**MEGN 481 Machine Design – Fall 2016**

LAB 2: Motion Simulator frequency and fatigue design

The second portion of your project consists of vibration and fatigue analysis of the structural you designed in Deliverable 1. Furthermore, this lab consists of revisiting your structural analysis engineering package from Lab 1 and fixing/revising to accommodate all of the feedback received on the first lab.

Specifically, you must:

1. Perform a frequency analysis in SW and determine the Motion Simulator Motion Base and Floor Platform structure’s first natural frequency (or fundamental mode). The structures natural frequency must then be compared to the input imparted to the structure from the drive-system fluctuations, assumed to occur at 210 rad/s. If the structure does not meet the design requirements for frequency design, the structure must be redesigned.
2. Perform a fatigue analysis of the structure given that the structure will see HCF-type force inputs from regular show operating conditions AND LCF-type force inputs from Failure Mode Effects loading. These two fatigue inputs must be superimposed upon one another to perform this analysis correctly. The Structure must have the design life specified in the Technical Specifications Document. You must perform this analysis using SWS. You have likely not done this in CAE. You will be self-learning here. Don’t ask your boss, that is why you were hired in the first place.
3. Create a full engineering deliverable on the frequency and fatigue analysis performed per the provided example.
4. Modify and/or fix your engineering deliverable package from Lab 1 to incorporate all suggestions provided as feedback.

When performing this analysis you may assume:

1. The “show” may be seen to impart a sinusoidal force input to the structure having the following function form:

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where *ts* is the time measured in seconds, *fmotion* is the imparted force in lbf, W is the total weight/force being supported and/or transmitted through that location and *ω*=1/π rad/sec. The design criteria for length and regularity of a “show” is provided in the Technical Specifications.

1. Failure Mode Effects can be modeled as an acceleration having the following form:

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where *ts* is the time measured in seconds, time starts at 0, *wn* is the natural frequency of the undamped system (having spring constant k=100,000 N/m and a mass of interest in this case of m=3600 kg), and *g* is the acceleration due to gravity, in your favorite units. You must assume that each Failure Mode event lasts for 10 seconds and occurs every 500 hours of operation.

A full engineering report must be submitted for this lab. The report must include everything provided in the example engineering report and follow the document titled “MEGN 481 Lab supplemental information.”