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Study and Research upon Creating a Laboratory for Testing of Doors, Windows and other Wooden Joineries

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Abstract
The paper presents the research studies performed in time in order to achieve a testing laboratory for joinery and furniture products, in view of certifying the quality of these products in Romania. The main installations and integrated systems functioning within the laboratories are pointed out, besides them some details and pictures are used for a better understanding. The achieved and presented installations offer the possibility to determine the strength properties for subassemblies, windows and doors. Furthermore, other installations and systems allow the determination of some physical parameters, such as water and air permeability, resistance to moisture content variation. The documentation of the quality management system was elaborated for this laboratory. The laboratory has accreditation and works under an integrated system with other laboratories from Romania. The laboratory functions in Bucharest and might represent an objective for other factors interested in the domain, due to its experience.

Keywords
testing stand, doors, windows

1. Introduction

The EU country-members must develop testing laboratories for the products resulted from specific departments, in order to respond to the demands of quality assurance within the unique European market. Within this context, the free traffic of the merchandise is the base of the Unique Market – the economical space where the goods, services, capital and working force can freely move. The mechanisms resorted to on European level for realizing the Unique Market are based on eliminating the technical barriers, harmonizing the technical settlements and mutually recognizing the conformity evaluation.

The products' conformity with the requests from the technical settlements harmonized according to the European directives based on the principle of the New Approach, must be recognized through the conformity declaration made by the producer or by the authorized spokesman of this, through the testing reports or by the conformity certificates emitted by the laboratory or by the certifying or inspection organs, chosen by the producer, in accordance with the evaluation producers, and through the conformity marking, due to the applicable technical settlements.

2. Objective

The objective of the studies that have been performed over the years was to create a laboratory testing of doors, windows and other finite wooden products (curtain walls, different structures aluminium - glass, subassemblies for constructions). The testing stands, equipment, testing devices and installations were selected according to European norms related to testing procedures and quality evaluation.

3. Laboratory for Testing Joinery Products

The main installations that make up the laboratory infrastructure were achieved in the framework of the research contracts coordinated by the author of the paper, were certified in accordance with the regulations existing in Romania and were aligned to the international standards. Their functioning is based on methodologies (procedures) correlated with the ISO standards and with the European Norms specific for every type of test [1]. The installations and the devices function within the Laboratory in an integrated system for data collection and processing. The aspects enhanced above are presented in detail in the documents of the management and quality assurance systems elaborated for accrediting the laboratory.

The Laboratory functions in the framework in Bucharest, being part, together with the laboratory for furniture testing, of the national network of the laboratories for quality evaluation and conformity certification of the wood products, throughout Romania.

Within the laboratory there are installations for effecting the dimensional verifications and the mechanical attempts which reproduce strains similar to those in the current exploitation of the products; and likewise installations for determining the characteristics afferent to the physical agents (determining the specific infiltrations at air and water, temperature and humidity variations), etc. The most representative installations in the laboratory, Figure 1, are presented as follows.

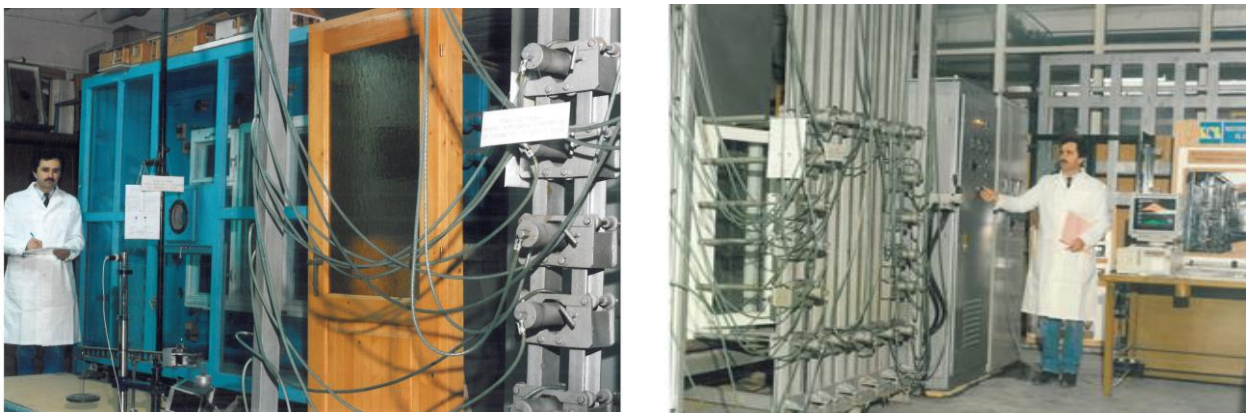

Fig. 1. Laboratory for door and window quality evaluation and conformity certification [2]

4. Results and Discussions

Stands and installations for door and window tests performed during the research carried out - test procedures [8].

