Tutorial 3
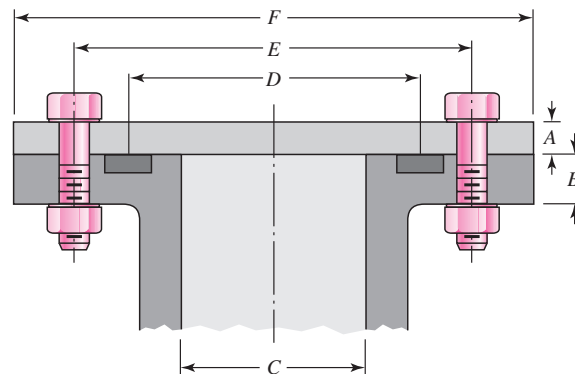## ME-351, 2013-14 2nd Semester

Problem 1:

The figure above shows the bolted connection between a steel cylinder head and Grade 30 cast iron cylinder. It has ten M12 x 1.75 bolts of grade ISO 9.8, a sealing gasket that is NOT a part of the members that carry the external load. The bolts are to be reused. The relevant dimensions are: $A = B = 25\text{mm}$, $C = 100\text{mm}$, $E = 200\text{mm}$, $F = 300\text{mm}$. Consider the half-apex angle of the pressure-cone to be 30 degrees.

    (a) Determine the bolt length to be used.
    (b) If the cylinder is subject to a maximum gas pressure of 10MPa, determine the factor of safety against yielding, against overload (loading factor), and against joint separation. Also check if the number of bolts is sufficient to achieve uniform sealing pressure on the gasket.
    (c) Determine the fatigue factor of safety and factor of safety against yielding if the cylinder is subject to a fluctuating pressure between 20MPa and 10MPa for infinite life. Also check if the preload satisfies the upper bound criterion for satisfactory fatigue performance.

Problem 2:

A 10mm thick cantilever beam made of AISI 1020 cold-drawn steel is fastened to a 30mm thick plate also made of same material. The plate is a part of a larger structure. Two M12 x 1.75 bolts of grade ISO 5.8 are arranged horizontally as shown below to fasten the cantilever to the plate. The left bolt center is placed 25mm away from the left edge. The shear-joint has to be designed with a factor of safety of 2.5. Bending of bolts, the shear tear out, and tensile tear out may be ignored.

    (a) Find the maximum safe load F on the cantilever. Check for bending of the cantilever at critical locations as well.
    (b) If the bolts are arranged vertically, keeping the centroid location and the distance between the bolts same, what would be the maximum safe load? Is this arrangement better than the horizontal one?
    (c) Arrange the bolts diagonally (at 45 degrees with the horizontal) keeping the centroid location and the distance between the bolts same. Without any further calculation, comment on which arrangement among horizontal, vertical, and diagonal can take largest load.