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(54) **INSULATION OF SLANTING ROOF STRUCTURES**

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(57) **ABSTRACT**

The invention refers to such type of insulation for slanting roof structures that provides for optimum heat stability and for simultaneous carrying support of the basic and the protective roofings. The insulation with slanting roof structures providing for optimum heat stability and for simultaneous carrier support consists of a layer of rock wool of a 160-170 kg/m$^3$; density and of 60-80 kN/m$^2$; crush strength, providing simultaneously for adequate heat stability of the roof structure and applied as the carrier support of the basic and the protective roofings.

# INSULATION OF SLANTING ROOF STRUCTURES

[0001] The invention refers to such type of insulation for slanting roof structures that provides for optimum heat stability and for simultaneous carrying support. The invention has been classified into class E 04B 1/74 of the International Patent Classification.

[0002] The technical problem successfully solved by the invention in question involves the design and the construction of such roofing for slanting roof structures that will provide for high heat insulation at heating of the attic, for a high suppression factor of the temperature variation amplitude, i.e. for high heat stability along with simultaneous carrying support for the basic roofing, as well as interruption of line heat bridges caused by the wooden roof truss.

[0003] At designing, construction and reconstruction of buildings, the attic often has to be utilized as a residence. In terms of construction and physical aspect, the most emphasis is laid on the roof structure that primarily consists of four typical elements: roofing, heat insulation, vapour barrier layers and ceiling claddings.

[0004] The achievement of the prescribed or optimum heat insulation does not impose any big problem because almost all heating and insulation materials known hitherto provide for quite balanced heat conductivity R 0,030-0,040 W/(m.K). Depending on the heat insulation gauge, it is possible to provide for heat conductivity of the roof structure up to the value of k=0,20 W/($m^2$.K) in a quite reasonable way. The heat conductivity is an in important physical characteristic, in particular in winter, when reference is made to the highest possible energy saving at heating of the rooms below the roof structure. In summer, the heat conductivity is, of course important, although this characteristic alone cannot secure the so-called heat stability of the structure. With reference to our regulation (JUS U.J5.600/87), the suppression factor of the temperature variation amplitude (v) for a slanting roof structure should be at least v=15, which is definitely too low. It would be correct, if this value equaled that prescribed for flat roofs, i.e. v=**25**.

[0005] It has been shown in practice that in the summer time and even in the transitional periods it is much too hot in the attic rooms, in spite of the low "k" value. In addition to the low "k" value it is necessary to provide for the highest possible thermal stability of the structure (high suppression factor of the temperature variation amplitude). A rather high suppression factor, however, may also be achieved with extremely big heat insulation gauges, which is impossible from the point of view of technology and design and mostly also for functional reasons because the wooden structure of slanting roofs most often does not allow for it.

[0006] In our practice in the field of design and construction there is a general belief that in summer time heat stability can be provided by aeration (constant air circulation) between the roofing and the heat insulation layer, although it has often been proved in foreign technical literature that this problem cannot be solved through aeration because in practice it is not always possible to achieve an intensive exchange of air (due to insufficient inclinations and/or heights of the roof truss for the required lifting power). Bigger layers of air also require thicker roof structures that are "thicker" already because of larger heat insulation. Besides, more air between the roofing and the heat insulation may often cause problems evident as abnormal moistening of the wooden structure and generation of condensed water in case of quick temperature & humidity changes. The most important thing to achieve adequate heat stability is the volume weight (density) of a specific layer in the roof structure. It is ideal and the most reasonable if this layer constitutes the heat insulation.

[0007] The most typical characteristic of heat insulating materials is that they are mostly lightweight and/or very light. Their density varies between 15 and 50 kg/$m^3$. Foamed glass and expanded cork, that both attain about 150 kg/$m^3$, make an exception. Rock wool, again, represents a special example, because its density varies from 30 to 200 kg/$m^3$, depending on the density of the fiber layers. Thereby the heat conductivity of this material equals the average value of other heat insulating materials as follows: R=0.040 W/(m.K).

