существующего и реконструируемого фонда объектов жилсоцкультбыта, а также сельского и загородного строительства объектов индустриальной и индивидуальной застройки [1 – 6].

Математически и физически формализована модель управляемой фильтрации наружного воздуха с рекуперацией трансмиссионной теплоты в приточном вентиляционном теплообменнике РПВЭ при противоточном режиме теплообмена, защищенные авторскими свидетельствами [2 – 4].

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PERSPECTIVES OF DEVELOPMENT OF ENERGYSAVINGS ACTIVITIES DETERMINING THE INDOOR ENVIRONMENT QUALITY IN THE BUILDING

Problems connected energy-saving determine of at present trends in projecting, realization and exploitation of buildings. Factors putting into influencing on character and dynamics of energy consumption for building one can divide on two groups. To first groups would belong to assemble these factors, which conditioned are location of building in definite climatic zone and time of year that is to say temperature of airs external, rose of winds, solar energy, precipitation and cloudiness. To second groups should credit factors connected with planning kind of object and with place his locations on concrete ground, on base of topical state of knowledge of projecting. These factors then architectural-builder's and material-construction solutions, energy characterization of building, destination and manner his of exploitation, holding suitable values of parameters of microclimate, quantity of exchanges of airs ventilated, parameters of heating system and technical state of building.

Energy-saving activities determine at present degree problems connected with influence of artificial environments of rooms on people. Main direction of activities leaded in aim of lowering wastes of energy to heating of buildings is sealing of building's barriers and modernization of ventilation and heating systems. Then attracts oneself change of microenvironment in the rooms. Sharpening of requirements of thermal protection of buildings leaded to height of thermal isolation of cooling barriers. In result noticed extension of participation of losses warm on ventilation in generally balance of losses. On base of analysis of structure of energy-waste in building sector one ascertained, that about 70 % happens on heating and ventilation of rooms. Energy consumption in residential building sector in Poland present Fig. 1.

Activities restrictive waste warmth on heating of airs exchanged in ventilation process caused drastic lowering quantities of exchanges of airs and worsening his qualities, what brought in effect to beginning of occurrence sick building syndrome. Sojourn in building embraced with occurrence of syndrome calls out and intensification many symptoms connected with incorrect working of organism and leading to his weaknesses or illness. Symptoms these called symptoms of syndrome this first of all irritation of eyes, of air passages and skin, dizziness and headache, bad frame of mind, irritation, fatigue and problems with concentration. It eats compactly with incorrect conditions of environment prevalent in the rooms. Main reason of occurrence of syn-

drome suspected in incorrect airs quality. Factors strengthening risk are also excessive noise, insufficient lighting and psychological factors. About 30 % newly raised energy-saving building and serfs of modernization is embraced this problem, 20-50% of persons spending his time in pathological environment notifies occurrence of related complaint with syndrome. One found correlations among formative factors of microenvironment in the rooms and occurrence symptoms of syndrome [4]. The values of „r" are presented in Table 1.

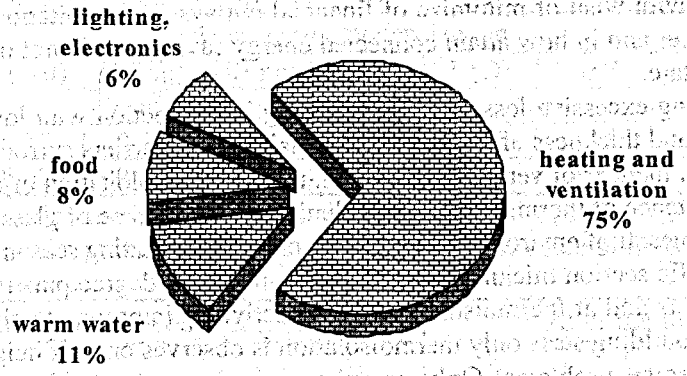

Figure 1 – Energy consumption in residential building sector in Poland

Table 1 – Correlation coefficient between syndrome factors and syndrome symptoms [4]

