ME 649
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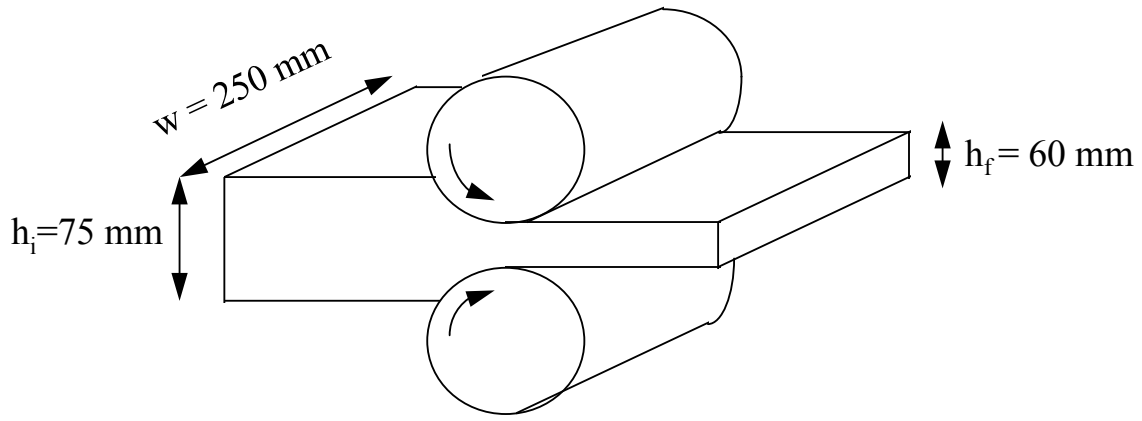
HW#3

1. A 5 mm thick Al-alloy strip is rolled to a thickness of 4 mm using steel rollers of radius 100 mm. The tensile yield stress of the material is 0.28 KN/mm^2 Determine:
   - The minimum coefficient of friction μ_{min} between the strip and the rolls for an unaided bite to be possible
   - The angle subtended by the contact zone at the roll center
   - The location of neutral point with $\mu = \mu_{min}$

2. A 75 mm thick by 250 mm wide slab of AISI 4135 steel is being **cold-rolled** to a thickness of 60 mm **in a single pass**. Assume the coefficient of friction μ = 0.2. Is the desired reduction feasible without any external force? A two-high non-reversing rolling mill (shown below) with 750 mm diameter rolls made of tool steel is available for this task. The rolling mill has a power capacity of 5 MW per roll. The rolls rotate at a constant angular speed of 100 rpm. The steel work material has the following flow curve at the rolling temperature: $\sigma_t = 800\varepsilon_t^{0.14}$ MPa. Is the available rolling mill adequate for the desired operation?



3. A round wire made of perfectly plastic material with a yield stress of 30,000 psi is drawn from 0.1" to 0.7" in a draw die of 15^0. Let the coefficient of friction be 0.1. Use ideal deformation approximation and the drawing stress equation to estimate the drawing forces. Comment on any differences in your answer.

4. You are cold, forward extruding a metal from an initial diameter of 75 mm to a final diameter of 20 mm. The initial length of the billet is 2 m. The metal has K = 965 MPa, and n = 0.19. The die angle is 90 degrees.
   - Determine the maximum power for an extrusion velocity of 1.5 m/s.
   - The die can be used until its diameter wears 10%. Determine how this will affect your answer.