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Structural Analysis of Shelter Structure of Composites Materials

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***Abstract**: The projects aim at Structural Analysis of Shelter Structure. Inputs of the design are analysis specifications. Specifications consider are shelter size 6058(L) x 2700(W)x 2200(H) (+/- 10mm) .height with 2o slope roof is 2231 mm. The floor will be capable of carrying a distributed load of 6000 kg .The roof load 200 kg's per Sq. meter . The corner fitting shelter will be equipped at its top and bottom corner fitting that comply with recommendation of ISO 1161.The additional ISO corner fitting in the bottom will be used for lifting and tying of the shelter by making use of suitable slings and weight 4667.95 kg's .NX-NASTRAN is used as per and post processing Finite element tool and NX- NASTRAN is used as solver for all structural analysis purpose.*

***Keywords:** NX 11- Nastran, Only Roof Load Condition, Floor Load and Roof Load, Floor Load and Roof Load & Wind Load, Floor Load and Roof Load & Lifting Condition Boundary Condition, Floor Load and Roof Load With 3g Acceleration.*

I. INTRODUCTION

It is required to carry out structural analysis of shelter as per given solid model and boundary condition. The shelter is built with material is accordance with applicable drawings and standards .the shelter will enable mounting of DGs and associated equipment as per configuration. The interiors of the shelter will provided with adequate lighting powered by DG batteries and DGs/AC power .shelter will also have adequate air circulation for human comfort. The shelter system was designed to intercept enemy aircraft, missiles, helicopters and drones at a range of up more than 70 km. It uses Barak 8 missiles. A mobile launch system was completely designed. The trailer-based launcher is towed by a prime mover. Also it can be transported by rail, or airlifted by cargo aircraft.as show in fig.1.

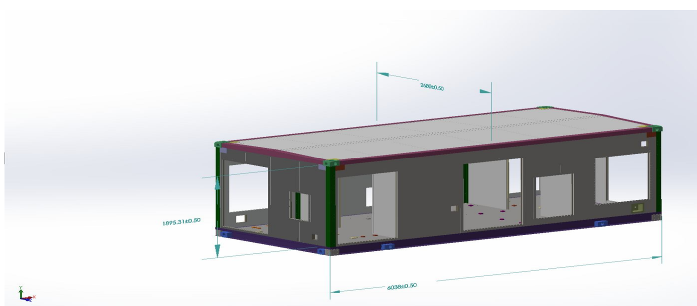


Figure 1: solid model of shelter assembly with outer dimensions

A. *Case Shelter Limite*

Material Properties

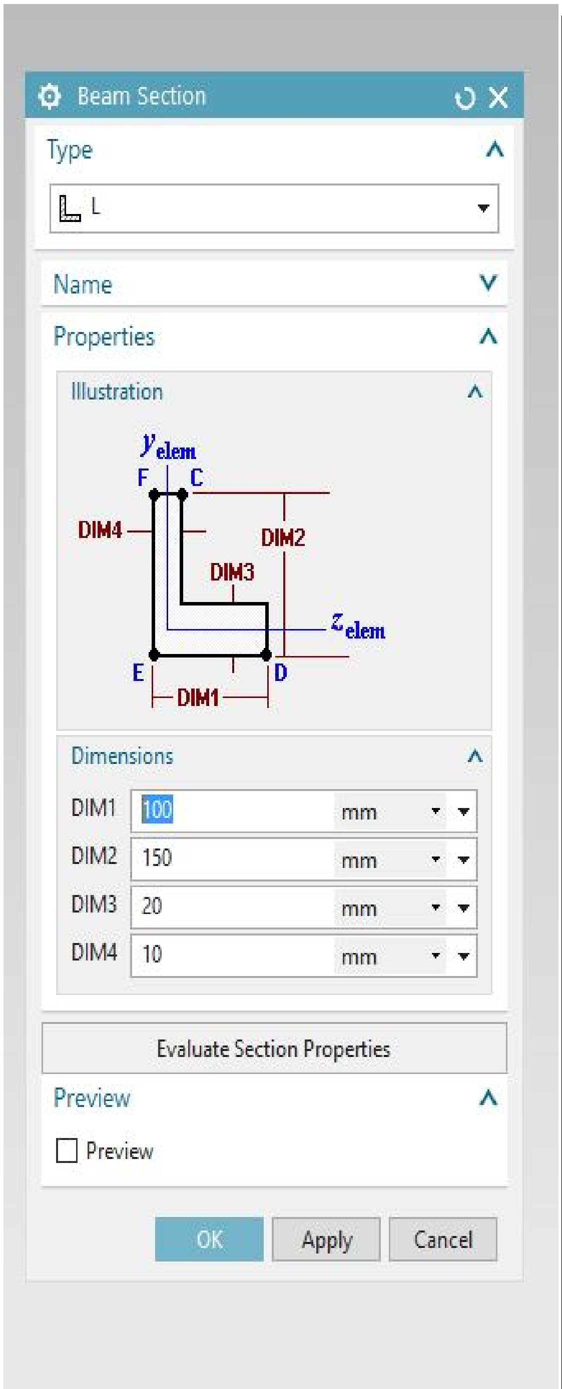
Table: 1

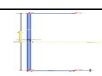
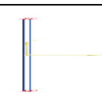
s.no	Material	Young`s modulus (GPA)	Poisson`s ratio	Density (kg /m3)	Yield strength (MPA)
1	Steel	210	0.30	7850	275
2	Foam	0.10545	0.40	70	_
3	Aluminium	71	0.33	2770	310

1) *Cross Section of Beams* A beam is generally considered to be any member subjected to principally to transverse gravity or vertical loading. The term transverse loading is taken to include end moments. There are many types of beams that are classified according to their size, manner in which they are supported, and their location in any given structural system. Beams

are generally classified according to their geometry and the manner in which they are supported. Geometrical classification includes such features as the shape of the cross section, whether the beam is straight or curved or whether the beam is tapered, or has a constant cross section. Beams can also be classified according to the manner in which they are supported. Some types that occur in ordinary practice are shown in Figures, the names of some of these being fairly obvious from direct observation.

Cross Section of Beam
Table: 2



S.NO	Material	Cross section Demission(mm)	Cross section view
1	Steel	Height: 50 Width, Top: 50 Thickness:2	
2	Steel	Height: 150 Width, Top: 80 Thickness: 6	
3	Steel	Height: 100 Width, Top: 100 Thickness: 6	
4	Steel	Height: 50 Width, Top: 50 Thickness: 6	
5	Steel	Height: 370 Width, Top: 40 Thickness: 2	
6	Steel	Height: 46 Width, Top: 185 Thickness: 2	
7	Steel	Height: 50 Width, Top: 25 Thickness: 2	
8	Steel	Height: 200 Width, Top: 3 Thickness: 3	
9	Steel	Height: 50 Width, Top: 3 Thickness: 3	
10	Aluminium	Bottom Plate 6.038X2.68X0.004	-

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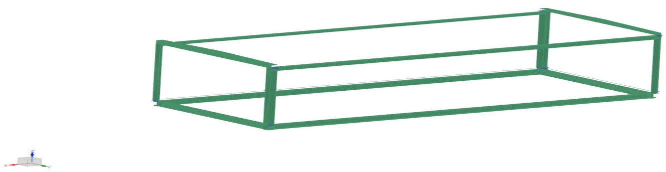


Fig.2.Cross section s.no.1

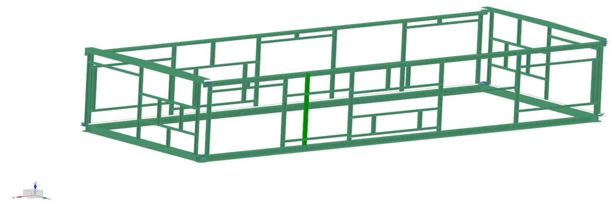


Fig.3.Cross section s.no.2

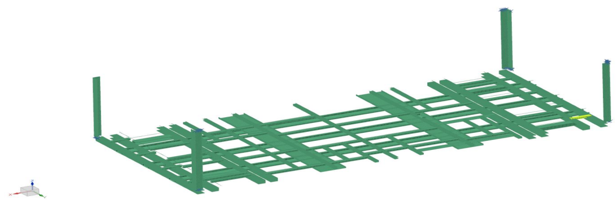


Fig.4.Cross section s.no.3

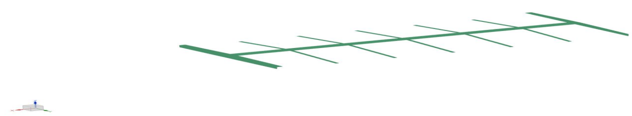


Fig.5.Cross section s.no.4

B. Literchier Review

1) Solid Modelling

a) Graphical Model Preparation through Unigraphics : The modern manufacturing environment can be characterized by the paradigm of delivering products of increasing variety, smaller batches and higher quality in the context of increasing global competition. Industries cannot survive worldwide competition unless they introduce new products with better quality, at lower costs and with shorter lead-time. There is intense international competition and decreased availability of skilled labour. With dramatic changes in computing power and wider availability of software tools for design and production, engineers are now using computer aided design (cad), computer aided manufacturing (cam) and computer aided engineering (cae) systems to automate their design and production processes. These technologies are now used every day for sorts of different engineering tasks. Below is a brief description of how cad, cam, and cae technologies are being used during the product realization process.

