English version **NEN 2916:1998**

ENERGY PERFORMANCE OF NON-RESIDENTIAL BUILDINGS.

DETERMINATION METHOD

Unauthorized translation

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Normcommissie 351 074 “Klimaatbeheersing in gebouwen”

Kalfjeslaan 2, PO Box 5059, 2600 GB DELFT, The Netherlands
phone: +32 15 2690390, fax +32 15 2690190

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Contents

Preface

This standard gives a determination method for the Energy Performance Coefficient (*EPC*) of non-residential buildings. It is intended to be an instrument for integral judgement of the energy efficiency of a building and the building related services. Through the use of an integral requirement to the Energy Performance Coefficient of a building, the design team will be given the possibility to realize the intended energy efficiency with an optimum choice of means.

The development of this standard is bound by specific conditions for standards if they are to be referred to by the Dutch Building Decree:

- a number of energy conservation measures are not accounted for as long as requirements can not be formulated in an unequivocal and testable manner. The energy conservation effect of Building Management Systems for instance cannot be determined in an unequivocal way.
- to be sure that the predicted energy efficiency is maintained after replacing parts of the installations, the performance of a number of services elements is placed in classes. Replacement of a fan will, as long as the new fan□s performances applies to the same class, not change the Energy Performance Coefficient. The disadvantage is that slight improvements of apparatus performance will not be valued in some cases.

For the sake of unequivocalness and lack of testability, fixed values are imposed for: the internal heat loads, user defined temperatures, times of usage, reduction factors for recirculation of air or flow reduction of fans and pumps.

For convenience no discrimination of zones with different orientations is imposed (beside the discrimination of zones on other criteria, e.g. set-point temperatures. Therefore differences in utilization of solar energy between different facades within the same zone are not accounted for in every calculation. For that reason indoor climate systems/techniques which moves surplus heat from one facade to another facade are not valued in this standard.

The development of this standard is at one hand largely based on NEN-EN 832* "Thermal performance of buildings - Calculation of the energy use for heating - Residential Buildings", on the other hand on NEN 5128* "Energy performance of dwellings and residential buildings - Determination method". Because of the amount of services in non-residential buildings determination of energy consumption of certain services is more elaborated than similar determinations in NEN 5128*.

Due to the formulation of this standard according to performance based criteria, so as to comply with the Dutch Building Decree, formulations are sometimes more complex than desirable for practical use.
It is strongly advised to use the computer program in which this standard is translated (NPR 2917). It will show that the number of needed variables is not as high as the number of formulas suggests. The reason for this is that some variables show up in different places

At the second edition

The second edition of NEN 2916 incorporates the corrections of January 1995 and alterations to optimise the (juridical) relation with the Building Decree.
Specific for the Building Decree is the definition of heated area: an area to be assumed heated for the comfort of human beings. A building heated for other purposes, e.g. flower production, is in the juridical sense for this standard not relevant. Industrial buildings are excluded from this standard.
The standard discriminates between several adjoining spaces:
- adjoining strongly ventilated spaces such as garages,
- adjoining heated spaces (e.g. industrial building when/if heated for the comfort of human beings) and
- adjoining unheated spaces like conservatories/greenhouses.

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* For the correct edition of this standard, see appendix A.

Minor changes (selection for the translation)

- transmission heat losses through internal separating constructions at the boundary of building-plots will be neglected (juridical; Building Decree);
- the infiltration/ventilation heat losses of adjoining spaces are related to the transmission heat losses of the external separating constructions instead of relation to the floor area of this space.

At the third edition

For most building types the time-averaged set-point temperatures are set at 19 ^{o}C.

Beside the demand for simplification there was also a demand to value new energy conservation features like:
- cold storage in the ground;
- heat pumps;
- co-generation;
- absorption cooling;
- photovoltaic solar energy systems
- new extra insulated glazing.

In chapter 5 several policy determined corrections are given. For example the average efficiency of power generation and heat generation for district heating is given for the present Dutch (public?) generation utilities. Other policy-determined/Building Decree factors are:
- standard budget per square metre floor area of 330 MJ (multiplied per building type by a specific factor)
- extra budget per square metre external surface of 65 MJ for the first 2000 m^2, as to make it possible to comply with regulations for small buildings with normal means;
- extra budget for comfort cooling;
- basic budget for minimum ventilation amount according tot Building Decree.

The third edition contains also some correction factors for specific purposes that only relate to the specific Dutch implementation process (chapter 5).

In this edition internal heat production is no longer an imposed fixed value as a whole but is deduced from the energy consumption for lighting and fans to which a (building type depending) fixed value is added for the heat production by computers and the like. The figure for internal heat production by e.g. computers is an imposed fixed value because this figure cannot be verified or controlled in an unequivocal way.

All tabulated values where a reference is given to determination of alternative values and an appropriate rounding rule are (so called) agreed (conventional/safe) values. This is also the case for:
- $S_{\text{pv;i}}$, the Watt-peek capacity per m^2 PV-panel;
- a, the weighing factor for constructions that separate an energy sector from the ground or the crawlspace;
- 0,75, the computation value in 6.6.4.2 for the reduction of window areas by the frame.

All other values are imposed, fixed or policy decided values, conversion values, values that determine standard use, standard conditions or standard appreciation from the viewpoint of equality of rights.

This standard is accepted by Dutch standardisation committee 351 074 "Klimaatbeheersing van gebouwen" (Indoor climate control in buildings), after preparation by subcommittee 351 074 16 "Energieprestatie utiliteitsgebouwen" (Energy performance of non-residential buildings).

English version

The English version is prepared to contribute to the development of an European standard for the calculation of energy use of non-residential buildings. The Dutch standard gives an example of possible incorporation of energy use for lighting, fans, domestic hot water and comfort cooling. The way in which the Dutch standard accounts for energy use of comfort cooling follows the principles of the calculation of energy use for heating according to prEN 832. The factors to determine the utilisation of "free cooling", depending on the thermal mass, are derived with a large number of dynamic heat balance calculations. These factors are specific for the dynamics of the Dutch climate, especially the diurnal temperature variations. For the use of this method in other climates these factors should be derived on a national (or with large differences in climate dynamics on a regional) base. If typical operation hours of buildings in other countries differ from those used in this standard, this will also play a role in the determination of that factors.

The way NEN 2916 is embedded in the Dutch Building Regulations (Building Decree) determines several terms and definitions and leads sometimes to physical or technical peculiar formulations.
If that formulations serve a goal in assuring equality of rights or the possibilities to verify or test input parameters, this is desirable for standardization. Some implications of the Dutch Building Decree are however strongly national. Therefore this translation omits in the preface and in chapter 5 some specific Dutch elements of the 1998 version. At other places specific Building Decree based elements are marked with DBD (Dutch Building Decree) and added text specific for this translation is underlined.
The Dutch version shows throughout the whole standard complex formulations for the dicrimination between residential and non-residential buildings. In this translation only the definitions show the complex formulation of the Dutch standard. Also clause 13.3.3 is reformulated in an easier way.

Valuation of district heating and co-generation is strongly influenced by considerations of national policy. The method and the applied reference values in this standard are based on these considerations. For other countries other methods could be more applicable.

1 Scope

This standard gives terms, definitions and the method for the determination of the Energy - Performance Coefficient (*EPC*) of a building or a part of a building.

NOTES
1. This standard characterises the energy performance of the building and the installations. No direct relationship exists between the determined energy performance and the actual energy consumption.
2. Application of this standard to buildings in which the heat flows due to the production process are dominant may lead to non-rational considerations to restrict energy.

DBD The formulation of the scope hides that this standard should not be applied for dwellings and residential buildings, but gives however procedures to incorporate calculations for dwellings and residential buildings, carried out with NEN 5128, if dwellings or residential buildings are combined with non-residential buildings.

2 Normative references

This standard incorporates by direct or indirect reference provisions from other standards. Direct normative references are cited at the appropriate places in the text and the standards are listed in the normative appendix A, with number, title and year of publication.

Amendments or revisions of later date apply only for this standard if they are cited in the list of standards

NOTES
1 ... DBD not relevant for this translation, refers to procedures around alterations of Dutch Building Decree
2. Beside normative references this standard contains also informative references. These informative references are also listed in appendix A.

3 Definitions

3.1 **accommodation building**: Building or part of a building, in which two or more accommodation facilities are situated that can be reached by one or more general spaces.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.2 **accommodation facility**: Building or part of a building intended to offer a recreational stay or a temporary accommodation to people who have their main residence elsewhere.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.3 **adjoining space**: an enclosed space which:
- is situated at the own building-plot, but outside the heated zone of a non-residential building;
- is bound at the heated zone of a non-residential building;

and which space may, apart form the influence of transmission heat loss from the heated zone, be excluded from the calculation of the energy consumption.

NOTE
In the calculation of the *EPC* the character of spaces on adjoining building-plots is not accounted for (DBD).

3.3.1 **adjoining unheated space (AUS)**: An adjoining space separated from the heated zone of the non-residential building by a fixed and closed separating construction, what means that the separation construction contains only openings that can be closed with a moveable construction part like a window or door and

1) for the calculation will be considered as not heated or not cooled, or
2) is heated or cooled, but not for comfort of people, and is situated within a building for which building applies no energy performance requirement.

NOTE
E.g. an industrial building heated in favour of the production process like a greenhouse for the production of vegetables, fruit or flowers.

