Comparative Study for Seismic Analysis of Truss Bridge

***Juned Khan, **Dr. Raghvendra Singh**

**PG Student, **Professor*

Department of Civil Engineering, Ujjain Engineering College- Ujjain M.P.

ABSTRACT

Bridge plays very important role in transportation, whether it is Highway Bridge or Footbridge Bridge or combination of both. There are so many types of bridges such as arch bridge, beam Bridge, truss bridge, cantilever bridge, suspension bridge, etc. But most of the footbridge bridges are constructed with the help of steel truss. Truss structure comprise of members that are joined to make a rigid frame of steel. The individual members of a truss bridge act as the load carrying components of the system, they are arranged in the form of triangle and because of this when load is applied on the truss there is only axial force (tension or compression) act on the members of the truss. Some of these bridges are situated in earthquake prone area, so it is very important to analyses different sections of truss by considering seismic forces and live load and select an appropriate section. For this dissertation 3 different type of sections are used (i.e. Warren truss, Pratt truss and Howe truss). Two span lengths are considered i.e. 50 meter and 100 meter with height of 7 meter and 6 meter width, simply supported at ends. the walk way bridge is being analyzed. The analysis has been done using STAAD. Pro V8i. The result has been interpreted by analyzing node displacements, beam end forces and support reactions.

INTRODUCTION

Construction of long span bridges has been very active in past few decades. Today, modern bridges tend to use high strength materials. Therefore, their structure is very slender. As a result, they are very sensitive to dynamic loadings such as wind, earthquake and vibration due to vehicle movement. As bridge span gets longer, they become more flexible and prone to vibration. Steel trusses are widely adopted for constructing footbridge bridges. Classification of truss bridges based on position of carriage way are: Deck type bridge, Through type bridge and Semi- through type bridge. In these three types, mainly through type truss bridge is used in India. The types of truss section used for bridges are: Warren truss, Pratt truss, Howe truss, K- type truss,etc.

In this research, three types of sections are used i.e. Warren truss, Pratt truss and Howe truss for the analysis of earthquake forces and live load due to locomotive acting on the bridge. There are many bridges which are located in different earthquake prone area. Some are very important bridges, for example, Bogi beel Bridge in Assam. It is located in seismic zone-V and with the longest span length of 128 meter. So, in this study, we have analyzed bridge with two different span lengths i.e. 50meter and 100 meter, height of 7 meter and width of 6 meter which is located in seismic zone-V and with proper locomotive loading as per IRS Bridge Rules by using Warren truss, Pratt truss and Howe truss.

Truss is a structure of hinged elements forming triangular units, and when this truss act as a load bearing super structure of a bridge then that bridge is called as truss bridge. Since trusses are assumed as hinged connection between adjacent truss members, so truss members act only in compression or tension and this also helps in simplification of calculation. For modern truss bridges, gusset plates are used for connection, then bending moment and shear force of members are also be considered for evaluating the performance of truss bridges with the help of finite element software. As the axial forces governs the stress conditions of the members but not bending moment and shear force, so such assumptions generally will not cause big difference between the real bridges and the design models. According to this assumption, the members of truss are in tension, compression or in both when responding to dynamic loading.

METHODOLOGY

Six models were considered for the study:

1. Three models of 50 meter span with Warren truss, Pratt truss and Howe truss
2. Three models of 100 meter span with Warren truss, Pratt truss and Howe truss
3. Height of all the truss bridge is 6&7 meter
4. Width is 6meter.
5. Modelling and analysis is done using STAAD pro and results are concluded.
6. Steel is selected to build the whole model due to following conditions.
7. All four end nodes at each corner are of pinned support .
8. Live load of locomotive is taken as per IRS Bridge 204 (2.5 t/m3)
9. For seismic forces, the provision given in code IS 1893 (Part 3)2014
10. Load combination is taken as per IS 1893 (Part 3) 2014

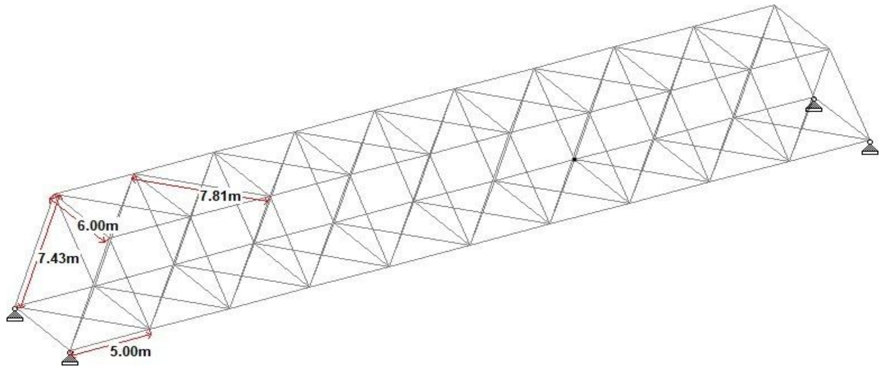


Figure 1 Parrat truss

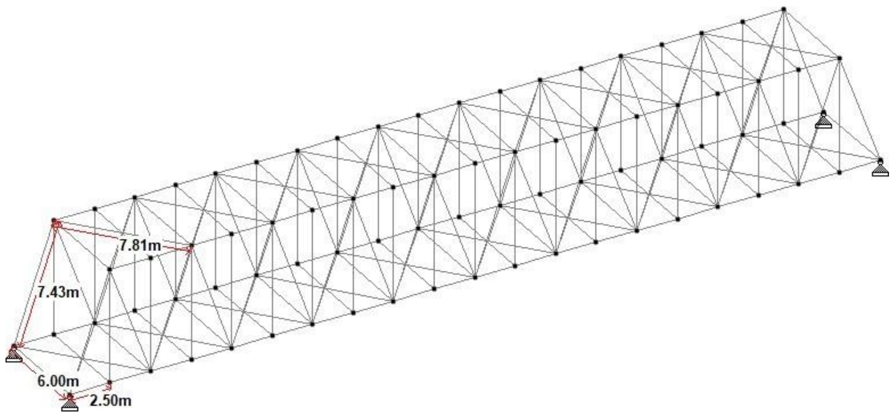


Figure 2 Warren Truss

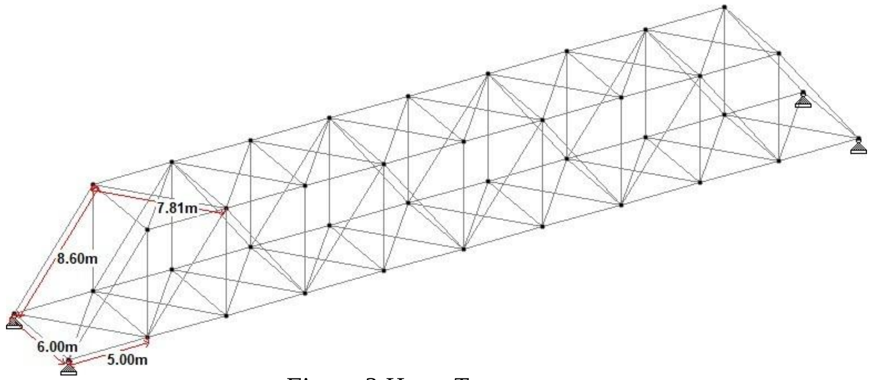


Figure 3 Howe Truss

ANALYSIS AND RESULTS

ANALYSIS RESULTS OF WARREN TRUSS BRIDGE WITH 50 METER SPAN LENGTH

Node displacement

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	33	77:LOAD GENE	**5.093**	-3.134	0.027	5.980
Min X	42	93:LOAD GENE	**-5.093**	-3.134	0.027	5.980
Max Y	33	6:LOAD GENEF	-0.001	**0.000**	-0.009	0.009
Min Y	27	85:LOAD GENE	-0.000	**-21.270**	-0.019	21.270
Max Z	38	166:1.5DL+0.4!	-0.249	-16.167	**25.012**	29.783
Min Z	16	167:1.5DL+0.4!	0.249	-16.167	**-25.012**	29.783
Max rX	17	166:1.5DL+0.4!	-0.177	-4.581	24.849	25.268
Min rX	37	167:1.5DL+0.4!	0.177	-4.581	-24.849	25.268
Max rY	1	167:1.5DL+0.4!	0.000	0.000	0.000	0.000
Min rY	22	166:1.5DL+0.4!	0.000	0.000	0.000	0.000
Max rZ	32	103:LOAD GEN	0.000	0.000	0.000	0.000
Min rZ	22	67:LOAD GENE	0.000	0.000	0.000	0.000
Max Rst	37	166:1.5DL+0.4!	0.593	-16.200	25.012	**29.806**