C. NX 11 Gateway

The following figure shows the typical layout of the NX 11 window when a file is opened. This is the Gateway of NX 11 from where you can select any module to work on such as modelling, manufacturing, etc. It has to be noted that these toolbars may not be exactly on the same position of the screen as shown below. The toolbars can be placed at any location or position on the screen. Look out for the same set of icons as show in fig: 6

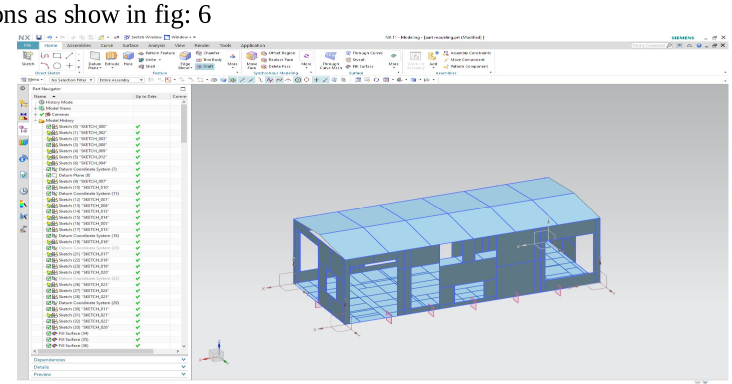
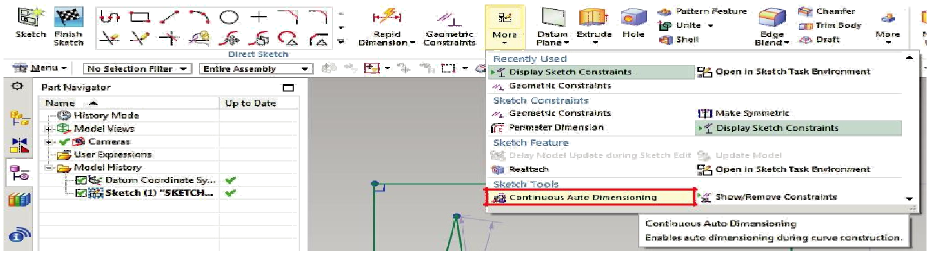


Figure :6

D. Sketch Curve Toolbar

This toolbar contains icons for creating the common types of curves and spline curves, editing, extending, trimming, filleting etc. Each type of curve has different methods of selection and methods of creation. Let us discuss the most frequently used options. This option creates both straight lines as well as arcs depending on the icon you select in the pop-up toolbar. You can pick the points by using the coordinate system or by entering the length and angle of the line as shown in the following figure. The degrees of freedom can be eliminated by giving dimensions with fixed entities like axes, planes, the coordinate system or any existing solid geometries created in the model. These dimensions can be linear, radial, angular etc. You can edit the dimensional values at any time during sketching by double-clicking on the dimension



E. Finite Element Method

The finite element method has become a powerful tool for the numerical solution of wide range of engineering problem .The basic idea of FEM is to find the solution of a complicated problem by replacing it by simpler one. Moreover in the FEM, it will be often possible to improve or refine the approximate solution by spending more computational effort.

Since it is difficult to find the exact response (like stress and displacement) of the complicated shape is approximant as composed of several finite elements inter convenient approximant solution is assumed and the condition of overall equilibrium the complicated shape are derived. With the advance in computer technology and CAD system, complex problem can be modeled with relative ease .several alternative configuration can be tried out on a computer before the first prototype is built .All of this suggests that we need to keep pace with this development by understanding the basic theory, modeling techniques, and computational aspects of finite element method. In this method of analysis, a complex region defining a continuum is discredited into simple geometric shapes called finite elements. The material properties and the governing relationships are considered over these elements and expressed in terms of unknown value at elements corners. An assembly process, duly considering the loading and constrains, results in a set of equations. Solution of this equation gives us the approximant behaviour of the continuum. FEM has been extensively used in the fields of structural mechanics, heat conduction, fluid dynamics, seepage flow, electric and magnetic fields.

F. Solution Steps

1) *Starting the Simulation*: you can select the solver algorithm from one of these: NX Nastran, NX Thermal/Flow, NX Nastran Design, MSC NASTRAN, Ansys, Abaqus, NX Electronic Systems Cooling, NX Space Systems Thermal, LS-DYNA, and NX Multiphysics. In addition, you can choose the type of analysis to be performed. In this tutorial, only Structural Analysis will be covered with NX Nastran Design.
2) *Choosing the Material Properties*: his allows you to change the physical properties of the material that will be used for the model. For example, if we use steel to manufacture the impeller, we can enter the constants such as density, Poisson’s ratio, etc. These material properties can also be saved in the library for future use or can be retrieved from Library of Materials.
3) *Applying the Loads*: This option allows you to exert different types of forces and pressures to act on the solid along with the directions and magnitudes
4) *Applying the Boundary Conditions* : Boundary conditions are surfaces that are fixed to arrest the degrees of freedom. Some surfaces can be rotationally fixed and some can be constrained from translational movement.
5) *Meshing the Bodie* : This is used to discretize the model as discussed in beginning of the chapter. Normally, we select tetrahedral shapes of elements for approximation. You can still select the 2-D and 1-D elements depending on the situation and requirements by choosing these options from the drop-down menu.
6) *Solution and Results* : This is the command to solve all the governing equations by the algorithm that you choose and all the above options. This solves and gives the result of the analysis of the scenario.

G. Shelter assembly

1) FE modeling has been carried out using FEMAP 11 as per and post processor and NX NASTRAN 11 as solver
2) Rectangular tubes are modeled using beam elements
3) Plate is modeled by using plate element type
4) Foam is modeled by solid element
5) Fixed boundary condition at ISO corners is considered

6) FE models for different element are show in figures

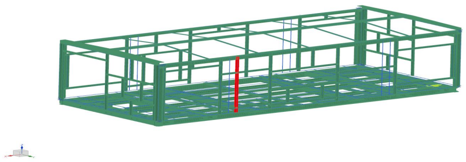


Fig7: finite element (fe) model of beams

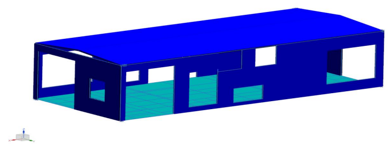


Fig8: finite element (fe) model of plate

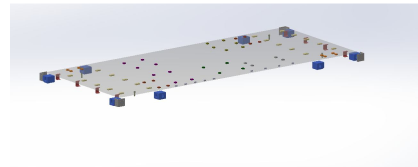


Fig9: load support plat form Application of Loads (Steel and Foam)

H. Static Analysis

1) Total structure weight of 4667.95 kg
2) Boundary condition: bottom 4 iso corners and top 4 iso corners wear fixed
3) roof load of 200 kg /m2 was applied on top surface of plate for both bottom fix and top fix condition
4) Acceleration of 3g in z direction has been simulated as per ground condition
5) Wind load of 120 k mph in X direction has been simulated as per ground condition

I. Analysis Results

1) *Case 1: only roof load condition*
a) Total structure weight 4667.95 kg
b) Boundary condition: bottom 4 iso corners and top 4 iso corners wear fixed
c) Maximum displacement and stresses observed on plate and beam are as follows

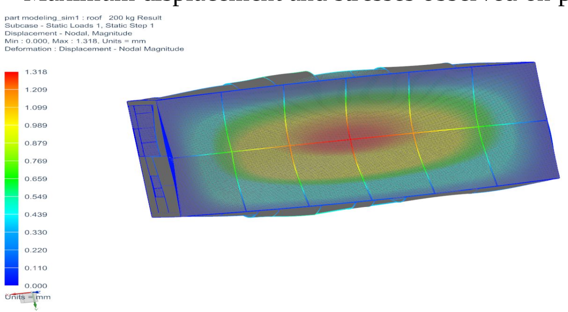


Fig: 10 Deformation of Max: 1.318mm on Plate

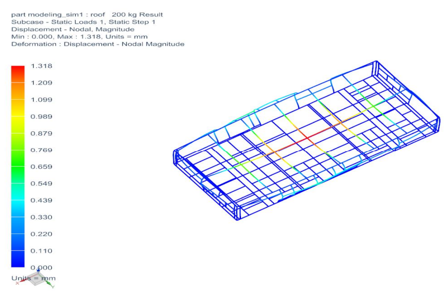


Fig: 11 Deformation of MAX: 1.318 mm on beam

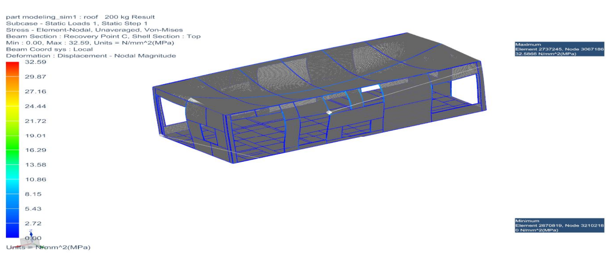


Fig: 12 Maximum stress of 32.59MPa obtained on top beam

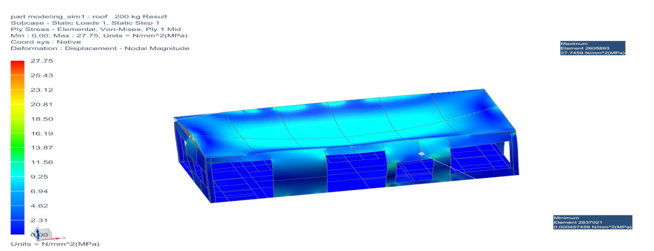


Fig: 13 Maximum ply-1stress of 27.75 MPa obtained on the plate

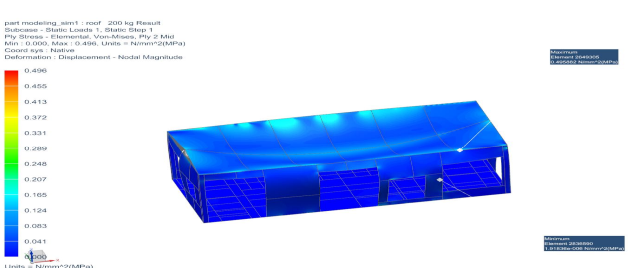


Fig: 14 Maximum ply-2stress of 0.496 MPa obtained on the plate

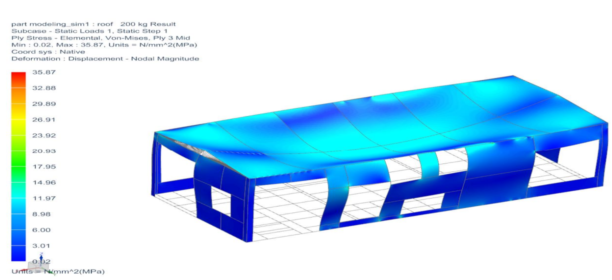


Fig: 15 Maximum ply-3 stress of 35.87 MPa obtained on the plate

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2) *Case 2: Floor Load and Roof Load*
a) Total structure weight 4667.95 KG
b) Roof load of 40000 N (200 kg /m2) applied on roof surface
c) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
d) Maximum displacement and stresses observed on plate and beam are as follows

