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PROPAGATION OF DAMAGE IN STRUCTURES UNDER BLAST LOAD

Keywords: material models, concrete, finite elements, blast load

1. INTRODUCTION

The main goal of the study was to present the results of authors' research on application of a nonlinear elasto-plastic material model for concrete in order to analyze the damage propagation in reinforced concrete structures under blast loads. The analysis was performed using nonlinear finite element system Abaqus with implemented material model. Due to availability of experimental results in the literature, it was possible to compare the obtained numerical results with experimental data. This enabled to formulate the adequate conclusions.

2. ANALYSIS

Propagation of damages in structures loaded by the explosion is a most important factor influencing their integrity, defined as the ability to preserve the partial structural functionality after the damage of several elements.

Stability and integrity structures (in particular – multistorey buildings) is studied in the framework of an international research programme COST TU0601 „Robustness of Structures", in order to define the criteria for the evaluation of the structure in terms of its integrity end resistance against local damages.

Former studies performed by the authors showed the importance of assumed material model for the quality and reliability of results obtained with the use of finite element method computer codes. For the concrete it is still an important problem, for its specific damage mechanisms (different for the compression, and different for tension).

The implemented material model in based on well-known idea of description of the damage using the scalar parameters (Kachanov [1] and Lemaitre [2]). The continuum damage mechanic assumption has been adopted together with effective stress conception:

$$\overline{\boldsymbol{\sigma}} = \mathbf{D}_o : (\boldsymbol{\varepsilon} - \boldsymbol{\varepsilon}^p)$$

The example considered in the paper consists of reinforced concrete vertical plate subjected to a blast load. The experiment was performed and described in details by Schenker et al. [3] and analyzed numerically by Ruchwa [4].

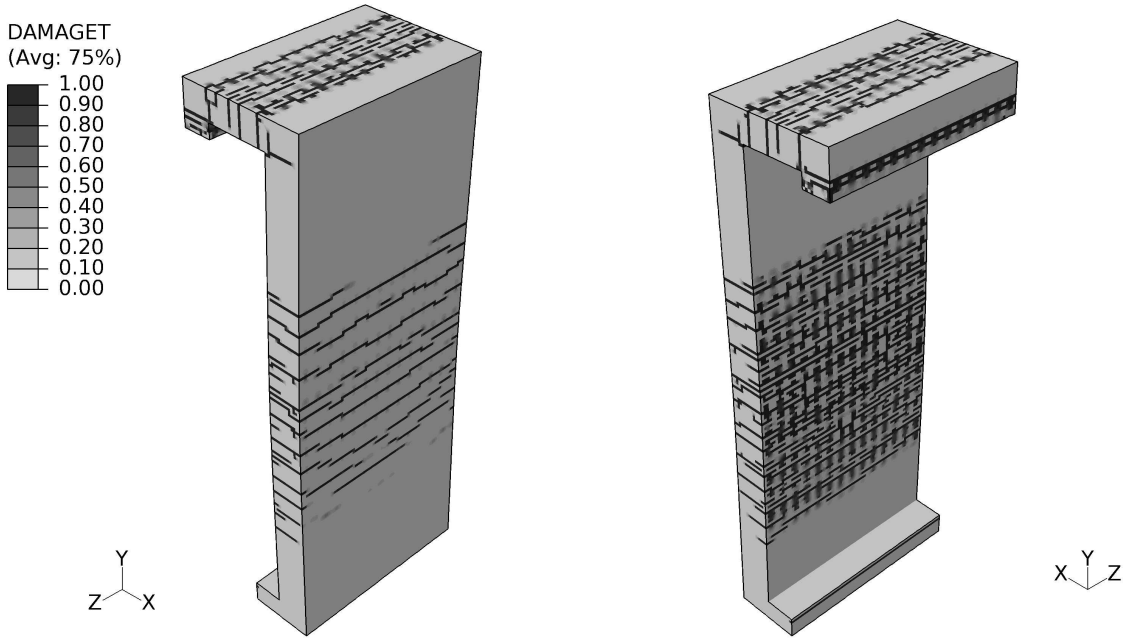

Fig. 1. Final distribution of damage parameter DAMAGET (black lines – damaged materials).

3. CONCLUSIONS

Results of numerical simulations performed for selected examples of reinforced concrete plates subjected to a blast load show the possibility to apply the presented material model for purposed of damage propagation analysis, including the definition of damages extent in the material. This is extremely important, when the damage mechanism is very complex, impossible to define *a priori*.

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