Universitatea *Transilvania* din Braşov

HABILITATION THESIS
SUMMARY

Contributions to the mechanics of polymer matrix composite materials

Domain: Mechanical Engineering

Author: Assoc.Prof. Horatiu TEODORESCU-DRAGHICESCU
University: Transilvania University of Brasov

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In this paper I have presented briefly some theoretical and experimental scientific contributions in the fascinating field of mechanics of polymer matrix composites. These contributions have been finalized after conferring the PhD title, distinction „*Cum Laudae*" in the field of Mechanical Engineering for the PhD thesis entitled "*Contributions to the increase of loading capability of fibers-reinforced polymer matrix composite tubes by introducing supplementary internal stresses*", titled conferred according to the Order of Minister of National Education no. 4202 from 27th July 2001.

In first chapter I have presented some major contributions materialized in computing the tensile strength of a multiphase Sheet Molding Compound (SMC) composite material taking into consideration the notion of substitute matrix formed by combination of resin and filler. I have computed the substitute matrix' Young's modulus as the harmonic mean between the elastic properties of the isotropic compounds. I have determined the upper and lower limits of the homogenized coefficients of a SMC composite material with 27% fibers volume fraction. I have used three averaging methods of the elastic properties of this material. The experimental results revealed close values to the arithmetic mean of the elastic properties of the isotropic compounds.

In the second chapter I have carried out simulations of the elastic properties of some fibers-reinforced composite laminates subjected to off-axis loading system. I have computed the matrix strain increase factor in case of transverse lamina's loading for a hexagonal arrangement of fibers in matrix. The comparison of this factor to that of a square arrangement of fibers in matrix indicates an advantage of hexagonal arrangement, this being closer to reality.

In chapter three I have performed simulations regarding the thermo-mechanical behavior of different unidirectional reinforced laminae with various fibers, subjected to some sequential and combined temperature and humidity variations. I have computed the coefficients of thermal and humidity expansions of these laminae. I have simulated the axial and transverse thermal conductivities of different unidirectional carbon fibers-reinforced thermo-conductive resins, with possible applications in heating radiant systems. I have presented the thermal response of a sandwich structure with nonwoven polyester mat as core and dissimilar skins.

In chapter four I have carried out a damping analysis of a twill weave carbon fabric. I have computed the fabric's dampings, rigidities and compliances using an equivalent model of it.

In chapter five I have presented the behavior of a three-phase composite material subjected to static tensile-compression cyclic loadings. I have accomplished experimental tests with different test speeds, load limits and number of cycles. The difference between the extension at first and last cycle put into evidence a maximum hysteresis effect at 10 mm/min test speed.

In chapter six I have experimentally determined the most important mechanical characteristics of seven types of composite laminates subjected to tensile as well as three and four-point bending loadings.

In the last chapter I have presented the most important mechanical properties of both a twill weave carbon fabric subjected to tensile and of a sandwich structure with expanded polystyrene core and skins from the same type of fabric, structure subjected to some three-point bend loadings. Loding-unloading flexural tests have been accomplished highlighting an outstanding stiffness of this structure.