Reuss model of composite

Plate composite

Model of the plate composite loaded in the direction of layer thickness

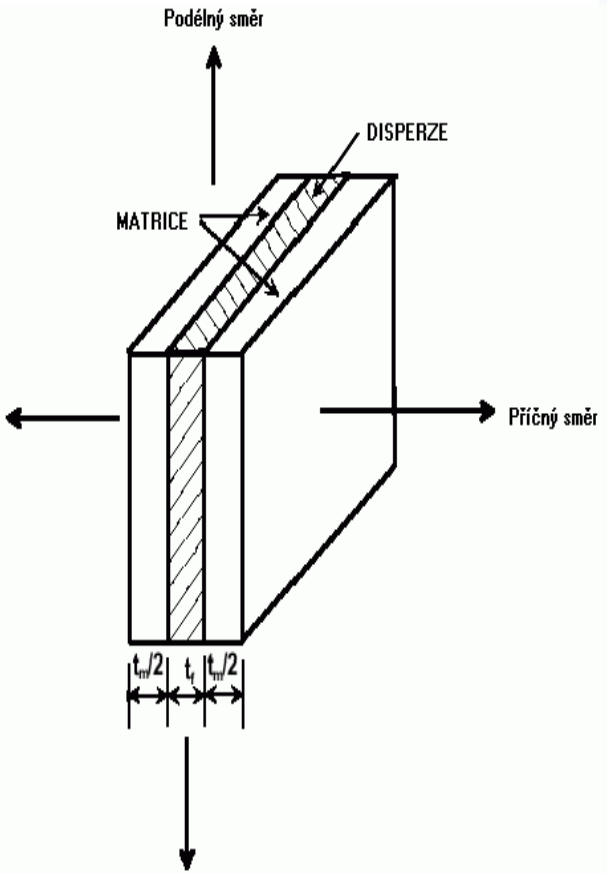
- In the main direction.

Since all plates have the same area, loading forces charged

$$P_k = P_d = P_m$$

Also stress

$$\sigma_k = \sigma_d = \sigma_m$$

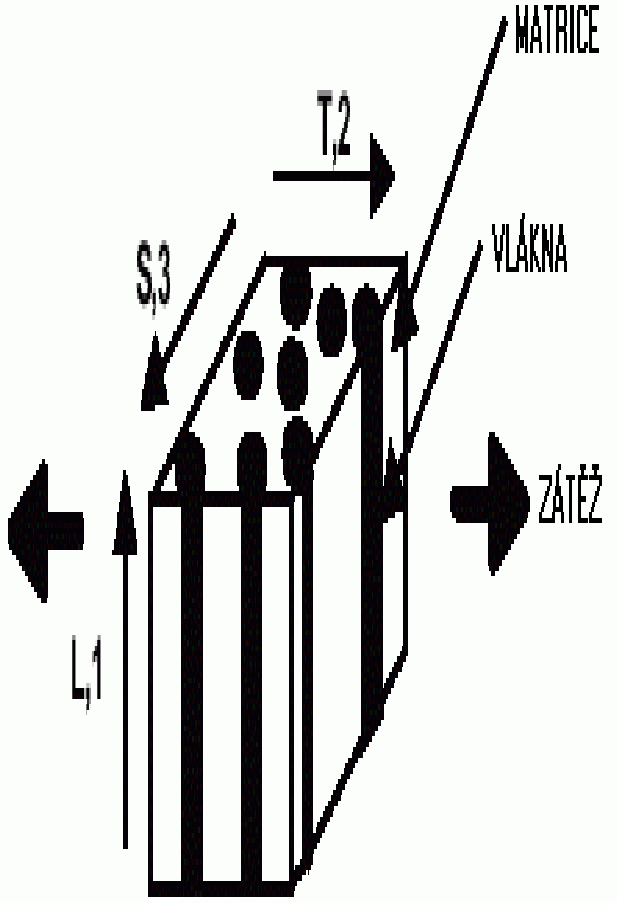


Fibre composite

The same assumption can also be used for the tensile stress of fiber composite in the transverse direction - in the plane of isotropy.

