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Response Spectrum and Impulse Excitation Analysis of DMAP Container

KEYWORDS: DMAP Container, Modeling, Meshing ,Stress Analysis.

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ABSTRACT *In the present work a DMAP (Dynamic Mounting Table for Analog Panels) container is modeled and testing for structural safety. Structural safety is anlaysed for three conditions. Initially static analysis is carried out with computer panel weight of 60kg mounted on the top plate through RBE3 element using a mass element. Later spectrum analysis based on single point response spectrum is analysed in the range of 4Hz to 32 Hz. A triangular shock pulse of 0.016 time duration is applied in the transient domain as per MIL standards with 30'g' acceleration loads. The results shows considerable stress development in the problem with a factor of safety of 2. Finally modal analysis is carried out to find resonant condition of the problem. The obtained frequencies shows complete safety of the problem.*

i. introduction

Vibrations are the most important aspect of structural design. From Human point of view vibrations found use in musical instruments and in segregation equipment like rice mills grade mills etc. But in general it is disastrous for machine structural integrity. Vibration became an important subject in structural dynamics. Due to the advances in structural engineering, it is possible to estimate vibration behavior of the object using Finite element packages.

Engineering Industry is fast growing in transportation of goods and for military applications from one place to other. Vehicles and ships of varied size and shape are designed based on transport requirements and comfort. For military applications submarines are built to take the dynamic loads arising from ocean loads and requirements. Normal structures on the road are maximum subjected to 6'g' loads. But the aero structures and submarine applications are subjected to many times of these 'g' loads. Dampers plays important role in absorbing this shock energy and prevents the members from heavy displacements and resulting higher stresses.

II.Problem definition & Methodology

Problem definition

The DMAP table used for computer panels placement in the submarine application is analysed for structural safety. The box type geometry is ribbed with stiffeners to increase the strength. The bottom of the structure is supported with dampers to reduce the vibration. Static, Spectrum and Shock response analysis of Dynamic Mounting table for Analog Panels(DMAP) is the main definition of the problem.

The objectives include

- Geometrical Modeling of the Dmap Table
- Meshing
- Static Analysis
- Spectrum Analysis
- Shock Response Analysis

Methodology

- Initial geometrical modeling
- Shell and solid meshing based on the thickness of the parts
- Connecting the different members using coupling and constraint equations
- Application of boundary conditions for initial static analy sis
- Analysis for Modal conditions
- Analysis for spectrum analysis
- Analysis for shock response

Geometric Model of the DMAP Container

Initially the geometry is built in cad modeling software for analysis. The modeled geometry is imported into Hypermesh for good quality meshing. The quality of mesh is checked for aspect ratio, warpage, skew angle and jacobian. A jacobian of 0.7 is maintained. The meshed model is imported to Ansys in 'inp' file format for further analysis. Total computer panel weight of 60 kg is applied on the top plate by a mass element connected to surround nodes by RBE3 element.

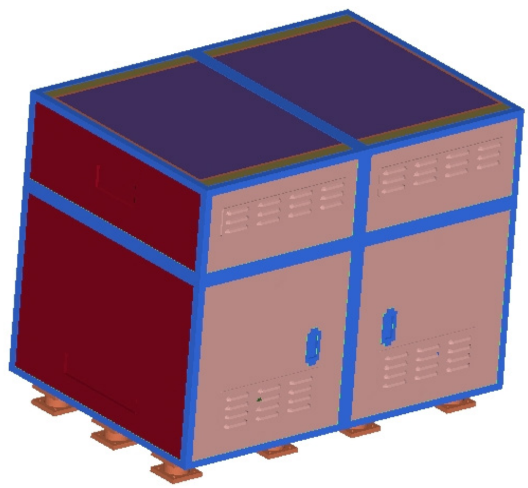

Fig 1 Geometric Model of the DMAP Container

Material Properties

Material	T7075-T6(Aluminum Alloy)
Density , ρ	2850kg/m^3
Yield Strength,σ_y	490N/mm^2
Allowable Stress,	392N/mm^2

III.RESULTS

The DMAP table has been analysed for static, spectrum and shock loads. The safety of the structure is important for doing this analysis. Ribbing is done to improve the strength of the problem.