Table 1 Node Displacement Summary for Warren truss (50m)

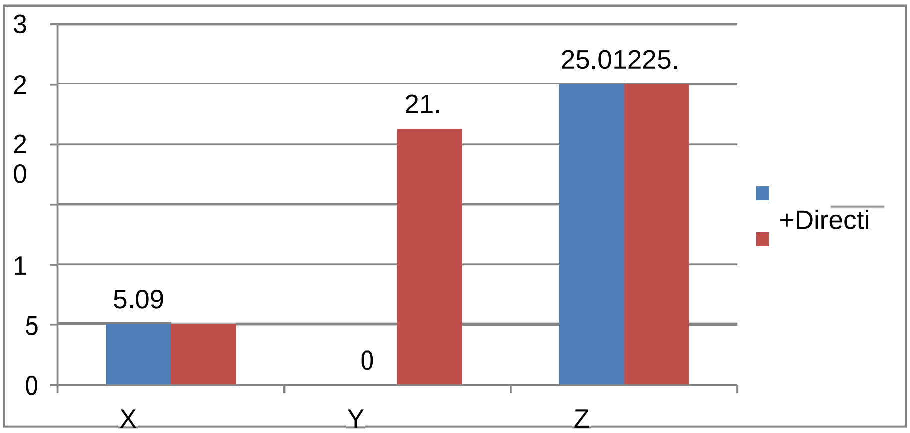


Figure 4 Bar graph for maximum node displacement in 50m Warren truss

Support reactions

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	167:1.5DL+0.4!	**3.1E+3**	2.19E+3	592.712	0.00(	0.000	0.000
Min FX	32	166:1.5DL+0.4!	**-3.1E+3**	2.19E+3	-592.712	0.00(	0.000	0.000
Max FY	32	166:1.5DL+0.4!	-3.1E+3	**2.19E+3**	-592.712	0.00(	0.000	0.000
Min FY	32	167:1.5DL+0.4!	980.827	**-443.874**	519.716	0.00(	0.000	0.000
Max FZ	1	167:1.5DL+0.4!	3.1E+3	2.19E+3	**592.712**	0.00(	0.000	0.000
Min FZ	32	166:1.5DL+0.4!	-3.1E+3	2.19E+3	**-592.712**	0.00(	0.000	0.000
Max MX	1	6:LOAD GENEF	-0.062	220.720	10.199	**0.00(**	0.000	0.000
Min MX	1	6:LOAD GENEF	-0.062	220.720	10.199	**0.00(**	0.000	0.000
Max MY	1	6:LOAD GENEF	-0.062	220.720	10.199	0.00(	**0.000**	0.000
Min MY	1	6:LOAD GENEF	-0.062	220.720	10.199	0.00(	**0.000**	0.000
Max MZ	1	6:LOAD GENEF	-0.062	220.720	10.199	0.00(	0.000	**0.000**
Min MZ	1	6:LOAD GENEF	-0.062	220.720	10.199	0.00(	0.000	**0.000**

Table 2 Support Reaction Summary for Warren truss (50m)

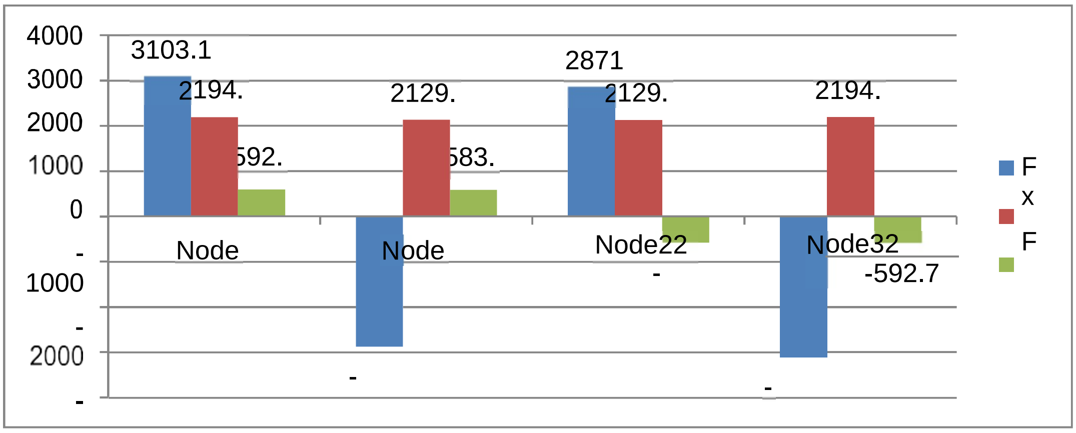


Figure 5 Bar graph for maximum support reaction in Warren truss (50m)

Beam end forces

				Axial	Shear		Torsion	Bending	
	Beam	Node	L/C	Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
Max Fx	15	16	85:LOAD GENE	**3.07E+3**	-0.000	0.000	0.000	-0.777	-24.589
Min Fx	60	33	71:LOAD GENE	**-1.68E+3**	-11.708	29.742	8.755	-57.128	-35.653
Max Fy	99	21	167:1.5DL+0.4!	-31.886	**307.538**	4.600	0.033	-13.852	892.349
Min Fy	99	42	166:1.5DL+0.4!	-32.436	**-307.538**	-4.600	-0.033	-13.855	892.152
Max Fz	78	42	166:1.5DL+0.4!	2.02E+3	33.786	**155.294**	38.903	-561.142	99.633
Min Fz	59	22	166:1.5DL+0.4!	1.99E+3	-18.96!	**-155.284**	-38.872	593.160	-96.539
Max Mx	20	1	167:1.5DL+0.4!	2.06E+3	-20.10:	155.294	**38.903**	-593.159	-100.642
Min Mx	59	22	166:1.5DL+0.4!	1.99E+3	-18.96!	-155.284	**-38.872**	593.160	-96.539
Max My	59	22	166:1.5DL+0.4!	1.99E+3	-18.96!	-155.284	-38.872	**593.160**	-96.539
Min My	39	11	167:1.5DL+0.4!	1.99E+3	18.969	-155.284	-38.872	**-593.160**	-96.539
Max Mz	99	21	167:1.5DL+0.4!	-31.886	307.538	4.600	0.033	-13.852	**892.349**
Min Mz	99	21	166:1.5DL+0.4!	-32.436	-284.584	-4.600	-0.033	13.743	**-884.213**

Table 3 Beam End force summary for Warren truss (50m)

