International Journal of Research
Available at https://pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 22
November 2018

Finite Element Analysis of Landing Grid Ship Assembly in Vertical Loading Conditions

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***Abstract**:*

The parts considered for analysis are the Grid and the grid support, which ismounted on the upper deck of the ship. Ship deck is meshed using shell mesh of shell 63. Support pins between the grid and the grid support are modeled as tapered beam of circular cross section as they have different diameter at ends. The support pins are modeled using beam44 element type. The grid is meshed with tetrahedral elements solid 45 and the grid support is meshed with hexahedral elements solid 45.The grid assembly is to be analyzed for vertical loading conditions and to calculate the stress and the deformation by using FEA Methods.

Keywords: *Shell Elements, FEA*

1. Introduction

A shipboard equipment or structure when subjected to a specified shock motion will experience stresses and deflection in excess of those present under operating conditions.
The first step in the evaluation process involves representing the item under consideration by a mathematical model . The parts considered for analysis are the Grid and the grid support, which is mounted on the upper deck of the ship. The Grid is fastened to the grid support assembly with the help of supporting pins with varying cross sections. The upper deck is modeled as a square with dimensions of twice the diameter of the grid . The bottom stiffeners are also modeled, since it contributes to both stiffness and strength of the system. The main objective of the paper is to analysis the Grid and the grid support, which is mounted on the upper deck of the ship assembly using FE Method

2. FINITE ELEMENT MODEL

2.1 Grid Assembly descriptions

The Fig. 1 shows the half cross-sectional view of the grid assembly. The parts considered for analysis are the Grid and the grid support, which is mounted on the upper deck of the ship. The Grid is fastened to the grid support assembly with the help of supporting pins with varying cross sections.
The upper deck is modeled as a square with dimensions of twice the diameter of the grid.The bottom stiffeners are also modeled, since it contributes to both stiffness and strength of the system. The different elements types used to build the grid assembly is shown in table 1.

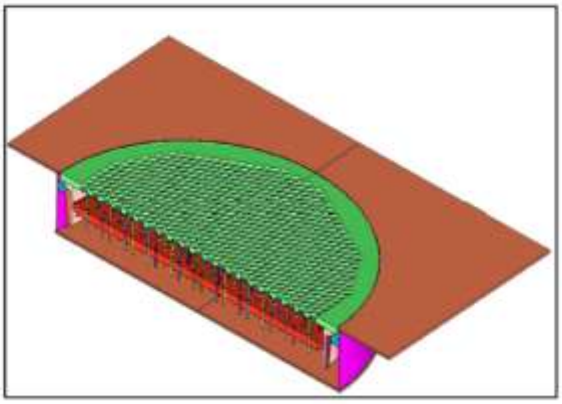

Figure 1 3D Half Cross-sectional view of grid assembly

S. No	Part	Type of Element
1	Grid	Solid 45
2	Support pin	Beam44
3	Grid support assembly	Solid45
4	Ship upper deck	Shell63
5	Bottom Stiffeners	Shell63

Table 1 Types of Elements used

2.2 Element Description:

SHELL63 has both bending and membrane capabilities. Both in-plane and normal loads are permitted. The element has six degrees of freedom at each node: translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z-axes. Stress stiffening and large deflection capabilities are included .

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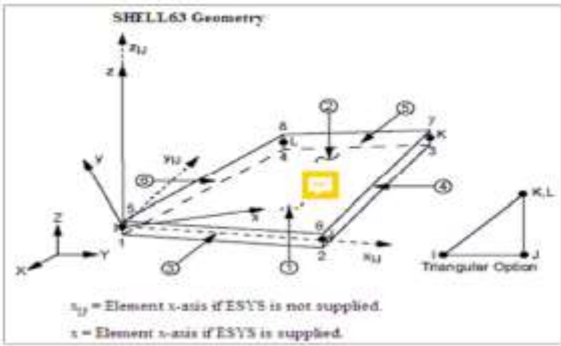

Figure 2 Shell 63 Element Geometry

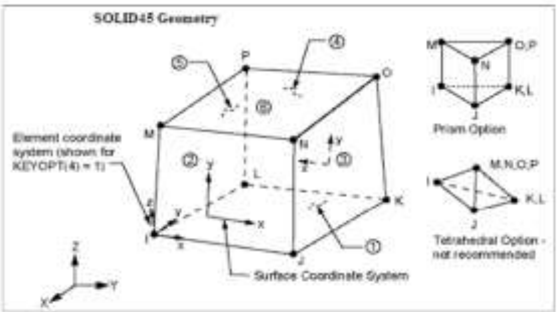

Figure 3 Solid 45 element geometry

SOLID45 is used for the 3-D modeling of solid structures. Eight nodes define the element, each having three degrees of freedom at each node: a translation in the nodal x, y, and z directions. The element has plasticity, creep, swelling, stress stiffening, large deflection, and large strain capabilities.

BEAM44 is a uniaxial element with tension, compression, torsion, and bending capabilities. The element has six degrees of freedom at each node: translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z-axes. This element allows a Finite Element Analysis of landing grid Ship Assembly For 6.5 Tonnes in Vertical Loading conditions different unsymmetrical geometry at each end and permits the end nodes to be offset from the centroidal axis of the beam.

