Integrated energy design in public buildings EU intend

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ABSTRACT
The buildings sector accounts for 40% of the energy requirements in Europe, which is more than by industry or transport. That is a lot and it is too much! Buildings therefore have a major part to play in the emissions reductions targets! And buildings of the future should therefore be designed in mutual cooperation in the design teams, i.e. between architects, developers, clients, engineers, etc. from day one of the design phase. This paper presents an EU supported project commenced in January 2007 looking especially on the processes of integrated energy design - IED.

1. INTRODUCTION

The World is facing a critical situation regarding energy supply and dependency on imported fuels in the coming years. All studies show an increase in the energy supply uncertainty. Research shows that more than one-fifth of the present energy consumption and up to 30-45 MT of CO$_2$ per year could be saved by 2010 by applying more ambitious standards to new and refurbished buildings. This represents a considerable contribution to meeting the Kyoto targets. Buildings therefore have a major part to play in meeting the emissions reductions targets! Therefore this IED initiative. Tools and methods for IED will be developed for practical use by the participants involved in a design process (building owners, developers, architects, consulting engineers, etc.). To demonstrate how IED can be used in practical, the integrated design concept will be carried out in app. 12 building projects in the 6 participating countries. It will be demonstrated, how IED can contribute to the utilisation of the passive energy measures in the design of these buildings. A comprehensive dissemination of the project will be initiated through seminars and workshops. EU INTEND is coordinated by KanEnergi AS in Norway and has participants from Denmark, Greece, Austria, Poland, UK and Norway.

2. MAIN TEXT

2.1 Background
A considerable amount of the energy used in Europe is spent on keeping a comfortable indoor climate in buildings. Efforts have been taken in many European countries to revise the national building codes in order to limit the energy use of buildings and at the same time ensuring a good indoor climate. In many situations, however, the designers (architects and consulting engineers) have difficulties to optimize the building design regarding energy use in combination with a good indoor climate. Therefore guidelines for an integrated design process are highly needed. It is necessary to focus on the whole building rather than on single technologies to be able to reduce the need for purchased energy as much as possible. The traditional way of designing buildings does not include an energy conscious design strategy, and the design process often focuses on extreme situations rather than on the running costs of the building.

2.2 Objectives
The main principle of the integrated energy design process (IED) is to focus on passive energy strategies, low energy measures, costs and indoor climate in the building. Experiences show, that the use of the IED process provides buildings with much lower energy demands and maintenance costs. Buildings, which are much more robust against changes of use and user behaviour than conventional designed buildings. IED allows the design team to focus on the passive performance of the building (daylighting, glazing, natural ventilation, shading, thermal mass etc.) before focusing on the mechanical and electrical installations, cooling etc. The objective of the project is to develop Integrated Energy Design (IED) as a standard European practice of building design and to set a new standard, which is substantially beyond the anticipated level of the Directive of Energy Performance of Buildings.

Figure 1: IED is about avoiding the situation with the two clubs and instead have a sound mutual teamwork, as the guys on the right
The long-term objectives are:
• To develop IED as a standard European practice of building design.
• To disseminate to users of the buildings that an IED process in the planning phase of a building is crucial for them (the users). Thereby users can disseminate IED as well.
• To bring the knowledge of IED to leading architects and consulting engineers all over Europe.
• To inspire public real estate organisations, building owners and investors to specify demands for high energy performance and low energy demands for new building projects or projects of major renovation.
• To set a new standard for the state of the art energy design of buildings, which will be substantially beyond the anticipated level of the Directive of Energy Performance of Buildings (Directive 2002/91/EC).

In the short term the objectives are:
• To show how IED can be used in practical by using and implementing the IED in at least two building projects in each of the participating country, i.e. at least 12 buildings. The planning and design of the projects will be completed through this project, however in some cases the erection of the buildings will not be within the time schedule of this project.
• To develop tools and methods for IED to support the implementation of the Directive on the Energy Performance of Buildings (EPBD) in a practical way.
• To develop www.ecoark.net as a European Internet database to spread knowledge and experience of buildings of high-energy performance, ecological design and spread the results from the project. See more information on ECOark on the webpage.
• To disseminate the IED methods and tools used for the more than 12 European buildings that are taking part in the project.
• To develop an INTEND homepage www.intendesign.com to communicate the IED message to architects, engineers, building owners, clients, etc.

