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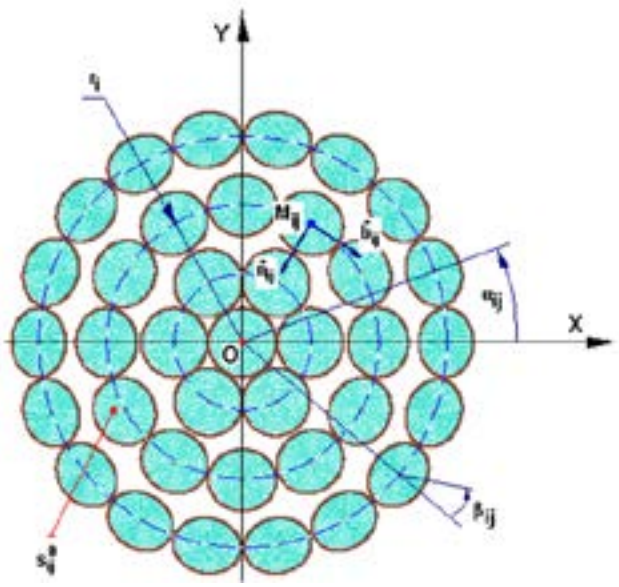
UNIFORM DISTRIBUTION OF ELASTIC DEFORMATION POTENTIAL ENERGY IN A TWISTED FIBROUS SHEAF

Ivelin Rahnev
E. Miroglio EAD, Industrial District, 8800 Sliven, Bulgaria
Ivelin.Rahnev@emiroglio.com



The uniform distribution of stresses and strains in the stretched fibrous sheaf is spread over its cross-section and longitudinally along the axis. The cross-section of the virtual sheaf represents a hexagonal matrix with concentric layers in which the fibres are arranged. The real fibrous sheaf has the structure of a three-phase fluid, in which the main phases are: the single fibres with the characteristics of ideal solid bodies; the air between the fibres and the contact area between them.

Since the fibres are the carriers of the mechanical behaviour of the sheaf, the structural analysis is focused on them. The cross-section of the fibre can be viewed in a similar hexagonal matrix. The virtual circle of the cross section is divided into a finite number of concentric sectors. The number of sectors can be increased until their thickness equals the thickness of the micro-fibrils or macromolecular chains of the fibre-forming polymers.

An optimal fibre cross-section division can always be found that balances calculation time and accuracy, but the number of sectors must be equal to and greater than the number of fibrous layers in the sheaf. The hexagonal division of the sectors progressively increases from the first to the peripheral fibrous layer. Thus, all tiles bounded in the sectors and between two virtual radii have the same area. Their shape is trapezoidal, but given their small size, it can be considered square. Virtual cells occupy the volume between two tiles, the distance between which is equal to the thickness of the sector.

Because of this separation of the virtual cells, each of them represents a finite element with definable metric parameters. This allows the application of the tensor determination of the stress state in a certain volume of the fibrous sheaf, which depends only on the location of the fibre and the cell in the cross section. Finally, the balance between the accumulated potential energy of elastic deformation and the virtual work from external torsion or elongation is based on the uniformly distributed state in the volume of the fibrous sheaf.

The subject of the article is the determination of the finite element of the fibre volumes according to the structure of the fibrous sheaf. The goal is to establish a uniform calculation of the stress state parameters in the twisted fibrous sheaf.

Keywords: *textiles, fibrous sheaf, stain-stress tensor fields.*