FEA ANALYSIS OF SATELLITE MODEL

Introduction:

The satellite structure shown in Figure 1 is used to conduct both a modal analysis and a thermal analysis. The model is subjected to two groups. The central core contains all the electronics that a satellite normally would have. This created heat which then was enclosing radiation on the core and conducted heat to any attached surfaces. All the external surfaces were exposed to deep space, which was models as radiation to ambient space. This lab report will present the first ten natural frequencies and screen shots of the first ten unique mode shapes. It will also report the minimum and maximum temperature and display the temperature distribution.

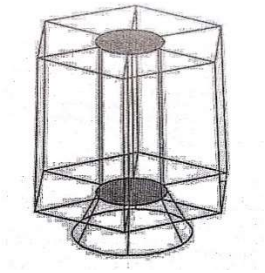

Figure 1: *Satellite structure*

Procedure:

The modal analysis is conducted first with a load case named "Launch Modal" being created. The load case type is set to static. For the input data, the "Disp_Launch Constraint" is selected. In the analysis tab, the job name is set to be "satellite_modal". The solution type is set to Normal Modes. In solution parameters, the mass calculation is set to coupled. The Plate Rz Stiffness Factor is set to 10.0 and the Wt.-Mass Conversion is set to 0.00259. In the subcase window, launch modal was selected. Then the subcase parameters were selected so that the Number of Desired Roots could be set to 10. Under the results tab, the fringe results selected is Eigenvectors, Translational. The deformation results are the Eigenvectors, and Translational.

Next, the thermal analysis is conducted. Geometry changes must be made in order to perform the analysis. When the geometry changes were made, heat loads were created and is only on the central core. This was done by creating an applied heat with an element uniform type. Under options, it was changed to normal fluxes. This heat load is given the name "Electronics heating". When inputting the data, the surface option selected is bottom and the bottom surf. heat flux is set to 2.0. This load was applied to the cylinder ends.

Next the internal enclosure radiation was created. This was done by creating a radiation load with an element uniform type. This load was given the name Core – Rad – Internal. The input data has the surface option set to Bottom with a bottom surf. emissivity set to 0.9. The enclosure ID is set to 100.

The external radiation for the central core is created next. The previous heat load, however, is set is ambient space. The set name is Core – Rad – Outside. In the input data selection, the surface top is check marked with "Top" and the top surface emissivity is 0.5, the top surface absorptivity is 0.5, with an ambient temperature of 0.0. View factor is set to 1.0.

For the heat loads on the external surfaces, the external surfaces were first posted. Then the heat load is created through using a radiation load with an element uniform type. The option is ambient space. The set name is External – Rad – Top. The data is the same as that from the external radiation placed on the central core.

Next the load case is created. This is done the same way as all the previous labs. For the material properties, the aluminum and titanium are modified. The only thing different is the constitutive model is set to solid properties and the thermal conductivity is set to 5.0. The titanium is done the same with the same value for the thermal conductivity.

For the analysis, the solution type is changed to Stead State Analysis. In the solution parameters, the default initial temperature is 400.0. In the radiation parameters, the Stefan-Boltzmann constant is set to 3.6580E-11 WATTS/IN2/K4. When these settings are finalized, the job is conducted for analysis. This result is found under "Fringe Results: Temperature."

Result:

Mode Shape	Frequency [rad/s]
1	11.220
2	11.414
3	11.414
4	11.646
5	11.643
6	11.714
7	19.664
8	20.838
9	20.838
10	22.870

