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Analysis and Design of Steel Structural Elements for Airbus A-380 Hangar as a P.E.B System

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***Abstract* - Design of any structure is defined as the process of doing calculations by taking various components weight and also lateral loads for the stability of the structure for getting optimum results and to get the nominal cost of any structure for its construction and execution. Structural elements are very much important for the design of any structure because they only carry compressive loads such as weight of roofing system, purlins, rafters, and other accessories etc. In this research work a unique steel structure has been designed with the help of design software called staad-pro. The steel structure is designed for the maintenance of an aircraft named as airbus A-380 which is a wide body aircraft whose dimensions are noted as 73m(239.5 feets) in length, 79.8m(261.8 feets) wingspan width, and 24.1m(79feets) in height. Thus, in this research a steel structure as a pre-engineered building has been designed for the dimensions 120m in span width, 115m in length, and peak rafter height 30m from the floor finished level. In this research work after the quantity of steel for various members are obtained as for primary members 2143.86 MT, flange bracings consumed 60.86MT steel, sag rods 10.72MT, CHS/SHS taken 78.82MT, secondary members 133.50MT, sheeting including walls and roof consumed as 145.81MT, anchor bolts 13.24MT and for high strength grip bolts consumed 34.50 MT. Hence the total steel is estimated as 2621.31MT.**

***Index Terms* – Design of Structural Elements, Aircraft Hangar Design, Airbus A-380, P.E.B Steel Structure System.**

INTRODUCTION

Steel is one of the most multipurpose commonly used structural materials. The structures that are constructed with structural steel are called steel structures. Pre-engineered building system were introduced in the early 1960's because of high consumption of steel in old structures for instance C.S.B who consumed more quantity of steel as all the members of C.S.B are hot rolled and cost of construction was becoming more and seen to be a heavy structure. Now a day's population is increasing and factories and industries also increasing, For the purpose of development in the city it requires stadium which are also constructed with pre-engineered building system. In P.E.B all the structural components such as tapered columns and rafters are manufactured in the steel plant itself and directly transported to the proposed site where steel building is to be erected and later roofing, wall sheeting, anchor bolts etc are used coverings and connecting the members with each other. The P.E.B is used for the establishment of residential buildings, car servicing centre, show rooms, grocery shops, and storage buildings etc. The P.E.B system takes less time for its erection when compared to C.S.B and required less skilled labours. In the P.E.B system tapered columns of I-shape and rafter as an incline beam and flat plates at their ends are used for making bolted connections by providing holes in their ends. In the roofing system sky lights and turbo ventilators are being provided for the natural lights and air. The engineers, architects, builders, are advising industrialists to go only with pre-engineered building concept due to the least cost and less time for its fast and efficient erection and execution.

METHODOLOGY

Pre-engineered building design involves the design of compression members as a columns and flexural members as rafters and sheeting material used as roof coverings, wall coverings, front and back coverings up to some extent. All these components are readily available in the standard companies as a raw stock, whenever these components are required for the erection it need not take much time for order supply it will be readily available and transported to the site in completely knock down condition (C.K.D). In this research work a soft ware called staad-pro is used to design the primary and secondary members of the structure by taking dead load, live load and wind load in to account. The structural design in the attached calculations is in accordance with the specifications of the General construction in steel AISC-2010/MBMA-2012, and wind load applications as per MBMA-2012 and Earthquake Analysis per IS-1893(Part-4)-2016.

LITERATURE REVIEW

ShalakaPatil, Dr.M.B.Kumthekar, 2021, *"Cost Comparative Study of PEB with Conventional Method for Industrial Building"*.
In this research work the authors have designed an industrial shed by considering only primary members using C.S.B and P.E.B concept and design results have been carried out in detail and given statement that the conventional steel building concept is an old concept and will take lots of time for its construction and erection. To improve the quality and different types of erection methods the concept of pre-engineered building has been used in this research as this P.E.B concept was introduced in the design industries in the 1990's. Also, it is observed in this design that how much time will the erection process takes for its execution. This design given most economical sections due to which it leads to less cost of construction, also it is being noticed in this research that P.E.B structures is very much advantageous over C.S.B and P.E.B is achieved as 30% lighter than C.S.B structures. In this research work it concludes that the P.E.B takes six to eight weeks for the delivery of the primary and secondary members and also takes fifteen to twenty days for its erection and execution or more less. In this design it is obtained that the P.E.B structure offer very high stresses against seismic loads and estimated cost will be twenty five to thirty percent lesser than C.S.B. P.E.B components are readily available in the factories at any time just it has to be order in a proper manner and get the accessories within the required time. The main advantage on P.E.B is that the life span of the structure is 25 years and all the components can be dismantle and re-use at different locations.

