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CRITICAL REVIEW ON COMPUTER AIDED ANALYSIS AND DESIGN OF INDUSTRIAL STRUCTURES

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ABSTRACT

Steel plays the major role in all the buildings. To a distinctly greater extent steel is used in Industrial buildings. As it is preferred due to its various properties like Ultimate strength, good ductility and easy fabrication. Due to its high strength, members of light sections can be used to carry heavy loads. By keeping all the positive point in mind I compare the four truss – Pratt truss(24m), Howe truss(24m), Fink truss(21m) and Fan truss(21m) by using the various software which gives the optimise quantity of steel. Considering the span of 24 m for Howe truss Pratt truss and 21 m span for Fink Truss Fan truss. From these Howe truss, Pratt truss are compared and Fink Truss, Fan truss are compared which is economical then designed and analysed by the SAP software as well as in STADD PRO software.

KEYWORDS: Steel, Fink truss, Fan truss, Howe truss, Pratt truss, SAP, STADD PRO

Any building structure used by the industry to store raw materials or for manufacturing products of the industry is known as an industrial building. Industrial buildings may be categorized as Normal type industrial buildings and Special type industrial buildings. Normal types of industrial building are shed type buildings with simple roof structures on open frames. These buildings are used for workshop, warehouses etc. These building require large and clear areas un-obstructed by the columns. The large floor area provides sufficient flexibility and facility for later change in the production layout without major building alterations.

Industrial buildings use steel framed structures and metallic cladding of all types. Large open spaces can be created that are efficient, easy to maintain, and are adaptable as demand changes. Steel is chosen on economic grounds, as well as for other aspects such as fire, architectural quality and sustainability.

In most cases, an industrial building is not a single structure, but is extended by office and administration units or elements such as canopies. These additional elements can be designed in a way that they fit into the whole building design. This publication describes the common forms of industrial buildings and large enclosures. Regional differences that may exist depending on practice, regulations and capabilities of the supply chain. The same technologies may be extended to a range of building types, including sports and leisure facilities, halls, supermarkets and other enclosures.

Objective

The objective of the thesis is to analysis and design an Industrial Building by using various software's to compare the following:

- To compare the results of the software to find which software gives the optimise quantity of steel.
- To compare the Pratt roof truss industrial building and Howe roof truss industrial building of area 24m x 60m to find which roof truss gives the optimise steel quantity.
- To compare the Fan roof truss industrial building and Fink roof truss industrial building of area 21m x 60m to find which roof truss gives optimise steel quantity.

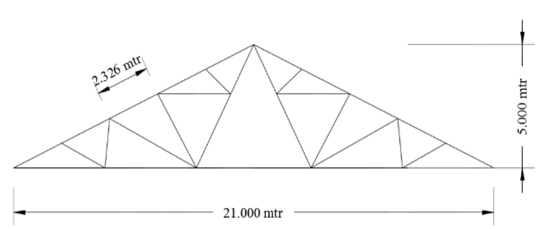
Industrial Building

In Industrial Structures we concentrate mainly on Truss configuration based on the load, span, tie members. Mainly we are discussing about 4 trusses listed below:

Fan Truss

A truss characterized by the radiating lines of the king post or queen post and appended struts.

- Span of truss is 21 m
- Spacing of truss is 5 m
- Spacing of purlins is 2.326 m



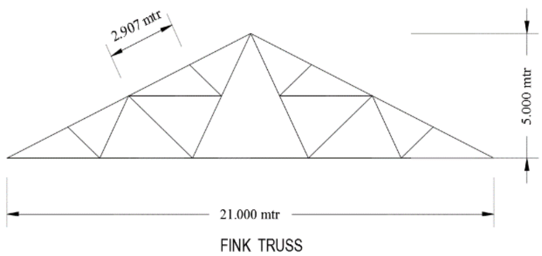
FAN TRUSS

[1]Corresponding Author

Fink Truss

A symmetrical truss, formed by three triangles, commonly used in supporting large, sloping roofs.

