

---

---

**Framework of the design process for  
energy-saving single-family residential  
and small commercial buildings**

*Cadre général d'un processus de conception d'habitations individuelles  
et de petits bâtiments commerciaux permettant d'économiser de  
l'énergie*

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

ISO 13153:2012

<https://standards.iteh.ai/catalog/standards/iso/f676decc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012>



iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

ISO 13153:2012

<https://standards.iteh.ai/catalog/standards/iso/f676decc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

Foreword .....	iv
Introduction.....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	1
4 Symbols, units and abbreviations .....	3
5 Fundamentals .....	3
5.1 General .....	3
5.2 Core decisions by designers in design process in this International Standard.....	4
5.3 Key information helpful for the core decisions.....	4
6 Energy consumption ratio and its grounds.....	6
6.1 General .....	6
6.2 Energy uses .....	7
6.3 Prerequisite design conditions for design process .....	7
6.4 Reference specifications for elemental technologies .....	7
6.5 Grounds for energy consumption ratio .....	8
6.6 Cogenerations and photovoltaic cells .....	8
6.7 Further information derived from energy consumption ratio.....	9
6.8 Overall structure for predicting total energy consumption by using reference energy consumptions and energy consumption ratios of specifications for elemental technologies .....	9
7 Design process.....	13
7.1 General .....	13
7.2 Flow of the design process .....	13
Annex A (informative) Examples of energy-saving elemental technologies and options for specification.....	15
Annex B (informative) Notes on the experimental estimation of systems, taking actual conditions of usage into consideration .....	34
Annex C (informative) Contents of design guidelines including expression of energy consumption ratio for elemental technologies and options for specification.....	36
Annex D (informative) Media for the design process.....	38
Bibliography.....	39

## 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 13153 was prepared by Technical Committee ISO/TC 205, *Building environment design*.

iTeh Standards  
(<https://standards.itih.ai>)  
Document Preview

ISO 13153:2012

<https://standards.itih.ai/catalog/standards/iso/f676dccc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012>

## Introduction

This International Standard provides the framework for a design process for single-family residential and small commercial buildings, characterized by the “energy consumption ratio” as the key criterion. The design process, or design guidelines explaining the design process, is prepared by suppliers of the design guidelines for designers of buildings as a whole system, building envelopes or building equipment, all of which are deeply related to the energy performance of buildings. Designers play the most important role in the wide propagation of energy-saving technologies because they often make the final decisions on whether energy-saving technologies should be adopted or not, and which energy-saving technologies should be adopted in actual building projects.

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

[ISO 13153:2012](https://standards.iteh.ai/catalog/standards/iso/f676dccc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012)

<https://standards.iteh.ai/catalog/standards/iso/f676dccc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012>



# Framework of the design process for energy-saving single-family residential and small commercial buildings

## 1 Scope

This International Standard specifies a framework of the design process for energy-saving single-family residential and small commercial buildings, with the energy consumption ratio as the key criterion. It is intended to assist in the development of design guidelines for practitioners who design energy-related parts of buildings.

This International Standard is applicable only to the design process for single-family residential and small commercial buildings.

## 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*

ISO 23045, *Building environment design — Guidelines to assess energy efficiency of new buildings*

<https://standards.iteh.ai/catalog/standards/iso/1676decc-3283-4ec8-9df0-3f78994d6939/iso-13153-2012>

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16813, ISO 16818 and ISO 23045 and the following apply.

### 3.1

#### **analogical inference**

prediction of energy consumption or effectiveness in energy saving of a certain specification of a certain elemental technology on the basis of a design process or design guidelines, where the prerequisite design condition does not agree completely with that of the building project of concern

### 3.2

#### **design condition**

condition which affects functions of energy-saving elemental technologies and is taken into account in order to design the building concerned

### 3.3

#### **designer**

##### **general designer**

practitioner who designs buildings and equipment, and does not necessarily have expertise in energy-related aspects of buildings

- 3.4**  
**design guidelines**  
media which include information on how to design buildings and on the design process
- 3.5**  
**design process**  
course of actions performed by designers to produce a set of specifications and drawings
- 3.6**  
**energy consumption ratio**  
ratio of predicted energy consumption for a certain energy use to the reference energy consumption
- 3.7**  
**elemental technology**  
**energy-saving elemental technology**  
group of design methods or specifications which constitute a common function in buildings and are proved to reduce energy consumption when compared with a reference method and specification
- 3.8**  
**energy use**  
purpose of the equipment for which energy is used
- EXAMPLE      Space heating, space cooling, ventilation, domestic hot water, lighting, cooking, consumer electronics, etc.
- 3.9**  
**predicted energy consumption**  
energy consumption in primary energy for a particular energy use or a sum of energy uses, which is predicted by taking actual performance of building components and actual efficiency of equipment into consideration as much as possible
- 3.10**  
**project definition**  
process of providing the relevant information for designers and others to define the scope of the work
- NOTE      The project definition lists the given constraints, which cannot be revised, and the project requirements, the theories and assumptions. All of these might not be completely defined at this stage. Some of these may be revised in response to feedback from later stages of the design process.
- 3.11**  
**reference energy consumption**  
predicted energy consumption of a building with reference specifications for elemental technologies
- 3.12**  
**reference specification for elemental technology**  
**reference specification**  
specification whose energy performance is regarded as a reference standard
- 3.13**  
**specification**  
information which specifies the construction of a part of buildings or the requirements for installed equipment
- 3.14**  
**supplier of design guidelines**  
expert who produces and supplies design guidelines for designers by using his/her expertise on energy-related aspects of buildings



## 4 Symbols, units and abbreviations

Table 1 — Symbols, units and abbreviations

Symbol	Quantity	Unit
$E_i$	reference annual energy consumption in primary energy for energy use “ $i$ ”	GJ/a
$E_T$	predicted annual energy consumption in primary energy taking power generation by photovoltaic cells into consideration	GJ/a
ET	elemental technology	
EU	energy use	
$e_e$	predicted annual electrical load	kWh/a
$e_i$	predicted annual energy consumption for energy use “ $i$ ”	GJ/a
$e_{PV}$	predicted power generation by photovoltaic cells	GJ/a
$e_T$	predicted total annual energy consumption for energy use “1”, “2”, ..., “ $N$ ”	GJ/a
$e_{i,j,k}$	predicted annual energy consumption in primary energy for energy use “ $i$ ”, when the level of option “ $k$ ” of the elemental technology “ $j$ ” is adopted	GJ/a
$e_{i,j_1,k_{j_1}+j_2,k_{j_2}+...+j_n,k_{j_n}}$	predicted annual energy consumption in primary energy for energy use “ $i$ ”, when the level of option “ $k_{j_1}$ ” of the elemental technology “ $j_1$ ”, the level of option “ $k_{j_2}$ ” of the elemental technology “ $j_2$ ”, ..., and the level of option “ $k_{j_n}$ ” of the elemental technology “ $j_n$ ” are adopted	GJ/a
$L_{dhw}$	predicted annual heat load for domestic hot water	GJ/a
$L_h$	predicted annual heat load for hot-water space heating	GJ/a
$N$	number of energy uses with which the design process deals	-
$n$	number of elemental technologies that are effective in saving each energy use	-
$r_{i,j,k}$	energy consumption ratio for energy use “ $i$ ”, when the level of option “ $k$ ” of the elemental technology “ $j$ ” is adopted	-
$r_{i,j_n,k_{j_n}}$	energy consumption ratio for energy use “ $i$ ”, when the level of option “ $k_{j_n}$ ” of the elemental technology “ $j_n$ ” is adopted	-
$r_{i,j_1,k_{j_1}+j_2,k_{j_2}+...+j_n,k_{j_n}}$	energy consumption ratio for energy use “ $i$ ”, when evaluating the interaction among options of multiple elemental technologies (the level of option “ $k_{j_1}$ ” of the elemental technology “ $j_1$ ”, the level of option “ $k_{j_2}$ ” of the elemental technology “ $j_2$ ”, ..., and the level of option “ $k_{j_n}$ ” of the elemental technology “ $j_n$ ”)	-

## 5 Fundamentals

### 5.1 General

The design process, whose framework is given by this International Standard, has its own characteristics. The primary characteristic is being equipped with quantitative information on the energy-saving effectiveness of design options. It comes from the fact that there are still many designers who are engaged mainly in small-scale building projects and cannot carry out their own tailor-made evaluation of the design options by themselves. The following shows the decisions by those designers, who are assisted by the design process and the design guidelines as their media. In this International Standard, “elemental technology” and “specification” are fundamental concepts in the design process.

