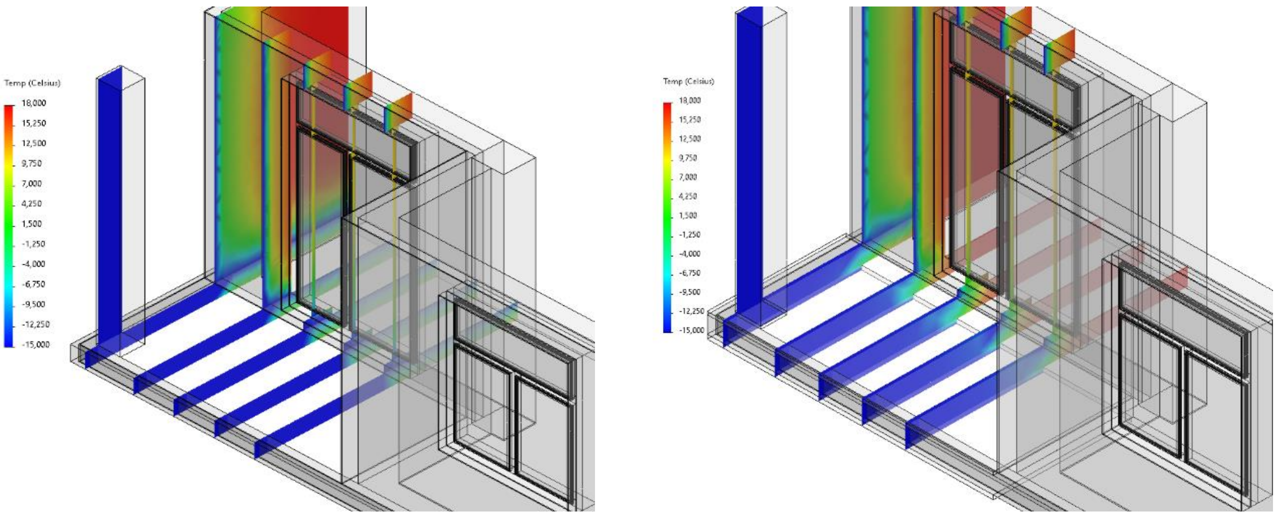
OPTIMIZATION OF THERMAL PROTECTION OF FRAME-MONOLITHIC BUILDINGS

KHLYTSOV M., BOCHOROSHVILI G.
Odessa State Academy of Civil Engineering and Architecture, Odessa, Ukraine

During the mass construction of frame-monolithic buildings, due attention is not always paid to the thermal insulation of parts of protruding ceilings, for example, balconies, bay windows and other structural elements, which leads to significant heat losses, but they are the “bridges” of cold that reduce thermal comfort in the premises and forces their residents to spend significantly more money on heating. It should be noted that cold bridges, in turn, can lead to the appearance of fungi, mold in the corners of rooms and disruption of the microclimate in general. The best way to solve the problem of reducing heat loss through the protruding parts of the building in accordance with the requirements of regulatory documents would be insulation using dense (140-160 kg/m3) mineral wool or, in extreme cases, expanded polystyrene (PSB-S) with a density of more than 25 kg/ m3 [1]. However, given that the thermal insulation of such places is quite labor-intensive and expensive, therefore many developers, despite the requirements of regulatory documents, do not comply with it at all. When designing and operating residential buildings in order to reduce costs for heating, ventilation, and air conditioning, optimal engineering solutions should be achieved. The possibility of optimizing enclosing structures from reducing heating costs point of view is that the building envelopes should have maximum thermal protection at minimal costs. First of all, this is possible through the use of less expensive thermal insulation materials, secondly, rationally selected thickness, and thirdly, the choice of cost-effective structural and technological solutions for thermal insulation of complex facade shapes. Thus, solving the problem of choosing optimal structural and technological solutions under given limiting conditions for installing bonded thermal insulation systems for facades is relevant.

The purpose of the work is to select economically justified, effective structural and technological solutions for thermal insulation of components of complex shapes of facades of frame-monolithic buildings with the condition of ensuring the required stable thermal insulation contour by modeling temperature fields. It is assumed that if we simulate the temperature fields of nodes of complex facade shapes and thereby determine possible zones of heat loss and places where cold bridges are created, this will reduce the cost and labor intensity of construction and installation work on thermal insulation of facades. Modeling of temperature fields was carried out using the example of an 11-story frame-monolithic residential building with a complex shape of facades insulated with 50 mm thick mineral wool. Thermal optimization of enclosing structures of complex shapes requires a separate detailed analysis of components to prevent “cold bridges”, freezing adjoining parts and the location of the front of dew points, hidden places, thus their real determination by external measuring means is difficult and time-consuming, and sometimes. This is especially true for field studies with a thermal imager, which must be performed at low ambient temperatures (possibly 1-2 °C) and positive temperatures (at least 16-18 °C) inside the house.

Modeling of insulation in modern software packages SolidWorks Simulation allows, at the design stage, to select cost-effective structural and technological solutions for thermal insulation of components of complex facade shapes [2]. In Figure 1.a. The temperature fields in the sections of the building without insulation of the balcony slab and with insulation are shown in Fig. 1.b.



a) b)

Fig. 1. Temperature distribution inspection of walls without insulation of the balcony slab (a) and with insulation (b)

When comparing these figures, the absence of “cold bridges” for the option with insulation of the balcony slab is clearly visible. It was found that it is most effective to insulate not the entire contour of the balcony slab, as required by regulatory documentation, but rather the size of the insulation from the outside wall is sufficient, equal to 750 mm with an insulation thickness of 30 mm on top of the slab and 50 mm on the bottom of the slab. It is economically feasible to use such insulation technology for modern multi-storey houses with non-standard volume-architectural solutions, built on frame-monolithic or monolithic schemes without thermal breaks between the balcony slab and monolithic floor slab with open types of balconies and bay windows, closed loggias. Subsequent analysis of temperature distribution made it possible to substantiate the size and shape of the insulation of open balcony slabs, which led to an improvement in the thermal insulation properties of the structure and savings in materials.

Currently, to process experimental data during non-destructive testing of the thermophysical properties of materials and products by thermal methods, the use of empirical dependencies is mainly used based on a large number of experiments in a fairly narrow range of controlled properties of materials. The simplicity of the mathematical support of measuring systems is an advantage of this approach. It becomes possible to implement them using cheap technical means.

References

1. Chernyavsky V.V. Thermal insulation and finishing facade systems as a means of thermal modernization of the housing stock of Ukraine / Chernyavsky V.V., Yurin O.I., Farenyuk G.G. //Resource-saving materials, structures, buildings and structures. – 2008.- Issue. 17.- P.365 – 372.
2. Aliyamovskaya A. A. Design engineering in SolidWorks Simulation. M.: DMK Press, 2010. –464 s. Il. (Series “Project”).