

Comparative Study on the Trussless Sheeting with Truss Sheeting for Different Span of Industrial Sheds

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ABSTRACT

In this present study, comparing the cost of roofing on Steel (Angular) Truss, Hollow Tube Truss with Self-Supporting Roof for the opening of 6 meter, 12 meter, 18 meter and 24 meter. Hollow tube truss is 40.35% and 44.15% cheaper than Steel (Angular) Truss and Self-Supporting Roof for the opening of 6 meter. Similarly 24.37% and 21.97% cheaper for the opening of 12 meter. As the length of opening increase from 12 meter Self-Supporting Roof becomes cheaper. Self-Supporting Roof is 36.26% and 4.41% cheaper than Steel (Angular) Truss and Hollow tube Truss for the opening of 18 meter. Self-Supporting Roof is 28.50% and 11.42% cheaper than Steel (Angular) Truss and Hollow tube Truss for the opening of 24 meter.

KEYWORDS: Truss, Hollow Pipe, Tubular Pipe, GI trussless Sheet, Steel (Angular) Truss STAAD.Pro V8i

How to cite this paper: Shashank Pratap Singh | Mr. Rohit Kumar Sahu "Comparative Study on the Trussless Sheeting with Truss Sheeting for Different Span of Industrial Sheds" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-1, February 2024, pp.586-595, URL: www.ijtsrd.com/papers/ijtsrd63457.pdf



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INTRODUCTION

The roofs are not only to protect the structure and its internal element but they also give an aesthetic view to the structure. As the roof occupies a very huge area and consumes large amounts of material for its construction, optimal design of such a structure is of utmost importance. The earlier research on the roof structures was mainly concentrated on the geometric design of the roof structure, giving less or no significance to the structural engineering aspect. But once the financial implications associated with roof system is confronted, the need for economical structural system is fully realized. With the invention of self-supporting structural elements as roof covering, it is now possible to develop innovative shapes of roofs especially for industrial, sports & other service buildings and public areas where long spans are desirable. Steel is a material which has high strength per unit mass. Steel as a construction material is one of the very important materials used in the industry, the reason is because of its

characteristics and properties that it has. Steel is strong, hard, tough, ductile, fire resistant and has also got a very high melting point. The designing of industrial Steel Structure includes designing of the structural elements including principal rafter or roof truss, column and column base, purlins, sag rods, tie rods, gantry girder, bracings, etc. India has the second fastest growing economy in the world and a lot of it, is attributed to its construction industry which figures just next to agriculture in its economic contribution to the nation. So, in regard of the same Steel industry is growing rapidly. The use of steel structures is not only economical but also ecofriendly at the time when there is a threat of global warming. Here, "economical" word is stated considering time and cost.

OBJECTIVES

1. Analysis of roofing with truss and trussless.
2. Effect of changes in section of roof truss.

3. Optimization of roofing system for industrial sheds of varying type of span.
4. Design and estimation of the all cases.

