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Optimization of Roof Truss Using STAAD PRO V8i

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Abstract-The purpose of this job is to study the effect of different spacing, span, and pitches, in order to find out the most economical truss by using angle section. The need of this study arises where sometimes it is difficult or taking too much time to choose an effective and economical truss shape or truss geometry during design period.

In design of steel trusses different types of geometries (Howe truss, Pratt truss, Fink truss, King post truss and Queen post truss are etc.) and sections (Angle section, Tube section, Square hollow section etc.) are widely used. In present work, "HOWE ROOF TRUSS" of span varying from 10m to 40m has been analyzed for different geometries to get the desired optimum truss design.

The various truss analyses are performed by using structural analysis software i.e. STAAD Pro. The analysis results are compared to obtain optimum and accurate truss design.

In investigating the effectiveness of various truss geometries, a total of 80 truss geometries are analyzed. The analysis of all sets of trusses enables comparisons to be made among the various spacing, spans, and pitches.

This study includes the determination of dead load, live load and wind load as per Indian Standard Codes IS 800:2007 and IS 875(Part 3)-1987.

The Howe truss is analyzed by taking different pacings at different spans and pitches.The loads at each panel and node are calculated manually and then the loads are entered into STAAD PRO software for analysis and designing.The STAAD PRO OUTPUT method is used for determining the steel takeoff (weight).The truss with a least value of steel takeoff is considered as most economical truss.

Keywords-**Roof Truss, Staad Pro.**

I. INTRODUCTION

A roof truss is a framed structure formed by adjoining various members in a particular pattern of triangles depending upon span, type of loading, slope and other requirements. Steel trusses are widely used in industrial buildings for many years. Every structure should have to fulfill the structural and economical requirements. Hence there is need of optimization of truss design to obtain minimum weight.

A truss is composed of members connected together at their joints. It is not essential but members of a truss is usually straight. All the joints are considered to be pinned although some or all the joints may be fixed rather than pinned. A truss acts like a deep beam. A beam becomes stronger and stiffer when it is deeper. But when span is long and just carries light load, it may waste a lot of material just carrying itself. Before steel became an economically useful material, trusses were made of wood and iron. The members used in steel truss are normally angles, channel section, square hollow section, circular hollow section, etc.

The tie erections are required to calculate in such a manner that they have adequate power and inflexibility to satisfy the strength and serviceability limitation. The topic of optimization is energetic theme in every discipline. The progress of structural optimization processes has helped engineers to a great extant in finding the utmost suitable structure shape for a particular loading system.

II. OBJECTIVES OF THE RESEARCH

The key objective of this examination is to govern the outcome of unlike truss geometries to the improved design of truss by using angle section with the help of STAAD Pro v8i. To elect the least weight truss is main objective. The examination should be able to attain the following objectives:-

(a) To govern the most effective truss geometry in terms of weight among the 80 truss geometries.

(b) To match the price tag of materials (by using weight) of the different truss geometries generally used in the construction industry.

III. RESEARCH METHODLOGY

Basically the 40 geometries of trusses can be categorized into 2 groups in terms of spacing is shown below:-

TABLE-3.1case distribution for 3m spacing

SPACING	SPAN	PITCH
3m	10 m	1/4,1/5,1/6,1/7,1/8
	20 m	1/4,1/5,1/6,1/7,1/8
	30 m	1/4,1/5,1/6,1/7,1/8

	40m	1/4,1/5,1/6,1/7,1/8

TABLE- 3.2 case distribution for 4m spacing

SPACING	SPAN	PITCH
4m	10 m	1/4,1/5,1/6,1/7,1/8
	20 m	1/4,1/5,1/6,1/7,1/8
	30 m	1/4,1/5,1/6,1/7,1/8
	40m	1/4,1/5,1/6,1/7,1/8