Syndrome factors	Syndrome symptoms	cor. coef.
Exceed norm of bacteria in a dust	Tiredness, headache, bad concentration	r = 0.73
Exceed norm of bacteria in a dust	Bad condition of mucous membrane of nose and throat	r = 0.76
A lot quantity of volatile organic subst.	Problems with concentration	r = 0.85
A lot quantity of volatile organic subst.	Languidness and tiredness	r = 0.72
A lot quantity of histamin from a dust	Bad mood, dizziness	r = 0.65
A lot quantity of histamin from a dust	Problems with concentration	r = 0.58

Problem of syndrome was not up to here in fullness seriously treated. This situation changing however from regard on sickness absence among new workers in modernized office and industrial complexes and her distinct relationship with environment quality of work. Potential one year's economic effects connected with elimination occurrences of syndrome and extension of production carried out 25-60 % with relation to uses other activities aiming to improvements of quality of work, unconnected with improvement environments.

Assurance of proper microclimate and thermal comfort should become one of the tasks of thermal buildings protections, because rational running a farm with energetic supplies leaded usually at present to making worse qualities of environment in the rooms and to reducing of thermal comfort of people. It seem, that limiting of warmth losses does not go in a pair with assurance of proper conditions in the rooms. Holding required values of microclimate parameters projects of course on energetic needs. On their size puts into port mostly value of temperature. Lowering temperatures at about 2°C causes fall of application on warmly at about 12%. Drastic lowering values of temperature joins of course with uncomfort feeling of environmental conditions.

On thermal feelings puts into port also radiation temperature related with temperature of surrounding barriers. In building with higher thermal isolation can hold both higher temperature of airs as well as higher temperature of surrounding barriers carrying of course less costs of heating. Requirement to hold relative moisture on level 50 % enlarges waste of energy. People spending in environment are more exposed on connected complaints with bad quality of airs than these, which more often spend in dry rooms. Universally met winter drying of nose membranes mucous, throats and larynx steps out mostly in consequence excessive contents in environment dioxide of sulphur with hygroscopic dusts. Worsening qualities of airs in the rooms and considerable moisture are reason of formation of allergy and asthma.

In Scandinavian is observed height of number of allergic illnesses in new and in modernized on level 12-13%. High is level of occurrence of allergic illnesses in children in school age. One noticed distinct correlations among high value of relative moisture of airs and quick development of allergic symptoms and asthma on level r = 0, 78.

Conducted in Poland energy-saving activities, concentrated first at all on thermoisolation and gasket woodworks, pull behind oneself constant lowering qualities of microclimate. Especially visible is making worse qualities of airs in the rooms, height of relative moisture of airs, appearance of different kind of mould and fungus and of height of symptoms of syndrome of pathogenic building. Too large hermetic sealing of building can call out illness and complaint even at 60-90% persons.

With difficulty is to reconcile expectations aiming to assurances correct conditions of microclimate with limitation dictated with wish of minimize of financial outlays on exploitation of buildings. Comes into being, so question whether and in how attain connected energy saving would not put into port this negatively on microenvironments state.

With factors causing excessive losses warmth, staying in connection with loss of conditions of thermal comfort are mostly kind and thickness of isolation of thermal cooling barriers surrounding room, excessive surface of glass of elevation, manner of ventilation of room, manner of exploitation of room and technical state of object. Enlarging of resistance of thermal barriers and limiting sizes surface of glass of buildings puts into port profitably on formation oneself of environment conditions not only in heating season but also in summer.

Enlarging in specific section thickness of isolation in not large degree puts into port on height of realization costs of new objects and at thermoisolation. These activities improve clearly thermal characterization of building. However in building serfs only thermoisolation is observes oneself height of waste of energy and intensification of wholesome problems. Only complexes thermomodernization permits on diminution of waste of energy to heating even about 40-50 % and improvement of microenvironment quality.