Rajnandan Verma, Raghvendra Singh, Jan 2020, *"Advantages of Pre-Engineered Building over Conventional Building"*.
In this research work the importance of time and cost has been explained as the clients may have amount but they don't have time so every clients need their building to be constructed with in less time and required more space for the utility purpose. Hence by keeping in mind an attempt has been made and a pre-engineered metal building with a maximum span of 40m with the help of finite element method-based software E-tabs(2013). And also for the purpose of comparison a structure of same dimensions has been taken and analysis is done results were compared. For this building the length 110m and eave height 9m, seismic zone II, minimum wind speed 39m/s, life span 50 years, slope of roof 1:10 and soil type medium has been considered in this design. In this design the authors concludes that the pre-engineered building are usually built up sections and the weight in P.E.B has been reduced as 38.47% has been reduced in the design. In this design the total weight of steel is estimated as 191898.4kg whereas in C.S.B it is obtained as 311879.68kg. the results in maximum deflection, maximum shear force, maximum moment, axial force, maximum storey force and maximum column forces are less when compared to C.S.B results. Hence the quantity of steel will be definitely less in P.E.B ultimately cost will be reduced.

ShaikKalesha, B.S.S.Ratnamala Reddy, Durga Chaitanya KumarJagarapu, april 2020. *"An analytical study onpre-engineered buildings using staad-pro"*.
This research work represents the best architectural look, better quality, fast erection, least cost, and innovative touch also tells about the usage of cost and time. The concept of pre-engineered building in this research stands in topmost level when compared with

other steel construction technology. In this study the authors explained that the designed members are reusable, recyclable and eco-friendly and steel is the material that reflects the power of saving the materials. It is also observed in this research that the consumption of steel is fifty percent less as compared to C.S.B structures and also the authors concluded that the estimated cost is thirty five percent less as compared to conventional steel structures.

Asswani M.Kadam, Prashant G.Chavan, Vinod.L.Patil, Pravin.S.Chanvanke, Azim.S.Shaikhi, april, 2020.“*Load analysis on an aircraft hangar”.*
In the above research the authors explain the utility of the steel is increasing day by day particularly in industrial buildings in the construction industries. Every owner of the industrial buildings wants their structure to be ready for use in less time and want estimated cost very less. Thus, to achieve the suggested requirement by the clients it essential to use steel to its small quantity for that purpose an attempt has been made by studying the modeling and design has been made for aircraft hangar with maximum dimensions with span width 8.5m and length 78.35m in plan outer to outer distance and depth of roof truss is restricted to 3m. For the above building SAP2000 software is being used. After doing all experimental analysis and design in the SAAP software the authors concludes that usage of PEB reduces the weight of the structure also reduces the dead loads and finally due to reduction in dead loads leads to reduce the size of foundation so that maximum cost can be saved.

Animesh Tripathi, Rituraj, Shezad Memon, Nishant Patil, August 2020, “P*arametric study on design of pre-engineered building using IS:800-2007 and AISC 360 13th edition”*.
In this study of research the authors explained the advantage of P.E.B as a speedy erection and control over quality and quantity of steel material by using two different code system and a building is designed as a single storey and suggested the P.E.B is efficient and best alternative to conventional steel structure. In this study a warehouse steel structure is designed and comparison done by using two designed codes by keeping loading parameters similar. In this research work all the load parameters are applied by following the IS-code and AISC code system and proven that all the structural engineers and steel designers follow the American institute code. This design considered the span width as 49.5m and length as 99m, clear height 11m and spacing of bay is provided as 7m each. The height for brick work in this design is considered as 3m and total number of bays are being 17 numbers and sloping angle is being considered as 5.7^{o}. Thus, after designing, the authors concludes that as per AISC code of system 27% steel can be saved when compared to IS-code and weight of steel is depend on spacing of bays. As per serviceability criteria it was observed that deflection limits for IS-code are higher when compared to AISC code. When it comes to limiting ratio’s as per table 2 of IS:800-2007 due to which steel will be heavy. Thus, it is clear that if a building is design using AISC code will give you better results when compared to the design done by IS:800-2007.

DESIGN CODES

The following are the design codes used in the design of structural elements for aircraft hangar for airbus A-380 as a pre-engineered building system.

1. Loads on the building are applied in accordance with: MBMA
2. Hot rolled sections and Built-Up Sections are designed in accordance with: AISC
3. Cold formed members are designed in accordance with: AISI
4. Welding is applied in accordance with: The Edition (2006) of Structural Welding Code - Steel (AWS D1.1M: 2006) By American Welding Society (AWS).
5. Wind Speed is calculated in accordance with: IS 875 (Part 3): 1987 Code of practice for Design Loads.
6. Seismic Load is calculated in accordance with: IS 1893 (Part 1): 2002 criteria for earthquake resistant design of structures.

