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ENERGY EFFICIENCY POLICY NEWS

This section comprises official events on the federal and regional levels, information on legislation, normative acts, decrees, and programs. It also includes comments and clarifications.

A NEW CONCEPT OF THERMAL PERFORMANCE STANDARDIZATION OF BUILDINGS

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Standards for thermal insulation of buildings now in force in Russia (SNiP II-3-79**) restrain thermal flow through each of the major parts of the exterior envelope (opaque wall sections, fenestration, etc.). The standards set limits on heat flow at design temperatures of indoor and outdoor air in steady-state heat transfer conditions. So, for example, thermal flow through walls of residential buildings is limited to 52 W/m^2, which is the product of the rated difference in temperatures between the inner surface of an envelope and indoor air (dt) and the convective heat exchange coefficient (alpha) at this inner surface. When the Thermal Insulation Code was first developed in 1937, the dew point of the indoor air was taken as the inner surface temperature while the temperature difference dt was set with a safety factor of approximately 1/3 in view of low construction workmanship. This value has not been changed since. In 1971 a requirement was first included into the standard prescribing heat transfer limits based on a calculation of economically reasonable heat transfer resistance of an envelope. This calculation was performed on the basis of the least present- value of cost, which consists of capital envelope fabrication costs and maintenance costs, particularly energy costs, over the design life of the building.

A general drawback of the above methods is that they take a component approach to building standardization, in which building components are viewed separately from each other and their whole assembly is not considered at all. It follows from this approach that thermal insulation of an opaque wall section, for example, is defined without regard for a window and its jambs that may be set within the wall. This omission limits the accuracy of the calculations. A more severe limitation with this approach is that it fails to address adequately the thermal performance of the building as a whole. Whole building performance depends on a combination of thermal insulation, air leakage, and in some cases, thermal storage and solar heat gain. Addressing the energy economics of the whole building is beyond the capabilities of a component approach.

A new concept of thermal performance standardization of a building is based on considering the building as a complete energy system. This approach relies on developing an energy consumption rating for the whole building. However, since there is a risk of attaining the energy consumption rating at the expense of reduced thermal comfort, a special comfort level requirement is introduced into the concept of the standard.

Keeping in mind these two requirements, for overall building energy use limits and for providing adequate thermal comfort, the thermal performance level of a building should be established from both:

— the system approach to a building. In this approach, the whole building is thought of as a single energy system consuming the assigned rated quantity of energy. The method for calculating the energy rating should depend on the energy supplies of the country or its particular regions. Thus, for example, if a building consumes one unit of heat and producing the heat in that region requires two equivalent units of natural gas, then the regional fuel input of two equivalent units should be the basis of the calculation;

— the component approach, in which different elements of the envelope are considered separately in terms of their contribution to providing the required comfort for the occupant's normal living both in the working spaces of the premises and on their margins.

In the design of buildings that comply with these standards, the component approach satisfies the minimum thermal performance requirements of individual envelope components required for thermal comfort, while the system approach dictates that a designer should choose higher thermal performance values than these minima for some or all of the envelope components in order to meet energy consumption requirements.

Comfortable conditions are formed by indoor temperature conditions, and depend on the indoor air temperature and the radiant temperature as well. The latter results from surface temperatures of all envelope components of the premises. Thermal performance standardization by comfort conditions is being suggested for the first time in Russia. These new thermal comfort requirements take the same format as the earlier condensation protection requirements, but generally add new content.

The basic measure of indoor thermal comfort is the average resultant indoor temperature in the center of working space, calculated as the mean of average indoor air and radiant temperatures.

Another parameter describing indoor microclimate is local radiant temperature asymmetry, defined as the difference in radiant temperatures between two opposite-looking surfaces of an object located at any point of the indoor space. An asymmetry requirement imposes a limitation on radiant heat exchange intensity near warm or cold envelope surfaces.

ISO and some Western standards take account of human physiology and present optimum standard values of the average resultant temperature and the radiant temperature asymmetry for living quarters. The ISO Standard, for example, recommends an optimum average resultant temperature between 20 and 21°C, and a minimum permissible value of 18°C; the radiant temperature asymmetry should not exceed 5°C. In some national standards this upper limit is raised to 7°C.

