Statically admissible singular stress fields for masonry-like vaults

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Abstract. This contribution presents a simple method for producing equilibrated and purely compressive stress fields in two-dimensional masonry structures (such as vaults), that is statically admissible stress fields for so called masonry-like materials. The existence of such fields for a set of given load is a sufficient condition for safe loads, that is loads for which the structure is stable. The method is based on the formulation of equilibrium through a stress function that, due to the unilateral constraint on stress, must be concave and whose construction is, in many cases, simplified by admitting folds. The folds on the surface represents lines along which one of the two principal curvatures of the surface is unbounded and correspond to stress fields that are line Dirac deltas on such curves. The magnitude of the Dirac deltas is the jump of slope in the direction orthogonal to the curve.
These singular stress fields consists of concentrated axial forces applied along the "folding" lines and balanced with the stress jump across them.
A number of examples is presented in which such singular stress fields are constructed for class of loads depending on a parameter. The critical value of the parameter corresponding to collapse loads is obtained by constructing statically admissible and kinematically admissible fields for the same load.

Keywords: safe loads, unilateral materials, masonry structures.

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