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Building environment design — Guidelines to assess energy efficiency of new buildings

Conception de l'environnement des bâtiments — Lignes directrices pour l'évaluation de l'efficacité énergétique des bâtiments neufs

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 23045 was prepared by Technical Committee ISO/TC 205, *Building environment design*.

Introduction

The world's energy resources are being consumed at a significant rate that will result in the depletion of non-renewable resources. It is imperative that energy be conserved. The building sector, through its use of energy, can represent up to 40 % of the total energy consumption (in mild climates, where heating and cooling correspond to the major energy demand in buildings). Conservation of energy in buildings can result in a slowing down of non-renewable resource usage and consequently of the build-up of greenhouse gases.

This International Standard gives guidelines to introduce energy requirements in the design process or to achieve the designed values of energy efficiency for new buildings. As most buildings are designed to last for a long period (80 y to 100 y), reducing energy consumption can also be considered a means of preserving the financial resources of owners and occupants if energy prices rise due to depleted energy resources or in the event of competition with other non-renewable energy resources.

Data and requirements are introduced in the design process, as described in ISO 16813.

Methods to express energy efficiency are also presented.

Building environment design — Guidelines to assess energy efficiency of new buildings

1 Scope

This International Standard gives guidelines related to energy efficiency in buildings as introduced in ISO 16813.

The objectives of this International Standard are to assist designers and practitioners when collecting and providing the useful data that are required at different stages of the design process and to fulfil the definitions of the building as prepared by building designers.

This International Standard applies to new buildings and is applicable to space air-conditioning equipment and the heating plant in new buildings.

It is assumed that the conditions of indoor spaces are maintained within a comfort range with regard to temperature, humidity, air quality, acoustics and light, or conditions maintained to provide freeze protection for piping or stored materials.

Systems to be considered when assessing the energy efficiency of the building are heating, cooling, lighting, domestic hot water, service water heating, ventilation and related controls.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16813, *Building environment design — Indoor environment — General principles*

ISO 16818, *Building environment design — Energy efficiency — Terminology*

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 16818 and the following apply.

3.1
calculation period
period of time over which assessment is carried out, considered as one year

3.2
practitioner
person engaged directly or indirectly in building design activity

EXAMPLE Architects, technical manager, owner, investor.

3.3
systems
processes undergoing assessment

EXAMPLE Heating, cooling, domestic hot water, lighting, ventilation and relevant automation or control.

3.4
surface reference
air-conditioned surface in square metres

4 Fundamentals on energy efficiency

4.1 General

Designing and constructing a building to a specified level of efficiency, starting with the global approach and progressing to the utilization of passive behaviour, shall ensure that the highest process standards are involved (such as HVAC[1]) , lighting, hot water systems and associated controls) and that the highest specifications of the HVAC system and structure are met.

A global approach in designing a system shall consider the interrelationship of how energy used in a process influences the gains or losses in other systems (e.g. the thermal influence of micro-computers on heating or air-conditioning).

The flowchart in Figure A.1 provides a summary of the process, with cross-references to works giving general principles that simplify the conception of the building (see ISO 16813).

Energy efficiency definition is the result of an iterative process from project information up to the final design.

This International Standard will assist in:

— collecting and providing information regarding the energy efficiency of the building under consideration;

— conducting the iterative process to ensure improved energy efficiency of buildings;

— obtaining the target values for energy efficiency ratios used in labelling or information to public or/and consumers.

The design process leads to a reduction in energy demand through a global approach to the building including analysis of the building location, definition of the building envelope, energy systems and products.

4.2 Project information in relation to energy efficiency

4.2.1 Location of the building

The elevation of the building (i.e. ground height above sea level) shall be given in addition to the longitude and latitude. Configuration of the surroundings shall be identified as they might cast shadows on the buildings. Other information about position and orientation of the building shall be given to increase the possibility of recovering energy from the sun, from ground sources (water), and from wind.

4.2.2 Building specification

Building dimensions: global dimensions and ratio of volumes versus external surfaces or windows, and transparent surfaces versus overall external surfaces shall be specified.

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1) Heating, ventilation and air conditioning.

Zone dimensions: when calculations are made for each room or zone, all dimensions for the building frame and any dimensions required for zone calculation concerned shall be specified.

Appearance: the nature of outside materials (glass, concrete) with respect to daylight influence shall be specified.

4.2.3 Weather data

Hour by hour data of the following items shall be prepared for a full year:

a) external air temperature in degrees centigrade;

b) relative humidity as a percentage, humidity ratio (dimensionless) or absolute humidity in grams per kilogram;

c) direct solar radiation on each normal surface in watts per square metre;

d) diffuse solar radiation on horizontal surface in watts per square metre;

e) nocturnal radiation on a horizontal surface in watts per square metre;

f) wind speed in metres per second;

g) wind direction in degrees or presentation on a wind rose;

h) precipitation in millimetres;

i) other element with appropriate units, if necessary.

4.2.4 Occupancy

The schedule of building occupancy shall be specified in hours when the space is occupied, as a percentage of full number of occupants. The designed number of occupants shall be taken into consideration.