IV. CALCULATION OF DEAD , LIVE & WIND LOAD MANUALLY FOR EACH PITCH OF EACH SPAN & SPACING.

SPACING= 3M	DEAD LOAD KN	LIVE LOAD KN	WIND LOADS KN	
SPAN=10M			WINDWARD SIDE	LEEWARD SIDE
PITCH=1/4	1.429	1.570	6.477	6.808
PITCH=1/5	1.424	1.919	6.548	5.722
PITCH=1/6	1.429	2.18	6.407	5.816
PITCH=1/7	1.429	2.367	6.609	5.348
PITCH=1/8	1.420	2.51	6.935	5.302

These are the values of Dead, Live & Wind load calculated manually for each pitch of 10 m span of 3m spacing.

Similarly values for each pitch of each span of 3m & 4m spacing are calculated.

After the calculation of these loads, the desired truss geometry is designed in STADD PRO V8i by applying these loads.

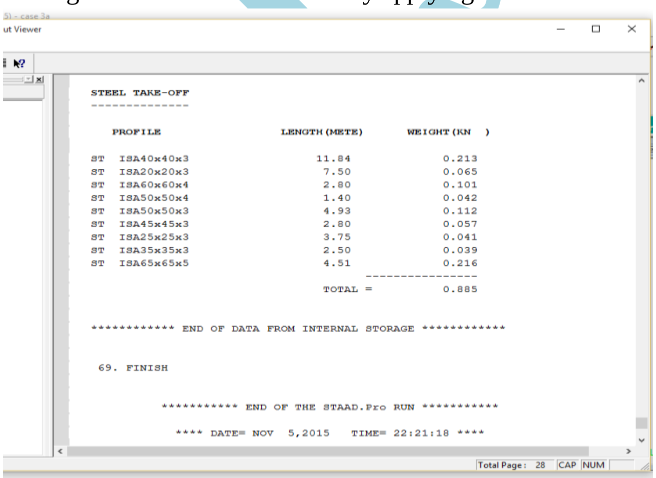


Image showing the optimum weight for ¼ pitch of 10 m span of 3m spacing.

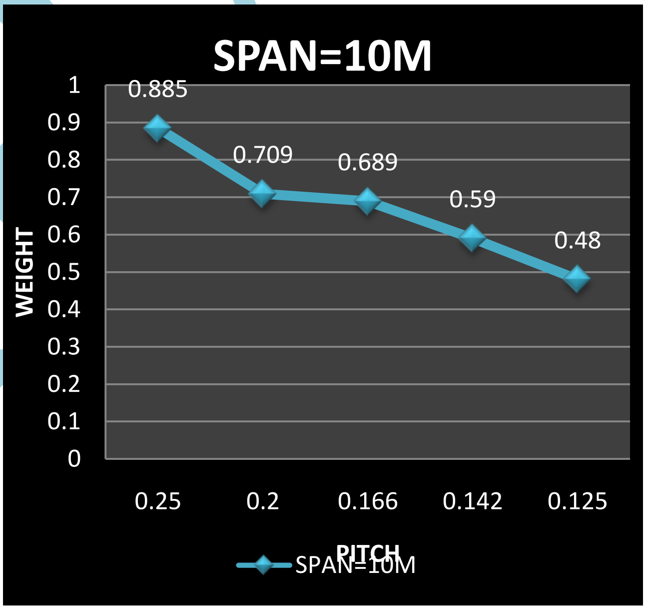
After the successful analysis of each geometry , the optimum weight is obtained. The optimum weight obtained on STAAD PRO V8i for each geometry is given below in tabular form.