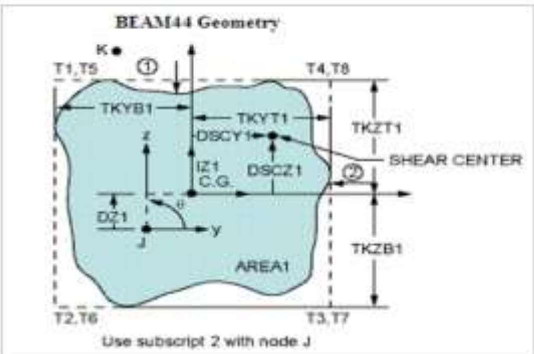

Figure 4 Beam 44 Element Geometry

2.3 finite element modeling description

The Fig.5 shows the cut section of the meshed model of the grid assembly. Appropriate elements are used to mesh the model and the details of elements used are listed in the Table 1. Also, the element used to mesh is marked in parenthesis in the below Fig.5 along with their parts

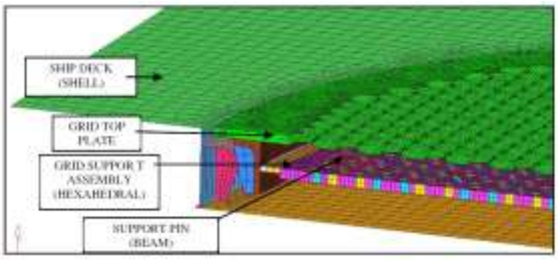

Figure 5 Details of the Finite Element mesh

2.4 Boundary Conditions

The shock load is primarily caused due to under ater explosion. The shock load is transmitted to grid through the ship deck. The grid is mounted on the ship deck which intern is mounted on the ship hull. The deck is modeled as per details made available by the customer. The deck is modeled as a square with dimension of twice the diameter of the grid. The upper deck outer surfaces along with support tiffeners are also constrained in all degrees of freedom.

Fig.6. Shows the boundary conditions applied to the grid assembly as a whole. The exterior ends of the upper deck are constraint for all degrees of freedom along with the sides of the bottom tiffeners as shown in Fig.6.the material properties are considered as given in Table.2

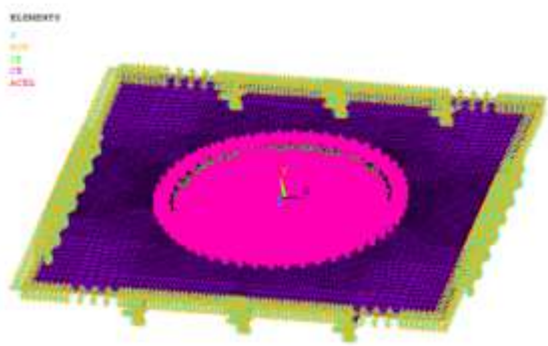

Figure 6 Boundary condition of the structure under analysis

art Material Name Young's modulus Poisson	Part Material Name Young's modulus Poisson	Part Material Name Young's modulus Poisson	Part Material Name Young's modulus Poisson
Grid	EN 10088/10028-1.4418 - X4 Cr Ni Mo 16-5-1	2.1 e5 N/mm2	0.3
Other structures	EN 10137-2 / ASTM 516	2.1e5 N/mm2	0.3

Table 2 Material Properties for all grid Assembly

3.RESULT AND CONCLUSIONS

The mathematical model used to define the equipment system is the method to analyze the system for shock performance can be demonstrated. The modal system analysis of the system generates dynamic response characteristic (frequencies and mode shapes). Care has been taken to check the closely spaces modes and the results are given in Table3 and Table. 4.

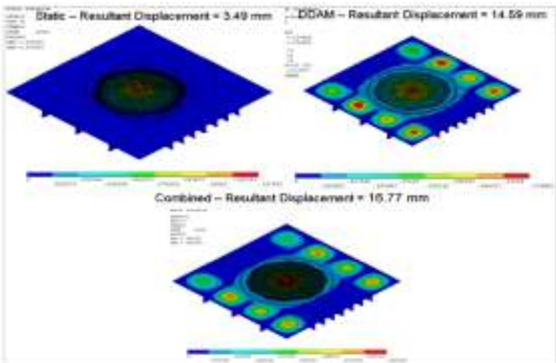

Figure 7 Total Displacement

Finite Element Analysis of landing grid Ship Assembly For 6.5 Tonnes in Vertical Loading conditions

The maximum vertical displacement in the operating condition at the grid (6.5 tonnes) is 3.49 mm, also the total von misses stresses induced in the ship assembly is around 790 N/mm2

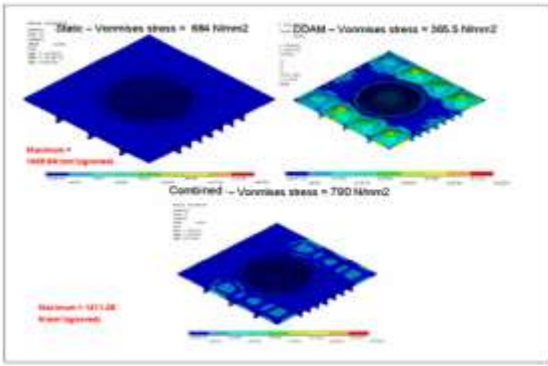

Figure 8 Total Vonmises stresses

MODE	FREQUENCY(Hz)
1	38.01
2	2 51.6382
3	3 51.6384
4	4 57.1756
5	5 57.1771
6	6 62.4791
7	7 62.4926
8	8 63.3193
9	9 63.5714
10	10 70.2909
11	11 74.3401
12	12 77.9668
13	13 100.806
14	14 100.926
15	15 08.609

4.CONCLUSION

The combined stresses and the maximum occurs at the grid top and is 114580 PSI (790 N/mm2), and is found to be safe limits. The yield of the material is 116030.2 PSI (800 N/mm2). The high stresses are a very localized and are within 10 % of the effective area as allowable as per section 6.1.2 of chapter 6 (Allowable stress criteria).Based on above observation the Landing grid is expected to withstand the operating load of 6.5 tonnes and shock loads as mentioned in the standards.

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