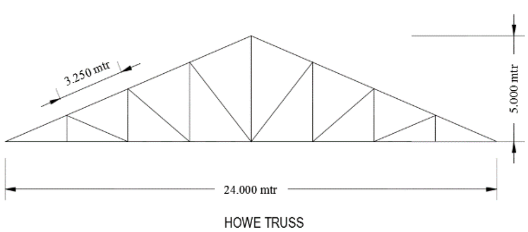
- Span of truss is 21 m
- Spacing of truss is 5 m
- Spacing of purlins is 2.907 m



Howe Truss

A truss having vertical and diagonal members between the upper and lower horizontal members.

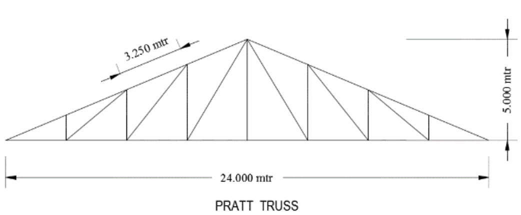
- Span of truss is 24 m
- Spacing of truss is 5 m
- Spacing of purlins is 3.250 m



Pratt Truss

A truss having vertical members between the upper and lower members and diagonal members sloping toward the centre

- Span of truss is 24 m
- Spacing of truss is 5 m
- Spacing of purlins is 3.250



ANALYSIS AND DESIGN OF INDUSTRIAL STRUCTURES

Load Calculations

Dead Load

Dead loads on the roof truss are estimated as per the Indian standard code IS:875-Part-I. The dead weight of sheeting, fastenings, bracings and self-weight of purlins are calculated as per geometry of the truss and applied as panel loads on the truss.

Live Load

Live loads on the roof truss are estimated as per the Indian standard code IS:875-Part-II. Based on the slope of roof truss and access provision condition for maintenance, the live load intensity is calculated as per the code. The loads on the panel points of the truss are estimated and applied.

Wind Load

Wind loads on the roof truss are calculated as per the Indian standard code IS:875-Part-III. Considering the location of Industrial Building, slope, height and topography of the site, wind loads are calculated as per the code IS:875-Part-III. The panel loads at intermediate and end positions are evaluated and applied normal to the sheeting.

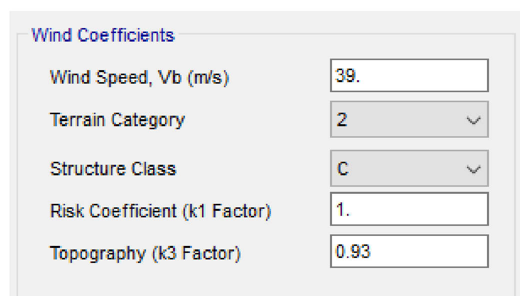


Figure 1: Wind Coefficients

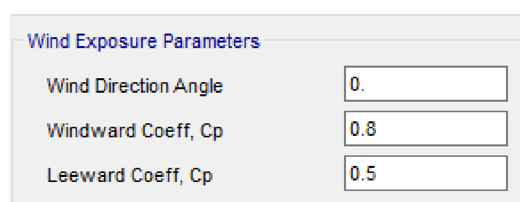


Figure 2: Wind Exposure Parameters

Earthquake Load

Earthquake loads are calculated as per the Indian standard code IS:1893-Part 1.

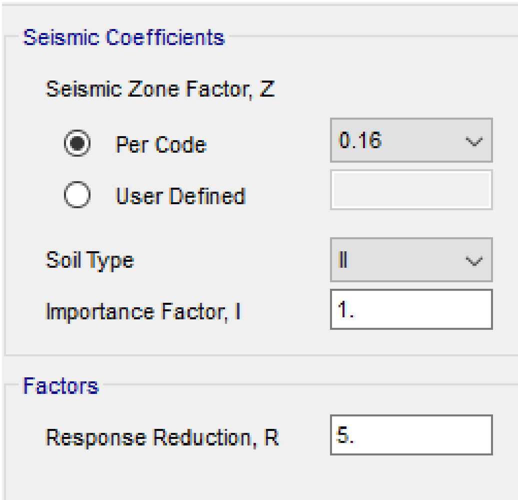


Figure 3: Seismic Coefficients

Truss

Fan Truss

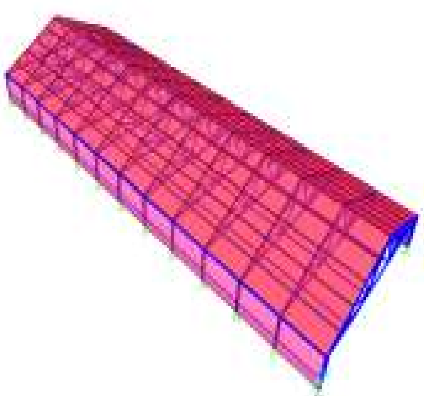


Figure 4: 3D View

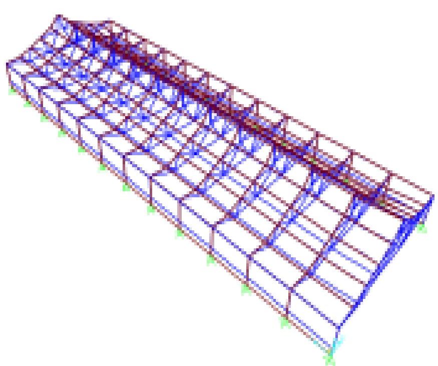


Figure 5: Deflection profile

Fink Truss

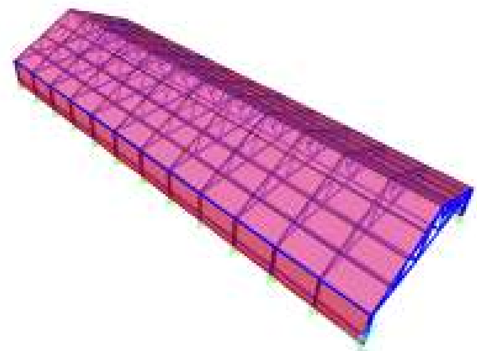


Figure 6: 3D View

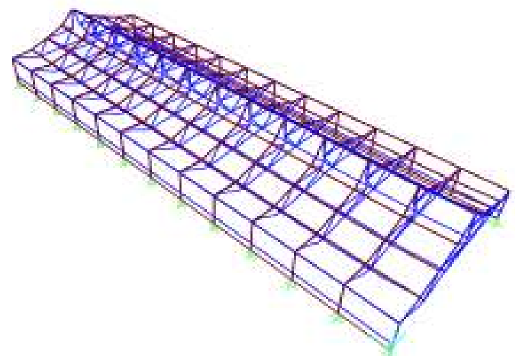


Figure 7: Deflection profile

Howe Truss

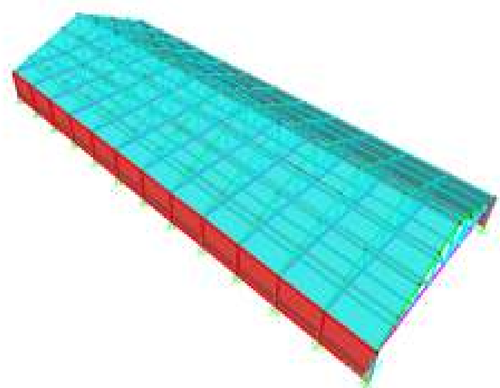


Figure 8: 3D View

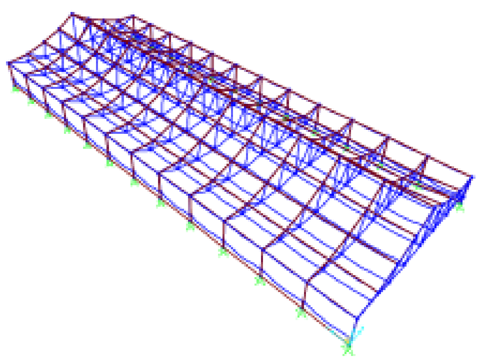


Figure 9: Deflection profile

Pratt Truss

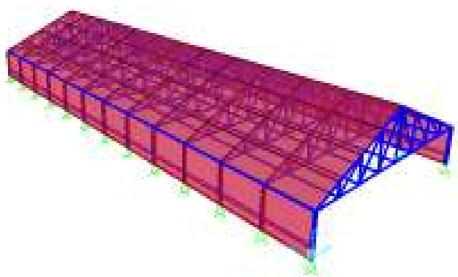


Figure 10: 3D View

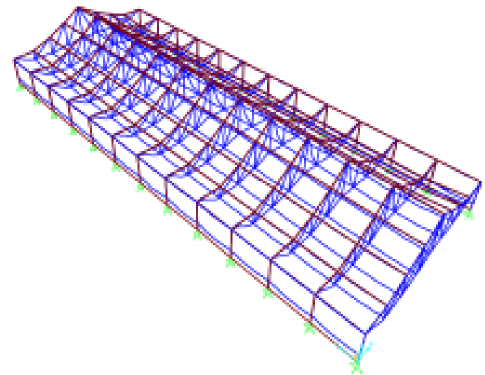