V. RESULTS

Table 5.1

(Optimized weight for spacing 3m, span 10m)

CASE 1			
SPACING=3M	SPAN=10M	PITCH	WEIGHT(KN)
		0.25	0.885
		0.2	0.709
		0.166	0.689
		0.142	0.59
		0.125	0.48



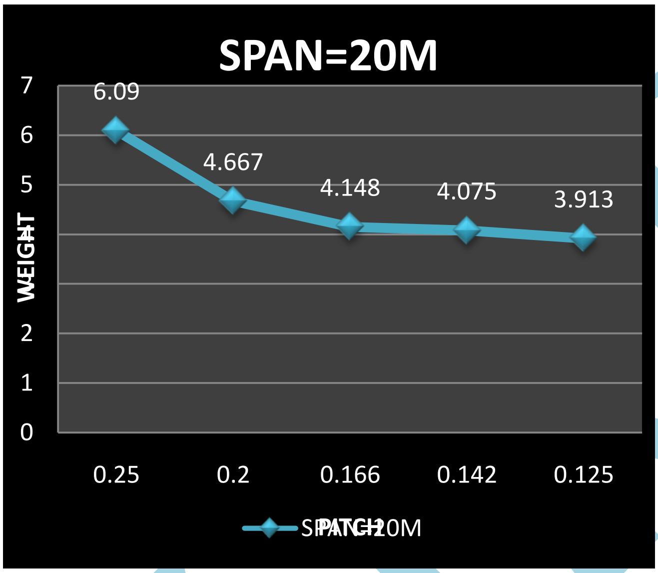
GRAPH 5.1

(Showing the variation of weight with respect to pitch)

Table 5.2

(Optimized weight for spacing 3m, span 20m)

CASE 2			
SPACING=3M	SPAN=20M	PITCH	WEIGHT(KN)
		0.25	6.09
		0.2	4.667
		0.166	4.148
		0.142	4.075
		0.125	3.913



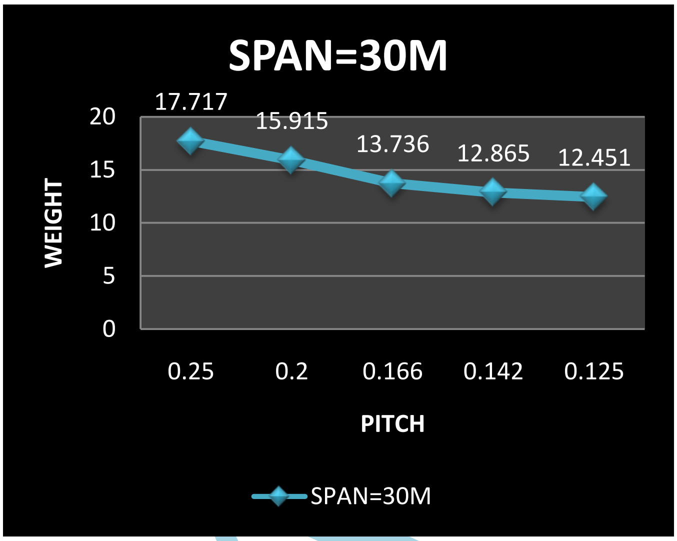
GRAPH 5.2

(Showing the variation of weight with respect to pitch)

Table 5.3

(Optimized weight for spacing 3m, span 30m)

CASE 3			
SPACING=3M	SPAN=30M	PITCH	WEIGHT(KN)
		0.25	17.17
		0.2	15.915
		0.166	13.736
		0.142	12.865
		0.125	12.451



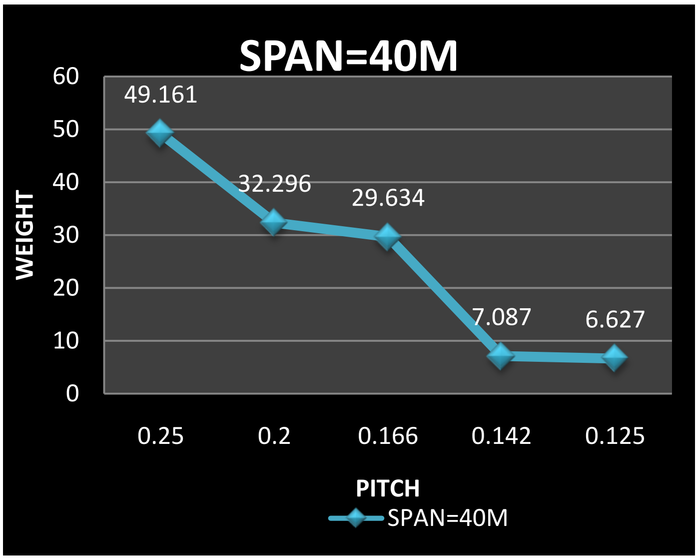
GRAPH 5.3

(Showing the variation of weight with respect to pitch)

