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# INFLUENCE OF MATERIALS ON THE THERMIC ISOLATION OF A CONSTRUCTION SITE

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***Abstract:*** *The object of the heat transfer research is obtaining a coherent quality balance for a building's structure because any wall assembly must have a convenient, suitable insulation and establishing a conventional energy consumption value for a building equal to the total of different forms of consumption (heating, warm water, ventilation, climatization, auxiliary equipments, lighting, etc.).*

*We did theoretical and experimental researches in many "sandwich" structures which can be largely used in prefabricated wood housing. The aim of the research is the possibility to compound some indigenous thermal insulator material (i.e. mineral wool, polystyrene, PAL) in order to obtain a "sandwich" structure with thermo-physical properties which matches the author preoccupations.*

*The results obtained by maintaining the layer of polystiren consistent in the middle and modifying the layer of mineral wool but keeping the 16 mm PAL sheets are comparable to the ones obtained by maintaining the layer of mineral wood consistent in the middle and modifying the layer of polystiren. The results are graphically represented and the thermal coefficients of the amples are taken into account.*
***Keywords****: thermic transfer, wood, structure, wood materials.*

## 1. INTRODUCTION

The wood houses are seen nowadays as well, as a habitat solution, and in the western countries they represent a part of the every day life, better than a fashion trend. The realization of such dwellings warrants the comfort, the durability and the beauty helped by the modern building technologies and best quality equipment. Along with the standard projects, the companies plan and realize wooden houses at the client's will, ensuring in the same time the delivery of the product in only a few week after the blueprint is realized.
In the same time, the clients, helped by the company's advisors can decide themselves the shape, the interior and exterior arrangements or different details of their house. For building houses it is used composit wooden material or other composite materials shaped in panels, specified on functions and destinations, materials that give resistance in time and a special look, realized using very modern technologies and, besides, all the equipments materials and accessories are conceived realized and used for this kind of constructions.

Wood is the oldest material used by man. In the last few decades, for no relevant reason, wood was thought not to be resistant enough, or burning very easy. Despite this, there are a lot of wooden buildings that lasted for hundreds of years. The modern technologies nowadays improve wood properties and offer to its beneficiary the reliability and the comfort needed.

These new thermo-insulated panels can be successfully used both for exterior and interior wall for all kinds of buildings. A profound study of frequently used composite materials is highly needed, the research around the world concerning this subject being very impressive. In this respect the moulding of composite materials structures for resisting wall panels elements is pursued.
To reduce the energy consumption is nowadays an important challenge for all involved scientists, who are interested in every advanced research. Reduction of heat transfer through a house wall is a critical question, and this paper deals with this question, which practical results are very important. Civil construction industry is highly interested in achieving certain results in this field, therefore the research is a must. Materials used in wall construction are various, and we are interested in finding out economical solutions with the energy supply

cutting down. In respect of this idea, wood and composite materials are an extraordinarily suitable compound, according to the previous research made by the authors.

The prefab panel houses are preferred by the builders only if they are produced serially which might be a disadvantage for the clients that wish to have a sole exemplar house. It is also the case for the houses with a "sandwich" structure.

As the name suggests, they are built on a multi-layer structure with delimited functional elements in order to allow an optimal individual dimension for each and every one of the components. Every building type has a static self-portant structure which insures durability and safety in exploitation. For the sandwich type ones, this function is ensured by a massif wood structure based on a system of pillars and traverses. The resistance structure of modern wood buildings is made of resinous wood, reinforced with OSB panels and other junction metal elements. This type of structure has a lot of advantages: obtaining a light and very resistant structure; the elasticity of the wood provides safety in case of an earthquake; the efficient and economic use of wood; the realization of the building in a short time.

