

TRANSVERSE ISOTROPY

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Annotatsiya

Ushbu maqola bugungi kundagi transversal izotrop paallileped uchun termoelastik masalani sonli yechishning tahlili keltirilgan.

Аннотация

В данной работе представлен анализ современного численного решения задачи термоупругости для трансверсально-изотропного паллипеда.

Annotation

This paper presents an analysis of the current numerical solution of the thermoelastic problem for a transversely isotropic pallileped.

Kalit so`zlar: ko'ndalang izotrop, izotropiya, tekislik, materiallar, Hisoblash, izotropiya, simmetriya, cheksiz tekisliklar.

Keywords: transversely isotropic, of [isotropy](#), plane, materials, Calculating, [isotropy](#), symmetry, infinite planes.

Ключевые слова: трансверсально-изотропный, изотропный, плоскость, материалы, расчет, изотропия, симметрия, бесконечные плоскости.

A **transversely isotropic** material is one with physical properties that are [symmetric](#) about an axis that is normal to a plane of [isotropy](#). This transverse plane has infinite planes of symmetry and thus, within this plane, the material properties are the same in all directions. Hence, such materials are also known as "polar anisotropic" materials. In geophysics, vertically transverse isotropy (VTI) is also known as radial anisotropy.

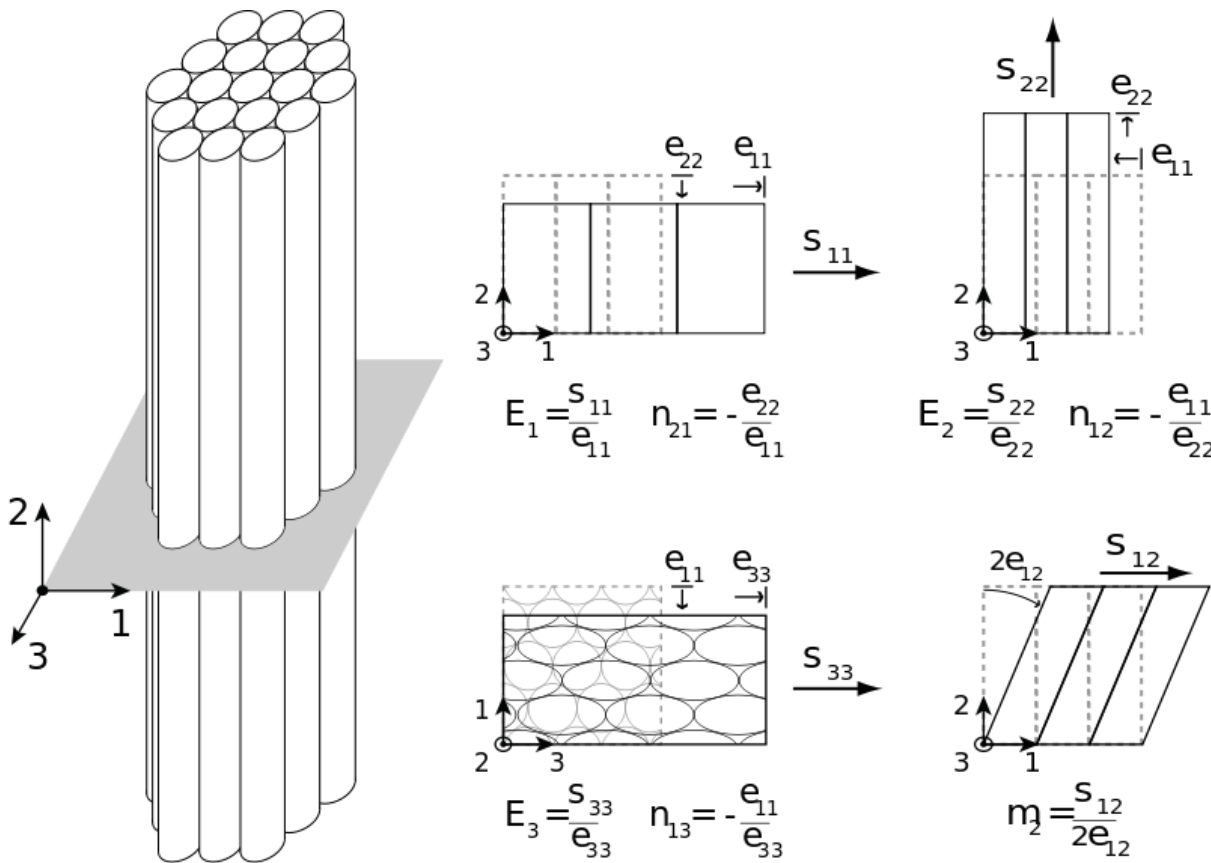
This type of material exhibits [hexagonal symmetry](#) (though technically this ceases to be true for tensors of rank 6 and higher), so the number of independent constants in the (fourth-rank) [elasticity tensor](#) are reduced to 5 (from a total of 21 independent constants in the case of a fully [anisotropic solid](#)). The (second-rank) tensors of electrical resistivity, permeability, etc. have two independent constants.



Example of transversely isotropic materials

An example of a transversely isotropic material is the so-called on-axis unidirectional fiber composite lamina where the fibers are circular in cross section. In a unidirectional composite, the plane normal to the fiber direction can be considered as the isotropic plane, at long wavelengths (low frequencies) of excitation. In the figure to the right, the fibers would be aligned with the x_3 axis, which is normal to the plane of isotropy.

In terms of effective properties, geological layers of rocks are often interpreted as being transversely isotropic. Calculating the effective elastic properties of such layers in petrology has been coined Backus upscaling, which is described below.



A transversely isotropic elastic material.

In geophysics

In geophysics, a common assumption is that the rock formations of the crust are locally polar anisotropic (transversely isotropic); this is the simplest case of geophysical interest. Backus upscaling is often used to determine the effective transversely isotropic elastic constants of layered media for long wavelength seismic waves.

Assumptions that are made in the Backus approximation are:

- All materials are linearly elastic
- No sources of intrinsic energy dissipation (e.g. friction)
- Valid in the infinite wavelength limit, hence good results only if layer thickness is much smaller than wavelength
- The statistics of distribution of layer elastic properties are stationary, i.e., there is no correlated trend in these properties.

For shorter wavelengths, the behavior of seismic waves is described using the superposition of [plane waves](#). Transversely isotropic media support three types of elastic plane waves:

- a quasi-[P wave](#) ([polarization](#) direction almost equal to propagation direction)
- a quasi-[S wave](#)
- a S-wave (polarized orthogonal to the quasi-S wave, to the symmetry axis, and to the direction of propagation).

Solutions to wave propagation problems in such media may be constructed from these plane waves, using [Fourier synthesis](#).

References

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