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DESIGN OF A 4 FLOOR PUBLIC BUILDING MADE OF REINFORCED CONCRETE PANELS ON THE BASIS OF ENERGY EFFICIENCY REQUIREMENTS

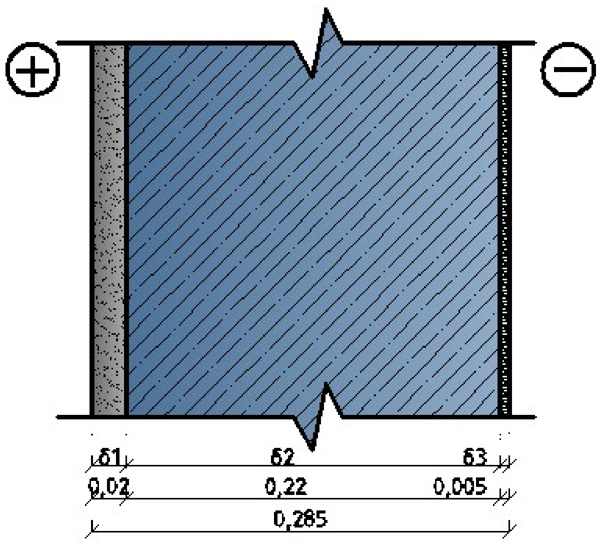
Abstract: *In this article, in order to create and maintain a moderate climate in the rooms for the winter season in a 4-floor reinforced concrete panel public building located in the city of Jizzakh, the overall heat transfer resistance of its external wall structures is increased based on the requirements of Building Codes 2.01.04-18 "Construction thermal engineering". , accounting works and their solutions are shown.*

Key words: *reinforced concrete panel, winter season, moderate climate, energy efficient, basalt slab, thermal inertia, heat absorption coefficient.*

49% of all energy consumed in 1 year in the Republic of Uzbekistan is accounted for by oil equivalent buildings. This indicator leads to spending a lot of energy and money not only for the state, but also for people. Energy loss in buildings. The loss of heat energy through external barrier constructions differs depending on the number of floors in buildings, the material of the surrounding walls, the year of construction, service life, and the quality of construction works. We consider energy loss in buildings in relation to the total percentage depending on the number of floors in residential buildings: Through external walls: it is 30 – 35% in one and two – floor buildings; up to 42% in five- floor buildings; and in nine- floor buildings it is up to 49%. Through the window: in one – two – floor buildings, it is 25%; five – floor makes up 32%; 35% in nine – floor buildings;10 to 20% of heat is lost through the foundation of the building, the basement covering and the roof construction. Also, residential buildings in operation in the territory of the Republic and our regions make up 50-60% of the total buildings. Thermal protection of such buildings does not fully meet current modern requirements. This leads to excessive consumption of electricity and gas in buildings that are being operated. This is one of the urgent problems of today.

MAIN PART

Thermal-physical calculation of external wall structure of 4-floor public buildings located in Jizzakh city area. The external wall structure of the building is made of reinforced concrete panels and the external surface is covered with ceramic tiles. When calculating its total heat transfer resistance, we determine the necessary information provided for thermal-physical calculations in Building Code 2.01.01-22 and 2.01.04-18. The city of Jizzakh is located in the dry zone in terms of humidity; The calculated outdoor air temperature of the city of Jizzakh is the average temperature of the coldest day with a guaranteed value of 0.98: t_o^1=-22 °C ; 0,92: t_o^1=-19°C ; the average temperature of the coldest five days is 0,92: t_o^5=-19 °C ; The average temperature of the coldest three days is 0,92: t_o^3= $t_o^1+t_o^5/2$= -19-19/2=-19°C ; July: t_o=+28°C ; maximum amplitude of daily fluctuations of outdoor air temperature in July: $A_¿$=23,1°C ; J_{max} = 746 vt/m², J_{mid} = 172 *vt/m²*; V=1,9m/c; $t_¿$ = 20 °C ; $\varphi_¿$ = 50 %; humidity mode of the room - moderate; operating conditions of the wall – A; the thickness of the reinforced concrete panel is 220 mm, it is covered with 20 mm thick lime-sand plaster from the inside, and from the outside with ceramic tiles 5 mm thick. We determine their volumetric weight, heat transfer coefficient and heat absorption coefficient. Reinforced concrete panel: $\gamma=2500\,kg/m^3$, $\lambda=1,92\,Vt/(m\cdot°C)$, S=17,98 $Vt/(m^2\cdot°C)$; lime-sand plaster: $\gamma=1600\,kg/m^3$, $\lambda=0,7\,Vt/(m\cdot°C)$, S =8,69$Vt/(m^2\cdot°C)$; ceramic tile: $\gamma=2000\,kg/m^3$,$\lambda=1,5\,Vt/(m\cdot°C)$, S =14$Vt/(m^2\cdot°C)$.



1st figure. Calculation scheme of the wall construction made of reinforced concrete panel. 1st layer (δ_1) lime - sand plaster, 2 nd layer (δ_2) reinforced concrete panel, 3 rd layer (δ_3) ceramic tile.

$\Delta t_{nor}=4°C$; $\alpha_¿=8,7\frac{Vt}{m^2}*°C$ and $\alpha_o=23\frac{Vt}{m^2}*°C$; n=1; $\rho=0,8$.