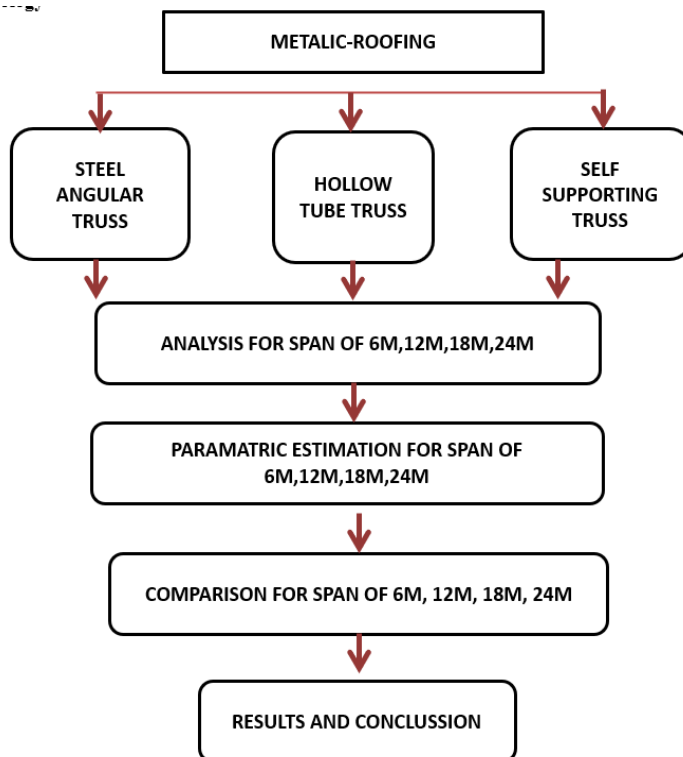
PURPOSE OF STUDY

Self-supporting Roofing is a constructive solution in which there isn't always any support roofing structure. The metallic profile is supported at the load beams. It is a metallic ribbed profile which it is curved by means of inlaying. This profile is fixed

with screws to the beams. Way to this fact, this solution is the lightest one in the market.

For this fact, in this present study comparison of roofing is done between the Steel (Angular) Truss, Hollow Tube Truss and Self-supporting Roofing for different openings. From this study conclusion will be made that which roofing is cheaper as compared to others.

METHODOLOGY



In this techno-commercial comparison is done of roofing on Steel (angular) truss, and Hollow tube

For this purpose, designing of roofing on Steel (angular) truss, hollow tube truss and self-supporting roofing is done for the opening of 6 meter, 12 meter, 18 meter and 24 meter and sheeting up to 10 meter. Once the design is completed using STAAD.pro v8i, estimating and costing is done for all the roofing. Then comparison of rate is done, through which conclusion will be made.

DESIGN AND CALCULATIONS

In this chapter include designing and calculations of roofing on Steel (angular) truss, hollow tube truss and self-supporting roofing is done for the opening of 6 meter, 12 meter, 18 meter and 24 meter and sheeting up to 10 meter. Once the design is completed using STAAD.pro v8i, estimating and costing is done for all the roofing. Then comparison of rate is done, through which conclusion will be made.

SECTION-1: DESIGN OF STEEL (ANGULAR) TRUSS

Design and estimating of steel (angular) truss for 6 m opening

Steel Take-Off

PROFIL	LENGTH(MMS)	WEIGHT(NEWT)
ST ISA25X25X5	21000.03	362.971
ST ISA55X55X8	18973.7	1192.27
ST ISA50X50X8	12486.86	710.789
ST ISA65X65X8	80000.02	5998.036
TOTAL		= 8264.065

Unit conversion: - 8264.065 Newton = 8.43 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc. are included)	2	10.3	3.16		65.096	sq.m
2	G.I. Ridging	1	10.3		10.3 m	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	3.16		32.548	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	8.43	q	4200	q	35,406
2	Painting two coats over one coat of priming in steel work	32.548	Sq. m	60	Sq. m	1,953
3	Galvanized corrugated iron(G.I.) roofing	65.096	Sq. m	265	Sq. m	17,250
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						55,444
Add 3% for Contingencies						1,663
Add 2% for Work charged Establishment						1,109
Grand Total						58,216

**Design and estimating of steel (angular) truss for 12 m opening
Steel Take-Off**

PROFILE	LENGTH(MMS)	WEIGHT(NEWT)
ST ISA50X50X8	40500	2305.38
ST ISA90X90X10	37107.95	4874.525
ST ISA65X65X10	34785.72	3206.649
ST ISA70X70X10	120000.03	11983.781
Total =		22370.335

Unit conversion:- 22370.335 Newton = 22.81 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc., are included)	2	10.3	6.18		127.308	sq.m
2	G.I. Ridging	1	10.3		10.3 m	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	6.18		63.654	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	22.81	q	4200	q	95,802
2	Painting two coats over one coat of priming in steel work	63.654	Sq. m	60	Sq. m	3,819
3	Galvanized corrugated iron(G.I.) roofing	127.308	Sq. m	265	Sq. m	33,737
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						134,192
Add 3% for Contingencies						4,026
Add 2% for Workcharged Establishment						2,684
Grand Total						140,902