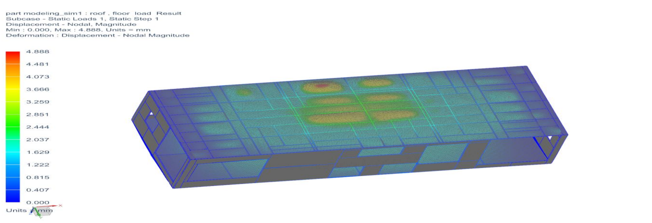

Fig: 16 Deformation of MAX: 4.88 mm on bottom plate

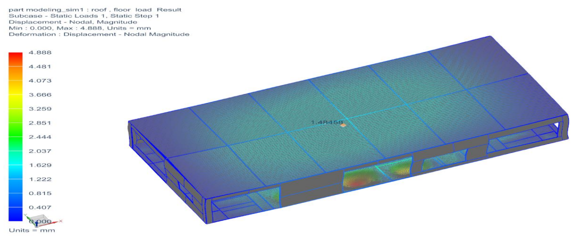

Fig: 17 Deformation of MAX: 1.48 mm on top plate

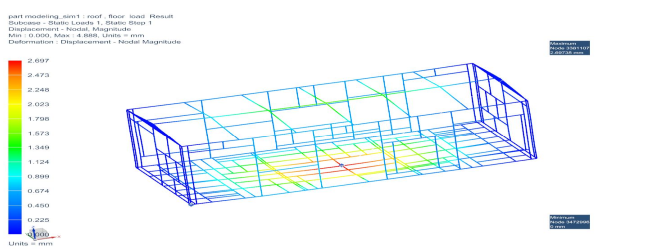

Fig :18 Deformation of MAX: 2.69 mm on the beam

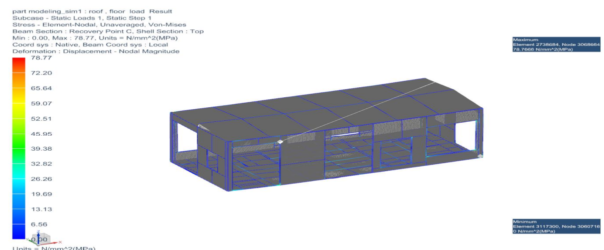

Fig: 19 Maximum stress of 78.77 MPa obtained on the beam

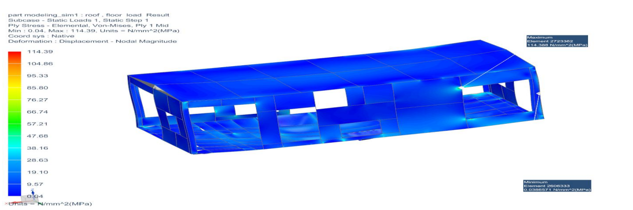

Fig: 20 Maximum ply-1 stress of 114.39 MPa obtained on the plate

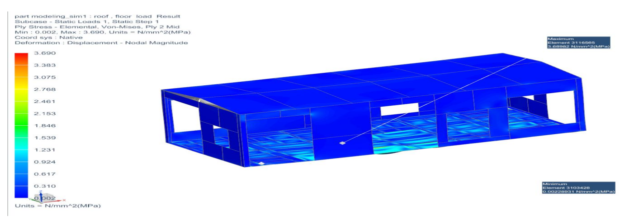

Fig: 21 Maximum ply-2 stress of 3.690 MPa obtained on the plate

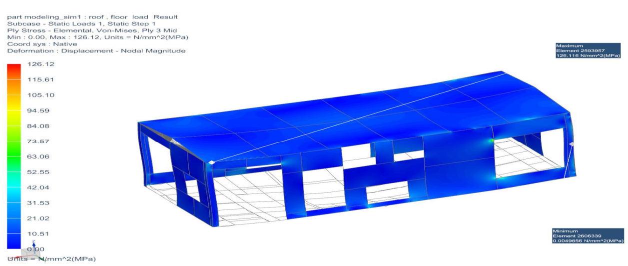

Fig: 22 Maximum ply-3 stress of 126.12 MPa obtained on the plate

3) *Case 3: Floor Load and Roof Load & Wind Load*
a) Total structure weight 4667.95 KG
b) Roof load of 40000 N (200 kg /m2) applied on roof surface
c) Wind load of 120 km/hr. has been applied on door side surface
d) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
e) Maximum displacement and stresses observed on plate and beam are as follows

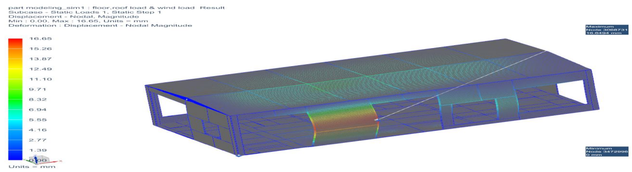

Fig: 23 Deformation of MAX: 16.65 mm on the side plate

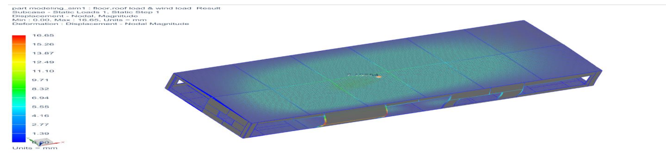

Fig: 24 Deformation of MAX: 7.13 mm on the top plate

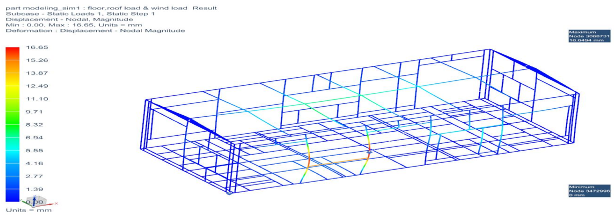

Fig: 25 Deformation of MAX: 16.65 mm on the beam

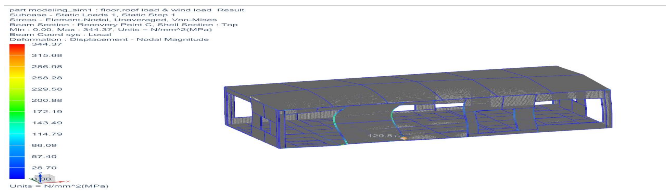

Fig: 26 Maximum stress of 129.81 MPa obtained on the beam

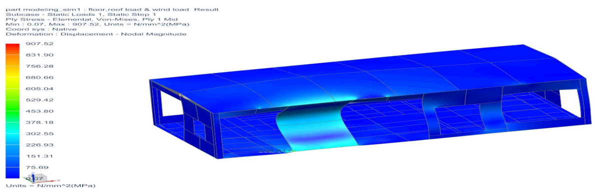

Fig: 27 Maximum ply-1 stress of 232.61 MPa obtained on the plat

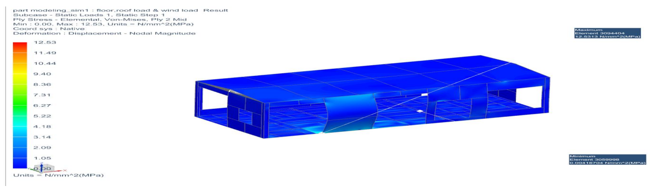

Fig28: Maximum ply-2 stress of 12.53 MPa obtained on the plate

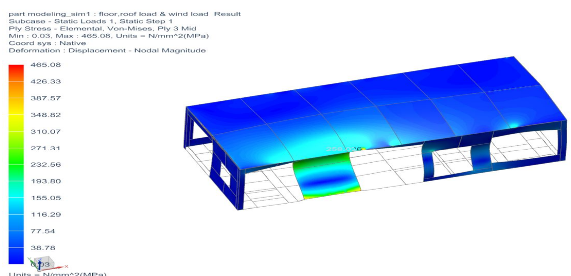

Fig: 29 Maximum ply-3 stress of 258.02 MPa obtained on the plate

4) *Case 4: Floor Load and Roof Load & Lifting Condition Boundary Condition*

a) Total structure weight 4667.95 KG
b) Roof load of 40000 N applied on roof surface
c) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
d) Maximum displacement and stresses observed on plate and beam are as follows

