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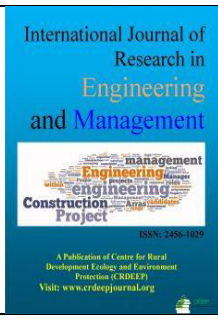

Full Length Research Paper

Forces Distribution in N-Truss Members

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ABSTRACT

Trusses are a special type structure known for its high strength-to-weight ratio. Truss structural form has been employed by designers in wide and different applications. This paper focuses on and presents the distribution of axial forces in trusses under static loads considering different parameters regarding the geometry of the truss and the slope of the upper chord. The results show that the maximum forces in truss members appear in the chord members in midspan for trusses with no upper-chord slope, and or trusses with upper-chord slope, they appear in the range between one-third and middle of truss span.

Introduction and Background

Trusses are used in a wide range for structures, mainly when a very large span is required in building. Trusses consist of only two-force members where the members are organized and adjusted so that the connected members work as a whole in single rigid object. They are used to carry heavy loads or the covering roof loads and to provide horizontal stability. Past researches took the trusses into consideration of studies but didn't discuss how the forces are distributed in trusses members.

Smith Jeffrey et al. [1] presented a method for designing trusses, a complex category of buildings, by using non-linear optimization. They represented the trusses as a set of rigid bars connected at edges by pin joints. They could simultaneously optimize the geometry and the mass of structures by including the location of the joints as well as the strength of individual beams in their design variables. Petrović Nenad et al. [2] developed parametric modeling of size optimization truss models considering element cross-sections as variables with the goal of maintaining the equivalent stresses within acceptable ranges while minimizing overall mass. The models were subjected to finite element analyzes to determine stress. Parametric models of standard 10, 17 and 25 bar trusses are created to facilitate optimization. Obtained results the models are compared to literature. Lianto Fermanto et al. [3] studied systems of trusses and discussed their application on different buildings in order to determine various types of truss systems that exist by using a literature study method on these systems. Abbasi Mehdi and Moshkabadi Ramin [4] evaluated combination of interior angles in vertical and horizontal displacement in Pratt truss by using statistical analyses methods considering parameters such as material, applied force on joints and diameter of bar. 45 models in total we analyzed. Then they used SPSS program to statistically analyze data considering the parameters and evaluate them. Obtained results showed that in single parameter mode, a scenario with combination bar diameter, elastic modulus and angles between elements results much better than scenario with considering force in joints.

The main objective of this paper is to present the force distribution in truss members subjected to static loads, this paper focuses on the typical single storey industrial structure with main systems considered as N-shape trusses.

Research Methodology

Finite element modeling software SAP2000 V20 [5] was used for analysis of a variety of configurations for N-trusses as that shown in Fig. 1 to determine the forces in the truss members.

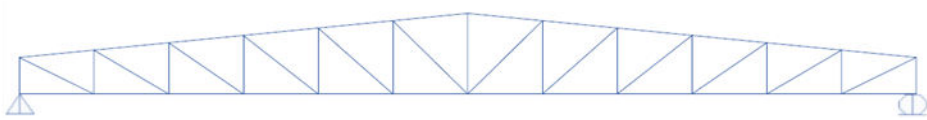

Fig. 1. N-truss

The obtained data from SAP2000 [5] truss models were taken and sorted according to each element type of the structure members for each joint with details.

Truss Models

Parameters of Trusses Geometry

Ten truss models were created considering certain parameters to achieve a variety of conditions and cases for the distribution of loads in truss members. First parameter considered for this study was the slope of the upper chord (angle of inclination), the values for this parameter were 0°, 5.7° and 2.86°. The second parameter taken was the span to truss span to its height ratio, its values were maintained between (8 to 16). The third parameter considered was the aspect ratio of the first panel of the truss making angles of between 30° and 65°. Subdivision was considered for truss spans exceeding 32 meters. Table 1present details of the parameters considered for each truss model.

Table 1. Parameters and geometry of truss models

Model Number	Database for SAP2000 Models (Variables)						
	Slope	$\tan^{-1}(h/a)$	(B/H)	B (m)	H (m)	h (m)	a (m)
1	0°	33.69°	9	10.8	1.2	1.2	1.8
2	0°	30°	13.85	16	1.16	1.16	2
3	0°	30.963°	16.67	20	1.2	1.2	2
4	0°	45°	8	16	2	2	2
5	0°	45°	12	24	2	2	2
6*	0°	45°	16	32	2	2	2
7	0°	60°	8.08	21	1.5	2.6	1.5
8	5.7°	30°	8.18	16	1.96	1.16	2
9	5.7°	45°	8.24	21	2.55	1.5	1.5
10*	5.7°	60°	8.18	36	4.4	2.6	1.5

**:sub-divided truss*

Loading of Truss Models

All models were loaded by vertical concentrated loads at the top chords of trusses at each of their nodes. the considered spacing between the structure's main systems is 6 meters. Own weight of trusses was calculated by the software itself, bracing and tie rods were assumed to be 14kg/m^2 and live load of 55kg/m^{2}respectively. A sketch of a truss model showing the applied forced at the upper chord nodes shown in Fig. 2.

