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CREEP FAILURE TIME PREDICTION USING THE RELIABILITY THEORY

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This paper proposes a probabilistic model of structural material creep failure, which is based on the reliability theory. It is assumed that for specimen failure under the action of a constant load, there exists a functional relationship between the creep strain accumulated to a given time and the nonfailure probability at that time. This assumption and the fact that in most cases the failure rate function and a typical creep strain rate vs. time curve are nonmonotonic and U-shaped made it possible to obtain the nonfailure probability. The creep and the long-term strength equations are adopted in power law form with account for specimen necking in the deformation process, For the power law of creep without strengthening, relationships are obtained for determining the average time to failure and the rms deviation of the long-term strength of a rod tensioned with a constant force in creep. The long-term strength variation coefficient is determined; the coefficient has two finite limits. It is shown that with decreasing strength the brittle zone demonstrates an increase in measured failure time spread at equal stress levels, while in the tough zone this is absent. Theoretical calculations are compared with long-term strength test results for 12Cr18Ni10Ti corrosion-resistant steel at 850°C. The material constants were determined from the results of creep and long-term strength test data processing. The theoretical creep failure time for the linear dependence of the failure rate function on the creep strain rate is less than for the quadratic one, while the rms deviations are greater. In both cases, the theoretical results are in satisfactory agreement with the experimental data both for the failure time and for its rms deviation.

Keywords: *creep, long-term strength, damageability, nonfailure probability, failure time, time-to-failure rms deviation*

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