International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Design, Optimization & Analysis of Antenna Mounting Bracket for QON System.

Pooja N Sureja[1], Ulkesh B Desai[2], Mitesh J Mungla [3]

[1]ME- CAD/CAM, Student, Indus University, Rancharda, Ahmedabad, Gujarat, India
[2] scientist-engineer (SF), ISRO-India Space Research Organisation, Ahmedabad, Gujarat, India
[3] Professor, Dept. of Mechanical Engineering, Indus University, Rancharda Ahmedabad, Gujarat, India

---***---

Abstract - *Antennas are the most used equipment for analyzing celestial objects as well as ground communications also it is most important component of satellite system. In this paper, a structure is designed to support antenna reflector for QON system. Initially the load of reflector is 15 kg which is act upon the mounting system and also this mounting is fixed with reflector hub by using screw. Further three dimensional modeling is carried out using INVENTOR software. Meshing is done through ANSYS. The analysis results are captured for the loading condition and result corresponding to the maximum and minimum frequency and deflection of mounting bracket. Modal analysis carried out to find the dynamic safety shows very high fundamental natural frequency compared to the operational frequency. All the results are represented with corresponding pictures to show structural safety.*

***Key Words*: Reflector Antenna, Modal Analysis, Antenna Mounting Bracket, Structural Analysis.**

1. INTRODUCTION

The main reflector and sub reflector of an antenna is typically mounted via a support structure. To avoid performance degradation, it is important that the shape of the main and sub reflector of antenna is maintained. For cost reduction purposes, the main reflector may be molded or stamped from materials such as a metal having relatively low stiffness characteristics. To add support for these reflectors, and thereby maintain their shape, a support structure having multiple contact points distributed across the reflectors may be applied. We have to design reflector bracket structure that did not much more deform above 200 Hz frequency. The support structure includes a similarity of sub-brackets and a main bracket.

In one aspect of the invention, the mounting bracket comprises a bracket support and a rotational or translation support. The rotational slide support provides three degrees of freedom and translation support provide three degree of freedom in its adjustment by allowing both rotation and translation on the bracket support. The invention provides a reflector mounting assembly that includes a base, the base having a bottom surface with a plate for mounting the bracket stand with help of ribs. A mounting bracket is used to holding the reflector, which is outside of the QON system base plate.

2. Design of Reflector Mounting Bracket

Support structures having multiple contact points distributed across the reflector necessarily have imperfect shape accuracy due to manufacturing tolerances. In the case of exactly eight to twelve mounting points, the reflector is normally not deformed by structure inaccuracies. The sub reflector and main reflector have a holes as per main and sub reflector back structure design which fixed with their bracket with the use of screw.

2.1 Design Consideration.

The following consideration were used in Design:

- The distance is measured from qon reflector position with reference to the surface. Reflector mounting stand is assemble by welding with top and bottom plate of bracket with ribs. Also ribs give more stiffness and strength to structure.
- This structure gives sufficient stiffness and rigidity to the reflector.
- The preferred mounting bracket also comprises a rotational slide support with the help of a horizontal and vertical adjustment plate.

In, design the use of vertical adjustment plate we can manage 2 DOF manually. It gives one linear motion in Y direction and rotation in B direction. Similarly, horizontal adjustment plate gives one linear motion in X direction and rotation in a direction. The base plate which fixed with system bracket structure with providing slot, which moves rotation and linear motion in Z and C direction. This 6 DOF concept we can solve the frequency error by manually adjusting a bracket.

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

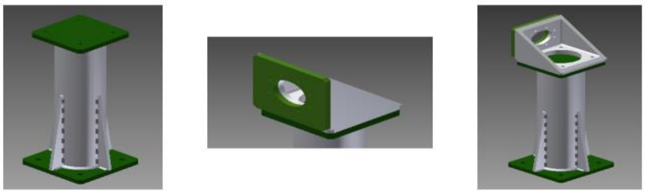

Fig- 1: Design of reflector mounting bracket

3. Analysis of Reflector Mounting Bracket.

3.1 Meshed Model

The below fig. shows meshed model of the bracket. Tetrahedral elements are used for representation of the mounting bracket. A total of 54134 elements and 195334 nodes are used for representation of the bracket.