3.3.2 **adjoining heated space (AHS)**:

1) an adjoining space, heated or cooled for the comfort of human beings, situated within a building for which no energy performance requirement applies, or
2) an adjoining space situated within the *EPC*-boundary of a dwelling or residential building or a not in an accommodation building situated heated lodging.

NOTES
Ad 1) An example is an industrial building.
Ad 2) A bungalow for holidays is an example of a not in an accommodation building situated accommodation facility.

3.3.3 **strongly ventilated space**: Adjoining space with provisions for ventilation, being one or more permanent (not closeable) openings, with a capacity for the supply of fresh air and the exhaust of inside air, determined according to 5.3 of NEN 1087[*], of at least 3 H 10^{-3} m^3/s per m^2 usable area.

3.4 **air flow**: Amount of air supplied or discharged per unit of time.

3.5 **air flow control**: Provision which can reduce fan-driven airflow.

3.6 **air permeability**:

NOTE
This notion is defined in 2.4 of NEN 2686[*].
At the time of publication of this standard the definition is as follows:
The ability of an object to let air pass through in case of air pressure difference.

3.7 **artificial lighting sector**: Part of a building where no reduction of operation hours is admitted for the utilisation of daylight.

3.8 **assembly building**: A building or a part of a building destined for verbal communication or cultural activities (congress centre, church, community building, cinema, theatre, exhibition building, museum and the like).

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

* For the correct edition of this standard, see appendix A

3.9 **building**: All structures forming a for human beings accessible covered space, whole or partially enclosed by walls.

NOTE
This definition has been adopted from the Housing Act.

3.10 **building installation**:

NOTE
This notion has been defined in 2.1.9 of NEN 2580*.
At the time of publication of this standard the definition is as follows:
Installations that meet the following criteria:
- the installation is fixated to the building;
- the constructions of the installation is closely related to constructional activities;
- the installation is primarily intended to create the correct interior climate for living and working in the building;
- the installation is not directed at the production of the company.

3.11 **building type**: Building or part of a building intended for specific purposes, like an assembly building, cell and penitentiary building, health care building, catering building, industrial building, office building, accommodation building, educational building, sports building, station building, shop building or residential building.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation and dwellings and residential buildings are not distinguished, see definition of residential building

3.12 **catering building**: Building or part of a building intended for the professional catering of refreshments and the consumption thereof on the spot (restaurants, pubs, (snack)bars and the like).

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.13 **cell**: building or part of a building intended for forced temporary accommodation to people who have their main residence elsewhere.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.14 **characteristic air permeability**: the in NEN 2686* as $q_{v;10;char}$ defined characteristic air volume flow.

NOTE
This notion is defined in 2.6.3 of NEN 2686*.
At the time of publication of this standard the definition is as follows:
$q_{v;10;char}$: Characteristic air flow being the air change rate at a pressure difference of 10 Pa between inside and outside, without correction to a standardized net volume of space.

* For the correct edition of this standard, see appendix A

3.15 **characteristic energy consumption**: Total primary energy consumption of a building, determined as the sum of the primary energy use for heating, ventilation, lighting, pumps, cooling, humidifying and preparation of domestic hot water by building installations of the non-residential part of the building, to which will be added the characteristic energy consumption of residential buildings and from which sum the possible contribution of photovoltaic solar energy and the possible contribution of electricity by co-generation is subtracted.

3.16 **class of occupation density**: Class representing the typical number of persons per m^2 usable area.

NOTE
The Building decree gives for several building types classes of occupation density or intensity (persons per m□ floor of a staying area) as to formulate requirements for the ventilation capacity per m□ floor area.

3.17 **(building bound) co-generation**: Combined generation of power and heat, were heat delivery is restricted to buildings on own building-plot, where the total amount of heat to be delivered by the building bound co-generation unit can be determined unequivocal and specific according to 6.2 of NEN 5128* and/or 6.3 of this standard. Other cases of co-generation will be considered as district heating.

NOTE
1 (Building bound) co-generation is characterized by the fact that the users of the produced heat can be identified in an unequivocal way. This will be clear in the case that all buyers are involved in the same building application.
Not-building bound is the delivery of heat for cases where the application of the building permit does not inform about the degree of useful application of heat and the distribution to more than one client, nor can influence the performance. Then two classes of systems are assumed with a simple efficiency figure, in which the complexity of energy flows is incorporated in a fixed (but reproducible) way.
2 Legal formulation bound to Building Decree. Valuation of district heating and co-generation are influenced by considerations of national policy.

3.18 **cooling**: The process of heat extraction for thermal comfort.

3.19 **cooling demand**: Amount of cooling energy needed as to realise the set-point temperature by the conditioning installations in cooled space(s).

3.20 **daylight sector**: Part of a building where for determination of the number of operation hours of artificial lighting, reduction of operation hours is admitted because of the utilisation of daylight.

3.21 **distribution efficiency**: The fraction of the generated usable heat and cold which is effectively delivered to a building.

NOTE
The distribution efficiency expresses the heat losses from terrain pipes if in the case of heat generation by the applicant, the heat generation unit (e.g. boiler) is not placed in the building for which the energy performance coefficient (EPC) is determined.

* For the correct edition of this standard, see appendix A

3.22 **district heating**: Delivery of heat coming forth from (a combination of)
- production of power or
- industrial production or
- waste combustion or
- upgrading of heat by a heat pump,

where delivery is not restricted to buildings on own building-plot respectively to buildings for which the building permit is applied.

NOTES
1 This implies (mostly large scale) applications where heat is delivered to several buildings not on own building-plot.
2 Co-generation that does not fulfil the conditions for the definition of co-generation will be considered as district heating.
3 Legal formulation bound to Building Decree. Valuation of district heating and co-generation is influenced by considerations of national policy.

3.23 **educational building**: A building or part of a building destined for educational purposes (schools, universities, academies and the like).

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.24 **effective thermal capacity**: Effective thermal capacity of a building or part of a building accessible for daily temperature fluctuations.

3.25 **efficiency of power generation facilities**: The national average efficiency of power generation, related to the upper calorific values of energy content of fuels, accounting for distribution losses.

3.26 **energy sector**: Building or part of a building that may be considered as one consistent unit for the calculation of the energy consumption for heating, fans, lighting, moistening, cooling and domestic hot water.

NOTE
If can be expected at a glance that certain parts of a building have strongly differing characteristics (e.g. different HVAC-systems) the energy-use of this parts should be determined separately. The formal way to discriminate between building parts at forehand in an unequivocal way (without having done calculations) is described in chapter 13.

3.27 ***EPC***: Measure for the energetic characteristics of a building or part of a building including building installations at a certain user□s behaviour.

3.28 **equipment**: Heat producing elements, necessary for the actual function of the building, which do not meet the criteria for building installations.

NOTE
Meant are computers, monitors, printers and the like.

3.29 **equivalent heat-generation efficiency**: The amount of used primary energy by a co-generation unit that is converted in usable heat, from which the amount of primary energy that would be needed for separate production of the same amount of electricity that is produced by the co-generation unit, is subtracted.

NOTES
1. Depending on the sort of facility a (part of) the distribution loss and/or (a part of) the additional energy can be included in the value of the equivalent heat-generation efficiency. This will be explained at the relevant places.
2. Valuation of district heating and co-generation is influenced by considerations of national policy.

3.30 **floor**:

NOTE
This notion is defined in 2.1.6 of NEN 2580*.
At the time of publication of this standard the definition is as follows:
A part of a building, consisting of one or more spaces, whereof the top of the floors of two adjoining spaces differs not more than 1,5 m in height.

3.31 **full load efficiency**: Generation efficiency of an installation when the maximum capacity of the installation is drawn on.

NOTE
Full load efficiency: meant is full load efficiency according to NEN-EN 677*

3.32 **general, non-residential building**: A building not intended for habitation, not being an assembly building, a cell, a penitentiary building, a health care building, a catering building, an industrial building, an office building, an accommodation building, an accommodation facility, an educational building, a sports building, a station building or a shop building.

3.33 **general space**: An enclosed space within a non-residential building, not being an accommodation building, which serves more than one building type.

NOTE
This definition has been adopted from the Building Decree.

3.34 **generation efficiency**: The fraction of the amount of supplied primary energy that is converted into usable heat, cold or power.

3.35 **health care building**: Building or part of a building destined for the benefit of nursing, health care or treatment or medical examinations.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.36 **health care building, clinical**: Health care building destined for accommodation to patients or people which, as a consequence of their physical of mental health, are permanently or temporarily bound to bed.

* For the correct edition of this standard, see appendix A.

3.37 **heated space**: Room or group of rooms in a building or a part of a building, for which building or part applies an *EPC* requirement, or a general space or group of general spaces, which space or group of spaces is heated or cooled for the benefit of people.

3.38 **heat gain**: The total of the internal heat production and incoming solar heat in a building or part of a building.

3.39 **heating**: Process of heat supply for the benefit of room conditioning.

3.40 **industrial building**: A building or part of a building intended for manufacturing or storage of materials or goods (factories, workshops, warehouses and repositories and the like).

NOTES
1 This definition has <u>for the Dutch edition</u> been adopted from the Building Decree.
<u>2 This definition is slightly simplified for the English translation</u>

3.41 **infiltration**: Outside air unintentionally entering through an exterior separating construction by among others seams and cracks.