MATERIAL SPECIFICATIONS

The following is the list of the material standards and specifications for which the building components have been designed.

Table(1) { material standards and specifications }

S.no	Materials	Specifications	Grade (F_y)
1.	Built-Up Members	ASTM A572 Grade 50 & A570	350 MPa
2.	Cold Formed members	ASTM A1011 Grade 50 / Plain	350 MPa
3.	Secondary Members	ASTM A 653 Grade 50 / Galvanized	350 MPa
4.	Hot-Rolled Section	I.S.-2062 E 250	250 MPa
5.	Sheeting Panels	ASTM A 792 Grade 3450 class 2	345 MPa
6.	Tubes	IS 1161 for Pipes	240 MPa
7.		IS 4923 for RHS / SHS	240MPa
8.	X- Bracings-Rod	IS:2062 & IS:1161	250 MPa
9.	Anchor Bolts	I.S. 2062	250 MPa
10.	High Strength Bolts	ASTM A325 Type1 Electro Galvanized (Grade 8.8)	635 Mpa 12mm-25mm dia
11.	Welding	70ksi Electrode	480 Mpa

DESIGN ASSUMPTIONS

The following are the assumptions made in the design of aircraft hangar for airbus A-380 they are described below.

1. The primary members(rafters and tapered columns) are assumed to be connected rigidly to each other.
2. The column bases connections are assumed to be pinned.
3. In the design it is assumed that the lateral stability of the steel building is provided through the complete frame action of the main rafters and columns.
4. In this design the building is provided longitudinal stability by providing crossed based bay system to protect the structure.
5. This design is provided with Z-shaped purlins as a continuous beam over the rafters at each bay.
6. For covering the side walls above the brick work which is 3m high is provided with girts with Z-shaped to cover the remaining 22m height between each bay.
7. At the end of the structure Z-shaped girts have provided as continuous beam to resist wind load.
8. Tube bracings is assumed in the design for roof and wall at each bay locations.

Aircraft Hangar for Airbus A-380 Configuration Details

Table (2) {structure configuration details}

S.No	Particulars	Specifications / Parameters
1.	Type Of Building	aircraft hangar for airbus A-380
2.	Type Of Structure	P.E.B steel structure
3.	Width Of Structure	120.0 m O/O of Steel line
4.	Length Of Structure	115.0 m O/O of Steel line.
5.	Roof Slope Of Structure	1:10
6.	Peak Rafter Height	30.0 Meter from FFL
7.	Bay Spacing	1@7.1875mO/C+14@7.1875mC/ C+1@7.1875mC/O
8.	Roof Cover	0.50 mm thick TCT (Bare Galvalume Sheet).
9.	Wall Cover	0.50 mm thick TCT (Pre Painted Galvalume Sheet).
10.	Sheeting Condition	
a)	Side walls:	
i	Axis x /(1-17)	3.0m Self supporting brick wall and above sheeted.
ii	Axis Y/(1-17)	3.0m Self supporting brick wall and above sheeted.
b)	End walls:	
i	GL - 1	3.0m Self supporting brick wall and above sheeted.
ii	GL - 17	3.0m Self supporting brick wall and above sheeted from GL-(A-C) and 0.5m sheeted from eave and open for access from GL-(C-V) and 3.0m Self supporting brick wall and above sheeted from GL-(V-Y).

DESIGN LOADS CONSIDERATIONS

The following are the loads that have been taken into considerations.

1) Self-weight / Dead load calculations:

Dead load has been considered as 0.1 kN/m^2 due to weight of sheeting + Purlins and
Roof insulation + self-weight of frame.

2) Live Load:

Live loadon roof has been considered as 0.57 kN/m^2

3) Wind loads:

V = 44 m/sec,
Wind Exposure-C
Importance factor -1.0
Roof and wall -Enclosed

qh = 0.00256 Kz x Kzt x Kd x V2I
qh = 0.00256 x 1.22 x 1.0 x 0.85 x 44
qh = 1.25 kN/m^2
Internal pressure coefficient = +/-0.18

4) Earthquake load:
Earthquake load as per IS 1893(Part-IV) – 2016
Zone-II = 0.10
Importance factor = 1.5
Response reduction factor = 4.0
Serviceability Criteria
1) Main frame
Vertical deflection : Span / 150
Lateral deflection : Height / 100
2) Purlins & Girts: Span / 150

