CONCRETE MODELED AS AN INHOMOGENEOUS MATERIAL: NUMERICAL SIMULATIONS OF CONTACT DETONATION CHARGES

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Applying the power of scalable software, it is now possible to simulate the response of unreinforced- and reinforced-concrete structural elements with zoning or element sizes smaller than the concrete aggregate. Scalable software and hardware allows an analyst to efficiently perform simulations with millions rather than thousands of elements. Using these tools, the fundamental behavior of concrete when subjected to intense transient loadings is being investigated by numerically treating the concrete as a heterogeneous material composed of mortar and aggregate. Modeling concrete at this scale permits much greater latitude to investigate cause-and-effect relationships. Numerical parameter studies can be used to investigate the effects of varying (1) the strength and compressibility of the mortar and aggregate, (2) the aggregate size, shape, size distribution, and orientation, and (3) the mortar and aggregate bond strength.

As part of this research effort, unreinforced concrete slabs (nominal dimensions of 2 x 2 x 0.2 meters) were subjected to the explosive loading environments produced by contact detonation charges; the charge masses varied from 0.3 to 1.2 kilograms. Using finite element meshes that modeled the large aggregate and the mortar, the responses of concrete slabs were numerically simulated. Results from these simulations were compared to simulations conducted with standard homogeneous modeling techniques.