HRVATSKO **D**RUŠTVO ZA **M**EHANIKU
CROATIAN **S**OCIETY OF **M**ECHANICS
✉ **Ivana Lučića 5, HR -10000 ZAGREB**
Republika Hrvatska
☎ **01 61 68 540**
Faks: **01 61 68 187**
Žiro račun: 2360000-1101406777
e-mail: jasna.biondic@csm.hr
http://www.csm.hr

Zagreb, 14. listopada 2008.

P o z i v

Pozivamo Vas na predavanje

"Finite Element Simulation of Concrete Failure at High Impact Loading Rate"

koje će održati ***Vanja Travaš****, dipl. ing. građ. sa Građevinskog fakulteta, Sveučilišta u Rijeci,* ***prof. dr. sc. Joško Ožbolt,*** *sa Institute of Construction Materials, University of Stuttgart,* ***prof. dr. sc. Ivica Kožar,*** *sa Građevinskog fakulteta, Sveučilišta u Rijeci,*

u ***četvrtak 23. listopada 2008. u 18,00 sati,***

na ***Fakultetu strojarstva i brodogradnje, Zagreb, Ivana Lučića 5, predavaonica F.***

Više o predavanju može se naći na web-stranici: www.csm.hr.

PREDSJEDNIK DRUŠTVA

Prof. dr. sc. Jurica Sorić

FINITE ELEMENT SIMULATION OF CONCRETE FAILURE AT HIGH IMPACT LOADING RATE

Vanja Travaš
Faculty of Civil Engineering, University of Rijeka, V.C. Emina 5, 51000 Rijeka, Croatia
E-mail: vanja.travas@gradri.hr

Joško Ožbolt
Institute of Construction Materials, University of Stuttgart, Pfaffenwaldring 4, 70550 Stuttgart, Germany
E-mail: ozbolt@iwb.uni-stuttgart.de
web page: http://www.iwb.uni-stuttgart.de/mitarbeiter/profile/63.htm

Ivica Kožar
Faculty of Civil Engineering, University of Rijeka, V.C. Emina 5, 51000 Rijeka, Croatia
E-mail: ivica.kozar@gradri.hr
web page: http://www.gradri.hr/~ivicak/

ABSTRACT: A numerical simulation of concrete failure at high impact loading rate will be presented. The contact/impact analysis is performed on the mechanical interaction between two bodies. Following the standard notations in contact mechanics, the contractor body is described with the hyperelastic material model using the second Piola-Kirchoff stress tensor conjugated with the Green-Lagrange strain tensor. Adopting the well known update Lagrange formulation (UL), the stress and strain are calculated with respect the referent system which is successively updated. During the contact time, the contact constrains are satisfied with the Lagrange multiplier method adapted for the explicit time integration. At the contact interface, the frictional energy dissipation is simulated by the constitutive Coulomb frictional law. On the implementation level, the frictional law is introduced by the relaxation of tangential nodal displacement. To simulate the mechanical behavior of the concrete body (target body), the stress-strain relationship is carried out via the rate sensitive microplane material model with relaxed kinematic constraint. The macroscopic strain measure is performed with the left logarithmic strain tensor (Henky strain). By including and excluding the rate effect from the numerical formulation, the influence of the rate sensitivity will be demonstrated on a concrete beam failure caused by impact loading. Also, an impact velocity influence will be presented. The numerical results predict the beam failure patters investigated with the experimental methodology. Namely, the type of beam failure is directly related to the rate of impact loading. For relative low impact velocity the numerical results coincide with the experimental results providing the expected bending failure mode (MODE I). For relative high impact loading, the crack trajectory describes the typical mixed mode of failure.