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METHODOLOGY OF SPECIFICATION AND DESIGN OF PUBLIC UTILITY BUILDINGS TO REACH THE MAXIMUM ENERGY PERFORMANCE ACCORDING TO EPBD AND EN 15232:2012 STANDARD

METODYKA PROJEKTOWANIA BUDYNKÓW UŻYTECZNOŚCI PUBLICZNEJ W CELU MAKSYMALIZACJI EFEKTYWNOŚCI ENERGETYCZNEJ W ŚWIETLE DYREKTYWY EPBD ORAZ NORMY PN-EN 15232

Abstract

New EPB Directive and standards based on this directive in the area of energy performance of buildings generate many changes in the building industry. In the article, the difference will be shown between "classical" and new methodology of design and specification of buildings with required energy performance, where automation systems and technical management use synergy of all technical systems to increase the energy efficiency of buildings.

Keywords: energy efficiency of buildings, building automation systems, BAS, BMS, EN 15232 Standard, impact of BAS on energy efficiency of building, design and specification

Streszczenie

Dyrektywa EPBD stawia nowe wzywania przed architektami i projektantami zarówno konstrukcji i przegród zewnętrznych budynku, jak i wszystkich instalacji technologicznych oraz systemów automatyki i sterowania budynków, a także systemów technicznego zarządzania budynkami. W artykule przedstawione zostanie porównanie między klasyczną metodyką projektowania, w której systemy sterowania instalacjami technologicznymi budynku są dostosowywane do tych instalacji i metodyką uwzględniającą osiągnięcie wysokiej efektywności energetycznej dzięki wykorzystaniu synergii pomiędzy wszystkimi technologicznymi instalacjami budynkowymi, w której instalacje technologiczne muszą być dostosowane do maksymalizacji wpływu systemów sterowania i automatyki na efektywność energetyczną budynku.

Słowa kluczowe: efektywność energetyczna, system automatyki budynku, BAS, BMS, norma EN 15232, wpływ BAS na efektywność energetyczną budynku, projektowanie budynków

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Acronims

BACS – Building Automation and Control System
TBM – Technical Building Management
BMS – Building Management System

1. Introduction

The requirements to provide high energy effectiveness of the buildings, arising from the EPBD Directive and the industry standards worked out on its basis, present new challenges for the architects and designers of both constructions and exterior partitions (walls, windows, roofs) of a building, as well as all technological installations and building automation and control systems (BACS), and also systems of technical building management (TBM). In order to provide high energy effectiveness of a building and at the same time usage comfort, it is necessary to use not only proper construction materials, but also proper technological installations, which would make possible control of energy distribution according to the current demand for specific forms of energy in particular to the rooms of the building, as defined in detail in EN 15232 standard.

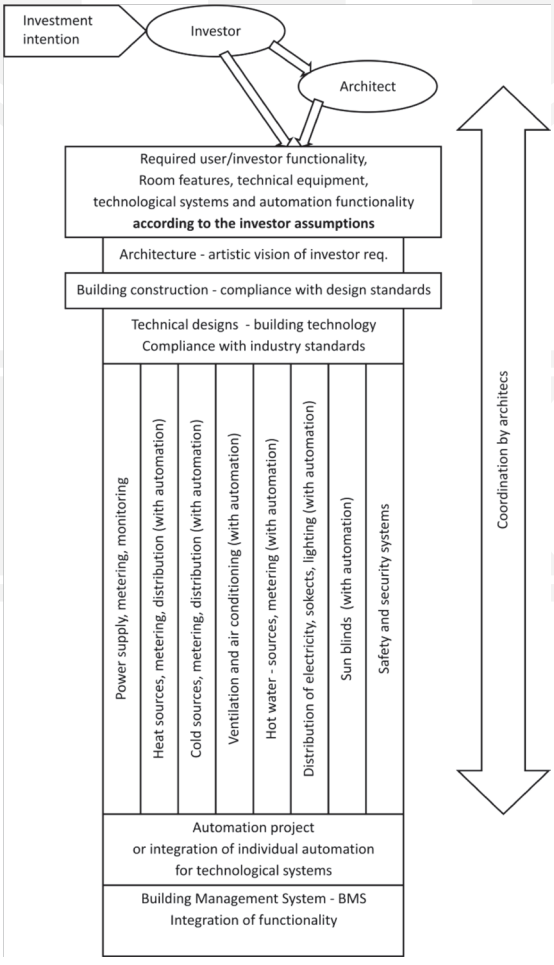
In the authors' opinion, the most important conclusion of [1] standard, should be the statement that the quality of impact of automation and control systems and technical building management on the energy effectiveness of buildings, depends directly on the proper construction of the basic technological installations in a building, which have a decisive influence on different forms of energy consumption. To obtain the highest influence of BACS and TBM systems on the energy effectiveness, the construction of such technological installations is necessary that would allow to supply any form of energy individually to each room, depending on the real needs. Coordination of all the technological installations should also be assured, so that all the installations would cooperate in economical energy usage. Integration on the object level seems to be especially important, both in automation and control systems of particular technological installations, as well as safety systems which provide information about the presence of the users in the rooms, thus allowing to control energy supply precisely according to the needs (on demand).

These simple demands cause fundamental changes which should absolutely be implemented in the process of preparation and designing of the investments, and which strictly fulfill the demands in respect of energy effectiveness.

2. Classical process of designing a building

A scheme of a classical designing process of a building is shown in Fig. 1. In this process particular demands concerning energy effectiveness are very often not taken into account, the exception being the demands determined in the present technical conditions of the binding building law. When defining the functional and utility programme of the building and functionalities of rooms and their technical equipment, the investor's demands and assumptions have to be taken into account as well as the binding building and sanitary

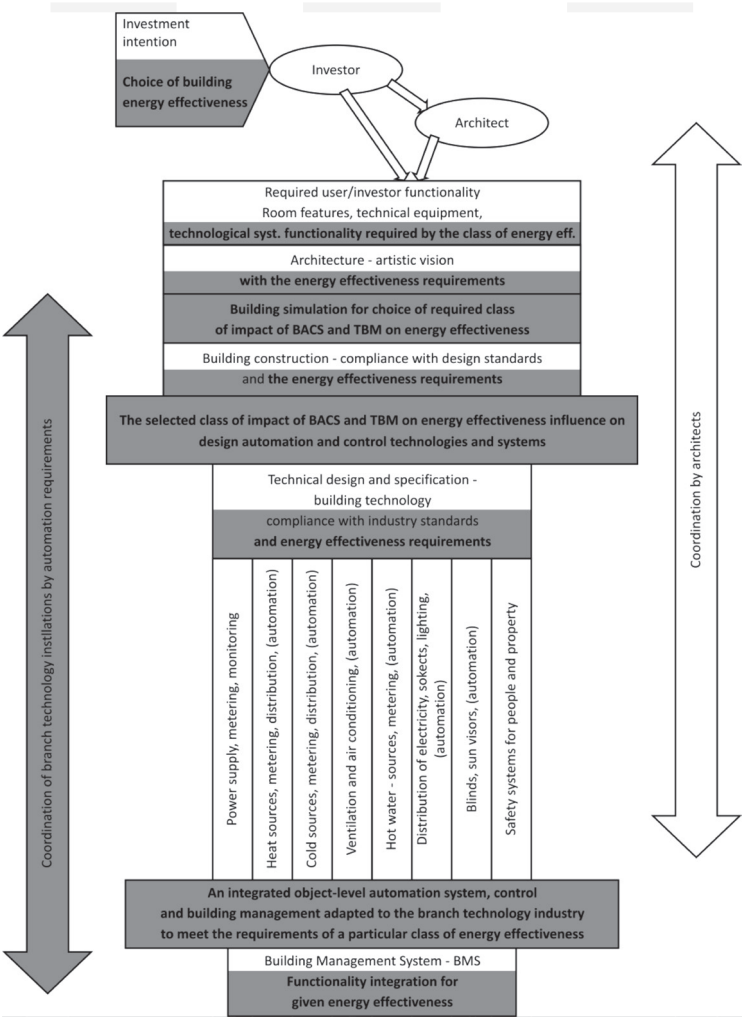
regulations. Having decided upon the functional and utility programme and an architectonic vision, there comes a stage of multi-branch designing, which theoretically should be coordinated by the design office responsible for the project. All branch installations, in the detail mentioned in Ill. 1 on vertical rectangles, are designed by branch designers, often with little exchange of information among them. Having completed branch specifications and designs for the basic sanitary installations, HVAC and others, the automation branch starts their part of designing. They usually have to fulfill the demands defined by particular technological branches. Due to this process, the system of building management integrates the functionalities resulting from the branch designs, but the branch designs themselves do not take into consideration the necessity of inter-branch cooperation. Having such a classical attitude to designing, it is difficult to speak about the realisation of energy effectiveness of the building; we should rather speak about the result effectiveness, which is in fact accidental.



