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Testing of Space Frames Made of Composite Materials

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Abstract: The main topic of the paper deals with presentation of several testing devices and used measurement methods for testing of qualitative parameters of rigidity and strength of both the whole module groups and their fundamental reinforcing components made of composite materials.

Keywords: Experimental Mechanics; Composite Materials; Experimental Arrangement.

1 Introduction

Innovative development and production trends particularly in automotive and aerospace industries significantly influence also design of opening panels assemblies (doors, windows, stiffened panels etc.). New trends show that metal constructions of these modules will be gradually replaced by new material conceptions leading to hybrid plastic material-composite-metal constructions. This fact is logically reflected by methods and methodologies in testing, used both in pre-development, prototype and finally even in batch phase of the development and production.

2 Customer's requirements

The basic condition for supplying services to the customers from industry in the field of physical experiment is to understand their requirements and ability to satisfy them from a number of demanding points of view. That is why realization of such services requires substantial efforts and considerable investments of both material and mental character. We will present several starting-points that should be kept in view:

- At development departments there is a pressure on innovative and creative approaches in product design, which results in module and integrated solutions.
- Modern modelling and simulation methods (CAD, FEM) are highly used.
- New materials including composite compositions and material structures are applied.
- New technologies are being developed (in production preparation and in production itself).
- Assembly procedures are automated and robotized.
- There is an enormous pressure on observance of quality criteria
- Optimization of rigidity, strength and long-term stability in a wide range of climatic conditions is required vis-à-vis traditional and generally over-designed solutions.
- The safety requirements on crew safety in the means of transport and outside them (pedestrian safety) have increased.
- Last but not least, the final products are optimized from the point of view of price.

3 Author's experimental departments

Experimental workplaces of the authors of the paper encounter following requirements of experimental testing:

- Rigidity and/or plasticity, respectively, under the conditions of common service.

- Limit states of plastic deformation occurrence, initiation of material discontinuities, strength and total fracture.
- Safety of passengers/pedestrians in and outside the means of transport.
- Stability under climatic conditions.
- Longevity and resistance against various influences.

The above stated cases elicited projects/design of experimental devices that make possible to realize:

- Slow/static tests.
- Dynamic tests by vibrations and impacts.
- Fatigue tests.
- Climatic tests focused on creep response of selected material structures.

A typical example of a developed experimental device is an all-purpose workplace for identification of directional rigidities and limit states of stiffening elements of opening panels composed of closed composite material structures, see Fig. 1 and Fig. 2.

Fig. 1: Loading by linear actuator, system of pulleys and a steel-wire rope.

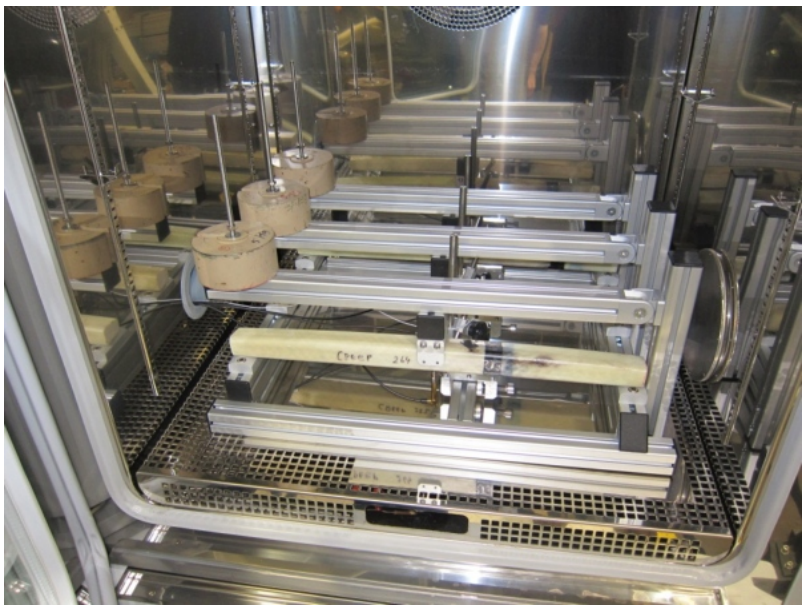

Fig. 2: Measurement of creep response of stiffening composite elements.