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possible to get quantitative estimates of these reactions, although very rough at the initial stage, but sufficient to identify beneficial tariff policies by switching from fortune telling and intuition to options consideration and making best decisions.

**Further work in this direction will allow each utility or regional public utility commission to assess the impact of its tariff policy on its revenues.**

# A NEW MODEL STANDARD "ENERGY EFFICIENCY IN BUILDINGS" FOR RUSSIA'S REGIONS

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The draft code "Energy Efficiency in Buildings. Regional regulations for thermal performance and heat supply" was developed by CENEf in cooperation with NRDC (Natural Resources Defense Council, USA) and Research Institute for Building Physics with support provided by the US Environmental Protection Agency. This draft code may be adjusted to the local conditions of any particular region (republic, krai, oblast or city), taking into account its specific features (climate, municipal construction or energy) and further approved and enacted by the local administration. In accordance with existing Russian legislation, such regional regulations may be approved by local administrations without official permission of the Ministry of Construction, provided that the regional regulations do not contradict federal regulations. The draft Code has been submitted to two Russia's regions: Chelyabinsk and Rostov Oblasts. Three more regions (Buryatia Republic, Tula and Kaliningrad Oblasts) have declared their intent to finalize and introduce the Code; and Kostroma and Yaroslavl Oblasts have included the development of a similar Code in regional energy efficiency programs. Apart from the authors, a number of experts took part in the development of the Code: I. Butovsky (Research Institute for Building Physics), L. Norford and M. Opitz (Massachusetts Institute of Technology, USA), and J. Hogan and M. Chao (Institute of Market Transformation, USA).

This standard shall be followed during design, manufacturing of building components, construction of new buildings and additions to or remodeling and renovation of existing buildings, and post-occupancy energy efficiency testing. This Code applies to all residential, commercial, and public building spaces (preschools, kindergartens, schools, nursing homes, hospitals) which have temperature and relative humidity requirements.

This Code is intended to be used in conjunction with the federal code SNiP II-3-79* (ed.1995) "Thermal Engineering", which specifies minimum thermal requirements for the design of the building envelope, and with the federal code SNiP 2.04.05-91* "Heating, Ventilation, and Air Conditioning", which specifies requirements for the design of heating and ventilation systems, SNiP 2.04.07-86 "Heat Networks", which defines the requirements for heat points and heat distribution pipe lines, and SNiP 2.08.01-89* "Residential Buildings," which establishes the requirements for residential buildings and SNiP 2.08.02-89* "Public (Office) Buildings and Constructions," which lays out the general requirements for public and office buildings.

The structure of the Code is presented in Fig.1. Fig.2 shows the Title of the Standard. The Standard includes the following 7 sections:

1. General;
2. Thermal performance of buildings;
3. Heating system equipment;
4. Combined building envelope and heating system;
5. Requirement for energy passport;
6. Quality control at the design and construction stages;
7. Quality surveillance at stages of acceptance and operation;
8. Appendices.

The main idea of the new standard (see CENEf Bulletin, Oct.-Dec., 1994, "A new concept of thermal performance standardization of buildings") consists in providing a certain dependable energy consumption level of a house. The basis of these Code requirements is a new standard value of specific energy consumption for heating the building in the heating period. The relevant energy efficiency is determined for the entire building, taking into account both the thermal performance of the building envelope and the efficiency of the heat supply system. But since there is a risk of achieving the energy consumption rating at the expense of reduced thermal comfort, special comfort level requirements are introduced into the concept of the Code. Proceeding from these two requirements — limits on overall building energy use and mandates for adequate thermal comfort — the thermal performance requirements of a building are established for both:

* **the system (performance)** approach to the building, i.e., viewing the latter as a unified energy system consuming not more than the target energy specified; and

* **the component (prescriptive)** approach to the building, in which the different components of the building envelope provide the required comfort.