Figure 11: Deflection profile

RESULTS AND DISCUSSION

STADD PRO

Table 1: Fan truss

SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord and Purlins	ISLC 250	1322.37	362.654	36265.4
2	Bottom Chord	ISLC 300	273	88.5	8850
3	Tie Members	ISA 120X120X10 LD	576.58	206.4	20640
4	Column	I80012A40012	104	315.57	31557
			TOTAL	**973.124**	**97312.4**

Table 2: Fink truss

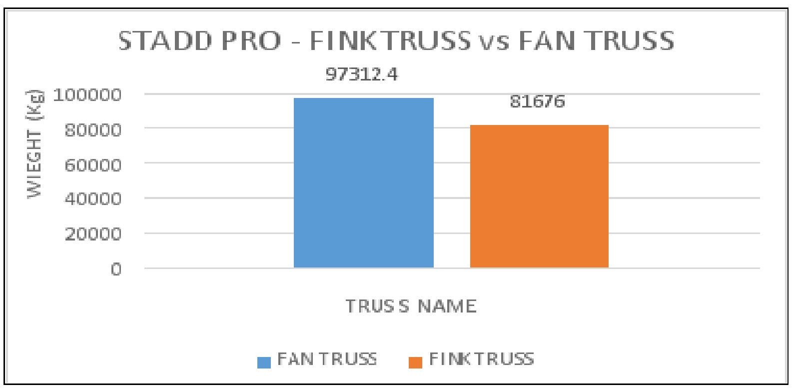
SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord and Purlins	ISLC 250	1202.37	316.11	31611
2	Bottom Chord	ISLC 250	273	88.5	8850
3	Tie Members	ISA 80X80X8 LD	515.276	96.58	9658
4	Column	I80012A40012	104	315.57	31557
			TOTAL	**816.76**	**81676**