Table 1: *Natural Frequencies for the 10 Modes of Satellite*

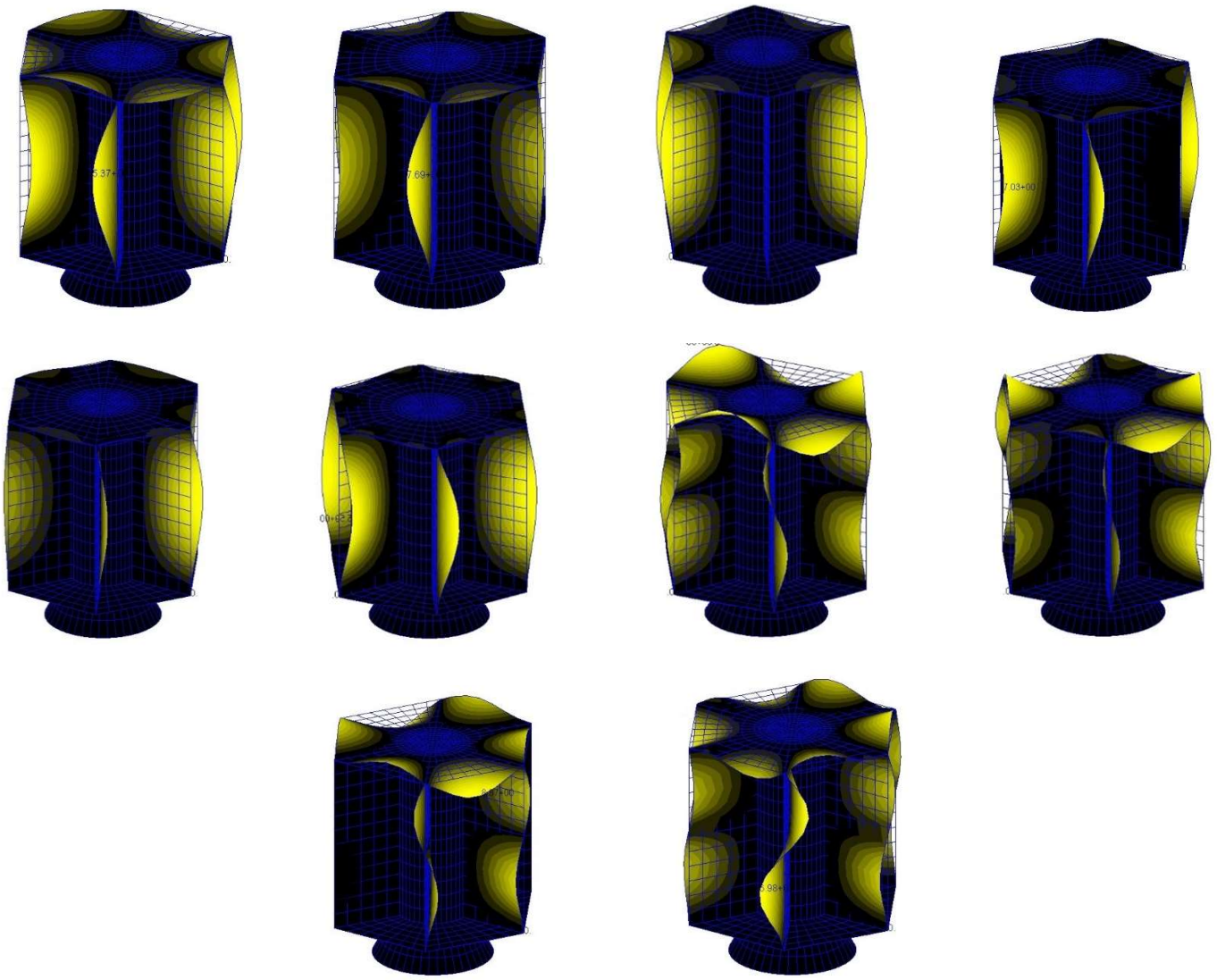

Figure 2: *These figures are the 10 mode shapes of the satellite. They are organized in order from left to right.*

	Temperature [K]
Maximum	284
Minimum	245

Table 2: *Maximum and Minimum Temperature of the Analyzed Model*

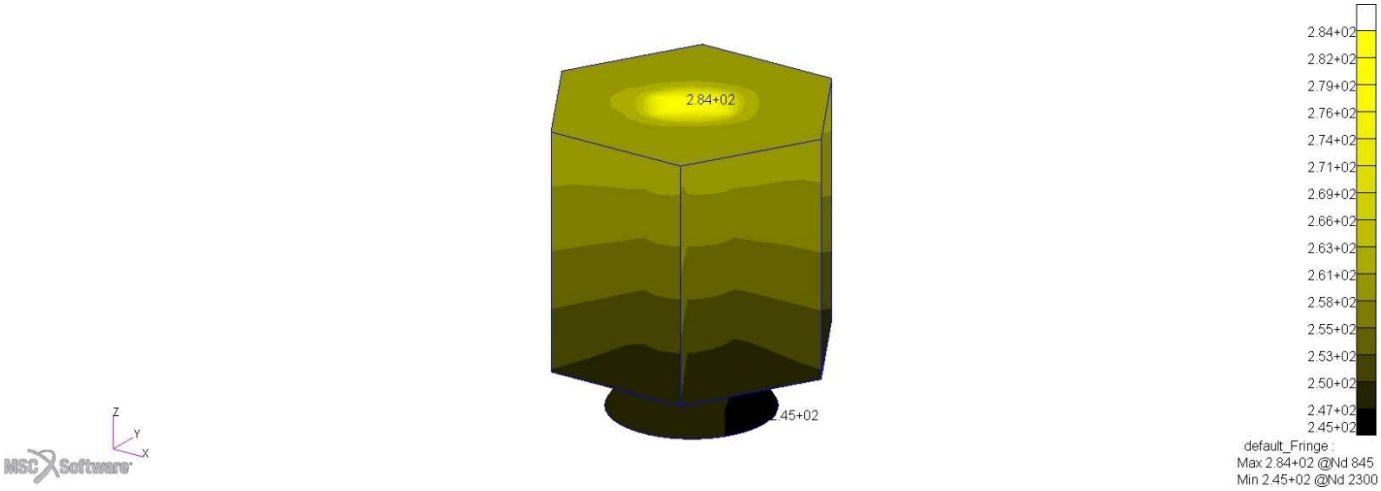

Figure 3: *Temperature Distribution of the Satellite*

Discussion/Conclusion:

The natural frequencies of the first six modes from Table 1 seem to stabilize around ~11.5 rad/s; however, there seems to be a big jump after sixth and remain steadily increased all the way to 22.87 rad/s at the tenth mode. These modes on Figure 2 represent different coupling and how the satellite looks under the loads generated earlier from the modeling process in previous lab. The minimum temperature from thermal analysis is 245K while the maximum is 284 according to Table 2. These numbers are below the initial temperature which was 400K, which makes sense because the satellite was out of space and the ambient temperature was much lower.