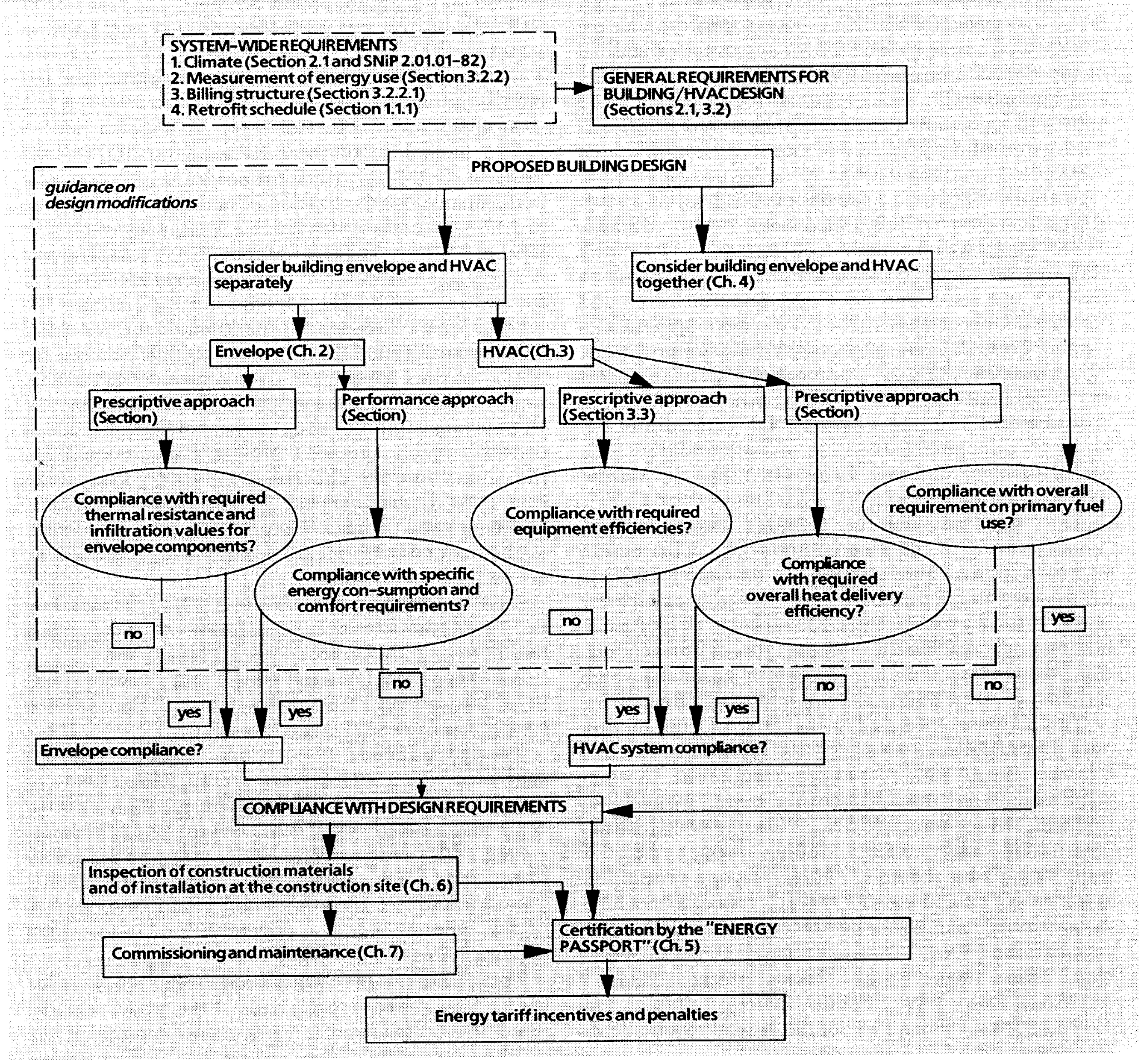
The key principle of this Code is **the performance approach**, which sets out **the overall requirements** of the energy performance of **the building**, based on expected demand. The methods of achieving these requirements are left to the designer. This choice gives the designer a freer hand to achieve compliance in a more rational way that reflects specific features (climatic, energy supply, building industry, etc.) of the region for which building is designed.

To implement **the systems approach**, a new index has been proposed into the basis of the model regional standards — the specific energy consumption of the building during the heating season. The specific energy consumption of heat energy for heating the building, measured in Wh/(m$^2$.°C.day), is defined as the quantity of heat required during the heating season for one square meter of usable floor area of the building and design values of degree-days, calculated as the temperature differences between indoor air and the average temperature of outdoor air during the heating period. For determination of compliance with required levels of specific energy consumption by a building, the efficiency of heat supply systems and equipment to transform primary energy (gas, oil, coal, wood, etc.) into heat, and also heat losses in distribution systems between the heat point/ control distribution point and the local boiler-house, are taken into account.

