

Special Issue Reprint

High-Performance Concrete

www.mdpi.com/books/reprint/11013

Edited by

Yekai Yang

Weiqliang Wang

Yiwei Weng

Zhaoyao Wang

Qiao Wang

Ruizhe Shao

ISBN 978-3-7258-4221-6 (Hardback)

ISBN 978-3-7258-4222-3 (PDF)



Over the past three decades, high-performance concrete (HPC) and ultra-high-performance concrete (UHPC) have emerged as transformative materials in civil engineering and construction. Characterized by their exceptional compressive strength (often exceeding 150 MPa for UHPC), high ductility (strain-hardening behavior under tension), and superior durability, these materials represent a paradigm shift from conventional concrete. The versatility of HPC/UHPC has enabled its adoption in cutting-edge engineering applications. In 3D-printed construction, their rheological properties—tailored through precise control of viscosity and thixotropy—allow for layer-by-layer extrusion without slump deformation, enabling complex geometries unachievable with ordinary concrete. For dry concrete construction, HPC/UHPC's rapid hardening and low water-to-binder ratio minimize curing time and reduce shrinkage cracks, which is critical for prefabricated modular systems. In protective engineering, UHPC's high fracture toughness and energy absorption capacity make it ideal for blast-resistant structures, seismic retrofitting, and coastal defenses exposed to chloride ingress. Emerging applications further underscore its transformative potential. Despite the growing body of research focused on HPC/UHPC, numerous challenges and unresolved research gaps persist, necessitating further innovative exploration.

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