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Aspects of improving the methods for accounting the costs of heat energy based on indicators in multi-family buildings

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Abstract: The article describes the criteria for assessing the methods of accounting for the costs of thermal energy used by housing communities and cooperatives based on the indications of divisors. The most common errors in the current practice of settlements were pointed out, causing the heating costs to be overstated, calculated as a fee for heating 1 m² of usable space or for a calculation unit of consumption. The aim of the publication is to present the methods of settling individual costs in a multi-room building, which allow for logical and fair division of the costs of heat supplied to the building for the heating of individual premises in accordance with Polish regulations. The principles of accounting for energy costs after the amendment to the Energy Law and the implementation of the provisions of the Regulation of the Minister of Climate and Environment of December 7, 2021 on the conditions for establishing the technical feasibility and profitability of using heat meters, heat cost allocators and water meters for measuring domestic hot water were discussed, as were the conditions for selecting the method of accounting for the purchase costs of heat and the scope of information contained in individual settlements.

Keywords: heat cost allocators, heating cost, building heating, system heat

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Introduction

System heat is a maintenance-free, economical heating available all year round. In Poland, about 15 million Poles use system heat, for whom the upcoming heating season of 2022/2023 may turn out to be the toughest in years. Growing inflation and emerging concerns about the availability of gas and coal mean that system heat

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recipients will face bill increases of several dozen percent, Heating costs are rising, and heating companies submit requests to the Energy Regulatory Office to change tariffs. In this situation, it will be particularly important for owners of premises in multi-family buildings with a central heating system to fairly settle the costs of heat energy. According to estimates, there are approx. 3 million flats left for metering, a significant number of which are located in buildings in the so-called technology large slab, with heat distribution through the risers. In these buildings, an allocative cost accounting system for heat consumption from central heating is usually used.

1. Previous methods of billing of heat energy

Until December 2021, the method of accounting for heat energy was regulated only by the Energy Law. On the basis of the guidelines indicated therein, the communities and cooperatives created internal regulations that determined the method of accounting for the costs of heat energy consumed. Pursuant to Art. 45a paragraph. 4 of the Act, the heat recipient, i.e. the owner or manager of a multi-family building, was obliged to settle the costs of heat delivery, and the amount of fees charged to apartment tenants should be determined in such a way as to ensure only the coverage of the heat purchase costs incurred by the recipient. Since fees related to heat are quite large costs for heat consumers, the legislator indicated the need to create regulations for their settlement. At the same time, a certain freedom was left in the choice of the method of accounting for the costs of thermal energy, while allowing the possibility of using methods that use the indications of heat meters, indicator devices that are not measuring instruments within the meaning of metrological regulations, the so-called heat allocators and methods based on the area or volume of the premises. The selected method of billing the costs of supplied heat should take into account the equalization factors, while maintaining the correct operating conditions of the building, stimulate energy-saving behavior and ensure that charges are set in a way that corresponds to the heat consumption for heating.

It is obvious that the most advantageous solution is the accounting of heat according to the indications of heat meters, which are the most accurate and enable remote reading. However, in practice, solutions of this type cannot usually be applied in already existing buildings, and therefore the accounting methods based on heat allocators are most often used. As the legislator allowed the settlement of energy costs without the use of any metering and billing devices, some housing communities still use methods based on billing the costs of heat consumption in proportion to the usable floor space of the premises.

2. Current criteria for assessing the correctness of the heating cost accounting

Already in 2009, the Association of German Engineers VDI (Verein Deutscher Ingenieure) formulated guidelines for assessing the correctness of the collective

settlement of heating costs for premises in a billing unit, which may be an independent building or a group of buildings powered by one heat source. These guidelines consider the following indicators:

- r_w index expressing the share of heat emitted by radiators completely warming the building. If the amount of heat emitted to individual rooms by radiators in relation to the total amount of heat supplied to the building is less than 34%, then accounting for heating costs only on the basis of heat registration from radiators is not correct.
- The S_v index is described by the standard deviation of the distribution of the values of the normalized heat consumption related to the surface of the premises in relation to the average value of consumption for the entire accounting unit (building). This ratio should be less than 0.85.
- The γ index specifying the share of premises with low unit consumption (quotient of consumption units by area) in the average unit consumption in the whole building. Up to 15% of the average unit consumption for the entire building is assumed as low consumption. The limit number of low consumption premises is also 15%.