Load calculations
1. Dead load = 0.1Kn/m2
= 0.1 x 7.1875
= 0.719Kn/m

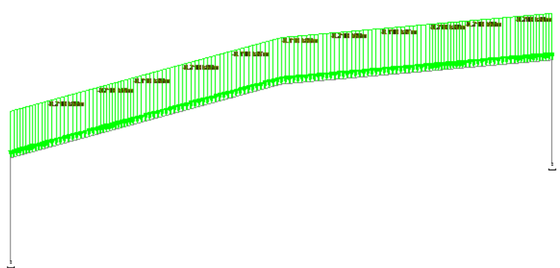

Fig.1 Dead Loading Diagram

2. LIVE LOAD = 0.75Kn/m2
= 0.57 x 7.1875
=4.1kn/m

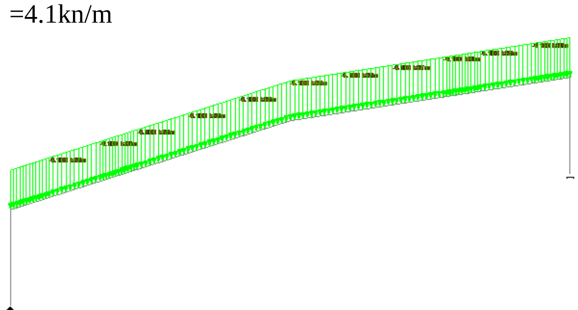

Fig.2 Live Loading Diagram

3. Wind application on staad members for High bay
V = 44 m/sec,
Wind Exposure = C
Importance factor = 1.0
Roof and wall = Enclosed
qh = 0.00256 x Kz x Kzt x Kd x V2I
qh = 0.00256 x 1.22 x 1.0 x 0.85 x 44
qh = 1.25 KN/m^2
Internal pressure coefficient = +/-0.18
Table (3){coefficients and qh values}

S.No	Coefficient	Bay spacing	qh	Load on member
1.	0.226	7.188	1.251	2.033
2.	-0.870	7.188	1.251	-7.822
3.	-0.555	7.188	1.251	-4.992
4.	-0.477	7.188	1.251	-4.285

4. Wind Pressure calculations
a) WLL-P

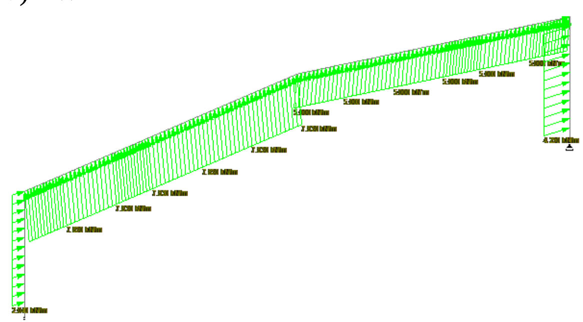

Fig.3 wind load left pressure diagram

b) WLR-P

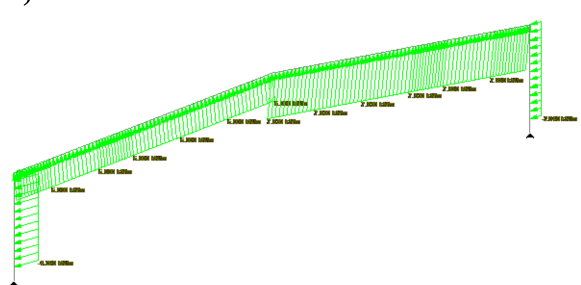

Fig.4 wind load right pressure diagram

Table (4){coefficients and qh values for pressure}

S.No	Coefficient	Bay spacing	qh	Load on member
1.	0.586	7.188	1.251	5.270
2.	-0.510	7.188	1.251	-4.585
3.	-0.195	7.188	1.251	-1.755
4.	-0.117	7.188	1.251	-1.049

5. Wind Suction calculations
a) WLL-S

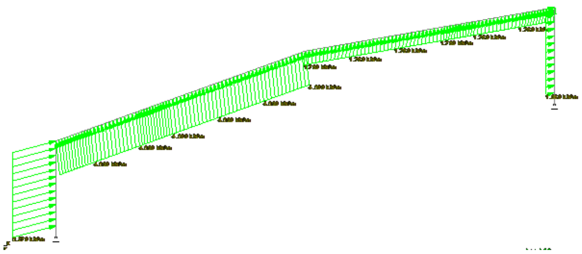

Fig.5 wind load left suction diagram

b) WLR-S

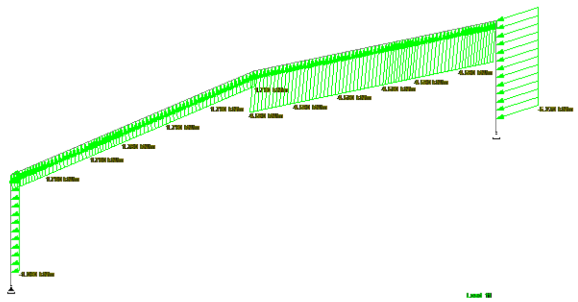

Fig.6 wind load right suction diagram

Table (5){coefficients and qh values for suction}

S.No	Coefficient	Bay spacing	qh	Load on member
1.	0.630	7.188	1.251	-5.664
2.	-0.870	7.188	1.251	-7.822
3.	-0.55	7.188	1.251	-4.95
4.	-0.63	7.188	1.251	-5.664

