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## ANALYSIS OF RING FLUID RING CONTAINERS FOR HIGH PRESSURE

A high-pressure-container design was suggested in Interim Report IV[21] which derives the benefit of both shrink-fit and fluid-pressure support. This design is shown in Figure 40. It is composed of two multiring units and therefore avoids the numerous difficulties encountered in segmented designs. Analyses of this advanced container design are described in this section. The analyses for calculating maximum pressure capability, residual stress, and required shrink-fit interferences were programmed for calculation on Battelle's CDC 3400 and 6400 computers.

### Generalized Fatigue Criteria

In the earlier analyses, two fatigue criteria were used for either high-strength liner steels or for ductile outer cylinders. These were a tensile-strength criterion and a shear-strength criterion repectively. These criteria were postulated for pressure-vessel stress conditons. The fatigue data available in the literature were used to determine the criterion for failure. Only uniaxial data could be found on high-strength steels. Some triaxial fatigue data from pulsating fluid-pressure tests were available on low-strength steels.[35]

In a general design of a multiring container, different steels with different fatigue behavior may be used to advantage for each ring. Since no definite fatigue data are available at this time on the biaxial or triaxial fatigue of high-strength steels in particular, generalized fatigue criteria with arbitrary coefficients are formulated here on both a tensile-strength and a shear-strength basis. (For example, it may be that a high-strength brittle steel will fail in a ductile manner when subjected to high bore pressures in a container.) These generalized fatigue relations are as follows:

$$A_n (\sigma_\theta)_r + B_n (\sigma_\theta)_m = \sigma_n \quad ,$$

or (73a, b)

$$A_n S_r + B_n S_m = \sigma_n \quad ,$$

where

$A_n$, $B_n$ are coefficients describing the material of ring number n,

subscript r denotes the semirange stress component,

subscript m denotes the mean stress component, and

$\sigma_n$ is the tensile strength of ring number n.

The linear relations (73a,b) can be used to describe in a stepwise manner, nonlinear behavior as illustrated by the semirange, mean-shear-stress plot in Figure 61. (The constant coefficients $A_n$ and $B_n$ in (73a) are related to the variable parameters $\alpha_r$ and $\alpha_m$ defined earlier as follows: $A_n = \frac{1}{\alpha_r}$ for $\alpha_m = 0$, $B_n = \frac{1}{\alpha_m}$ for $\alpha_r = 0$.) The shear fatigue relation

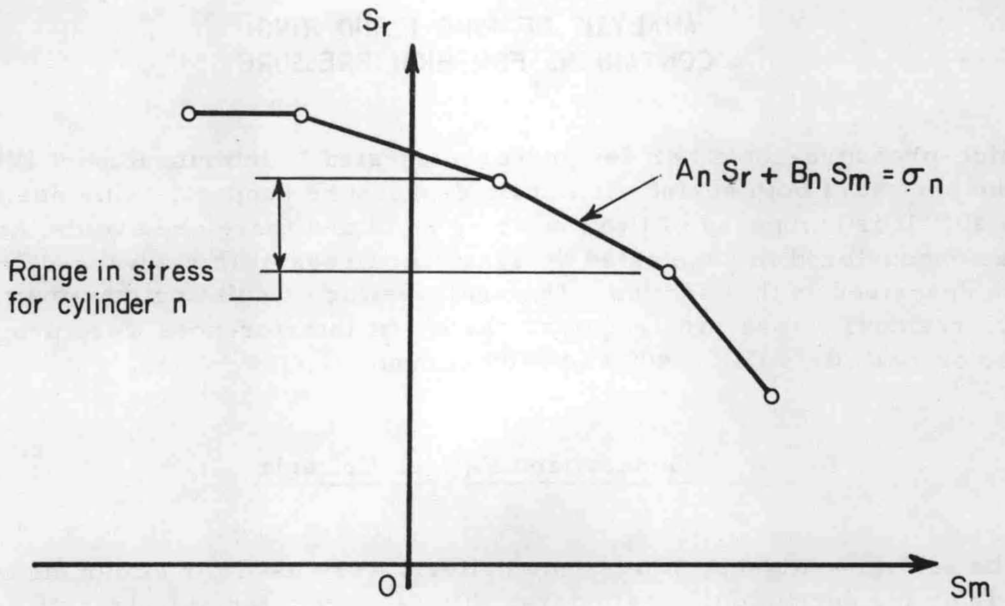


FIGURE 61. GENERALIZED FATIGUE RELATION IN TERMS OF SHEAR STRESSES

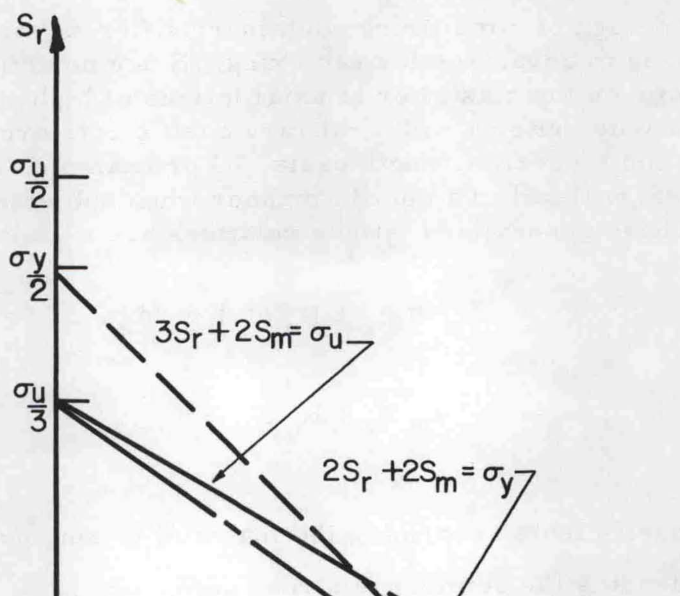


FIGURE 62. SHEAR-YIELD- AND SHEAR-FATIGUE-STRENGTH RELATIONS