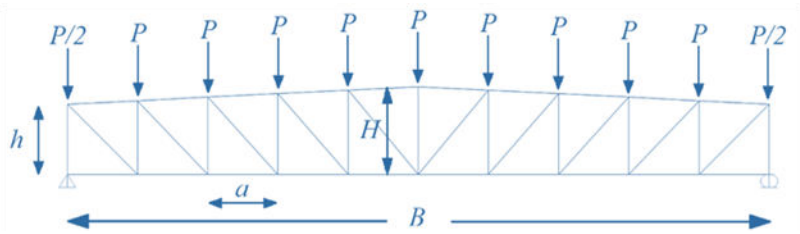

Fig. 2. Truss model with the applied loads on it

The data obtained from that analysis carried on SAP2000 [5] for the ten models is the determination of loads in all steel members for each truss model. These determined loads were all sorted for each model according to the joints and the type of truss elements. Figures fromFig. 3**.** to Fig. 13show the shapes of the truss models. Tables from Table 2 to Table 12 present the axial forces of trusses' members, where (V) represents vertical truss members, (D) represents diagonal truss members, (LC) represents lower chord truss member and (UC) is for the upper chord truss member.

Truss 1:

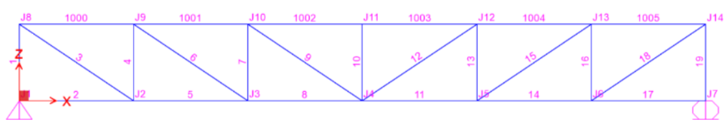

Fig. 3 Truss 1

Table 2. Axial forces of members of truss 1

Frame	P (ton)	Joint	span (m)	H (m)	h (m)	a (m)	Element Type
1	-1.2	J1	10.8	1.2	1.2	1.8	V
2	0.4885	J1	10.8	1.2	1.2	1.8	LC
2	0.4885	J2	10.8	1.2	1.2	1.8	LC
3	1.797	J2	10.8	1.2	1.2	1.8	D
4	-0.922	J2	10.8	1.2	1.2	1.8	V
5	2.0093	J2	10.8	1.2	1.2	1.8	LC
5	2.0093	J3	10.8	1.2	1.2	1.8	LC
6	1.0635	J3	10.8	1.2	1.2	1.8	D
7	-0.508	J3	10.8	1.2	1.2	1.8	V
8	2.9092	J3	10.8	1.2	1.2	1.8	LC
8	2.9092	J4	10.8	1.2	1.2	1.8	LC
9	0.3007	J4	10.8	1.2	1.2	1.8	D
10	-0.327	J4	10.8	1.2	1.2	1.8	V
11	2.9092	J4	10.8	1.2	1.2	1.8	LC
12	-0.327	J4	10.8	1.2	1.2	1.8	D
1	-1.2	J8	10.8	1.2	1.2	1.8	V
3	1.797	J8	10.8	1.2	1.2	1.8	D
UC1	-1.728	J8	10.8	1.2	1.2	1.8	UC
4	-0.9	J9	10.8	1.2	1.2	1.8	V
6	1.1	J9	10.8	1.2	1.2	1.8	D
UC1	-1.728	J9	10.8	1.2	1.2	1.8	UC
UC2	-2.64	J9	10.8	1.2	1.2	1.8	UC
7	-0.5	J10	10.8	1.2	1.2	1.8	V
9	0.3	J10	10.8	1.2	1.2	1.8	D
UC2	-2.64	J10	10.8	1.2	1.2	1.8	UC
UC3	-2.9	J10	10.8	1.2	1.2	1.8	UC
10	0	J11	10.8	1.2	1.2	1.8	V
UC3	-2.9	J11	10.8	1.2	1.2	1.8	UC
UC4	-2.9	J11	10.8	1.2	1.2	1.8	UC

Truss 2:

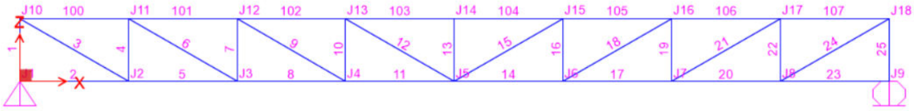

Fig. 4 Truss 2

Table 3 Axial forces of members of truss 2

Frame	P	Joint	span	H	h	a	Element Type
1	-4.42	J1	16	1.16	1.16	2	V
3	7.6613	J1	16	1.16	1.16	2	D
2	0.1163	J2	16	1.16	1.16	2	LC
3	7.6613	J2	16	1.16	1.16	2	D
4	-3.778	J2	16	1.16	1.16	2	V
5	6.8679	J2	16	1.16	1.16	2	LC
5	6.8679	J3	16	1.16	1.16	2	LC
6	5.5377	J3	16	1.16	1.16	2	D
7	-2.687	J3	16	1.16	1.16	2	V
8	11.742	J3	16	1.16	1.16	2	LC
8	11.742	J4	16	1.16	1.16	2	LC
9	3.3123	J4	16	1.16	1.16	2	D
10	-1.566	J4	16	1.16	1.16	2	V
11	14.658	J4	16	1.16	1.16	2	LC
11	14.7	J5	16	1.16	1.16	2	LC
12	1	J5	16	1.16	1.16	2	D
13	-1	J5	16	1.16	1.16	2	V
14	14.7	J5	16	1.16	1.16	2	LC
15	1	J5	16	1.16	1.16	2	D
1	-4.42	J10	16	1.16	1.16	2	V
3	7.6613	J10	16	1.16	1.16	2	D