The building can be decomposed in various surfaces (walls) that can be also decomposed in various elements:

- the surfaces of the opaque or transparent walls:
  - exterior walls
  - terraces
  - panels (towards the garage, attics, etc.)
  - windows and doors (gates)
- a jonction line between panels and walls

The coefficient $K_{referință}$ $[W/m^2 \cdot K]$ , represents a medium coefficient of loss through the walls, being a global heat shift coefficient $K_{ref.} = 1/R_p$ where, $R_p$, represents the thermical resistance of the wall. The conductive thermical resistence of a wall depends on the wall's thickness (□) and on the material's conductiveness coefficient (□): $R_p$ = □ □

In order to fiind the correct solutions from a thermical point of view, we must take into account the following:

- *the insulation* of the walls, of the roofs, or terraces;
- the presence of *thermical bridges*;
- the types of *windows and window frames;*
- *ventilation;*
- *the system of producing heat and hot water;*
- the construction *site.*

In what the *insulation* of different elements is concerned, the materials have a great importance. Their resistance must be higher than the minimum one depending on the destination and on the type of wall.

By *thermical bridge* we understand a region where the thermical insulation is interrupted and by which there is a heat loss to the exterior. These thermical bridges can damage the insulation. The more significant thermical bridges occur at the connections between:

- walls and superior panels
- walls and intermediary panels
- walls and inferior panels
- separating walls and inferior panels
- separating walls and exterior panels
- separating walls and intermediary panels
- separating walls and superior panels

*Windows and window frames* have different thermical qualities, depending on the materials that have been used (glass, wood, plastic, metal). They must have a global thermical resistance following reglementations or calculations of minimum thermical loss.

The objectives of the heat transfer research:

- *obtaining a coherent quality balance* for a building's structure because any wall assembly must have a convenient, suitable insulation;
- establishing a *conventional energy consumption value* for a building as a **C** coefficient (kilowatore primarily energy / year – Kwh/year) equal to the total of different forms of consumption (heating, warm water, ventilation, acclimatization, auxiliary equipments, lighting, etc.),

The scheme below represents a complete, annual, energetic balance of a building and shows that a dwelling has, by its very conception to:

- *be well insulated,* to minimize the energy loss in winter and to avoid acclimatization in summer;.
- *have well oriented surfaces* in order to optimize solar heating in winter and avoid excessive heat in summer

Exigencies related to the summer comfort refer to the inner temperature that cannot be higher than a certain value (25- 26ºC), windows closed. This temperature depends on:

- the nature of the walls, opaque surfaces, transparent ones, especially, their orientation and inclination
- climate region
- building thermical inertia
- solar protection: volets, stores, etc.

Research motivation:

There are 4 major challenges that support the optimization of the heating systems:

*The social reason* directed towards the thermal charges and costs control by improving the thermical performances of a building without depending on the region;

*Simplicity* – helping the implementation of reglementation and inovations in this field, that would encourage specialists to find simple, malleable, low cost technical solutions;

*The motivation connected to competitiveness of the solutions on the intern and extern market* reffering to the calculation methods and to the construction materials' properties (defined by the European reglementations as well);

*The motivation connected to the environment protection*: referring to the fight against the hot-house effect. The Rio, Kyoto and Bologna conventions had established objectives of lowering the emission of gas with hot-house effect. The heating consumption of the buildings has this effect for about a quarter of the total emission of hot-house effect gas. Therefore, founding solutions to this problem is compulsory.

The aim of the research is the possibility to compound some indigenous thermal insulator material (i.e. mineral wool, polystyrene, PAL) in order to obtain a "sandwich" structure with thermo-physical properties which matches the author preoccupations.

By using the constructive solutions adopted for the version of structures (the triplestratified ones) the study of the influence of the thickness of the PAL sheets on the thermal transfer coefficient was considered.
For this purpose, the data obtained experimentally and the calculated data were put together in table 1 in order to explain graphically this influence.

