

Preface

Concrete materials and structures have been widely used in both civil and military engineering. The responses of concrete materials and structures hit by kinetic energy projectiles as well as large aircrafts are the main focuses for both protective structural engineers and weapon designers. For the local responses of concrete targets hit by projectiles, the following four regimes of penetration mechanics can be classified roughly by initial striking velocity of the projectile (denoted by V_0). They are the non-deformable penetration regime ($V_0 \leq 0.9$ km/s for the traditional earth penetration weapon, etc.), the mass abrasive projectile penetration regime (0.9 km/s $< V_0 \leq 1.5$ km/s for the advanced earth penetration weapon, etc.), the semi-hydrodynamic (eroding) projectile penetration regime (1.5 km/s $< V_0 \leq 3$ km/s for the long-rod penetrator), and the hydrodynamic penetration regime ($V_0 > 3$ km/s for the shaped charge jet, space debris, etc.).

Aircraft crash on targets can be classified as the soft impact. The collision velocity of the aircraft is around 120 m/s for the taking off and landing scenarios and may reach about 250 m/s for the deliberate collision in the hijacking.

In this book, the authors present their theoretical, experimental, and numerical investigations on concrete materials and structures under projectile and aircraft impacts in recent years. The main contents consist of three parts.

Part I: Projectile Impact. Introduction of the local response of concrete targets under projectile impact as well as a review of the existing empirical, analytical, and numerical studies (Chap. 2); an extended cavity expansion model as well as a unified rigid projectile impact model for both thick and thin concrete slabs (Chap. 3); mass abrasive projectile penetration models (Chap. 4); eroding projectile and shaped charge jet penetrations (Chap. 5); analysis of terminal ballistic trajectory (Chap. 6); numerical simulation of projectile impact with a modified HJC model and a modified K&C model (Chap. 7).

Part II: Aircraft Impact. Determination of aircraft impact force (Chap. 8); numerical simulations of dynamic response of the prestressed nuclear power plant containment against commercial aircraft A320 collisions (Chap. 9); two series of aircraft engine model collision experiments on ultra-high-performance steel

fiber-reinforced concrete (UHP-SFRC) slabs and mesoscopic numerical simulations (Chap. 10).

Part III: Protective Materials and Structures. Impact resistance of two new types of ultra-high-performance cement-based composites (UHPCs), e.g., basalt- and corundum-aggregated UHP-SFRC (denoted by UHP-BASFRC and UHP-CASFRC, respectively) hit by ogive- or flat-nosed projectiles (Chap. 11); impact resistance of four types of concrete structures (UHP-BASFRC/fabric composite slab; monolithic and segmented RC slabs with a rear steel liner; SFRHSC/steel liner/sandy soil-layered composite target; and the rock-rubble overlay) (Chap. 12).

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