3.42 **installation function**: The whole of building installations destined to fulfil at least a following function:
- heating;
- air transport;
- heat/cold distribution by means of pumps;
- lighting;
- cooling;
- humidifying;
- preparation of domestic hot water.

3.43 **internal heat production**: Heat released in a building or part of a building by persons, lighting, fans and other <u>(computer</u>) appliances.

3.44 **lighting control**: Way to control artificial lighting.

3.44.1 **daylight switch**: A lighting control, which when the illumination level (outside) exceeds a certain value, switches off partially or wholly the artificial lighting in daylight sectors, centrally or per facade, or gradually or sliding dims the artificial lighting.

3.44.2 **room switch**: An user controlled switch in a room, which switches the lighting on or off in the room.

NOTE
Systems controlling the lighting in the whole room and systems controlling the lighting in the zone at the facade are distinguished.

3.44.3 **central on/off**: System that switches the lighting in a whole building or whole part of a building on or off only.

3.44.4 **sweeping switch**: System that enables automatically switching off the lighting in a building or part of a building at regular times/intervals.

NOTE
This system automatically switches off the lighting at several times during working hours with a so-called overrule-system.

3.45 **lighting sector**: Building or part of a building that may be considered as a whole for the calculation of the energy consumption for lighting.

3.46 **local system**: Installation for heating, cooling, or a combination of it, producing heat/cold for only one energy sector, in which sector at the minimum 90% of the usable area lies within one space.

3.47 **mechanical ventilation**:

NOTE
This notion is defined in 2.12 of NEN 1087*.
At the time of publication of this standard the definition is as follows:
Ventilation with the aid of a fan.

3.48 **natural ventilation**:

NOTE
This notion is defined in 2.15 of NEN 1087*.
At the time of publication of this standard the definition is as follows:
Ventilation through the influence of the wind and/or the influence of the temperature difference between the outside air and inside air.

3.49 **office building**: Building or part of a building destined for administrative purposes.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation.

3.50 **outside temperature**: The average temperature of the outside air over the period considered.

3.51 **part load efficiency**: The generation efficiency of an installation under partial load.

NOTE
Meant is the part load efficiency according to NEN-EN 677*.

3.52 **penitentiary buildings**: building or a part of a building, in which two or more cells are situated which can be reached through one or more circulation spaces (part of a police station, jail).

NOTE
This definition has been adopted from the Building Decree.

3.53 **primary energy consumption**: The total yearly consumption of energy derived from fossil fuels, in MJ, directly or via district heating and electricity, by means of building installations.

* For the correct edition of this standard, see appendix A

3.54 **residential building**: Dwelling(s) or building or part of a building, in which building or which part two or more dwellings are situated which are accessible through one or more common circulation spaces or one or more, heated for thermal comfort for people, not in an accommodation building situated accommodation facility or facilities.

NOTES
1 This definition overrules in this English version of NEN 2916 the definition used in the Dutch version to get in this standard a clear division between residential and non-residential buildings. In the Dutch standard many places show elaborate descriptions of (heated) accommodation facilities for which the energy performance calculation should be done with NEN 5128.
2 The definition in the Dutch version runs with:
residential building: Building or part of a building, in which building or which part two or more dwellings are situated which are accessible through one or more common circulation spaces.

NOTE
This definition has been adopted from the Building Decree.

3.55 **separating construction**:
- Internal: The construction that forms the partition between two enclosed spaces of a building, accessible to persons, including the connecting parts of other constructions, in as far as those parts influence compliance of that separating construction with the regulations, given by or in virtue of this decree.
- External: The construction that forms the partition between an enclosed space of a building, accessible to persons, and the open air, ground, or water, including the connecting parts of other constructions, in as far as those parts influence compliance of that separating construction with the regulations, given by or in virtue of this decree.

NOTE
The definitions have been adopted from the Building Decree.

3.56 **shaft capacity**: Maximum mechanical capacity of the drive motor.

NOTE
The shaft capacity of a motor as meant in NEN 3173*.
At the time of publication of this draft standard the definition is as follows:
The shaft capacity of a motor is the allowed capacity during full continuous operation.

3.57 **shop building**: Building or part of a building intended for trading of materials, goods or services (shops, warehouses, travel agencies and the like).

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.58 **solar energy system, photovoltaic (PV-system)**: Facility for the collection of solar energy and the conversion into electricity.

3.59 **solar energy system, thermal**: Facility for the collection of solar heat and the delivery of that heat to reduce the heat demand for the boiler-units for space heating and/or domestic hot water.

* For the correct edition of this standard, see appendix A

3.60 **solar energy transmittance** (*g*):

NOTES
1. This notion is defined in 3.1.15 of NEN 1068*.
   At the time of publication of this standard the definition is as follows:
   The ratio of the density solar heat entering the window system and the incoming solar radiation density of that window system
2. In this quantity both direct radiation and diffuse radiation have been taken into account. To compare the solar entry by various glazing systems one should preferably employ the quantity "$g_\perp$" for measurement technical reasons, which exclusively relates to perpendicularly projected direct radiation.
   The values of $g_\perp$ are approximately 10% higher than the corresponding values.

3.61 **specific air flow**: The air flow resulting from infiltration or ventilation per unity of floor area.

3.62 **specific electricity consumption**: Amount of electric energy consumed per year per m^2 usable area.

3.63 **speed control**: Facility to enable the variation of revolutions per unit of time of a pump or a fan.

3.64 **sports building**: Building or part of a building intended for sports (swimming pool, gym, sports hall, fitness centre and the like).

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.65 **station building**: Building or part of a building intended for arrival or departure of public transport by road, railway, water or air (bus and railway station, airport, port and the like.

NOTES
1 This definition has for the Dutch edition been adopted from the Building Decree.
2 This definition is slightly simplified for the English translation

3.66 **staying area:** Enclosed space, consisting of one or more interconnected staying rooms and other separate rooms, situated on the same storey, other than a toilet or bathroom, installation room or common circulation space.

NOTES
1. This definition has been adopted from the Building Decree.
2. Whether a room (or a collection of rooms) may be considered as staying area depends however on the compliance with several specific conditions formulated in the Building Decree.

3.67 **system efficiency**: The fraction of the generated useful heat or cold that is effectively used.

3.68 **thermal efficiency of a solar energy system**: The ratio between the yearly heat amount delivered by the system as far as covering the heat demand and the total solar insulation at the collectors, respectively during the heating season (space heating) or during the whole year (domestic hot water).

3.69 **thermal transmittance**: the heat flow per construction per unity of area per K.

* For the correct edition of this standard, see appendix A

3.70 **transmission heat loss**: The total of heat transmission through a collection of separating constructions.

3.71 **transmission heat loss coefficient**: The total of transmission heat losses through all relevant separating constructions per K.

3.72 **usable area**:

NOTE
This notion has been defined in 4.5 of NEN 2580*.
At the time of publication of this standard the definition is as follows:
The usable area of a space or a group of spaces is the area, measured at floor level, between the rising separating constructions that enclose that space or group of spaces.

3.73 **utilisation factor for heat gain**: The fraction of the heat from the sun and internal sources released in a building or a part of a building that results in a decrease of the heat demand for space heating.

3.74 **utilisation factor for heat loss**: The fraction of the maximum amount of heat to be released to its surroundings, through transmission and ventilation during the period of cooling demand that results in a decrease of the cooling demand.

3.75 **ventilation heat loss**: Heat loss resulting from the heating of the time averaged amount of air that enters a building or part of a building per unit of time in one way or another.

3.76 **ventilation heat loss coefficient**: Heat loss resulting from the heating per K of the time averaged amount of air that in one way or another enters a building or part of a building per unit of time.

3.77 **whole or actual building**: One or more buildings that form an architectural entity.

<u>NOTE</u>
<u>The definition in the Dutch Housing Act of a building comprises both a whole building as well as parts of a building. To avoid confusion a new definition is given for what in daily language is taken as a building.</u>

* For the correct edition of this standard, see appendix A

4 Symbols and indices

4.1 Symbols

symbol	name	unit
A	area	m^2
C	effective thermal capacity	MJ/K
C	correction factor	-
D	specific effective thermal capacity	MJ/(m^2 K)
E	amount electrical energy	kWh
EPC	energy performance coefficient	-
H	heat loss coefficient	W/K
I	electric current	A
LTA	light transmission factor	-
P	power	W
Q	quantity of heat or energy	MJ
R	thermal resistance	(m^2 K)/W
U	thermal transmittance	W/(m^2 K)
U	electric voltage	V
V	volume	m^2
X_h	gram hour moisture per volume-unity	g∗h/liter
a	weighing factor for unheated adjoining space	-
a	number of heat production units	-
a	auxiliary variable	-
a	weighing factor for humidifying systems	MJAs/(gAh)
a	factor for pipe and/or duct losses	-
c	specific heat, constant	J/(kgAK)
c	coefficient	-
d	thickness	m
d	reduction factor for the heat loss area	-
e	specific electricity consumption	kWh/ m^2
e	power factor of the electromotor	-
f	(weighing) factor, fraction	-
g	total solar energy transmittance	-
h	height	m
k	auxiliary symbol	-
l	length	m
m	effective thermal mass	kg
n	air change rate	h^{-1}
p	pressure	N/m^2
q	specific heat flow	W/m^2
q_v	air flow	liter/s
r	shading correction factor	-
t	time	h
u	specific air flow	liter /(s∗m^2)
w	width	m
z	shading correction factor for the horizon	-
α	proportion of covering demand of cold	-
β	proportion of heating or cooling capacities	-