Table 3: Howe truss

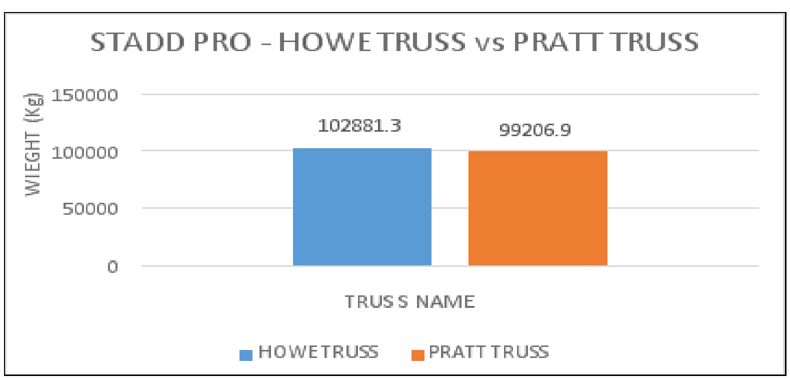
SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord and Purlins	ISLC 250	1298	355.97	35597
2	Bottom Chord	ISMC 400	312	152.913	15291.3
3	Tie Members	ISA 120X120X10 LD	570.89	204.36	20436
4	Column	I80012A40012	104	315.57	31557
			TOTAL	**1028.81**	**102881**

Table 4: Pratt truss

SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord and Purlins	ISLC 250	1298	355.97	35597
2	Bottom Chord	ISMC 400	312	152.913	15291.3
3	Tie Members	ISA 110X110X8 LD	637.998	167.616	16761.6
4	Column	I80012A40012	104	315.57	31557
			TOTAL	**992.069**	**99206.9**



Graph 1: Fink Truss VS Fan Truss



Graph 2 – Howe Truss VS Pratt Truss

SAP

Table 5: Fan truss - SAP

SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord	ISMC 125	302.54	38.4226	3842.26
2	Bottom Chord	ISMC 250	273	82.992	8299.2
3	Tie Members	ISA 100X100X8	576.29	69.7311	6973.11
4	Purlins	ISMC 150	900	147.6	14760
5	Column	ISHB 250-2	104	56.888	5688.8
			TOTAL	**395.634**	**39563.4**

Table 6: Fink truss - SAP

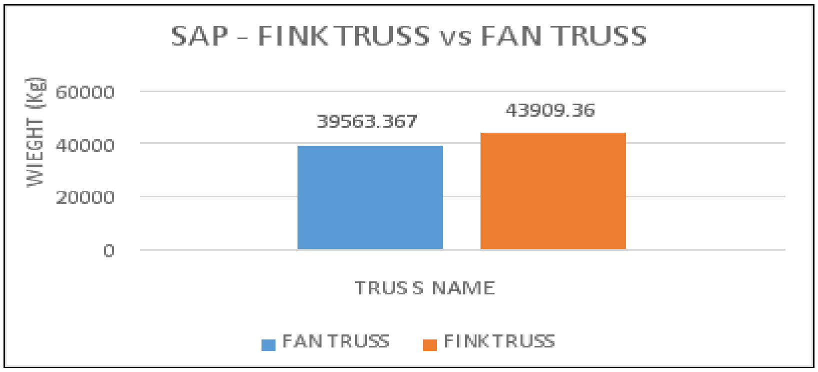
SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord	ISMC 125	302.38	38.4023	3840.23
2	Bottom Chord	ISMC 250	273	82.992	8299.2
3	Tie Members	ISA 100X100X8	515.26	62.3465	6234.65
4	Purlins	ISMC 150	780	127.92	12792
5	Column	ISHB 250-2	104	56.888	5688.8
			TOTAL	**368.549**	**36854.9**