c) WL longitudinal 90^0 in x-direction

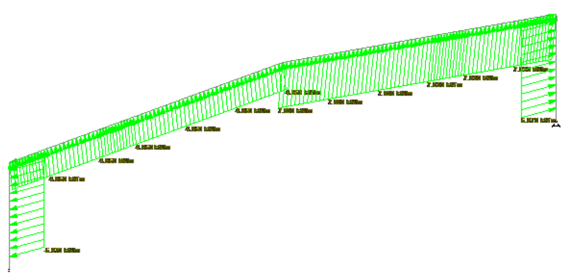

Fig.7 wind load longitudinal 90^0 diagram

d) WL longitudinal 90^0 in y-direction

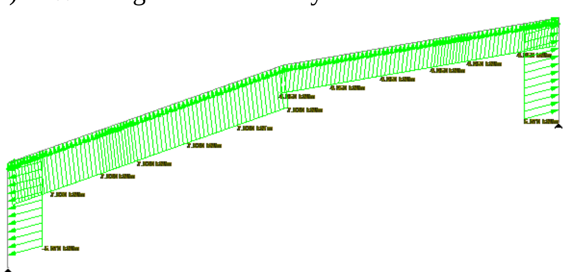

Fig.8 wind load longitudinal 90^0 diagram

Staad Member Diagram

The below is the staad member diagram.

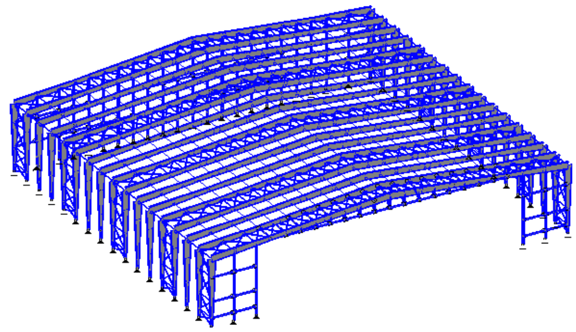

Fig.9 STAAD 3D MODEL

Load Combination for Design& Serviceability

DL+CL+LL
DL+0.6WLL P
DL+0.6WLL S
DL+0.6WLR P
DL+0.6WLR S
DL+0.6WLE S
(0.6DL+0.6WLL-0.2P)
(0.6DL+0.6WLR-0.2P)
(0.6DL+0.6WLL-0.2S)
(0.6DL+0.6WLR-0.2S)
(0.6DL+0.6WLP-0.5P)
(0.6DL+0.6WLP-0.5P)
****
(DL+ CL + 0.75LL + 0.75(0.6WLL-0.2P)
(DL+ 0.75LL + 0.75(0.6WLR-0.2P)
(DL+ CL + 0.75LL + 0.75(0.6WLL-0.2S)
5 1.0 6 1.0 7 0.75 10 0.45
(DL+ CL + 0.75LL + 0.75(0.6WLR-0.2S)
(DL+ CL + 0.75LL + 0.75(0.6WLP-0.5P)
(DL+ CL + 0.75LL + 0.75(0.6WLP-0.5P)
****
(DL+ CL + 0.75LL + 0.75(0.7EL-VE)
(DL+ CL + 0.75LL + 0.75(0.7EL+VE)
(DL+ CL + 0.75LL + 0.75(0.7EL-VE)
(DL+ CL + 0.75LL + 0.75(0.7EL+VE)
****
(0.6DL+0.7EL-VE)
(0.6DL+0.7EL+VE)
(0.6DL+0.7EL-VE)
(0.6DL+0.7EL+VE)

Node Displacement Summary

AISC_3D_FRAME1 - Node Displacements:

All | Summary

	Node	L/C	Horizontal X mm	Vertical Y mm	Horizontal Z mm	Resultant mm	Rotational rX rad	rY rad	rZ rad
Max X	124	120 (DL+ CL + 0.75LL + 0.75(0.7EL-VE)	106.806	-1.149	-1.743	106.826	-0.000	-0.001	0.002
Min X	120	121 (DL+ CL + 0.75LL + 0.75(0.7EL+VE)	-106.804	-1.149	-1.743	106.824	-0.000	0.001	-0.002
Max Y	312	113 (0.6DL+0.6WLP-0.5P)	43.464	41.884	-78.144	98.742	0.004	-0.002	0.000
Min Y	551	101 DL+CL+LL	0.001	-656.427	-71.475	660.307	-0.004	0.000	0.000
Max Z	824	112 (0.6DL+0.6WLP-0.5P)	-4.262	-0.129	191.037	191.084	0.001	0.000	0.000
Min Z	824	107 DL+0.6WLE S	4.261	-0.203	-200.323	200.368	-0.001	-0.000	-0.000
Max rX	24	101 DL+CL+LL	-0.003	-0.711	-55.439	55.443	0.090	0.010	-0.000
Min rX	743	101 DL+CL+LL	-22.037	-137.388	2.351	139.164	-0.025	-0.001	-0.001
Max rY	732	107 DL+0.6WLE S	0.000	0.000	0.000	0.000	-0.000	0.014	-0.001
Min rY	736	107 DL+0.6WLE S	0.000	0.000	0.000	0.000	-0.000	-0.014	-0.002
Max rZ	111	101 DL+CL+LL	36.118	-276.259	-24.597	279.694	0.037	-0.005	0.018
Min rZ	89	101 DL+CL+LL	-36.115	-276.260	-24.597	279.695	0.037	0.005	-0.018
Max Rs	551	101 DL+CL+LL	0.001	-656.427	-71.475	660.307	-0.004	0.000	0.000

Maximum Deflection = 656.0mm(vertical)

Limiting deflection (span/180) = 120.0 x 10 ^{3}/180 =666.66mm

Since maximum deflection is less than limiting deflection.

Hencesafe in Deflection.

Maximum Deflection = 106.826 mm (Horizontal)

Limiting deflection (H/150) = 25.0m/150=166.66mm

Since maximum deflection is less than limiting deflection.

Hence safein Deflection.

Support Reactions Summary

AISC_3D_FRAME1 - Support Reactions:

All | Summary | Envelope

	Node	L/C	Horizontal Fx kN	Vertical Fy kN	Horizontal Fz kN	Moment Mx kNm	My kNm	Mz kNm
Max Fx	117	101 DL+CL+LL	421.580	915.416	17.979	0.000	0.000	0.000
Min Fx	121	101 DL+CL+LL	-421.580	915.417	17.979	0.000	0.000	0.000
Max Fy	758	101 DL+CL+LL	-1.348	1339.273	-0.000	0.000	0.000	0.000
Min Fy	740	101 DL+CL+LL	0.222	-369.829	0.003	0.000	0.000	0.000
Max Fz	117	107 DL+0.6WLE S	113.378	618.722	55.322	0.000	0.000	0.000
Min Fz	736	118 (DL+ CL + 0.75LL + 0.75(0.6WLP-0.5P)	-19.887	423.461	-59.818	0.000	0.000	0.000
Max Mx	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000
Min Mx	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000
Max My	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000
Min My	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000
Max Mz	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000
Min Mz	1	101 DL+CL+LL	0.228	188.991	0.069	0.000	0.000	0.000

Relative Displacement Details For Beams

AISC_3D_FRAME1 - Beam Relative Displacement Detail:

All Relative Displacement | Max Relative Displacements

Beam	L/C	Length m	Max x mm	Dist m	Max y mm	Dist m	Max z mm	Dist m	Max mm	Dist m	Span/Max
1	101 DL+CL+L	7.539	-0.000	4.398	-0.017	2.513	0.005	0.500	0.018	3.770	>10000
	102 DL+0.6W	7.539	0.000	5.654	-0.131	3.770	0.002	0.417	0.131	3.770	>10000
	103 DL+0.6W	7.539	-0.000	0.628	0.110	4.398	0.001	0.417	0.110	4.398	>10000
	104 DL+0.6W	7.539	-0.000	0.628	-0.112	3.770	0.002	0.417	0.112	3.770	>10000
	105 DL+0.6W	7.539	-0.000	5.654	0.129	4.398	0.002	0.500	0.129	4.398	>10000
	106 DL+0.6W	7.539	0.000	3.770	0.003	4.398	-0.145	0.417	0.145	3.141	>10000
	107 DL+0.6W	7.539	0.000	3.141	-0.085	3.770	0.148	0.417	0.170	3.770	>10000
	108 (0.6DL+0	7.539	-0.000	1.885	-0.128	4.398	0.001	0.417	0.128	4.398	>10000
	109 (0.6DL+0	7.539	-0.000	0.628	0.110	4.398	0.001	0.417	0.110	4.398	>10000
	110 (0.6DL+0	7.539	-0.000	0.628	-0.109	3.770	0.002	0.417	0.109	3.770	>10000
	111 (0.6DL+0	7.539	-0.000	6.283	0.130	4.398	0.002	0.500	0.130	4.398	>10000
	112 (0.6DL+0	7.539	0.000	0.628	0.005	5.026	-0.146	0.417	0.146	3.141	>10000

Beam design summary

Postprocessing: Displacements Reactions Beam Results Plate Results Solid Results Dynamics