4.1. Testing of the window permeability to air and water

It is carried through on the basis of a specific procedure which is part of the quality management system within the laboratory, elaborated on the basis of the standards SR EN1026 (*Windows and doors. Air permeability. Testing method*); SR EN1027 (*Windows and doors. Water permeability. Testing method*).

Method of testing.

The verifications and the tests are effected under static and dynamic regime, aiming at achieving pressure scales equivalent to the forces developed by the action of the wind and of the rain water. The equipment afferent to the installation may measure pressures equivalent to a wind speed ranging between (0-1000)Pa, recording at the same time the infiltrated quantity of air in m^3 / linear meter of closure joint and m^2 of window; calculating the coefficient of specific infiltration, Figure 2.

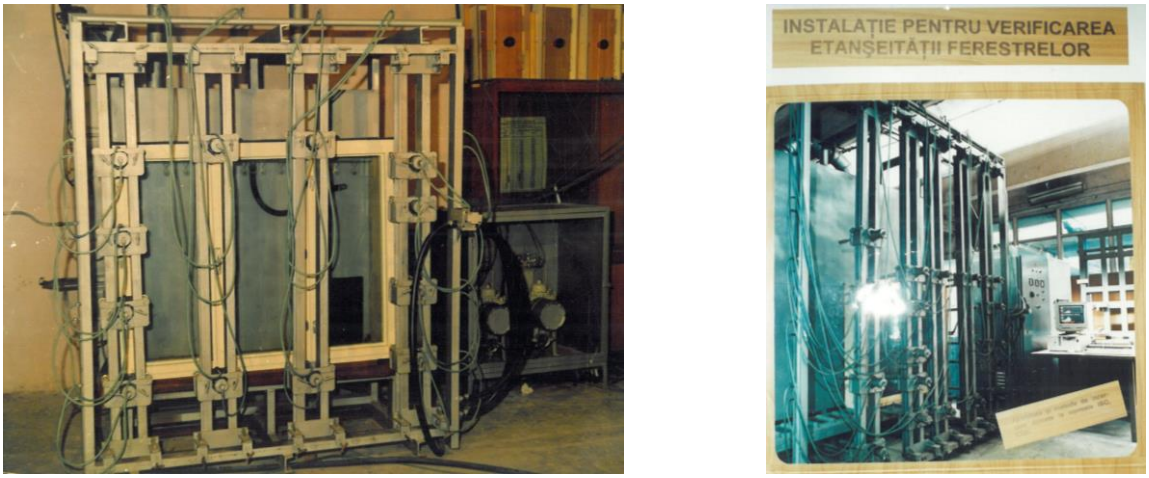

Fig. 2. Installations for verifying the permeability at air and water of the joinery products

The system for the infiltrated air flow measurement, fig.3, uses an anemometer with propeller and tacho-generator, and the output is an alternating voltage, which, rectified and filtered, represents the speed value of the air in the pipe, that is, of the flow at a given section. Considering the output characteristic, the computer performs a correction of this characteristic part by part in order to achieve linearization [2]. The system of measuring the pressure equivalent to wind pressure is composed of two decoders of differential pressure for low pressures of the types EFL 271 with ELT 370 adapters ensuring two measuring intervals depending on necessities (0…50 mm water column, respectively 0…100 mm water column). The signal of unified current 2…10 mA produced by the adapter is applied to a fixed resistance of 750 Ω on which the input voltage is obtained in the board of data acquisition.