ε	conversion efficiency	-
γ	gain-loss ratio	-
η	efficiency	-
θ	temperature	EC
λ	loss-gain ratio	-
ρ	density	kg/m^3
τ	time constant	h
Φ	well water flow	m^3/s
Ψ	linear thermal transmittance	W/(mAK)

4.2 Indices

ACM	absorption chilling machine
adm	admissible
agr	agreed
artlight	artificial lighting sector
aux	auxiliary energy
b	utilisation
b	obstruction
c	construction
CCM	compression chiller
char	characteristic
cntrl	control
cog	(building bound) co-generation
comp	compensation
cool	cooling
cs	cold storage
d	net light transmission area
day	day period
daylight	daylight, daylight sector
dem	demand
dh	district heating
dhw	domestic hot water
distr	distribution
e	outside, external
eff	effective
req	requirement
el	electric
elm	electromotor(s)
EHP	electric heatpump
g	usable
geb	building
gen	generation
GMHP	gasmotor heat pump
H	highest
h	hour
heat	heating
heatz	heated zone

hor	horizontal
HP	heat pump
hr	heat recovery
hum	humidifying
i	inside, internal
i	numerator
inf	infiltration
L	lowest
l	air, latent
lc	loading cold
li	lighting
m	mechanical, month
marg	marginal
max	maximum
min	minimum
n	natural
night	evening- and night period
npref	non-preferential
nt	not transparent (opaque) construction parts
over	remaining
perf	performance
pers	persons
pref	preferential
prim	primary
pump	pumps
pv	photovoltaic
r	radiation, window (including frame)
res	residential building
room	room or space
sec	energy sector
ses	solar energy system
shaft	shaft of electromotor
sun	solar, sun, shading
sys	(installation-)system
t	transparent external separating construction
th	thermal
tot	total
tr	transmission
v	perceptible, volume flow
vent	ventilation
vert	vertical
vg	staying area
w	water

5 Determination of the energy performance of a building or part of a building

5.1 Principle

The building or part of the building is divided into a residential section and a non-residential section, see figure 1. For the residential section the characteristic energy consumption, the usable area of the heated zone(s) and the area of the loss envelope must be determined according to respectively 5.3.1, 5.3.2.6 and 5.3.2.3 of NEN 5128*.
For the (part of the) non-residential building first the primary energy consumption per installation function is determined, see figures 2 and 3. Subsequently the characteristic energy consumption of a building is calculated as the sum of the energy uses of the installation functions, increased, if relevant, by the energy consumption of residential buildings and decreased by contributions of photovoltaic solar energy systems and, as far as relevant, a part of the generated electricity by the (building bound) co-generation.
Finally, the energy performance coefficient of a building(sort) is calculated.

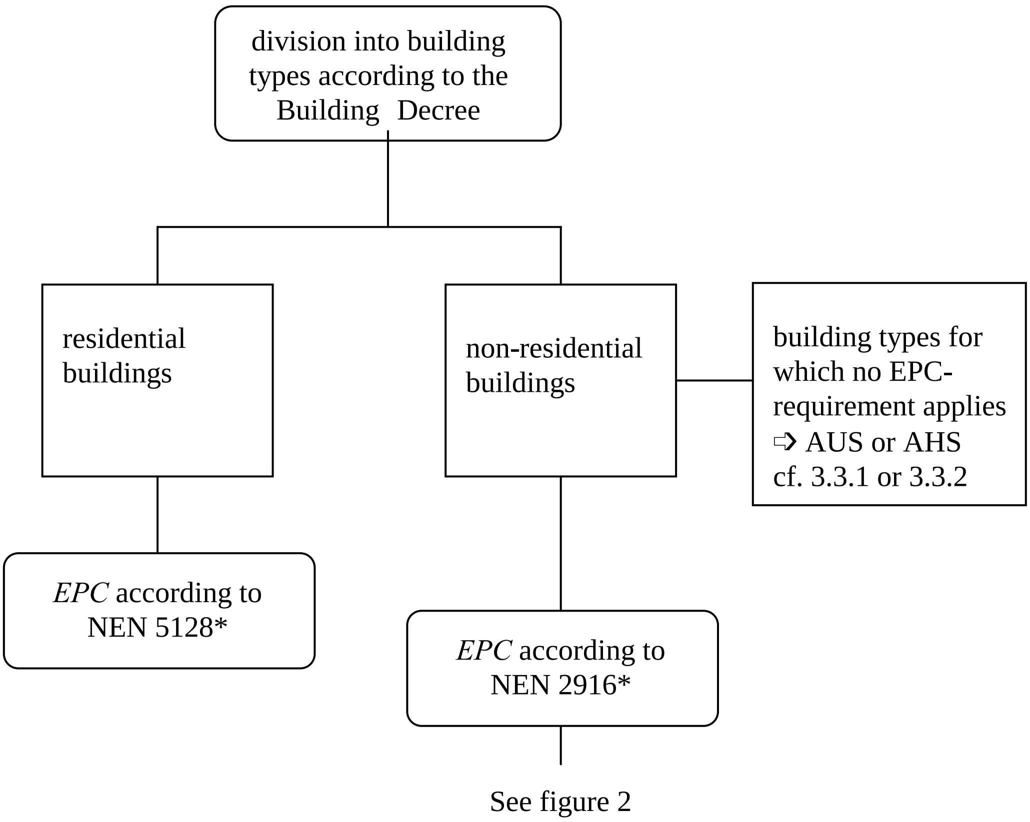


Figure 1: Discrimination between residential and other building parts.

* For the correct edition of this standard, see appendix A.

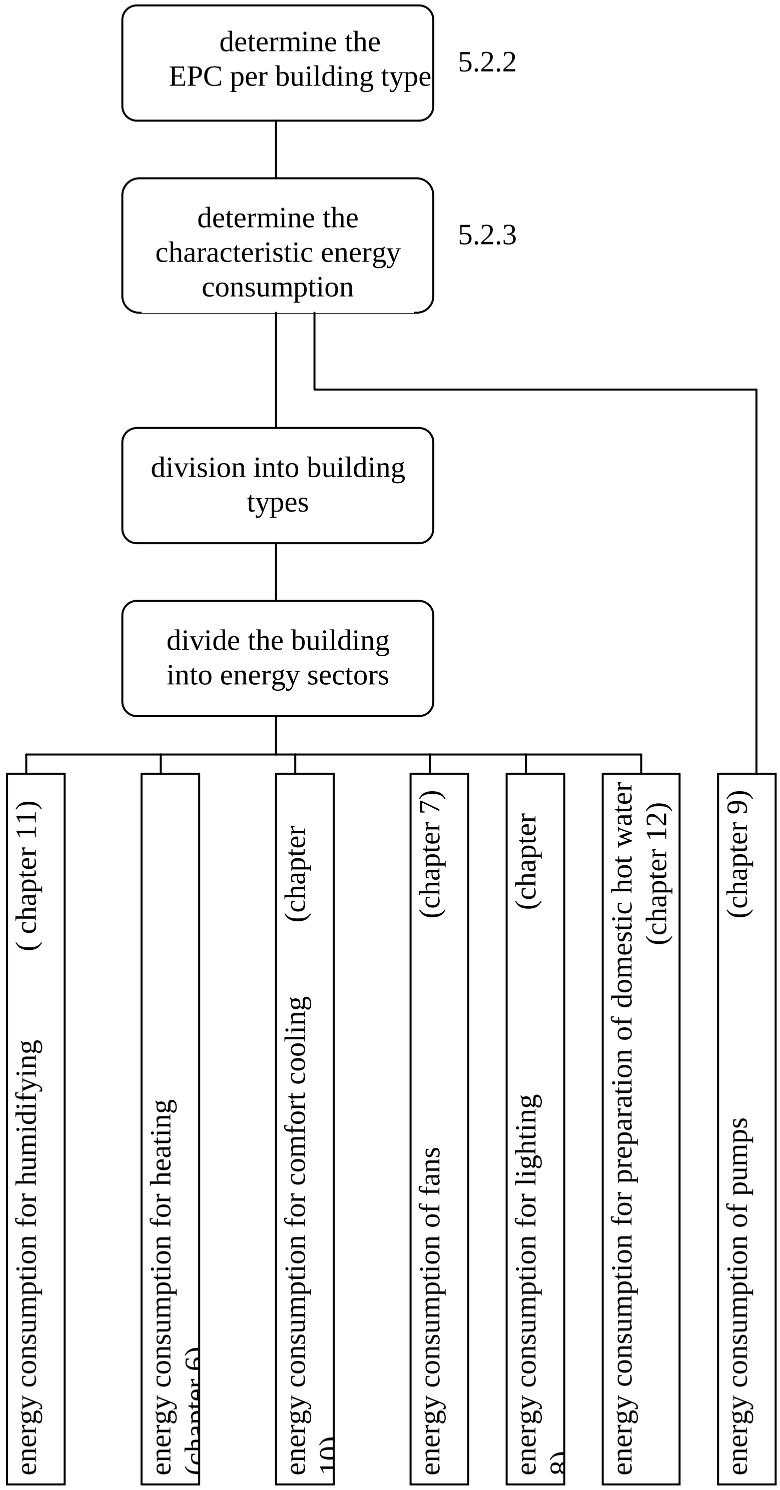


Figure 2: Working method determination energy consumption per installation function

