

Competition "Architectural concept of building with zero energy consumption"

students Petrov Klim Valerijevich, Sled Ivan Alexandrovich, Orlov Oleg Anatoljevich, Rys Ivan Vladimirovich, Urustimov Ajdos Imankanovich
*Saint-Petersburg State Polytechnical University,
Faculty of Civil Engineering*

In April 2012 in Saint-Petersburg State Polytechnical University (Faculty of Civil Engineering) competition on development architectural concept of demonstration building model with zero energy consumption took place.

The mass media and scientific publications at regular intervals publish articles, considering materials about similar buildings in many European countries. Articles include materials that buildings with zero energy consumption in many European countries any more only are designing, but are under construction and put into operation. Today, in Russian Federation there are no even projects of such buildings. Of course, there are some buildings with low energy consumption level, which annual rate of use level nothing more than 45 kilowatt per hour/cubic meter per year. In contrast to the latest, buildings with zero heat energy of consumption have no costs of heating, because losses of heat are compensating by incoming heat energy from utilization renewable energy sources (for example, solar collectors or heat pump systems) as well as common and solar thermal incomings. External enclosures of such buildings have very high indicators of thermal protection (a resistance to heat transfer R_0 more than $8 \text{ m}^2 \cdot \text{C}/\text{watt}$) and modern engineering energy-saving technologies (autoregulation systems of heat carrier parameters, recuperation equipment etc.) Certainly, it does not mean that buildings with zero energy consumption not in the least lose energy. Most of all, it means, there is not required using energy by nonrenewable sources, like petroleum or natural gas, during the operation. Furthermore, carbonic acid gas emissions into the atmosphere are absent. This foul gas is universally recognized as aggravating factor of ecological environment. Problems of ecology and energy efficiency are deciding by designing buildings with zero energy consumption simultaneously. For Russia, it is matter natural resources preservation for future generations.

The idea of holding a competition on development building architectural conception belongs to Finnish Company SPU Oy and their Russian partner Ltd. "SPU Systems". SPU Oy is the first-rate producer of heat-insulated goods out of polyurethane (brand name SPU INSULATION). This company is leader on the Finnish building market in energy effective construction, in reconstruction exploiting buildings (intended for buildings, constructed earlier at lower standards of heat energy. Heat conduction coefficient of goods out of polyurethane SPU is no more than $0.023 \text{ watt}/\text{m} \cdot \text{C}$. It is the least index among all types heat-insulated goods. SPU Oy spends more than 4% from the income annually, to research and develop their output production. This company cooperates with Finnish: RYM, VTT University Aalto, TUT, and Russian research centers: D.I.Mendeleyev Institute for Metrology, FGU VNIPO of EMERCOM of Russia. December, 20,2011 between the company SPU Oy and Saint-Petersburg State Polytechnical University concluded the memorandum of understanding, within the bounds of that competition was held.

To the final stage of competition got 5 projects which have been selected by jury. Representatives of Polytechnical University and organizers of contest were members of jury. As the result, was chosen 3 best students in competition. Winners received diplomas and monetary awards by SPU Oy.

Rewarding took place in April, 20, 2012 near SPU Oy company stand at an exhibition "Interstroyexpo-2012".



Photo 1. Winners of competition and members of jury L to R: Janne Jormalainen (Chief Executive Officer of SPU Oy), Ivan Rys, Ivan Sled, Klim Petrov, Oleg Orlov, Aydos Urustimov, Nikolay I. Vatin (D.Sc, professor, Dean of Faculty of Civil Engineering)

Competition results

The diploma of I degree was received by Klim Petrov, diploma of II degree - Ivan Sled, diploma of III degree – Oleg Orlov. Diplomas of competition finalists were given to Ivan Rys and Aydos Urustimov.



Photo 2. Klim Petrov



Photo 3. Klim Petrov

Энергопотребление

Расчет энергопотребления лаборатории произведен в программе IDA Room.

