

Analytical study on the dynamic strength of brittle materials

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Summary

Dynamic behaviors of tensile strength of brittle materials are investigated analytically, and an explicit mathematical expression for the dynamic tensile strength under a quadratic boundary loading is derived, together with the so-called structural-temporal failure criterion. The analytical solution shows reasonably good agreement with the previous dynamic experimental data. Moreover, it is shown by using the explicit expression that the dynamic tensile strength of brittle materials can be determined completely by the quasistatic material parameters such as the quasistatic tensile strength, material density and the incubation-time, which implies that the so-called strain-rate effect on the strength of brittle materials should not be considered as an intrinsic material property, but a structural response feature to the dynamic loadings. Additionally, it is also demonstrated that the scatter nature of the previous experimental data for the dynamic tensile strength is resulted directly from the interaction between the boundary loadings and the material properties, which can be predicated well by the obtained analytic expression.