Ill. 1. Diagram of the classical process of designing of building with consideration of investor requirements

3. Integrated designing process of a building, oriented towards obtaining specific energy effectiveness

The scheme of an integrated designing process of a building taking into consideration target energy effectiveness is presented in Ill. 2. In the figure, all the differences in relation to the classical designing process are shaded. The whole of the designing process is closely subordinated to achieve a particular, presumed energy effectiveness of the object. On the basis of energy simulations of the building [6], we should determine the class of influences of the BAC and TBM systems on energy effectiveness. The choice of target energy effectiveness of the building is of fundamental importance to the whole ongoing designing process, both in



Ill. 2. Diagram of the integrated process of designing and specification of a building with consideration of the final energy performance

building construction and technological installations as well as the functionality of the BAC and TBM systems. The decision has influence on:

- the engineering process of erecting the building, which must meet specific demands indispensable to achieve high energy effectiveness,
- the choice of technological installations functionality which would enable the realisation of automation and control functions required for a given class on the impact of the BAC and TBM systems on energy effectiveness,
- the necessity of implementing particular functionalities by automation, control system and technical management of a building that requires a definite structure of technological installations,
- designs and construction of all branch technological installations, which must make possible the realisation of particular automation, control and management functions,
- the necessity of integration on the object level of the automation and control functions of all technological installations having influence on energy consumption, among them safety systems, in order to provide synergy of all the installations to minimise energy usage.

The result of the integrated designing process, is obtaining such functionality of the technological installations, automation and control systems as well as technical building management, that they guarantee the programmed and planned class of the BACS and TBM systems influence on the building energy effectiveness.

The basic condition to achieve such a result, is to involve the automation branch designer in a very early phase of designing, already at the stage of defining the functionality of the systems and technological installations, because these are just functionalities of technological installations that decide whether it is possible to implement particular functions of the BACS and TBM systems, which in turn determine the affiliation of the automatic system to a given influence class on energy effectiveness.

4. Conclcusions

The presented discussion clearly shows that achieving a definite degree of automation and control system influence on the energy effectiveness of the building does not only depend on the automation system functionality, but first of all on the way the technological installations are constructed. They have to be designed in such a way as to allow implementing definite, required functions of the automation, control and management systems for a given class influence of the BACS and TBM systems on energy effectiveness. This means that it is necessary to change the attitude to the building designing process. Firstly, in the initial phase of designing, after having chosen the programmed energy effectiveness of the building, simulations must be carried out in order to determine the necessary degree of influence of BAC system and TBM on the total energy effectiveness of the building.

On the basis of those simulations [6], a definite, indispensable for application BAC and TBM class of systems influencing the energy effectiveness of a building should be chosen. This choice decides the necessary realisation of particular technological installations, which must be susceptible to a definite, standardized, control and management method. The role of the automation system designer cannot be limited to working out automation for already designed technological installations (what is now a common practice), but after having

defined the building's required class influence of automation, control and management systems on energy effectiveness, the whole process of designing technological installations and their control and management systems, must be subordinated to this decision. It can be concluded from the above, that on the basis of the investor's decision about the expected energy effectiveness of the building and determined on the basis of simulation, the indispensable class of influence of the BAC and TBM systems on energy effectiveness, the automation designer has to be involved right from the beginning in the designing process; he has to participate in formulating the assumptions of the technological installations designers and to coordinate the designed solutions paying special attention to their susceptibility to integrated controlling, which is indispensable for achieving an adequate influence of the BAC and TBM systems on energy effectiveness, and not as it used to be in former designing practice, to yield to the demands of the branch designers.

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