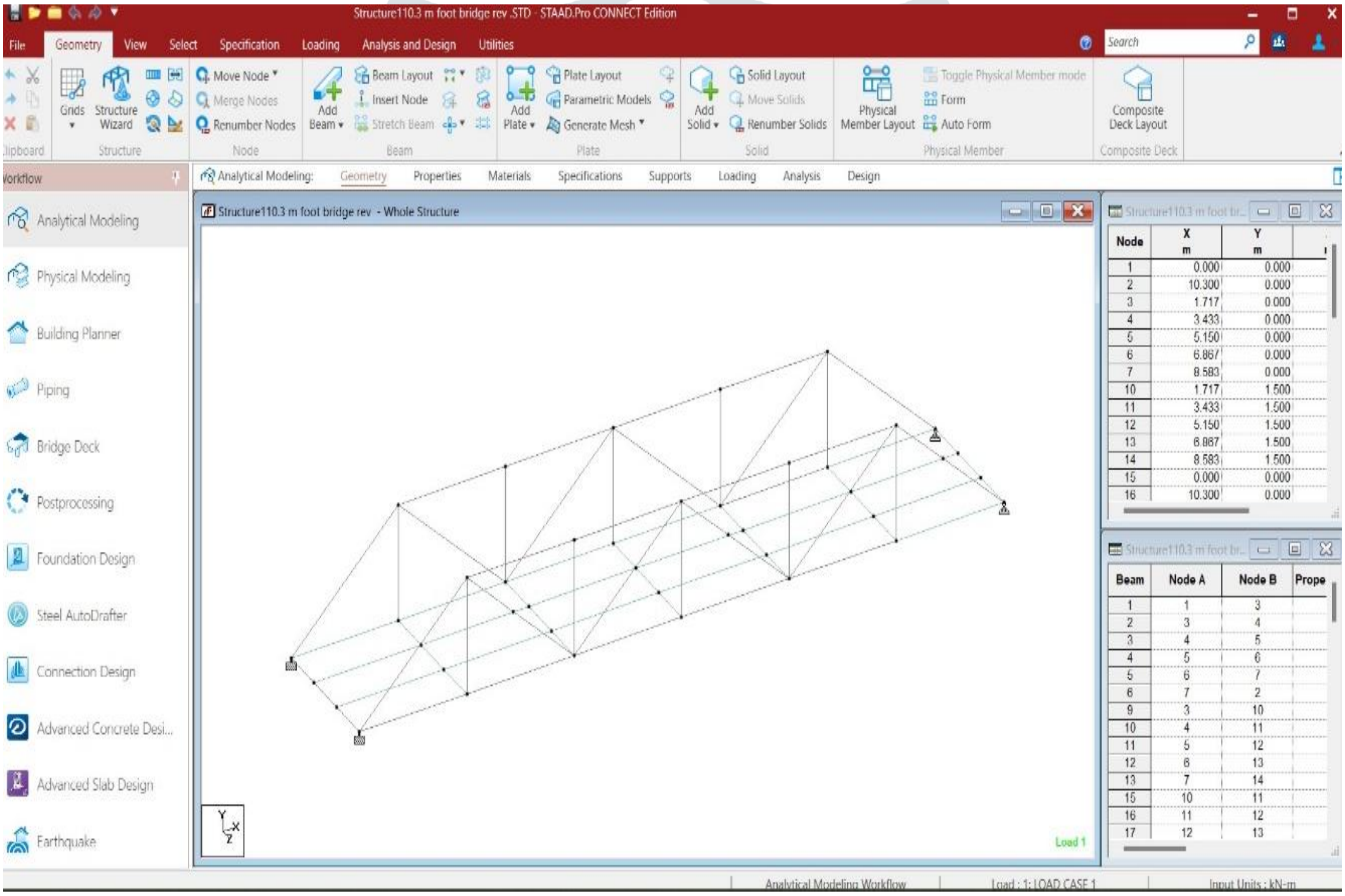
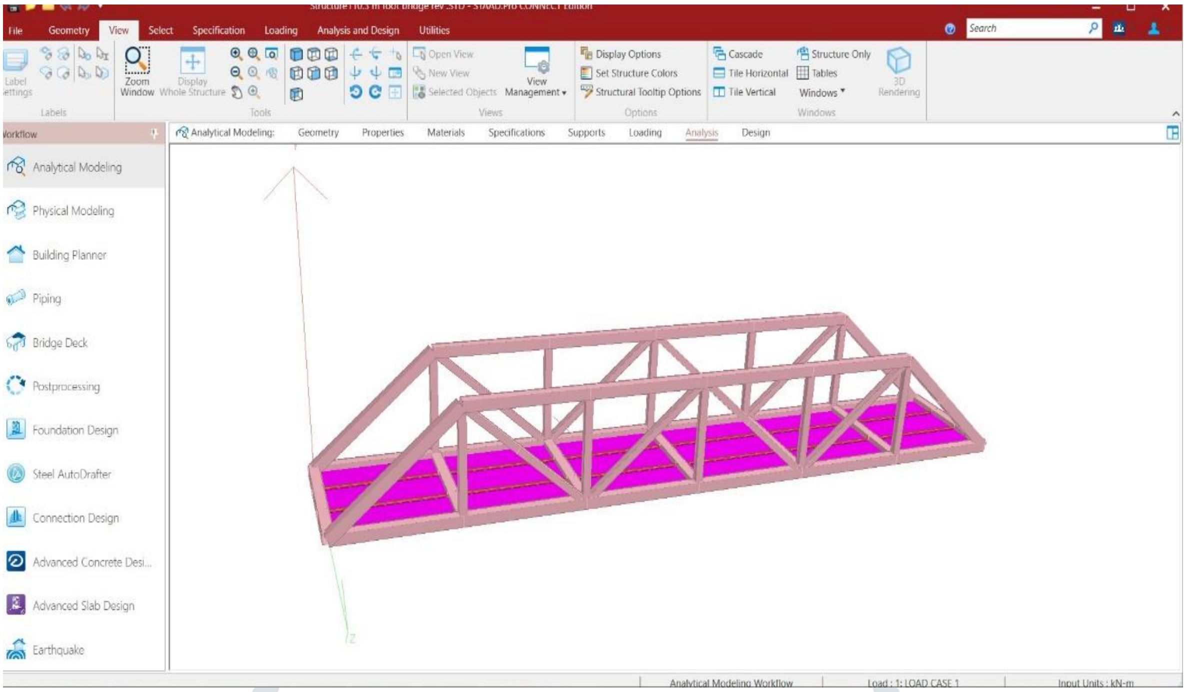