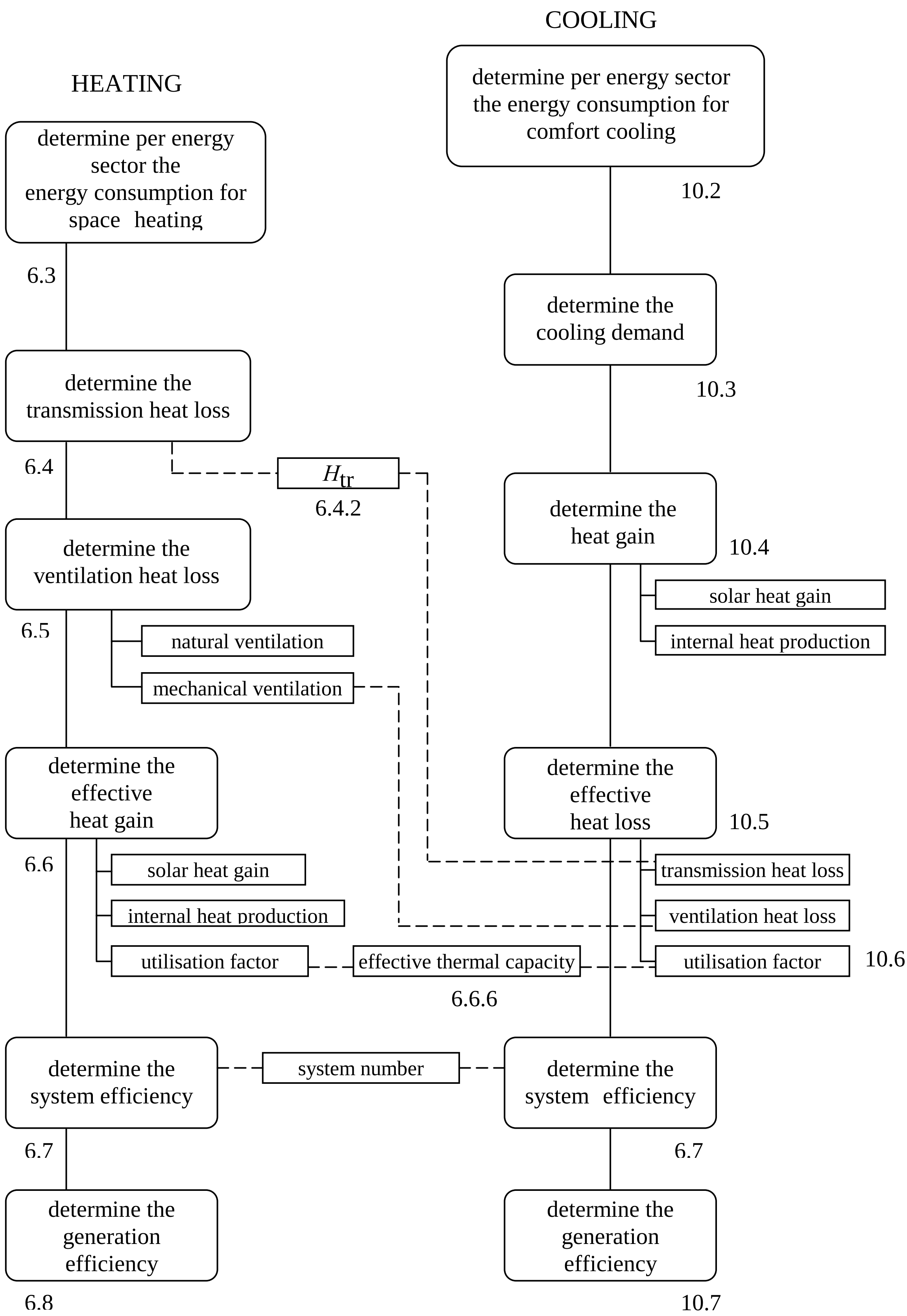


Figure 3: Relationship between provisions for the determination of the energy consumption for heating and the energy consumption for comfort cooling.

5.2 Calculation rules

5.2.1 *Procedure*

The calculation proceeds as follows:

- divide the building if it contains one or more building types for which an *EPC*-requirement applies, according chapter 13 in:
  - building types and one or more groups of general spaces;
  - heated zones, adjoining heated spaces and adjoining unheated spaces according to 13.2;
- divide the heated zones in energy sectors according to 13.3;
- find the characteristic energy consumption of the building according to 5.2.3;
- find according to 5.2.2 the *EPC* per non-residential building type for which an *EPC*-requirement applies.

5.2.2 *EPC* of a building type

NOTE
The Building Decree states an *EPC*-requirement per building type. Beside the Building Decree states that for buildings with more than one building type for which an *EPC*-requirement applies, that the calculated characteristic energy consumption should be equal or less than the admissible characteristic energy consumption.

Determine the *EPC* per building type *i* with:

$$EPC_i = \frac{Q_{\mathrm{perf;tot}}}{Q_{\mathrm{perf;adm}}} \text{ x } EPC_{\mathrm{req;i}}$$

<u>NOTE</u>
<u>This part of the formula has only juridical sense (DBD)</u>

where:

$$Q_{\mathrm{perf;adm}} = \left(\frac{1}{f_{\mathrm{cool}}}\right) \text{ x } 330 \text{ x } (A_{\mathrm{g;heatz;1}} \text{ x } EPC_{\mathrm{req;1}} + A_{\mathrm{g;heatz;2}} \text{ x } EPC_{\mathrm{req;2}} + \ldots) +$$

$$+ \left(\frac{1}{f_{\mathrm{cool}}}\right) \text{ x } 330 \text{ x } (A_{\mathrm{g;heatz;res;1}} \text{ x } EPC_{\mathrm{req;res}} + A_{\mathrm{g;heatz;res;2}} \text{ x } EPC_{\mathrm{req;res}} + \ldots) +$$
$$+ c_{\mathrm{vent}} \text{ x } (f_{\mathrm{vent;1}} \text{ x } u_{\mathrm{v;min;1}} \text{ x } A_{\mathrm{g;1}} + f_{\mathrm{vent;2}} \text{ x } u_{\mathrm{v;min;2}} \text{ x } A_{\mathrm{g;2}} + \ldots) +$$
$$+ 65 \text{ x } A_{\mathrm{loss}} + 65 \text{ x } EPC_{\mathrm{req;res}} \text{ x } A_{\mathrm{loss;res}}$$

in which:

EPC_i	is the energy performance coefficient (*EPC)* of building type *i*;
$Q_{\mathrm{perf;tot}}$	is the characteristic energy consumption of the building, in MJ, determined according to 5.2.3;

$Q_{perf;adm}$ is the admissible characteristic energy consumption of the building, in MJ;
f_{cool} is a weighing factor that gives partial compensation for the presence of cooling, determined according to 5.2.4;
$A_{g;heatz;i}$ is the usable floor area of the heated zone in m^2 of non-residential building type *i*, for which an *EPC*-requirement applies;
$EPC_{req;i}$ is the *EPC*-requirement for building type *i* of a building;
$A_{g;heatz;res;i}$ is the usable floor area of the heated zone in m^2 of the residential building *i*;
$EPC_{req;res}$ is the *EPC*-requirement for a residential building;
c_{vent} is a factor which enlarges the admissible energy consumption as to compensate for ventilation according to minimum ventilation rates required by the Building Decree;
$f_{vent;1,2,..}$ is the usable area weighed time fraction that energy sector 1,2,... is ventilated, determined according to 6.5.2.2;
$u_{v;min;1,2,..}$ is the required minimum specific air flow of direct entering fresh outside air in staying areas in energy sector 1,2,... in liter/(s∗m^2), determined according to 6.5.3.5;
$A_{g;1,2,.}$ is the usable area of energy sector 1,2,... in m^2;
A_{loss} is the total area of the loss envelope in m^2 of the non-residential building parts, determined according to 5.2.5;
$A_{loss;res}$ is the area of the loss envelope in m^2 of the residential building parts, determined according to 5.3.2.3 of NEN 5128*;

NOTES
1. Elaboration of this formula for the *EPC* gives for a large building with only one building type, neglecting the compensation for area of the loss envelope, $EPC = Q_{perf;tot} / (330\ H\ A_g)$. The number 330 forms a reference energy consumption that for reasons of uniformity is based on dwellings according to NEN 5128*, with the units MJ/m□.
2. If $Q_{perf;tot}$ is smaller than $Q_{perf;adm}$, compliance with energy performance requirements in the Building Decree is proved.
3. De weighing factor f_{cool} is an auxiliary factor in order not to discriminate in requirements in the Building Decree between buildings with and buildings without cooling. For $f_{cool} = 1$ no compensation is given for the presence of cooling.
4. The coefficient c_{vent} has the same function for ventilation as f_{cool} and is more or less a measure for the admissible energy consumption for ventilation, based on required minimum, occupation density related, ventilation rates per building type. The Building Decree describes (classes of) occupation density for several building types.

For the determination of $A_{g;heatz;i}$ should, as far as general spaces within the heated zone in the building, the usable area of that general spaces be allocated in proportion to the floor areas of the building types related to that general spaces.

