**Saint-Gobain Construction Products Rus LLC**



**Thermo-technical calculation**

**SP 50.13330.2012**

**“Thermal protection of buildings”**

**VIRMAK**

**2020**

**Initial data**

**Type of construction:** Sandwich wall

**Territory:** Krasnodar Region, Krasnodar

|  |  |
| --- | --- |
| text Design external air temperature:  (reliability of 0.92, SP 131.13330.2012 t.3.1) | - 16 °C |
| tht Design average air temperature of heating season:  (with daily average temperature t ≤ 8°C, SP 131.13330.2012 t.3.1) | 2.5 °C |
| zht Duration of heating season:  (with daily average temperature t ≤ 8°C, SP 131.13330.2012 t.3.1) | 145 days |
| Humidity area | dry |

**Intended use of building and room**

Building: residential unit

Room: habitable room

|  |  |
| --- | --- |
| Coefficient a:  (SP 50.13330.2012, t.3) | 0.00035 |
| Coefficient b:  (SP 50.13330.2012, t.3) | 1.4 |
| aint - Internal film heat-transfer coefficient:  (as per SP 50.13330.2012, t.4) | 8.7 |
| Rate temperature drop between temperature of internal air and temperature of internal surface of enclosing structure:  (as per SP 50.13330.2012, t.5) | 4°C |
| aext - External film heat-transfer coefficient:  (as per SP 50.13330.2012, t.6) | 12 |
| tint Temperature of staying:  (as per GOST 30494-2011) | 20°C |
| ф - Relative humidity:  (as per GOST 30494-2011, SP 131.13330.2012, t.3.1) | no more than 60% |
| Moist room conditions:  (SP 50.13330.2012, t.1) | regular |
| Enclosing structures operation practices:  (SP 50.13330.2012, t.2) | A |
| Coefficient of structure uniformity r:  (as per GOST R 54851-2011) | 0.8 |
| Dependency ratio of enclosing structure position n:  (SP 50.13330.2012, f.5.3) | 1 |

Saint-Gobain Construction Products Rus LLC

140300, Moscow Region, Egorievsk, Smychka Street, bld. 60

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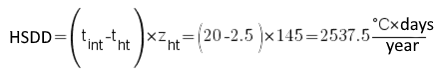
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**Makeup of structure**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Layer | Thickness, mm | Note |
| 1 | Сement bonded particleboard | 12 | λ = 58 W/(m °C) |
| 2 | Thermal insulating layer  ISOVER Sandwich LIFE | 110 | λ = 0.04 W/(m °C)  μ = 0.3 mg/ m·h·Pa |
| 3 | Сement bonded particleboard | 12 | λ = 58 W/(m °C) |

Heating season degree-day (HSDD):

(SP. 50.13330.2012 f.5.2)



Normalized heat transfer resistance:

(SP 50.13330.2012)



Calculation of heat transfer resistance

CBPB, homogeneous layer, δ=12 mm, λ =58 W/(m °С)

**Heat transfer resistance:**

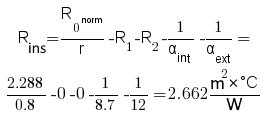


CBPB, homogeneous layer, δ=12 mm, λ =58 W/(m °С)

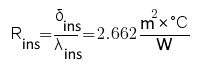
**Heat transfer resistance:**



Calculation of an approximate heat transfer resistance of insulant



Calculation of an approximate thickness of insulant layer from condition:



where λins = 0.04 W/(m °C)



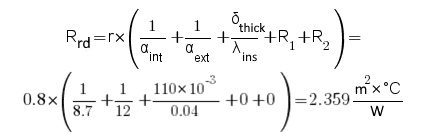
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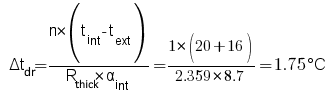
Due to the multiplicity of materials, the thickness of thermal insulating layer is taken to be equal to δthick = 110 mm. Then the reduced total thermal resistance:



The condition R0norm≤Rrd is fulfilled: 2.288 ≤ 2.359.

Sanitary requirements

Calculation of temperature drop between temperature of internal air and temperature of internal surface of enclosing structure:



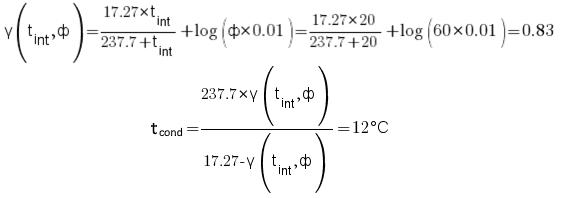
The condition Δtrated ≥ Δtdr is fulfilled: 4≥1.75

The temperature of internal surface – Ti, °С of enclosing structure (not including heat-conducting factor) shall be calculated according to the formula:



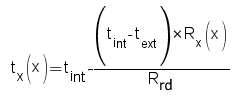
The condition Тi ≥ tcond is fulfilled : 18.25 ≥ 12

where tcond stands for condensing point temperature.