100	-6.754	J10	16	1.16	1.16	2	UC
4	-6.148	J11	16	1.16	1.16	2	V
6	7.2303	J11	16	1.16	1.16	2	D
100	-11.67	J11	16	1.16	1.16	2	UC
101	-11.67	J11	16	1.16	1.16	2	UC
7	-5.037	J12	16	1.16	1.16	2	V
9	5.619	J12	16	1.16	1.16	2	D
101	-14.61	J12	16	1.16	1.16	2	UC
102	-14.61	J12	16	1.16	1.16	2	UC
10	-3.9	J13	16	1.16	1.16	2	V
12	4.0175	J13	16	1.16	1.16	2	D
102	-15.58	J13	16	1.16	1.16	2	UC
103	-15.6	J13	16	1.16	1.16	2	UC

Truss 3:

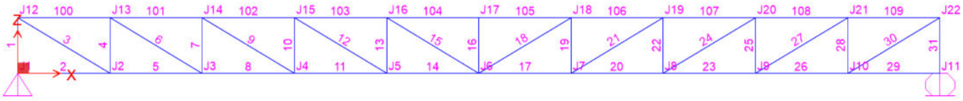

Fig. 5 Truss 3

Table 4. Axial forces of members of truss 3

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-5.9824	J1	20	1.2	1.2	2	V
2	0.1306	J1	20	1.2	1.2	2	LC
2	0.1306	J2	20	1.2	1.2	2	LC
3	9.6165	J2	20	1.2	1.2	2	D
4	-4.903	J2	20	1.2	1.2	2	V
5	8.5057	J2	20	1.2	1.2	2	LC
5	8.5057	J3	20	1.2	1.2	2	LC
6	7.5681	J3	20	1.2	1.2	2	D
7	-3.8266	J3	20	1.2	1.2	2	V
8	15.085	J3	20	1.2	1.2	2	LC
8	15.085	J4	20	1.2	1.2	2	LC
9	5.3964	J4	20	1.2	1.2	2	D
10	-2.714	J4	20	1.2	1.2	2	V
11	19.7688	J4	20	1.2	1.2	2	LC
11	19.7688	J5	20	1.2	1.2	2	LC
12	3.242	J5	20	1.2	1.2	2	D
13	-1.6108	J5	20	1.2	1.2	2	V
14	22.5703	J5	20	1.2	1.2	2	LC
14	22.5703	J6	20	1.2	1.2	2	LC
15	1.1135	J6	20	1.2	1.2	2	D
16	-1.0628	J6	20	1.2	1.2	2	V
17	22.57	J6	20	1.2	1.2	2	LC
18	1.1092	J6	20	1.2	1.2	2	D
1	-5.9824	J12	20	1.2	1.2	2	V
3	7.7757	J12	20	1.2	1.2	2	D
100	-5.5698	J12	20	1.2	1.2	2	UC
100	-8.376	J13	20	1.2	1.2	2	UC
4	-4.903	J13	20	1.2	1.2	2	V
6	7.5681	J13	20	1.2	1.2	2	D
101	-14.9948	J13	20	1.2	1.2	2	UC
101	-14.9948	J14	20	1.2	1.2	2	UC
7	-3.8266	J14	20	1.2	1.2	2	V
9	5.3964	J14	20	1.2	1.2	2	D
102	-19.7108	J14	20	1.2	1.2	2	UC
102	-19.7108	J15	20	1.2	1.2	2	UC
10	-2.714	J15	20	1.2	1.2	2	V
12	3.242	J15	20	1.2	1.2	2	D
103	-22.5464	J15	20	1.2	1.2	2	UC
103	-22.5464	J16	20	1.2	1.2	2	UC
13	-1.6108	J16	20	1.2	1.2	2	V

15	1.1135	J16	20	1.2	1.2	2	D
104	-23.522	J16	20	1.2	1.2	2	UC

Truss 4:

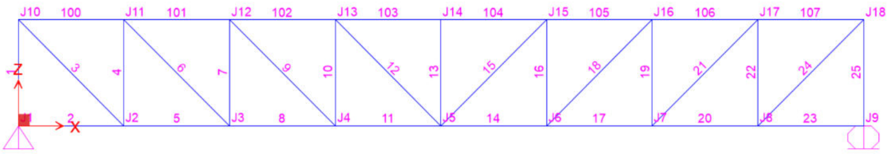

Fig. 6 Truss 4

Table 5. Axial forces of members of truss 4

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-4.5388	J1	16	2	2	2	V
2	0.0322	J1	16	2	2	2	LC
2	0.0322	J2	16	2	2	2	LC
3	5.5984	J2	16	2	2	2	D
4	-3.8877	J2	16	2	2	2	V
5	4.0181	J2	16	2	2	2	LC
5	4.0181	J3	16	2	2	2	LC
6	4.0197	J3	16	2	2	2	D
7	-2.7696	J3	16	2	2	2	V
8	6.8769	J3	16	2	2	2	LC
8	6.8769	J4	16	2	2	2	LC
9	2.4137	J4	16	2	2	2	D
10	-1.635	J4	16	2	2	2	V
11	8.5899	J4	16	2	2	2	LC
11	8.5899	J5	16	2	2	2	LC
12	0.8059	J5	16	2	2	2	D
13	-1.0581	J5	16	2	2	2	V
14	8.5899	J5	16	2	2	2	LC
15	0.8059	J5	16	2	2	2	D
1	-4.5388	J10	16	2	2	2	V
3	5.5984	J10	16	2	2	2	D
100	-3.9896	J10	16	2	2	2	UC
100	-3.9896	J11	16	2	2	2	UC
4	-3.8877	J11	16	2	2	2	V
6	4.0197	J11	16	2	2	2	D
101	-6.8585	J11	16	2	2	2	UC
101	-6.8585	J12	16	2	2	2	UC
7	-2.7696	J12	16	2	2	2	V
9	2.4137	J12	16	2	2	2	D
102	-8.5804	J12	16	2	2	2	UC
102	-8.5804	J13	16	2	2	2	UC
10	-1.635	J13	16	2	2	2	V
12	0.8059	J13	16	2	2	2	D
103	-9.1553	J13	16	2	2	2	UC

Truss 5:

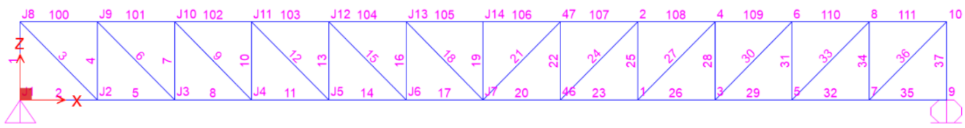

Fig. 7 Truss 5

Table 6. Axial forces of members of truss 5

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-6.8158	J1	24	2	2	2	V
2	0.0481	J1	24	2	2	2	LC
2	0.0481	J2	24	2	2	2	LC
3	8.794	J2	24	2	2	2	D
4	-6.1479	J2	24	2	2	2	V

5	6.3146	J2	24	2	2	2	LC
5	6.3146	J3	24	2	2	2	LC
6	7.2303	J3	24	2	2	2	D
7	-5.0368	J3	24	2	2	2	V
8	11.4643	J3	24	2	2	2	LC
8	11.4643	J4	24	2	2	2	LC
9	5.619	J4	24	2	2	2	D
10	-3.8999	J4	24	2	2	2	V
11	15.4639	J4	24	2	2	2	LC
11	15.4639	J5	24	2	2	2	LC
12	4.0175	J5	24	2	2	2	D
13	-2.768	J5	24	2	2	2	V
14	18.3203	J5	24	2	2	2	LC
14	18.3203	J6	24	2	2	2	LC
15	2.4145	J6	24	2	2	2	D
16	-1.6371	J6	24	2	2	2	V
17	20.0326	J6	24	2	2	2	LC
17	20.0326	J7	24	2	2	2	LC
18	0.8138	J7	24	2	2	2	D
19	-1.065	J7	24	2	2	2	V
20	20.0323	J7	24	2	2	2	LC
21	0.7999	J7	24	2	2	2	D
1	-6.8158	J8	24	2	2	2	V
3	8.794	J8	24	2	2	2	D
100	-6.2674	J8	24	2	2	2	UC
4	-6.1479	J9	24	2	2	2	V
6	7.2303	J9	24	2	2	2	D
100	-6.2674	J9	24	2	2	2	UC
101	-11.4276	J9	24	2	2	2	UC
7	-5.0368	J10	24	2	2	2	V
9	5.619	J10	24	2	2	2	D
101	-11.4276	J10	24	2	2	2	UC
102	-15.4366	J10	24	2	2	2	UC
10	-3.8999	J11	24	2	2	2	V
12	4.0175	J11	24	2	2	2	D
102	-15.4366	J11	24	2	2	2	UC
103	-18.3027	J11	24	2	2	2	UC
13	-2.768	J12	24	2	2	2	V
15	2.4145	J12	24	2	2	2	D
103	-18.3027	J12	24	2	2	2	UC
104	-20.0243	J12	24	2	2	2	UC
16	-1.6371	J13	24	2	2	2	V
18	0.8138	J13	24	2	2	2	D
104	-20.0243	J13	24	2	2	2	UC
105	-20.6036	J13	24	2	2	2	UC

