

IMPACT OF ENGINEERING EDUCATION ON DESIGNING AND MANAGEMENT OF HVAC PROJECTS

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ABSTRACT

Recent experiences in new buildings and reconstruction of existing buildings with HVAC installations in postwar Kosova has shown an entire lack of engineering culture and education in the designing process, application of the current standards and scientific achievements, and serious confrontation between educated engineers and trained specialists as well. Designing and management of HVAC projects has been simplified till banal and as a consequence today we face with nonfunctional installations and buildings, which does not fulfill no one of designing criteria's required according international standards and of cause with extremely high energy consumption.

Knowing that a design is a unique venture with a beginning and an end, conducted by educated engineer to meet required goals within standards, the purpose of an engineering education for HVAC experts is education as a general principle, making an clear distinction between educated and trained experts, which includes perspective, as those who do not learn from past mistakes are bound to repeat them in the future.

Today's designers are not only faced with technical disciplines such as heat transfer, fluid mechanics and thermodynamics but also architecture, building design, interior and exterior building materials, building destination , occupants etc. Futures engineer have to be equipped with spectrum of information and needs for an integrated approach and close collaboration with Architects, Building engineers and other specialists in early phase of defining building function, destination, construction, envelope and interior. This is challenge for the engineers.

The purpose of this paper is to show differences in engineering education and their impact on designing and management of HVAC projects, with matrix treating structural and human factors in all designing phases.

Keywords: Engineering Education, design and management, technical solutions,

1. PROJECT DESIGN AND PROJECT MANAGEMENT METHODS

Based on their experience and being in touch directly or collaterally with the different types of designing and management of the HVAC projects, authors have identified ruining of the traditional technical approach to the designing principles.

Whatever the type of building, there are always number of basic properties of HVAC installations that it must possess if it is to be used for its intended purposes. Buildings have to be pleasant, with good indoor air quality, energy efficient and maintenance friendly etc.

All these properties can be expressed by Investor in the form of a requirements specification and this should be presented at the very beginning of the building process, before any detailed planning work starts. A carefully compiled list of requirements is one of the prerequisites for ensuring that the HVAC installation will function well.

Only, in some sporadic cases, investments made by KFOR, banks and some international funds were done providing a prescribed quantity of outside air to a given indoor air volume.

These basic criteria's were anticipated by design duty task or so called "Cahier de charge". But, in the most cases trained specialists were closer to the investors and having in mind that their education deals with empirical facts rather than theoretical, elementary technical disciplines such as heat transfer, fluid mechanics and thermodynamics were not applied in proper way and as a consequence today we face with nonfunctional installations and buildings, which does not fulfill no one of designing criteria's required according international standards and of cause with extremely high energy consumption.

In some other cases, as energy saving measures building techniques were developed that increased air tightness in building envelopes but it was forgotten to compensate for the reduction in air leakage by installing suitable HVAC equipment and installation to ensure an acceptable indoor climate, more focused on human requirements. This results with problems with poor indoor air quality, condensation on windows in the winter and in most cases moisture damages.

From HVAC designers are requested much broader and more multidisciplinary knowledge and understanding of issues such as material emission, microbial contamination, odor emission, human senses etc. Different information's from medicine science, human physiology and psychology etc. does not make an engineer able to solve complex issues from these fields, but will certainly facilitate communication with different specialists in a multidisciplinary team.

Unfortunately, trained engineers are conservative and impervious to such multidisciplinary knowledge and this transition will take some time as there seems to be certain reluctance among some engineers to accept this new approach. The engineer who is narrowly trained will find it difficult to cope when conditions changes. It is easier to train an educated engineer than to reeducate a trained engineer.

Situation became more complicated in realization and management process of the projects due to the complexity of the activities, heterogeneity of the participants etc. There is a high potential for the development of installation faults, installing of inadequate equipment, conflicts within established project management goals and failures. Project management of HVAC is the combination of people, systems and techniques required to coordinate the resources needed to complete project, to fulfill requirements with adequate technical solution. The role of HVAC engineer is not anymore conventional and is changing, so must the education.