Энергопотребление:
Для 28.03.2012: 612,6 Вт/ч
Среднее за год: 700 Вт/ч
Итого: 6132 кВт·ч/год

Восполнение потерь:
Солнечный коллектор: 2700 кВт·ч/год
Солнечные батареи: 4750 кВт·ч/год
Итого: 7450 кВт·ч/год

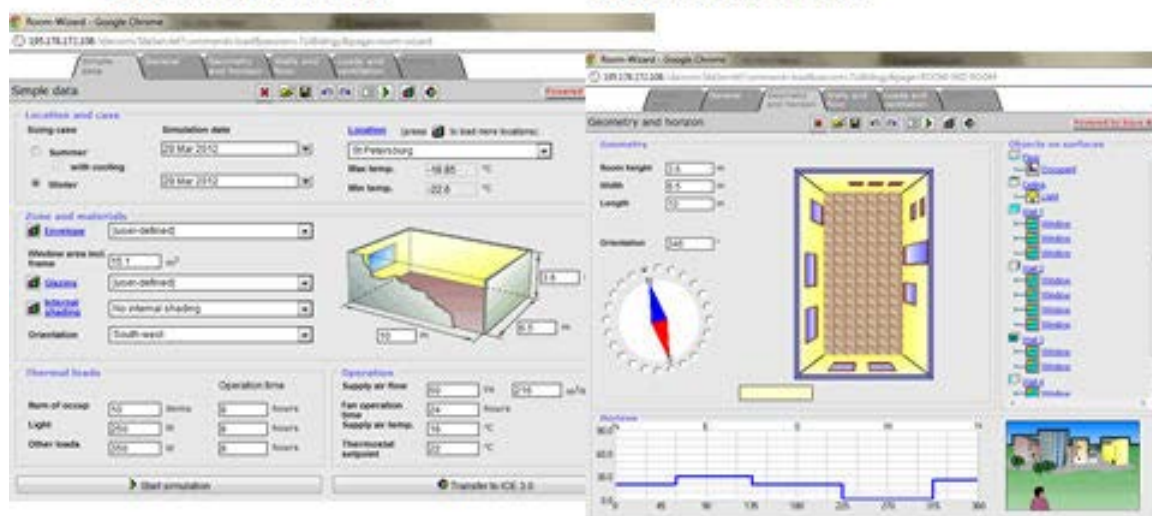


Photo 4. Klim Petrov



Photo 5. Oleg Orlov



Photo 6. Oleg Orlov



Photo 7. Oleg Orlov



Photo 8. Oleg Orlov

Строение здания

- 1 – рейки крепления фасада
- 2 – вентилируемый фасад
- 3 – наружный слой изоляции непрерывен

