ME 465—Machine Design II

MAJOR COURSE PROJECT

Fall 2020

This is a team project and must be completed in teams of two students (or in rare cases of a maximum of three students, when course enrollment requires it), each participating equally toward the completion of the project.

The project includes the 3 parts shown below, with report submission deadlines shown:

1. Progress Report #1: Gear design & selection, due on **October 8, 2020**.
2. Progress Report #2: Shaft design, due on **October 22, 2020**.
3. Final Report: Bearing selection & overall report, due on **November 5, 2020**.

Submission links are available on Bb Learn.

Each progress report is worth 25%, and the final report 50%, of your design project grade. The progress reports should be on the order of 4 pages long, while the final report 10 pages. Your report should always include a title page. Typical sections in your report include objectives, approach, results, discussion of results, and conclusions.

See the "ME 465 Report Grading Rubric" document for information on how the reports will be graded, and what things to keep in mind when writing the reports.

Keep in mind that the project is a design problem, and as such, multiple correct solutions are possible.

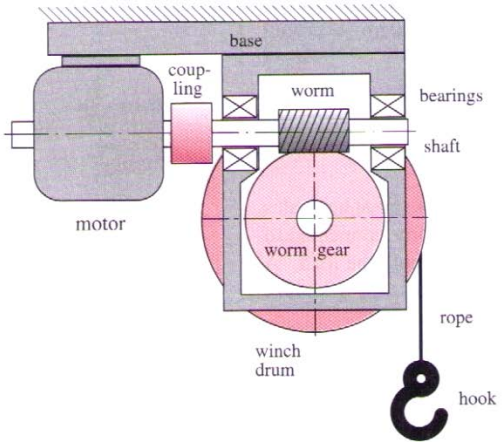
Project statement

A winch, schematically shown in the figure below, is operated by a worm-gear mesh. The input torque to the worm is provided by an electric motor that rotates at 1,500 rpm. The expected speed of the worm gear is between 30 and 35 rpm. The peak torque requirement for the winch is about 4,000 lbf·in, the operating ambient temperature is 120 °F, and the average output power doesn't have to exceed 1.2 hp. Knowing that the winch drum radius is 8 inch and that the winch operates 4 to 5 hours a day, perform the following tasks, which combined lead to the overall design project:

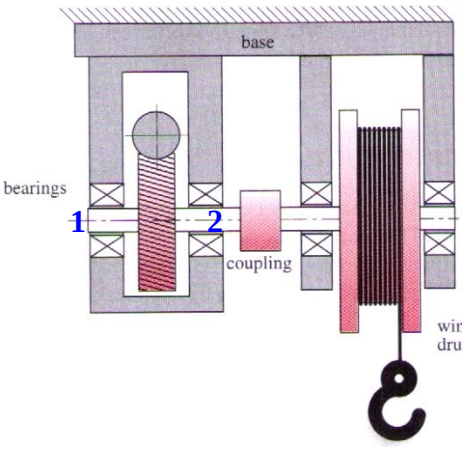
1) (Progress Report #1) Design the worm-gear mesh that meets the requirements for the operation of the winch (i.e. perform force, bending and wear analyses for the worm-gear mesh). Assume a design factor of 1.2 for the gear teeth and make sure that the mesh is self-locking. Using a gear manufacturer's catalog, select a readily available worm-gear mesh that meets the design requirements. Your report should incorporate, but not be limited to, the following:
   - A computer code that allows the design of the worm-gear mesh based on the given inputs, meeting the imposed bending and wear requirements for the worm-gear mesh.

2) (Progress Report #2) Design the shaft (**from bearing 1 to bearing 2 in figure "side view"**), for stress and deflection constraints, that will support the worm gear. Your report should incorporate, but not be limited to, the following:
   - A free body diagram of the shaft holding the worm gear.
   - The bending moment, shear, and torque diagrams for the shaft holding the worm gear.
   - A computer code that calculates the factor of safety and deflections on the shaft that you design to support the worm gear and the drum.
   - A manufacturing part drawing for the designed shaft including appropriate GD&T specifications. Refer to Chapter 18, in the textbook, for examples of correct part drawings, and to Chapter 20 for details on how to specify GD&T for the shaft.

3) (Final Report) Select the bearings (**1 & 2**) required to support the shaft holding the worm gear. Your report should incorporate, but not be limited to, the following:
   - The overall project design, including the deliverables that were submitted in the progress reports.
   - Updated deliverables from Progress Reports 1 & 2 based on the feedback you received on the correctness of your initial submissions.
   - An overall summary (no longer than two pages) detailing the assumptions made during the design process, the outcomes of the design, and the lessons learned from this project.



Front view



Side view

Hints: *You may use book (11th edition) Examples 13.10, 15.3, 7.2, 11.8 as references for completing the project. Use "rushgears.com" to find the worm-gear mesh.*