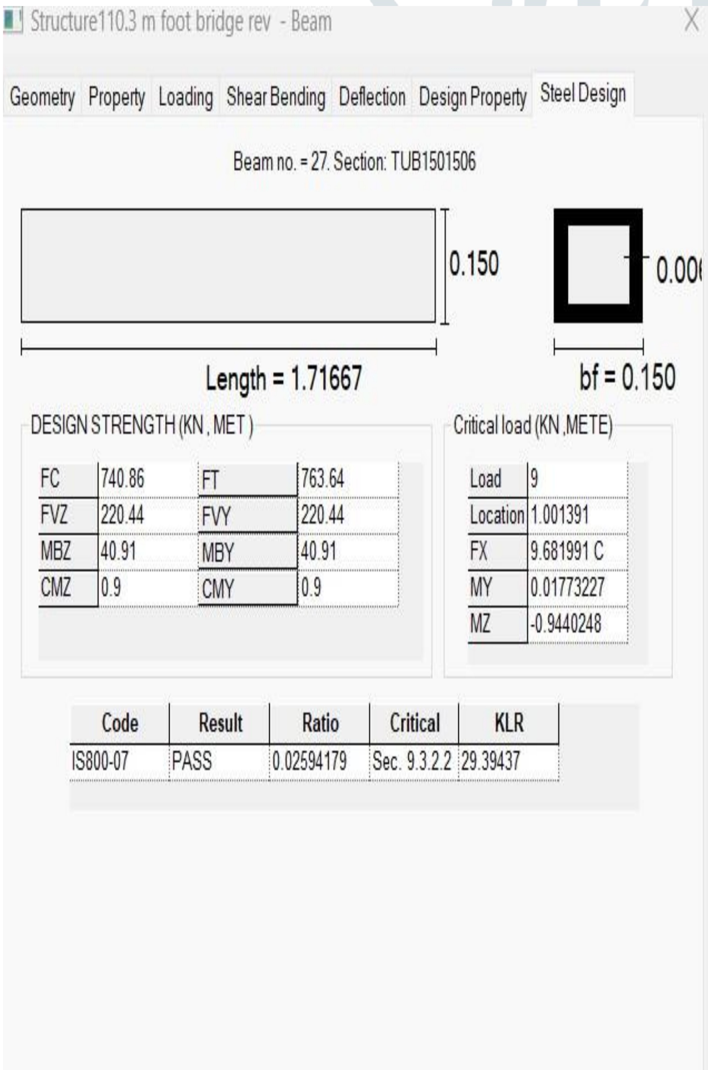
2.3. View of the STAAD.Pro user interface:

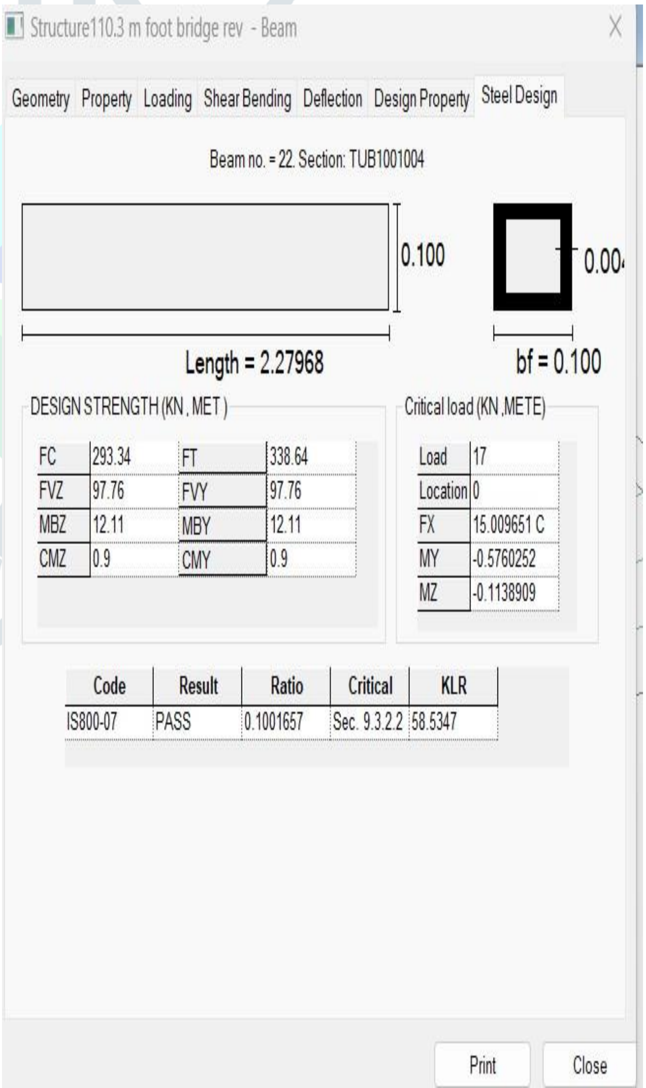


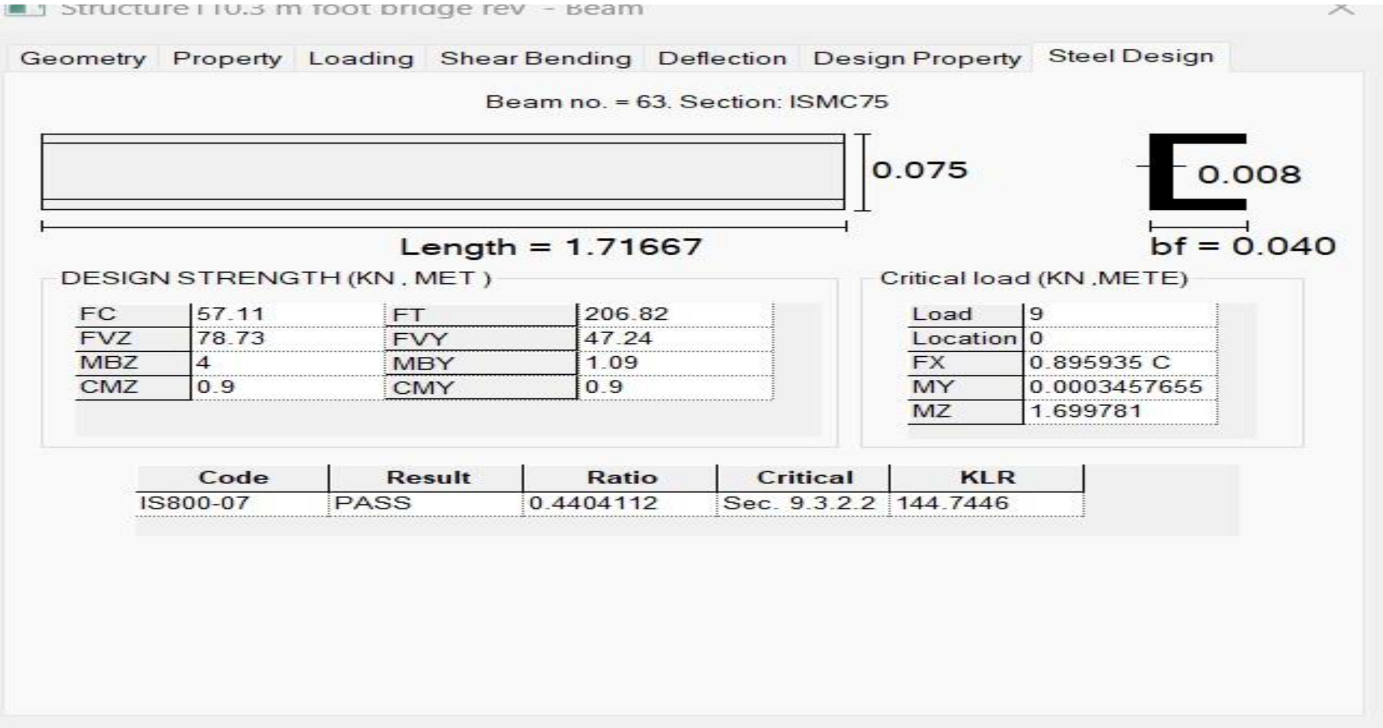
2.4. 3D Rendering View of the Foot Bridge (STAAD.Pro Modal)



