9th European Solid Mechanics Conference (ESMC 2015)
July 6 - 10, 2015, Leganés-Madrid, Spain

Perturbations and shear bands

Davide Bigoni[1,*]

[1] DICAM University of Trento, Italy, bigoni@ing.unitn.it

Key words: Material Instabilities, Green's Functions, Perturbative Approach

Shear bands are a common example of material instability. They occur at a broad range of spatial scales: from the kilometric scale of the earth crust [1], down to the nanoscale in metallic glass [2]. In addition to their ubiquity, shear bands have the typical feature of remaining straight during mode II propagation (whereas cracks do not, see for instance the example reported in Fig. 1).

Figure 1: A runestone (shown at the Museum of Edimburgh) with several parallel and rectilinear localization bands, inclined at angles of approximately 45°.

Using the perturbative approach, proposed by Bigoni and co-workers [3-4] it is possible to *explain* the tendency of ductile materials towards failure into shear bands and the typical straight propagation [5]. Moreover, it is possible to analyse dynamical effects [6] and the interactions between a shear band and a rigid thin inclusion [7].

New possibilities of exploiting the perturbative approach will be presented to address situations where a dislocation dipole is emitted in a highly deformed metal [8] or where three-dimensional effects lead to cone-cup failure [9].

Acknowledgement: Financial support from the ERC Advanced Grant 'Instabilities and nonlocal multiscale modelling of materials' FP7-PEOPLE-IDEAS-ERC-2013-AdG (2014-2019) is gratefully acknowledged.

REFERENCES

[1] S.H. Kirby, Tectonophysics, 119 (1985) 1.

[2] B. Yang et al. Applied Phys. Letters 86 (2005) 141904.

[3] D. Bigoni Nonlinear Solid Mechanics Bifurcation Theory and Material Instability. Cambridge University Press, 2012.

[4] D. Bigoni, D. Capuani, J. Mech. Phys. Solids 50 (2002) 471.

[5] D. Bigoni, F. Dal Corso, Proc. Roy. Soc. A, 464 (2008) 2365.

[6] D. Bigoni, D. Capuani, J. Mech. Phys. Solids 53 (2005) 1163.

[7] D. Bigoni, F. Dal Corso, Proc. Roy. Soc. A, 465 (2009) 143.

[8] L. Argani, D. Bigoni, G. Mishuris, Proc. Roy. Soc. A, 469 (2013) 2154.

[9] L. Argani, D. Bigoni, D. Capuani, N.V. Movchan, Proc. Roy. Soc. A, 470 (2014) 2014.