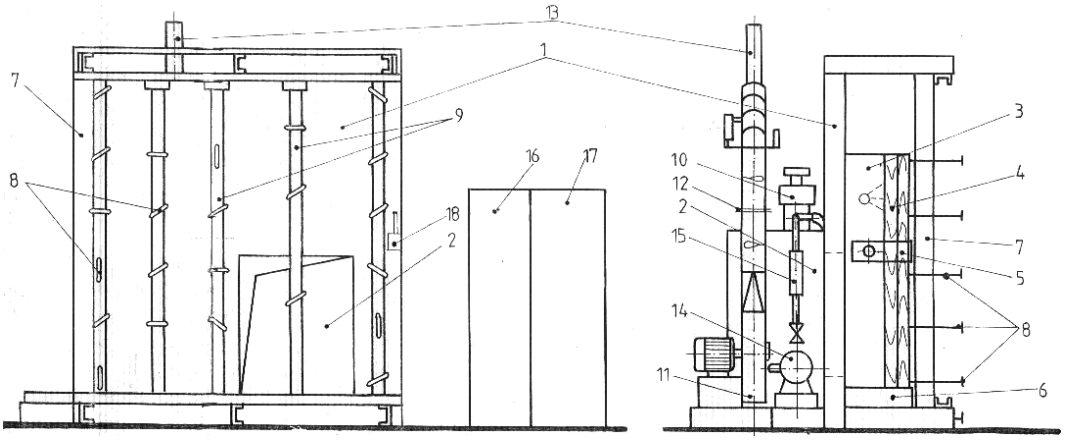

Fig. 3. System for tightness testing of windows at wind and rain water [2]

1- front board, 2- pressure room, 3- pressure box, 4- testing product, 5- system for assembling the product with the pressure box, 6- roller frame, 7- rigid frame for the fixing system, 8- pneumatic pistons, 9- adjustable fixing elements, 10- transducers of differential pressure, 11- ventilator, 12- anemometer for air flow, 13- air pipe with adjustment and exhaust valves, 14- water pump, 15- rotameter for water flow measurement, 16- CSFV 25kWA convertor, 17- electric connection pane, 18- distributor

The data acquisition system performs the analogue numeric conversion of the flow signal as well as the pressure signal [2]. The converter used in the conversion board is of twelve bits. The data processing system is composed of an computer which possesses a disc memory which can store the testing data and which can display or print them as diagrams or result Tables [3, 4].

Air permeability

The air permeability determination is according to SR EN 1026 (*Windows and doors, Air permeability - Test method*), and SR 799 (*Windows and doors. General technical conditions*). The testing method consists in measurement of the air flow by the not airtight spaces.

According to the internal and international standards the reference values are:

- Class A1 - the windows with a characteristic curve under the straight line, passing through the debit value of 12 $m^3/h \cdot ml$ and pressure of (100-150) Pa.
- Class A2 - the windows with a characteristic curve under the straight line, passing through the debit value of 6 $m^3/h \cdot ml$ and pressure of (100-300) Pa.
- Class A3 - the windows with a characteristic curve under the straight line, passing through the debit value of 2 $m^3/h \cdot ml$ and pressure of (100-600) Pa.

The air penetrated through the window spaces determined by the ALCOR-4 method was below 1 $m^3/h \cdot ml$ of backlash. Comparing with the reference values previously presented, the tested window is included in A3 permeability class.

Water permeability

The test consists in determination of pressure level until the product remains water-tight under an artificial rain with a debit of 2 l/m^2 and minute. The procedure is according to EN 1027 (*Windows and doors. Water tightness. Test method*), and STAS 9317/1. The reference values are classified in four classes: Class E1 > 50 Pa and < 150 Pa, E2 >150 Pa and < 300 Pa, E3 > 300 Pa and < 500 Pa, E4 > 500 Pa.

After testing, the window remained water tight at pressure of 500 Pa. By comparing with the reference values from the European norms, the tested product is included in class E3.

4.2. Testing at mechanical strains upon the window sashes

It is carried out according to the specific procedures aligned to the standards SR EN107 (*Windows testing methods. Mechanical testing*), SR EN 12400 (*Mechanical durability Requirements and classifications*), and SR EN1629 (*Resistance to burglary*). The specific installations for these tests are presented in Figure 4.