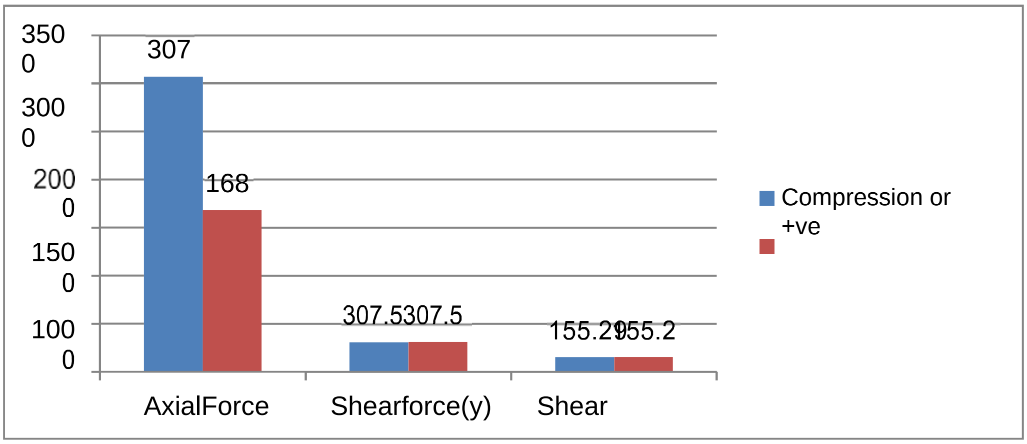


Figure 6 Bar graph for maximum Axial force and Shear force in warren truss (50m)

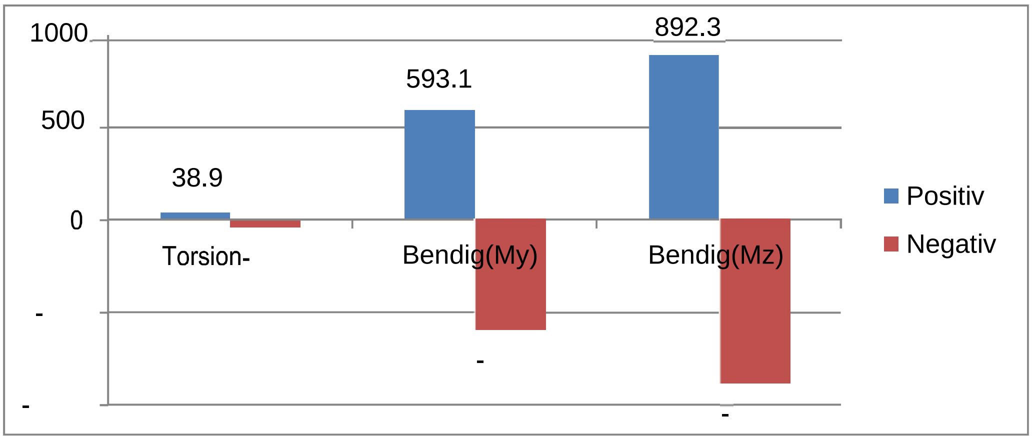


Figure 7Bar graph for maximum torsion and bending moment in Warren truss (50m)

ANALYSIS RESULTS OF PRATT TRUSS BRIDGE WITH 50 METERSPAN LENGTH

Node displacement

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	62	166:1.5DL+0.4	**5.861**	-4.542	40.023	40.704
Min X	80	166:1.5DL+0.4	**-5.342**	-4.445	40.023	40.622
Max Y	42	6:LOAD GENER	-0.000	**0.003**	0.016	0.016
Min Y	71	166:1.5DL+0.4	0.271	**-25.943**	38.835	46.704
Max Z	80	166:1.5DL+0.4	-5.342	-4.445	**40.023**	40.622
Min Z	32	82:LOAD GENE	-0.777	-20.134	**-0.164**	20.150
Max rX	40	166:1.5DL+0.4	-1.802	-0.307	39.973	40.015
Min rX	61	138:LOAD GEN	0.000	0.000	0.000	0.000
Max rY	61	166:1.5DL+0.4	0.000	0.000	0.000	0.000
Min rY	41	166:1.5DL+0.4	0.000	0.000	0.000	0.000
Max rZ	60	166:1.5DL+0.4	0.812	-4.596	2.907	5.499
Min rZ						
Max Rs						

Table4 Node Displacement Summary for Pratt truss(50m

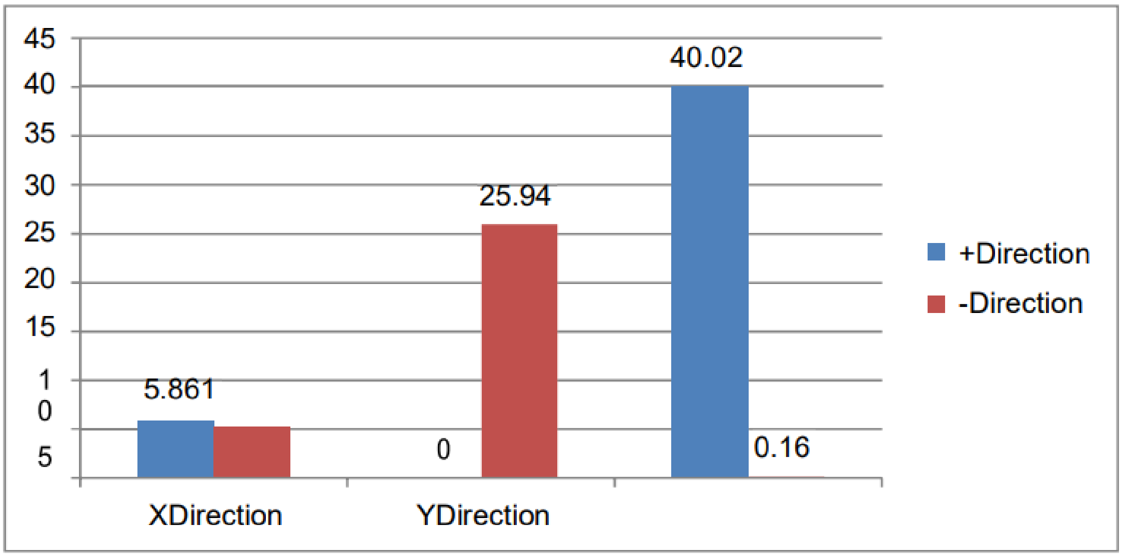


Figure 8 Bar graph for maximum node displacement in 50m Pratt truss

Support reaction

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	41	166:1.5DL+0.4!	**4.53E+3**	3.17E+3	-889.832	0.00C	0.000	0.000
Min FX	61	166:1.5DL+0.4!	**-4.9E+3**	3.27E+3	-912.311	0.00C	0.000	0.000
Max FY	61	166:1.5DL+0.4!	-4.9E+3	**3.27E+3**	-912.311	0.00C	0.000	0.000
Min FY	1	166:1.5DL+0.4!	-1.69E+3	**-664.931**	-751.668	0.00C	0.000	0.000
Max FZ	1	165:1.5DL+1.5I	2.42E+3	1.53E+3	**129.025**	0.00C	0.000	0.000
Min FZ	61	166:1.5DL+0.4!	-4.9E+3	3.27E+3	**-912.311**	0.00C	0.000	0.000
Max MX	1	6:LOAD GENEF	-0.001	220.720	9.539	**0.00C**	0.000	0.000
Min MX	1	6:LOAD GENEF	-0.001	220.720	9.539	**0.00C**	0.000	0.000
Max MY	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00C	**0.000**	0.000
Min MY	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00C	**0.000**	0.000
Max MZ	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00C	0.000	**0.000**
Min MZ	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00C	0.000	**0.000**

