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Structural Testing of Composite Crash Structures

By

Iman Babaei

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Supervisor(s):

Prof. Giovanni Belingardi

Prof. Davide Salvatore Paolino

Doctoral Examination Committee:

Prof. Valentina Lopresto, Referee, Università degli Studi di Napoli Federico II

Dr. Pietro Russo, Referee, CNR Istituto per i Polimeri Compositi e Biomateriali

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Iman Babaei
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Structural Testing of Composite Crash Structures

Iman Babaei

Since 1980s scientists have demonstrated that fiber reinforced polymer composites exhibit high specific energy absorption capabilities. However, lack of understanding of their energy absorbing mechanisms under different conditions has hindered full potential applications of composite structural components. Testing the final structures under various scenarios is complex, expensive, and time consuming. Therefore, it is necessary to have a methodology for assessing energy absorption capacities in element levels. With the help of the building block approach, a testing methodology has been developed to solve this problem.

For the element level experiments, saw-tooth triggered flat rectangular specimens with dimensions of 150×100 *mm* have been used. A new fixture has been designed and manufactured to support this flat specimens under impact and initiate stable failure by preventing global buckling. Four cylindrical anti-buckling columns with adjustable heights have been adopted to support the specimens from two opposite sides. Cylindrical columns to avoid tearing of the elements, gap in the bottom to avoid jamming, up to 50 *mm* of crushable lengths, and the possibility of capturing the fracture mechanisms with high speed camera from the lateral side are some of the advantages of this fixture compared to the previously developed ones.

Using this fixture, effects of unsupported height, impact velocity, and impact mass on the crashworthiness evaluations have been studied. The promising reproducible results have proven the reliability of the fixture. These results have been used for the optimization of the numerical simulations performed in a companion PhD work. Moving upward in the building block, quasi-static and dynamic crush tests have been performed on Formula SAE crash boxes made of carbon fiber/epoxy composite. These results have proven the validity of the proposed approach.