# THEORETICAL CONSIDERATIONS ON THE MICROMECHANICS COMPOSITE MATERIALS

**Constantin D. STĂNESCU**[1], **Doina TĂRĂBUŢĂ (ENE)** [1], **Mariana PĂTRAŞCU (ANTONESCU)** [1], **Melania TĂMAŞ**[1]

[1]"Politehnica" University of Bucureşti

**Abstract**: the efficiency of a composite material is distinguished by the top level of the technical characteristics and its properties. For their study, it appeals to a number of considerations, such as: minimum dimensions of the primary elements of reinforcement section, made up of fibres or threads; the high volumetric fraction ($V_f$ > 0.5); knowledge of the geometry of reinforcement phases. These considerations lead to the concept of composite plate.
**Keywords**: composite, reinforcement, fibre, straw.

## 1. INTRODUCTION

The effectiveness of a composite material is distinguished by the top level of the technical characteristics and its properties. For their study, it appeals to a number of considerations, such as: minimum dimensions of the primary elements of reinforcement section, made up of fibres or threads; the high volumetric fraction ($V_f$ > 0.5); knowledge of the geometry of reinforcement phases. These considerations lead to the concept of composite plate.

A composite tab is a thin layer of composite material consisting of a single reinforcement and the matrix corresponding to (Fig. 1).

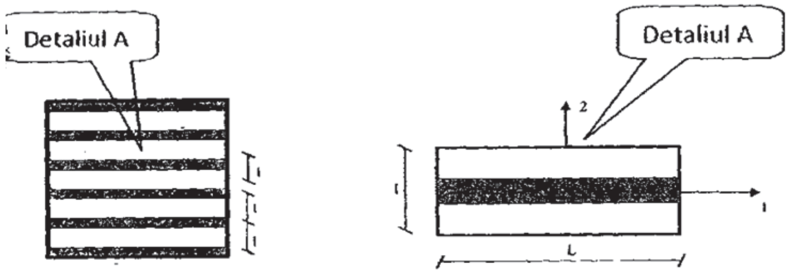


**Fig. 1.** Composite plate.

In practice, a composite material is composed of several straws that are studied on the basis of a representative elementary volume (VER). Characteristics of composite VER are shown in Figure 1 b), respectively: the distance between the wires, layer thickness (distance between the strands layer) – if there are several layers of arbitrary size. In this context, VER is the smallest part of the tensions and composite deformations are evenly distributed from the macroscopic point of view.

To study the properties of the composite should be provided:-VER site obtained by cross cutting of composite to be constant on the full length L (Fig. 2).

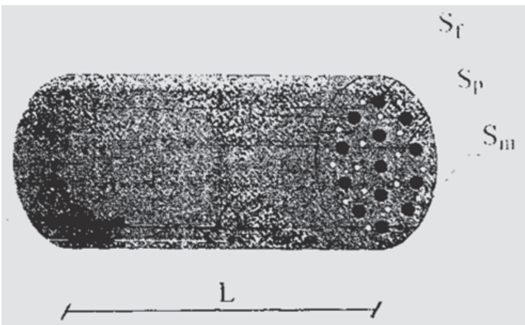


**Fig. 2.** Elementary volume VER: $S_m$ – matrix surface; $S_f$ – thread surface; $S_p$ – surface of porosities; $L$ – length of VER.

## 2. MATHEMATICAL RELATIONSHIPSOF VER

Table 1 presents the mathematical relations of VER.

*Table 1*

| Geometric element name | Symbol | Mathematicalrelations | Comments |
|---|---|---|---|
| Cross-sectionalarea | $S$ | $S = S_m + S_p + S_f$ | |
| The volume of the VER. | $V^*$ | $V^* = S \cdot L$ | |
| The volume of thematrix | $V_m^*$ | $V_m^* = S_m \cdot L$ | |
| Volume conductors | $V_f^*$ | $V_f^* = S_f \cdot L$ | |
| Porozitatilor volume | $V_p^*$ | $V_p^* = S_p \cdot L$ | |
| The matrix table | $M_m$ | $Mm = Vm^* \cdot \rho_m$ | $\rho_m$=densitymatrix |
| The mass of wires | $M_f$ | $Mf = Vf^* \cdot \rho_f$ | $\rho_f$= threaddensity |
| Composite table | $M$ | $M = M_m + M_f$ | |

