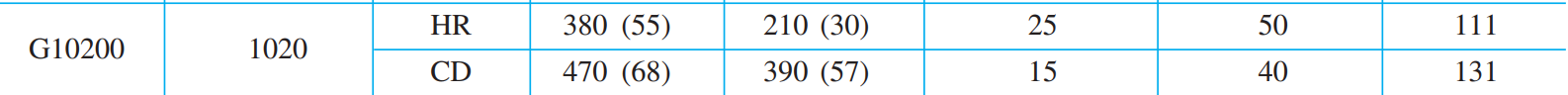
**Force Analysis:**

Choose the inexpensive steel, 1020CD steel, parameter are from Shigley’s book Table A-20:





Start with point C, where the bending moment is high and there is a stress concentration of the shoulder.

Forces at C:

Therefore,

Based on the inner radius of the gear (12 mm), let’s design the diameter d to be 12 mm.

Next, check for failure:

Choose diameter ratio for the shoulder: D/d = 1.5, thereby

Select standard value D = 18 mm.

Check if estimates were acceptable:

Choose fillet ratio for well-rounded shoulder, based on Shigley’s book [Table 7-1].

So the fillet radius is .

Choose the stress concentration factors from Shigley’s book

From the Shigley’s book equation 6-32:

Then the modifying factors:

**Surface factor** from the Shigley’s book Table 6-2, from cold draw.

From equation 6-18:

**Size factor** from the Shigley’s book equation 6-19, due to the ,

**Load factor** from the Shigley’s book equation 6-25, and since there is not fluctuating axial loading, and the loading factor for torsion is already taken into account when using Mises Stress.

**Temperature Factor** the endurance limit is available or being estimated based on the ultimate strength at the operating temperature.

**Reliability Factor**

Estimating the Endurance Limit from equation 6-10,

Finally, the endurance limit: From equation 6-17:

Use von Mises stresses from equation 7-4 and equation 7-5:

Then calculate the safety, using the Goodman Criterion from equation 6-41

And the yielding safety factor: