



Numerical simulation on continuous penetrating/blasting behavior of multi-projectiles against concrete target

S P Wang, J Z Tan, C H Su and Y F Zheng*

State Key Laboratory of Explosion Science and Technology, Beijing Institute of Technology

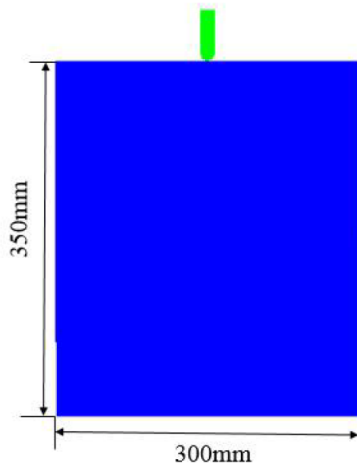
Abstract

Deep digger weapon system uses continuous kinetic energy and chemical energy of the penetrating/blasting projectiles to dig the concrete target. In the present paper, numerical simulations are conducted to study the continuous penetrating/blasting effects of multi-projectiles against concrete target. The simulation results show the KE penetration produces the crushing and rupturing zone, providing conditions for subsequent damage due to explosions. Then, the explosion further increases the diameters of the crushing and rupture area, and the cracks propagate inside the concrete target. The second penetration and blast further increase the depth and the damage area, achieving deep digger behavior to the concrete target. However, the throwing effect of secondary penetration/blast is slightly weaker than that of first one. Moreover, the simulation also shows the continuous penetrating/blasting behavior is influenced markedly by impact velocity.

Introduction

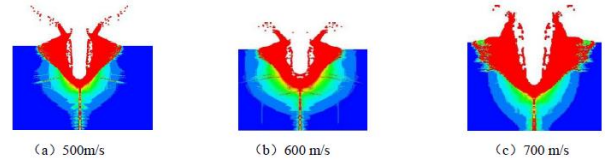
In order to study the penetrating/blasting effect of multiple continuous penetrating/blasting projectiles on concrete targets, this paper, based on AUTODYN-2D software, simulates and analyzes the penetrating/blasting effect on concrete targets under different impact velocities, projectile diameters and charge types.

1. In the numerical simulation to study the impact velocity, the initial velocity of the projectile was changed to 500, 600 and 700m/s, respectively, to observe the damage effect of the projectile penetration and blast on the concrete target, and study its influence law; 2. In the numerical simulation to study the influencing factor of projectile diameter, by changing the diameter of the projectile to 14, 16 and 18mm respectively, observe the damage effect of projectile penetration and blast on the concrete target, and study its influence law; 3. In the numerical simulation on the concrete target, and study the damage effect of explosive power influence of studying the influencing factor of the charge type, by changing the charge types to TNT, EXPLOSIVE B and OCTOL, observe the damage effect of projectile penetration and blast.

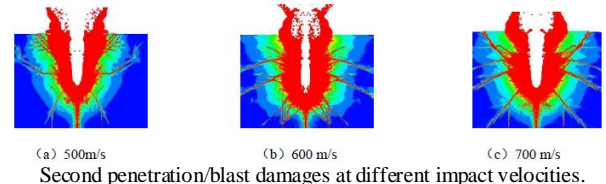


The model in initial state

Result 1

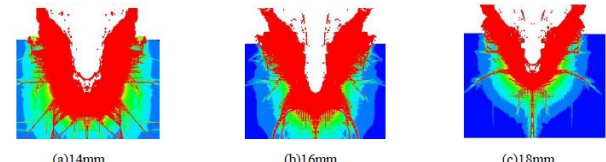


Target damages caused by first penetration/blast at different impact velocities.

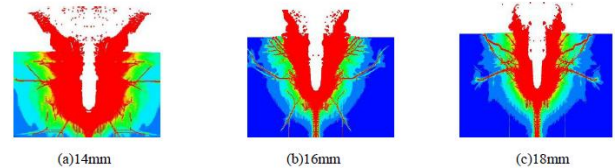


Second penetration/blast damages at different impact velocities.

Result 2

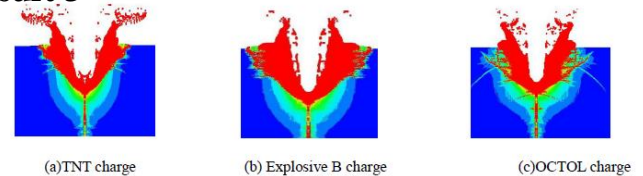


Target damages caused by first penetration/blast at different projectile diameters.

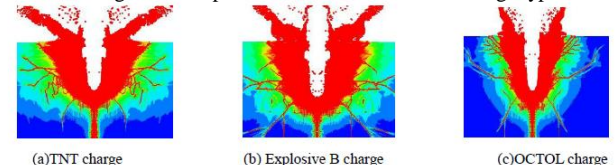


Second penetration/blast damages at different projectile diameters.

Result 3



The damages of first penetration/blast at different charge types.



The damages of second penetration/blast at different charge types.

Conclusion

Based on the numerical simulation of AUTODYN-2D software, the influence of three different factors on the continuous penetrating/blasting behavior is obtained. When the penetrating/blasting projectile is applied to the concrete target, the explosive effect increases the crater diameter and the crushing area significantly. The impact velocity, projectile diameter and charge type of the projectile have significant influences on the penetrating/blasting behaviors to concrete target. Compared with the first penetration/blast on the concrete target, the second one produces a greater penetration depth to the target plate, but because the explosion area is far away from the free surface, the throwing effect of the second penetration/blast to the free surface particles is lower than that of the first one.