**Table 1.** Table of cumulative data for triplestratified sample

| Sample | Thickness (mm) | Thermal transfer coefficient determined experimentally $\lambda_e$ ( W/mK) | Thermal transfer coefficient determined theoretically $\lambda_t$ (W/mK) | Thermal resistance determined theoretically R ($m^2K/W$) | Correction coefficient $c = \frac{\lambda_e}{\lambda_t}$ |
|---|---|---|---|---|---|
| PpvpP 16,20,50,20,16 | 122 | 0,046 | 0,053 | 2,285 | 0,867 |
| PpvpP 16,30,50,30,16 | 142 | 0,041 | 0,052 | 2,749 | 0,788 |
| PpvpP 16,40,50,40,16 | 162 | 0,044 | 0,050 | 3,215 | 0,880 |
| PpvpP 16,50,50,50,16 | 182 | 0,041 | 0,049 | 3,706 | 0,836 |
| PpvpP 18,20,50,20,18 | 126 | 0,049 | 0,055 | 2,302 | 0,890 |
| PpvpP 18,30,50,30,18 | 146 | 0,042 | 0,053 | 2,766 | 0,792 |
| PpvpP 18,40,50,40,18 | 166 | 0,040 | 0,051 | 3,233 | 0,784 |
| PpvpP 18,50,50,50,18 | 188 | 0,042 | 0,050 | 3,700 | 0,840 |

By maintaining the layer of mineral wool consistent in the middle and modifying the two layers of polystiren but keeping the 16 mm PAL sheets, one can notice slightly lower figures for the thermal transfer coefficient than in the former case (double stratified structures).
The results are presented graphically in figure 1.

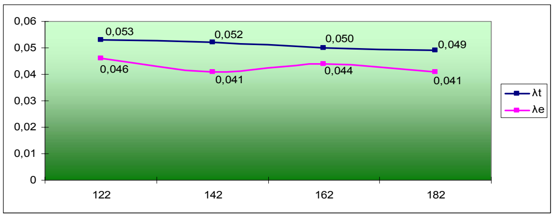


**Fig 1.** The variation of the thermal transfer coefficient $\lambda_e$ şi $\lambda_t$
function of the thickness of the sample (for PAL of 16 mm)

The variation of the thermal transfer coefficient determined theoretically shows a liniar decrease, while due to the lack of homogeneity of the component layers, the thermal transfer coefficient determined experimentally shows an almost sinusoidal variation.

By maintaining the thickness of the themal insulation layer consistent, but modifying the thickness of the PAL from 16 mm to 18 mm, one can notice figures for the thermal transfer coefficient that are very similar to the previous ones, their variation being indicated in the graphic below.

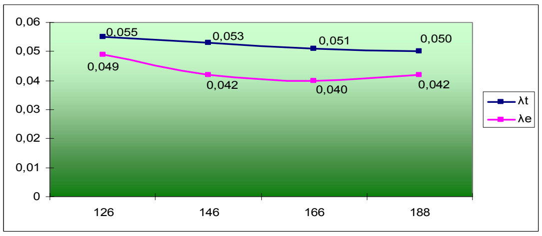


**Fig. 2.** The variation of the thermal transfer coefficients $\lambda_e$ şi $\lambda_t$
function of the thickness of the sample (for 18 mm PAL sheets)

Having the graphic representations separately for each category of sample (of the triple stratified type) and considering that the thermal insulated layer is consistent, it was possible to represent on the same graphic the variation of the thermal transfer coefficient determined experimentally.

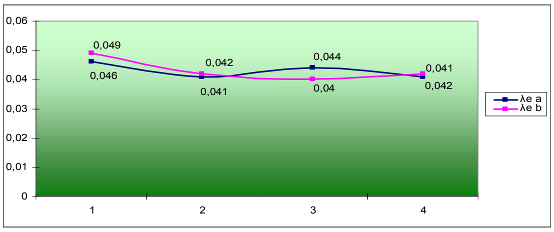


**Fig. 3.** The variation of the thermal transfer coefficients $\lambda_e$
function of the thickness of the sample: a – for 16 mm PAL; b – for 18 mm PAL

## 2. CONCLUSION

The very small difference between the variation of the thermal transfer coefficient in the two categories of structures and also the close figures of these coefficients justifies the fact that by replacing the 16 mm PAL sheets with 18 mm PAL sheets has not got a significant influence on the heat transfer through these types of sample.

The achieved results can be used as a rough guide for thicknesses larger than those studied in the thesis. Te aim of the research is the possibility to compound some indigenous thermal insulator material (i.e. mineral wool, polystyrene, PAL) in order to obtain a "sandwich" structure with thermo-physical properties which matches the author preoccupations.

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