How to achieve energy efficiency in construction?

Energy efficiency, nearly zero-energy building, air tightness, and renewable energy – these concepts have become increasingly common in the daily vocabulary of the builders. Is the Wolf Group as a producer and reseller of building materials ready for the imminent changes in the building market?

TEXT: **KULDAR KONGO**, PRODUCT MANAGEMENT DEPARTMENT

GLOBAL reports and studies suggest that human activities have contributed to climate warming for as much as hundreds of years. The European Union and international climate policies are therefore aimed at alleviating climate change and adapting to its impact. To decrease anthropogenic greenhouse gas emissions, the European Union has set the ambitious goal of reducing greenhouse gas emissions by 80–95% by 2050 compared to 1990. Every EU country has to contribute to reducing greenhouse gas emissions by 20% by 2020 and 40% by 2030.

What does this all have to do with the energy performance of buildings? According to studies made in the EU Member States, buildings are responsible for about 40% of the EU's total energy consumption and are therefore the largest energy consumers. To contribute to a reduction of greenhouse gas emissions, it is therefore obvious that the amount of energy spent on heating, cooling, ventilation, hot water, lighting, and other processes in a building has to be diminished, and renewable sources of energy should be used whenever possible. To make sure that things are moving in the right direction, the EU Energy Performance of Buildings Directive has established that all new buildings completed after December 31st 2020 must be nearly zero-energy buildings. This requirement will apply as early as from December 31st 2018 to new buildings occupied and owned by public authorities. Considering how volumous and time-consuming the construction process is, the deadlines are approaching at a frightening pace and require readiness and competence from everyone involved in the construction sector.

Nearly zero-energy buildings and energy performance indicator

A nearly zero-energy building is a building involving energy efficient solutions and renewable energy technologies following the best possible building practice. The energy performance indicator for nearly zero-energy buildings must be lower than the nationally established limit. The energy performance indicator (EPI) reflects the amount of energy used to provide the indoor climate, hot water, household and other electrical equipment in the normal use of the house per square metre of heated area in a year. The EPI is calculated by taking into account the amounts of energy supplied to and produced by the building. The established EPI limits may vary by country. In Estonia, small residential buildings with an EPI less than 50 kWh/(m^2*yr) and apartment blocks with an EPI less than 100 kWh/(m^2*yr) are regarded as nearly zero-energy buildings. The current EPI limits in Estonia are 160 kWh/(m^2*yr) for small residential buildings and 150 kWh/(m^2*yr) for apartment blocks. These figures are a vivid illustration of the changes facing us in the forthcoming years, as the EPI for private residential buildings alone will have to improve more than three-fold (see the Table on page 9).

How can all this be achieved? Broadly speaking, energy performance depends on the general energy demand of the building, the type of energy supplied, the production of energy from renewable sources on-site, and the heat losses through the building envelope. The EPI value depends on the combination of all these factors.

To meet the requirements for nearly zero-energy buildings, special measures and solutions have to be applied in combination: from the correct planning of the position of the building and the use of renewable sources of energy to an elaborate solution for the building envelope to reduce heat losses.

Heat losses through the building envelope

It is commonly believed that increasing the thickness of the building's thermal insulation layer is enough to minimise heat losses. This is certainly true in most part, as heat conduction loss through the envelope is one of the main factors that impacts the total energy losses of a building. However, in addition to heat conduction losses, a building also loses heat through unplanned air leaks and cold bridges. Often the thickness of a building's thermal insulation has reached the limit of its cost efficiency, meaning that instead of adding additional thermal insulation, it is much more practical to close air leaks and avoid cold bridges. The importance of air tightness is also highlighted by the fact that measuring this parameter at the completion of a construction has become inevitable for nearly zero-energy buildings.

A number of other important requirements apply to the building envelope: avoidance of moisture problems, ensuring the quality of the indoor climate, noise reduction and also fire safety. To achieve the desired results, professional and thoughtful solutions are required from all those involved – architects, engineers, builders and producers of building materials.

Energy efficient solutions for window installation

One of the major challenges for buildings is the correct installation of windows, since in the course of this activity both the outer thermal insulation and the air-tight and vapour-tight layers are interrupted. I will present the factors and potential solutions for correct window installation, leaving aside the thermal and other issues related to the glazing unit and the window frame. The following conditions have to be met, while an aesthetic appearance should be maintained both indoors and outdoors.

- **Heat losses reduced to a minimum**
  Window joints have to be sealed

INNOVATION

using materials with thermal conductivity as low as possible, such as PU foam. In addition to thermal conductivity, heat conductivity losses at the joint also depend on the joint depth – losses are smaller for windows with a wide jamb because the joints are deeper.

