SIMULATIONS OF BLAST AND FRAGMENT IMPACTS ON REINFORCED CONCRETE

U. Nyström, K. Gylltoft

Chalmers University of Technology, Department of Civil and Environmental Engineering, Division of Structural Engineering, Concrete Structures
Sven Hultins gata 8, SE-412 96 Göteborg, Sweden

ABSTRACT

The complex phenomena involved in combined blast and fragment loading and the subsequent response of the loaded structure are the main reasons for the limited knowledge within this area.

In order to increase the knowledge of the effects of combined blast and fragment loading of a reinforced concrete beam, numerical simulations were conducted in the hydrocode ANSYS AUTODYN 3D. Since simulations of blast and fragment loading may place different, and sometimes conflicting, demands on the numerical model, the study presented in this paper was preceded by the work of calibrating and validating the numerical model. This preliminary work is briefly described.

A few cracks to which the elongation of the rear face of the beam was localized were formed in the case of blast loading alone, while the number of flexural cracks in the cases where fragments were involved was numerous. The increased number of flexural cracks in the cases of fragment impacts may affect the energy-absorbing capacity positively.

In the simulations involving fragment impacts the damage also consisted of local damage, i.e. craters on the front face of the beam, scabbing cracks at the rear of the beam, and direct shear cracks close to the supports. Since most damage caused by the fragment impacts occurred very early in the response (within 0.25 ms), the fragment impacts may have highly influenced the response in the case of combined loading since the load-carrying capacity of the beam may have been seriously decreased.

It can be concluded that the damage caused by combined blast and fragment loading was more severe than if adding the damages caused by the blast and fragment loading treated separately, indicating a synergy effect in combined loading.