Truss 6:

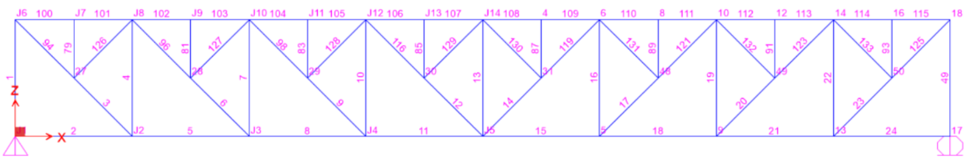

Fig. 8 Truss 6

Table 7 Axial forces of members of truss 6

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-9.302	J1	32	2	2	2	V
2	0.0254	J1	32	2	2	2	LC
2	0.0254	J2	32	2	2	2	LC
3	11.6	J2	32	2	2	2	D
4	-8.04	J2	32	2	2	2	V
5	8.25	J2	32	2	2	2	LC
5	8.25	J3	32	2	2	2	LC
6	8.22	J3	32	2	2	2	D

7	-5.6	J3	32	2	2	2	V
8	14.08	J3	32	2	2	2	LC
8	14.08	J4	32	2	2	2	LC
9	4.9	J4	32	2	2	2	D
10	-3.8999	J4	32	2	2	2	V
11	17.5757	J4	32	2	2	2	LC
11	17.5757	J5	32	2	2	2	LC
12	1.6424	J5	32	2	2	2	D
13	-2.177	J5	32	2	2	2	V
14	1.6424	J5	32	2	2	2	D
15	17.5757	J5	32	2	2	2	LC
1	9.2	J6	32	2	2	2	V
94	12.1	J6	32	2	2	2	D
100	-8.6	J6	32	2	2	2	UC
4	-8	J8	32	2	2	2	V
96	8.7	J8	32	2	2	2	D
101	-8.6	J8	32	2	2	2	UC
102	-14.4	J8	32	2	2	2	UC
126	0.5	J8	32	2	2	2	D
7	-5.6	J10	32	2	2	2	V
98	5.4	J10	32	2	2	2	D
103	-14.4	J10	32	2	2	2	UC
104	-17.9	J10	32	2	2	2	UC
127	0.5	J10	32	2	2	2	D
10	-3.3	J12	32	2	2	2	V
105	-17.9	J12	32	2	2	2	UC
106	-19.2	J12	32	2	2	2	UC
116	2.3	J12	32	2	2	2	D
128	0.6	J12	32	2	2	2	D
13	-2.14	J14	32	2	2	2	V
107	-19.2	J14	32	2	2	2	UC
108	-19.2	J14	32	2	2	2	UC
129	0.7	J14	32	2	2	2	D
130	0.7	J14	32	2	2	2	D

Truss 7:

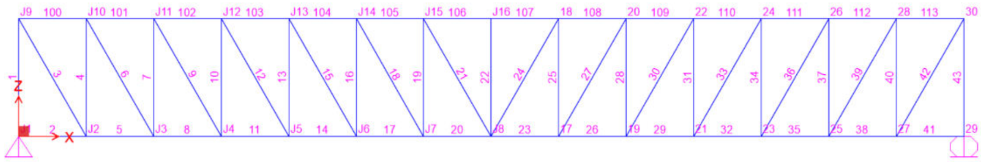

Fig. 9 Truss 7

Table 8. Axial forces of members of truss 7

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-6.1529	J1	21	1.5	2.6	1.5	V
2	0.0299	J1	21	1.5	2.6	1.5	LC
2	0.0299	J2	21	1.5	2.6	1.5	LC
3	6.535	J2	21	1.5	2.6	1.5	D
4	-5.6002	J2	21	1.5	2.6	1.5	V
5	3.3313	J2	21	1.5	2.6	1.5	LC
5	3.3313	J3	21	1.5	2.6	1.5	LC
6	5.5692	J3	21	1.5	2.6	1.5	D
7	-4.7605	J3	21	1.5	2.6	1.5	V
8	6.1441	J3	21	1.5	2.6	1.5	LC
8	6.1441	J4	21	1.5	2.6	1.5	LC
9	4.5506	J4	21	1.5	2.6	1.5	D
10	-3.8797	J4	21	1.5	2.6	1.5	V
11	8.4412	J4	21	1.5	2.6	1.5	LC
11	8.4412	J5	21	1.5	2.6	1.5	LC
12	3.5433	J5	21	1.5	2.6	1.5	D
13	-3.0077	J5	21	1.5	2.6	1.5	V