The correctness of the division of the costs of heat supplied to a multi-family building into individual apartments can be assessed on the basis of a statistical analysis of heating bills. Such analyzes allow us to conclude that a significant part of them significantly differs from the results consistent with the Gaussian curve, i.e. the normal distribution. Therefore, the Zoellner test is a frequently used indicator that allows the assessment of how correct is the settlement of heating costs on the basis of allocators. In this method, the quotient K_v is determined for each apartment, which is the ratio of the share of heat consumption to the share of area.

The guidelines presented above make it possible to assess the correctness of accounting for heating costs, which is based only on recording the amount of heat from radiators, without taking into account other heat sources, e.g. heating risers. If the share of heat indications in the total delivered to the building is small, the distribution of its consumption differs from the norm and there is a large number of small consumptions, then the use of such indications of allocators for accounting for heating costs is problematic (Michnikowski, 2015).

3. Verification of accounting of heating costs

From the author's own experience (Kysiak & Ujma, 2018), the increasing number of cases of incorrect heating cost accounting described in scientific publications indicate that the current methods of accounting based on the indications of divisors require a radical change. Due to the lack of precise technical and legal provisions that should regulate the settlement procedure in the conditions of the Polish construction industry, heating costs are usually settled on the basis of regulations developed by housing resource managers. Despite the fact that the allocators used

in Poland are analogous to those used in Germany, the VDI guidelines are practically not applied.

The publication (Michnikowski, 2015) defines the principles of correct accounting for heating costs in multi-unit buildings in terms of the following criteria: legal, technical and social.

The legal aspect is a set of provisions regulating the issue of heating costs accounting in Polish conditions, the technical aspect is the analysis of various methods of accounting in the context of the specificity of the Polish construction industry, while the social aspect is the analysis of accounting procedures in the context of a sense of social justice and life experience.

In technical terms, proper operation of the building should be understood as ensuring a minimum room temperature of 16°C and sufficient ventilation. It should be noted that Polish construction law takes into account the problem of significant energy consumption by ventilation and air conditioning systems. It is assumed that the basic requirements concerning appropriate hygienic and health conditions as well as environmental protection take precedence over the requirements concerning energy saving. The technical aspect of accounting for heating costs requires inclusion in the individual accounting of heating costs based on the indications of heat allocators for heating divisions, if their impact significantly affects the result of the cost allocation.

The social aspect of settlements requires that the method of dividing the costs of heat supplied to the building into individual premises is fair, i.e. it must not overstate the heating costs of premises users rationally using heat from radiators in order to ensure design conditions in terms of temperature and air quality. Therefore, it cannot be a method that sanctions such a state of affairs that the users of premises with zero indications of indicator devices do not pay for heating because they did not use the heat from the radiators. The sources of this heat were heating risers or walls of the neighbors.

4. Problems encountering the appropriate cost of heating in a multi-family building

The most common related problems are listed below with the determination of the appropriate cost of heating the premises in a multi-family building (Ciuman & Specjał, 2018):

- Due to the deviations from the design assumptions, as well as from standard conditions (PN-EN 12831:2006; PN-EN 834:2013), the operating conditions of central heating systems occur in residential premises, which affect the operation of radiators and heat cost allocators, e.g. oversizing of radiators resulting in the necessity to throttle in heating water jets. In practice, these changes are not taken into account in the settlement algorithms.
- Total costs related to the supply of thermal energy are divided into two components: independent variable costs K_w , which do not depend on heat consumption, i.e.: charges for ordered power, transmission charges for power, subscription

fees and dependent variable costs K_p , i.e. costs related to the consumption of thermal energy expressed in GJ. Only when the level of dependent variable costs is adopted at a level consistent with reality, the bill of a specific user becomes insensitive to the behavior of other tenants. When settling using the divisional method, it is necessary to correctly determine which part are shared costs and which are variable. In the current practice of settlements, the unit amount of PLN/units, adopted for calculations, is a derivative of the obligatory ratio of K_w/K_p and the behavior of tenants, and not the unit amount for variable heat. The reason for this situation is, among others not taking into account in calculating the concept of sensitivity of EB allocators, determined as the relationship between the consumption value read from the allocator and the heat emission from QHW heaters.