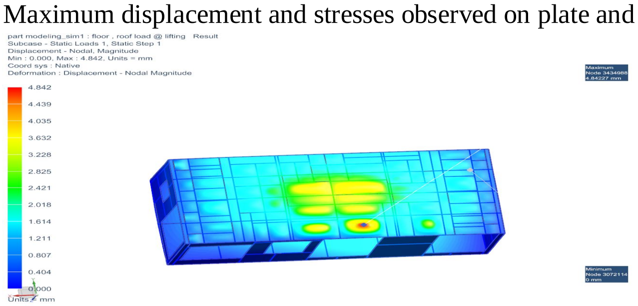

Fig: 30 Deformation of MAX:4.82 mm on the bottom plate

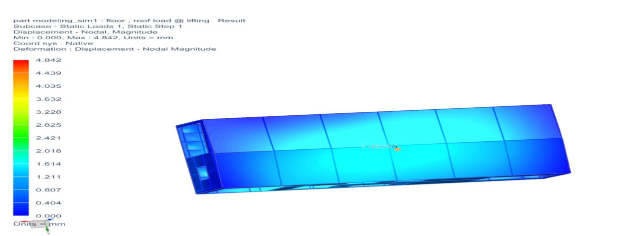

Fig:31 Deformation of MAX:1.46 mm on the top plate

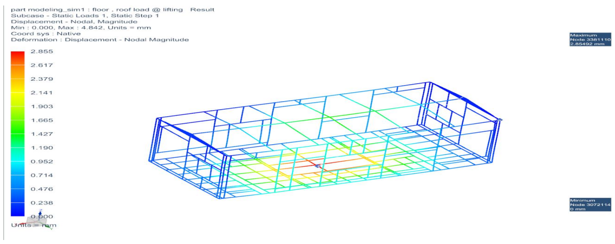

Fig: 32 Deformation of MAX:2.855 mm on beam

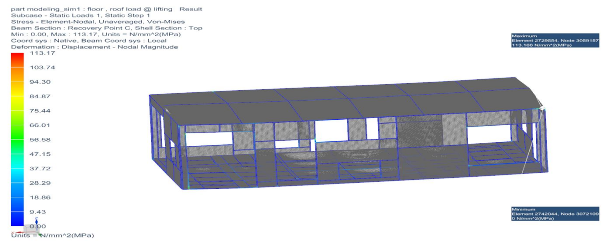

Fig: 33 Maximum stress of 113.17 MPa obtained on the beam

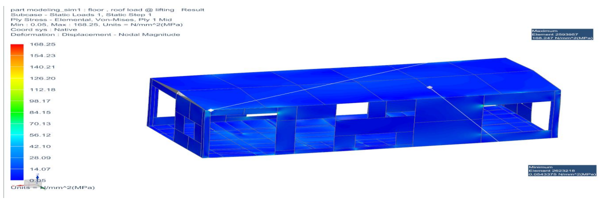

Fig: 34 Maximum ply-1 stress of 168.25MPa obtained on the plate

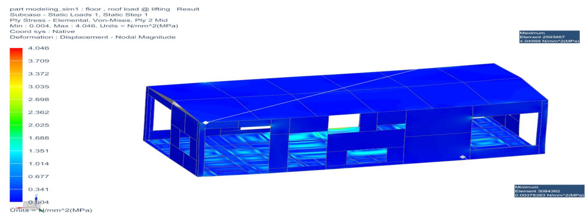

Fig: 35 Maximum ply-2 stress of 4.046 MPa obtained on the plate

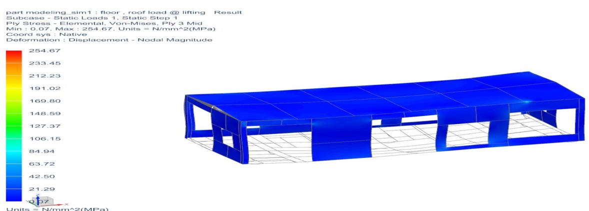

Fig: 36 Maximum ply-3stress 254.67 MPa obtained on the plate

a) Case 5: Floor Load and Roof Load With 3g Acceleration

i) Total structure weight 4667.95 KG

ii) Roof load of 40000 N (200 kg /m2) applied on roof surface

iii) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

iv) Maximum displacement and stresses observed on plate and beam are as follows

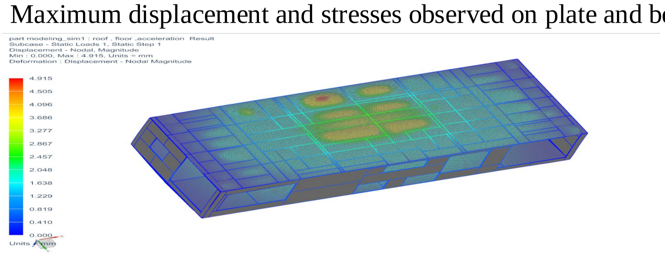

Fig: 37 Deformation of MAX: 4.915 mm on the bottom plate

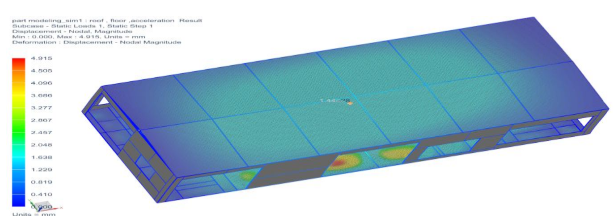

Fig: 38 Deformation of MAX: 1.44 mm on the top plate

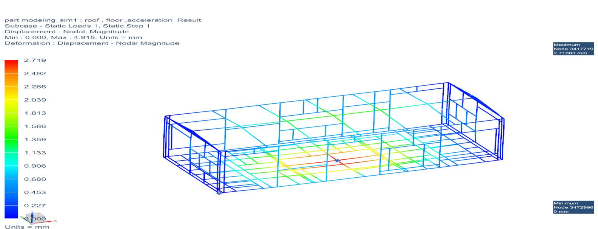

Fig: 39 Deformation of MAX: 2.719 mm on beam

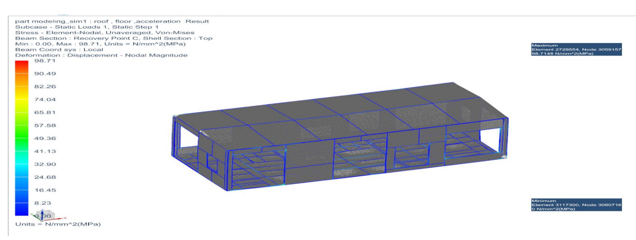

Fig: 40 Maximum stress of 98.71 MPa obtained on the beam

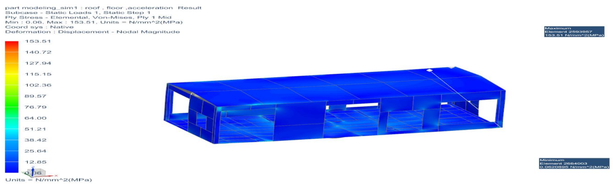

Fig: 41 Maximum ply-1 stress of 153.51 MPa obtained on the plate

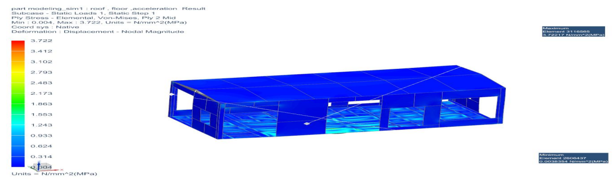

Fig: 42 Maximum ply-2 stress of 3.722 MPa obtained on the plat

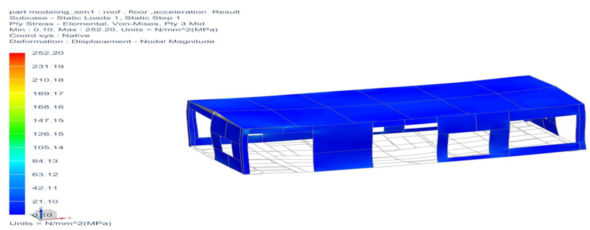

Fig: 43 Maximum ply-3 stress of 252.20 MPa obtained on the plate

J. Application of Loads (Steel and Foam and Aluminium)

1) Static Analysis

a) Total Structure Weight of 4667.95 Kg

b) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

c) Roof load of 200 kg /m2 and floor load 6000 Kg was applied on top and bottom surface of plate for both bottom fix and top fix condition

d) Acceleration of 3g in Z direction has been simulated as per ground condition

e) Wind load of 120 k mph in X direction has been simulated as per ground condition

K. Analysis Results

1) Case 1: only Floor load condition

a) Total structure weight 4667.95 KG

b) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

c) Maximum displacement and stresses observed on plate and beam are as follows

d) floor load 6000 Kg was applied on bottom(floor) surface of plate

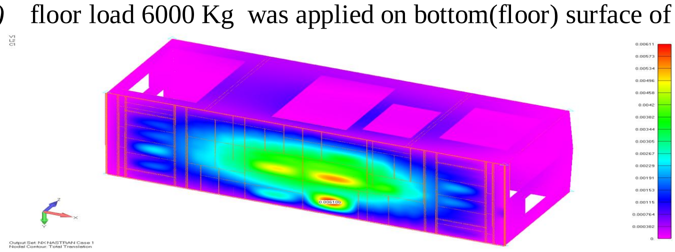

Fig: 44 Deformation of MAX: 6.11 mm on plate

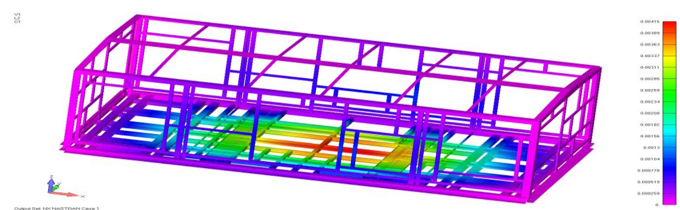

Fig: 45 Deformation of Max: 4.15 Mm On Beam

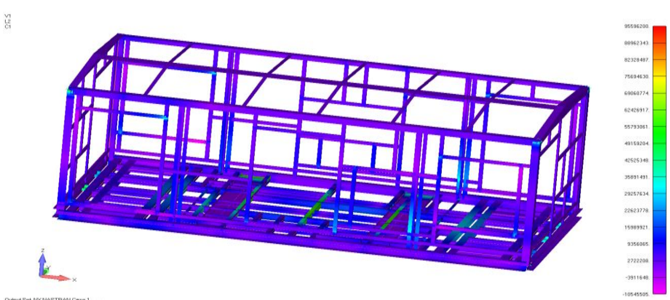

Fig: 46 Maximum Stress of 95.59mpa Obtained On Beam

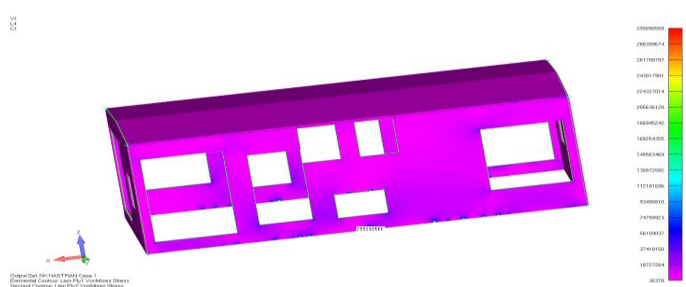

Fig: 47 Maximum Stress Of 143 Mpa Obtained On The Side Plate

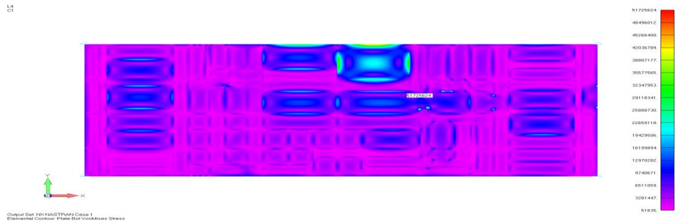

Fig: 48 Maximum Stress of 51.72 Mpa Obtained On the Bottom Plate

2) *Case 2: Floor Load and Roof Load*
a) Total structure weight 4667.95 KG
b) floor load 6000 Kg was applied on bottom(floor) surface of plate
c) Roof load of (200 kg /m2) applied on roof surface
d) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
e) Maximum displacement and stresses observed on plate and beam are as follows