Design and estimating of steel (angular) truss for 18 m opening Steel Take-Off

PROFILE		LENGTH(MMS)	WEIGHT(NEWT)
ST	ISA80X80X10	60000.02	6959.811
ST	ISA110X110X12	55317.27	10666.051
ST	ISA75X75X10	85380.29	9182.372
ST	ISA90X90X10	239999.98	31526.563
		Total =	58334.797

Unit conversion:- 58334.797 Newton = 59.48 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc., are included)	2	10.3	9.22		189.932	sq.m
2	G.I. Ridging	1	10.3		10.3 m	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	9.22		94.966	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	59.48	Q	4200	q	249,816
2	Painting two coats over one coat of priming in steel work	94.966	Sq. m	60	Sq. m	5,698
3	Galvanized corrugated iron(G.I.) roofing	189.932	Sq. m	265	Sq. m	50,332
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						306,680
Add 3% for Contingencies						9,200
Add 2% for Workcharged Establishment						6,134
Grand Total						322,014

Design and estimating of steel (angular) truss for 24 m opening Steel Take-Off

PROFILE		LENGTH(MMS)	WEIGHT(NEWT)
ST	ISA80X80X10	79500.02	9221.75
ST	ISA120X120X10	73545.91	13163.871
ST	ISA75X75X10	109856.93	11814.757
ST	ISA90X90X10	239999.98	31526.563
		Total =	65726.941

Unit conversion:- 65726.939 Newton = 67.02 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc., are included)	2	10.3	12.26		252.556	sq.m
2	G.I. Ridging	1	10.3		10.3	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	12.26		126.278	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	67.02	Q	4200	q	281,484
2	Painting two coats over one coat of priming in steel work	126.278	Sq. m	60	Sq. m	7,577
3	Galvanized corrugated iron(G.I.) roofing	252.556	Sq. m	265	Sq. m	66,927
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						356,822
Add 3% for Contingencies						10,705
Add 2% for Workcharged Establishment						7,136
					Grand Total	374,663

SECTION-2 DESIGN OF HOLLOW TUBE TRUSS**Design and estimating of steel (angular) truss for 6 m opening****Steel Take-Off**

PROFILE	LENGTH(MMS)	WEIGHT(NEWT)
ST PIP E	21000.03	348.427
ST PIP E	18973.7	801.326
ST PIP E	12486.86	244.848
ST PIP E	80000.02	1810.007
Total =		3204.608

Unit conversion:- 3204.607 Newton = 3.20 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	2	10.3	3.16		65.096	sq.m
2	G.I. Ridging	1	10.3		10.3	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	3.16		32.548	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	3.2	q	4200	q	13,440
2	Painting two coats over one coat of priming in steel work	32.548	Sq. m	60	Sq. m	1,953
3	Galvanized corrugated iron(G.I.) roofing	65.096	Sq. m	265	Sq. m	17,250
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						33,478
Add 3% for Contingencies						1,004
Add 2% for Workcharged Establishment						670
					Grand Total	35,152

Design and estimating of steel (angular) truss for 12 m opening**Steel Take-Off**

PROFILE	LENGTH(MMS)	WEIGHT(NEWT)
ST PIP E	40500	2199.159
ST PIP E	37107.95	3134.398
ST PIP E	34785.72	2098.746
ST PIP E	120000.03	5792.025
Total =		13224.328

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	2	10.3	6.18		127.308	sq.m
2	G.I. Ridging	1	10.3		10.3 m	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	6.18		63.654	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	22.81	q	4200	q	95,802
2	Painting two coats over one coat of priming in steel work	63.654	Sq. m	60	Sq. m	3,819
3	Galvanized corrugated iron(G.I.) roofing	127.308	Sq. m	265	Sq. m	33,737
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						134,192
Add 3% for Contingencies						4,026
Add 2% for Work charged Establishment						2,684
Grand Total						140,902

Design and estimating of steel (angular) truss for 18 m opening Steel Take-Off

PROFILE	LENGTH(MMS)	WEIGHT(NEWT)
ST PIP E	60000.02	7330.53
ST PIP E	55317.27	8260.288
ST PIP E	85380.29	4636.169
ST PIP E	239999.98	14480.054
	Total =	34707.041