2.3 Passive performance of buildings
A key issue in setting the goals for a satisfying and energy efficient indoor climate is the recognition of the fact that mechanical & electrical installations and services only provide part of the solution to provide a good indoor climate and low energy consumption. The energy and indoor climate performance of the building itself, often referred to as the passive performance of the building, is even more crucial and is determined by its physical characteristics:
• Orientation of the facades
• Width, height and depth of the different parts of the building
• Glazing to floor ratio
• Type of glazing
• Shading characteristics of the building itself (overhangs etc.)
• Availability of day lighting (roof lights and side lights)
• Insulation levels
• Exposed thermal mass e.g. concrete floors or slabs
• Possibilities for free airflow through the building interior
• Interior lay-out (concentration of internal heat gains from persons or equipment)

These are the primary elements, which influence the indoor climate and the overall energy consumption of the building. Open collaboration between the architect and the consultants is crucial to allow benefits to be obtained from the optimum combination of these elements. A building with optimized physical characteristics is the best starting point for obtaining an optimum energy efficient indoor climate. The mechanical and electrical installations and services can then be used only when necessary to supplement heating, cooling and ventilation needs with minimized energy consumption.

2.4 Steps in IED
The initial step of IED is to identify the actual processes and methods to achieve the required level of comfort. The indoor climate of a building is influenced by many parameters including ventilation, operational strategies, daylight properties, draughts, maintenance etc. It is essential to treat the chosen parameters in a well-considered order to achieve effective implementation of energy conscious designs. In order to ensure that the building itself contributes to a good indoor climate and low energy consumption, the various design issues should be treated in a certain order to make maximum use of the passive features of the building before planning the mechanical and electrical installations. One method of IED has the recommended sequence as given below:

![Figure 2: The principle of the Integrated Energy Design Process with a focus on energy flow and indoor climate](image-url)

The figure shows the prioritized order of analysis of 7 key topics related to energy flow in a building. The dot-
ted arrows indicate that the design process is iterative and changes due to one topic may influence the analysis of the topics above. Therefore it may be necessary to re-evaluate some of the topics more than once in order to obtain a correct and reliable analysis. This can then form the basis for effective implementation of integrated energy design.

The result can then form the basis for effective implementation of integrated energy design. The first topic, energy supply, refers to the infrastructure at the site and the conditions for current and planned available energy supplies (types of power stations nearby, district heating, wind, biomass etc.). The next topic, programming/structure relates to both the external physical boundaries (placement, orientation, building type etc.) of the planned building and the internal physical boundaries, i.e. the layout of areas within the building considering movement of people and equipment and grouping together areas with similar requirements, e.g. daytime use, ventilation, cooling, access to specific areas etc. The third subject, daylight, involves the planning of day lighting strategies at an early stage, as this is crucial to obtaining maximum energy saving from artificial lighting and good visual conditions. The fourth subject, fire conditions, are closely connected to the choice of ventilation strategies, as openings for natural ventilation can be used for smoke ventilation as well, which may lead to avoidance of complicated sprinkler systems. The fifth topic, thermal indoor climate, needs to be analysed thoroughly and compared to national standards in order to secure a satisfying indoor climate and determine the need for ventilation i.e. how much fresh air is required, at what temperature, when and where. It is then possible to decide the balance between natural and mechanical ventilation. The sixth topic, ventilation strategies, should whenever possible refer to natural or hybrid ventilation. Mechanical ventilation and the last topic, cooling, should be avoided whenever possible. If shown to be necessary they should be considered as a supplement to natural ventilation.

