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INNOVATIVE MODERNIZATION IN HEATING AND AIR SUPPLY OF LOFT BUILDINGS WITH HINGED VENTILATED FACADE SYSTEMS CONDUCTING LIGHT

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Research refers to the technique of heating and ventilation and is proposed for use in the town- planning industry for energy- and resource- saving of heating and air supply to buildings with modern warm attics and ventilated transparent facade systems.

In all kinds of energy transformation at present because of the imperfection of the technological processes to final consumption is lost over 60% of the potential energy resources used. Energy-saving priorities is of particular significance for countries importers of fuel-energy resources, and the Republic of Belarus. At the State level in recent years adopted a series of measures to enhance the energy saving mode. Developed and approved the State program for energy development and energy conservation for the near term, the Cabinet of Ministers established the Committee on energy efficiency and energy oversight, a number of fundamental decisions aimed at strengthening the work in the national economy for energy efficiency.

The largest consumers of energy in the Republic of Belarus, with its temperate climate after industrial facilities are the engineering systems of buildings, where heat supply and ventilation spent about 35% of all kinds of solid, liquid and gaseous fuels, which is a heavy burden for the economy of the entire national economic complex of the country. On the basis of the above, the scientific and technical development in the field of energy saving are relevant and a priority.

In practice, urban planning widely use attics in buildings. Some functional and structural characteristics can be named: warm, ventilated and cold.

Warm attics are intermediate sectional extraction of 3-d cameras, which offer all of the exhaust channels organized system and exhaust ventilation located within one section of the building, followed by the removal of the warm exhaust air via a separate sectional shaft into the atmosphere.

In ventilated attics exhaust channels are also open in sectional volumes of attics, but instead separate sectional shaft to remove air in the atmosphere through the ventilation openings in the side opposite walls of the attic through cross-ventilation.

In buildings with cool verandas all exhaust pipes separate transit pass through volumes of attics and emit warm air through individual shaft directly into the atmosphere.

When garret buildings for a warm and ventilated attics under the influence of the bias, the pulsating wind pressure due to the difference of the aerodynamic pressures on the windward side and the facade is leeward formation of garret volumes, pressure increase, which is effect of reverse circulation or "rollover" ventilation, exhaust ventilation or completely off or converted into intake with air exchanges and regulated microclimate parameters of ventilated premises. In cold attics organized air exchanges is more resistant, but to all the garrets of buildings the main drawback is the warm exhaust air emission into the atmosphere without prior selection of the heat consumption for heating outdoor cold inlet air heating systems through infiltration.

Photoconductive ventilated facade systems with air gap not only provide excellent appearance of buildings for years to protect enclosures from external climatic influences of humidity and low temperatures, but also significantly increase their heat-shielding characteristics.

Energy efficiency, adaptability, durability, reliability and respectability of hinged ventilated translucent systems evaluated by the builders and operators of buildings of various purposes in all civilized countries of the world and, since the 90 's, are widely used in urban planning and reconstruction of old buildings [1].

Solar energy [2] in the form of direct and diffuse radiation influences the building, equipped with a hinged ventilated light noise facade systems in such a way that the capacity of conventional silicate glass façade almost completely passed through a the rays heat energy in the spectrum of visible light wavelengths, 380 – 750 nm and infrared optical zone of the solar spectrum with wavelength within the 750 – 2500 NM, all this warmth is perceived by external surfaces of enclosing constructions which when heated become secondary sources of thermal energy in the form of infrared radiation with wavelengths from 7.5 to 14 mm. For radiation with a wavelength range of ordinary glass becomes a screen, because its transmission is limited by the wavelength of about 5 mm.

So the radiant energy of the Sun under the influence of greenhouse effect convertible into heat, the accumulated air which is in the slot area, limited hinged ventilated of light-transparent the facade and the outer surfaces of the building envelope, causing it to heat up. When heated air rises, its temperature and decreases the density that promotes the movement of the forces of gravity from the bottom up, giving the effect of natural air circulation.

Outside air that fills the slot channel simultaneously accumulates not only heat from solar radiation coming through the front system from the outside, but warmth, lost transmission building through exterior fencing from the inner side of the slotted feed not only during daylight hours, and 24 hours a day throughout the heating season.

On the basis of the foregoing, it is appropriate to abolish the high quality energy efficiency fenestration hinged ventilated facade systems

Completed staircase-lift volume, usually placed inside buildings and occupy up to 20% of the heated space, is not binding, as in the heating period the tenants are in them in warm clothing.

By design completed staircase-lift volumes of high-rise buildings represent a huge shaft, vertical passing through the entire building, constantly opening through exterior entry doors from below into the atmosphere, and are also linked to the atmosphere through the machinery space elevators and reinforced ventilation pipes with a diameter of 500 mm with deflectors from remove debris systems. Such constructive solutions to buildings violate aerodynamic and powerful rising air stream that arises under the influence of the force of gravity, not only blows, but also disrupts the operation of ventilation systems, causing it to "rollover".