Table 7: Howe truss – SAP

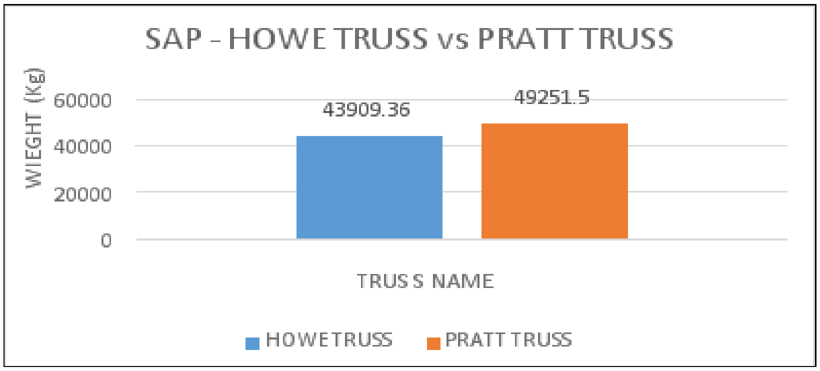
SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord	ISMC 125	338	42.926	4292.6
2	Bottom Chord	ISMC 225	312	80.808	8080.8
3	Tie Members	ISA 100X100X12	570.8	101.032	10103.2
4	Purlins	ISMC 150	960	157.44	15744
5	Column	ISHB 250-2	104	56.888	5688.8
			TOTAL	**439.094**	**43909.4**

Table 8: Pratt truss – SAP

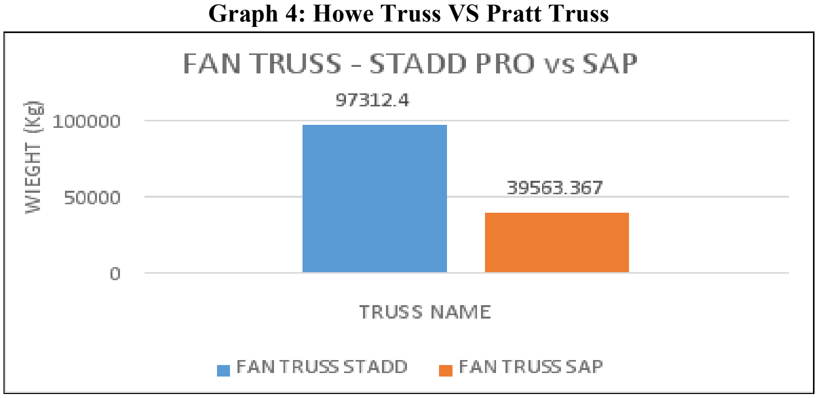
SL.NO	MEMBER	SECTION	LENGTH	WIEGHT	
			mtr	KN	Kg
1	Top Chord	ISMC 125	338	42.926	4292.6
2	Bottom Chord	ISMC 150	312	51.168	5116.8
3	Tie Members	ISA 130X130X15	637	184.093	18409.3
4	Purlins	ISMC 150	960	157.44	15744
5	Column	ISHB 250-2	104	56.888	5688.8
			TOTAL	**492.515**	**49251.5**