- Errors in the settlement of heat costs in the allocating system stimulate unfavorable behavior of apartment tenants. The natural consequence of receiving a disproportionately high bill is to reduce consumption in the next heating season. This results in an increase in the amount of bills for all those apartment tenants with above average consumption. This aggravates the tendency to continue saving until the equilibrium is finally established at a very low level. Consumption saving methods consist in turning off all radiators permanently and using electric heaters if necessary, and even heating the apartments with gas.
- Incorrect behaviors of building users consisting in excessive saving result in further irregularities in settlements related to heat flows between premises. In the case of a tenant in an apartment, in the extreme case, he does not turn on the radiators at all, and the heat flows from the neighboring apartments anyway. Then the temperature, although lower than that of the neighbors, may be sufficient to stay in the apartment, and the neighbors' bills are increased by the cost of heat that the neighbor took from them.
- The abnormalities presented above occur when multi-family buildings are not properly prepared for the introduction of billing systems in the allocative system. Measurement and billing devices should enable users to obtain a temperature lower than the calculated temperature in rooms, but not lower than 16°C in rooms with a design temperature of 20°C and higher.
- The inaccuracies of billing also result from the fact of unmeasured heat gains from central heating risers and the presence of other heat sources in the premises that are not registered, e.g. illegal connection of underfloor heating to the central heating network
- LAF equalization factors in billing heating costs are used to compensate for losses related to heat losses faced by users of one-story corner apartments in relation to users of identical apartments located internally in the building block. In practice, however, the compensation coefficients should be updated on an ongoing basis due to the additional thermal insulation of e.g. loggias and balconies, or in order to take into account the location of part of the apartment area above the basement heated rooms. After carrying out modernization measures, affecting the losses and heat supply to apartments, the building

manager should adapt the central heating system, including radiators, to the new working conditions and provide the company accounting for heat consumption with new data for the inventory of heaters and oblige it to re-scale the cost allocators (Kysiak & Ujma, 2018).

- Despite the fact that the settlement regulations of housing co-operatives caused huge discrepancies in the amount of bills, and some tenants incurred the cost of heat consumption, which was not able to provide heat in their apartments during the heating season, billing companies did not properly verify the heating costs per apartment.

5. Methods of repairing the methods of settling costs of heating

This chapter presents a brief overview of the methods of eliminating irregularities in the allocative system heat cost accounting. In the Czech Republic, the principle of the unit cost of heating to fluctuate within 40% of the average value, regardless of the consumption of indicator devices, has been introduced. In Germany, for buildings equipped with single-pipe systems of the same diameter, if the proportion of heat flowing through radiators is too small as a result of the VDI guidelines, the difference between 43% of the actual share of heaters per consumption unit is converted and divided into all residential premises. As a result, there are no premises with zero indications in the verified settlement.

Swiss regulations on heat accounting include the obligation to estimate the amount of heat from pipes depending on the diameter and length of pipes passing through the premises, the average temperature of the heating medium in the season and the length of the heating season. The amounts of heat estimated in this way are then converted into consumption units of the electronic allocator and summed up with the indications of the allocators in individual premises.

In Poland, attempts were made to adjust the method of allocating heating costs to an acceptable form by increasing fixed costs up to 90-95%, reducing consumption units using lower and upper limits and estimating heat gains from divisions. Michnikowski and Matys (2005) applied an approach to the problem of settling heating costs in a multi-apartment building, based on linking heating fees with the amount of heat supplied from external sources to heat the premises. The starting point for its explanation is the standard (PN-EN ISO 13790:2009) used to determine the energy for heating and cooling. Based on this standard, an equation describing the heat consumption for a building consisting of the i -th number of premises was developed:

$$Q_{H,nd} = \dot{Q}_{tr,sol} t \sum \frac{\Delta\Theta_{e,i} F_i}{\Delta\Theta_e F} + \dot{Q}_{ve,int} t \sum \frac{x_i}{x} \quad (1)$$

where:

$\dot{Q}_{tr,sol}$ – total transmission heat consumption after taking into account profits from insolation of the building [W],

- $\Delta\Theta_{e,i}, \Delta\Theta_e$ – the average of the difference between the temperature in the billing period internal and external for the i -th premises and respectively for the whole building [K],
- $\frac{x_i}{x}$ – the ratio of the normalized consumption units of the divisors in the premises until completely consumed in the building,
- $\dot{Q}_{ve,int}$ – total heat consumption by ventilation after taking into account profits from internal sources for the building [W],
- t – duration of the billing period [s],
- F_i, F – area of the premises, building [m²].

The heat consumption $Q_{H,nd}$ specified in equation (1) is used in the procedure of determining individual heating costs of the premises in a multi-apartment building and are used to settle between the building owner or manager and the heat supplier according to a two-component tariff.

Another method of determining the variable costs of heating residential premises was presented in the article by Ciuman and Specjał (2018). This method requires calculations of the annual final energy demand for heating the residential part of the building $Q_{k,H}$ [Wh/year] and the ratio of this demand related to 1 m² of heated area E_{KH} [kWh/(m²·year)] within the residential part, i.e. excluding staircases, corridors and other shared spaces, which are charged as a consumption-independent fee.

