Response Spectrum and Impulse Excitation Analysis of DMAP Container

**Keywords**
- DMAP Container, Modeling, Meshing, Stress Analysis

**Abstract**
In the present work a DMAP (Dynamic Mounting Table for Analog Panels) container is modeled and tested for structural safety. Structural safety is analyzed 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 is based on single point response spectrum is analyzed in the range of 4Hz to 32Hz. A triangular shock pulse of 0.016 time duration is applied in the transient domain as per MIL standards with 30g acceleration loads. The results show 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 show complete safety of the problem.

**I. Introduction**
Vibrations are the most important aspect of structural design. From a 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.

**II. Problem definition & Methodology**

**Problem definition**
The DMAP table used for computer panels placement in the submarine application is analyzed 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 analysis
- Analysis for Modal conditions
- Analysis for spectrum analysis

**Fig 1 Geometric Model of the DMAP Container**

**Material Properties**
- Material: T7075-T6 (Aluminum Alloy)
- Density, $\rho = 2850$ kg/m$^3$
- Yield Strength, $\sigma_y = 490$ N/mm$^2$
- Allowable Stress, $392$ N/mm$^2$

**III. Results**
The DMAP table has been analyzed 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.
i) Static Analysis

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

The figure 3 shows von misses stress in the problem due to spectrum data. The resultant stresses are negligible compared to the allowable stress of the members.

iii) Shock Spectrum Analysis

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

iv) Modal Analysis

Further Modal analysis is carried out to find the resonant condition of the problem. Resonance is a undesirable character for the structure, as it creates un-necessary deformation. Resonance will take 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>
<thead>
<tr>
<th>Set NO</th>
<th>Frequency (Hz)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>21.23</td>
</tr>
<tr>
<td>2</td>
<td>38.548</td>
</tr>
<tr>
<td>3</td>
<td>50.987</td>
</tr>
<tr>
<td>4</td>
<td>55.936</td>
</tr>
<tr>
<td>5</td>
<td>57.414</td>
</tr>
</tbody>
</table>

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 show stresses generation is 58Mpa and deflection is 0.3mm. Both are within the allowable 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 result 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 show effect of shock load on the DMAP table and the stress levels are up to 120Mpa. But this stress is also less than the allowable stress of the problem. 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.

REFERENCE