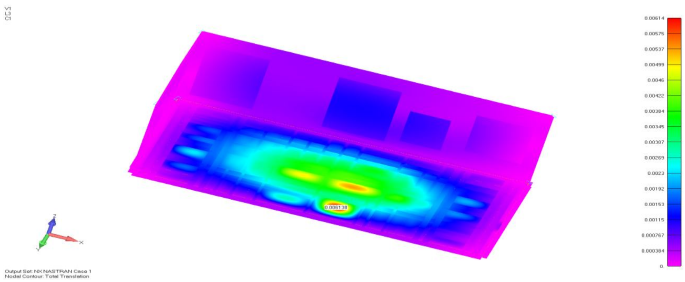

Fig: 49 Deformation of Max: 6.18 Mm On Bottom Plate

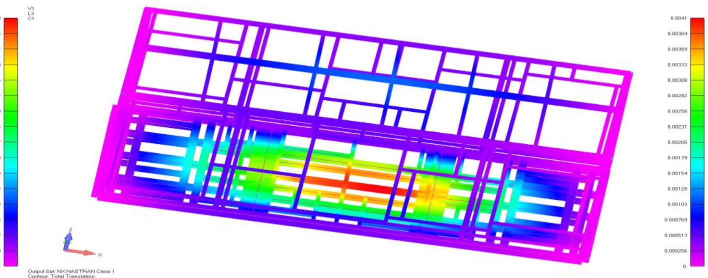

Fig: 50 Deformation of MAX: 4.1 mm on the beam

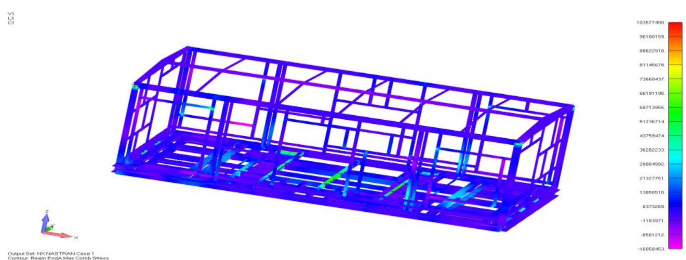

Fig: 51 Maximum stress of 103MPa obtained on beam

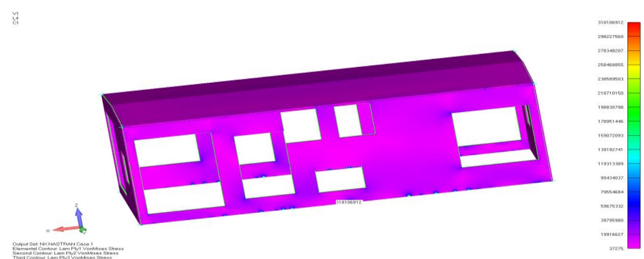

Fig: 52 Maximum stress of 192MPa obtained on the side plate

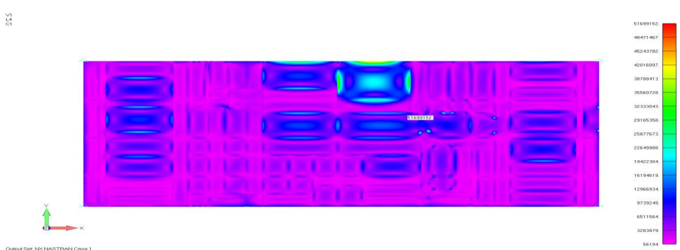

Fig:53 Maximum stress of 51.69 MPa obtained on the Bottom plate

3) *CASE 3: Floor Load And Roof Load & Wind Load*
a) Total structure weight 4667.95 KG
b) floor load 6000 Kg was applied on bottom(floor) surface of plat
c) Roof load of (200 kg /m2) applied on roof surface
d) Wind load of 120 km/hr. has been applied on door side surface
e) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

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f) Maximum displacement and stresses observed on plate and beam are as follows