Table 5.4

CASE 4			
SPACING=3M	SPAN=40M	PITCH	WEIGHT(KN)
		0.25	49.161
		0.2	32.296
		0.166	29.634
		0.142	7.087
		0.125	6.627

(Optimized weight for spacing 3m, span 40m)

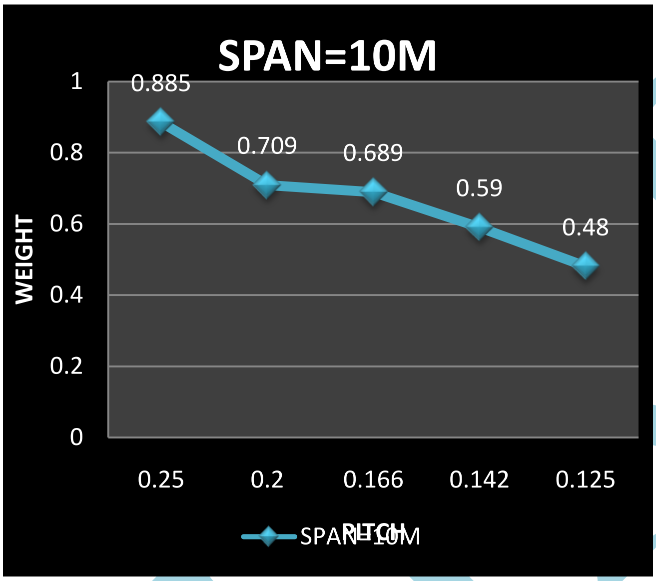


GRAPH 5.4

(Showing the variation of weight with respect to pitch)

Table 5.5
(Optimized weight for spacing 4m, span 10m)

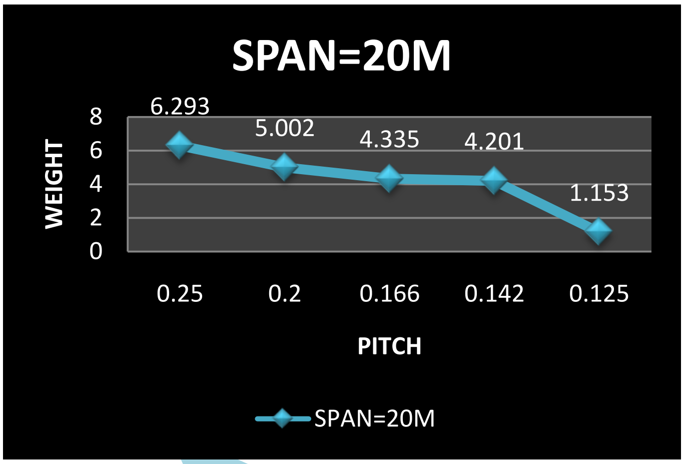
CASE 5			
SPACING=4M	SPAN=10M	PITCH	WEIGHT(KN)
		0.25	0.936
		0.2	0.846
		0.166	0.797
		0.142	0.777
		0.125	0.763



GRAPH 5.5
(Showing the variation of weight with respect to pitch)

Table 5.6
(Optimized weight for spacing 4m, span 20m)