Heating pattern in structural section

The temperature tx, °С of enclosing structure in plane corresponding to the layer x boundary, shall be calculated according to the formula:



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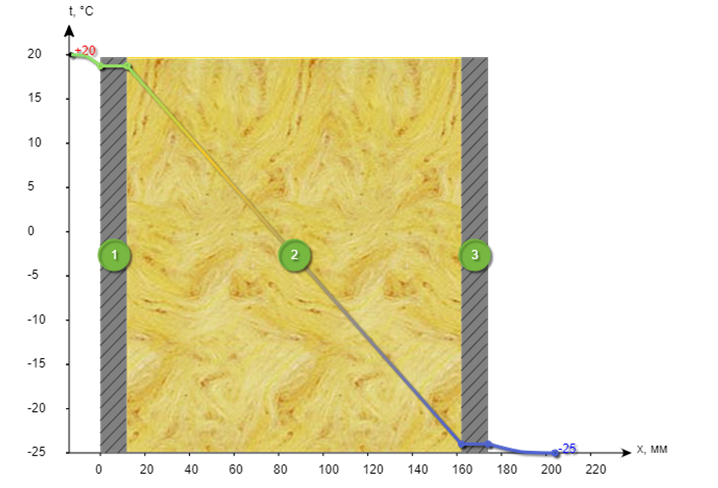
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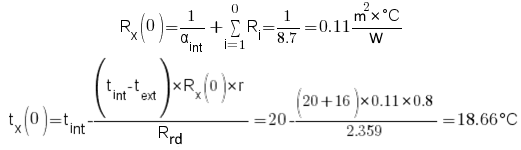


where x stands for the number of layer, x=0 stands for the internal space, Ri stands for heat transfer resistance of layer with number I, in the direction from internal space.



Point 1: tint = 20°С – temperature inside the room

Point 2: tx(0) = 18.66°С – temperature at the internal boundary of layer No.1 – *“CBPB”*



Point 3: tx(1) = 18.66°С – temperature at boundary of layer No.1 *“CBPB”* and layer No.2 *ISOVER Sandwich Life*

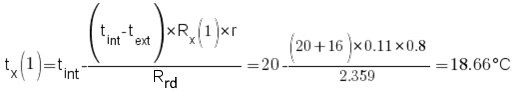


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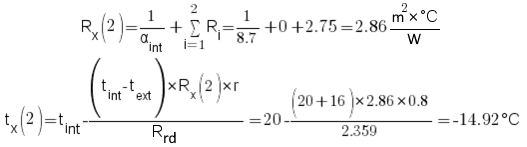
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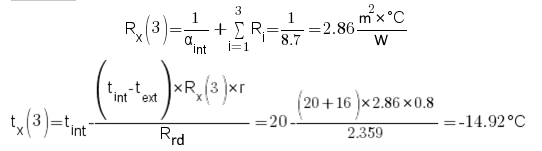
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Point 4: tx(2) = -14.92°С – temperature at boundary of layer No.2 *ISOVER Sandwich Life* and layer No.3 “CBPB”



Point 5: tx(3) = -14.92°С – temperature at the outside boundary of layer No. 3 - *“CBPB”*



Point 6: text = -16°С - outside temperature

Determination of the plane of a maximum moistening (condensation)

This is a calculation procedure based on the use of method of dimensionless characteristics.

The value of fi (tmax.m.), an indicative of the temperature in the plane of maximum moistening, shall be calculated for each layer of multilayer structure.

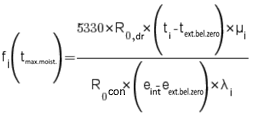
|  |  |  |  |
| --- | --- | --- | --- |
| No. of layer | Layer of structure | Rni=δi/μi | μi/λi |
| Internal surface of enclosing structure | | Rint,vp = 0.0266 | 0 |
| 1 | CBPB | 0 | 0 |
| 2 | ISOVER Sandwich Life | 0.11 / 0.3 = 0.367 | 0.3 / 0.04 = 7.5 |
| 3 | CBPB | 0 | 0 |
| Outside surface of enclosing structure | | Rext,vp = 0.0133 | 0 |
| Rint,vp and Rext,vp – resistance to moisture exchange respectively of internal and outside surfaces of enclosing structure, (m2·h·Pa / mg).  *Note:*  1. Resistance to vapour permeability of close air spaces in enclosing structures shall be taken as equal to zero regardless the position and thickness of these spaces.  2. Layers of structure, located between an air space, ventilated with outside air, and outside surface of enclosing structure shall not be taken into calculation. | | | |