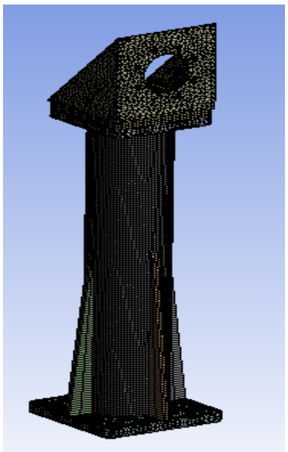

Fig-2: Mesh model of mounting bracket.

3.2 Loading Condition and Constraints:

In loading condition, the Specific values of load are implemented for a typical mounting bracket. The load is taken as 15N and 30N, which is considerable as the distributed weight of the antenna is less than this value. Load is applied at the mounting bracket holes, which are connected to the antenna structure with the help nut and bolts. Also gravitational force 9.8g will be applied on the mounting bracket. We need frequency nearly 200 Hz as per reflector design criteria.

The nodes around the bracket mounting holes have a rigid element connecting them with hole which has fixed with reflector. The element which is used to fix reflector-mounting bracket is fixed at bottom plate of antenna system bracket plate with use of nut and bolts.

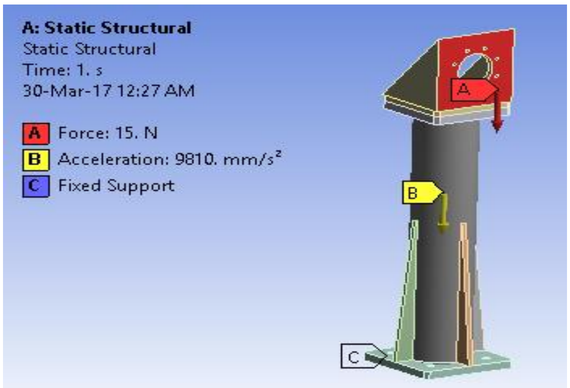

Fig-3: Loading Condition of mounting bracket.

3.3 Structural Analysis

A static structural analysis is the analysis displacements, stresses, strains and forces on structure or a component due to load application. The structures response and loads are assumed to vary slowly with respect to time. There are various types of loading that can be applied in this analysis, which are externally applied forces and pressures, and temperatures. [1]

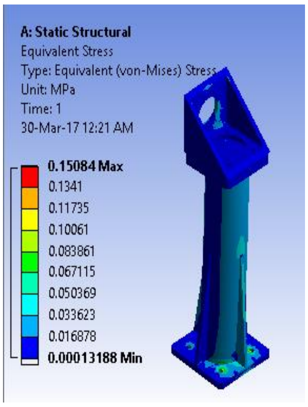

Fig-4: Stress analysis of Mounting bracket

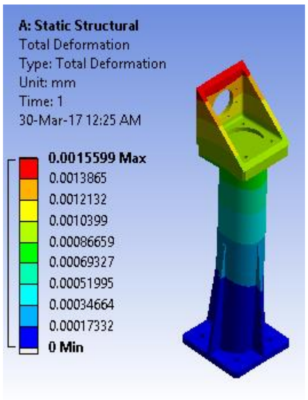

Fig-5: Deflection analysis of Mounting bracket

3.4 Modal Analysis

The motion simulator used for Antenna mounting is designed with basic calculations for structural requirements. Initially the total vertical loads are calculated based on the design specifications. Total load is calculated as 15 N. Based on the CG position and mass, mass moment of inertia. We can select base hole as a fixed support for modal analysis.