Participation application on warmly connected dug losses on penetration is more and more smaller in comparison with application on warmly necessary to heating of airs ventilating. Ventilation process in our climatic zone joined with big energetic outlays. In ventilation systems stay considerable potential of energy saving, this does not behave in most to natural ventilation. Usage not regulated natural ventilation is inadequate for simultaneous realizations of connected requirements from proper exchange and airs quality in the rooms and with energy-saving in buildings. At hermetic windows ventilation take place through them opening, what enlarges waste of energy and lowers level of comfort from regard on impetuous affluence of cold airs or observes oneself disappearance of process of ventilation and worsening of airs quality.

Present connected tendencies of ventilation process should aim to bringing of airs in controlled manner, in quantities resulting from manner of use of rooms. Most straight and simultaneously exacting of not large financial outlays, manner of adjustment is steering quantity of airs reaching to rooms. Large energy-saving potential stays in recovering warm from airs removed from rooms. Diminution of ventilating losses of warm should realize exclusively through improving and controlling of oneself process of ventilation. Inadmissible is thrift of energy cost of limitations of exchange of airs below reasonable hygienic-wholesome norms.

In presented below material introduced the results of investigations passed in building, which did not realize requirements in range of thermal buildings protection and in building after removal in then the thermomodernization works. Object of analysis was waste warm to heating of rooms and state of microenvironment and persons thermal comfort. Analysis one passed under angle of estimation of influence of energy-saving activities on quality of environment and persons thermal comfort.

Analysed buildings became surrendered thermomodernization in different time, range of works was different in each objects. Basic executed works former additional thermoisolation of walls and of partly horizontal cooling barriers, and also exchange of opening woodwork and modernisation work in boiler room zone.

In building passed investigations in heating season, before and after realization the thermomodernization works, in range of estimations of thermal parameters of research buildings and of microclimate in rooms persons thermal comfort state.

It was to determine thermal transmittance of partition (U), season demand for heating (E), shape coefficient (A/V) and heat consumption (Q/V). The results are shown in Table 2.

All buildings before thermomodernization didn't realize technical, builder's conditions in the range of thermal isolation and energy-saving.

In building were measurement microclimate thermal elements air temperature (t_a), air humidity (φ_a), air velocity (v_a), and mean radiant temperature (t_{ra}). Thermal resistance of clothing (I_{cl}) and physical activity level, i.e. the value of metabolism (M) were determined taking advantage of data given by ISO 7730: 1994 standard. The results are shown in Table 3 and 4.

The feelings analysis was carried out using predicted mean vote of thermal comfort PMV (+3 ÷ –3) and predicted percentage of dissatisfied with thermal comfort (PPD). Measurements were carried out using thermal comfort measuring instrument. The results are shown in Table 4.

Table 2 – Thermal-energy parameters of research building

Before thermomodernization										
Statistical indexes	U(S)	U(Std)	U(Snp)	U(Png)	U(O)	U(D)	A/V	E	E_0	Q/V
	$W/(m^2 K)$					1/m		$kWh/(m^3 rok)$		
H	1.29	0.80	1.01	0.80	2.6	2.6	0.48	51.2	32.3	58.8
s	0.16	0.16	0.06	0.15	0	0.9	0.08	10.2	1.0	14.1
After thermomodernization										
Statistical indexes	U(S)	U(Std)	U(Snp)	U(Png)	U(O)	U(D)	A/V	E	E_0	Q/V
	$W/(m^2 K)$					1/m		$kWh/(m^3 rok)$		
H	0.22	0.18	0.46	0.62	1.5	2.5	0.48	17.5	32.3	20.7
s	0.02	0.02	0.18	0.09	0.19	0	0.08	3.4	1.0	4.7

Symbols: (H) harmonic mean, (s) standard deviation, (S) wools, (Std) roof, (Snp) ceiling over the unheated room, (Png) floor on the ground, (O) windows, (D) door, max value of E (E_0)