## 5.2 Core decisions by designers in design process in this International Standard

### 5.2.1 Provisional selection of elemental technologies

In the design process for energy conservation in buildings, the provisional selection of elemental technologies, which are to be evaluated for their effectiveness before the final selection, shall be made. The number of provisionally selected elemental technologies depends on design conditions.

**EXAMPLE** In cold climates, the insulation of the building envelope is selected as an elemental technology, which contributes to energy conservation in space heating energy. Other examples of the elemental technologies are given in A.2.

### 5.2.2 Provisional selection of specification for the elemental technology

After the selection of a certain elemental technology, the specification for the elemental technology shall be provisionally selected so that the effect of the design on energy consumption can be quantitatively evaluated.

**NOTE** Examples of specifications for elemental technologies are given in Annex A.

**EXAMPLE** The performance of the insulation of the building envelope is dependent on thermal resistance of insulation materials, thermal transmittance of windows and construction method affecting the air movement in or through the building envelope. Options for overall specification of the envelope from the viewpoint of the insulation are prescribed by those parameters.

### 5.2.3 Final selection of the options for specifications to be adopted in the building project

After checking predicted energy consumption or the reduction of energy consumption from the reference specifications, and after checking the balance between initial cost increase and running cost reduction, designers make the final selection on the options for specifications of elemental technologies if they give satisfactory results from the viewpoint of energy conservation and cost-effectiveness.

## 5.3 Key information helpful for the core decisions

### 5.3.1 Characteristics of elemental technologies

The elemental technologies, which are covered by the design process according to this International Standard, shall be clearly defined and explained in the design guidelines in plain terms with explanations of technical terms in engineering fields with which general designers of buildings may not be familiar. Technologies for energy conservation in buildings are not necessarily well-known to general designers of buildings. In order to propagate such technologies, even basic information shall be provided in design guidelines so that the designers can understand how each elemental technology can reduce energy consumption.

### 5.3.2 Characteristics of options of specifications for elemental technologies

It is necessary not only to let designers know of the existence and characteristics of elemental technologies for energy conservation in buildings, but also to give them enough knowledge about specifications for the elemental technologies. Among the options, the reference specification shall be included and explained so that the designers can evaluate each option in comparison with the reference specification.

Specification options are accompanied with requirements and warnings (e.g., higher skill level of workers, indispensability of heavier maintenance, etc.), which shall be followed by the designers or installers to assure the performance of the options. The descriptions of options for specifications shall clearly stipulate how to design and construct/install the part of the buildings. If the designers or installers cannot follow such requirements and warnings in their circumstance, they cannot adopt the options, however large an energy reduction they can make.

### 5.3.3 Quantitative information on the effectiveness of each option for specification

The reduction of energy consumption is the most important objective of the design process prescribed in this International Standard. Therefore, the information on the predicted reduction of energy is the key information, which shall be prepared by suppliers of the design process and its medium. The predicted reduction shall be expressed by the energy consumption ratio, which is defined by the ratio of predicted energy consumption to the reference energy consumption as for a related energy use.

All options of specifications for each elemental technology shall be named "LEVEL 0", "LEVEL 1", "LEVEL 2" and so on. "LEVEL 0" shall be allocated to the reference specification as a standard level. Options with smaller energy consumption ratios shall be given a level with a higher number. If there are any specifications with a predicted energy consumption higher than the standard level included in the options, they shall be named "LEVEL -1", "LEVEL -2" and so on.

