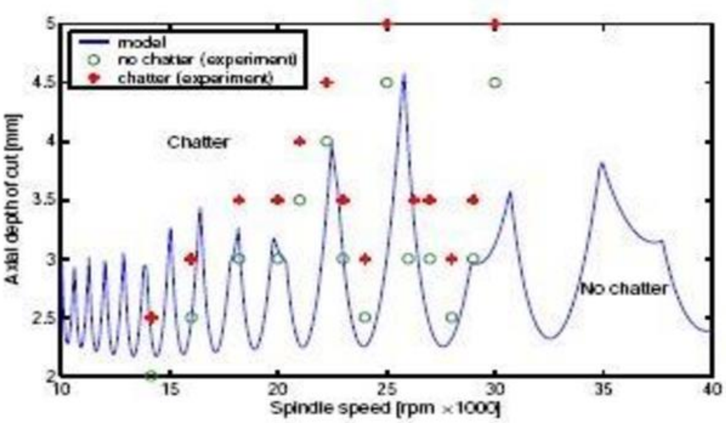
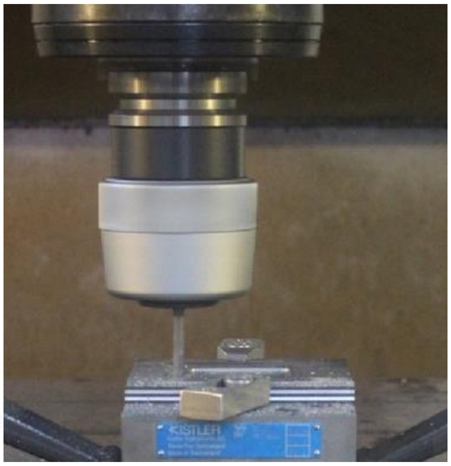
Assignment # 2. MECH 392

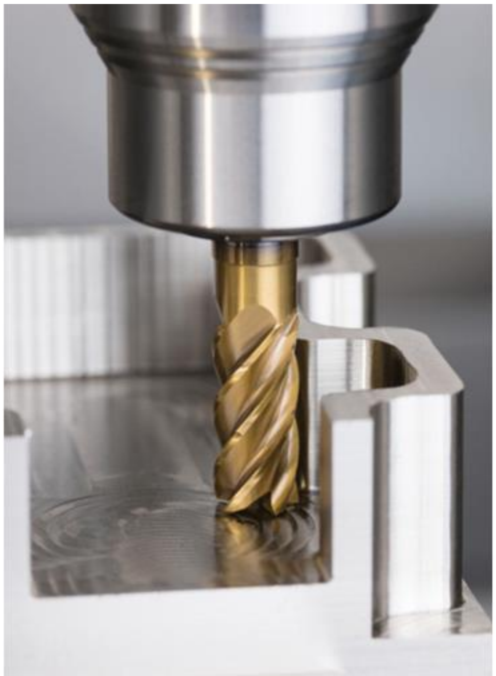
Please upload your solution on Canvas.

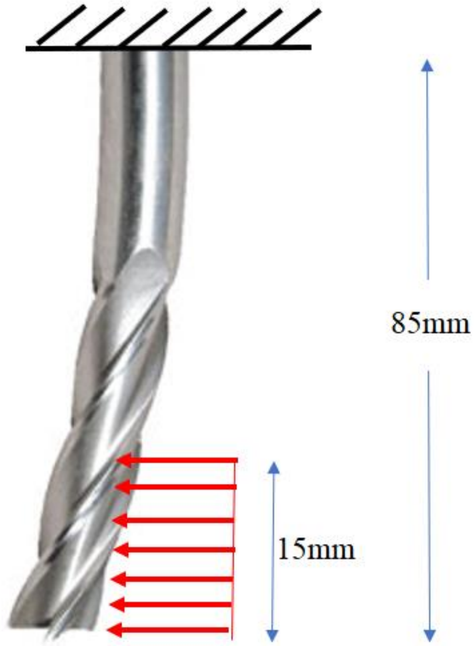
1. The following figure shows the stability lobe of a milling machine. The operator is running the machine at 24000RPM, with depth of cut 3.5mm. At this setup the tool chatters excessively. According to the stability lobe diagram decreasing the depth of cut is not a good option (since he must decrease the depth of cut to 2.1mm to avoid chatter, see the stability lobe below). Increasing the rpm is not also an option (since, based on the chart, the machine must be run at 26000rpm to pass the unstable zone when the depth of cut is 3.5mm. Unfortunately, the machine does not have enough power to go over 25000rpm when cutting this workpiece (mid carbon steel)). Please provide some possible solutions to avoid chatter in this operation, if changing the depth of cut and rpm are not an option, and state why they will solve the chatter? (brief and to the point)