Table 3 – The microclimate factors of the rooms

Statistical indexes	Before thermomodernization				After thermomodernization			
	t_a	t_{tra}	φ_a	v_a	t_a	t_{tra}	φ_a	v_a
	[°C]		[%]	[m/s]	[°C]		[%]	[m/s]
$\bar{x}$	21.7	22.2	31	-	22.4	23.1	34	-
H	-	-	-	0.08	-	-	-	0.06
s	2.7	2.6	12	0.04	2.1	2.5	14	0.03

Table 4 – The indicators of people's thermal comfort

Before thermomodernization								
Statistical indexes	Adults				Children			
	I_{cl}	M	PMV	PPD	I_{cl}	M	PMV	PPD
	clo	met	-	%	clo	met	-	%
$\bar{x}$	0.81	1.4	-0.3	17	0.80	2.3	0.6	24
s	0.09	0.2	0.7	15	0.08	0.5	0.8	21
After thermomodernization								
Statistical indexes	Adults				Children			
	I_{cl}	M	PMV	PPD	I_{cl}	M	PMV	PPD
	clo	met	-	%	clo	met	-	%
$\bar{x}$	0.78	1.4	0.1	19	0.74	2.2	1.1	29
s	0.09	0.05	0.7	16	0.1	0.4	0.7	18

The influence of microclimate element on people's thermal comfort was determined. Fig. 2. present influence of air temperature on people's thermal comfort evaluate.

The influence of Q/V on people's thermal comfort evaluate is shown in Fig. 3.

One traced percentage of occurrence most often met of symptoms from group of symptoms of syndrome of pathogenic building before and after thermomodernization (Table 5.).

Table 5 – The symptoms of sick building syndrome

Type of symptoms of sick building syndrome	Percentage of symptoms	
	Before thermomodernization	After thermomodernization
Irritate of eyes, pain of eyes	16.2	36.6
Irritate of skin	3.4	1.2
Irritate of nose, runny nose	18.0	31.1
Irritate of throat, cough	26.4	58.3
Infection of respiratory tract	13.6	28.7
Headache	38.1	62.8
Tiredness, sleepiness	21.3	52.1
Irritate, nervousness	15.4	28.4
Problems with concentration	17.7	36.7
General bad mood	24.6	45.5
Bad air quality	66.7	98.6

