# Numerical evaluation of the homogenized limit domain of structured metamaterials.

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**ABSTRACT**

The design of the material grid at the scale of the elementary cell allows the behavior to be designed at the scale of the structure. In this way, a wide variety of geometries is now widely analyzed and proposed in literature.

It is known that the prediction of the structural behavior at the macroscale of aggregates of these elementary cells requires the preliminary study of homogenization to derive the average properties to be used in the finite analysis.
A large literature on the subject exists that allows the finite properties of the equivalent continuous material to be considered since the description of the elementary cell. An important aspect of homogenization lies in the knowledge of the constitutive behavior of the element in the elastic range, which is also accompanied by the definition of the admissibility domain of the elastic stress and possibly the definition of the flow rule of the permanent strain in the inelastic regime.

In the proposed work, we make use of a procedure developed for the calculation of the collapse load of elastoplastic structures that is based on the discretized writing by finite elements of a procedure based on Mélan's theorem of limit analysis that allows us to directly calculate the collapse load as the constrained optimal of the statically admissible stress states. Through the limit analysis, the representative points of the intersection of the elastic domain with the axes of stress in the reference frame of the stress in special components in hexa-dimensional space are obtained, which allows us not to hypothesize a priori any form of isotropy of the behavior of the material.

The procedure has been applied to some geometries typical of structural grids, in particular cubic symmetry, face-centered and body-centered.
The results highlight the dependence of the response in terms of elastic and inelastic isotropy on the texture and dimensional ratios of the elements that make up the lattice. Typical measure of the material anisotropy in the elastic range is reported and discussed in detail. The dependence on the ratio between the element dimensions is highlighted.

**References**

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