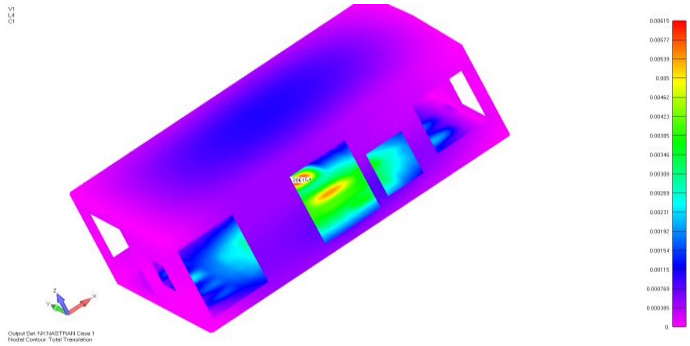

Fig: 54 Deformation of MAX: 6.15 mm on the plate

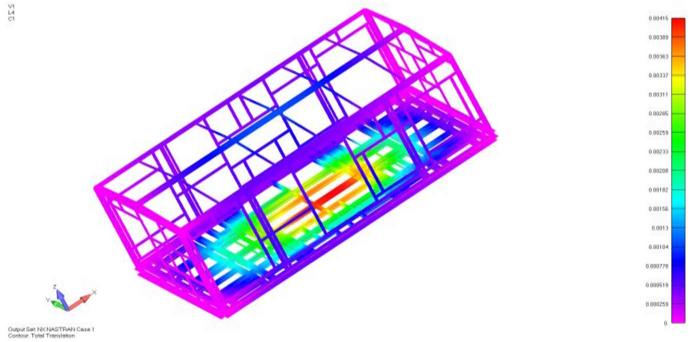

Fig: 55 Deformation of MAX: 4.15 mm on the beam

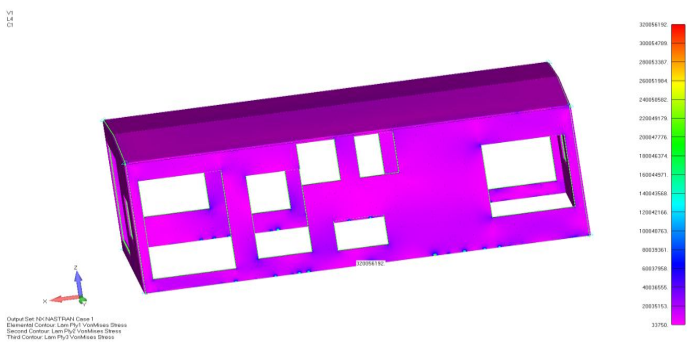

Fig:56 Maximum stress of 206 MPa obtained on the side plate

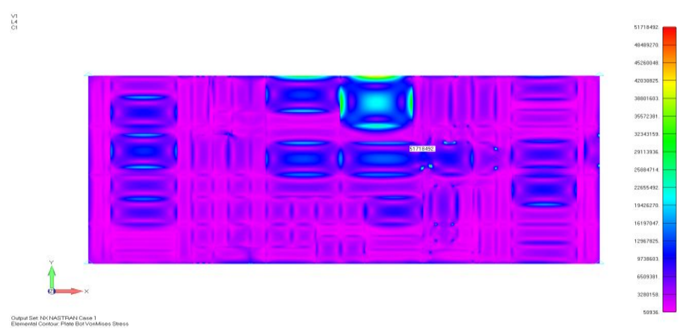

Fig: 57 Maximum stress of 51.7 MPa obtained on the Bottom plat

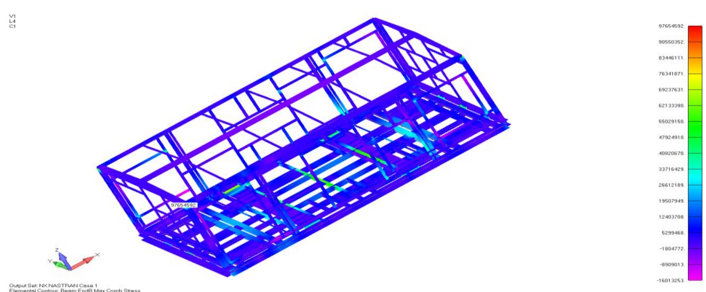

Fig: 58 Maximum stress of 97.65MPa obtained on beam

4) *Case 4: Floor Load, Roof Load @Lifting Condition Boundary Condition*

a) Total structure weight 4667.95 KG

b) Roof load of 200Kg/m2 applied on roof surface

c) Boundary condition: top 4 ISO corners wear fixed

d) Maximum displacement and stresses observed on plate and beam are as follows

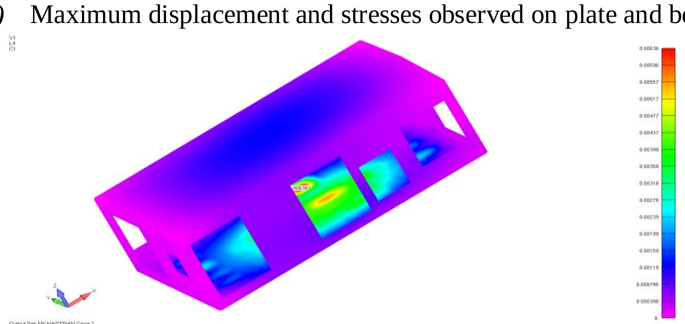

Fig: 59 Deformation of MAX: 6.36mm on the plate

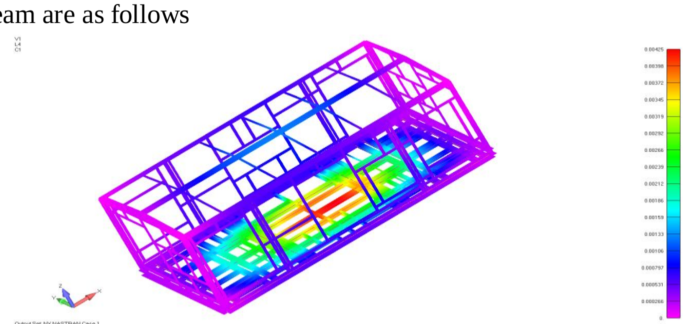

Fig: 60 Deformation of MAX: 4.25 mm on the beam

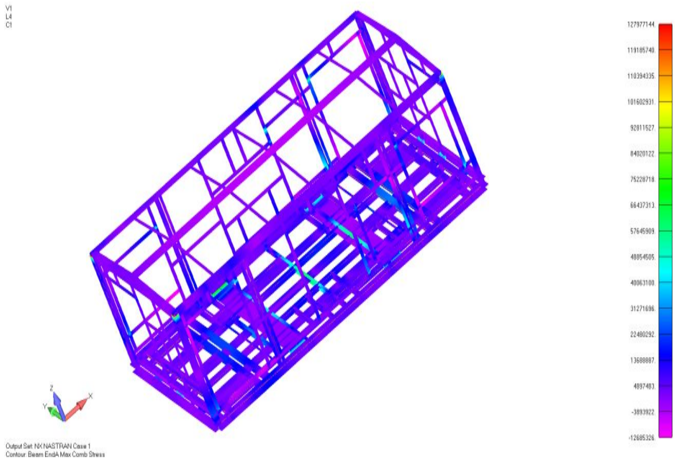

Fig:61 Maximum stress of 127.9 MPa obtained on the beam

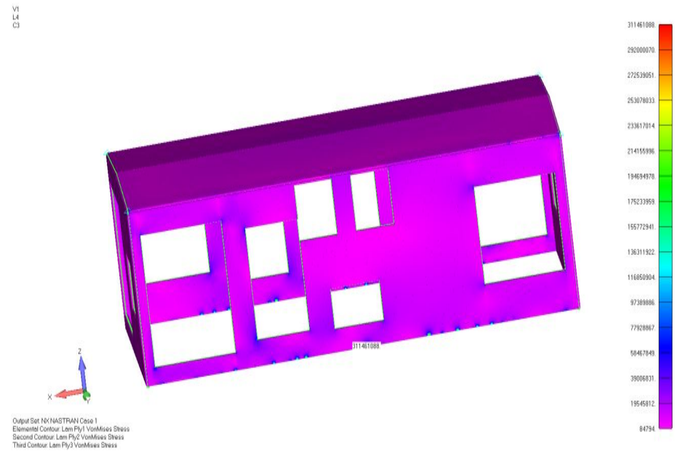

Fig: 62 Maximum stress of 149 MPa obtained on the side plate

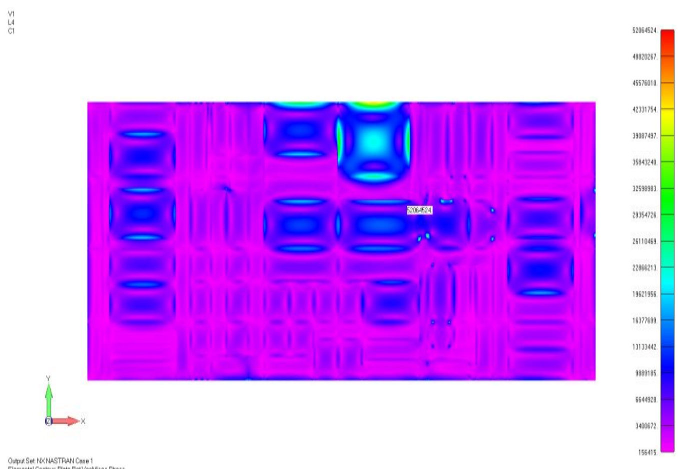

Fig: 63 Maximum stress of 52.06 MPa obtained on the Bottom plate

5) Case 5: Floor Load and Roof Load with 3g Acceleration

a) Total structure weight 4667.95 KG

b) Roof load of (200 kg /m2) applied on roof surface

c) Boundary condition: bottom 4 extreme top 4 ISO corners wear fixed

d) Maximum displacement and stresses observed on plate and beam are as follows

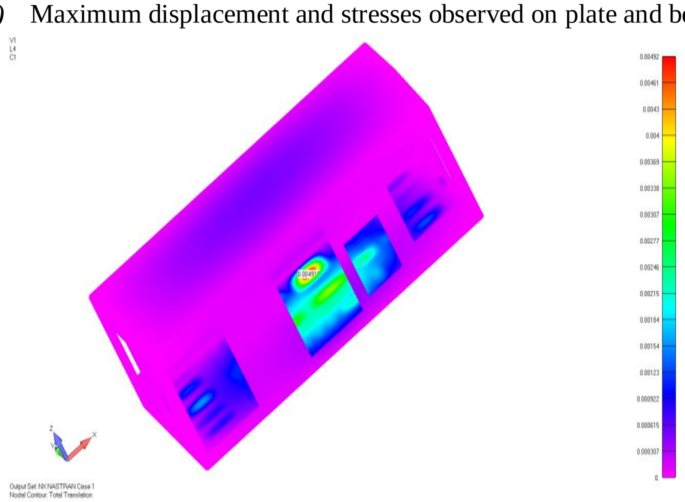

Fig: 64 Deformation of MAX: 4.92 mm on the bottom plate

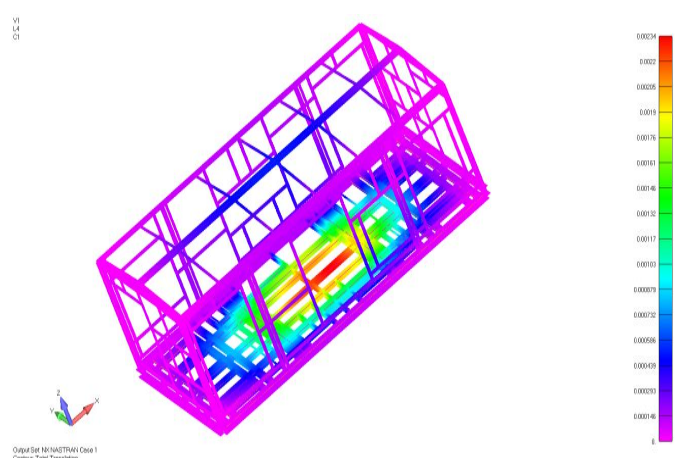

Fig: 65 Deformation of MAX: 2.34 mm on beam

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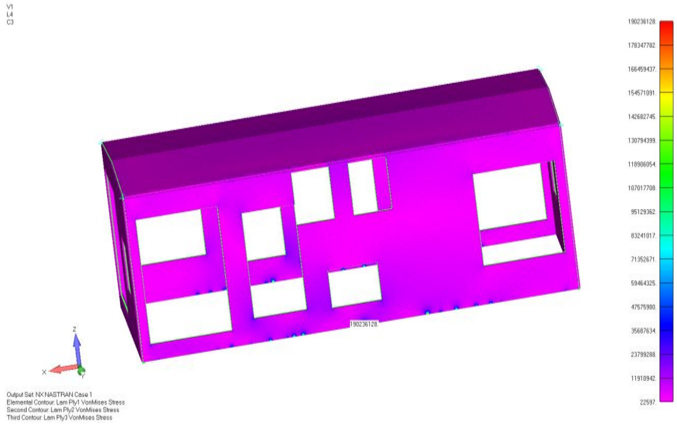

Fig: 66 Maximum stress of 190 MPa obtained on the side plate

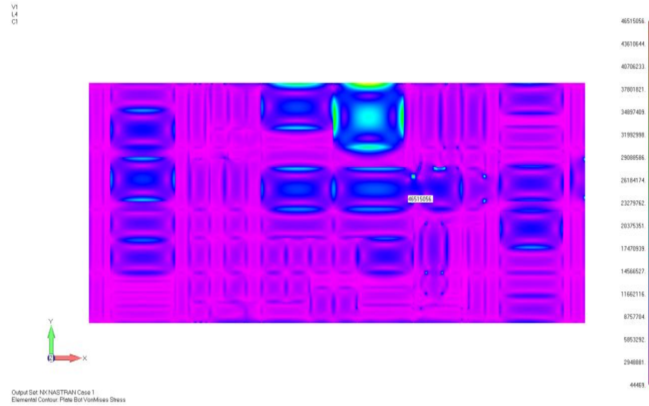

Fig: 67 Maximum stress of 46.51 MPa obtained on the Bottom plate

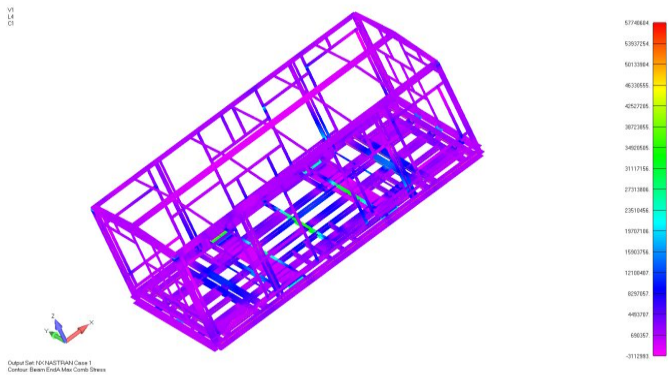

Fig: 68 Maximum stress of 57.7 MPa obtained on the beam

L. Application of Loads (Only Steel)

1) Static Analysis

a) TOTAL STRUCTURE WEIGHT OF 4667.95 KG

b) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

c) Roof load of 200 kg /m2 was applied on top surface of plate for both bottom fix and top fix condition

d) Acceleration of 3g in Z direction has been simulated as per ground condition

e) Wind load of 120 k mph in X direction has been simulated as per ground condition