Set-points for temperature and humidity for the space or zone during the occupied period shall be specified.

Bandwidth acceptability for deviation of set-points shall be specified.

Thermal load and indoor air quality (IAQ) will vary depending on whether the design values used refer to an adapted or a non-adapted person. The category of persons (and related activity, see Annex C) shall be defined for the design.

4.2.5 Identification of site factors for reduction of energy load

Global passive behaviour: reducing energy demand where thermal protection (insulation) is adapted to external climate and local opportunities.

Solar gains: building orientation, windows, solar protection, solar capitation (solar collectors or solar cells).

Water/ground source: input for heat pump inlet.

Wind: natural ventilation.

Daylight: lighting systems and/or solar shading.

Annexes C, D and E provide information about thermal loads due to human activity, lighting and equipment.

4.2.6 Commissioning and operation information

Commissioning occurs at the end of the construction stage. The aim of commissioning is to ensure that the energy performance target values of the building are achieved.

4.3 Introducing the energy efficiency framework

The purpose of the energy efficiency framework is to introduce the correct parameters at any of the four stages of the design in progress.

The flowchart in Figure A.1 provides a summary of the processes, with cross-referencing to works giving general principles that simplify the conception of the building. It shall be completed with respect to the progress of the project as defined in the flowchart in ISO 16813.

Table 1 gives a more detailed description of the requirements that are necessary to meet the energy requirements according to the progress of the design.

Table 1 — Correspondence between different stages of the design and energy requirements

Stage	Building	"System" + "Process"	Products
Project definition	Identify requirements and constraints. Labelling target for energy-efficient building or maximum values for energy delivered should be considered at this stage.	—	—
Stage I Conceptual design	From global approach to passive behaviour of the building Checklist of input and output minimum and maximum level grades for energy requirements Choice of rating (possible or not possible) Information of the optional solutions for design Definition of the systems that directly connect to the energy performance and are linked to the definition of the building. → Highlight design performance of the envelope of the building (solar protection, insulation).	Select the building performance/systems under consideration and analyse the potential for reducing energy demand, then check the possibility of combining it with renewable energy. Some specific guidelines can be introduced at this stage to optimize the use of solar active systems: inclination, orientation conditions and comparison of integration strategies (wall, roof, etc.) in terms of efficiency. heating/cooling ventilation air conditioning lighting electric power service water Process: laundry, kitchen, storage	Not under consideration at this stage
Stage II Schematic design	Acceptance of the choice for design of the energy systems after the trade-off between systems	Basic design of the systems Simplified calculation of energy consumption should be available at this stage.	Not under consideration at this stage
Stage III Detail design	—	Detailed design of the system. Calculation of energy consumption available at this stage.	—
Stage IV Final design	Validation of the target (versus energy consumption)	Complete the design of the system by defining the products. Introduce commissioning and operation requirements.	Sizing/labelling of product refer to energy efficiency requirements of the products.

4.4 Renewable energy integration

4.4.1 General

Integration of solar systems into the HVAC systems, lighting and the building envelope is important to reduce the energy load (demand) used to achieve the target value for energy efficiency of the building.

Daylighting and solar gains shall be considered for both positive and negative aspects. Positive aspects are considered to balance lighting and heat load.

4.4.2 Passive solar heating (to be considered at Stage I)

Direct solar heat gain through ordinary windows in winter is automatically taken into account in the procedure, as it will reduce space-heating load.

Solar heat gain through sunny spaces, winter gardens, greenhouses, atria and other sunny spaces shall also be included.

Passive solar components and systems of various designs shall be incorporated using the appropriate procedures, such as Trombe walls and ventilated façades.

Balance between lighting and cooling shall appear in the discussion; the use of passive masks to reduce cooling demand in the summer (hot) season may contribute to increased energy for lighting.

Natural ventilation and complex insulation of the envelope (double coating) are also solutions that can achieve summer thermal comfort with reduced thermal load for the HVAC systems.

4.4.3 Active solar heating and cooling

When the active solar heating and cooling systems are included in the system design, heating and cooling loads may be reduced by the amount supplied by the solar heating and cooling system. If the active solar heating and cooling systems are provided separately from the conventional air cooling system, the refrigeration load and the boiler load are to be reduced accordingly.

Solar systems are considered in two stages:

— calculation of the solar contribution ➔ (energy demand reduced);

— calculation of the energy consumption of the supply system, necessary to achieve thermal comfort and other scheduled objectives.

4.4.4 Photovoltaic integration

Integration of a photovoltaic system is considered to reduce of the electrical energy delivered.

A distinction shall be made between a photovoltaic system that is connected to the electricity grid and that used internally to the building to reduce electrical energy demand, as conception and components of the system may be different.

Hourly scenarios of solar radiation and electricity demand are necessary to identify clearly the real amount of photovoltaic energy produced.

Photovoltaic systems that are only connected to the electrical network shall not be considered as a way to reduce the energy demand (and increase energy performance) of the building.

NOTE When the photovoltaic system of a grid-connection type is provided, a certain amount of electricity to drive refrigeration machines and lighting can be reduced to the extent that the diurnal profile of electricity demand and power generation by photovoltaic system are balanced.