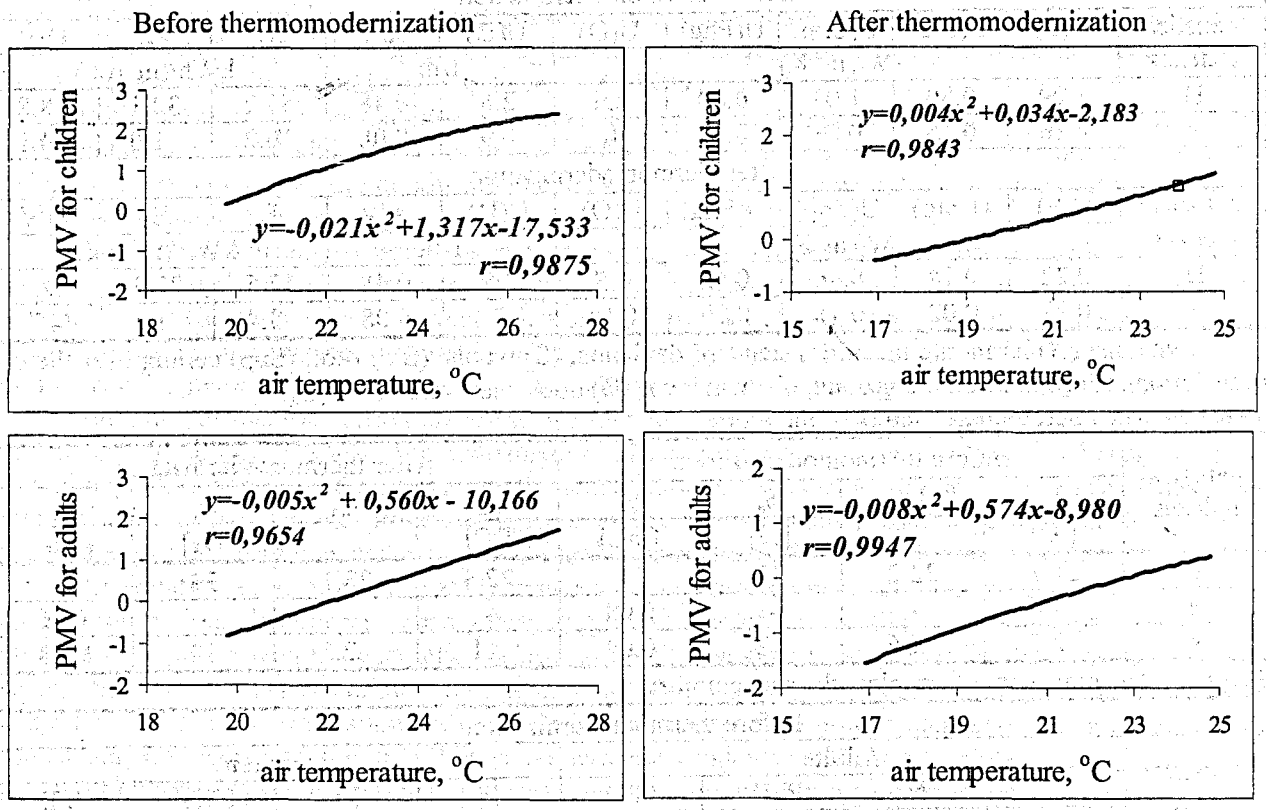

Figure 2 – The influence of air temperature on people's thermal comfort evaluate

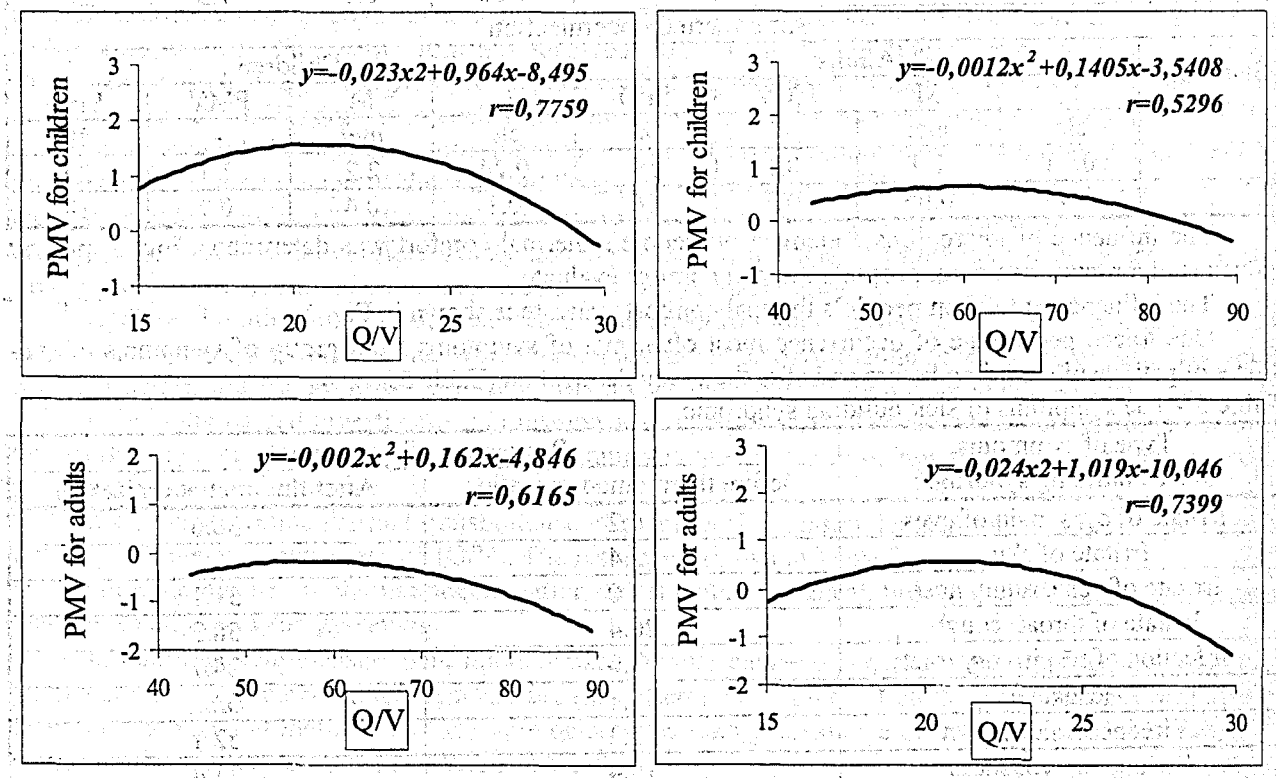

Figure 3 – The influence of Q/V on people's thermal comfort

After thermomodernization one observed considerable making worse of environment conditions. Respondents signalled making worse qualities of airs and lack of sufficient ventilation. One noted intensification oneself of symptoms of syndrome, in peculiarities irritations of air passages and headache. Lack possibilities of adjustment of temperature, unsuitable ventilation, and bad airs quality in research rooms were effective with necessity additional, frequent ventilations of rooms. Put into port on excessive warm waste, considerably above appointed seasonal applications on warmly.

Conceived at present on wide scale energy-saving activities not always lead to improvements of microclimate conditions existing in closed rooms whether but their maintenances in original state. Requirements behaving to microclimate of rooms and people thermal comfort can be found in conflict with too categorical order of minimize quantities of thermal energy used up in process of exploitation of buildings. Does not mark necessities of entire resignation with energy-saving activities. Outgoings connected with realisation the programme of rational uses of thermal energy in building, at maintenance correct conditions of thermal comfort, are relatively not very high in relation to entire investment costs.

