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THICK WALLED CYLINDERS UNDER INTERNAL PRESSURE

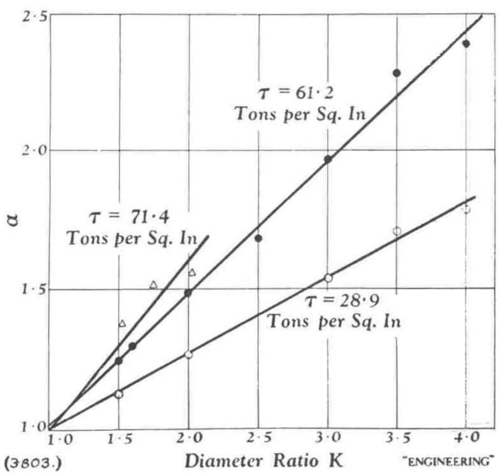
SIR, We were interested to note that Helmut Leinss (ENGINEERING, vol. 180, page 132, 1955) was able to represent the experimental results of Crossland and Bones (ENGINEERING, vol. 179, pages 80 and 114, 1955) concerning the strength of thick-walled cylinders, by the empirical relation,

$$\frac{(K-1)}{P}\sigma = \alpha = \alpha_1 + \beta(K-1)$$

where K is the ratio of outer to inner diameters of a cylinder, σ is the ultimate tensile stress of the mild steel, P is the experimental bursting pressure, and α_1 and β are independent of K.

Leinss pointed out that, since $(K-1)\sigma$ is the bursting pressure of a thin cylinder α_1 should be unity, and this was found to be true for the results of Crossland and Bones.

We felt it worthwhile to investigate the question, raised by Leinss, of whether such a relation is valid for other materials. Accordingly we have analysed some published results to test their conformity with the above relation, putting in σ, the ultimate stress, or τ, the yield stress, appropriate to the experimental pressures of bursting or yielding of cylinders. The results of Cook and Robertson (ENGINEERING, vol. 72, page 786, 1911) and Cook (*Phil. Trans. Roy. Soc.*, vol. 230A, page 103, 1932) and *Proc. I.Mech.E.*, vol. 126, page 407, 1934) for mild steel, those of Cook and Robertson (*loc. cit.*) for cast iron, and those of MacRae (*Overstrain in Metals*, H.M.S.O., 1930) for nickel steel are satisfied with only small random errors to equations of the above form. In most cases, however, α_1 is less than unity.



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There is some indication that β, the slope of the α,K-line varies smoothly with τ for a particular material. To investigate this further we have measured the yield pressures, in the range 2,000 to 12,000 atmospheres, of some cylinders of a Ni-Cr-Mo steel, heat-treated to three different tensile strengths. The values of K range from 1·5 to 4·0 for two of the specimens and from 1·5 to 2·0 for the specimen of highest tensile strength. The results are shown in the diagram where it will be seen that β increases as τ increases. It is interesting to note that, if a simple relationship could be established between β and τ for a given material, this relationship, together with the Leinss formula, would permit the prediction of yield pressures of cylinders of given dimensions and tensile strengths without further tests.

It is intended to publish later full details of our experimental method and of the results.

We are indebted to Mr. H. J. Vogan, Reader in Civil Engineering at the University of Sydney, for carrying out the tensile tests.

Yours faithfully,

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