14	10.2282	J5	21	1.5	2.6	1.5	LC
14	10.2282	J6	21	1.5	2.6	1.5	LC
15	2.532	J6	21	1.5	2.6	1.5	D
16	-2.1334	J6	21	1.5	2.6	1.5	V
17	11.5031	J6	21	1.5	2.6	1.5	LC
17	11.5031	J7	21	1.5	2.6	1.5	LC
18	1.528	J7	21	1.5	2.6	1.5	D
19	-1.2604	J7	21	1.5	2.6	1.5	V
20	12.27	J7	21	1.5	2.6	1.5	LC
20	12.27	J8	21	1.5	2.6	1.5	LC
21	0.5034	J8	21	1.5	2.6	1.5	D
22	-0.8059	J8	21	1.5	2.6	1.5	V
23	12.2696	J8	21	1.5	2.6	1.5	LC
24	0.4861	J8	21	1.5	2.6	1.5	D
1	-6.1529	J9	21	1.5	2.6	1.5	V
3	6.535	J9	21	1.5	2.6	1.5	D
100	-3.3002	J9	21	1.5	2.6	1.5	UC
4	-5.6002	J10	21	1.5	2.6	1.5	V
6	5.5692	J10	21	1.5	2.6	1.5	D
100	-3.3002	J10	21	1.5	2.6	1.5	UC
101	-6.1184	J10	21	1.5	2.6	1.5	UC
7	-4.7605	J11	21	1.5	2.6	1.5	V
9	4.5506	J11	21	1.5	2.6	1.5	D
101	-6.1184	J11	21	1.5	2.6	1.5	UC
102	-8.4205	J11	21	1.5	2.6	1.5	UC
10	-3.8797	J12	21	1.5	2.6	1.5	V
12	3.5433	J12	21	1.5	2.6	1.5	D
102	-8.4205	J12	21	1.5	2.6	1.5	UC
103	-10.2127	J12	21	1.5	2.6	1.5	UC
13	-3.0077	J13	21	1.5	2.6	1.5	V
15	2.532	J13	21	1.5	2.6	1.5	D
103	-10.2127	J13	21	1.5	2.6	1.5	UC
104	-11.4928	J13	21	1.5	2.6	1.5	UC

Truss 8:

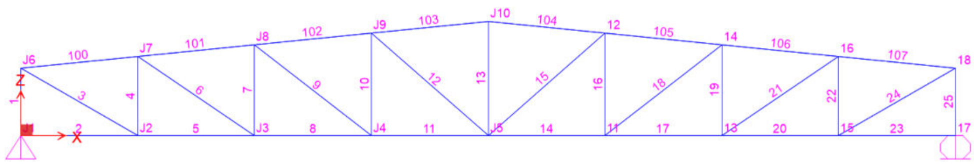

Fig. 10 Truss 8

Table 9 Axial forces of members of truss 8

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-6.1529	J1	16	2	1.2	2	V
2	0.0	J1	16	2	1.2	2	LC
2	0.0	J2	16	2	1.2	2	LC
3	6.268	J2	16	2	1.2	2	D
4	-3.0828	J2	16	2	1.2	2	V
5	5.5867	J2	16	2	1.2	2	LC
5	5.5867	J3	16	2	1.2	2	LC
6	3.3456	J3	16	2	1.2	2	D
7	-1.7742	J3	16	2	1.2	2	V
8	8.3732	J3	16	2	1.2	2	LC
8	8.3732	J4	16	2	1.2	2	LC
9	1.1298	J4	16	2	1.2	2	D
10	-0.6223	J4	16	2	1.2	2	V
11	9.2616	J4	16	2	1.2	2	LC
11	9.2616	J5	16	2	1.2	2	LC
12	-0.4429	J5	16	2	1.2	2	D

13	0.7385	J5	16	2	1.2	2	V
14	9.2613	J5	16	2	1.2	2	LC
15	-0.4558	J5	16	2	1.2	2	D
1	-4.2444	J6	16	2	1.2	2	V
3	6.268	J6	16	2	1.2	2	D
100	-5.5676	J6	16	2	1.2	2	UC
4	-8.0652	J7	16	2	1.2	2	V
6	8.2267	J7	16	2	1.2	2	D
1000	-6.7538	J7	16	2	1.2	2	UC
1001	-11.6672	J7	16	2	1.2	2	UC
7	-5.6817	J8	16	2	1.2	2	V
9	4.9331	J8	16	2	1.2	2	D
1001	-11.6672	J8	16	2	1.2	2	UC
1002	-14.6144	J8	16	2	1.2	2	UC
10	-3.3509	J9	16	2	1.2	2	V
12	1.6424	J9	16	2	1.2	2	D
1002	-14.6144	J9	16	2	1.2	2	UC
1003	-15.5849	J9	16	2	1.2	2	UC

Truss 9:

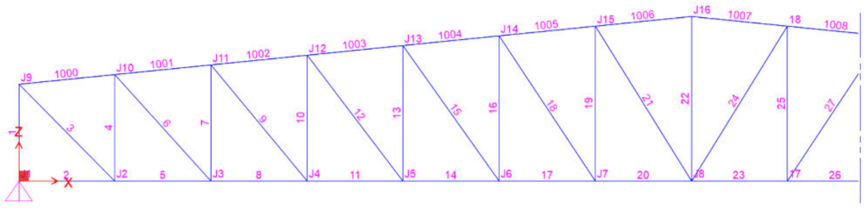

Fig. 11 Truss 9

Table 10. Axial forces of members of truss 9

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-6.1529	J1	21	2.6	1.5	1.5	V
2	0.0	J1	21	2.6	1.5	1.5	LC
2	0.0	J2	21	2.6	1.5	1.5	LC
3	6.665	J2	21	2.6	1.5	1.5	D
4	-4.672	J2	21	2.6	1.5	1.5	V
5	4.8306	J2	21	2.6	1.5	1.5	LC
5	4.8306	J3	21	2.6	1.5	1.5	LC
6	4.9207	J3	21	2.6	1.5	1.5	D
7	-3.5842	J3	21	2.6	1.5	1.5	V
8	8.1746	J3	21	2.6	1.5	1.5	LC
8	8.1746	J4	21	2.6	1.5	1.5	LC
9	3.4068	J4	21	2.6	1.5	1.5	D
10	-2.5627	J4	21	2.6	1.5	1.5	V
11	10.375	J4	21	2.6	1.5	1.5	LC
11	10.375	J5	21	2.6	1.5	1.5	LC
12	2.129	J5	21	2.6	1.5	1.5	D
13	-1.6324	J5	21	2.6	1.5	1.5	V
14	11.6813	J5	21	2.6	1.5	1.5	LC
14	11.6813	J6	21	2.6	1.5	1.5	LC
15	1.0191	J6	21	2.6	1.5	1.5	D
16	-0.7689	J6	21	2.6	1.5	1.5	V
17	12.2738	J6	21	2.6	1.5	1.5	LC
17	12.2738	J7	21	2.6	1.5	1.5	LC
18	-0.0085	J7	21	2.6	1.5	1.5	D
19	0.0381	J7	21	2.6	1.5	1.5	V
20	12.2601	J7	21	2.6	1.5	1.5	LC
20	12.2601	J8	21	2.6	1.5	1.5	LC
21	-0.774	J8	21	2.6	1.5	1.5	D
22	1.4438	J8	21	2.6	1.5	1.5	V
23	12.2602	J8	21	2.6	1.5	1.5	LC
24	-0.7929	J8	21	2.6	1.5	1.5	D
1	-5.6439	J9	21	2.6	1.5	1.5	V

3	6.665	J9	21	2.6	1.5	1.5	D
1000	-4.8149	J9	21	2.6	1.5	1.5	UC
4	-4.672	J10	21	2.6	1.5	1.5	V
6	4.9207	J10	21	2.6	1.5	1.5	D
1000	-4.8149	J10	21	2.6	1.5	1.5	UC
1001	-8.1903	J10	21	2.6	1.5	1.5	UC
7	-3.5842	J11	21	2.6	1.5	1.5	V
9	3.4068	J11	21	2.6	1.5	1.5	D
1001	-8.1903	J11	21	2.6	1.5	1.5	UC
1002	-10.4136	J11	21	2.6	1.5	1.5	UC
10	-2.5627	J12	21	2.6	1.5	1.5	V
12	2.129	J12	21	2.6	1.5	1.5	D
1002	-10.4136	J12	21	2.6	1.5	1.5	UC
1003	-11.7348	J12	21	2.6	1.5	1.5	UC
13	-1.6324	J13	21	2.6	1.5	1.5	V
15	1.0191	J13	21	2.6	1.5	1.5	D
1003	-11.7348	J13	21	2.6	1.5	1.5	UC
1004	-12.3352	J13	21	2.6	1.5	1.5	UC

Truss 10:

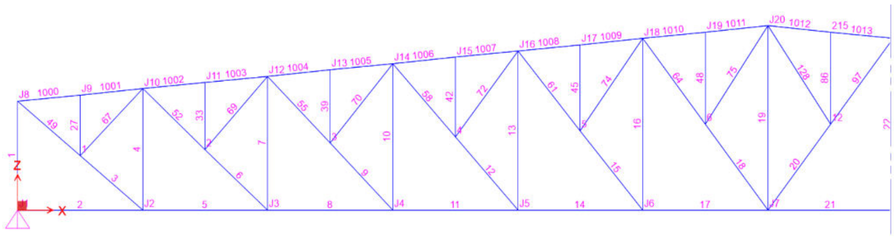

Fig. 12 Truss 10

Table 11 Axial forces of members of truss 10

Frame	P (ton)	connection no.	span (m)	H (m)	h (m)	a (m)	Element Type
1	-9.9184	J1	36	4.4	2.6	1.5	V
2	0.0	J1	36	4.4	2.6	1.5	LC
2	0.0	J2	36	4.4	2.6	1.5	LC
3	12.5569	J2	36	4.4	2.6	1.5	D
4	-8.12	J2	36	4.4	2.6	1.5	V
5	9.5817	J2	36	4.4	2.6	1.5	LC
5	9.5817	J3	36	4.4	2.6	1.5	LC
6	8.4815	J3	36	4.4	2.6	1.5	D
7	-5.7888	J3	36	4.4	2.6	1.5	V
8	15.7013	J3	36	4.4	2.6	1.5	LC
8	15.7013	J4	36	4.4	2.6	1.5	LC
9	5.3272	J4	36	4.4	2.6	1.5	D
10	-3.7827	J4	36	4.4	2.6	1.5	V
11	19.3552	J4	36	4.4	2.6	1.5	LC
11	19.3552	J5	36	4.4	2.6	1.5	LC
12	2.7127	J5	36	4.4	2.6	1.5	D
13	-1.9543	J5	36	4.4	2.6	1.5	V
14	21.1229	J5	36	4.4	2.6	1.5	LC
14	21.1229	J6	36	4.4	2.6	1.5	LC
15	0.4688	J6	36	4.4	2.6	1.5	D
16	-0.2774	J6	36	4.4	2.6	1.5	V
17	21.4085	J6	36	4.4	2.6	1.5	LC
17	21.4085	J7	36	4.4	2.6	1.5	LC
18	-1.4245	J7	36	4.4	2.6	1.5	D
19	2.4403	J7	36	4.4	2.6	1.5	V
20	-1.4245	J7	36	4.4	2.6	1.5	D
21	21.4085	J7	36	4.4	2.6	1.5	LC
1	-9.9184	J8	36	4.4	2.6	1.5	V
49	12.6	J8	36	4.4	2.6	1.5	D
1000	-9.7	J8	36	4.4	2.6	1.5	UC
4	-8.12	J10	36	4.4	2.6	1.5	V
52	8.56	J10	36	4.4	2.6	1.5	D

67	0.12	J10	36	4.4	2.6	1.5	D
1001	-9.7	J10	36	4.4	2.6	1.5	UC
1002	-15.8	J10	36	4.4	2.6	1.5	UC
7	-5.8	J12	36	4.4	2.6	1.5	V
55	5.53	J12	36	4.4	2.6	1.5	D
69	0.08	J12	36	4.4	2.6	1.5	D
1003	-15.8	J12	36	4.4	2.6	1.5	UC
1004	-19.61	J12	36	4.4	2.6	1.5	UC
10	-3.7827	J14	36	4.4	2.6	1.5	V
58	3	J14	36	4.4	2.6	1.5	D
70	0.2	J14	36	4.4	2.6	1.5	D
1005	-19.56	J14	36	4.4	2.6	1.5	UC
1006	-21.44	J14	36	4.4	2.6	1.5	UC
13	-1.92	J16	36	4.4	2.6	1.5	V
61	0.8	J16	36	4.4	2.6	1.5	D
72	0.32	J16	36	4.4	2.6	1.5	D
1007	-21.4	J16	36	4.4	2.6	1.5	UC
1008	-21.77	J16	36	4.4	2.6	1.5	UC
16	-0.25	J18	36	4.4	2.6	1.5	V
64	-1	J18	36	4.4	2.6	1.5	D
74	0.42	J18	36	4.4	2.6	1.5	D
1009	21.77	J18	36	4.4	2.6	1.5	UC
1010	20.8	J18	36	4.4	2.6	1.5	UC
19	2.44	J20	36	4.4	2.6	1.5	V
75	0.41	J20	36	4.4	2.6	1.5	D
128	0.41	J20	36	4.4	2.6	1.5	D
1011	-20.88	J20	36	4.4	2.6	1.5	UC
1012	-20.88	J20	36	4.4	2.6	1.5	UC

Discussion

There is no doubt that the parameters chosen have effect on the distribution of load in the steel members of the truss. And that the maximum forces for each truss appear in the truss chords for each one.

Effect of Change in Upper Chord Slope

From the obtained results, it can be noted that in the trusses with horizontal chords, the maximum forces in members appear in the chord members exactly at the mid-span. Also, the forces in chord members tend to increase from minimum to maximum in members from edges to midspan. While in trusses with inclined upper chords of 5.7^o (1:10 slope) the maximum forces appear also in chord members but at one-third of the truss span length.

Effect of Change in Span to Height Ratio

It can be assured from results that all forces in all members increase as the span of the truss increases in general. Nevertheless, the height of the truss has a significant effect on the values of the forces where they decrease as the height of truss increases.

Effect of Change in Panel Aspect Ration

Panel aspect ratio's effect appears clearly in changing the height of the truss where as the aspect ratio of the first truss panel increases, the height of the truss increases, hence the loads values in all of the truss decreases. In addition, as the angle of the aspect ratio changes from 45^o, the load values of the diagonal members decreases in general, where if the angle decreases, the distribution of loads increases in the chord members of truss, hence their forces increases.

Conclusion

This paper was presented to study the distribution of loads in the members of ten N-trusses using the analysis of SAP2000 [5] FE software of 10 truss models and was obtained the following:

- The maximum forces in trusses are in the chord members in general, which are located in midspan for trusses with no upper-chord slope and in the range between one-third and middle of truss span for trusses with upper-chord slope.
- As the span increases, the values of forces in all truss members increases.
- As the height of the truss increases, the forces in all truss members decreases.
- Loads in diagonal members tend to decrease as the aspect ratio of the truss panel changes from 45^o.

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