2.5 Actors in the IED process

Energy conscious design strategies include the methodology of an integrated energy design process (IED), which involves the building owner, the architect and the consultants in close cooperation from the very begining of the design phase. IED will allow the design team to benefit from the passive performance of the building and combine this with the more traditional HVAC-design issues to achieve an optimum indoor climate and provide a building with a high degree of flexibility and minimum energy consumption.

Implementation of energy conscious design requires involvement and participation, from the beginning, of all the relevant actors mentioned above. If good communication between the different parts of the design team does not occur from the start, there is a tendency for the collaboration to develop into a rather hostile negotiation, where none of the actors wants to take responsibility. To achieve good communication and consensus about the prioritisation of the various issues, planning at the early phase is essential. An important aspect of this planning is the sequence of decisions and a common understanding that the design process of buildings, especially seen from the architect’s point of view, is an iterative process where the design is progressed through refinement of earlier designs based on new information and details gained during the process.

2.6 Emphasis of the paper

The emphasis of the presentation will be more on the process focussed method, i.e. how to work in integrated design teams, what to consider when and by whom rather than on the technology prioritizing methods, i.e. what technologies to apply, and in what order, etc. Although the latter will also be touched upon in the presentation. Further the emphasis of the presentation will be on the development of the IED Guidelines, how these are structured, the content, etc.

2.7 IED Guidelines

Regarding the Guidelines, also called tools and methods of IED, there are three tasks; 1) mapping of existing tools and methods for IED, 2) development of tools and methods with a focus of IED on a general level to see the interconnection between different processes to reduce the energy demand and utilise RES applications in new buildings and major renovation, i.e. the actual IED Guideline. This task will focus on the development of new methods for IED in order to obtain more practical tools for the participants involved in a design process. The third task covers an IED workshop for the participating project teams with the purpose of facilitating the exchange of design ideas and approaches between the participating partners and their design teams.

2.8 Results of the project

As implementation of energy conscious designs will contribute significantly to the reduction of the overall energy demand in the European building sector, public buildings would play a very important role. This project will develop the concept for, how the IED can contribute to optimised design buildings in each of the participating countries, i.e. in Denmark, Poland, United Kingdom, Greece, Austria and Norway. This will be presented in the so-called IED Guidelines.
Further at least two buildings in each country (i.e. at least total of 12 buildings) will undergo a thoroughly IED in the initial start up phases of the planning of these buildings. The buildings will mainly be public buildings together with the sub-contractors, the architectural firms. The project will support the implementation of EPBD in Europe and in the participating countries, support the implementation of the RES Directive and reach national goals on energy efficiency and RES.

2.9 Target group of the project
The target groups for this project are:

• Architects
• Architect organisations
• Consulting engineers – HVAC, electro technical and civil engineering
• Building developers
• Public real estate organisations
• Building owners
• Investors
• Urban planners
• Universities
• Energy agencies and energy experts

2.10 Partners in the project
The project has eight partners:

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<th>Country</th>
<th>Name of partner</th>
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<tbody>
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<td>Norway</td>
<td>KanEnergi AS</td>
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<td>Green Building Alliance</td>
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<td>Denmark</td>
<td>Esbensen Consulting Engineers AS</td>
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<td>Engineering College of Aarhus</td>
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<td>Austria</td>
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KanEnergi AS in Norway is the coordinator of the EU-project.

3. CONCLUSIONS

The paper presents an EU-supported project, the so-called INTEGRATED ENERGY DESIGN IN PUBLIC BUILDINGS; with the acronym “INTEND”. The project is still in the early phase, however by September 2007 one of the main objectives of the project will be in full progress, i.e. the development of the integrated energy design guidelines – IED Guide. The emphasis of the paper will therefore be on the IED Guide. Further the emphasis of the presentation will be on the process-focussed method, i.e. how to work in integrated design teams, what to consider when and by whom, etc.

REFERENCES

Material from the preparation of the proposal for the Intelligent Energy Europe (IEE) programme, the EU INTEND project with the projectref. no. EUContract no. EIE/06/021/SI2.448295-INTEND.