2) Analysis Results

a) Total structure weight 4667.95 KG

b) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

c) Maximum displacement and stresses observed on plate and beam are as follows

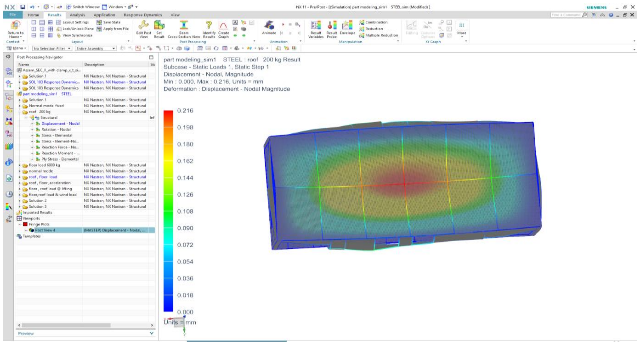

Fig: 69 Deformation of MAX: 0.216 mm on the plate

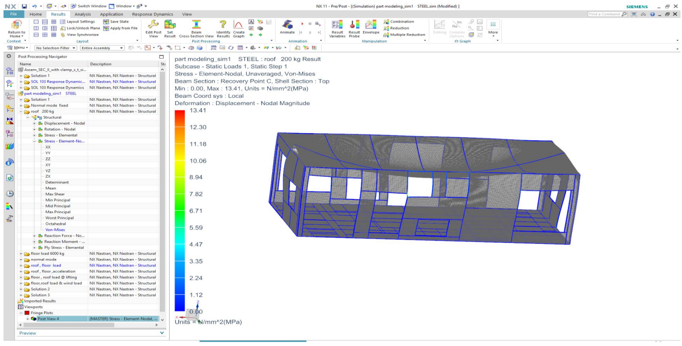

Fig: 70 Maximum stress of 13.41 MPa obtained on the beam

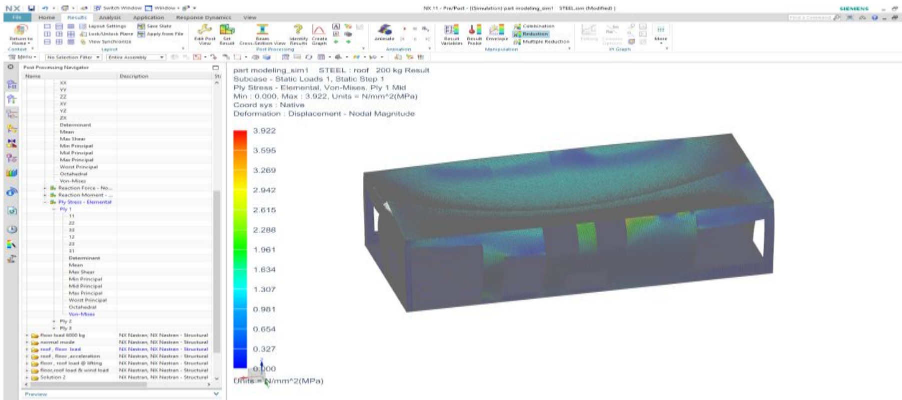

Fig: 71 Maximum stress of 3.92 MPa obtained on the plate

3) *Case 2: Floor Load and Roof Load*

a) Total structure weight 4667.95 kG

b) Roof load of 40000 N (200 kg /m2) applied on roof surface

c) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed

d) Maximum displacement and stresses observed on plate and beam are as follows

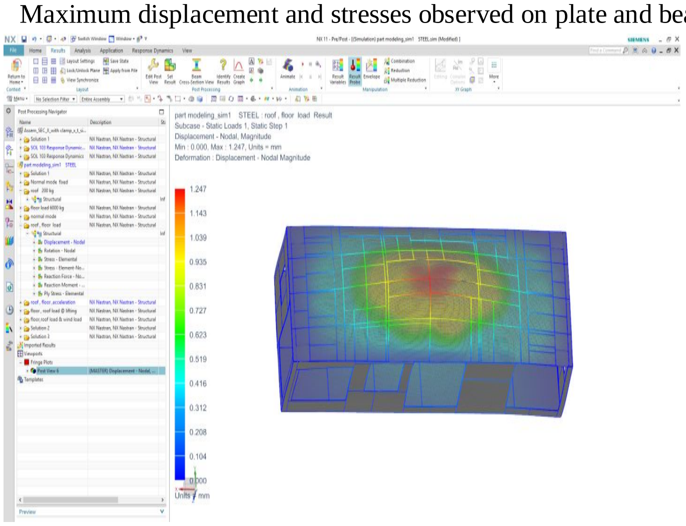

Fig:72 Deformation of MAX: 1.24 mm on the plate

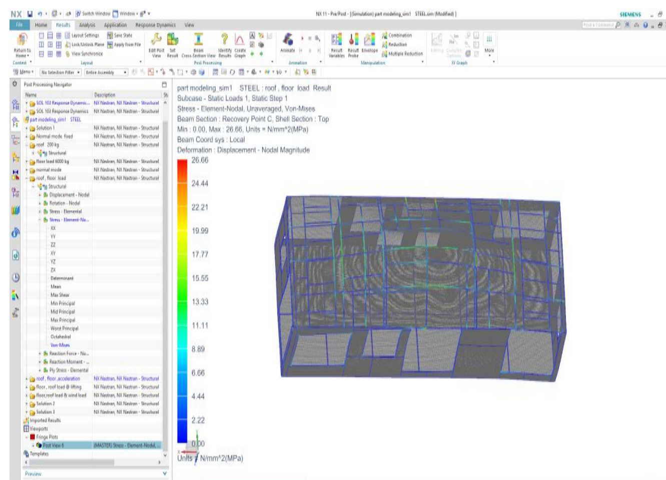

Fig: 73 Maximum stress of 26.66 MPa obtained on the beam

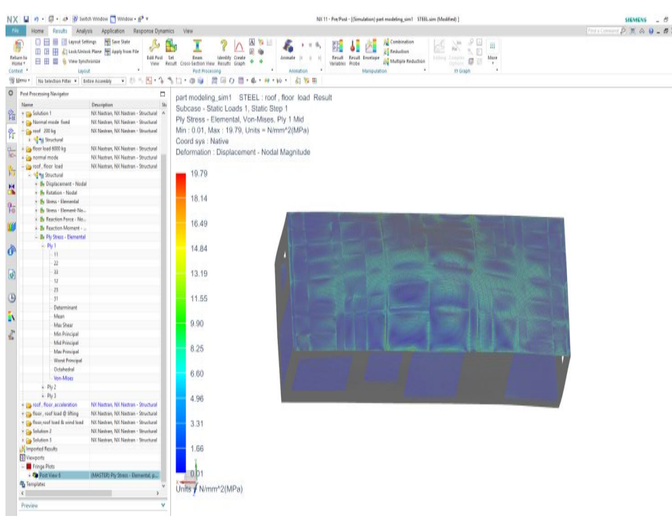

Fig:74 Maximum stress of 19.79 MPa obtained on the plate

4) *Case 3: Floor Load and Roof Load & Wind Load*
   a) Total structure weight 4667.95 KG
   b) Roof load of 40000 N (200 kg /m2) applied on roof surface
   c) Wind load of 120 km/hr. has been applied on door side surface
   d) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
   e) Maximum displacement and stresses observed on plate and beam are as follows

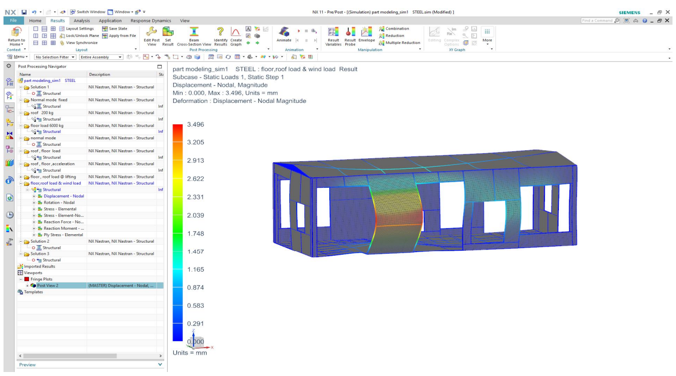

Fig:75 Deformation of MAX: 3.49 mm on the plate

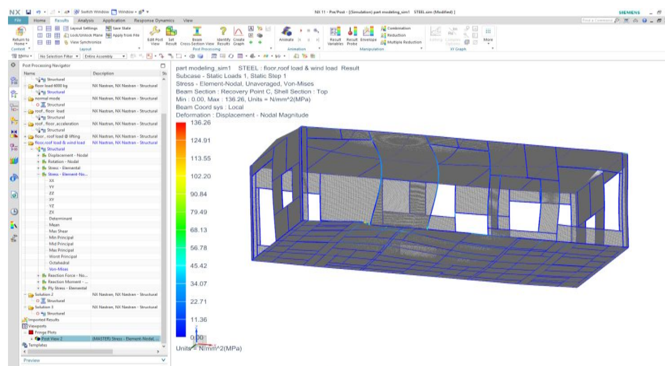

Fig: 76 Maximum stress of 136.26 MPa obtained on the beam

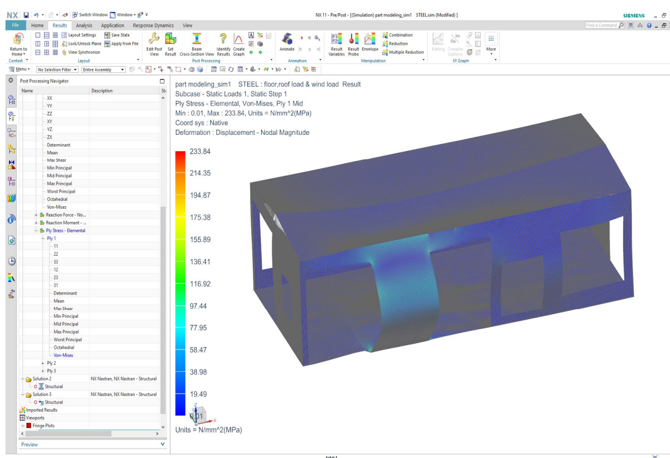

Fig: 77 Maximum stress of 233.84 MPa obtained on the plate

5) *Case 4: Floor Load and Roof Load & Lifting Condition Boundary Condition*
   a) Total structure weight 4667.95 KG
   b) Roof load of 40000 N applied on roof surface Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
   c) Maximum displacement and stresses observed on plate and beam are as follows