Under the current regulatory framework in the residential buildings to remove exhaust air is organized through volumes of kitchens L_{ud} = 90 m^3/h of toilets and bathrooms L_{ud} = 25 m^3/h and for combined toilets in L_{ud} = 50 m^3/h.

The driving force of airflow in ventilation vertical exhaust pipe (mine) is the gravitational pressure, whose value is estimated (by) of the expression:

$$P_{gr} = hg\left(\rho_n - \rho_v\right), \quad (1)$$

where h – is the excess of the mouth of the canal above the middle exhaust grilles, m;

g – is gravitational acceleration, m/s^2;

ρ_v – density of air inside the ventilated premises, kg/m^3;

ρ_n – density of air inside the ventilated premises, kg/m^3.

Braking force of the air flow in the channel (mine) is the aerodynamic resistance, which includes friction pressure loss of length and local resistance and is determined by the formula:

$$S = \sum\left(R \cdot l \cdot \beta + Z\right), \quad (2)$$

where $R = \frac{\lambda}{d} \cdot \frac{\rho v^2}{2}$ – is the resistance to movement of the air flow inside the channel (mines) from the friction of the surface roughness of the walls, Pa/m$

l – length conductive air channel (duct, mines), m;

β – wall pipe roughness coefficient (mines, air);

λ – drag coefficient of friction;

d – channel diameter, m;

v – velocity of air movement in the channel, m/s;

ρ – air density in kg/m.

The resistance coefficient of friction is determined by the formula:

$$\lambda = 0{,}11 \cdot \left(\frac{K_э}{d} + \frac{68}{\mathrm{Re}} \right)^{0{,}25}, \quad (3)$$

where $K_э$ – is the absolute equivalent roughness of the surface of the pipe (duct), m;

d – duct diameter, mm;

v – velocity of air flow in the duct, m/s;

$\mathrm{Re} = \frac{\upsilon \cdot d}{v}$ – Reynolds number;

υ – is the kinematic viscosity of air (temperature dependent, for ventilation when t_V = 20°C, $\upsilon = 12{,}59 \cdot 10^{-6}$ m^2/s).

As the basic prerequisite for sustainable operation of natural ventilation is significant excess (more than 10%) magnitude of the gravitational pressure of the P_{gr} over the forces of air motion resistance S in real variables operating systems, this condition is almost not doable, especially for the upper floors of high-rise buildings in the approximation of external and internal temperatures, as in the formula (1) value of h is minimized, and the value $(\rho_n - \rho_v)$ generally tends to zero. In these real world conditions of natural ventilation does not work with all of the negative effects of the gas, water, reduce heat-shielding properties of exterior fencing, mould, rotting wooden structures, destruction of finishing materials and the like.

Thus, the regime organized the aerodynamic ventilation of residential buildings excludes the unorganized flow of external air in ventilated premises through infiltration and the creation of a compulsory regulatory air exchange on sanitary-hygienic requirements.

Based on the above, the main conclusion is that the design and construction of residential buildings with external enclosures with increased thermal insulation and tightness, that in the conditions of contemporary urban development is required, preferably use organized filing outdoor ventilation air inlet, structurally and methodically set out in papers [1-22] using the latest effective energy technology, waste energy recovery, recovery of assimilating low heat emissions and natural sources of solar radiation and wind energy.

In order to reduce material and energy spent on housing and garret heat and power supply public buildings using ventilated translucent systems requires a functional modernization of warm attics with converting them from intermediate bulk section exhaust vent chambers for removing the warm exhaust air to the atmosphere through the sectional extraction mine ventilation air volume camera technology to capture previously heated in slot conductive air channels formed by hinged ventilated conducting light facade systems and external vertical structures, protecting outdoor ventilation air inlet and then serving it via "tube inside the ventilated premises.

Energy efficiency technological scheme heating and air supply loft buildings with external enclosures with increased thermal insulation and tightness, hinged ventilated conducting light systems and upgraded warm verandas is presented on Fig. 1, which shows a fragment of the attic of the building with a regenerative device influx-and-extract ventilation, proposed for implementation in urban planning practice.

Regenerative device and exhaust ventilation of the building includes a vertical air guide channel 1, formed translucent hinged facade 2 and the outer surface of the external load-bearing design 3 and bottom slotted hole 4 the whole width of the facade 2 for fresh intake of external air, and at the top of the opened in the warm attic 5. In the warm attic 5 is a central plate heat exchange 6 with four ports:

- inlet first opened in volume 7 of the warm attic 5;
- another nozzle 8 is connected with vertical suction air duct chassis 9, to which are attached the floor flat horizontal ventilation ducting 10 with adjustable grates for airflow 11;
- the third tube 12 connected with vertical exhaust air duct chassis13, to which are attached the floor flat horizontal exhaust ducting 14 with adjustable grates 15 to remove air from the ventilation of the premises;
- the fourth tube 16 compounds from shafted 17 which was reported to the atmosphere from above through roof fan 18 or 19 the air valve.

Works regenerating device and exhaust ventilation as follows.