Using relations in table 1 can be calculated:
Composite mass $M$

$$M = Vm^* \cdot \rho_m + Vf^* \cdot \rho_f \tag{1}$$

Composite volume $V$

$$V^* = V_m^* + V_f^* + V_p^* \tag{2}$$

Composite color density ρ

$$\rho = \frac{M}{V*} = \frac{Vm* \cdot \rho m + Vf* \cdot \rho f}{V*} \tag{3}$$

where:

$$\rho = V_f \cdot \rho_f + V_m \cdot \rho_m \tag{4}$$

It follows the volumetric fractions:

$$V_f = \frac{Vf*}{V*} \; ; \quad V_m = \frac{Vm*}{V*} \; ; \quad V_p = \frac{Vp*}{V*} \tag{5}$$

or

$$\rho = \frac{M}{V*} = \frac{M}{\frac{Mf}{\rho f} + \frac{Mm}{\rho m} + Vp*} \tag{6}$$

where:

$$\rho = \frac{1}{\frac{m_f}{\rho_f} + \frac{m_m}{\rho_m} + \frac{V_p^*}{M}} \tag{7}$$

with mass fractions

$$m_m = \frac{Mm}{M} \; ; \; m_f = \frac{Mf}{M} \tag{8}$$

## 3. STUDY OF THE TENSION IN THE COMPOSITE

Tensions in the composite Media considered is given by:

$$\overline{\sigma_i} = \frac{1}{V^*} \int_{V^*} \sigma_i \mathrm{d}V^* = \frac{1}{V^*} \left[ \int_{V^*} \sigma_i \mathrm{d}V^* + \int_{V_m} \sigma_i \mathrm{d}V^* \right] \tag{9}$$

where $\sigma_i$ are void in the pores of composite.

For composite material reinforced with fire in one direction, it is considered triortogonal system axes:

- axis 1along the wires;
- axis 2 perpendicular to axis 1, defines the width of the armed unidirecțional composite (Fig. 3.c), obtained by extension of VER (Fig. 3.b);
- axis 3 is perpendicular to the axis 1 and 2.

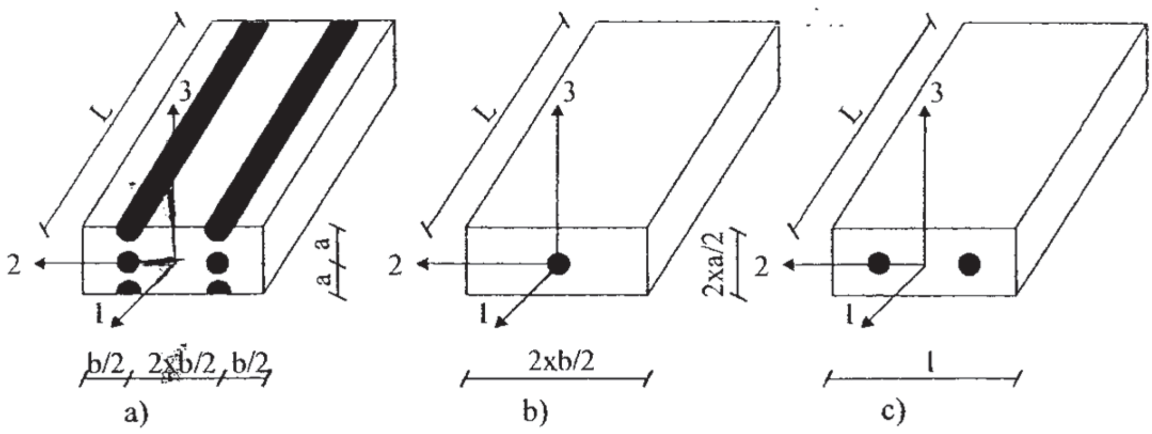


**Fig. 3.** Composite material reinforced with fire in one direction.

## 4. CONCLUSIONS

For the study of micromechanics composite slats, one must meet the following conditions:

– *the tab to be*: macroscopically homogeneous; linear elastic; orthotrop examination; without initial tension;

– *the fibers to be*: homogeneous; linear elastic; isotropic; arranged at equal intervals; perfectly aligned;

– *the array to be*: linear elastic; homogeneous; isotropic.

In these circumstances, there are no flaws in strings and arrays to interface between them.

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# CONSIDERAŢII TEORETICE PRIVIND MICROMECANICA MATERIALELOR COMPOZITE

**Constantin D. STĂNESCU[1], Doina TĂRĂBUŢĂ (ENE) [1], Mariana PĂTRAŞCU (ANTONESCU) [1], Melania TĂMAŞ[1]**

[1] Universitatea "Politehnica" din Bucureşti

**Rezumat** Eficiența unui material compozit se remarcă prin nivelul superior al caracteristicilor tehnice și al proprietătilor acestuia. Pentru studiul acestora, se face apel la o serie de considerații, cum ar fi: dimensiunile minime ale secțiunii elementelor primare ale armăturii, alcătuită din fibre sau fire; fracțiunea volumetrică a firelor ridicată ($V_f$ > 0,5); cunoasterea geometriei fazelor armăturii. Respectarea acestor consideratii conduce la noțiunea de lamelă compozită.