Round the result downwards to two decimal places.

* For the correct edition of this standard, see appendix A.

5.2.3 *Characteristic energy consumption*

5.2.3.1 *Characteristic energy consumption of a building*

Determine the yearly characteristic energy consumption of a building as the sum of primary energy consumption for heating, fans, lighting, pumps, cooling, humidifying and domestic hot water and add the energy consumption of residential buildings in that building according to:

$$Q_{\text{perf;tot}} = Q_{\text{prim;heat}} + Q_{\text{prim;vent}} + Q_{\text{prim;li}} + Q_{\text{prim;pump}} + Q_{\text{prim;cool}} + Q_{\text{prim;hum}} + Q_{\text{prim;dhw}} + \Sigma_i Q_{\text{perf;tot;res;}i} - Q_{\text{prim;pv}} - Q_{\text{prim;comp;cog}}$$

where:

$Q_{\text{perf;tot}}$ is the characteristic energy consumption of a building, in MJ;
$Q_{\text{prim;heat}}$ is the primary energy consumption for heating, determined according to chapter 6, in MJ;
$Q_{\text{prim;vent}}$ is the primary energy consumption for mechanical ventilation, determined according to chapter 7, in MJ;
$Q_{\text{prim;li}}$ is the primary energy consumption for lighting, determined according to chapter 8, in MJ;
$Q_{\text{prim;pump}}$ is the primary energy consumption for pumps, determined according to chapter 9, in MJ;
$Q_{\text{prim;cool}}$ is the primary energy consumption for comfort cooling, determined according to chapter 10, in MJ;
$Q_{\text{prim;hum}}$ is the primary energy consumption for humidifying, determined according to chapter 11, in MJ;
$Q_{\text{prim;dhw}}$ is the primary energy consumption for domestic hot water, determined according to chapter 12, in MJ;
$Q_{\text{perf;tot;res;}i}$ is the yearly characteristic energy consumption, determined according to 5.3.1 of NEN 5128*, of the in the building situated residential building *i*, in MJ;
$Q_{\text{prim;pv}}$ is the decrease of the primary energy consumption due to photovoltaic solar energy, determined according to 5.3, in MJ;
$Q_{\text{prim;comp;cog}}$ is the decrease of the primary energy consumption for electricity due to (building bound) co-generation, determined according to appendix F, in MJ.

5.2.3.2 *Efficiency of power generation*

Take at the appropriate places for the efficiency of power generation, η_{el}, 39%, being the numerical value of the efficiency of power generation for the national public generation utilities, related to the higher combustion value, taking account of distribution losses.

NOTE
This value of the efficiency of power generation is a policy based choice at the instance of the Ministry of Housing, Physical Planning and Environment and the Ministry of Economic Affairs.

Take for building bound co-generation for the determination of the energetic value for the amount

* For the correct edition of this standard, see appendix A

to the public net delivered electricity the marginal efficiency related to the higher combustion value $\eta_{el;marg}$, 50%, being the marginal efficiency for separate power generation with new utilities, taking account of distribution losses.

NOTE
This value of the efficiency of power generation is a policy based choice at the instance of the Ministry of Housing, Physical Planning and Environment and the Ministry of Economic Affairs.

5.2.3.3 *Efficiency district heating*

Take for the efficiency of district heating, $\eta_{equiv;heat;dh}$ and $\eta_{equiv;dhw;dh}$, being the efficiency of heat generation related to the higher combustion value, taking account of distribution losses and accounting for the benefit of combined heat and power generation, reuse of waste, process integration or sustainable energy sources, from table 1.

Table 1: Equivalent efficiency for district heating $\eta_{equiv;heat;dh}$ and $\eta_{equiv;dhw;dh}$

Type of district heating	equivalent efficiency of district heating $\eta_{equiv;heat;dh}$	equivalent efficiency for the preparation of domestic hot water by district heating $\eta_{equiv;heat;dh}$
gasmotor	1,0	1,0
upgrading of heat with a heat pump	1,0	1,0
CCPP	1,1	1,0
industrial production process	1,1	1,0
waste combustion	1,1	1,0
where: CCPP is process heat resulting from power generation with a steam cycle (Combined-Cycle Power Plant)		

NOTES
1. The fixed imposed values in this table form a policy decided expression of energetic performances of these systems. These numerical values can be higher than 100%, because the real energy conservation lies in the simultaneous production of heat and power generation and this energy conservation is totally accounted for in the efficiency of heat generation, because of the lack of possibilities in energy performance standardization to value separately the efficiency of power generation. These values are imposed, because the real performance of these systems depends strongly on local conditions. The energy performance standardization is not the appropriate instrument to value this. There is a separate development called "district energy performance". Possibly "district energy performance" will in future take the place of the imposed values from table 1.

2. This values of the efficiency of district heating are a policy based choice at the instance of the Ministry of Housing, Physical Planning and Environment and the Ministry of Economic Affairs.

5.2.4 *Weighing factor for comfort cooling*

Determine the weighing factor which partly compensates for comfort cooling, f_{cool}, with:

$$f_{cool} = \frac{3 \text{ x } c_{cool}}{3 \text{ x } c_{cool} + \frac{A_{g;cool}}{A_{g;tot;heatz} + A_{g;res;heatz}}}$$

where:

$A_{g;cool}$ is the usable area of the part of the building that has comfort cooling, in m^2;
$A_{g;tot;heatz}$ is the sum of the usable areas of the heated zones according to 13.2, in m^2;
$A_{g;res;heatz}$ is the sum of the usable areas of the heated zones of the residential building parts in the whole building, in m^2;
c_{cool} the coefficient for comfort cooling.

NOTE
De value for c_{cool} is given in the Building Decree. The present value of c_{cool} in the Building Decree is effectively 12.

5.2.5 *Area of the loss envelope*

Determine the area of the loss envelope, A_{loss}, in m^2, of a building, excluding the area of the loss envelope of residential building parts, with:

$A_{loss} = d_1 * A_1 + d_2 * A_2 + ...$

where:

If $A_{loss} > 2{,}000$, then $A_{loss} = 2{,}000$

where:

$A_{1,2,..}$ are the projected areas of the individual separating constructions determined according to 4.2.2 of NEN 1068*, in m^2;
$d_{1,2,..}$ are the weighing factors of the individual separating constructions according to 5.2.6.

* For the correct edition of this standard, see appendix A

5.2.6 *Weighing factors for area of the loss envelope*

Take for the weighing factor d:

- for internal separating constructions at the border of the building-plot and for separating constructions that separate the heated zone from of an other heated zone or an adjoining heated space:
  $d = 0$;

- for constructions that separate the heated zone from outside air, water or adjoining unheated spaces:
  $d = 1$;

- for constructions that separate the heated zone from the ground or a crawlspace:
  $d = 0,7$.

5.3 Contribution of photovoltaic solar energy systems

5.3.1 *Principle*

In the case that (building bound) photovoltaic (PV) solar energy systems contribute to the electricity supply of a non-residential building, this contribution will be determined by the amount insolation multiplied by the conversion efficiency. The determination method can, apart from the determination of the yield per unit of insolation, be compared with the determination of the contribution of a solar boiler for domestic hot water preparation. The contribution of PV however is bound to a fixed maximum, as to express that the energy-conservation potential of a relatively large PV-system in general exceeds the elements of energy consumption this energy performance standard accounts for. Because the PV-system delivers electricity the calculated yield is divided by the usual efficiency of power generation (conversion to primary energy conservation).

5.3.2 *Calculation rule*

Determine the yearly contribution of (building bound) photovoltaic solar energy systems according to:

$$Q_{\mathrm{prim,pv}} = Q_{\mathrm{pv};1} + Q_{\mathrm{pv};2} + \ldots$$

Take for $Q_{\mathrm{prim;pv}}$ however as maximum the next value:

$$Q_{\mathrm{prim;pv;max}} = Q_{\mathrm{prim;vent}} + Q_{\mathrm{prim;li}} + Q_{\mathrm{prim;pump}}$$

in the appropriate cases enlarged with $Q_{\mathrm{prim;heat}}$, $Q_{\mathrm{prim;cool}}$, $Q_{\mathrm{prim;hum}}$ and $Q_{\mathrm{prim;dhw}}$ if operated by power,

where:

$Q_{\mathrm{prim;pv}}$	is the reduction of the primary energy consumption due to photovoltaic solar energy systems, in MJ;
$Q_{\mathrm{pv};i}$	is the contribution of the photovoltaic solar energy system *i*, in MJ, determined according to 5.3.3;
$Q_{\mathrm{prim;heat}}$	is the primary energy consumption for space heating, determined according to chapter 6, in MJ;
$Q_{\mathrm{prim;vent}}$	is the primary energy consumption for mechanical ventilation, determined according to chapter 7, in MJ;
$Q_{\mathrm{prim;li}}$	is the primary energy consumption for lighting, determined according to chapter 8, in MJ;
$Q_{\mathrm{prim;pump}}$	is the primary energy consumption for pumps, determined according to chapter 9, in MJ;
$Q_{\mathrm{prim;cool}}$	is the primary energy consumption for comfort cooling, determined according to chapter 10, in MJ;
$Q_{\mathrm{prim;hum}}$	is the primary energy consumption for humidifying, determined according to chapter 11, in MJ:
$Q_{\mathrm{prim;dhw}}$	is the primary energy consumption for domestic hot water preparation, determined according to chapter 12, in MJ.