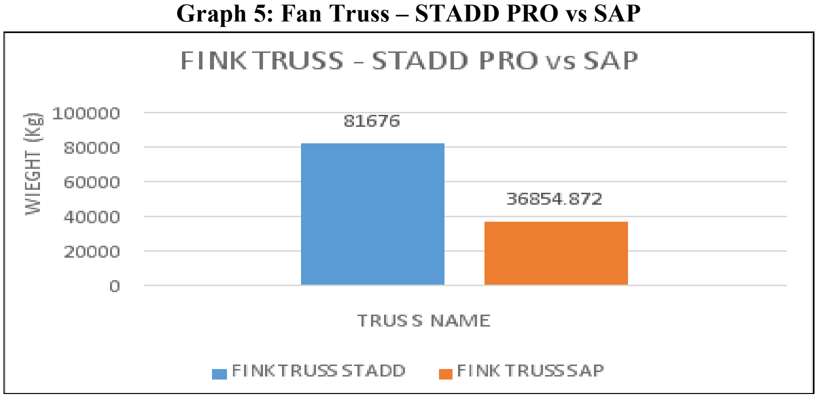
Graph 3: Fink Truss VS Fan Truss



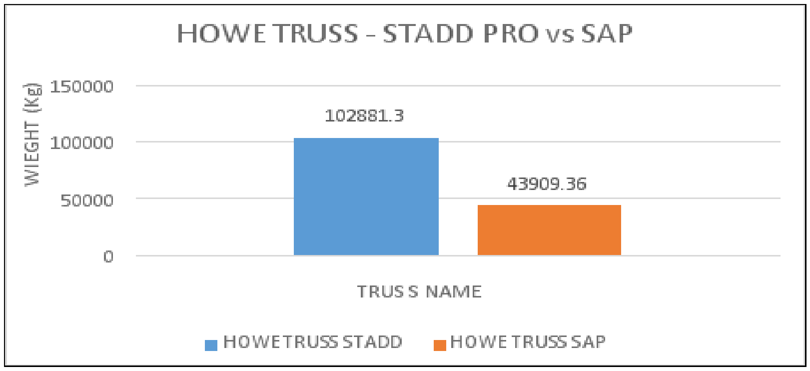
Graph 4: Howe Truss VS Pratt Truss



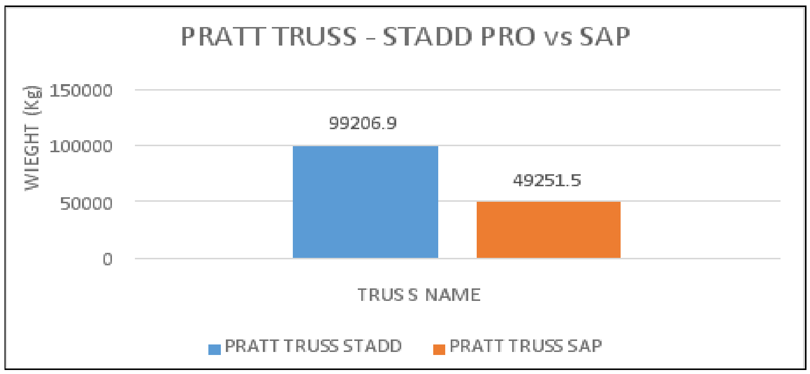
Graph 5: Fan Truss – STADD PRO vs SAP



Graph 6 - Fink Truss – STADD PRO vs SAP



Graph 7 – Howe Truss – STADD PRO vs SAP



Graph 8 – Pratt Truss – STADD PRO vs SAP

CONCLUSION

According to the results obtained from the analysis of these Structures in which optimum steel sections were assigned to the various Industrial structures for every member following conclusion can be made.

- By comparing the results of both Fink Truss and Fan Truss each of spans 21m by using STADD PRO software, it is clearly found that the Fink truss gives the optimised steel quantity (Saves about 16% of steel).
- By comparing the results of both Howe Truss and Pratt Truss each of spans 24m by using STADD PRO software, it is clearly found that the Pratt truss gives the optimised steel quantity (Saves about 4% of steel).
- By comparing the results of both Fink Truss and Fan Truss each of spans 21m by using SAP software, it is clearly found that the Fan truss gives the optimised steel quantity (Saves about 10% of steel).
- By comparing the results of both Howe Truss and Pratt Truss each of spans 24m by using STADD PRO software, it is clearly found that the Pratt truss gives the optimised steel quantity (Saves about 4% of steel).
- By comparing the results of both Howe Truss and Pratt Truss each of spans 24m by using SAP software, it is clearly found that the Howe truss gives the optimised steel quantity (Saves about 11% of steel).
- By comparing the results of both STADD PRO and SAP software for Fan Truss, it is clearly found that the SAP software result gives the optimised steel quantity (Saves about 59% of steel)
- By comparing the results of both STADD PRO and SAP software for Fink Truss, it is clearly found that the SAP software result gives the optimised steel quantity (Saves about 55% of steel)
- By comparing the results of both STADD PRO and SAP software for Howe Truss, it is clearly found that the SAP software result gives the optimised steel quantity (Saves about 57% of steel)
- By comparing the results of both STADD PRO and SAP software for Pratt Truss, it is clearly found that the SAP software result gives the optimised steel quantity (Saves about 50% of steel)

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