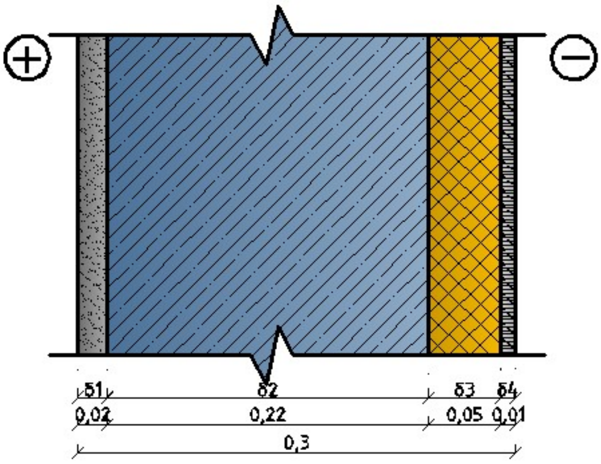
Heat-physical calculation of reinforced concrete outer wall construction for winter. Determine the total heat transfer resistance of the reinforced concrete panel structure:

$$R_{tot}=R_¿+R_{con}+R_{out}=\frac{1}{\alpha_¿}+\frac{\delta_1}{\lambda_1}+\frac{\delta_2}{\lambda_2}+\frac{\delta_3}{\lambda_3}+\frac{1}{\alpha_t}=\frac{1}{8,7}+\frac{0,02}{0,7}+\frac{0,22}{1,92}+\frac{0,005}{1,5}+\frac{1}{23}=0,304\,m^2\cdot°C/Vt.$$

Determine the thermal inertia of the structure:

$D=\frac{\delta_1}{\lambda_1}\cdot S_1+\frac{\delta_2}{\lambda_2}\cdot S_2+\frac{\delta_3}{\lambda_3}S_3=\frac{0,02}{0,7}\cdot 8,69+\frac{0,22}{1,92}\cdot 17,98+\frac{0,005}{1,5}\cdot 14=0,3$ Since 4>D=0.3, we take the calculated temperature of the outside air as $t^1_{mid}=-19,0\,{}^0$C. Required value of resistance to heat transfer for the structure: $R^D_{tot}=\frac{(t_{in}-t_{out})\cdot n}{\Delta t^n\cdot\alpha_{in}}=\frac{(20-(-19))\cdot 1}{4\cdot 8,7}=1,12\,m^2\cdot{}^\circ C/Vt$. $R_{tot}\geq R^D_{tot}$ we check the fulfillment of the condition: $R_{tot}=0,304¿R^D_{tot}=1,12\,m^2\cdot{}^\circ C/Vt$ the condition was not met. Therefore, it is necessary to adapt the public building made of reinforced concrete panels to the 3 levels of heat protection specified in the Construction Code 2.01.04 - 18 and increase its thermal protection. First of all, the heating period and its degree day should be determined: $D_d=(t_i-t_{mid.gr.})\cdot Z_{h.p}$; $t_{midgr.}=\frac{1,7+3,6+9,1+8,3+3,0}{5}=5,14°C$; $D_d=(20°C-5,14°C)\cdot 143,5=2132,4°\,sutka$.We will check the fulfillment of the condition on 3 levels $R_{tot}\geq R^D_{tot}$ given in Building Code 2.01.04-18: For level 1: $R_{tot}=0,304>R^D_{tot}=1,5\,m^2\cdot{}^oC/vt$ the condition was not met. For level 2: $R_{tot}=0,304>R^D_{tot}=2,2\,m^2\cdot{}^oC/vt$ the condition was not met. For level 3: $R_{tot}=0,304>R^D_{tot}=2,6\,m^2\cdot{}^oC/vt$ the condition was not met.

Therefore, the external density of the public building wall is $\gamma=100\,kg/m^3$, thickness is 50 mm, $\lambda=0,022\,Vt/(m\cdot°C)$, S=0,37$Vt/(m^2\cdot°C)$(heat absorption of penoplex was assumed to be equal to the coefficient) covering the basalt facade slab, its density $\gamma=1200\,kg/m^3$, thickness 10 mm, $\lambda=0,41\,Vt/(m\cdot°C)$, S = 6,01 $Vt/(m^2\cdot°C)$, we increase its heat protection by covering facade gypsum boards: $R_{tot}=R_¿+R_c+R_o=2,6\,m^2\cdot°C\,/Vt$



2nd figure. Calculation scheme of the wall construction made of reinforced concrete panel covered with heat insulating material. 1st layer (δ_1) lime - sand plaster, 2 nd layer (δ_2) reinforced concrete panel, 3 rd layer (δ_3) basalt facade plate, 4 rd layer (δ_4) facade gypsum tile.

We will check the fulfillment of the condition on 3 levels $R_{tot} \geq R_{tot}^{D}$ given in Building Code 2.01.04-18: For level 1: $R_{tot} = 2{,}6 > R_{tot}^{D} = 1{,}8\, m^2 \cdot {}^oC / vt$ the condition is met. For level 2: $R_{tot} = 2{,}6 > R_{tot}^{D} = 2{,}2 m^2 \cdot {}^oC / vt$ the condition is met. For level 3: $R_{tot} = 2{,}6 > R_{tot}^{D} = 2{,}6\, m^2 \cdot {}^oC / vt$ the condition is met.

From the results of the above-mentioned theoretical thermal-physical calculations, it can be concluded that the external wall structure of the public buildings built from reinforced concrete panels with 4 and above floors in operation in the city of Jizzah, by covering the basalt facade plates with a thickness of 50 mm from the outside, its total heat transfer resistance is Building Code 2.01.2018. It is possible to increase according to the requirements of 3 levels of heat protection given in Building Code 2.01.04-18.

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