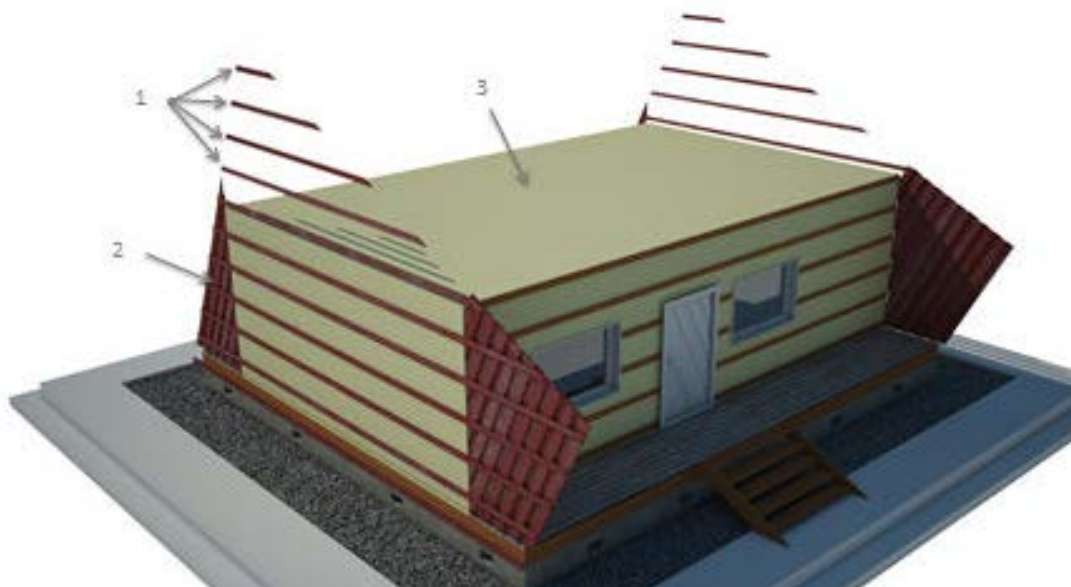


Photo 9. Ivan Rys

Строение здания

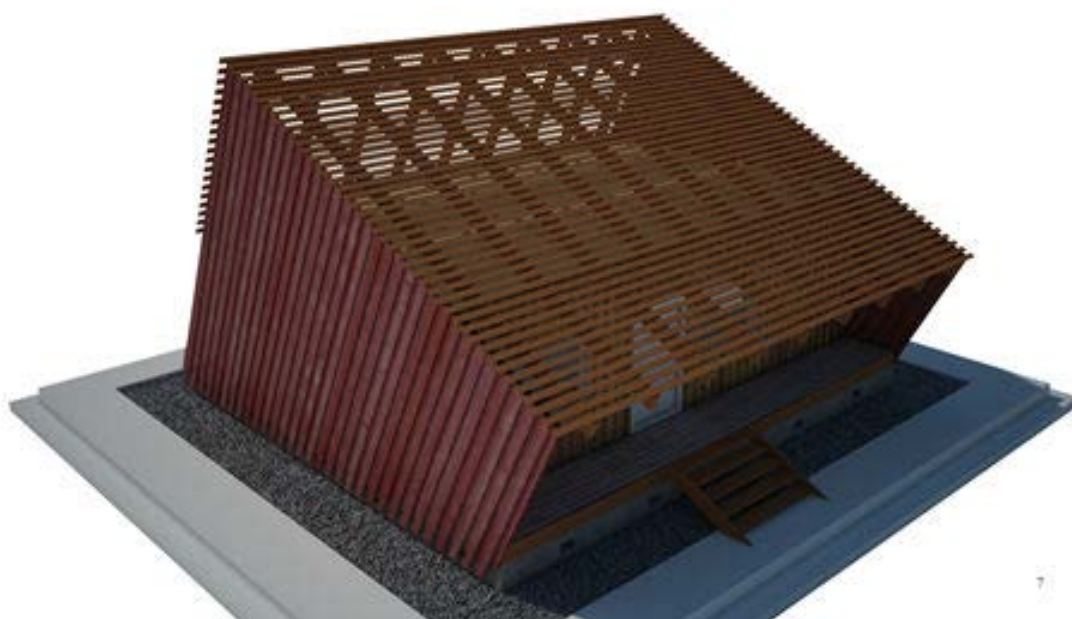


Photo 10. Ivan Rys

Разрез Здания

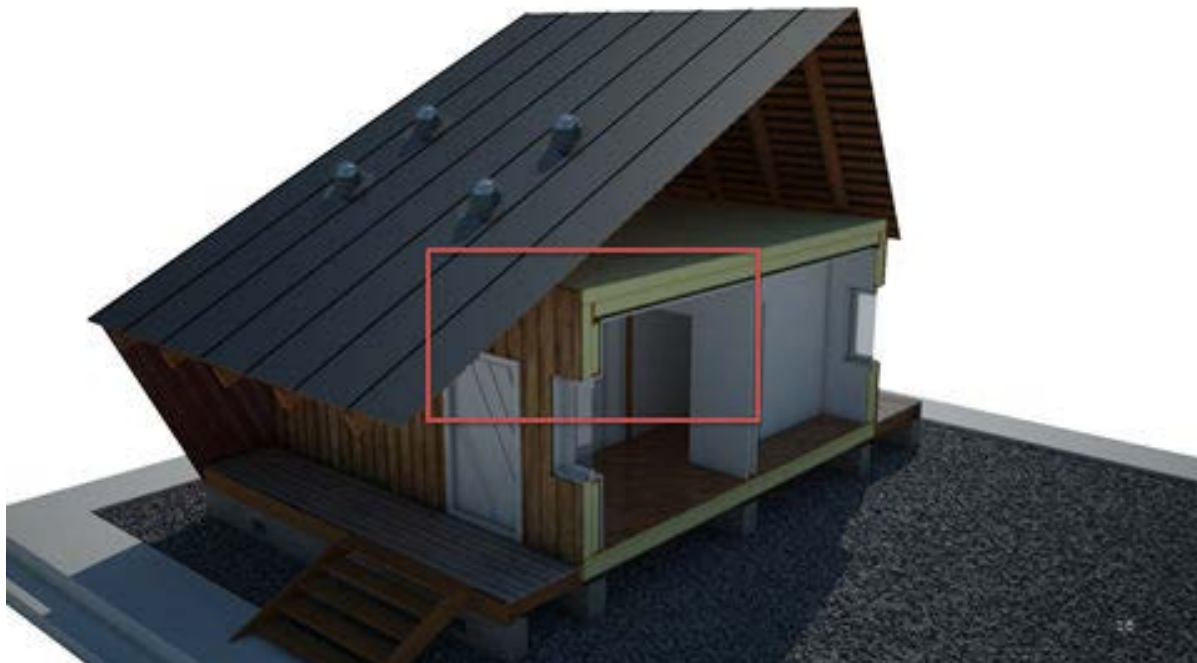


Photo 11. Ivan Rys

Разрез Здания



Photo 12. Ivan Rys

Next stage idea's development is creation of project (on the base of worked out architectural conception). This building will be with zero energy consumption on heating. To this end, will be organized the group of design engineers. Certainly, this membership will consist of the best students of Faculty. We are expecting to attract large organization, which will realize chief-control. Today, we accepted tentative agreement with famous Russian design department.

After last designing stage our building will construct on the Polytechnical University's territory. Furthermore, this house is planned to equip with all modern technologies, corresponding to the highest world trends of the Passivehaus type. We are going to install the Laboratory of energy-efficient innovative technologies there. During the all utilization stage we will organize an energetic monitoring of building, assessment of thermalphysic characteristics walling, definition of energy consumption indexes.

Participation of Polytechnical University's students will create a lot of Russian designers, who can not only adapt foreign projects, but make home-produced and enough competitive. Such step will reduce a lag of our country in