5.3.3 *Contribution of photovoltaic solar energy systems*

Determine the yearly contribution of a (building bound) photovoltaic solar energy system *i* according to chapter 14 of NEN 5128*.
Contrary to this clause the contribution may also be determined as:

$$Q_{pv;i} = \frac{2800 * z_{pv,i} * A_{pv;i} * S_{pv,i} * 0,5}{(1000 * \eta_{el})}$$

where:

$Q_{pv;i}$ is the yearly contribution of the photovoltaic solar energy system *i*, in MJ;
$S_{pv;i}$ is the Watt-peak capacity per m^2 PV-panel, determined according to NEN 10904-1*, where for opaque panels can be taken:
- amorf: $S_{pv;i}$ = 40 Wp/m^2;
- cristallyne: $S_{pv;i}$ = 115 Wp/m^2;

$z_{pv;i}$ is the shading correction factor for the horizon of the relevant solar panels, taken from table 33;
$A_{pv;i}$ is the area of the relevant PV module or the PV modules, without bearing construction, in m^2;
i is the numerator of the relevant photovoltaic solar energy system;
η_{el} is the efficiency of power generation, taken from 5.2.3.2;
2800 is the yearly amount of solar radiation collected at the modules of system *i* in MJ per m^2;
0,5 is a reduction factor.

If another value for *S* is demonstrated, determined according to NEN 10904-1*, this value shall be rounded downwards to a multiple of 5 Wp/m^2.

NOTES
1 The PV-system is building bound if it is a part of the application for a building permit.
2 1000: The Watt-peak capacity of PV-panels is defined per 1000 W/m□ radiation at a certain frequency distribution and for perpendicular incidence, see C.8 of NEN 5128*.
3 The value of the reduction factor 0,5 incorporates: the in 14.2 of NEN 5128* given reduction factor of the relevant PV-panel, with as minimum value 0,67, an imposed value for a shading reduction factor and an extra correction factor for the influence of shading on the relevant PV-panels.

* For the correct edition of this standard, see appendix A

6 Energy consumption for heating

6.1 Principle

Determine the energy consumption for heating as the quotient of the heat demand and the heat generation efficiency, increased with the primary energy consumption for auxiliary energy of the heat generation appliances.
The heat demand consists of the sum of the transmission heat loss and the ventilation heat loss minus the utilized heat gain, divided by a factor that indicates the energy efficiency of distribution and temperature control.
The calculation consists of the following steps:

- the schematization as meant in chapter 13;
- determination of the energy consumption for heating per energy sector according to 6.3;
- addition of the energy consumption of the energy sectors according to 6.2.

6.2 Calculation rule

Determine the primary energy consumption for heating of the non-residential part of the building as the sum of the energy consumptions of the energy sectors, including the required auxiliary energy with:

$$Q_{\text{prim;heat}} = Q_{\text{aux}} + Q_{\text{heat;1}} + Q_{\text{heat;2}} + \ldots$$

where:

$Q_{\text{prim;heat}}$ is the primary energy consumption for heating the non-residential part of the building, in MJ;
Q_{aux} is the auxiliary energy consumption of the heat generation appliances as determined in 6.8.4, in MJ;
$Q_{\text{heat;1,2,...}}$ is the energy consumption for heating of energy sector 1,2,..., determined according to 6.3, in MJ.

6.3 Calculation method for energy consumption for heating per energy sector

6.3.1 *Principle*

Calculate per individual month the sum of (month averaged) transmission heat loss and ventilation heat loss. Deduct the usable heat gain of the internal heat and solar heat.
Determine then from the thus determined heat demand the need for primary energy consumption by charging the efficiency for heat generation and the energy efficiency of the distribution and temperature control of the indoor climate system.

6.3.2 *Calculation rules*

6.3.2.1 *Energy consumption for heating per year*

Determine the energy consumption for heating per year with:

$Q_{heat} = Q_{heat;m\,1} + Q_{heat;m\,2} + ... + Q_{heat;m\,12}$

where:

Q_{heat} is the energy consumption for heating per year, in MJ;
$Q_{heat;m\,1...12}$ is the energy consumption for heating in month 1 ... 12, determined according to 6.3.2.2, in MJ.

6.3.2.2 *Energy consumption for heating per month*

Determine the energy consumption for heating per month with:

$$Q_{heat;m} = \frac{Q_{dem;heat;m}}{\eta_{gen;heat}}$$

in which:

$Q_{heat;m}$ is the energy consumption for heating in the month, in MJ;
$Q_{dem;heat;m}$ is the heat demand in the month, determined according to 6.3.2.3, in MJ;
$\eta_{gen;heat}$ is the efficiency of heat generation, determined according to 6.8.

6.3.2.3 *Heat demand per month per energy sector*

Determine the heat demand per month per energy sector with:

$$Q_{dem;heat;m} = \frac{Q_{dem;heat;m;room}}{\eta_{sys;heat}}$$

in which:

$Q_{dem;heat;m}$ is the heat demand in the month, in MJ;
$Q_{dem;heat;m;room}$ is the heat demand in the month at room level, in MJ, determined according to 6.3.2.4;
$\eta_{sys;heat}$ is the distribution system efficiency for distribution of heat, determined according to 6.7.

6.3.2.4 *Heat demand per month at room level*

If the gain-loss ratio, determined according to 6.6.5.2, is larger than 2,5, or the inside temperature θ_i in EC, taken from table 2 is smaller than the outside temperature, θ_e, taken from table 3 in EC, then applies:

$Q_{dem;heat;m;room} = 0$

Determine in all the other cases the heat demand per month with:

$$Q_{dem;heat;m;room} = Q_{tr} + Q_{vent} - Q_{gain}$$

in which:

$Q_{dem;heat;m;room}$ is the heat demand in the month at room level, in MJ;

Q_{tr} is the transmission heat loss, determined according to 6.4, in MJ;
Q_{vent} is the ventilation heat loss, determined according to 6.5, in MJ;
Q_{gain} is the utilized heat gain, determined according to 6.6, in MJ.

Table 2: Imposed inside temperature θ_i for the determination of the heat demand

Building type	θ_i EC
sports building, moderate heated	13
office building educational building accommodation building cell and penitentiary building catering building shop building assembly building sports building health care building, not clinical	19
health care building, clinical	22

NOTE
Moderate heated sports buildings are:
- tennis halls;
- squash courts;
- indoor carting halls;
- maneges;
- velodromes;
- boulodromes (for the jeux the boulle);
- short courts;
- raquetball courts;
- boxing facilities;
- shooting facilities; and
- covered roll skating lots.

It must be demonstrated by the applicant that the capacity of the heating system of moderate heated sports buildings is clearly designed for this low temperatures.

6.4 Transmission heat loss (Q_{tr}) per energy sector per month

6.4.1 *Calculation rule*

Calculate the transmission heat loss of an energy sector per month with:

$$Q_{tr} = H_{tr} * (\theta_i - \theta_e) * 2{,}63$$

where:
Q_{tr} is the transmission heat loss in MJ;
H_{tr} is the transmission heat loss coefficient of an energy sector in W/K, determined according to 6.4.2;
θ_i is the inside temperature in EC, according to 13.3.3, taken from table 2;
θ_e is the outside temperature in EC, taken from table 3.

NOTE
The numeric value 2,63 is explained in appendix C.3

Month	Θ_e EC
January	1,7
February	2,0
March	5,0
April	8,5
May	12,4
June	15,5
July	17,0
August	16,8
September	14,3
October	10,0
November	5,9
December	3,0

Table 3: Outside temperature θ_e per month

6.4.2 *Transmission heat loss coefficient H_{tr}*

Internal separating constructions situated on the borders of building-plots and internal separating constructions that separate the considered energy sector of a heated zone or of an adjoining heated space must be neglected.

Determine for the remaining constructions the transmission heat loss coefficient H_{tr} with:

$$H_{tr} = a_1 * A_1 * U_1 + a_2 * A_2 * U_2 + ...$$

where:

H_{tr} is the transmission heat loss coefficient, in W/K;
$U_{1,2,...}$ are the thermal transmittances of the individual separating constructions, determined in accordance with 6.6.3 of NEN 5128*, in W/(m^2 AK);
$A_{1,2,...}$ are the areas of the projections of the individual separating constructions, determined according to 4.2.2 of NEN 1068*, in m^2 ;
$a_{1,2,...}$ are the weighing factors of the individual separating constructions of which the value has to be adopted from 6.4.3;

NOTES

1 The influence of thermal bridges on the transmission heat loss coefficient is not systematically accounted for. In several cases this can lead to a serious underestimation of the transmission heat loss coefficient. European standards are prepared to calculate the effect of linear thermal bridges. Thermal bridges which are integrated in the separating constructions have to be taken in account according to NEN 1068; geometric thermal bridges at the edge of the ground floor are implicitly accounted for in the weighing factor *a* for ground floors. In absence of standardised determination methods other linear thermal bridges are neglected like thermal bridges between window frame and wall, between facade parts, etc.. If linear thermal bridges will be added to the determination of the transmission heat loss coefficient, it means that the formula should be enlarged with the next term:

$+ \Psi_1 * l_1 + \Psi_2 * l_2 + ...$

where:

$\Psi_{1,2,...}$ are the linear thermal transmittances of linear thermal bridges, in W/(mAK);

$l_{1,2,...}$ are the lengths of the individual linear thermal bridges, in m.