To perform a valid and meaningful analysis of current standard requirements for Russia, two prototype multi-storied residential buildings were used: one building, using steel convector units, for heat distribution, and made of three-layer reinforced concrete panels with expanded polystyrene as the insulating material and with steel rods connecting the inner and outer concrete layers, and the other building made of single-layer expanded-clay concrete panels and using with cast-iron radiators. The thermal comfort level was determined by calculations. These calculations considered the assumptions about radiators and convectors in determining radiant temperature. The valid Code of Standards establishes the following standard temperature difference between indoor air and inner surface temperatures: 6°C for exterior walls, 4°C for ceilings below roofs, and 2°C for ground floor floors.

Calculations made for corner rooms of the top story of the building have shown that with the indoor air temperature equal to 18°C the required comfort level is not attained and with $t = 20$°C the comfort requirement is met only in case of dt being lowered to 4°C for exterior walls and to 3°C for ceilings.

The availability of comfortable conditions in the center of room is insufficient for assuring the provision of adequate comfort level in its entire working space (extending as far from the room center as 0.5 m from inner wall surfaces). Therefore, the radiant temperature asymmetry has been also calculated for these rooms. In all cases this temperature asymmetry varies from 9.5 to 11.5°C at the level of a human head 0.5 m from an exterior wall with a window. Substituting triple for double glazing can reduce the temperature asymmetry by 3°C, but the comfort requirement will not be met all the same. In the new dt proposals, which effectively require enhanced thermal insulation, this comfort requirement is satisfied.

The system approach proposed is to be based on requiring a standard value for specific energy consumption for heating or cooling any building. To figure out this standard value, thermal performance properties of the envelope assembly or building shell should be determined. The specific heating energy consumption (for building heating) is defined as the quantity of heat consumed in the heating period per sq.m of the total heated floor area of a building, per degree-day, Wh/(m^2.°C.day). This parameter is a product of the difference between the indoor air temperature and the average outdoor air temperature over the heating period and the duration of this period.

This suggestion works best to the extent that the proposed parameter is indeed climate independent — that is, the extent to which the same building with a different level of thermal performance yields approximately the same value for annual heating energy use per degree days, irrespective of climate. For Russia, this appears to be the case to within good approximation, as determined by separate calculations. Such a universal parameter — which ideally is independent of climatic conditions — is being suggested as a component of thermal performance standardization for the first time.

This parameter has been tested on the territory of Russia with its most diverse climatic conditions in the range of thermal protection required by the standards. For this purpose energy computations have been made for three apartment houses most typical of Russia (5 -, 9 -, and 17-storied) located in its 302 climatic points. In these computer calculations the following has been taken into account: building dimensions, rated heat transfer and air permeability resistances of walls, floors, ceilings, and windows; the average temperature, duration of the heating period and the average wind velocity over this period, all depending on the construction area.

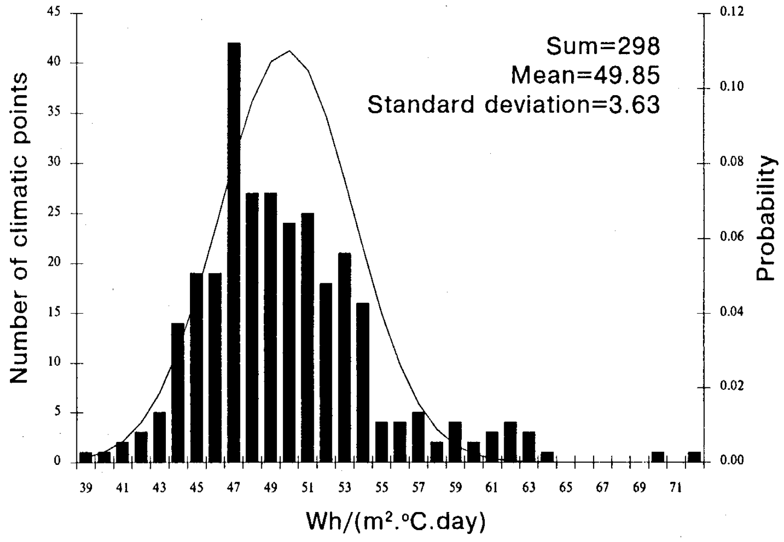
To set standards, the received data on specific annual energy consumption by 17-storey buildings in 302 Russia's regions were analyzed statistically: they were groupped in the lowest-highest values order with the period of 1 Wh/(m^2.°C.day) and distribution of regions with the same energy consumption values was made (a histogram). For this histogram variance and standard deviation were calculated. Based on these values a normal distribution was calculated, and based on the received statistical parameters the standard (maximum value) for specific annual energy consumption for various types of residential buildings was identified.