Modal Analysis is carried out to find the natural frequencies of the system subjected to dynamic conditions. Finding the natural frequencies allows the design changes to prevent possible resonance in the system. Natural frequency values directly depend on the mass distribution and stiffness in the structure.[2] High dense material has less frequency and low mass has generally high frequency. It also influence by elastic modulus of the material. High elastic material has high stiffness. Also the frequencies are varied by support conditions. [3]

Node	Frequency
1	200 Hz
2	199.35 Hz
3	103.69 Hz

Table-1: Natural Frequency analysis with different nodes.

The table 1 shows natural frequencies obtained in the process. The frequency is much higher than the operational frequency of the system. So system is safe for resonance conditions

Although Analysis has been carried out on motion simulator structure is safe for given conditions, the individual results are represented below the table 2.

Component	Von-Mises stress	Deformation	Strain Energy
Base plate	0.08386 Mpa	0.00 mm	1.9601e-6 MJ
Mounting stand	0.03362 Mpa	0.000866 mm	1.3068e-6 MJ
Mounting Bracket	0.01687 Mpa	0.001559 mm	1.6454e-10 MJ

Table-2: Analysis with different parts of mounting structure.

4. Optimization:

The bracket was designed using the rough dimension so in order to make design the best for the application where is has to be used it has to optimized as per the parameter mentioned in above chapter. The basic definition of the optimization is determining design parameters that lead to the best "performance" of a mechanical structure or system. The reason for optimization of the design is as follows:

4.1 Classification of Optimization

Type of design variables

- Optimization of continuous variables
- Mixed variables

Type of optimization problems

- Unconstrained optimization
- Constrained optimization

Capability of the search algorithm

- Search for a local minimum
- Global optimization; multiple objectives; etc.

4.2 Procedures to Solve an Engineering Optimization Problem.

Formulation of the Optimization Problem:

- Simplifying the problem
- Identifying the major factor(s) that determine the performance or outcome of the physical system, such as costs, weight, frequency output, etc.
- Objective
- Finding the primary parameters that determine the above major factors
- Objective function
- Constraint functions

Selecting the most suitable optimization technique or algorithm to solve the formulated optimization problem.

- Requiring an in-depth know-how of various optimization techniques. [4]

4.3 Optimization with Analysis

From the above section it is clear that what optimization is why it important to be performed and how it is to be performed. In this optimization the design parameters are mid solid height, number of ribs and distance from the bottom. There is only mass reduction requirement of design constraints in this optimization. The design goal is to maintain nearly 200 Hz frequency. Changes in these parameters ultimately change the height, weight and strength of the bracket. So it is important to optimize these parameters with minimize mass.