Unit conversion:- 34707.041Newton = 35.40 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	2	10.3	9.22		189.932	sq.m
2	G.I. Ridging	1	10.3		10.3 m	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	9.22		94.966	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	35.4	Q	4200	q	148,680
2	Painting two coats over one coat of priming in steel work	94.966	Sq. m	60	Sq. m	5,698
3	Galvanized corrugated iron(G.I.) roofing	189.932	Sq. m	265	Sq. m	50,332
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						205,544
Add 3% for Contingencies						6,166
Add 2% for Workcharged Establishment						4,111
Grand Total						215,821

Design and estimating of steel (angular) truss for 24 m opening Steel Take-Off

PROFILE	LENGTH(MMS)	WEIGHT(NEWT)
ST PIP E	79500.02	9712.952
ST PIP E	73545.91	11647.879
ST PIP E	109856.93	7290.87
ST PIP E	239999.98	22806.094
	Total =	51457.795

Unit conversion:- 51457.795Newton = 52.57 quintal

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Quantity Or Content	Total Qty. Or Weight	Unit
1	Galvanized corrugated iron(G.I.) roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	2	10.3	12.26		252.556	sq.m
2	G.I. Ridging	1	10.3		10.3	10.3	sq.m
3	Painting two coats over one coat of priming in steel work	1	10.3	12.26		126.278	sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate Rs. P.	Per	Amount Rs. P.
1	Steel Work	52.47	Q	4200	q	220,374
2	Painting two coats over one coat of priming in steel work	126.278	Sq. m	60	Sq. m	7,577
3	Galvanized corrugated iron(G.I.) roofing	252.556	Sq. m	265	Sq. m	66,927
4	G.I. Ridging	10.3	Rm	81	Rm	834
Total						295,712
Add 3% for Contingencies						8,871
Add 2% for Work charged Establishment						5,914
Grand Total						310,498

SECTION-3 DESIGN OF TRUSS-LESS SHEETING

Design of self-supporting sheet for 6 meter

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Total Qty. Or Weight
	Galvalume roofing				
1	(All fittings, hook bolts, G.I. bolts, washers, etc, are included)	1	6	10	60 sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate		Per	Amount	
				Rs.	P.		Rs.	P.
1	Galvalume roofing	60	Sq. m	1090		Sq. m	65,400	
Add 3% for Contingencies							1,962	
Add 2% for Work charged Establishment							1,308	
Grand total							68,670	

Design of self-supporting sheet for 12 meter

Details of Measurement and Calculation of Quantities

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Total Qty. Or Weight
1	Galvalume roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	1	12	10	120 sq.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate		Per	Amount	
				Rs.	P.		Rs.	P.
1	Galvalume roofing	120	Sq. m	1090		Sq. m	1,30,800	
Add 3% for Contingencies							3,924	
Add 2% for Workcharged Establishment							2,616	
Grand total							1,37,340	

Design of self-supporting sheet for 18 meter**Details of Measurement and Calculation of Quantities**

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Total Qty. Or Weight
1	Galvalume roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	1	18	10	180 .m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate		Per	Amount	
				Rs.	P.		Rs.	P.
1	Galvalume roofing	180	Sq. m	1090		Sq. m	1,96,200	
Add 3% for Contingencies							5,886	
Add 2% for Workcharged Establishment							3,924	
Grand total							2,06,010	

Design of self-supporting sheet for 24 m**Details of Measurement and Calculation of Quantities**

Item No.	Particulars of items and details of works	No.	Length (m)	Breadth (m)	Total Qty. Or Weight
1	Galvalume roofing (All fittings, hook bolts, G.I. bolts, washers, etc, are included)	1	24	10	240.m

Abstract of Estimated Cost

Item No.	Particulars of Items	Quantity	Unit	Rate		Per	Amount	
				Rs.	P.		Rs.	P.
1	Galvalume roofing	240	Sq. m	1090		Sq. m	26,61,600	
Add 3% for Contingencies							7,848	
Add 2% for Workcharged Establishment							5,232	
Grand total							2,74,680	

RESULTS AND DISCUSSION

In this chapter include Results And Discussion of roofing on Steel (angular) truss, hollow tube truss and self-supporting roofing is done for the opening of 6 meter, 12 meter, 18 meter and 24 meter and sheeting up to 10 meter. Once the design is completed using STAAD.pro v8i, estimating and costing is done for all the roofing. Then comparison of rate is done, through which conclusion will be made.