This situation is more profitable then, when energy-saving recommendations initiating on projecting phase and not in already existing building. In perspective superior value should be state good frames of mind and health of persons spending one's own time in the rooms.

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MATERIAL-CONSTRUCTION INDEXES IN CORRELATION TO THERMAL REQUIREMENTS OF BUILDING

Energy-saving is current one of the important problems in designing and exploitation of building. The idea of the research was to find the correlation between the material and constructional features of educational buildings and the heat consumption of these building. Energy consumption in educational building sector in Poland present Fig. 1.

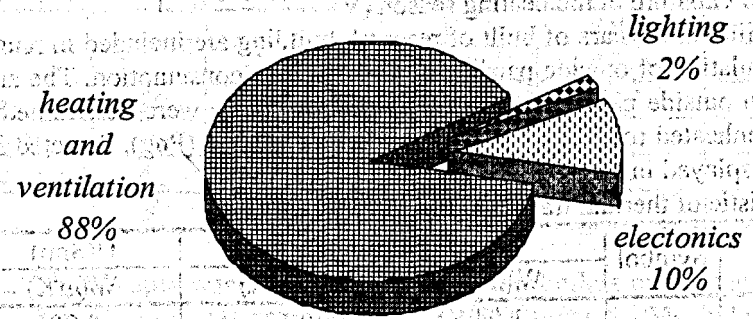

Figure 1 – Energy consumption in educational building sector in Poland

The studied statistical sample consisted of 28 educational building, especially building for children in nursery age. This paper presents an analysis of material-construction indexes of educational buildings from the point of view of their influence on heat consumption on cubic metre of cubature in the heating season. General characteristic of research building are presented in Table 1.