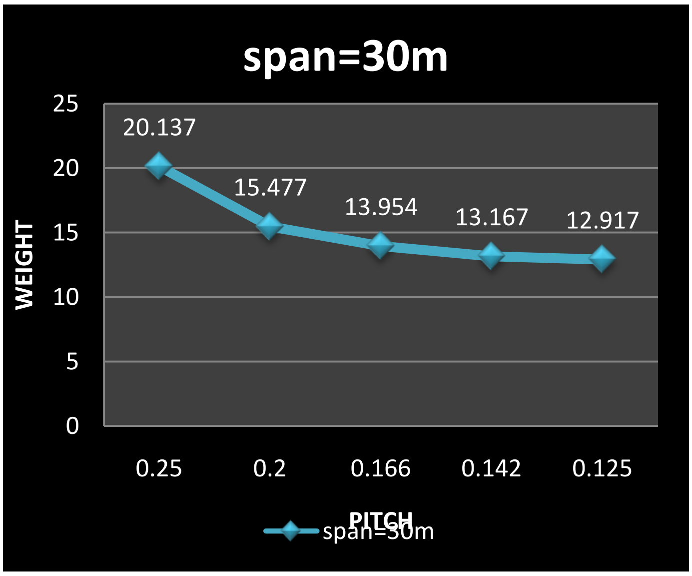
CASE 6			
SPACING=4M	SPAN=20M	PITCH	WEIGHT(KN)
		0.25	6.293
		0.2	5.002
		0.166	4.335
		0.142	4.201
		0.125	1.153



GRAPH 5.6
(Showing the variation of weight with respect to pitch)

Table 5.7
(Optimized weight for spacing 4m, span 30m)

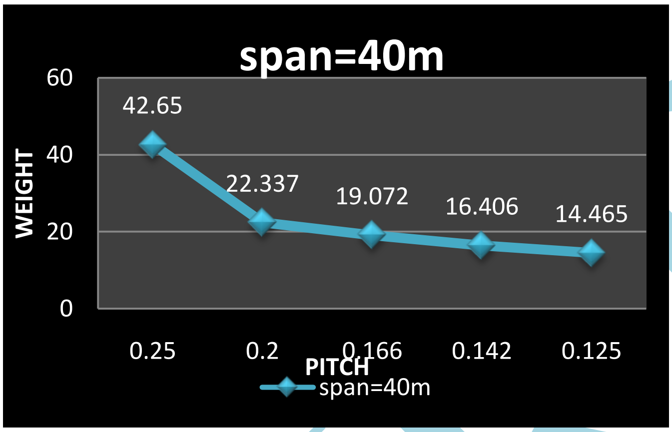
CASE 7			
SPACING=4M	SPAN=30M	PITCH	WEIGHT(KN)
		0.25	20.137
		0.2	15.477
		0.166	13.954
		0.142	13.167
		0.125	12.917



GRAPH 5.7
(Showing the variation of weight with respect to pitch)

Table 5.8
(Optimized weight for spacing 4m, span 40m)

CASE 7			
SPACING=4M	SPAN=40M	PITCH	WEIGHT(KN)
		0.25	42.65
		0.2	22.337
		0.166	19.072
		0.142	16.406
		0.125	14.465



GRAPH 5.8
(Showing the variation of weight with respect to pitch)

VI. CONCLUSION

By compiling all the results tables it is concluded that:-

1. The most economical truss is at a spacing of 3m,span10m with a pitch of 1/8 having a total weight of 0.48KN.
2. In all the spacings, most economical truss is found at 0.125 pitch.
3. For 20 m span with spacing 3m the most economical truss is find out at pitch 0.125 with optimized weight of 3.913 KN
4. For 20 m span with spacing 4m the most economical truss is find out at pitch 0.125 with optimized weight of 1.153 KN.
5. For 30 m span with spacing 3m the most economical truss is find out at pitch 0.125 with optimized weight of 12.451 KN.
6. For 30 m span with spacing 4m the most economical truss is find out at pitch 0.125 with optimized weight of 12.917 KN
7. For 40 m span with spacing 3m the most economical truss is find out at pitch 0.125 with optimized weight of 6.627 KN
8. For 40 m span with spacing 4m the most economical truss is find out at pitch 0.125 with optimized weight of 14.465 KN

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