Table 5 Support Reaction Summary for Pratt truss

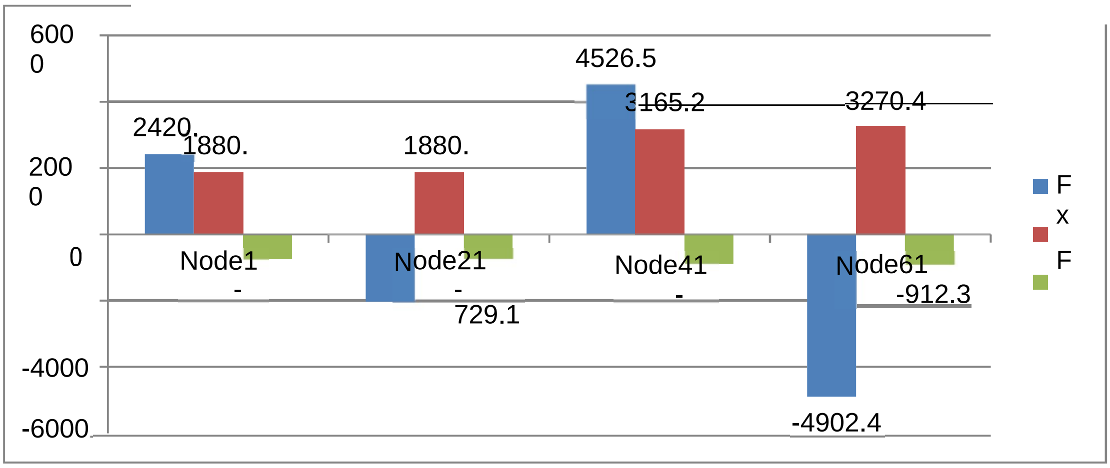


Figure 9 Bar graph for maximum support reaction in Pratt truss (50m)

Beam end forces

	Beam	Node	L/C	Axial Fx (kN)	Shear Fy (kN)	Fz (kN)	Torsion Mx (kNm)	Bending My (kNm)	Mz (kNm)
Max Fx	97	60	166:1.5DL+0.4!	**3.16E+3**	-99.137	33.717	47.751	-158.365	-123.502
Min Fx	134	80	166:1.5DL+0.4!	**-2.33E+3**	10.314	-59.258	6.996	-188.380	-51.331
Max Fy	171	17	86:LOAD GENE	-63.793	**239.301**	0.000	-0.000	-0.013	272.768
Min Fy	176	62	166:1.5DL+0.4!	-39.368	**-252.636**	5.872	0.044	17.500	741.065
Max Fz	135	80	166:1.5DL+0.4!	3.11E+3	53.093	**128.138**	58.389	-413.406	160.041
Min Fz	116	41	166:1.5DL+0.4!	3.04E+3	-37.726	**-128.056**	-58.454	538.760	-177.666
Max Mx	97	60	106:LOAD GEN	993.202	26.504	-43.157	**125.542**	23.238	-6.543
Min Mx	20	20	106:LOAD GEN	993.202	26.504	43.157	**-125.542**	-23.238	-6.543
Max My	135	61	166:1.5DL+0.4!	3.15E+3	39.410	128.138	58.389	**539.050**	-183.748
Min My	135	80	166:1.5DL+0.4!	3.11E+3	53.093	128.138	58.389	**-413.406**	160.041
Max Mz	176	62	166:1.5DL+0.4!	-39.368	-252.636	5.872	0.044	17.500	**741.065**
Min Mz	194	40	166:1.5DL+0.4!	-40.088	-236.597	-5.872	-0.044	17.729	**-726.721**

Table 6 Beam End force summary for Pratt truss (50m)

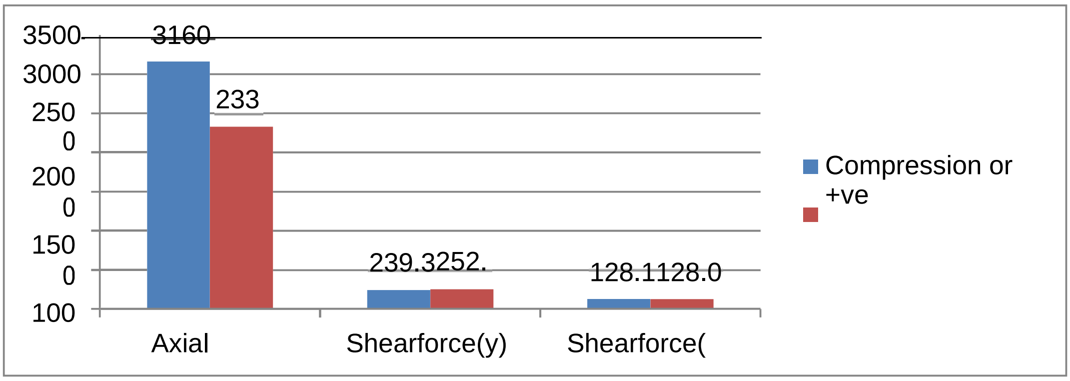


Figure 10 Bar graph for maximum Axial force and Shear force in Pratt truss (50m)

ANALYSIS RESULTS OF HOWE TRUSS BRIDGE WITH 50 METER SPANLENGTH

Node displacements

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	32	78:LOAD GENE	**4.725**	-5.377	0.028	7.158
Min X	40	92:LOAD GENE	**-4.725**	-5.377	0.028	7.158
Max Y	10	166:1.5DL+0.4!	-0.360	**0.035**	2.946	2.968
Min Y	26	85:LOAD GENE	0.000	**-19.770**	-0.020	19.770
Max Z	40	166:1.5DL+0.4!	-3.933	-5.321	**41.051**	41.581
Min Z	12	167:1.5DL+0.4!	3.933	-5.321	**-41.051**	41.581
Max rX	20	166:1.5DL+0.4!	-0.525	-0.035	41.018	41.022
Min rX	32	167:1.5DL+0.4!	0.525	-0.035	-41.018	41.022
Max rY	1	167:1.5DL+0.4!	0.000	0.000	0.000	0.00C
Min rY	21	166:1.5DL+0.4!	0.000	0.000	0.000	0.00C
Max rZ	31	103:LOAD GEN	0.000	0.000	0.000	0.00C
Min rZ	21	67:LOAD GENE	0.000	0.000	0.000	0.00C
Max Rst	36	166:1.5DL+0.4!	0.144	-18.921	37.660	**42.146**

Table 7 Node Displacement Summary for Howe truss (50m)

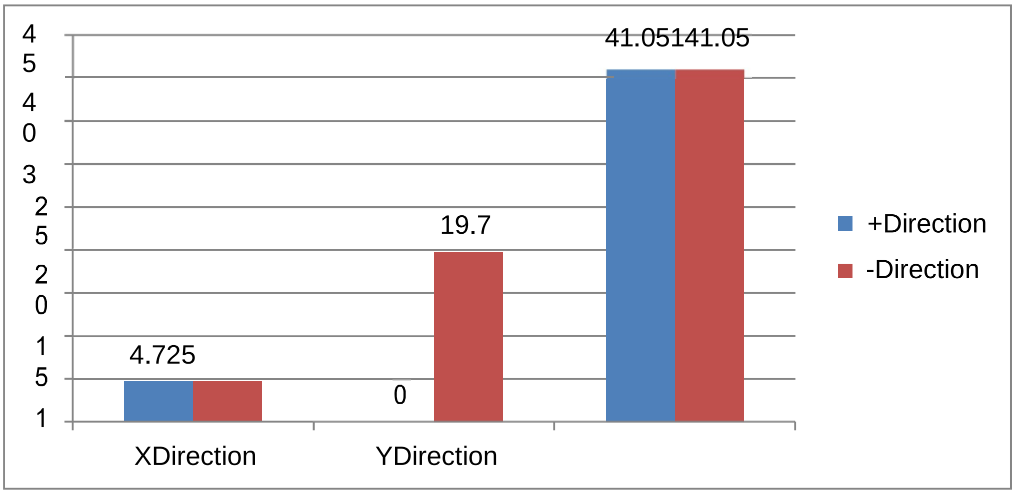


Figure 11 Bar graph for maximum node displacement in 50m Howe truss

Support Reaction

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	267:1.5DL+0.4!	**9.64E+3**	3.87E+3	1.16E+3	0.00C	0.000	0.000
Min FX	62	266:1.5DL+0.4!	**-9.64E+3**	3.87E+3	-1.16E+3	0.00C	0.000	0.000
Max FY	62	266:1.5DL+0.4!	-9.64E+3	**3.87E+3**	-1.16E+3	0.00C	0.000	0.000
Min FY	62	267:1.5DL+0.4!	1.28E+3	**-392.420**	668.021	0.00C	0.000	0.000
Max FZ	1	267:1.5DL+0.4!	9.64E+3	3.87E+3	**1.16E+3**	0.00C	0.000	0.000
Min FZ	62	266:1.5DL+0.4!	-9.64E+3	3.87E+3	**-1.16E+3**	0.00C	0.000	0.000
Max MX	1	6:LOAD GENEF	-0.118	220.720	17.453	**0.00C**	0.000	0.000
Min MX	1	6:LOAD GENEF	-0.118	220.720	17.453	**0.00C**	0.000	0.000
Max MY	1	6:LOAD GENEF	-0.118	220.720	17.453	0.00C	**0.000**	0.000
Min MY	1	6:LOAD GENEF	-0.118	220.720	17.453	0.00C	**0.000**	0.000
Max MZ	1	6:LOAD GENEF	-0.118	220.720	17.453	0.00C	0.000	**0.000**
Min MZ	1	6:LOAD GENEF	-0.118	220.720	17.453	0.00C	0.000	**0.000**

Table 8 Support Reaction Summary for Warren truss (100m)

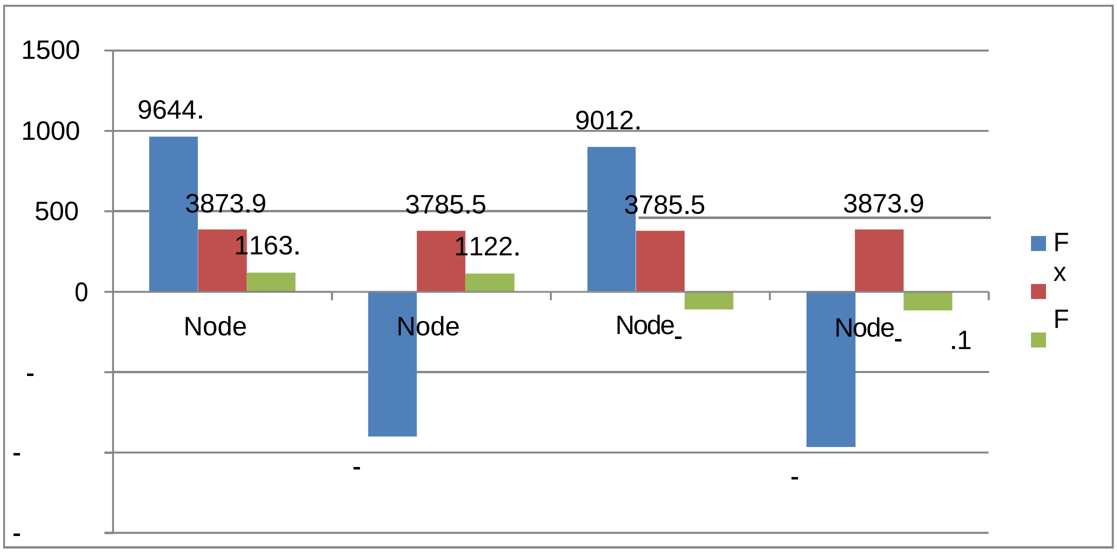


Figure 12 Bar graph for maximum support reaction in Warren truss (100m)

Beam end forces

	Beam	Node	L/C	Axial	Shear		Torsion	Bending	
				Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
Max Fx	109	72	135:LOAD GEN	**7.58E+3**	0.000	-0.000	-0.000	1.419	-59.820
Min Fx	89	51	266:1.5DL+0.4!	**-3.29E+3**	14.899	0.093	-0.608	-17.450	-32.229
Max Fy	180	22	267:1.5DL+0.4!	-61.675	**311.237**	-5.712	-0.040	17.369	915.054
Min Fy	180	63	266:1.5DL+0.4!	-61.002	**-311.237**	5.712	0.040	17.351	915.289
Max Fz	158	82	266:1.5DL+0.4!	3.72E+3	69.890	**187.679**	48.562	-638.593	235.120
Min Fz	79	41	267:1.5DL+0.4!	3.63E+3	67.796	**-187.593**	-48.373	638.105	226.598
Max Mx	99	61	238:LOAD GEN	221.049	-0.643	-23.288	**57.415**	29.141	-70.508
Min Mx	20	20	238:LOAD GEN	221.049	-0.643	23.288	**-57.415**	-29.141	-70.508
Max My	158	62	266:1.5DL+0.4!	3.76E+3	56.206	187.679	48.562	**756.429**	-233.519
Min My	40	1	267:1.5DL+0.4!	3.76E+3	-56.206	187.679	48.562	**-756.429**	-233.519
Max Mz	180	63	266:1.5DL+0.4!	-61.002	-311.237	5.712	0.040	17.351	**915.289**
Min Mz	199	41	266:1.5DL+0.4!	-61.675	-295.197	-5.712	-0.040	16.900	**-904.249**

Table 9 Beam End force summary for Warren truss (100m)

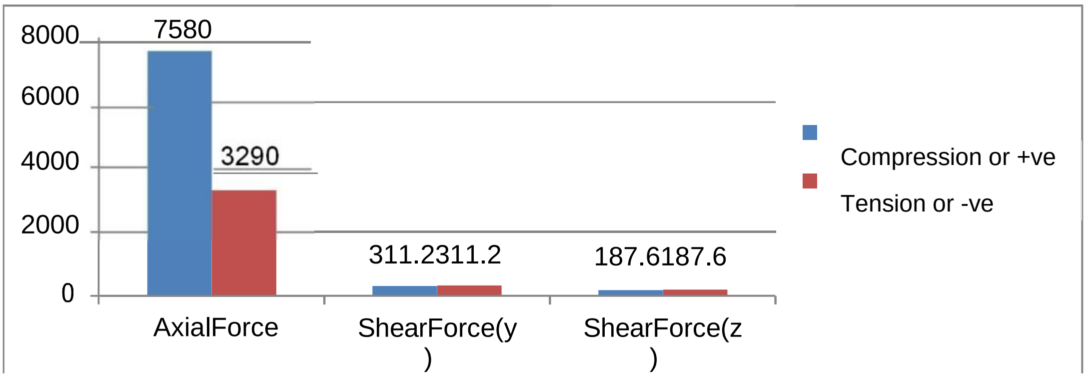


Figure 13 Bar graph for maximum Axial force and Shear force in Warren truss (100m)

