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# Lattice discrete particle modeling of plain concrete perforation responses

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**Abstract**

This paper numerically investigates the large-caliber hard projectile perforation of plain concrete slab with steel culvert confinement by using the recently developed Lattice Discrete Particles Model (LDPM). With mesoscale constitutive laws governing the interaction between adjacent particles, LDPM simulates concrete features like cohesive fracture, strain hardening in compression and compaction due to pore collapse. The perforation simulation model is established with LDPM for concrete, elastoplastic model for steel culvert and penalty contact for projectile-concrete interaction. Simulation of 5 shots concrete perforation tests are carried out to validate the numerical model, and the numerical results are in good agreement with the experimental data in terms of residual velocities as well as target damage mode. Extensive simulations are further performed to investigate the effects of aggregate discretization, steel culvert confinement and diameter size on perforation responses. Comparative numerical study indicates that with culvert confinement, the projectile residual velocity is significantly reduced except for perforation case with 0.3 m thickness target. Meanwhile, crack fills the 0.6 m diameter target which poses less resistance to projectile impact.

*Keywords:* Concrete perforation; Steel culvert; Lattice Discrete Particle Model; Residual velocity; Damage mode.

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