2.5. Steel Design Results and Section Properties of Foot Bridge: -





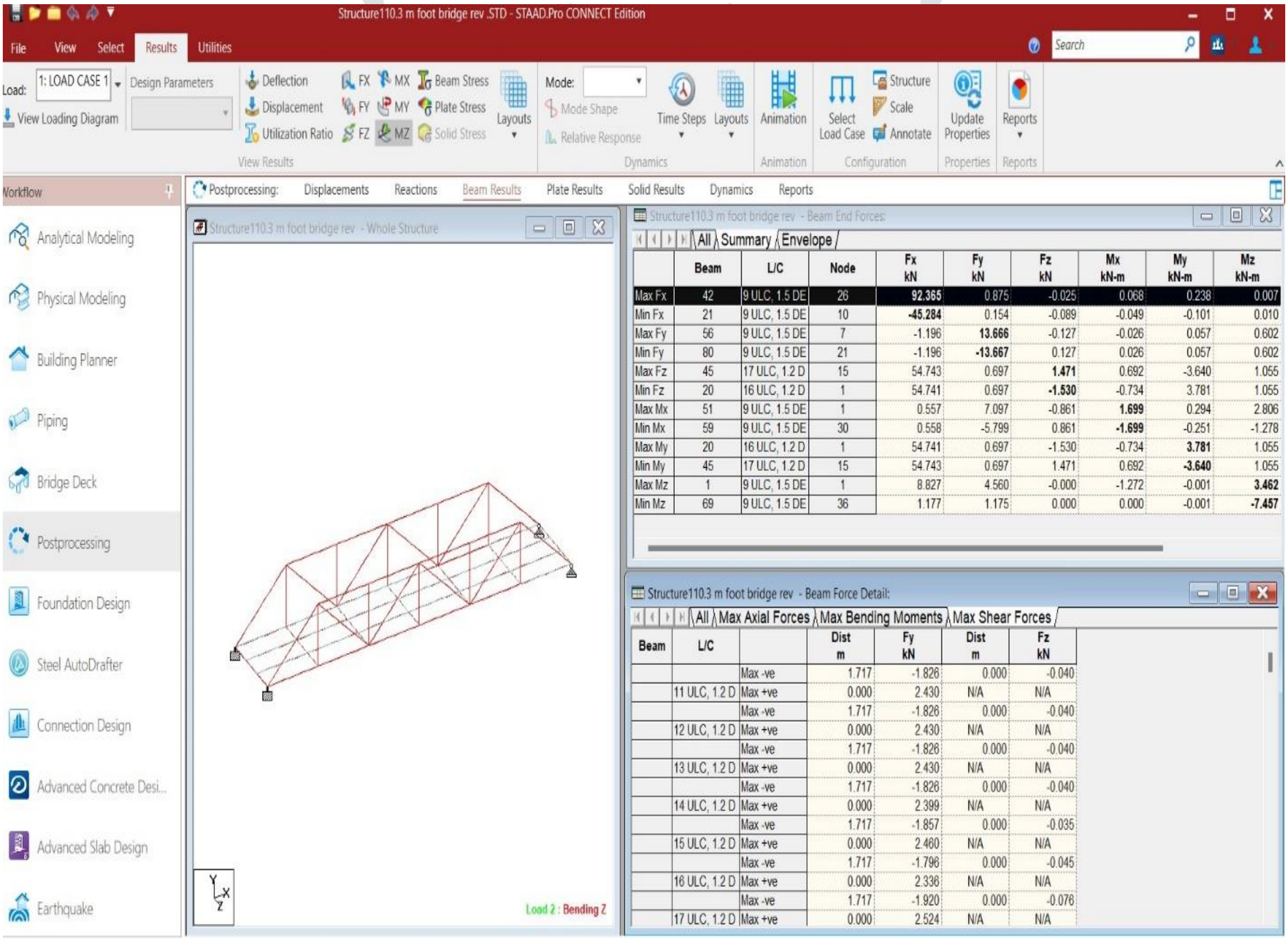


FC	57.11	FT	206.82
FVZ	78.73	FVY	47.24
MBZ	4	MBY	1.09
CMZ	0.9	CMY	0.9

Load	9
Location	0
FX	0.895935 C
MY	0.0003457655