- **Ensured air tightness to reduce heat loss through air leaks**
  Frankly, the air tightness of a joint should be ensured if a good quality mounting foam is used correctly. In order to guarantee air tightness during the use of the building when it is exposed to various loads, special tapes, membranes or mastics should be applied as an additional airtight layer.
- **Ensured vapour-tightness to protect the inner structures from excessive moisture that can led to deviations from the intended properties of materials, cold bridges and mould**
  Water vapour moves from inside-out or from outside-in depending on the climatic conditions. The former illustrates is the case in Northern countries for most of the year, and the latter in warmer regions. Special tapes, membranes or mastics are used to keep water vapour from infiltrating the envelope structure. These materials are usually air- and vapor-tight simultaneously. It has to be also considered, that a vapor-tight and airtight structure must always have a high quality, elaborate ventilation solution.
- **Any moisture accidentally caught in the structure must be led out.**
  Accidental moisture can mean the moisture of materials during construction or moisture caught in the envelope due to poor engineering and/or construction. The "trapping" of accidental moisture in the structure must be avoided and it must be led out in the desired direction. This is done with the help of materials of low vapour resistance, such as special tapes or self-expanding seals.
- **All inner structures must be protected from external climate impacts, such as UV radiation, precipitation, wind, etc.**
  To meet these requirements, joints have to be filled from the outside with a high quality weatherproof sealant or a self-expanding tape. If joints are filled from the outside with a highly vapour-tight material, moisture must be allowed to move out of the structure, for example through facade ventilation.
- **Avoid cold bridges**
  A window should always be installed in the thermal insulation layer to reduce the cold bridge effect. The cold bridge effect is also significantly reduced by choosing windows with wide jambs and sealing the installation joints with a mounting foam of low thermal conductivity.
- **Joints can endure various movements and deformations without problems**
  During the life-cycle of a building, the window frame and the adjacent wall structure are exposed to various loads that cause deformation. It is important that the joint between the window jamb and the wall structure is designed considering all these potential deformations, and that the materials used at the joint can endure these movements without losing their properties. For example, it is recommended that more elastic foams are used for large windows, where the linear expansion of the window frame due to temperature and moisture is greater, and sealants with higher movement capability are also better suited for weather sealing.
- **Ensured sound insulation**
  It is important during window installation to seal any cracks and leaks as this improves sound insulation in addition to air tightness. Properly installed high quality mounting foam meets this requirement to a large extent, while special sealants, such as acrylic sealant, are suitable for filling smaller cracks such as the crack between the inner window reveal and the window jamb.
- **Fire resistance**
  If a fire rated window is installed, only certified products with improved fire resistance and reaction to fire may be used.

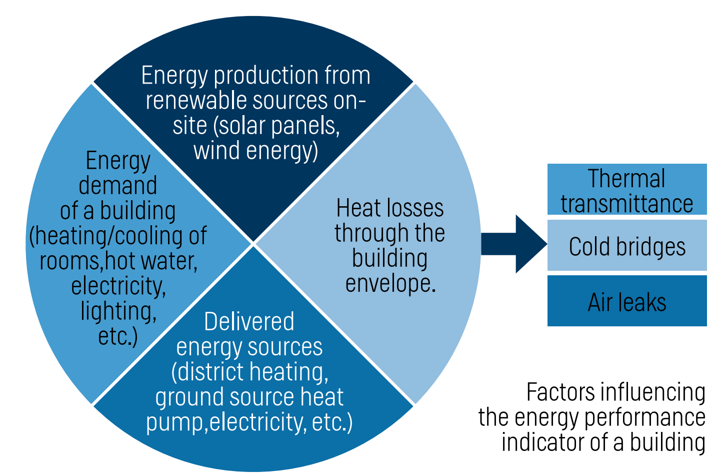
How does the Wolf Group contribute to energy efficiency?

With the erection of nearly zero-energy buildings in Europe, customers' expectations of the quality of materials and the competence of the people selling them are growing. Based on the above example of a window installation, it can be said that our portfolio already includes products that can be used to successfully solve the hydrothermal issues of a building, and therefore contribute to energy efficiency. All these necessary properties also have to be kept in mind when developing future products.

Our own knowledge and competence are at least as important as the technical characteristics of the materials. It is vital to understand the role and contribution of each product in terms of energy efficiency, and to deliver these values to the customer. This is the professional approach that helps us win and keep the trust of customers, which is the cornerstone for the success of any company.

	Maximum EPI limit	Low energy building	Nearly zero-energy building
Small residential building	160 kWh/(m²*yr)	120 kWh/(m²*yr)	50 kWh/(m²*yr)
Apartment block	150 kWh/(m²*yr)	120 kWh/(m²*yr)	100 kWh/(m²*yr)
Office building, library and research building	160 kWh/(m²*yr)	130 kWh/(m²*yr)	100 kWh/(m²*yr)
Business building	210 kWh/(m²*yr)	160 kWh/(m²*yr)	130 kWh/(m²*yr)
Public building	200 kWh/(m²*yr)	150 kWh/(m²*yr)	120 kWh/(m²*yr)
Commercial building and terminal	230 kWh/(m²*yr)	160 kWh/(m²*yr)	130 kWh/(m²*yr)
Educational building	160 kWh/(m²*yr)	120kWh/(m²*yr)	90 kWh/(m²*yr)
Pre-school institution	190 kWh/(m²*yr)	140 kWh/(m²*yr)	100 kWh/(m²*yr)
Health care building	380 kWh/(m²*yr)	300 kWh/(m²*yr)	270 kWh/(m²*yr)

The energy performance indicator limits according to the Government of the Republic of Estonia Regulation No. 55 "Minimum requirements for the energy performance of buildings".



Factors influencing the energy performance indicator of a building