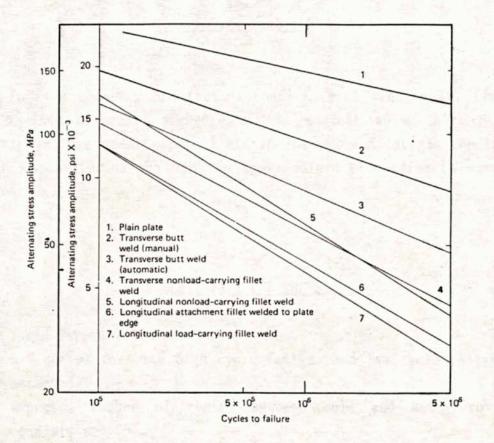**Problem Set III**

Due 10/05/06

1. For the same vessel described in Problem II-2, find out the maximum allowable pressure of the coolant so as not to cause elastic failure under expected static loading and fatigue conditions. State the criterion you wish to apply before proceeding to numerical evaluation.

  - Yield stress = 320 MPa, Ultimate tensile stress = 500 MPa.

  - S-N curves for both high cycle fatigue and low cycle fatigue are attached.

  - Expected number of cycles between cold and hot zero power conditions = 500.

  - Expected number of cycles between hot-zero power and hot-full power conditions = 10^5

  - Temperature profile is distributed parabolically at hot-full power conditions:

$$T = T_{out} - \frac{1}{4}\Delta T(1 - 2z/t)^2$$

    Where T_{out} is the outside wall temperature. ΔT = -50 K is the temperature difference between inside and outside wall.
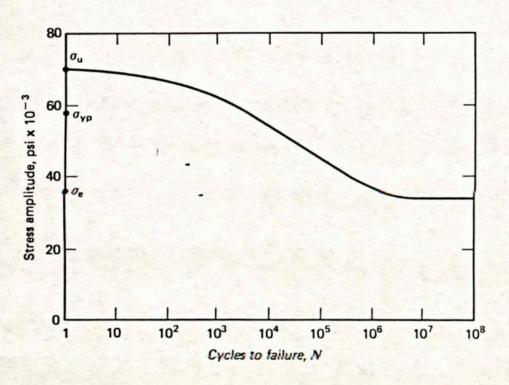
Fig 1:
high-cycle
fatigue

Vertical axis (left outer): Alternating stress amplitude, MPa — 150, 100, 50, 20

Vertical axis (left inner): Alternating stress amplitude, psi $\times 10^{-3}$ — 20, 15, 10, 5

1. Plain plate
2. Transverse butt weld (manual)
3. Transverse butt weld (automatic)
4. Transverse nonload-carrying fillet weld
5. Longitudinal nonload-carrying fillet weld
6. Longitudinal attachment fillet welded to plate edge
7. Longitudinal load-carrying fillet weld

Horizontal axis: Cycles to failure — 10^5, 5×10^5, 10^6, 5×10^6

Fig 2:
low-cycle
fatigue

Vertical axis: Stress amplitude, psi $\times 10^{-3}$ — 0, 20, 40, 60, 80
Marked points: σ_u, σ_{yp}, σ_e

Horizontal axis: Cycles to failure, N — 1, 10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8