Some Computational Issues in the Elasto-Plastic Modeling of Snow

Gianmarco Vallero, Monica Barbero, Fabrizio Barpi,
Mauro Borri-Brunetto and Valerio De Biagi

Department of Structural, Building and Geotechnical Engineering (DISEG)
Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129 Torino, Italy
E-mail: gianmarco.vallero@polito.it

ABSTRACT

Snow is a high porosity and multi-phase material whose behavior is strongly influenced by peculiar features, such as time-driven metamorphisms of its microstructure and sintering processes between ice grains. Furthermore, from a mechanical point of view, the response of snow to external actions (anthropic, atmospheric, etc.) is characterized by both material and geometric non-linearities. This latter item is also accompanied by a clear strain-rate dependence induced by volumetric viscous effects acting on the ice microstructure.

These factors influence the choice of the best constitutive model capable of reproducing this complex behavior especially in the framework of Finite Element (FE) analyses [1]. In the scientific literature, many authors suggested the use of elasto-plastic constitutive models, in many cases derived from soil mechanics applications, to perform reliable FE analyses of snow behavior with reference to both laboratory [2] and on-site experiments [3]. Nevertheless, the available models often show some issues both in their initial hypotheses and in the following FE implementations. For instance, problems may arise in: i) choosing the proper deformation field (e.g., small or large strains), ii) selecting the most appropriate shape of the yield function, iii) defining the hardening and plastic-flow rules, etc.

In this work, some of the still open and unsolved questions related to the constitutive modeling of snow and suggestions on possible computational solutions through FE tools are highlighted. The goal is twofold: first, we try to summarize the current state-of-the-art of FE analysis on snow; and second, we suggest some possible research directions and computational solutions to improve the existing mechanical models.

REFERENCES

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