Fresh outdoor air under the influence of the natural gravitational pressure or by forced circulation comes out from the bottom through the slotted hole in the air Guide 4 channel 1, which is a preview of his heated through a hinged ventilated facade light transparent 2 through direct and diffuse solar radiation during the day and through the outer surfaces of enclosing constructions 3 constantly day and night during the heating period, foregone the transmission of heat. Outdoor air in the air Guide Channel 1 enters from the bottom through the

slotted hole 4, and the top opens in warm attic volume 5, which also sees the lost building transmission warmth through the ceiling of the top floor, as well as direct and scattered solar radiation through a topcoat of warm attic 5. In the warm attic 5 pre heated inlet ventilation air inlet 7 passes through the Central plate 6 heat exchanger, which selects the heat of the exhaust air vent, and enters through pipe 8 in vertical supply air duct 9 continue on experiencing horizontal venting the air ducts through 10 through the adjustable grilles for air flow 11 comes in ventilated premises from which the warm exhaust air is removed through adjustable grille 15 floor apartment horizontal exhaust ductwork 14 vertical exhaust duct hose 12, 13 operation 6, 16, 17 shaft tube, fan 18 or 19 the air valve to the atmosphere.

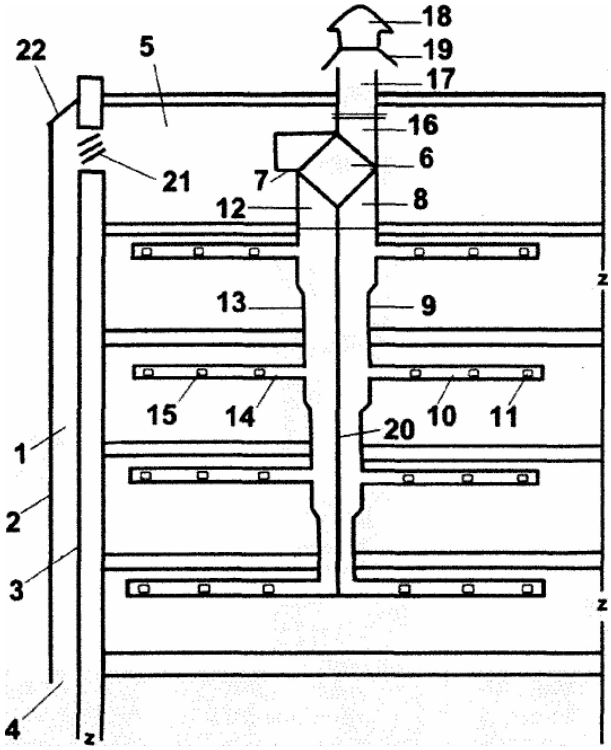

Fig. 1. Regenerative device and exhaust ventilation building

Vertical supply air duct and exhaust air duct vertical 9, 13 to have a common wall, 20, is transit heat exchange between suction and exhaust airincreasing effect of recovery and increasing the thermal efficiency of the entire system of heat and air supply buildings increased thermal insulation and tightness.

To ensure effective summer operating mode in order to avoid overheating the building under the influence of solar radiation at the top of the pipe conducting air, 1 provided 21 adjusting device which closes, and the air valve opens the 22 that creates air cooling mode of irradiated by the Sun outdoor enclosures with hinged ventilated facade systems to skip.

Analyzing and summarizing the results of the executed two State scientific and technical programs GTIN 1.5.159 "to develop and implement energy saving materials and technologies in the construction and operation of buildings and structures and the GTIN 4.02.08". "To create and introduce new materials, technologies and design system for resource savings, homes, reducing resource and energy consumption during the construction and operation of housing", and based on many years of theoretical, experimental and patent research, multi-year survey of the existing housing stock with the best world experience and achievements of science and technology in the area of housing are justified the proposed innovations.

In order to create a favourable and comfortable microclimate of dwellings with a minimum of material and energy, achieving a significant reduction in the consumption of thermal energy in the urban sector of the economy requires the following changes to buildings with external enclosures with increased thermal insulation and tightness, used for mass housing development model.

1. Completed staircase-lift in a spatial volume of the building is necessary to make inside the building and position adjacent to the Northern face milling in facade without heating as tenants in the heating period are in warm clothes and use it as a platform.

2. A warm attic functionally modernized with the transformation of its volumetric of the exhaust chamber to remove warm air into the atmosphere in large intake sectional camera to gather pre heated outdoor fresh air blower and then heated in recuperate with heat of exhaust air.

3. Use the external decoration of the building ventilated curtain facade system, which not only improve the aesthetic appearance of buildings, but for years to minimize the heat power for spending when their exploitation at the expense of the greenhouse effect.

4. In order to significantly reduce energy consumption, heat buildings recommend for wide introduction in practice of authentic urban development of regenerative devices supply and exhaust ventilation under the patent of the Republic of Belarus using the latest energy-efficient and resource-efficient technologies, a three-stage scheme of waste energy recovery, recovery of assimilating low heat emissions and using the natural heat of solar energy.

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