In the various sections is different ratio of dispersion and matrix, but if the matrix is not much, it can be assumed alternating layers of matrix and fibers.

Therefore, only a very approximate calculation



Calculation of global deformation

Global deformation of composite in the direction of force is sum of deformations thickness of matrix and dispersion plates. Therefore deformation of thickness of each plate is product of its relative deformation and thickness and deformations of plates we can sum, we can for whole composite write

$$\varepsilon_c * t_c = \varepsilon_d * t_d + \varepsilon_m * t_m$$

Dividing with the thickness of the composite tc get

$$\varepsilon_c = \varepsilon_d * v_d + \varepsilon_m * v_m$$

Calculation of Young's modulus

If we assume that all deformations are below the limit of elasticity, can be used again Hooke's law for fiber, matrix and composite :

$$\sigma_c / E_c = \sigma_d / E_d * v_d + \sigma_m / E_m * v_m$$

Therefore all the stress are equal, we have relation

$$\mathbf{1 / E_c = 1 / E_d * v_d + 1 / E_m * v_m}$$

We have mixing rule for the inverse of the Young's modulus

Limitations of the model

Model again applies only approximately, inequality Poisson ratios of dispersion and matrix causes transverse stress.

For fiber composite is it only a very simplified model.

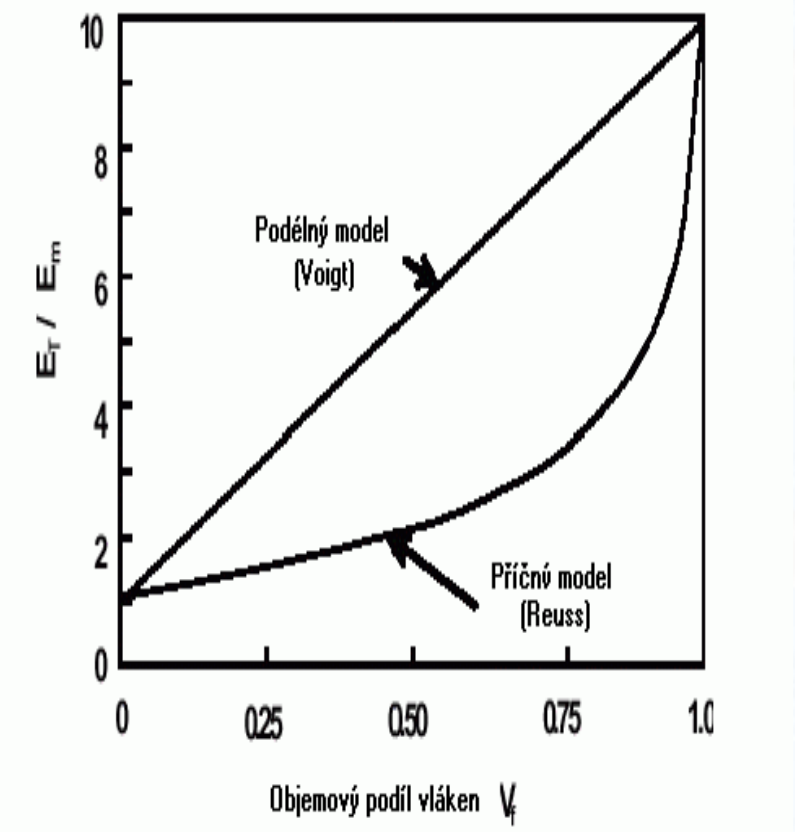
From the principle of minimum energy can be derived that Reussův model represents a lower bound (minimum) for the Young's modulus of the composite.

Comparison of Voigt's and Reuss model

Comparison of dependences of Young´s modulus on the proportion of fibers for

$E_d / E_m = 10.$

Can be understood as limits for composite with a different shape of dispersion (eg particle).



Models evaluation

- While Voigt's model describes well the behavior of fiber composites in tension in the direction of fibers, Reuss model describes the behavior of fiber composite with load perpendicular to the fibers (tension or pressure) only very approximately.
- Therefore, efforts to develop better models.