BLAST MITIGATION BY SMART COATING: EXPERIMENTAL AND NUMERICAL INVESTIGATION OF POLYUREA COATED CONCRETE PANELS

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ABSTRACT

In case of an explosion event, in addition to the direct risk from the blast wave, secondary risks arise from component debris ejected from an affected structure. In particular, concrete and masonry wall elements represent a potential hazard because they show a high degree of fragmentation when exposed to an extreme load (e.g. blast waves, contact detonation). It is therefore essential in the structural protection design to ensure that load-bearing elements such as the outer walls of a building can withstand an explosion load not only with respect to the structural integrity and robustness of the structure but also for the safety of the surrounding area.

It is both possible to increase the strength of the load bearing structure and to reduce the amount and velocity of debris by adopting a polyurea-based coating. The general effectiveness of this approach has already been demonstrated [1, 2, 3]. However, a systematic research for this specific application is still lacking.

The paper describes an experimental and numerical work with to investigate the behavior of polyurea coated concrete wall panels under blast load. By comparing the results to uncoated concrete wall panels, the blast mitigation effect of polyuria coating for concrete wall panels is assessed. Experiments were performed with the Blast Star shock tube at Fraunhofer EMI in Freiburg, Germany for different load pressure level. Additionally, a numerical model has been implemented in LS-DYNA©.

Furthermore, component tests have been performed for the numerical simulation of the polyurea as well as the adhesive bond between polyurea and concrete. The results were used to establish and evaluate a Polyurea constitutive model as well as a contact formulation for the polyurea-concrete interface adopted in the simulation.

Parameters such as concrete compressive strength, reinforcement ratio, dimension of the wall slab and explosion scenario (near field, far field) were analyzed to obtain a systematic overview of the effectiveness of the Polyuea coating as protective measure. This can be transferred into application recommendations or guidelines for structural protection.

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