MZ	1.699781

Code	Result	Ratio	Critical	KLR
IS800-07	PASS	0.4404112	Sec. 9.3.2.2	144.7446

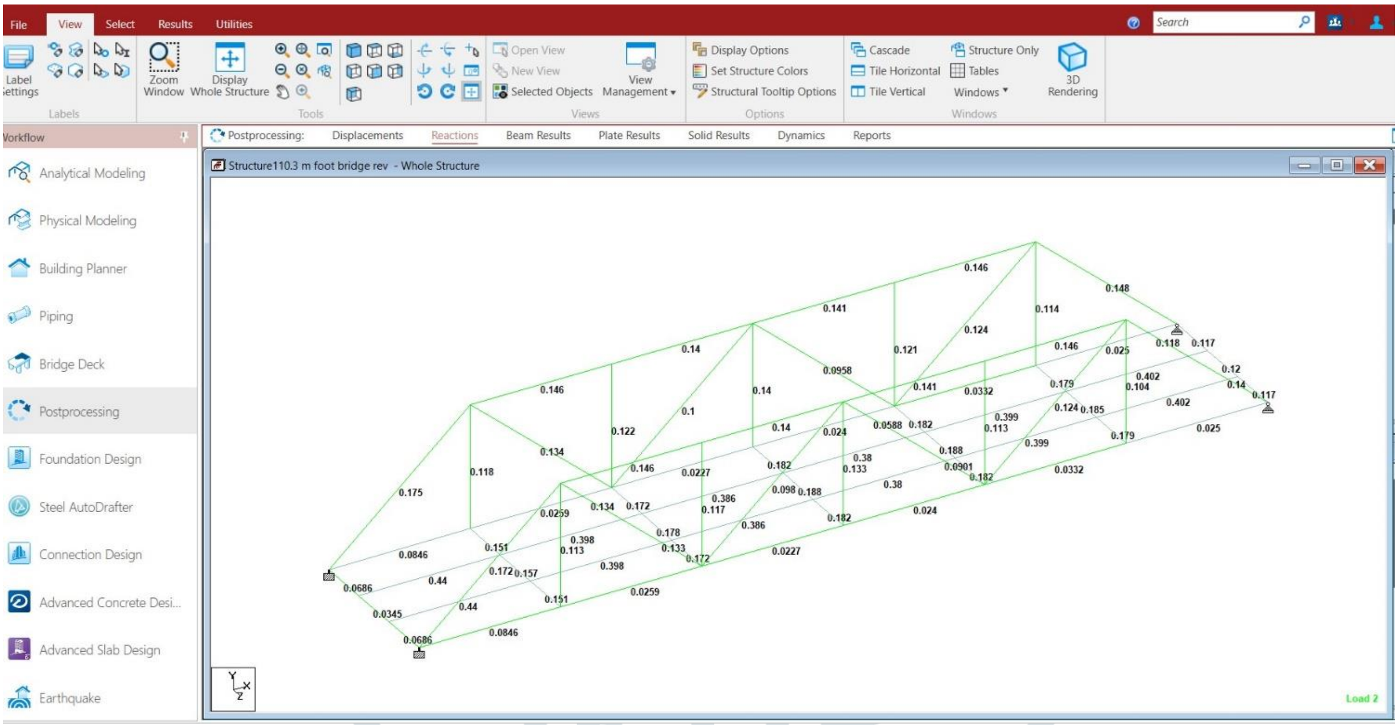
2.6. Beam Results for Max. & Min. Axial, Shear Forces and Bending Moments in Members: -



