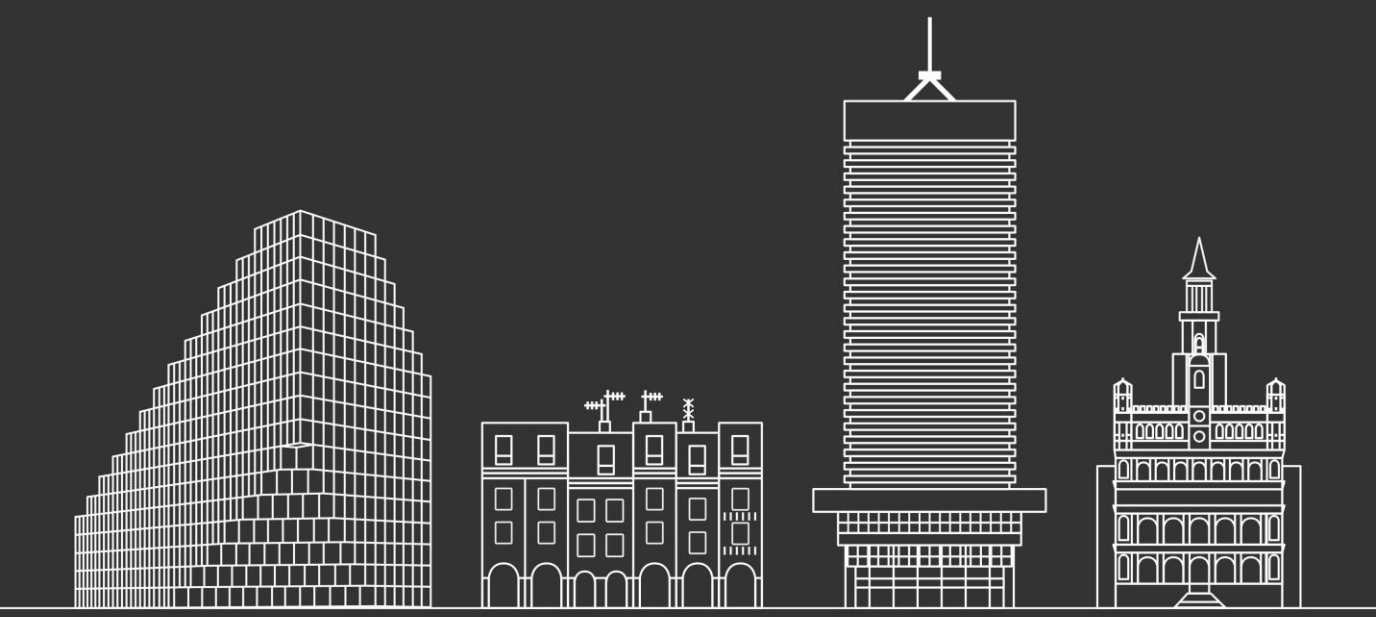
ICPS5

5th International Conference
on Protective Structures
19-23 August 2018, Poznań, Poland

BOOK OF ABSTRACTS



Book of Abstracts

5th International Conference on Protective Structures (ICPS5)

19-23 August 2018, Poznan, Poland

Poznan University of Technology PUT | Poland

Honorary patronage

Ministry of Science and Higher Education
Republic of Poland

PAN

IAPS International Association of Protective Structures

Poznan, 2018

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100# Analysis of impact resistance and protective characteristics of fibre reinforced concrete plates

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Abstract

The results of numerical analyses carried out on concrete elements produced from waste aggregate (ceramic rubble) and steel fibres have been presented in this study. The elements taken into consideration were circular plates of 1 m diameter, thickness 0.1 m, with various percentage of steel fibres. Main study has been performed for plates without steel fibres and for three variants of reinforcement. Three types of fibres have been considered. Impact loads have been realized by the free fall of 40 kg mass from the height of 1 m. After each impact the permanent deflections of the plate were measured in several selected points, as well as localization of cracks, their configuration and dimensions. Nonlinear Finite Element Method computer code ABAQUS was applied, and the continuous plastic damage model for concrete was used, where the damage is defined by two scalar parameters.

This study shows the necessity of experimental verification for numerical analysis performed with the use of advanced nonlinear finite element algorithms. Among many important factors for such analysis the assumption of adequate material model for concrete describing the entire dynamic response: from initial pure elastic behaviour until the total material damage is the most important factor for the adequacy of numerical results. Another important factor for numerical analysis is the assumption concerning the spatial distribution of fibres in a volume of the plate. Simplified approach presented in this paper is adequate for this specific case, but in general the random (or pseudo-random) distribution should be applied.

For lower values of fibre percentage in the material, the development of large cracks (i.e. large volume of damaged material) has been observed. Plates with higher fibre percentage are much more resistant to impacts, due to larger amount of energy dissipated by plastic effects in steel fibres. This allows to avoid development of large cracks in concrete matrix and consequently separation of the plate into several non-connected parts.

Special attention has been paid to study the relationship between the energy delivered to the system by impacts, and the development of damage in various types of plates (type of fibre and the reinforcement percentage). Although the values of damage energy changes for various types of impactors, certain regularity is observed. For higher mass of impactor, total failure of the plate occurs for lower values of total impact energy.

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