

# **Energy Use and Climate -Technology and Design for Energy Conservation**

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## **1. Energy Consumption in Buildings**

The 20th century was the so-called “century of energy.” Since 1950, the total annual energy consumption worldwide has almost doubled every 20 years. The 20th Century was the first century in human history in which the extraction and supply of a huge amount of energy became available. The global environmental issue has come to press mankind for how to deal with the “debt of enormous energy consumption.” Nowadays, the share of the total green house gas emissions from the building sector exceeds 30%, and more than a half of this is caused by energy consumption in buildings while they are in use. It has become possible to build a comfortable built environment anytime and anywhere, thanks to the remarkable progress of energy-consuming technology, such as air conditioning and lighting systems. It can be said that today’s designers have much more freedom than in the past, because they seem to be liberated from the restrictions of the natural environment. However, on the other hand, the diffusion of such technology shakes the foundations of mankind and its life, and has significantly changed people’s perception of nature and the environment. The current philosophy which depends excessively on energy use is being questioned.

## **2. Energy Conservation for Buildings, Communities and Cities**

The purpose of energy conservation in a narrow sense is to efficiently maintain a comfortable indoor climate as an environmental unit. However, beyond the boundary of this small unit, there are larger external environmental units such as regional communities, and cities, which can not be dealt with separately. An environment forms a “nested box” structure, and the outermost one has been recognized as the global environment. It has come to be required to seek optimal energy conservation considering the dynamic relations between units within some nested boxes. It is the basic principle of indoor environmental control to select a method in accordance with the conditions of the outdoor environment. The introduction of energy-efficient air conditioning system appears to be a practical solution for indoor climate control under the polluted outdoor environmental conditions. It is not, however, only solution. It is not necessary for designers to think of the given conditions of the outdoor environment as being unchangeable, fixed conditions. An alternative solution for designers is to consider the given conditions and develop strategies to improve them if necessary. If the outdoor environment is sufficiently improved, the pressure for energy conservation for new buildings is reduced, and this may result in the reduction of the negative environmental impact caused by new buildings. It also has the reciprocal effect of improve the outdoor environment. It is hoped that such a positive spiral structure will take the place of the negative spiral structure (match pump structure) of the vicious cycle between the aggravation of the environment and the increase of the environmental impacts of buildings. The research on local climate proceeds on a citywide scale such as the heat island phenomenon analysis. Research on energy and material circulation on a citywide scale are active, too. Various environment conscious plans are being developed for energy infrastructures, traffic systems, preservation of the green space and for water and sewage systems in the city. Collaboration with city planning sectors is most important for the promotion of implementing energy conscious buildings.

## **3. Diversifying Technology and Design for Energy Conservation**

In this unit, the innovative technology and design for energy conservation in building in use is focused on, and reports on various pioneering practices are called for. Topics included here should be discussed from the following viewpoints;

- 1) Improvement of performance of buildings themselves
- 2) Development of energy-efficient building service systems
- 3) Integration of 1) and 2)
- 4) Energy management systems
- 5) Life style

It is required to create the proper technologies and designs with consideration of regional climates, the natural environment and the social and historical background of each region. Improvement of building performance depends on various elements of technology from the level of the material to the level of the parts and finally to the level of the whole building. Attention must be paid to the development of energy-efficient building service systems, and these technologies should be integrated into buildings with a whole building concept. Furthermore, there may be included buildings integrated with natural and renewable energy systems such as solar photovoltaics and so on. The new fields of R&D can be called building envelope technology or building envelope design, in which the above mentioned technology is applied. It appears that a “responsive envelope”, a building envelope which is sensitive to the natural outdoor environment and responds to changes as if it were a living breathing thing, is the objective.

The concept of energy conservation is not only confined to only new construction. The enormous existing building stock is also a target for energy conservation, and the effect of implementing energy conservation measures would be greater than that of new construction. The discussion here will cover proposals of design and technology in terms of lifecycle. Furthermore, it may extend beyond a building itself, to a community or a city and to people’s life style.

It has become obvious that energy management and commissioning systems play an important role in conserving energy, in addition to the hardware installation of a building. The latest reports from these fields are welcome, too.

#### **4. Improvement of Quality of the Built Environment**

The reduction of building-related environmental impact has been mandated for all buildings constructed now and in the future. It has appeared though that the quality of the built environment differs depending on the adopted technology and design. It will be emphasized in the future that all new energy conscious buildings will be required to answer what kind of environmental “quality” has been achieved. There is still much argument as to what the environmental quality should be. In addition to the more sophisticated factors of comfort levels such as indoor air quality and nature friendliness, other factors will be referred to architectural fascination, and the social and cultural environmental quality. It is expected that energy conservation of a building will be effective for not only for the reduction of the environmental load but also for the achievement of a more advanced quality of built environment.

#### **Topics**

- Low Energy/ Energy Design Concepts
- Design Process / Decision Making Process
- Design Tools
- Innovative Materials
- Responsive Building Elements
- Innovative Building Envelope

Energy Efficient HVAC System  
Energy Efficient Lighting System  
Innovative Ventilation System  
Intelligent Energy Management System  
Lifestyle and Energy Conservation