Abstract Submitted
for the SHOCK05 Meeting of
The American Physical Society

Modeling the Shock Compression of Concrete Under 20 GPA
ERIC BUZAUD, Centre d'Etudes de Gramat, PIERRE-LOUIS HEREIL, Centre d'Etudes de Gramat, CHRISTOPHE PONTIROLI, CS-SI, PHILIPPE LAMBERT, SA — The aim of the authors is to model the shock response of concrete in a range of pressure levels from 0 to 20 GPA. The limitations of current computers imply the need to homogenize the response of the different constituents of concrete into a single macroscopic model. Though concrete is currently the most widely used construction material, the knowledge concerning its response under shock loading response remains rather modest. An exhaustive review of the research effort in this field illustrates this fact. The origin of the important dispersion that affects the limited available data is analysed and discussed. The authors propose a simple method to predict the shock Hugoniot of concrete based on a mixture theory, considering concrete as a mix of cement hydrates, free water, rock and voids. The potential of this approach is illustrated by comparisons to the available data. Finally, experimental results recently obtained on special concrete compositions are presented. Those results allow to relate the wave structure to the size of the aggregates, and so, the level of heterogeneity of the composition. Complementary numerical simulations illustrate the ability of a mesoscopic model to describe this phenomenon, and the failure of the homogenized approach to do so.

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Date submitted: 31 Mar 2005 Electronic form version 1.4