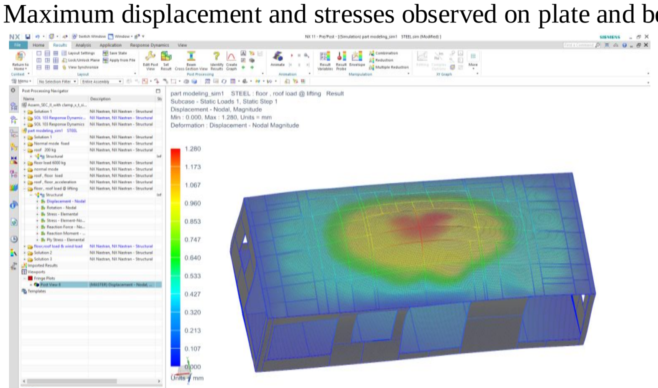

Fig :77 Deformation of MAX: 1.28 mm on the plate

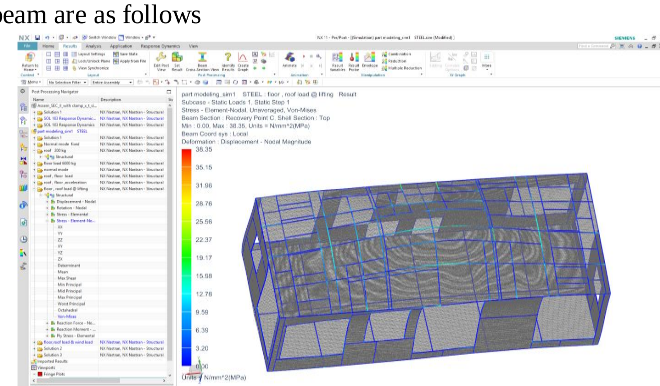

Fig: 78 Maximum stress of 38.35 MPa obtained on the beam

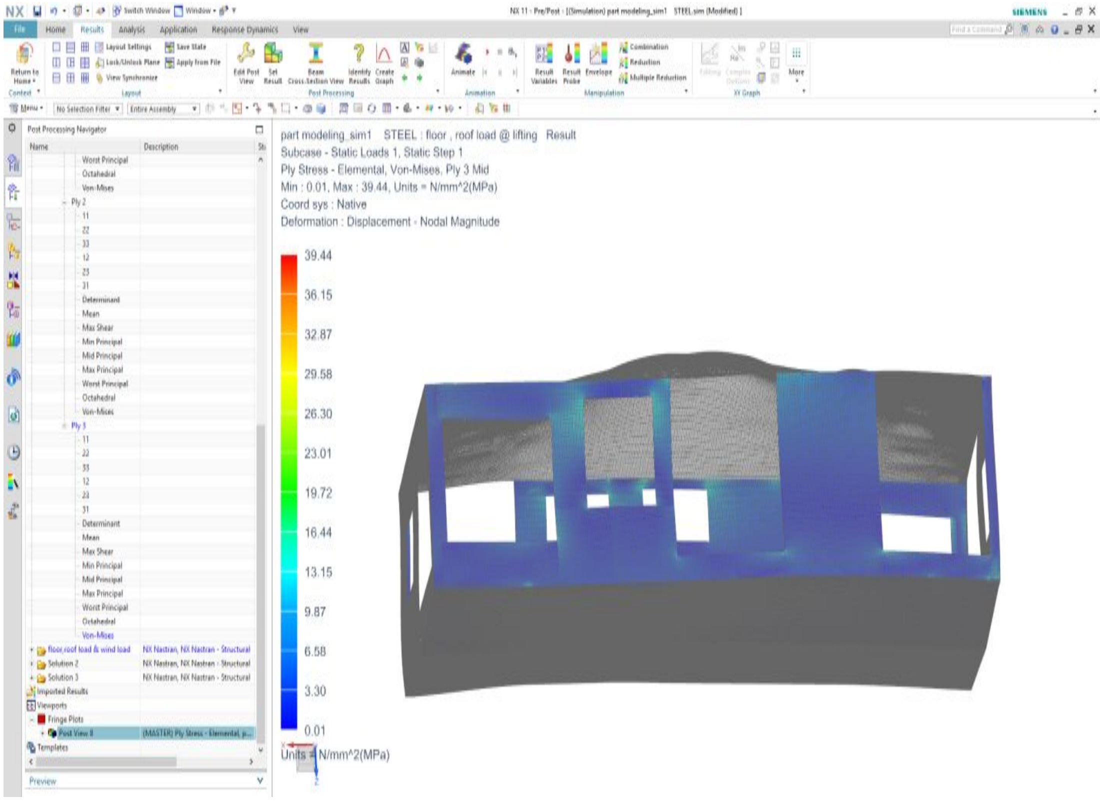

Fig: 79 Maximum stress of 39.44 MPa obtained on the plate

5) *Case 5: Floor Load and Roof Load With 3g Acceleration*
a) Total structure weight 4667.95 KG
b) Roof load of 40000 N (200 kg /m2) applied on roof surface
c) Boundary condition: bottom 4 ISO corners and top 4 ISO corners wear fixed
d) Maximum displacement and stresses observed on plate and beam are as follow

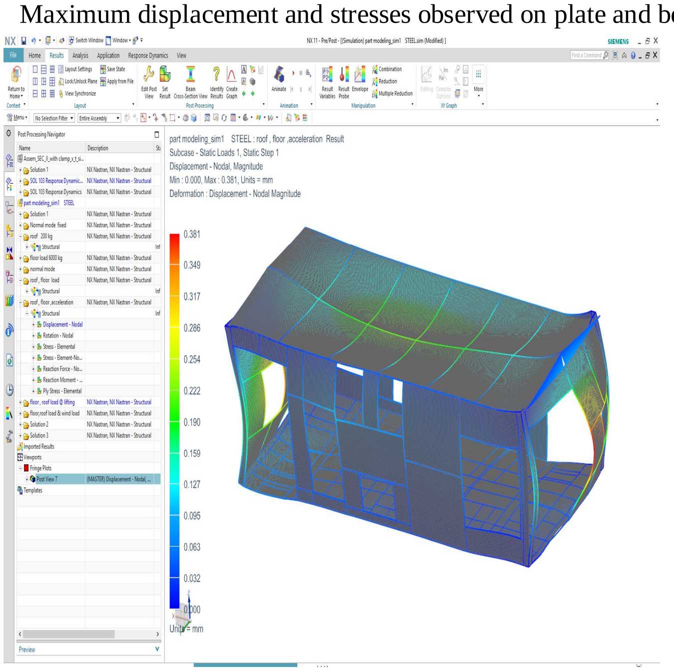

Fig: 80 Deformation of MAX: 0.38 mm on the plate

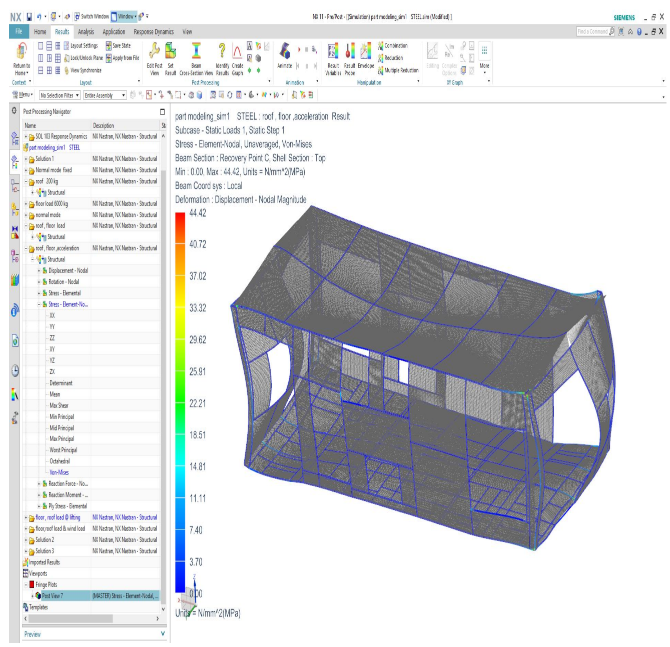

Fig: 81 Maximum stress of 44.42 MPa obtained on the beam

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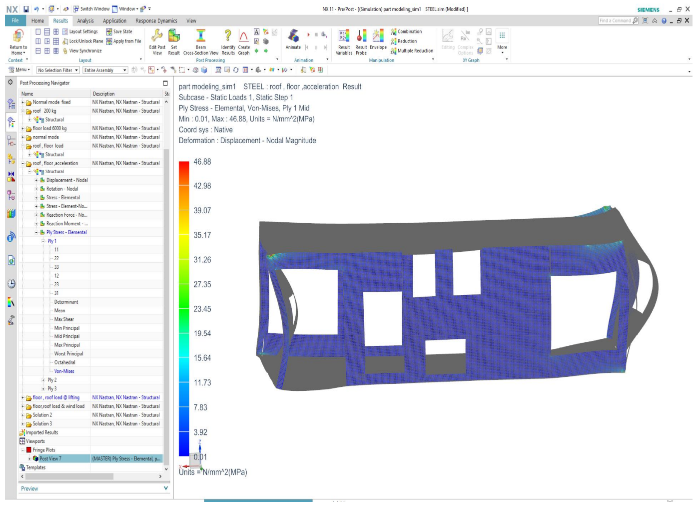

Fig: 82 Maximum stress of 46.88 MPa obtained on the plate

II. SUMMARY OF RESULTS

Table 3: RESULTS (STEEL AND FOAM)

S.N	Boundary Condition	Load condition	Deformation (mm)			Stress(MPa)		
			ON PLATE		on beam			
			TOP plate	Bottom plate		On Bottom plate	On beam	On side plate
1	8 ISO corners fixed	floor load condition	-	6.11	4.15	51.72	95.59	143
2	8 ISO corners fixed	floor load and Roof load condition	1.9	6.18	4.1	51.69	103	192
3	8 ISO corners fixed	Roof load and floor & Wind load condition	1.8	6.15	4.15	51.7	97.65	206
4	4ISO corners fixed	Lifting condition@ floor load and roof load	1.99	6.36	4.25	52.06	127.9	149
5	4 ISO corners fixed	Floor load and roof load with 3g acceleration	1.94	4.92	2.34	46.51	57.7	190

Table 4: RESULTS (ONELY STEEL)

S.N	boundary condition	Load condition	Deformation (mm)			Stress(MPa)		Ply stress MPa	
			ON PLATE		on beam	Mxm On plate-3	On beam	Ply-1	Ply-2
			TOP plate	Bottom plate					
1	8 ISO corners fixed	Roof load condition	1.318	-	1.318	35.87	32.59	27.75	0.496
2	8 ISO corners fixed	Roof load and floor load condition	1.48	4.88	2.69	126.12	78.77	114.39	3.690
3	8 ISO corners fixed	Roof load and floor & Wind load condition	7.13	16.65	16.65	258.02	124.81	232.61	12.53
4	4 ISO corners fixed	Lifting condition@ floor load and roof load	1.46	4.82	2.85	254.27	113.17	168.25	4.046

5	4 ISO corners fixed	Floor load and roof load with 3g acceleration	1.44	4.915	2.71	252.20	98.71	153.51	3.72

Table 5: RESULTS (STEEL AND FOAM AND ALUMINIUM)

`S.N	boundary condition	Load condition	Deformation (mm)	Stress(MPa)	
				Mxm On plate	On beam
1	8 ISO corners fixed	Roof load condition	0.216	3.97	13.41
2	8 ISO corners fixed	Roof load and floor load condition	1.24	19.15	26.66
3	8 ISO corners fixed	Roof load and floor & Wind load condition	3.49	233.84	136.26
4	4 ISO corners fixed	Lifting condition@ floor load and roof load	1.28	39.44	38.35
5	4 ISO corners fixed	Floor load and roof load with 3g acceleration	0.38	46.88	44.42

III. CONCLUSION

Shelter is analyzed for different given load conditions.
Shelter is analyzed for different materials.
Maximum deflection is found to be within the permissible limits of the materials for all load condition.
The maximum stresses obtained from FE analysis are well within the allowable limits of steel and foam for all load condition.
A full proofing against water seepage and extreme weather conditions given enhanced protection to goods, store in the facility thus reducing the cost related to product failure or rejection.
The advantages are more safety, high durability, resistance to decay and increased design flexibility. The Innovative roofing system is moderately economical.
Hence the shelter is safe with a factor of safety more than the 1.5 for all load case considered above.

IV. ACKNOWLEDGEMENT

I wish to take this opportunity to express my deep gratitude to all the people who have extended their cooperation in various ways during the project work. It is my pleasure to acknowledge the help of those individuals. I would like to thank my external project guide .s.y.veerabhadrareddy, sc "e" and A. Kartik, sc “c” of control system laboratory at research center imarat for his guidance and help throughout the development of the project work by providing with the required information. It was only due to his guidance, cooperation and encouragement that i was able to realize the project. I am also thankful to mr. Mrinalchandra and mr.srikanth and mr. Naresh who’s valuable and timely suggestions helped me a lot

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