The element-by-element approach is not new in building standards in Russia; this approach implies setting energy consumption values for separate elements of the building, for example for walls, attics, windows, heating systems, heating appliances, etc.

Standards offering the choice of these two methods have been very effective in the state of California, and have been adopted by ASHRAE in Standards 90.1 and 90.2. The component approach was preserved for a number of reasons. First, the American experience has been overwhelmingly consistent that the construction industry does not understand, trust, or accept pure performance standards. Even after years of implementing a standard in California where 90% of applicants complied using performance methods, there was considerable political support for retention and even expansion of prescriptive options. Another key reason to retain the prescriptive option is to encourage market transformation within the wall panel and fenestration industries. By providing numerical targets far in advance, we encourage

## Structure of the Regional Standards



industry to redesign to meet performance levels.

Therefore the model regional standards of CENEf and NRDC offer BOTH the element-by-element approach, as well as the performance approach, to building designers.

One of the important features of the proposed standard is a new principle, called the trade-off approach. This feature encourages designers to consider envelopes and heating systems as a single entity. The standard permits efficiency trade-offs between the building envelope and the heating systems used to provide heat for heating. Innovations in envelopes that reduce energy consumption below that of a carefully selected reference building are rewarded with a reduction in the required efficiency of heating systems. Similarly, designers are rewarded for trying highly efficient heating systems by being allowed a credit that permits a less efficient envelope. These trade-offs will encourage designers to try alternative envelopes or systems even when such alternatives incur high additional first costs. The new trade-off feature is intended to accomplish several goals:

- Encourage innovations in building envelopes or in heating systems that provide space heat;
- Determine the performance of the building envelope and heating systems as a single entity;
- Permit and guide the use of electric space heat and/or electric water heating when justified by local fuel prices.

The following sequence of work with the Code is anticipated:

- identification of the construction area and selection of local climate parameters;
- making building design decisions;
- identification of specific energy consumption by design in accordance with the building type and number of floors;
- initial selection of envelopes based on the comfort level;
- identification of heat resistance of walls, attics, floors of the first floor, and windows;
- selection of heat supply system, identification of the effectiveness coefficients;
- selection of the required air exchange;
- calculation of specific energy consumption by a building an comparison to the required value. It will be satisfactory in case the index is equal or less than the required value;
- if the calculated value is higher than that required, other options are tested to comply with the required value. There are four ways:

1. Modification of the building design (dimensions and shape);

Improving the level of thermal resistance for separate envelopes;

Selection of more efficient heating, ventilation and heat supply systems;

Combination of (2) and (3).

The Code also contains requirements for testing energy parameters at the design and construction stages, as well as after a year of operation. So as to achieve these requirements, energy parameters are certified and documented.

To address this need, the Energy Passport of Building was developed (see "Energy Passport of Building", Energy Efficiency Bulletin, CENEf, Issue 11, April-June 1996). For quality control at the design stage the Code contains methods for thermal performance designing of buildings, an Energy Passport format and a manual to fill it out.

In conclusion two positive aspects for regions, in our opinion, are that:

* The first aspect lies with standardization of the energy-consumption properties of the building. This aspect makes it possible to achieve a reduction in energy consumption, using various technical possibilities such as improvement of building-envelope performance as well as the improvement of heating and heat supply systems.

* The second aspect consists of the use of the Energy Passport of the building. This advantage makes it possible to calculate more precisely the monthly energy consumption of an operating building, from which the outlays for the consumption of heat energy are generated, and ultimately, tariff reduction incentives for heating in residential buildings.

*Model of Regional Energy Standard for Russia*
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**CENEF (Russia) — NRDC (USA)**

**ENERGY EFFICIENCY IN BUIDINGS**
**Regional Norms for Thermal Performance and Heat Supply**
**ЭНЕРГЕТИЧЕСКАЯ ЭФФЕКТИВНОСТЬ В ЗДАНИЯХ**
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