ANALYSIS RESULTS OF PRATT TRUSS BRIDGE WITH 100 METER SPANLENGTH

Node Displacement

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	42	111:LOAD GEN	**23.874**	-9.909	-0.037	25.849
Min X	80	159:LOAD GEN	**-23.874**	-9.909	-0.037	25.849
Max Y	82	6:LOAD GENEF	-0.000	**0.003**	0.016	0.016
Min Y	21	135:LOAD GEN	-0.000	**-146.382**	0.165	146.382
Max Z	141	266:1.5DL+0.4!	0.970	-53.619	**91.685**	106.217
Min Z	61	267:1.5DL+0.4!	-0.970	-53.619	**-91.685**	106.217
Max rX	122	266:1.5DL+0.4!	6.921	-4.931	46.732	47.499
Min rX	80	267:1.5DL+0.4!	-6.921	-4.931	-46.732	47.499
Max rY	81	267:1.5DL+0.4!	0.000	0.000	0.000	0.000
Min rY	81	266:1.5DL+0.4!	0.000	0.000	0.000	0.000
Max rZ	77	158:LOAD GEN	-22.748	-41.144	-0.036	47.014
Min rZ	45	112:LOAD GEN	22.748	-41.144	-0.036	47.014
Max Rst	21	135:LOAD GEN	-0.000	-146.382	0.165	**146.382**

Table 10 Node Displacement Summary for Pratt truss (100m)

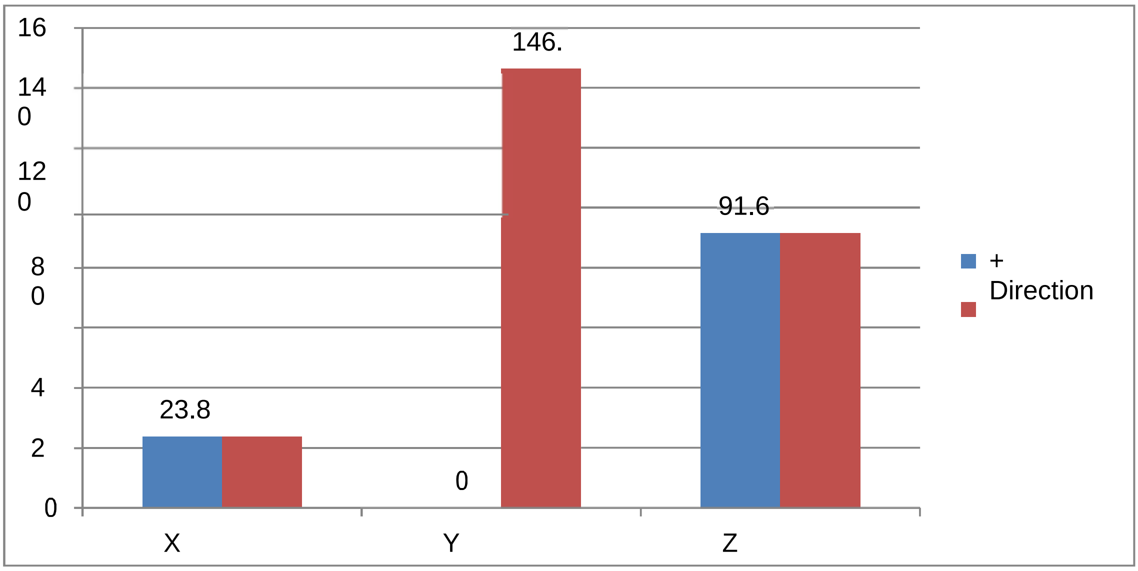


Figure 14 Bar graph for maximum node displacement in 100m Pratt truss

Support reaction

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	267:1.5DL+0.4!	**8.31E+3**	3.31E+3	1.26E+3	0.00(	0.000	0.000
Min FX	121	266:1.5DL+0.4!	**-8.31E+3**	3.31E+3	-1.26E+3	0.00(	0.000	0.000
Max FY	121	266:1.5DL+0.4!	-8.31E+3	**3.31E+3**	-1.26E+3	0.00(	0.000	0.000
Min FY	121	267:1.5DL+0.4!	5.67E+3	**-2.2E+3**	1.11E+3	0.00(	0.000	0.000
Max FZ	1	267:1.5DL+0.4!	8.31E+3	3.31E+3	**1.26E+3**	0.00(	0.000	0.000
Min FZ	121	266:1.5DL+0.4!	-8.31E+3	3.31E+3	**-1.26E+3**	0.00(	0.000	0.000
Max MX	1	6:LOAD GENEF	-0.001	220.720	9.539	**0.00(**	0.000	0.000
Min MX	1	6:LOAD GENEF	-0.001	220.720	9.539	**0.00(**	0.000	0.000
Max MY	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00(	**0.000**	0.000
Min MY	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00(	**0.000**	0.000
Max MZ	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00(	0.000	**0.000**
Min MZ	1	6:LOAD GENEF	-0.001	220.720	9.539	0.00(	0.000	**0.000**

Table 11 Support Reaction Summary for Pratt truss (100m)

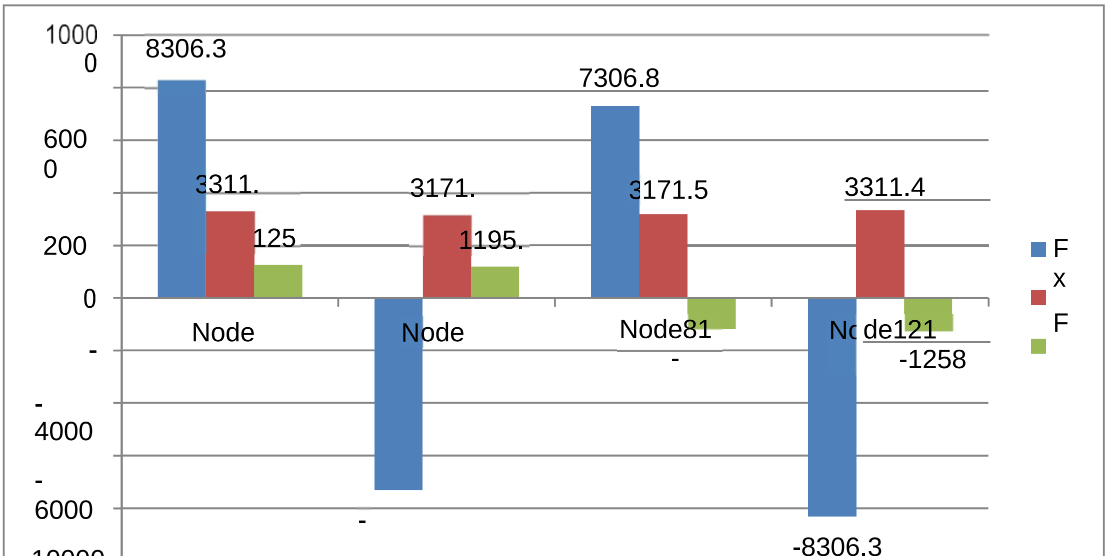


Figure 15 Bar graph for maximum support reaction in Pratt truss (100m)