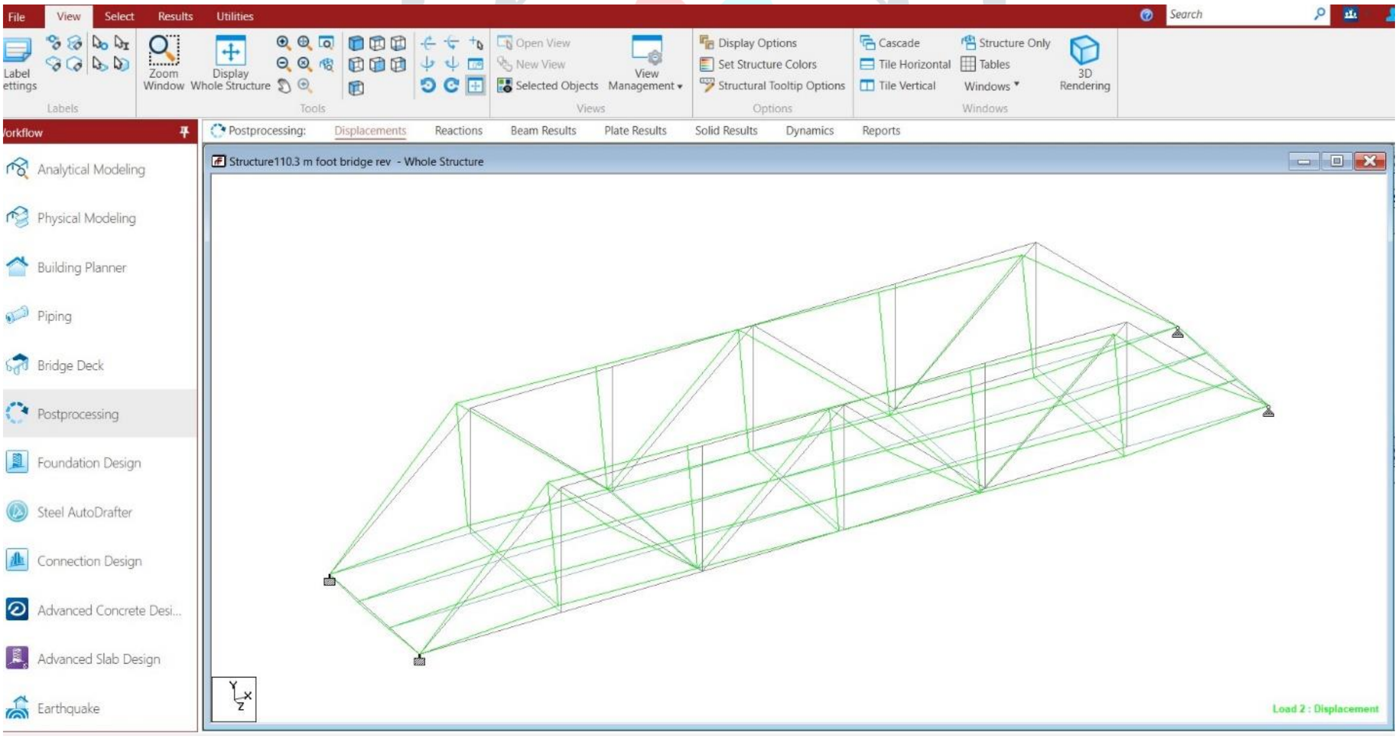
	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	42	9 ULC, 1.5 DE	26	92.365	0.875	-0.025	0.068	0.238	0.007
Min Fx	21	9 ULC, 1.5 DE	10	-45.284	0.154	-0.089	-0.049	-0.101	0.010
Max Fy	56	9 ULC, 1.5 DE	7	-1.196	13.666	-0.127	-0.026	0.057	0.602
Min Fy	80	9 ULC, 1.5 DE	21	-1.196	-13.667	0.127	0.026	0.057	0.602
Max Fz	45	17 ULC, 1.2 D	15	54.743	0.697	1.471	0.692	-3.640	1.055
Min Fz	20	16 ULC, 1.2 D	1	54.741	0.697	-1.530	-0.734	3.781	1.055
Max Mx	51	9 ULC, 1.5 DE	1	0.557	7.097	-0.861	1.699	0.294	2.806
Min Mx	59	9 ULC, 1.5 DE	30	0.558	-5.799	0.861	-1.699	-0.251	-1.278
Max My	20	16 ULC, 1.2 D	1	54.741	0.697	-1.530	-0.734	3.781	1.055
Min My	45	17 ULC, 1.2 D	15	54.743	0.697	1.471	0.692	-3.640	1.055
Max Mz	1	9 ULC, 1.5 DE	1	8.827	4.560	-0.000	-1.272	-0.001	3.462
Min Mz	69	9 ULC, 1.5 DE	36	1.177	1.175	0.000	0.000	-0.001	-7.457