2. A side milling operation is set to cut 2.0mm from one side of an aluminum block. An end milling bit with 3 flutes, and nominal diameter of 10mm is used. If the total lateral force during the cutting is measured 125N. What tolerance can we get for the final dimension in this operation? The tool material is AHSS (advanced high-strength, also called ultra-high-strength steels) with Tensile Strength of 670 MPa, and Modulus of Elasticity 272GPa. (*hint: model the tool as a cantilever beam and distribute the load along the high of 15mm of the tool, as shown, then approximate the tool deflection due to this load*).





3. Following figure shows a schematic of a mold which is designed for forming of an Aluminum sheet metal with thickness of 2.5mm. Assume the sheet is not stretched before forming. First find out if the mold meets the requirement for the minimum radius. Then, find the final radius of the sheet after exiting the mold?

- $\rho = 2700\frac{kg}{m^3},\ E = 69GPa,\ \sigma_y = 400MPa, \sigma_u = 655MPa,$
- $R1 = 15\ cm, R2 = 17cm, R3 = 19cm$

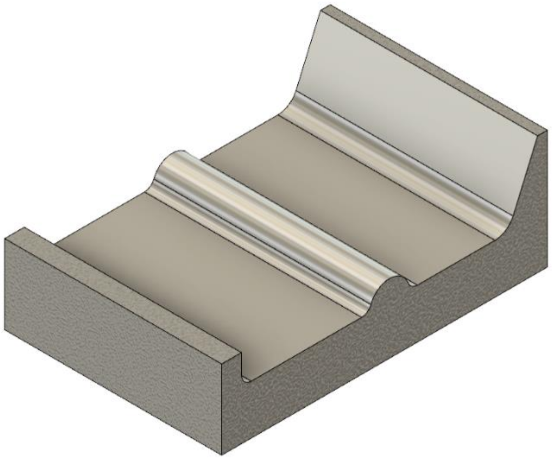
Note: Correct Spring Back formula:

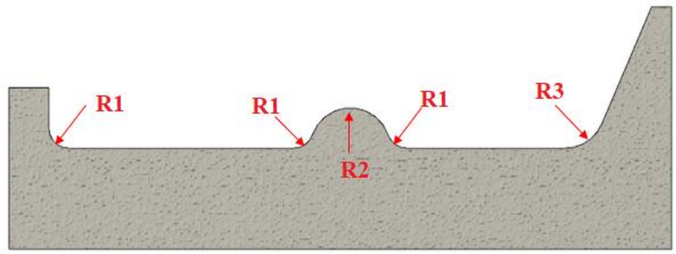
$\Delta K = 1.5K_y\left(1 - \frac{1}{3}(\frac{K_y}{K_L})^2\right)$

$K_{final} = K_L - \Delta K$

Yield curvature: $K_y = \frac{\sigma_y}{E\frac{h}{2}}$, K_L: Mold curvature (1/R)

Note: If you get large numbers for the final radius of curvature, that is correct (it shows if the sheet is not stretched before forming, we will not get the shape we want, because of the spring back!)





4. The LEGO brick is the most recognized injection molded part in the world. i- Estimate the

cooling time of a LEGO brick (1.2mm thickness). Assume ABS is injected at 220C, the mold temperature is 45C, the thermal conductivity k of ABS is 0.5 W/m-K, and the part is ejected at 95 C. Assume ABS has a density ρ of 1000kg/m^3 and a specific heat capacity C_p of $1985\,\frac{J}{Kg.K}$?

ii- If the thickness is halved, determine how much the cooling time is reduced?

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