All | Summary | Envelope

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	232	121	70	3566.697	287.432	-3.530	-0.672	28.839	846.388
Min Fx	17	121	3	-3289.593	-194.132	-0.019	-0.720	30.821	-1246.446
Max Fy	845	101	697	-445.212	949.970	0.679	-2.000	-6.346	9597.897
Min Fy	819	101	671	-459.132	-893.013	0.126	0.397	3.126	9748.343
Max Fz	10597	101	877	-0.140	-18.125	499.421	-0.002	-0.211	1.887
Min Fz	10606	101	886	-0.150	-18.118	-499.429	0.002	0.211	1.886
Max Mx	752	114	602	197.936	54.339	44.694	13.199	-266.910	-4418.297
Min Mx	751	114	602	204.798	-14.472	-44.732	-13.085	267.010	-4418.297
Max My	751	114	602	204.798	-14.472	-44.732	-13.085	267.010	-4418.297
Min My	752	114	602	197.936	54.339	44.694	13.199	-266.910	-4418.297
Max Mz	411	101	218	905.990	-612.642	-3.118	-0.538	-9.089	15305.275
Min Mz	415	101	249	906.051	612.841	-3.119	0.537	-9.096	-15306.427

Detailing And Drawings

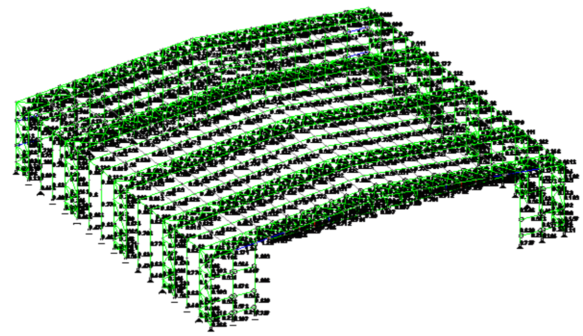

Fig.10 unity check diagram

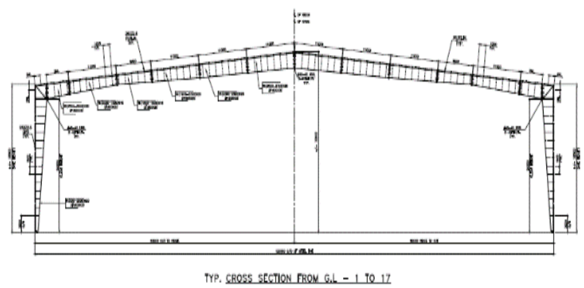

Fig.11 Sectional elevation for air-bus A-380 hangar

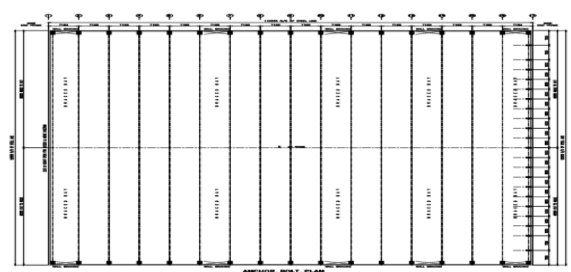

Fig.12 plan for airbus A-380 hangar

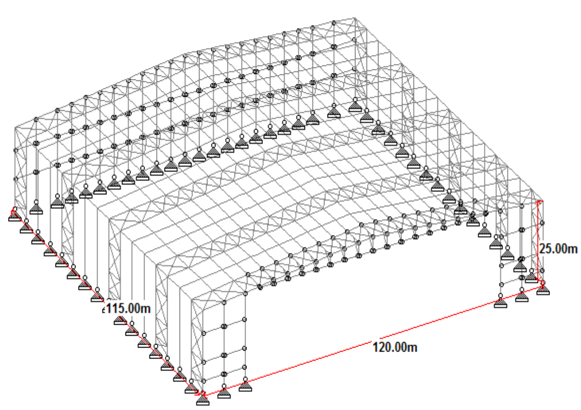

Fig.13Staad Model for air-bus A-380 P.E.B hangar In Dimensions

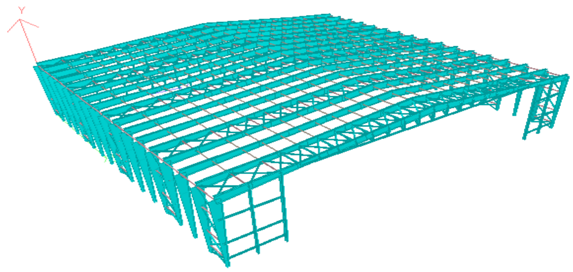

Fig.14 3D- Rendering In staad - pro software

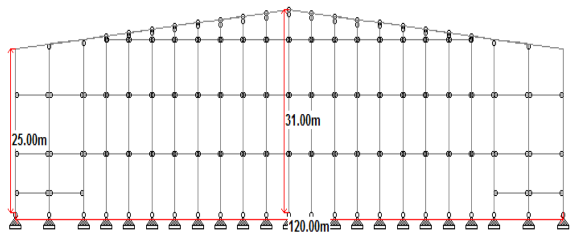

Fig.15 Front elevation of staad- model for A-380 P.E.B hangar

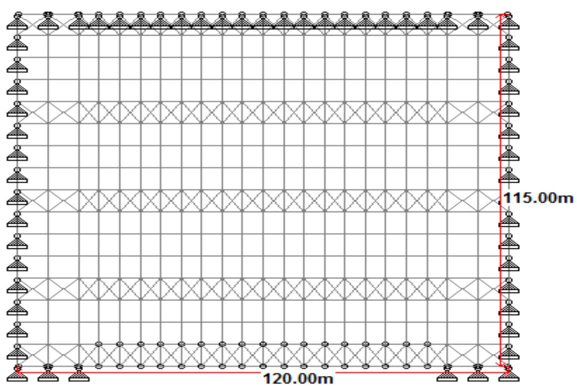

Fig.16 Top View (Plan) of Staad- Model for Air-Bus A-380 P.E.B Hangar

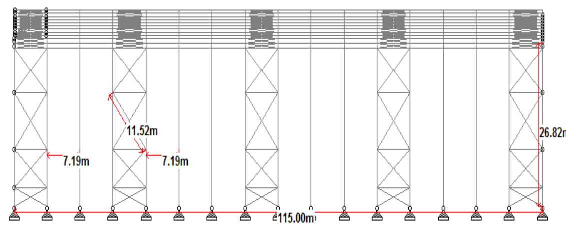

Fig.17 Side Elevation of A Staad Model for Airbus A-380 P.E.B Hangar

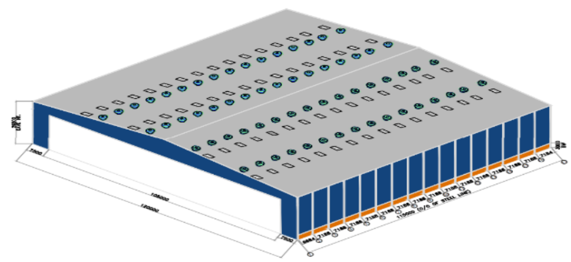

Fig.18 P.E.B in architectural 3D view.

RESULTS AND DISCUSSIONS

The structural analysis and design has been done for airbus A-380 hangar as a pre-engineered steel framed building by considering the maximum dimensions as 120M x 115M x 26m eave height and 31M clear height as from floor finish level to the top of the frame. For designing the steel frame pre-engineered building hangar staad-pro software has been used. In this design 3d analysis has been done and in the above all the structural details and drawings have been mentioned. The following results have been obtained from this design.

Table (6) {software analysis results and summary}

Maximum Displacements in mm				Rotational Displacements in radians		
s.no	X-axis	Y- axis	Z- axis	X- axis(Rx)	Y- axis(Ry)	Z- axis(Rz)
1.	106.806 mm	-1.149mm	-1.743mm	-0.000 radians	0.002 radians	0.001 radians
Maximum Shear Force in KN				Maximum Bending Moment in KN-M		
	X- axis	Y- axis	Z- axis	X- axis(Mx)	Y- axis(My)	Z- axis(Mz)
2.	3566.697 KN	287.432KN	-3.530KN	-0.672KN-M	28.839KN-M	846.388KN-M
Estimated Quantity of Steel in Metric Tonne						
	Primary Members	Flange Bracings, Sag Rods And CHS/SHS	Secondary Members	Roof Sheetings and Wall Sheetings	Anchor Bolts and High Strength Bolts	Total Quantity of Steel Obtained
3.	2143.86MT	150.4MT	133.50MT	145.81MT	47.74MT	2621.31MT

CONCLUSION

Analysis and design in this study yielded the following conclusions.

1. The structure designed in this research for a maximum dimension of 120MX115M X 30M as pre-engineered building as a hangar for the maintenance of an air bus A-380 has consumed the total quantity of steel as 2621.31MT.
2. The above design concludes that the obtained amount of steel mainly depends on primary members and type of purlins of the structure.
3. While designing the pre-engineered building structure it is seen that when bay spacing is provided between two frames quantity of steel will get decreased but there is a increment in steel for secondary members due to increase in secondary members length.
4. To resist the wind load effect less weight flexible members for pre-engineered building can be provided because light weight structural members offers better resistance against the wind forces.
5. If self-weight of structural members i.e primary and secondary members is reduced then it may leads to economical sizes for footings and foundations.
6. The aircraft hangar for air bus A-380 designed in this research is a unique design with pre-engineered building design concept in accordance with AISC codes is consuming less quantity of steel compare to other countries codes.

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