Beam end forces

	Beam	Node	L/C	Axial Fx (kN)	Shear Fy (kN)	Shear Fz (kN)	Torsion Mx (kNm)	Bending My (kNm)	Bending Mz (kNm)
Max Fx	59	60	135:LOAD GEN	**7.54E+3**	52.361	-92.637	0.009	114.795	1.894
Min Fx	197	120	267:1.5DL+0.4!	**-4.15E+3**	73.567	-37.994	-51.544	173.408	71.482
Max Fy	356	42	267:1.5DL+0.4!	-16.423	**286.840**	-5.725	-0.038	17.150	861.368
Min Fy	356	42	266:1.5DL+0.4!	-15.568	**-286.840**	5.725	0.038	-17.212	-859.449
Max Fz	275	160	266:1.5DL+0.4!	3.18E+3	51.296	**144.138**	57.010	-456.100	180.226
Min Fz	118	80	267:1.5DL+0.4!	3.03E+3	48.369	**-143.943**	-57.212	455.339	167.604
Max Mx	197	120	206:LOAD GEN	1.4E+3	14.758	-44.065	**125.582**	25.537	-15.845
Min Mx	40	40	206:LOAD GEN	1.4E+3	14.758	44.065	**-125.582**	-25.537	-15.845
Max My	275	121	266:1.5DL+0.4!	3.18E+3	51.296	144.138	57.010	**615.283**	-201.057
Min My	79	1	267:1.5DL+0.4!	3.18E+3	-51.296	144.138	57.010	**-615.283**	-201.056
Max Mz	356	122	266:1.5DL+0.4!	-15.568	-286.840	5.725	0.038	17.137	**861.593**
Min Mz	356	122	267:1.5DL+0.4!	-16.423	286.840	-5.725	-0.038	-17.199	**-859.675**

Table 12 Beam End force summary for Pratt truss (100m)

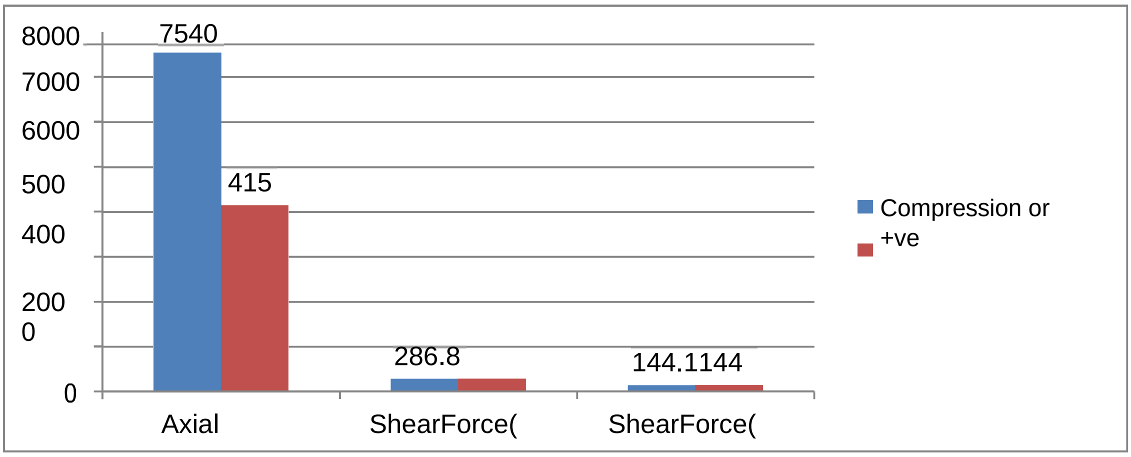


Figure 16 Bar graph for maximum Axial force and Shear force in Pratt truss (100m)

ANALYSIS RESULTS OF HOWE TRUSS BRIDGE WITH 100 METERSPAN LENGTH

Node Displacement

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)
Max X	22	111:LOAD GEN	**29.677**	-23.956	-0.046	38.140
Min X	40	159:LOAD GEN	**-29.677**	-23.956	-0.046	38.140
Max Y	62	6:LOAD GENEF	-0.002	**0.000**	-0.018	0.018
Min Y	51	135:LOAD GEN	-0.000	**-180.379**	-0.270	180.379
Max Z	71	266:1.5DL+0.4!	0.626	-145.760	**85.439**	168.956
Min Z	31	267:1.5DL+0.4!	-0.626	-145.760	**-85.439**	168.956
Max rX	71	266:1.5DL+0.4!	0.626	-145.760	85.439	168.956
Min rX	31	267:1.5DL+0.4!	-0.626	-145.760	-85.439	168.956
Max rY	1	267:1.5DL+0.4!	0.000	0.000	0.000	0.000
Min rY	41	266:1.5DL+0.4!	0.000	0.000	0.000	0.000
Max rZ	57	163:LOAD GEN	3.771	-99.975	-0.041	100.046
Min rZ	45	107:LOAD GEN	-3.771	-99.975	-0.041	100.046
Max Rst	51	135:LOAD GEN	-0.000	-180.379	-0.270	**180.379**

Table 13 Node Displacement Summary for Howe truss (100m)

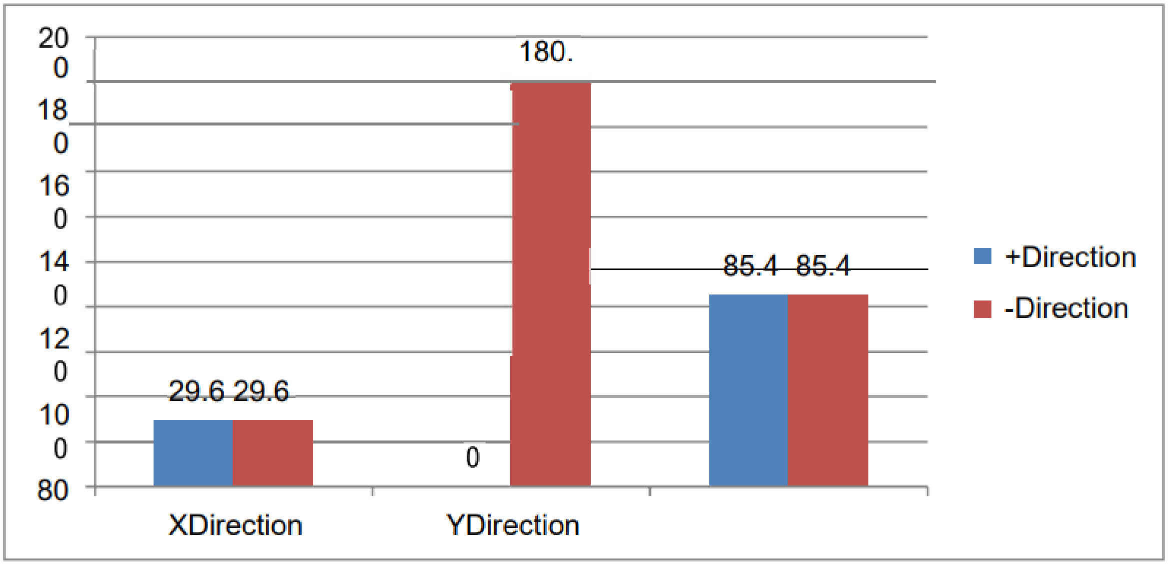


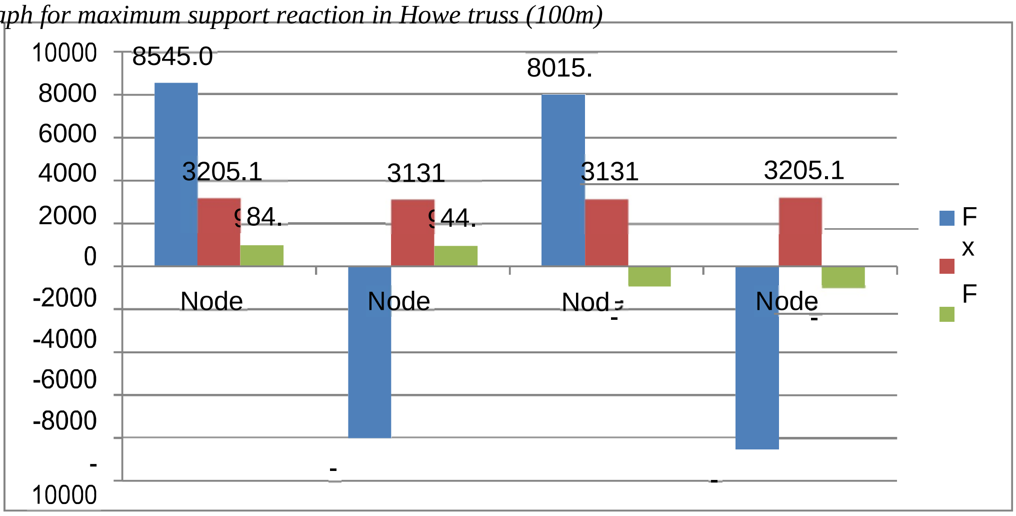
Figure 17 Bar graph for maximum node displacement in 100m Howe truss