2. THE CRITERIA'S FOR ENGINEERING EDUCATION IN HVAC

There are different educational areas that must be covered by an educated engineer. This is connected with knowledge in the buildings destination, buildings function, conditions in which building is supposed to work or must work, identifying of malfunctions, remediation's and finally management process of realization.

The planning and construction a building and respective HVAC installation's is complicated process that does not always result, in every detail, in what the Investor had in mind. If the requirements have been wrongly stipulated ore if the planning work itself has not been carried out, than it is most probably that the results of those mistakes will be part of an unfunctional building. The role of educated engineer is to collaborate with investor in drawing up of the project program and in early faze to avoid poorly executed installation works which will often lead to an inferior building.

Buildings and required HVAC installations should be normally built as planned and designed, but real works consists from deviations comparing with the glossy world of building design, where everything supposed to be smooth, where air moves in accordance with laws of CFD, fans are installed according specification and in right direction, windows are installed to have required insulating capacity, building materials have the properties listed in catalogues and do not swell, peel, oxidize or smell. This ideal theory should have a place in the education of engineers but it is more important to understand deviations and perturbing factors which constitute real world of engineers who work in HVAC field. Educated engineer have to insist that HVAC installations must be designed, executed and function so that can be used as intended.

It is meaningless to treat building design, operation and maintenance as pure technical problem without taking into account economic impact at every stage in which the problems must be solved. Furthermore, HVAC engineers must realize that buildings are depending by performance requirements that must be met in a building: *legal requirements, usage requirements and building requirements*. Legal requirements are primarily concerned with safety and health. A detailed requirements specification is always an important part of designing programme. The usage requirements are those which are concerned with the use of the building and which must be fulfilled so that the building can be used for its intended purpose. The building requirements ensure that building must be designed so that it has both a satisfactory indoor climate and a low energy demand. Engineers must be educated so that they are able to interface with these interlinked performance requirements.

The HVAC technical solutions that are chosen, however, must fulfill the building requirements with the regard to good architecture, site planning, execution, efficient use and minimized life cycle cost. Good planning assumes close cooperation when choosing architectural design and building services, especially HVAC installations, with regard to both technical solutions and their complexity. This request that all requirements must be fulfilled, running cost as well. Cost-benefit calculations should be based on risk analysis over the life cycle of building and installations, but seldom are. The consequences of the design should therefore be analyzed at an early stage in the planning process. Engineers must be educated to appreciate the cost of malfunction, if they are to be able to argue for design and operation that is cost-effective.

After issuing of provisional acceptance certificate, the process which is very rare in private investments, Investors are persuaded that HVAC systems that regulate the indoor climate are completed and self-contented neglect operation and maintenance phase. When buildings malfunction, the last persons to know of all those involved are usually engineer responsible for design and engineer who have to do something about it. Engineers must be educated to be part of the open loop process of building design and to be constant recipient and processor of feedback information of various kinds. This includes two groups of measures. The preventive measures include stable, fail-safe systems with adequate safety margins, system that allow for human diversity and unpredictability. Remedial measures must be taught, together with the need for an exploratory approach to discover reasons for currently malfunctioning building.

3. CONCLUSIONS

The HVAC systems must ensure that as minimum the air is clean and that room temperatures are kept within designed and standardized limits. Although they can be designed in a number of different ways to achieve desired function, proper operation and maintenance, the most important criteria's are that they can provide the required room temperatures and air quality. It is therefore extremely important that technical solutions provide satisfactory solutions for building engineering, building economy, diagnosis and maintenance.

This means that in education process of HVAC engineers it is not anymore sufficient traditional, strictly technical role of engineering. Future engineers will face far more diverse challenges in the multidisciplinary fields. They must be educated to work as part of multidisciplinary team of

professionals and in an early phase to solve the problems and to approve best and cost efficient solutions for buildings HVAC systems.

4. REFERENCES

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