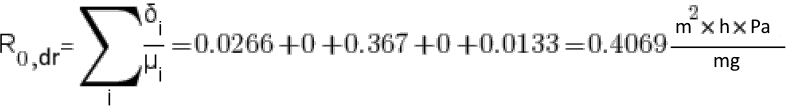
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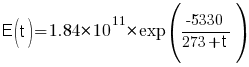
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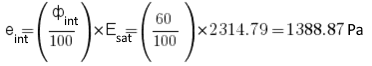
Esat - partial pressure of saturated steam, Pa, at the air temperature from -40 to + 45 °C is determined according to the formula:



For the temperature tsat = 20 °C:



eint - partial pressure of saturated steam of internal air, Pa, at the designed temperature and relative humidity in room is determined according to the formula:



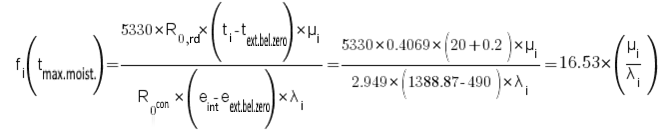
eext.bel.zero - partial pressure of saturated steam of external air for the period of months with below zero monthly average temperature is determined according to SP 131.13330:

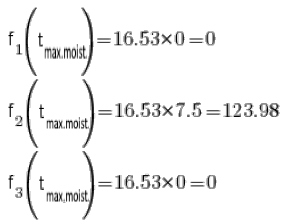
eext.bel.zero = 100 x 4.9 = 490 Pa

text.bel.zero – average temperature of external air for the period of months with below zero monthly average temperature is determined according to SP 131.13330:

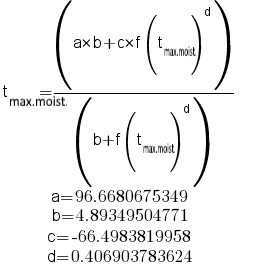
text.bel.zero = -0.2 = -0.2 °C

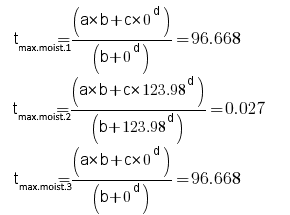
μi/λi – the ratio of heat-transfer coefficients, W/(m2 x °C ), and steam permeability, mg/(m x h x Pa), of material of corresponding layer, or 0 if the coefficients are not set.



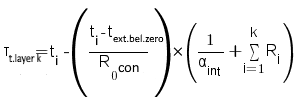


According to SP 50.13330 table 11, when fi(tmax.moist) is not negative, than tmax.moist can be calculated according to formula:

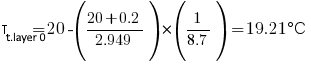


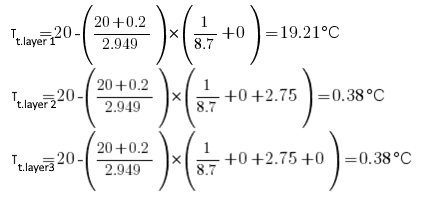


Calculation of temperature at boundaries of layers



where Ri – heat transfer resistance of the layer I (or 0 if this layer is not included in thermo-technical calculation), k – number of layer for which the temperature is calculated.





Summary table tmax.moist. and τt.layer k

This is the table that includes the value of tmax.moist. for each layer and temperatures at boundaries of layers (at average temperature of external air in a period of below zero monthly average temperatures):

|  |  |  |  |
| --- | --- | --- | --- |
| No. of layer | Layer of the structure | *Τt.layer k*, °C | *tmax.moist.*, °C |
| 0 | CBPB | 19.21 | 96.668 |
| 1 | 19.21 |
| 1 | ISOVER Sandwich Life | 19.21 | 0.027 |
| 2 | 0.38 |
| 2 | CBPB | 0.38 | 96.668 |
| 3 | 0.38 |

Determination of the maximum moistening plane

As you can see in the table, there is not a single layer with a temperature of *t max. moist.* within the limits of*τt.layer*. Also, there are no pairs of adjacent layers where the condition *t* *max. moist.* > max(*τt.layer*) for the colder layer and the condition *t max. moist.* > max(*τt.layer*) for the warmer layer are satisfied.

In this case, the plane of maximum moistening is taken on the external surface of the structure. Protection from excessive moistening is not required.

The structural components does not require additional measures to protect against excessive moistening.

# Conclusion

The structure is designed to meet the requirements of SP 50.13330.2012 "Thermal protection of buildings" and SP 131.13330.2012 "Construction Climatology".

The thickness of the thermal insulation layer of ISOVER Sandwich Life is 110 mm. According to the calculation:

* The structural components meet the requirements for thermal protection.
* The structural components meet the sanitary and hygienic requirements.
* The structural components does not require additional measures to protect against excessive moistening.

# Where to buy

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For purchasing materials, please contact

Alexey Voloshchuk

Sales Manager

LLC Saint-Gobain Construction Products Rus

Mobile: 89181887676

E-mail: [Alexey.Voloshuk@saint-gobain.com](mailto:Alexey.Voloshuk@saint-gobain.com)

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