Science Arts & Métiers (SAM)
is an open access repository that collects the work of Arts et Métiers Institute of Technology researchers and makes it freely available over the web where possible.

This is an author-deposited version published in: https://sam.ensam.eu
Handle ID: .http://hdl.handle.net/10985/20361

To cite this version :

Hocine CHALAL, Farid ABED-MERAIM - Simulation of structural applications and sheet metal forming processes based on quadratic solidshell elements with explicit dynamic formulation - 2018

Any correspondence concerning this service should be sent to the repository Administrator : scienceouverte@ensam.eu

Simulation of structural applications and sheet metal forming processes based on quadratic solid–shell elements with explicit dynamic formulation

Hocine CHALAL *, Farid ABED-MERAIM

Laboratory LEM3, Université de Lorraine, CNRS, Arts et Métiers ParisTech, F-57000 Metz, France;

Abstract

In this work, nonlinear dynamic analysis of thin structures is investigated using quadratic solid–shell (SHB-EXP) elements. The proposed SHB-EXP elements are based on a fully three-dimensional formulation using an in-plane reduced-integration scheme along with the assumed-strain method in order to alleviate most locking phenomena. These developments consist of a twenty-node hexahedral element, denoted SHB20-EXP, and its fifteen-node prismatic counterpart, denoted SHB15-EXP. The formulation of these elements is combined with fully three-dimensional behavior models, including elastic behavior as well as anisotropic plastic behavior for metallic materials. The resulting formulations are implemented into ABAQUS explicit/dynamic software package in the framework of large displacements and rotations. First, to assess the performance of the SHB-EXP elements, four representative nonlinear dynamic benchmark tests have been conducted. Then, impact / crash problem and deep drawing of cylindrical cup have been performed to demonstrate the capabilities of the SHB-EXP elements in handling various types of nonlinearities (large strains, anisotropic plasticity, and double-sided contact). Comparisons with results obtained by ABAQUS elements as well as with reference solutions taken from the literature show the good capabilities of the developed quadratic SHB-EXP elements for the explicit dynamic simulation of thin structures.

Keywords: finite elements, quadratic solid–shell elements, explicit dynamic analysis, 3D simulations, thin structures, sheet metal forming.

* Corresponding author. Tel.: +(33) 3.87.37.54.30.

E-mail address: hocine.chalal@ensam.eu (H. Chalal).