[0008] As a rule, technical documentations by renowned manufacturers contain solutions that involve advertising of heat insulation products of the biggest possible gauges. We have not yet come across any documentation that would explicitly point out to the negative consequences of the roof structure overheating in summer time and/or to the problem of heat stability of such structure. Such documentations often describe the product that is extremely lightweight as well as very rigid (hard) and as such difficult to incorporate between the elements of wooden structures. Most often great importance is attributed to the aeration between the insulation and the roofing. We can note that attempts are made to advertise every product as equally useful in all possible building structures—accordingly in slanting roofs as well. With slanting roof structures, the insulation providing for the optimum heat stability and for simultaneous adequate carrier support referred to in this invention consists of a layer of rock wool whereof the density is 160-170 kg/$M^3$ and the crush strength 60-80 kN/$m^2$. It is simultaneously used for achievement of the heat stability of the roof structure and as a carrier support of the sub-structure for the roofing and the protective roofing.

[0009] The invention will be explained in detail on the basis of a concrete example and the pictures, whereof:

[0010] FIG. 1 shows the longitudinal section of the roof truss, including the application of the rock wool as an element providing for heat stability and representing the carrier support of the sub-structure for the roofing;

[0011] FIG. 2 shows the cross-section of the roof truss, including the application of the rock wool as an element providing for heat stability and representing the carrier support of the sub-structure for the roofing.

[0012] FIGS. 1 and 2 show the longitudinal section and the cross-section of the roof truss, including the application of the rock wool of specific density and crush strength, designed for insulation of a slanting roof structure. With reference to the picture (viewed from the side of the roofing), the slanting roof structure consists of wood laths **1** for supporting the roofing, connected with counter-laths **3** that are fixed to the beams **10** in the way that the laths **1** and the counter-laths **3** are separated by the air layer **2**. The protective roofing **4**, fixed with counter-laths **3**, lies on a layer **5** of rock wool with a density of 160 kg/$M^3$ and a crush strength of 70 kN/$m^2$ whereby to achieve the heat stability, while the

layer **5** simultaneously carries the sub-structure for the roofing. Below the layer **5**, there is the rock wool layer **6** with a density of 50 kg/m$^3$, that provides for additional heat insulation, the vapour barrier **7**, made of a PE foil, as well as a layer of air **8** and wood laths **11** for fixing the vapour barrier and for mounting any ceiling claddings whatsoever.

[**0013**] With the above mounting and arrangement of insulating materials and above all with the use of the layer **5** of the rock wool of high density (160-170 kg/m$^3$) and of high crush strength (60-80 kN/m$^2$), applied simultaneously as a carrier element and as a heat stable insulating material we manage to successfully solve the imposed technical problem and to enable above all:

[**0014**] high thermal insulation at heating of the room (winter period);

[**0015**] high suppression factor of the temperature variation amplitude high heat stability;

[**0016**] carrier support for the basic roofing and for the so-called protective roofing, and

[**0017**] interruption of line heat bridges caused by wooden beams, provided that the beams may be visible in part or as a whole.

**1**. The insulation for slanting roof structures that provides for optimum heat stability and for simultaneous carrying support,

characterized In that

it consists of layers of rock wool of high density (160-170 kg/m$^3$) and of high crush strength (60-80 kN/m$^2$), providing simultaneously for adequate heat stability of the roof structure and applied as the carrier support of the basic and the protective roofings.

**2**. The insulation for slanting roof structures that provides for optimum heat stability and for simultaneous carrying support,

characterized in that

wood laths **(1)** for supporting the roofing are connected with counter-laths **(3)** that are fixed to the beams **(10)** in the way that the laths **(1)** and the counter-laths **(3)** are separated by the air layer **(2)**; the protective roofing **(4)**, fixed with counter-laths **(3)**, lies on the layer **(5)** of rock wool of high density and high crush strength whereunder there is a layer of rock wool **(6)** of lower density, a vapour barrier **(7)**, made of a PE foil, as well as a layer of air **(8)** and wood laths **(11)**.

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