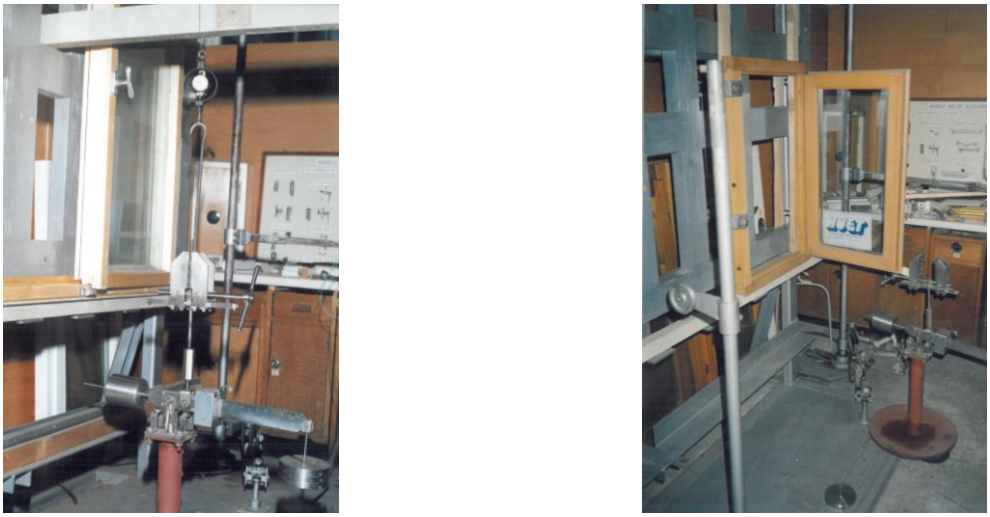

Fig. 4. Installations for straining on the vertical plane the window sashes with closed/open to 90° wing

The device is fixed on the tested sash after the entire window was previously reinforced on the stand from Figure 4. The fixing system is adjustable on the width of the sash and the distance from the hinges can be selected [4]. The fixing elements are provided with ripples for a good adherence to hold the wood surface which is fixed by a clamp. The device adjustment and calibration is done before it is fixed on the sash using the back balance and the adjustment element from Figure 5. The testing force is obtained by the moving of the cursor on the scale 10-100 N, and when the value of 100 N is attained, a balance equivalent with the obtained force is fixed on the end of the gradually prop.

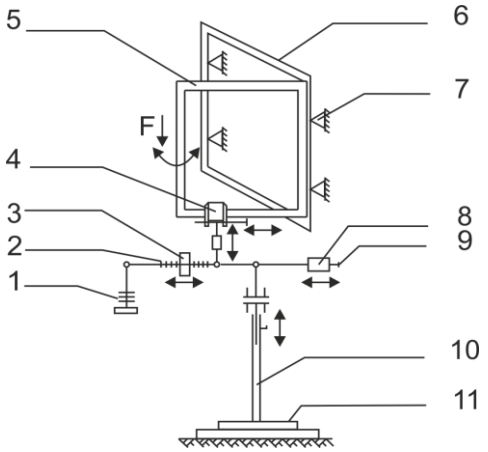

Fig. 5. Device for mechanical testing of window sash in vertical plane
1- Measuring unit, 2- Gradually prop, 3- Cursor, 4- Sash fixing system, 5- Window sash,
6- Window frame, 7- Test stand, 8- Back balance, 9- Adjustment element, 10- Adjustable prop, 11- Fixing prop

The stress ratio made by the additional units of measurement is from 1 to 10. This ratio results by sizing the support and other accessories. The residual deformations resulting from the tests are

recorded with a comparator clock device mounted on a rigid support on the test stand. The deformations recorded are compared with the reference ones to show if the product corresponds from this point of view. The device is controlled by a control panel.

4.3. Testing the door sheets at bending on horizontal and vertical plane

It is carried through according to the specific procedures aligned to the standards SR EN948 (*Swivel doors. Determination of the resistance to static bending*), SR EN947 (*Swivel doors. Determination of the resistance to vertical force*), and SR EN108 (*Doors. Door testing methods. The deformation testing of the door sheet in its plane*). The attempt at deforming the sheet door in the plane is according with SR EN129 (*Doors. Door testing methods. Torsion deformation testing of the door sheets*). The attempt at deforming at torsion the sheet doors is according with SR EN130 (*Doors. Door testing methods. Testing for the determination of the rigidity modifications of the door sheets by repeated torsions*). The afferent installations are presented in Figure 6.