Beam	L/C		Dist m	Fy kN	Dist m	Fz kN
		Max -ve	1.717	-1.826	0.000	-0.040
	11 ULC, 1.2 D	Max +ve	0.000	2.430	N/A	N/A
		Max -ve	1.717	-1.826	0.000	-0.040
	12 ULC, 1.2 D	Max +ve	0.000	2.430	N/A	N/A
		Max -ve	1.717	-1.826	0.000	-0.040
	13 ULC, 1.2 D	Max +ve	0.000	2.430	N/A	N/A
		Max -ve	1.717	-1.826	0.000	-0.040
	14 ULC, 1.2 D	Max +ve	0.000	2.399	N/A	N/A
		Max -ve	1.717	-1.857	0.000	-0.035
	15 ULC, 1.2 D	Max +ve	0.000	2.460	N/A	N/A
		Max -ve	1.717	-1.796	0.000	-0.045
	16 ULC, 1.2 D	Max +ve	0.000	2.336	N/A	N/A
		Max -ve	1.717	-1.920	0.000	-0.076
	17 ULC, 1.2 D	Max +ve	0.000	2.524	N/A	N/A

2.7. Utilizations Ratios for all Members of Foot Bridge: -



2.8. Displacements in All Members From STAAD.pro: -



II CONCLUSIONS:

1) From the results, the utilization ratios for all top chord, bottom chord, vertical and diagonal members is less than 1 and not equal to 1. So, bridge is safe and design for the given loading.

2) The tensile force in members are more than the compressive forces in all members and tensile forces are always preferred over compressive force in case of foot bridge.

3) Staad.pro provides a wide-ranging varieties of design codes, and covers all aspects in the field of structural designing.

4) With the help of STAAD Pro software the validity and position of any steel structure analysis is done.

5) Designing in Software is lot faster and more accurate. Ultimately, this results in saving of design time and achieving highly accurate results.

6) All the loading conditions like seismic loads, wind loads, dead and live loads can easily be considered as per Indian standards. Maximum and minimum shear forces, bending moments are evaluated in the foot bridge design.

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