Drive Wheel Gearbox Design

The goal is to design the gearbox for the drive wheels.

The input is set by one or more FIRST CIM motors (for now, we'll design around 1). For specs on the motor, go to calliope.ualr.edu & look at the bottom of the mechanical design page under actuators.

The wheels are 9" in diameter and 2.5" wide. They have a 1/2" hex hole broached in the center.

The maximum load on the gearbox is set by the weight of the robot, the radius of the wheel, and the coefficient of friction. Presume that the weight born by each wheel is 500 lb and that the maximum coefficient of friction between wheel and surface is 0.2. Use these numbers to determine the maximum output torque. NOTE: this is the torque to use in failure calculations.

Available gears are 20 pitch, 20 pressure angle, with the following teeth: 60, 45, 30, 18, 15, 14. All gears are made from steel gear stock. See stock drive products (www.sdp-si.com) for gear stock specifications.

Step One: Due Wednesday, Dec. 4
What are the functional requirements of the gearbox?

Design a two stage gear box that won't stall the motor when subjected to maximum load. The output of this step are the number of teeth on the motor pinion, the first stage gears (the gear that mates with the motor pinion and the gear that mates with the output gear), and the output gear. Four numbers. How hard can that be?

Fill in the gear stress table for this gearbox using face widths of 1/2".

What is the output speed of the gear box at ¾ no load speed? What does this say about the likely top speed of the robot? (i.e., multiply this number by the wheel radius … that's the robot's top speed under load)

Turn in a brief report summarizing the above information.

Step Two: Due: Monday, Dec. 9
Based on your stress calculations, set the face widths to insure that no tooth exceeds 0.3 Sy.

NOTE: figure out some minimum face width … don't just blindly calculate a face width. Round your numbers to something sensible (i.e. if the calculation says that a face width of 0.24778934" would be satisfactory, go with a face width of 0.25").

What are the gear spacings for this gearbox?

The output bearings will be ??? angular contact bearings. The middle bearings will be 608 series bearings (8 mm bore, 22 mm OD, 7 mm thick). Support the middle & output shafts at both ends. The motor pinion does not need bearings (they're in the motor).

Perform a CAD design of the gear set. Include your shafts and spacers. Include any bearing washers that might be needed.

What is the dimension and tolerance on the shaft ends and bearing bores for all bearings?

Output of this step will be a summary of calculations listed above along with a isometric picture of the gear set assembly.

Step Three: Due: Wednesday, Dec. 11 at the final location & time
Wrap the gear box around the gear set. This needs to be capable of assembly.

Provide assembly drawings & engineering drawings for all fabricated parts (gear box plates, axles mainly).