THE UNIVERSITY OF CONNECTICUT
CIVIL & ENVIRONMENTAL ENGINEERING

MOSTAFA HASSAN

PHD DISSERTATION
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
UNIVERSITY OF CONNECTICUT

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CAST 306

Advisory Committee:
Dr. Kay Wille (Major Advisor)
Dr. Ramesh Malla (Associate Advisor)
Dr. Jeongho Kim (Associate Advisor)
Dr. Wei Zhang (Associate Advisor)
Dr. Shinae Jang (Associate Advisor)

ULTRA-HIGH PERFORMANCE FIBER REINFORCED CONCRETE BEHAVIOR UNDER IMPACT LOADING

ABSTRACT

Increasing the dynamic resistance for the structures is one of the benefits of using ultra high performance concrete (UHPC) and ultra-high performance fiber reinforced concrete (UHP-FRC). This current research focuses on the ultimate compressive and tensile impact strength represented by the dynamic increase factor (DIF), the ratio between the dynamic strength and the quasi-static strength, for UHPC and steel fiber ultra-high performance concrete (SF-UHPC) using split Hopkinson pressure bar (SHPB). The main goal is to obtain and validate the experimental test results of UHPC and UHP-FRC under high compressive and tensile strain rate range from 22-200 s^{-1}. Also, Achieving the experimental requirements for the dynamic testing using the SHPB for brittle materials (having stress equilibrium (SE) during the test, constant strain rate (CSR) over an effective time period, and reducing the inertial, friction, and wave dispersion effects).

Different steel mono-fiber volume fraction content (0% - 4%) will be used to develop a general equation for the (DIF) for the SF-UHPC with a compressive strength exceeds 200 MPa. The quasi-static and the dynamic compression strength for UHPC and SF-UHPC with different volume fraction was reported.

Digital image correlation (DIC) was used to monitor the strains of some samples using a high speed camera at 105,000 - 186,000 frames per second and thus to compliment the calculated strain values that was obtained by the SHPB equations.

A three-dimensional finite element analysis has been performed using ABAQUS/Explicit to model multi- impacts on UHPC to check the frictional effect contribution to the DIF and the validity of the constitutive model in representing the behavior of UHPC.

Finally, addressing the tensile static and dynamic behavior of UHP-FRC. Static tensile test according to the ASTM requirements is used while modified dynamic tensile setup of split Hopkinson tensile bar (SHTB) is used to determine the dynamic behavior and the dynamic increase factor (DIF) for UHP-FRC under high strain rates ranging from 55.3 - 156.04 s^{-1}.