Table 1:- Data of trusses for different openings

Truss Opening (in meter)	Parameters	Steel Truss	Hollow Truss	Structure less truss
6 M	Cost	58,683	35,000	68,670
	Weight (quintal)	8.43	3.20	
12 M	Cost	1,41,701	1,07,156	1,37,340
	Weight (quintal)	22.81	13.224	
18 M	Cost	3,23,220	2,15,517	2,06,010
	Weight (quintal)	59.48	35.41	
24 M	Cost	3,84,140	3,10,104	2,74,680
	Weight (quintal)	67.02	52.57	

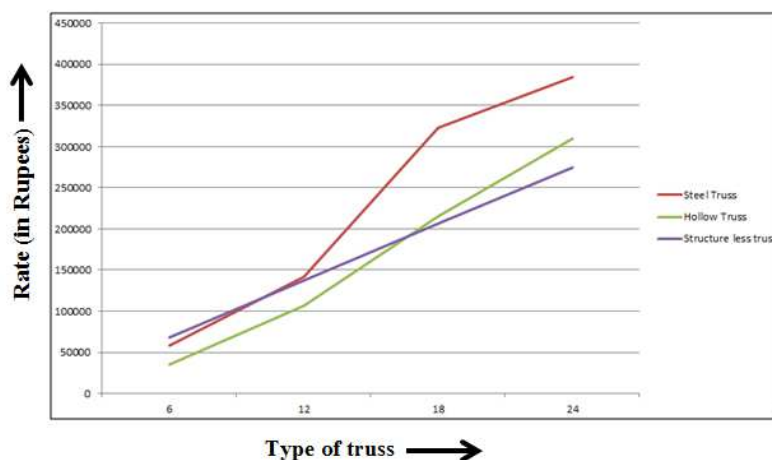


Figure 1:- Increase in rate of trusses for different openings

- For 6 m opening of Hollow tube is 40.35% cheaper than Steel (angular) truss and 44.15% cheaper than Truss-less sheeting.
- For 6 m opening of Hollow tube truss is 62.04% saving material than Steel (angular) truss.
- For 12 meter opening of truss sheeting on Hollow Tube Truss is 24.37% cheaper than Steel (Angular) truss and 21.97% cheaper than Truss-less Sheeting.
- For 12 m opening of Hollow tube truss is 42.02% saving material than Steel (angular) truss.
- For 18 meter opening of truss Truss-less Sheeting is 36.26% cheaper than Steel (Angular) truss and 4.41% cheaper than Hollow Tube Truss.
- For 18m opening of Hollow tube truss is 40.46% saving material than Steel (angular) truss.
- For 24 meter opening of truss Truss-less Sheeting is 28.50% cheaper than Steel (Angular) truss and 11.42% cheaper than Hollow Tube Truss
- For 24 m opening of Hollow tube truss is 21.56 % saving material than Steel (angular) truss.
- Steel angular truss is too heavy and costly
- Hollow tube truss is good for long span trusses
- Truss-less sheeting structure is more economical for more than 18 m.
- Truss-less sheeting structure is more economical than Hollow Tube Truss and Steel (angular) truss the saving depends on various parameters.

CONCLUSIONS

After the research work some conclusions are made. The conclusions are given below:

- For 6 m opening of Hollow tube is 40.35% cheaper than Steel (angular) truss and 44.15% cheaper than Truss-less sheeting.
- For 12 meter opening of truss sheeting on Hollow Tube Truss is 24.37% cheaper than Steel (Angular) truss and 21.97% cheaper than Truss-less Sheeting.
- For 18 meter opening of truss Truss-less Sheeting is 36.26% cheaper than Steel (Angular) truss and 4.41% cheaper than Hollow Tube Truss.
- For 24 meter opening of truss Truss-less Sheeting is 28.50% cheaper than Steel (Angular) truss and 11.42% cheaper than Hollow Tube Truss
- Truss-less sheeting structure is more economical than Hollow Tube Truss and Steel (angular) truss the saving depends on various parameters.

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