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Fitting hot and cold climates into the “envelope”

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Buildings account for 36% of CO₂ emissions in Europe, and energy consumption in this sector has increased in recent decades. A report led by the Building Performance Institute Europe (BPIE) shows that more than 40% of the European stock was built before 1960s, “where there were only few or no requirements for energy efficiency and only a fraction has undergone major energy retrofits. This means that this building stock has low insulation levels and its systems are old and inefficient.”

Besides the age of buildings, the lack of strict national requirements has played an important role. “Although heating needs in southern countries such as Portugal and Italy are lower due to milder winters, the energy use is relatively high, which could be a sign of insufficient thermal envelope insulation in their building stock,” BPIE underlines.

On the other hand, even though older buildings have the biggest share in the North-West, many countries in cold climatic zones, such as the UK, have pushed for stricter thermal building regulations and now excel in the energy efficiency performance of their stock.

In Finland thermal requirements have been in place since 1976. Moreover, a significant set of regulations was introduced in 2010, energy consumption for heating has dropped by 30% in new buildings, with a further drop of 20% in 2012. “The Ministry of the Environment establishes the minimum energy efficiency requirements for new buildings. Planning permission can only be granted to buildings that will fulfil them,” confirms researcher Juha Jokisalo, specialist in building technology at the Aalto University in Espoo”.

The European Union covers different climatic zones and landscapes, and its 500 million inhabitants live in a wide array of building types, with different thermal characteristics. “Of course, the sufficient level of energy efficiency also depends on the climate,” Jokisalo points out.

Can a same refurbishment system be used in northern and southern countries? This is a challenge that the European project BRESAER (Breakthrough Solutions for Adaptable Envelopes for Building Refurbishment) is trying to solve with a universal “envelope” to be installed over the existing façade.

“The system is an industrialised aluminium substructure that combines different cladding solutions on the same frame,” explains Imanol Agirre, Innovation manager at Spanish LKS group in San Sebastian, who is collaborating with the project. “These claddings include active and passive solutions such as lightweight, ventilated façade modules and transpired solar panels that are connected to a co-heating system. Multifunctional insulation concrete panels enable greater cladding spans, whereas dynamic windows provide solar protection and automated daylight control. Furthermore, a nano-coating enhances the cooling and photocatalytic properties of the claddings,” continues Agirre.

He is confident that “the envelope could suit all the different climates in Europe, by adjusting the combination of the different cladding systems to local environments.” The passive solutions, which increase thermal properties and provide solar protection, will result in a reduction of heat gains and consequent cooling demands. By combining active renewable cooling and automation solutions, the system will be efficient in hot climates.

“It will also work in cold climates,” Agirre adds. “Increased thermal insulation can reduce heat loss, as solar gain is beneficial in these climates during the coldest months, and the dynamic windows will contribute when required. These solutions associated with the renewable heating solutions will greatly reduce energy consumption in cold climates.”

The results of three prototypes are now being analysed “in order to certify the correct behaviour related to mechanical, fire, and safety requirements,” he concludes. The system will then be tested in a real teaching building located in Ankara, Turkey.

Moreover, four virtual demonstrations will be performed in facilities located in four other European countries covering complementary climatic zones.

By Jessica Haapkylä