

Homogenization of Elasto-Plastic Plate Equations with Vanishing Hardening

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Abstract

In this work, we consider a lower dimensional homogenized thin plate model within the framework of linearized elasto-plasticity. Building on recent work analyzing the interaction between homogenization and dimension reduction in perfectly plastic materials, we focus on the extreme regime where the plate thickness vanishes much faster than the period of oscillation of the heterogeneous material. Our investigation is devoted to the derivation of the existence of a quasistatic evolution for a multiphase elasto-plastic composite without imposing any kind of ordering constraints on admissible yield surfaces of the various phases, generalizing in that way the result of [1].

The analysis is carried out in two steps: we first derive a heterogeneous plate model with hardening via dimension reduction using evolutionary Γ -convergence techniques and generalizing the result of [2], and then perform two-scale homogenization while simultaneously letting the hardening parameters tend to zero by using a stress-strain approach. This approach allows us to reconcile the Kirchhoff-Love structure of limiting displacements with the expected requirement that the effective dissipation potential at each point of the interface between two phases needs to be the pointwise-in-space inf-convolution of that in either phase.

References

- [1] M. Bužančić, E. Davoli and I. Velčić. "Effective quasistatic evolution models for perfectly plastic plates with periodic microstructure: The limiting regimes" *Advances in Calculus of Variations* **17**, no. 4, 1399–1444 (2024). <https://doi.org/10.1515/acv-2023-0020>
- [2] M. Liero, and T. Roche. "Rigorous derivation of a plate theory in linear elastoplasticity via Γ -convergence", *Nonlinear Differential Equations and Applications NoDEA*, **19**, no. 4, 437—457 (2012).