

**ME 777/877 – Computer Aided Engineering**  
**Homework #2 – due Week 3 of the semester**

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The goal of this homework assignment is to provide you with knowledge and experience regarding the Finite Element Analysis (FEA) capabilities of SolidWorks. The exercises are primarily from the Simulation which is available in the coursepack.

Beyond what is asked for in this homework assignment, there are obviously several other topics in the Simulation tutorial (e.g., contact analyses, mixing element types, etc.) that have not been covered. I will leave it up to you to seek the SolidWorks information you need as you work on your projects in the class or for your personal interests.

**Objective 1.** Learn how to perform a quick SimulationXpress analysis.

**Exercise 1.** Perform pages 216 – 237 in the Mountain Board tutorial. Take a screen shot of the final analysis with the holes included in the analysis for a tutorial check when finished.

- On page 219, note that you are suppose to create the parallelogram sketch first before creating the Split Line (starts on page 220). Also, note in this sketch that there are two perpendicular relationships (see top figure on page 221).
- On page 221, the circular Split Line sketch should be on the bottom face of the board. You will get reasonably different results if you use the top face instead.
- On page 223, note that the Acrylic material has already been assigned to the part but the properties may not be identical to those in the tutorial.
- On page 224, the “Appearance” tab on the Task Pane is the multicolored ball on the right side of the screen.
- On page 225, set the results location to a folder that you have access to. Also, note that even though the tutorial specifies that the units are English, the forces are entered as Newtons.
- On page 231 and 232 (and elsewhere), the numbers in the tutorial may not exactly match those that you obtain (e.g., 12.49 instead of 12.47 for the minimum factor of safety).
- On Page 233, to access the reports, click on “Done Viewing Results” then on “Generate report.” The current version of SolidWorks generates a Word document report.

**Objective 2.** Learn how to perform a more detailed analysis using Simulation.

**Exercise 2.** Perform pages 23 – 70 in the Simulation tutorial (noting that pages 65 and 66 are not included in your course pack). Take a screen shot of the final part for a tutorial check when finished.

- On page 44, “High” quality (i.e., second order) elements simply mean that the “Draft Quality Mesh” (i.e., first order elements) in the Mesh, Advanced window is not selected.
- On page 61, the “default analysis” tab, which you need to right click to duplicate the analysis, is at the bottom of the screen and is now called “Copy Study” instead of “Duplicate Study.”

**Objective 3.** Compare simulation results to theoretical calculations.

**Exercise 3.** Perform hand calculations to compare the theoretical stress on the tensile loaded plate with a hole and the results from the FEA analysis. You performed such

calculations during your strength of materials and machine design courses. Fairly reasonable results should be obtained. Be sure to include a percentage difference to verify this. You will turn these calculations and comparisons in to be graded as a hand written Homework assignment.

**Objective 4.** Consider limitations of SimulationXpress compared to the full Simulation capabilities in SolidWorks.

**Exercise 4.** List at least 4 technical limitations (not trivial details such as controlling contour plot details) of SimulationXpress compared to the full Simulation capabilities in SolidWorks. While SimulationXpress allows you to quickly create a FEA simulation, this is not the most appropriate method for most applications. Again, turn this in as a hand written Homework assignment.

**Objective 5.** Conduct a FEA analysis without step-by-step instructions.

**Exercise 5.** Conduct Exercise 2 on pages 81 – 82 at the end of Lesson 1 to determine the spring constant the spring modeled in SolidWorks.

**Objective 6.** Compare the theoretical spring stiffness, displacement, and maximum shear stress to the simulation results.

**Exercise 6.** Based on parameters such as the materials shear modulus, diameter of the wire, mean coil diameter, and number of active coils (assume 8.75), determine the theoretical spring stiffness and displacement. Compare these values to the FEA results. For the shear stress, consider which component of stress is of interest. (Create a coordinate system to use as the reference for the calculation.) Again, be sure to include a percentage difference for comparison. You performed such calculations during your machine design course and must turn this in as a hand written Homework assignment.

**Objective 7.** Learn the importance of mesh controls and stress concentrations.

**Exercise 7.** Perform pages 85 – 106 in the Simulation tutorial. Take a screen shot of the various studies for a tutorial check when finished.

- On Page 93, the .msg file is listed as an “Outlook Item” in the results folder. To open it, right click and select Open With -> Notepad.
- On Page 99, in step 3 in the “Copy Study” menu, be sure to use the “Configuration to use” dropdown to select the “fillet” configuration.

**Objective 8.** Learn the importance of boundary conditions.

**Exercise 8.** Perform pages 109 – 117 in the Simulation tutorial. Take a screen shot of the various studies for a tutorial check when finished.

- On page 115, add two separate mesh controls (one for the cylindrical hole constraint and another for the fillets).

Grading of tutorial checks for this assignment will be out of 50 pts.

- parts from Exercises 1, 2, 5, 7, and 8. (10 pts. each)

Grading of homework questions for this assignment will be out of 30 pts.

- Hand in answers for Exercises 3, 4, and 6.