Support reaction

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	1	267:1.5DL+0.4!	**8.55E+3**	3.21E+3	984.591	0.00C	0.000	0.000
Min FX	61	266:1.5DL+0.4!	**-8.55E+3**	3.21E+3	-984.591	0.00C	0.000	0.000
Max FY	61	266:1.5DL+0.4!	-8.55E+3	**3.21E+3**	-984.591	0.00C	0.000	0.000
Min FY	61	267:1.5DL+0.4!	1.29E+3	**-309.964**	530.525	0.00C	0.000	0.000
Max FZ	1	267:1.5DL+0.4!	8.55E+3	3.21E+3	**984.591**	0.00C	0.000	0.000
Min FZ	61	266:1.5DL+0.4!	-8.55E+3	3.21E+3	**-984.591**	0.00C	0.000	0.000
Max MX	1	6:LOAD GENEF	-0.135	220.720	3.531	**0.00C**	0.000	0.000
Min MX	1	6:LOAD GENEF	-0.135	220.720	3.531	**0.00C**	0.000	0.000
Max MY	1	6:LOAD GENEF	-0.135	220.720	3.531	0.00C	**0.000**	0.000
Min MY	1	6:LOAD GENEF	-0.135	220.720	3.531	0.00C	**0.000**	0.000
Max MZ	1	6:LOAD GENEF	-0.135	220.720	3.531	0.00C	0.000	**0.000**
Min MZ	1	6:LOAD GENEF	-0.135	220.720	3.531	0.00C	0.000	**0.000**

Table 14 Support Reaction Summary for Howe truss (100m)

Figure 18 Bar graph for maximum support reaction in Howe truss (100m)



CONCLUSION -

The analysis of bridges with different truss section as super structure shows significant behavior during seismic analysis. For this, proper consideration of dynamic factors was taken to obtain results. The analysis of two different span truss bridge (i.e. 50 meter and 100 meter) for the region having seismic zone V is done to observe the node displacement, support reactions, axial forces, shear forces, torsion and bending moments of truss members. For the analysis, STAAD. Pro V8i software is used. Based on the Foregoing study, following conclusions are drawn.

For 50-meter span truss bridge –

a) For 50-meter span bridge, overall Warren truss shows less node displacement and support reaction in comparison to the Pratt truss and Howe truss.
b) On the basis of axial force and torsion, here also Warren truss plays better role than other two truss bridges.
c) For shear force and bending moments of the truss members, the values are greater in Warren truss than in Pratt or Howe truss, but axial force governs the stress condition of the members and not bending moments or shear forces in truss bridge.
d) From the results it is also conclude that Pratt truss behaves worst as super structure among all the three types of truss for 50 meter span bridge.

So over all we can say that, for 50-meter span truss bridge the best section of truss which is suitable is Warren truss.

For 100-meter span truss bridge –

a) Surprisingly, the truss which behaves worst in 50-meter span length, performs good for 100 meter span length.
b) Overall node displacement is less for Pratt type truss bridge in comparison to other two type of truss bridge.
c) Though, in terms of support reaction, Howe truss performs well but values are very much similar for Howe truss and Pratt truss.
d) Pratt truss and Howe truss performs good in comparison to Warren truss on the basis of axial compression force and shear force but for axial tension, the values are minimum for Howe truss and Maximum for Pratt truss. But we know that steel performs good in tension so we can consider that overall Pratt truss is good on the basis of axial force and shear force.
e) For torsion and bending moments of members the Howe truss performs best in comparison to other two trusses.

So with little modification in member cross-section the Pratt truss or Howe truss can be used as the super structure for 100 meter span bridge and Warren truss behaves worst among three types of truss for the same.

REFERENCES

1) Sanjay Mehta a project engineer with New York city offic of Lichtenstein "Seismic analysis options for steel truss bridges" MSC, American Institute of Steel Construction. (1999)
2) Wanchalearm, Seung et al "Seismic analysis of truss arch bridge crossing the Mississippi river" 12th World Conference on Earthquake Engineering(2000).
3) Indian Footbridge Schedule of Dimensions (2004).
4) RDSO Guidelines on seismic design of footbridge bridges, January (2005).
5) Sangeeta Pandey, "Dynamic analysis of footbridge steel arch bridge" Department of Earthquake Engineering, IIT Roorkee. (2006)
6) Huang, M, Liu, L. K, Law, S. s. and Lu, Z. R, "Vibration analysis of prestressed concrete bridge subjected to moving vehicles" *Interaction and Multiscale Mechanics* **Vol: 4, No. 4 pp 237-289**(2011)
7) Phyoe, T. Htat, K. L. " Vibration effects on steel truss bridge under moving loads" *International Journal of Science Engineering and Technology Research.* **Vol: 3, No.11 pp 1-5** (2014).

8) T. Pramod Kumar et al "Analysis and design of superstructure of road cum footbridge bridge across Krishna river" *International Journal of Engineering and ScienceResearch.* **Vol:6 Issue-7/830-838** (2015)
9) Kavita k. Ghogare (2015) "Comparative study of seismic forces for the industrial structure" *International Journal for Research in Applied Science & Engineering Technology.* **Vol:2 issue-11** (2015)
10) K.Venkateswara Rao, G.Ramakrishna, Dr. M. KameswaraRao, " A comparative design of RCC and Prestressed Concrete flyover along with RCC Abutments" *International Journal for Science Research & Development* **Vol: 3 Issue -6** (2015).
11) Vipin A. Saluja and S. R. Satone "Seismic analysis of foot over bridge for different soil conditions", *International Journal of Engineering Development and Research.* **Vol: 1 Issue- 7** (2016)
12) Shubhank Gupta et al " Comparative analysis of different truss type footbridge bridge considering footbridge loading" *International Journal of Engineering Science and ResearchTechnology.* **ISSN:2277-9655** (2017)
13) Abdul Rashid et al "Analysis of girder bridge with IRC and IRS loadings – A comparative study" *International Journal of Innovative Research in Science Engineering andTechnology.* **Vol:6 Issue -8** (2017)
14) Mohamad Ibrahim Zaed Ammar et al "Effect of vibration located on the steel truss bridges under moving load" *The 2nd International Conference on Civil Engineering Research.* (2017)
15) T.J. Jayakrishnann, LekshmiPriya R., "Analysis of seismic behavior of a composite bridge using ANSYS" *International Journal of Engineering Research & Technology* **Vol: 6 Issue -5** (2017)
16) Rohit Gakre et al "Analysis of footbridge bridge steel sections with different types of trusses for 32.5t axle loading" *International Journal for Research in Applied Science & EngineeringTechnology.* **Vol:6 Issue 11,** (2018)