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Impact Fragmentation and Crushing of Concrete and Other Solids Due to Kinetic Energy of High Shear Strain Rate ZDENEK BAZANT, KEDAR KIRANE, Northwestern University — While numerous studies have dealt with dynamic crack propagation, they have not led to a macroscopic continuum model usable in FE analysis. Recent work on such a model is reviewed. The key idea is that comminution under high-rate shear is driven by the release local kinetic (rather than strain) energy of the shear strain rate field in forming finite-size fragments. At strain rates >103/s, this energy exceeds the maximum possible elastic strain energy by orders of magnitude. It is found that the particle size scales as the -2/3 power of the shear strain rate and as the 2/3 power of interface fracture energy, and the released and dissipated kinetic energy as the 2/3 power of the shear strain rate. These results explain the long debated phenomenon of "dynamic overstress". In FE simulations, this kinetic energy of strain rate field can be dissipated either by equivalent viscosity or by the work of increased strength limits. In simulating the impact of missiles into concrete walls, both approaches give nearly equivalent results. A dimensionless indicator of the comminution intensity is also formulated. The theory was inspired by noting that the local kinetic energy of shear strain rate plays a role analogous to the local kinetic energy of eddies in turbulent flow.

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