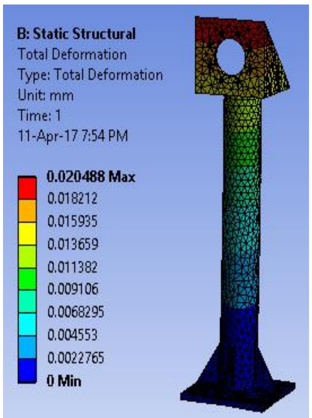

Fig-6: 0.020mm Deflection of Mounting bracket

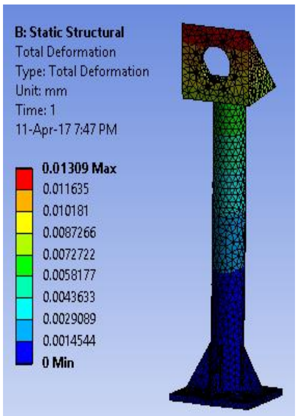

Fig-7: 0.013mm Deflection of Mounting bracket

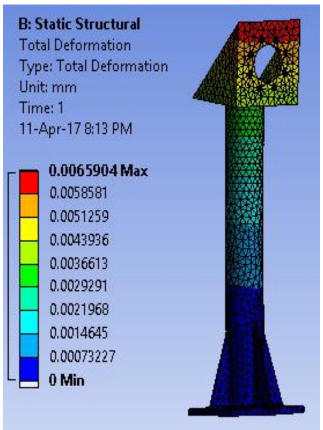

Fig-8: 0.0065mm Deflection of Mounting bracket

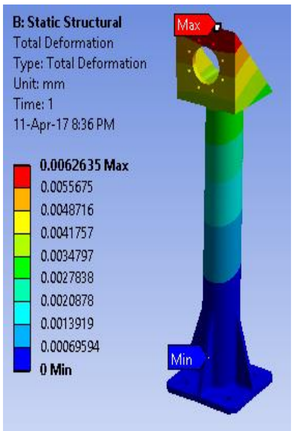

Fig-9: 0.0062mm Deflection of Mounting bracket

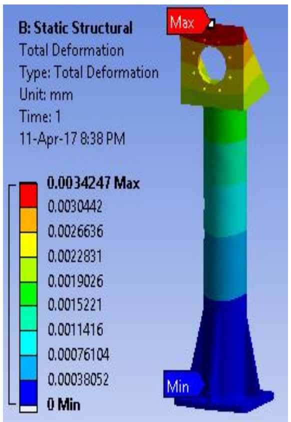

Fig-10: 0.0034mm Deflection of Mounting bracket

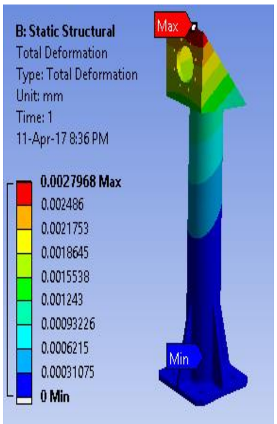

Fig-11: 0.0027mm Deflection of Mounting bracket

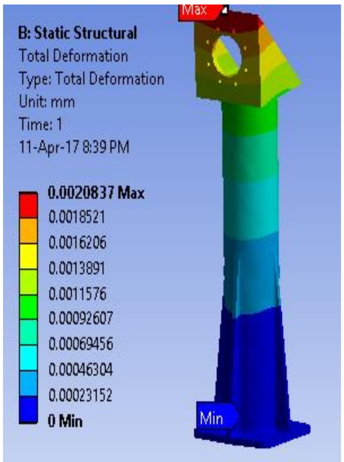

Fig-12: 0.0020mm Deflection of Mounting bracket

5. CONCLUSIONS

The mechanical design of antenna mounting structures, is used in QON system for humidity sounding unit. This design developed by optimization with analysis results. The analysis tool has been used to analyze the reflector-mounting bracket using ANSYS. This work is done with material for reflector mounting bracket. The results obtained for the static structural and modal analysis are frequency stress and deflection. From the results it can be seen that which structure is fulfill the frequency constrain and also gives a minimum deflection of structure also all the result are presented with necessary data in above table. So, as per the above optimization we define reflector bracket design.

ACKNOWLEDGEMENT

The authors can acknowledge any person/authorities in this section. This is not mandatory. This research work is sponsored by ISRO- INDIAN SPACE RESEARCH ORGANISATION. I would specially like to thanks my guide Mr. Ulkesh B Desai, Dr. Mitesh J Mungla and my colleague Mr. Abhishek khandelwal for guidance and providing necessary help when required.

REFERENCES

[1] Finite Element Analysis Of Mount Bracket- P.D. Jadhav 1, Ramakrishna 2 P.G. Student, Department Of Mechanical Engineering.

[2] Vranic, D. And Saupe, D. 2001. 3d Model Retrieval With Spherical Harmonics And Moments. In Proceedings Of The 23rd Dagm Symposium On Pattern Recognition, 392–397.

[3] Design And Analysis Of Motion Simulator Structure Used In Antenna Mounting System B Naga Sindhujaa & R Satya Meherb.

[4] Light Weighting Of Primary Mirror In Space Telescope - Iyer Ramakrishnan Balaji Shri Anurag Vermsa.- Symbiosis Institute Of Technology-Pune