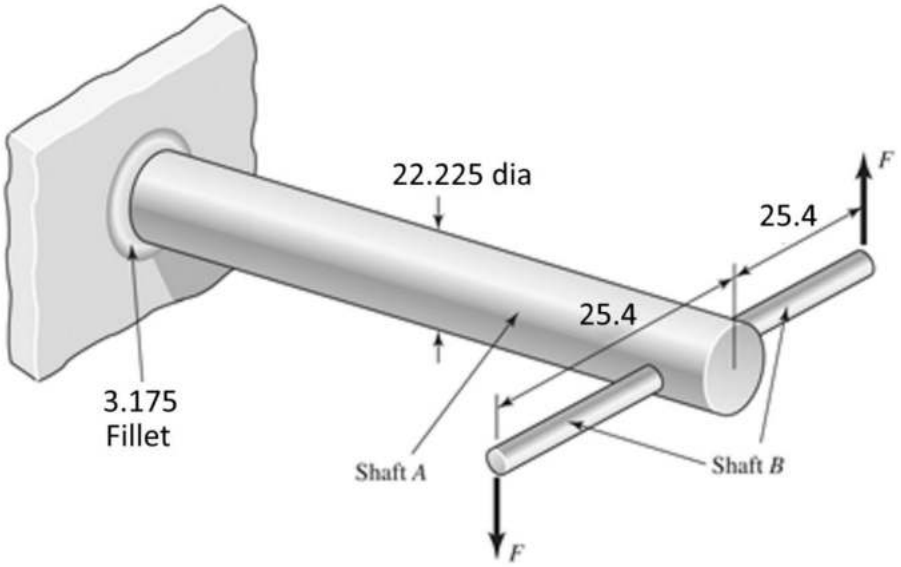
Chapter 6 & 7– Fatigue Failure Resulting from Variable Loading	Due Date – 4th April, 2020

Problem 3 (15 Marks)

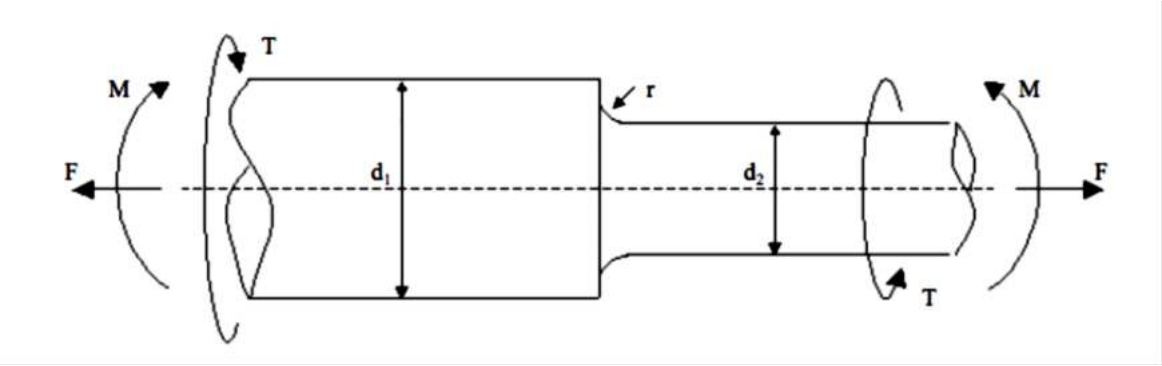
In the figure shown, shaft A, made of AISI 1050 hot-rolled steel, is welded to a fixed support and is subjected to loading by equal and opposite forces F via shaft B. A theoretical stress concentration factor K_{ts} of 1.6 is induced in the shaft by the weld fillet. The length of shaft A from the fixed support to the connection at shaft B is 610 mm. The load F cycles from 0.25 kN to 0.50 kN. Find the factor of safety for infinite life using the Gerber fatigue failure criterion.

[Hint: All dimensions are in mm]



Problem 4 (25 Marks)

A rotating circular shaft, machined from AISI 1030 Q&T* steel, is subjected to a torque that varies from a value of 20 N.m to 200 N.m and to a fluctuating bending moment that varies from a value of - 500 N.m to 1500 N.m. Also an axial tensile force of 15 kN acts on the element. The torque and the bending moments have their peak values at the same time and their frequencies are same. Find the factor of safety of the element for an infinite operation life assuming the reliability as 0.90. Use Modified Goodman Diagram and take d_1 = 80 mm, d_2 = 60 mm and r = 6 mm.



Problem 5 (35 Marks)

The shaft shown in the figure is driven by a gear at the right keyway, drives a fan at the left keyway, and is supported by two deep-groove ball bearings. At steady-state speed, the gear transmits a radial load of 230 lbf and a tangential load of 633 lbf at a pitch diameter of 8 in.

(a) Proceed with the next phase of the design, in which a suitable material is selected, an appropriate diameters for each section of the shaft are estimated, based on providing sufficient fatigue and static stress capacity for infinite life of the shaft, with minimum factor of safety of 1.5.

(b) Check that deflections satisfy the suggested minimums for bearings and gears.