MAT COMPOSITES

Mats are made of cut fibers (fiber lengths between 5 and 10 cm) or of continuous fibers making a bidimensional layer

MAT COMPOSITES

Mats are **isotropic** within their plane (x, y). They can therefore be characterized by two elastic constants only. If E_1 and E_2 are the elastic moduli (longitudinal and transverse directions, respectively) of the **unidirectional** ply which would have the same volume fraction V_f of reinforcement as that of the mat ply, we have then

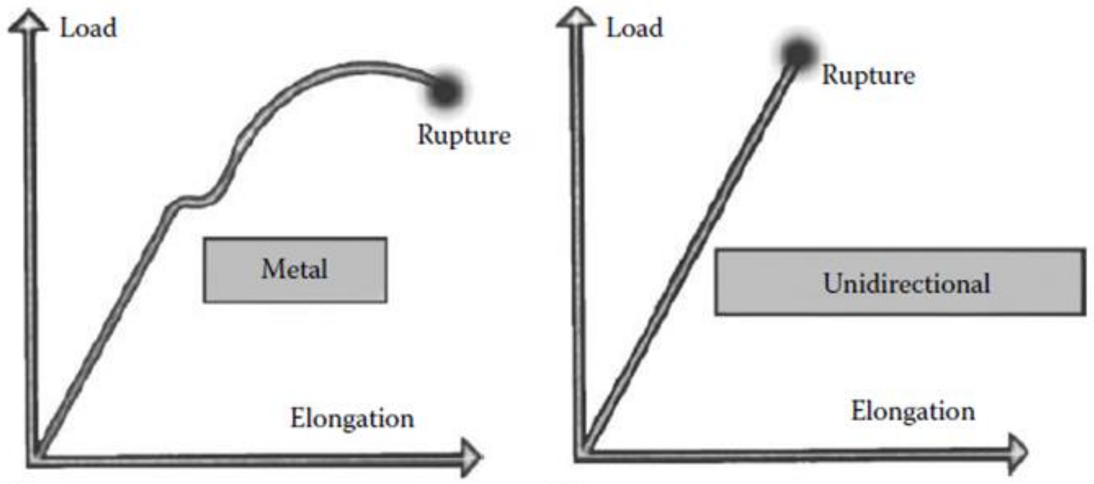
$$E_{mat} \cong \frac{3}{8} E_1 + \frac{5}{8} E_2$$

$$G_{mat} \cong \frac{E_{mat}}{2(1 + \nu_{mat})}$$

$$\nu_{mat} \cong 0.3$$

ULTIMATE STRENGTH OF A PLY

The curves in Figure below show the significant difference in failure behavior between classical metallic material and the unidirectional plies.



(a) (b)

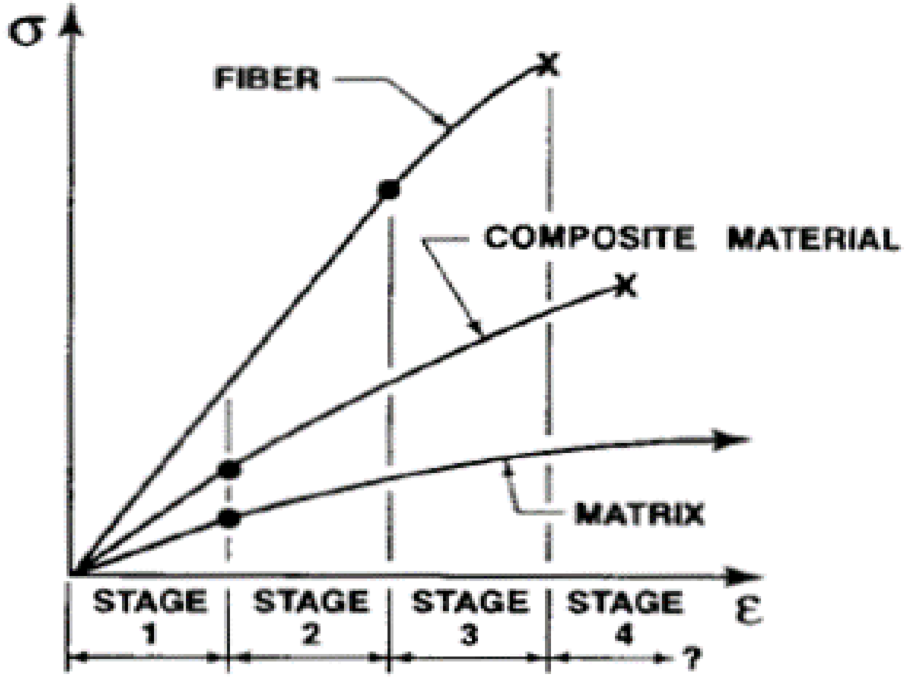
Such difference can be summarized in the few points listed here:

- A lack of plastic deformation in the unidirectional ply—this is a disadvantage.
- A high ultimate tensile stress for the unidirectional—this is an advantage.
- An important elastic deformation of the unidirectional, which can constitute an advantage or a disadvantage depending on the applications—for example, this is an advantage for springs, bows, or poles.

ULTIMATE STRENGTH OF A PLY

A unidirectional fiber-reinforced composite material deforms as the load increases in the following four stages, more or less, depending on the relative brittleness or ductility of the fibers and the matrix:

(1) Both fibers and matrix deform elastically
(2) The fibers continue to deform elastically, but the matrix deforms plastically
(3) Both the fibers and the matrix deform plastically
(4) The fibers fracture followed by fracture of the composite material



ULTIMATE STRENGTH OF A PLY

When the fibers break before the matrix during loading along the fiber direction, we obtain the following for the composite:

$$\sigma_1^{rupture} = \sigma_f^{rupture}\left[V_f + \left(1 - V_f\right)\frac{E_m}{E_f}\right]$$

or approximately,

$$\sigma_1^{rupture} \approx \sigma_f^{rupture} \times V_f$$