The curve below presents the outcome of calculations for a 17-storied apartment house and shows distribution of climatic points with the same annual specific energy consumption (rounded-off to the nearest Wh/(m^2.°C.day)).

Similar distribution curves have been also plotted for the other two types of buildings. The explicit extreme of all these curves suggests that standard values of specific energy consumption can be unified by building type irrespective of climatic conditions. Note there is no correlation between climates on left side of curve or on right side.

The analysis of the present-day situation has given the following results. Apartment houses built according to the valid Russian Standards consume for their heating 75 to 125 Wh/(m^2.°C.day), and consumption of one-family houses varies from 125 to 170 Wh/(m^2.°C.day). In Russia the average energy consumption for heating residential buildings on a centralized basis makes 425 kWh/(m^2.year), and this figure refers to 80% of the mentioned buildings. Just for comparison, buildings in Germany consume an average of 260 kWh/(m^2.year), in Sweden their average consumption is 135 kWh/(m^2.year), and in the USA it is 120 kWh/m^2/year.

It is evident from these international comparisons that energy consumption in Russian buildings should be lowered. Experience from a number of countries suggests that policies specifically directed at energy efficiency are the most effective means for reducing energy consumption. Energy efficiency standards are a part of the policy that has proven successful in many regions. This suggests a mechanism for lowering energy consumption: that a new method should be developed for establishing standard values for specific heating energy consumption. Such a mechanism based on the least cost planning method was developed in the USA and was initially applied to electric power supply. Adaptation of this mechanism to heat supply systems and its application for establishing standard values of energy consumption for buildings will contribute to improving the economic situation in regions and in the whole of Russia, by assuring lower cost improvements in building energy efficiency are implemented before higher cost upgrades to heat supply systems.



So, the new standardization concept put forward here is based on a principle of gradual reduction of long-term costs of the energy infrastructure that provides buildings with heat. At the same time, energy saving in buildings is being viewed as the equivalent of extra input to heat supply system development. Owing to many countries' having already proved in practice that saved energy is the cheapest, implementing building energy efficiency improvements is becoming one of the top priorities as energy costs go up.

Standard values are likely to undergo changes in future years. The dynamics of their variation with time will be affected by the introduction of new technology for energy efficiency improvements in construction, and for construction practices in general. As the cost of achieving a given level of thermal protection decreases, as has been the case in the U.S.A., requirements for specific heating energy consumption will decrease. Optimal levels for specific heating energy consumption will also depend on the expected rate of increase or decrease of energy costs in buildings. This rate of change is forecasted on the basis of the energy resources balance in the national or regional economy using the least cost planning methods. Also, possible environmental, economic and any other impacts as well as the engineering feasibility of achieving the projected rate of energy cost decrease is taken into account.

Uncertainties in regional energy needs may be reduced by the introduction of new standard values. The economic value of reduced uncertainty in the need for new energy supplies under different scenarios can be calculated as part of the least cost plan. In many cases, higher standards for energy efficiency are justified by reducing the uncertainty of energy demand and preventing the need for construction of power plants that are required only in scenarios of high growth and low energy efficiency of new buildings.

In conclusion, the new concept of thermal performance standardization of buildings allows the integration of the characteristics of building thermal performance into the broader context of providing for regional energy needs at the lowest cost. In many cases, it will be less expensive to cut energy consumption in new buildings by increasing performance standards than to expand the energy supply. Such comparisons can be made on a detailed level in which incremental changes in building performance can be compared to incremental energy resources in terms of their economic and environmental impact. Thus, thermal performance standardization of buildings provides a way of integrating economic criteria at the microeconomic or component level to those at the macroeconomic or regional system level at which decisions concerning new energy supplies are made.

POWER INDUSTRY PROBLEMS IN FINLAND AND THE ROLE OF THE RUSSIAN FACTOR

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Finland

Finland is a north-western neighbor of Russia and this fact has long been conducive to formation of close trade and economic relations with the former USSR, primarily to cooperation with its fuel and energy complex (FEC). FEC products, in the first instance coal, oil, natural gas, nuclear fuel for nuclear power stations (APS) built with the USSR's technical assistance, were among the main commodities exported to Finland at that time. Finland is a permanent buyer of electric power from Russia, which enters Finland's power grid by a d.c.transmission line (TL) at Vyborg, a frontier town.

It should be mentioned that Finland is the only western partner of Russia (not counting the Central and East European countries, the former COMECON members) directly connected to the NIS power grid and therefore purchasing electric power without any agents.