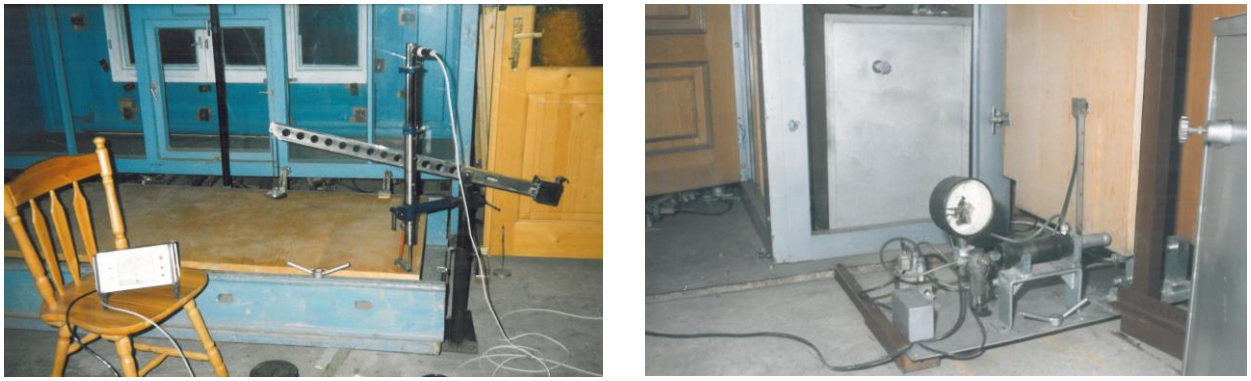

Fig. 6. Installations for testing the sheet doors at bending on the horizontal plane (left) and on the vertical plane (right)

The adjustable steel frame, electro-pneumatic equipment and measuring instruments are shown on Figure 7. These are fixed by mechanical screws to the wood framework and base plate of the stand [4].

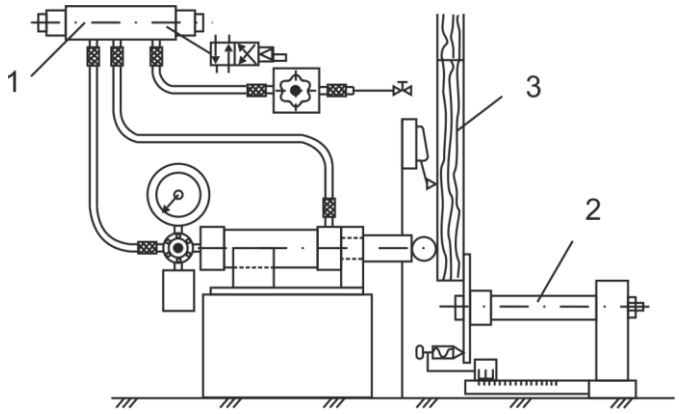

Fig. 7. Electro-pneumatic equipment and measuring instruments for testing the door sheets at bending
1 – electro-pneumatic equipment, 2 – measurement instruments, 3 – door leaf

The test door is installed by means of flexible joints in the frame consisting of wood members of the stand and steel sections of the installation. For the static and dynamic bending it is provided a pneumatic cylinder mounted by a fixed fitting to the support plate. The cylinder is controlled by a system consisting of pneumatic distributor (electric drive), electric contract pressure gauge and limit switch. The above equipment together with the circuit breaker, valve and oiler they all form the force driving system.

For recording of electric drift and residual deformation the installation includes also a device including a guide roll support, a slide and a graduated rule (Figure 7).

4.4. Testing the doors and the windows at temperature and humidity variations

It is carried through according to the specific procedure aligned to the following standards SR EN43 (*Doors. Door testing methods. Behaviour of door sheets placed in uniform successive climates at humidity variation*), SR EN 12219 (*Doors. Climatic influences. Requirements and classification*), and SR EN 1121 (*Doors. The behaviour between two different climates. Testing method*).

To perform such tests an automated climatic chamber for testing the doors and windows at temperature and humidity variations was designed and built, Figure 8.

Fig. 8. Automated climatic chamber for testing the doors and windows at temperature and humidity variations

5. Conclusions

The stands and the testing installations are situated on the level of the technical performances promoted on the international plane, ensuring cycles of automatic testing assisted by computer and printer which perform the setting, processing, display and editing of the data and of the testing bulletins.

The testing stands have been building according to the proposed objectives and the new Laboratory for Testing of Doors, Windows and Other Wooden Products have been accredited.

The testing stands are important to solve the following aspects:

- it gives the possibility of presenting the product at the level of the international demands by applying on the product a CS mark, after signing the accession agreements to UE, and to the CE market;
- it gives to the clients the conviction that the certificated products fulfil the quality requirements;
- it allows the continuous improvement of the products;
- it introduces the transparency of the technological flow;
- it identifies the weak points regarding the fabrication and allows an optimum solving of the problems;
- it allows the analyses of the product characteristics especially of those regarding the security, health and environment in all the phases of the life cycle from conception to recycling;
- it allows the optimization of the rapport quality/price.

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