6. Changes in the methods of billing of heat energy introduced by the amendment of the energy law

In December 2021, the Regulation of the Minister of Climate and the Environment was announced on the conditions for determining the technical feasibility and profitability of using heat meters, heat cost allocators and water meters for measuring domestic hot water, the conditions for selecting the method of accounting for the costs of heat purchase and the scope of information contained in individual billings, which implemented the guidelines of the EU Directive 2018/2002/EU to art. 45d of the Energy Law. A pursuant to the amendment to the Energy Law introduced in 2021, by January 1, 2027, the owner or manager of a multi-unit building is required to replace the existing heat meters, heating cost allocators or water meters used to measure domestic hot water with devices with a remote reading function. If heat meters or heat cost allocators with remote reading function are installed in the building, the owner or manager of the building must provide information on: heat consumption for a given dwelling or business unit – once a month, heat costs at least once for every half a year.

The legislator clearly indicated that the billing of costs should be based on the installed equipment, but still billing based on the area or cubic capacity of the premises is allowed in cases where the use of heat meters or heat cost allocators

is technically impossible or unprofitable. In practice, it will be extremely difficult to install heat meters on old installations without incurring huge expenses, therefore heat allocators will be commonly installed on radiators. The heat cost allocator system will be used when it is not technically possible to install heat meters and the following conditions are additionally met:

- technical analysis shows that it is possible to use heat cost allocators,
- an economic analysis conducted for a five-year period will show that the projected energy savings as a result of the use of heat cost allocators is higher than the cost of purchase, installation and operation of these devices,
- heat centers enable the minimizing of the resulting heat losses from the transport of the carrier with an external receiving installation.

Conclusions

Until 2021, in Poland there were no coherent and comprehensive regulations regulating the method of accounting for heat energy. Moreover, it was necessary to adjust Polish law to EU requirements by implementing Directive 2012/27/EU of the European Parliament and of the Council of October 25, 2012 on energy efficiency. The changes introduced to the Energy Law will require a redesign of the existing regulations for the settlement of system heat costs in Housing Cooperatives. If the changes are to be beneficial for users, the new regulations must adequately reflect the costs incurred individually for heating the apartment from the central heating installation.

The criteria for assessing the correctness of billing heating costs and examples of repair methods for billing heating costs indicated in this article prove that, in the current technical conditions, there is no ideal method for supplying heat to premises in multi-unit buildings. Efforts should be made to ensure that the method of heat billing in the allocating system adopted in the new billing regulations fully implements the principles of correct billing of heating costs in multi-unit buildings in terms of the following criteria: legal, technical and social.

Bibliography

- Ciuman, H. & Specjał, A. (2018) Propozycja modyfikacji rozliczeń indywidualnych kosztów ogrzewania w budynkach wielorodzinnych. *Instal*, 1, 6-12.
- Kysiak, A. & Ujma, A. (2018) Ocena prawidłowości rozliczania kosztów ogrzewania w budynkach wielorodzinnych na podstawie wskazań podzielników ciepła. *Budownictwo o Zoptymalizowanym Potencjale Energetycznym*, 7, 2, 103-110.
- Michnikowski, P. (2015) Jak rozliczać indywidualne koszty ogrzewania lokali w budynkach wielolokalowych. *Ciepłownictwo, Ogrzewnictwo, Wentylacja*, 46/10, 400-405.
- Michnikowski, P. & Matys, S. (2005) Metody podziału indywidualnych kosztów ogrzewania w budynkach wielorodzinnych w świetle znowelizowanego Prawa energetycznego. *Ciepłownictwo, Ogrzewnictwo, Wentylacja*, 36(12), 24-29.

PN-EN 12831:2006 *Instalacje grzewcze w budynkach. Metoda obliczania projektowego obciążenia cieplnego.*

PN-EN 834:2013 *Podzielniki kosztów ogrzewania do rejestrowania zużycia ciepła przez grzejniki. Przyrządy zasilane energią elektryczną.*

PN-EN 835:1999 *Podzielniki kosztów ogrzewania do rejestrowania zużycia ciepła przez grzejniki. Przyrządy bez zasilania energią elektryczną działające na zasadzie parowania dyfuzyjnego.*

PN-EN ISO 13790:2009, *Energetyczne właściwości użytkowe budynków – Obliczanie zużycia energii na potrzeby ogrzewania i chłodzenia.*