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i) Static Analysis

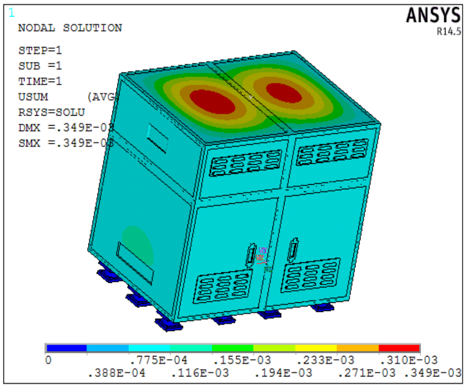

Fig 2 Deflection for Static Load

The figure 2 shows maximum deflection of 0.349mm or 0.000349m. Maximum displacement location shown by red colour on the top plate.

ii)Spectrum Result

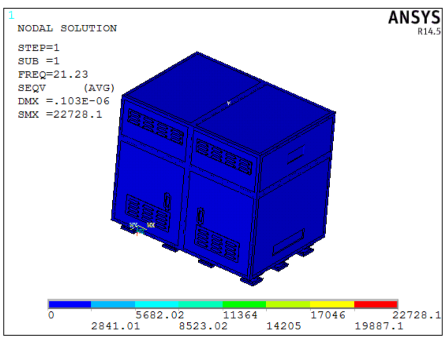

Fig 3 vonmises Stress

The figure 3 shows vonmises stress in the DMAP table due to spectrum data. The resultant stresses are negligible compared to the allowable stress of the members.

iii)Shock Spectrum Analysis

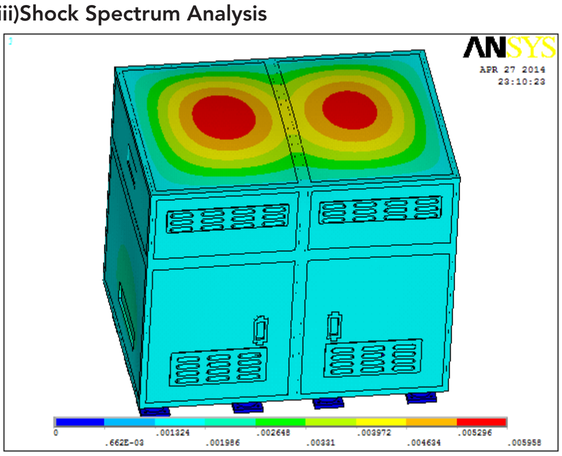

Fig 4 Maximum Deflection plot

The figure 4 shows Maximum deflection in the problem is around 5.958mm(0.005958m). The deflection is with in the allowable limits of the problem.

iv)Modal Analysis

Further Modal analysis is carried out to check the resonant condition of the problem. Resonance is a undesirable character for the structure, as it creates un-necessary deformation.

Resonance will takes place in the system when applied frequency match with natural frequency of the system. The objective of this analysis to find natural frequencies and mode shapes. The mode shapes are useful to find the weak regions in the problem which can be improved later. Also it gives idea for giving constraints for the problem. For a rigid system the natural frequencies should not match with operations frequencies and natural frequencies should be as high as possible. The analysis results are as follows.

Table 1

Set NO	Frequency (Hz)
1	21.23
2	38.548
3	50.987
4	55.936
5	57.414

IV.conclusion

The DMAP table used for computer panels placement in the submarine application is analysed for structural safety. The summary of analysis is as follows.

- The initial static analysis results shows stresses generation is 58Mpa and deflection is 0.3mm. Both are with in the allowble limits of the material. So structure is safe for the given static load.
- Further analysis is done for spectrum or base vibration loads based on Single point Response Spectrum. The results shows minimum stress development or no effect of spectrum load on the structural stability of the problem
- Shock analysis is carried out with a single triangular pulse in the transient domain. The load is applied through time specifications and response is obtained.
- The stress and deflection corresponding to maximum response is obtained and results are presented for individual components. The results shows effect of shock load on the DMAP table and the stress levels are upto 120Mpa. But this stress is also less then the allowable stress of the problem. But any increase of load will reduce the factor of safety in the problem.
- Further model analysis is carried out to find possible resonant condition. The base vibration frequency is not matching with the natural frequency of the system. So no possibility of resonance and the DMAP table is free from resonance conditions.

FUTURE SCOPE :

- The DMAP table can be design optimized
- Composite usage can be checked for still better strength
- Topology optimization can be carried out
- Possible thermal effects can be considered
- Material change can be considered for better strength
- Further MIL standards can be applied.

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