# NUMERICAL ANALYSES OF LOCALISATION OF DEFORMATIONS

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Failure in most engineering materials like metals, soils, rocks, polymers and concrete is proceeded by the occurrence of narrow zones of intense deformation. Due to these zones, a degradation of the material strength develops. The localizations of deformation can occur as cracks (if cohesive properties of the material dominate over frictional ones) or shear bands (if frictional properties are crucial). An understanding of the mechanism of the formation of these zone is of a crucial importance since they act as a precursor to ultimate fracture and failure. Classical FE-analyses within a continuum mechanics are not able to describe properly both the thickness of localizations and distance between them since they do not include a characteristic length of micro-structure. Thus, they suffer from strong mesh sensitivity (its size and orientation) because differential equations of motion change their type and the rate boundary value problem becomes mathematically ill-posed. Thus, they require an extension by a characteristic length to accurately capture the formation of localizations. It can be achieved by the introduction in the continuum representation of strain gradients, polar terms, non-local quantities or viscosity.

The intention of the paper is to analyze plane strain localizations in granular bodies using a polar hypoplastic constitutive model [1] and in quasi-brittle materials using a non-local elasto-plastic model [2]. The hypoplastic constitutive law can reproduce essential features of granular bodies in dependence on the void ratio, pressure level and deformation direction. It is characterized by simplicity and a very wide range of applications. The material constants can be found by means of standard element tests and simple index tests. This model was formulated within a Cosserat continuum by an extension of a non-polar model by polar quantities: rotations, curvatures, couple stresses and mean grain diameter The different rate quasi-static boundary value problems are dealt with: cyclic shearing of an infinite narrow layer between two very rough boundaries, cyclic plane strain compression-extension test and earth pressures behind a retaining wall. The localizations in quasi-brittle materials were investigated with a non-local elasto-plastic constitutive law for plane strain compression. A yield surface following Drucker-Prager was assumed. The non-locality was related only to the equivalent plastic strain measure in the softening regime according to the Brinkgreve's proposal [3]. The FE-results were compared with results of calculations with a lattice discrete model wherein the continuum was discretized in a random triangular framework of beam elements [4]. In a lattice model, a simple linear elastic fracture law was assumed. The beams were removed from the specimen when their tensile strength was achieved. A realistic crack propagation was obtained.

**References**

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