The relationship among the reference energy consumption, the energy consumption ratio and the predicted energy consumption is as expressed in Equation (1).

$$e_{i,j,k} = E_i \times r_{i,j,k} \quad (1)$$

where

$e_{i,j,k}$  is the predicted energy consumption for energy use "i" (GJ/a), when the level of option "k" of the elemental technology "j" is adopted;

$E_i$  is the reference energy consumption for energy use "i" (GJ/a);

$r_{i,j,k}$  is the energy consumption ratio for use "i", when the level of option "k" of the elemental technology "j" is adopted.

The reality and reliability of the method of predicting energy consumption is crucial for designers. For this reason, the grounds for the prediction shall be explained within the design guideline, as specified in 6.5.

In cases where plural elemental technologies are effective in reducing energy consumption for a common energy use, prediction by multiplying energy consumption ratios for those plural elemental technologies is acceptable as an approximation, as shown in Equation (2).

$$e_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}} = E_i \times r_{i,j_1,k_{j_1}} \times r_{i,j_2,k_{j_2}} \times \dots \times r_{i,j_n,k_{j_n}} \quad (2)$$

where

$e_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}}$  is the predicted energy consumption for energy use "i" (GJ/a), when the level of option " $k_{j_1}$ " of the elemental technology " $j_1$ ", the level of option " $k_{j_2}$ " of the elemental technology " $j_2$ ", and the level of option " $k_{j_n}$ " of the elemental technology " $j_n$ " are adopted;

$E_i$  is the reference energy consumption for energy use "i" (GJ/a);

$r_{i,j_n,k_{j_n}}$  is the energy consumption ratio for energy use "i", when the level of option " $k_{j_n}$ " of the elemental technology " $j_n$ " is adopted.

If the interaction of different elemental technologies on the effectiveness in energy saving is to be taken into consideration, the energy consumption ratio evaluating combined effectiveness can also be used as expressed in Equation (3).

$$e_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}} = E_i \times r_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}} \quad (3)$$

where

$e_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}}$  is the predicted energy consumption for energy use “ $i$ ” (GJ/a), when the level of option “ $k_{j_1}$ ” of the elemental technology “ $j_1$ ”, the level of option “ $k_{j_2}$ ” of the elemental technology “ $j_2$ ”, ... and the level of option “ $k_{j_n}$ ” of the elemental technology “ $j_n$ ” are adopted;

$E_i$  is the reference energy consumption for energy use “ $i$ ” (GJ/a);

$r_{i,j_1k_{j_1}+j_2k_{j_2}+\dots+j_nk_{j_n}}$  is the energy consumption ratio for energy use “ $i$ ” evaluating combined effectiveness in energy saving, when the level of option “ $k_{j_1}$ ” of the elemental technology “ $j_1$ ”, the level of option “ $k_{j_2}$ ” of the elemental technology “ $j_2$ ”, ... and the level of option “ $k_{j_n}$ ” of the elemental technology “ $j_n$ ” are adopted.

### 5.3.4 Prediction of total energy consumption by using reference energy consumption and energy consumption ratios

The total energy consumption is predicted by summing up predicted energy consumptions for energy uses of concern, as shown in Equation (4).

$$e_T = \sum_{i=1}^N e_i \quad (4)$$

where

$e_T$  is the predicted total energy consumption for energy use “1”, “2”, ..., “ $N$ ” (GJ/a);

$e_i$  is the predicted energy consumption for energy use “ $i$ ” (GJ/a) and can be calculated using Equation (1), (2) or (3).

### 5.3.5 Initial cost of each option for specifications

The payback period of implemented elemental technologies is useful information for designers and clients. When actual prices of products and labour costs are not available, price lists of products supplied by manufacturers or any existing database for construction labour cost are used, with an additional explanation on the source of the information.

### 5.3.6 Merits of elemental technologies other than energy conservation

Depending on design conditions, some elemental technologies may need a longer payback period. Even in that situation, designers may choose such kinds of elemental technologies because of merits other than energy conservation and cost effectiveness, such as the improvement of the indoor environment. Due to such diverse values of the elemental technologies, merits other than energy conservation shall be included in the explanation of the elemental technologies.

## 6 Energy consumption ratio and its grounds

### 6.1 General

As defined in Clauses 3 and 4, the energy consumption ratio contains information on the change of energy consumption for a related energy use, when a certain specification of a certain elemental technology is