world pace of energy-efficient, energy-passive buildings and buildings with zero energy consumption. Now demand for similar structures is small in Russia, but will increase in rise process in prices for energy carrier in the near future.

References

1. Ehhort H., Reiss J., Hellwig R. Энергоэффективные здания. Анализ современного состояния и перспектив развития на основе реализованных проектов // АВОК. 2006. №2. С. 36–49.
2. Шилкин Н. В. «Пассивные» здания: возможности современного строительства // Энергосбережение, 2011. №4. – С. 34–40.
3. Табунщиков Ю. А., Бродач М. М., Шилкин Н. В. Энергоэффективные здания. М.: АВОК-ПРЕСС, 2003. 100 с.
4. Дмитриев А. Н. Пассивные здания. Перспективы проектирования и строительства зданий с низким уровнем энергопотребления // СтройПРОФИль, 2005. №2. 1-5 с.
5. Jormalainen J., Käkälä P. Sustainability of Polyurethane Thermal Insulation // NSB-2011. 9-th Nordic Symposium on Building Physics, Tampere, Finland. 29 May – 2 June, 2011.
6. BRE Global 2010. Life cycle environmental and economic analysis of polyurethane insulation in low energy buildings. Prepared for: PU Europe, Belgium. Client report number 254 – 665.
7. ПРОТОКОЛ № 40 от 28.09.11. Санкт-Петербургский Государственный архитектурно-строительный университет. Испытательный центр «БЛОК».
8. ПРОТОКОЛ № 10 от 10 февраля 2011 измерений теплопроводности продукции SPU Systems Oy. ФГУП «Всероссийский научно-исследовательский институт метрологии им.Д.И.Менделеева».