2 It is expected that the relevant CEN standards for the determination of transmission heat losses will be incorporated in the determination of this transmission heat loss coefficient.

6.4.3 *Weighing factors a*

The value of the weighing factor *a* of the separating constructions is:

- For constructions separating the considered energy sector from the outside air or water:

  $a = 1$

- For constructions separating the considered energy sector from a space provided with ventilation openings that cannot be closed, with a capacity for the supply and exhaust, determined according to 5.3 of NEN 1087*, of at least $3 * 10^{-3}$ m^3/s per m^2 usable area (strongly ventilated spaces):

  $a = 1$

- For construction separating the considered energy sector from an unheated adjoining space, other than meant under the preceding dash:

  $a = 1$

  For these constructions *a* can also be determined according to:

$$a = \frac{1{,}5 \ x \ H_{\mathrm{tr;\,e}}}{(1{,}5 \ \mathrm{x} \ H_{\mathrm{tr;\,e}}) + H_{\mathrm{tr;\,i}}}$$

in which:

$$H_{tr;i} = A_{i;1} * U_{i;1} + A_{i;2} * U_{i;2} + ...$$

$$H_{tr;e} = A_{e;1} * U_{e;1} + A_{e;2} * U_{e;2} + ...$$

where:

$H_{tr;i}$ is the transmission heat loss coefficient of the relevant energy sector to the adjoining unheated space in W/K;
$H_{tr;e}$ is the transmission heat loss coefficient of the adjoining unheated space to the outside in W/K;
$A_{i;1,2,...}$ is the area of the projection of internal separating constructions 1, 2, ... that separates the considered energy sector from the adjoining unheated space in m^2, determined according to 4.2.2 of NEN 1068*;
$U_{i;1,2,...}$ is the thermal transmittance of internal separating construction 1, 2, ... that separates the considered energy sector from the adjoining unheated space in W/(m^2 AK), determined in accordance with 6.6.3 of NEN 5128*;
$A_{e;1,2,...}$ is the area of the projection of construction 1, 2, ... that separates the adjoining unheated space from the outside air or water in m^2, determined according to 4.2.2 of NEN 1068*;
$U_{e;1,2,...}$ is the thermal transmittance of external separating construction 1, 2, .. that separates the adjoining unheated space from the outside air or water in W/(m^2 AK), determined in accordance with 6.6.3 of NEN 5128*.

NOTES
1. The above formula is derived from appendix B and this appendix gives also a not-standardized method for the determination of *a* for an adjoining space with insolation, whether or not ventilated by inside air.
2. Adjoining unheated spaces are defined in 3.1.1.
3. Linear thermal bridges: see the note in 6.4.2.

- For constructions separating the considered energy sector from the ground or a crawl space:

$$a = \frac{1}{U + 1}$$

4 where:

U is thermal transmittance of the considered separating construction in W/(m^2 AK), determined according to 5.3.3 of NEN 1068*.

NOTE
The formula given is based on transmission heat losses of floors of dwellings in which the effect of thermal bridges at edges is incorporated. For larger floor areas this can lead to overestimation of heat losses. Contrary to the calculation rules indicated here the heat losses via the ground can also be calculated according to NEN-EN 13370, Thermal performance of buildings - Heat transfer via the ground - Calculation methods.

6.5 Ventilation heat loss (Q_{vent}) per energy sector per month

6.5.1 *Calculation rule*

Calculate the ventilation heat loss per month with:

$Q_{vent} = H_{vent} * (\theta_i - \theta_e) * 2,63$

in which:

$H_{vent} = 1,2 * u_{v;heat} * A_{g;sec}$

where:

Q_{vent} is the ventilation heat loss in MJ;
H_{vent} is the ventilation heat loss coefficient of the energy sector W/K;
θ_i is the inside temperature in EC, according to 13.3.3, taken from table 2;
θ_e is the outside temperature in EC, taken from table 3;
$u_{v;heat}$ is the specific air flow of direct entering fresh outside air to be heated in liter /(s*m^2), determined according to 6.5.2;
$A_{g;sec}$ is the usable area of the energy sector in m^2.

NOTES
1. If ventilation air is (partially) supplied by a conservatory/greenhouse or an atrium, it is allowed for that part to multiply H_{vent} with the weigh factor a according to appendix B.

2. 1,2 = ρ_l H c_l,
   where:
   ρ_l is the density of air in kg/liter (= 0,0012 kg/liter);
   c_l is the similar heat of air in J/(kg*K) (= 1000 J/(kg*K)).
3. The numerical value 2,63 is explained in appendix C.3

* For the correct edition of this standard, see appendix A

In case of loading cold in the ground by means of air conditioning units the ventilation heat loss may also be determined according to appendix D.

6.5.2 *Determination of the specific air flow to be heated* ($u_{v,heat}$)

6.5.2.1 *Calculation rule*

Determine the specific air flow of air to be heated with:

$$u_{v;heat} = u_{v;inf} + f_{vent;sec} * ((1 - \eta_{hr}) * u_{v;m;e} + u_{v;n})$$

where:

$u_{v;heat}$ is the specific air flow of direct entering fresh outside air to be heated in liter /(s∗m^2);
$u_{v;inf}$ is the computation value for the specific air flow resulting from infiltration, taken from table 4, in liter /(s∗m^2);
$f_{vent;sec}$ is the usable area weighed time fraction in which the ventilation is operational, determined according to 6.5.2.2;
η_{hr} is the efficiency of the applied heat recovery appliances, taken from table 6 or determined according to 5.3 of NEN 5138;
$u_{v;m;e}$ is the specific air flow of direct entering fresh outside air to be heated resulting from mechanical ventilation during operation time, determined according to 6.5.3, in liter/(s∗m^2);
$u_{v;n}$ is the specific air flow of direct entering fresh outside air to be heated resulting from natural ventilation during operation time, determined according to 6.5.3, in liter/(s∗m^2).

When different mechanical ventilation systems with various forms of heat recovery are applied, the efficiency of every individual heat recovery η_{hr} and the air flow $u_{v;m;e}$ of every individual system should be taken to calculate (1 - η_{hr}) x $u_{v;m;e}$, after which they should be added up.

Contrary to this provision the determination of the specific air flow of air to be heated can for loading cold by air conditioning also be determined according to appendix D.

Table 4: Computation value for the specific air flow per m□ usable area through infiltration $u_{v;inf}$ depending on air permeability of the external separating constructions per m□ usable area and the building height h

$q_{v;10;char} / A_{g;sec}$ liter/(s*m^2)	$u_{v;inf}$ liter/(s*m^2)		
	Building height h m		
	0 to 10	from 10 up to and including 20	higher than 20
less than 0,20	0,03	0,05	0,09
from 0,20 to 0,40	0,07	0,10	0,18
from 0,40 to 0,60	0,11	0,16	0,30
from 0,60 to 0,80	0,15	0,22	0,42
from 0,80 to 1,00	0,20	0,29	0,54
equal to or larger than 1,0	0,26	0,38	0,72
unknown	0,50	0,75	1,35

where:

$q_{v;10;char}$ is the air permeability of the energy sector, defined as the characteristic air flow, determined according to chapter 5 of NEN 2686*;

$A_{g;sec}$ is the usable area of the energy sector, in m^2 .

* For the correct edition of this standard, see appendix A

For the determination of the specific air flow for infiltration in an energy sector the building height *h* should be determined as the height of the highest floor in or above the relevant energy sector, on which a staying area is situated, above land level, see figure 4.
Round the thus determined height downwards to metres.

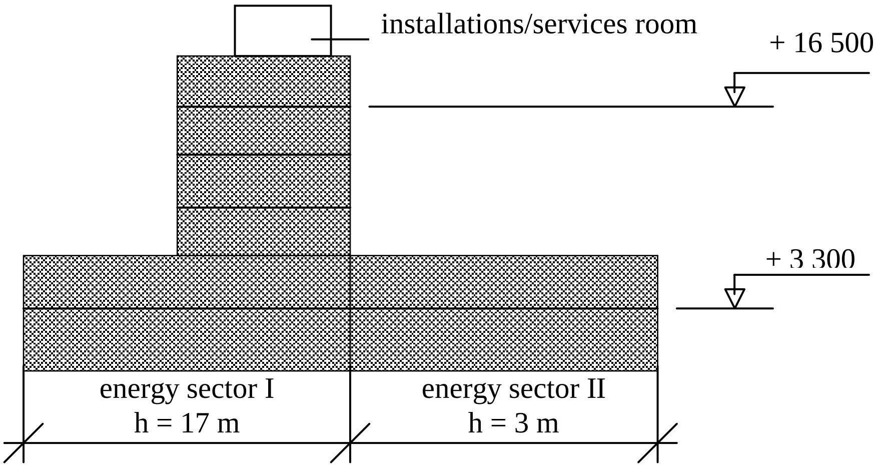


Figure 4: Determination building height *h* for the computation value for infiltration

Table 5: The fraction of the time f_{vent} that ventilation is operational

Building type	The fraction of the time that ventilation is operational f_{vent}
office building health care building, not clinical educational building sports building assembly building catering building shop building	0,30
accommodation building cell and penitentiary building health care building, clinical	0,80

Table 6: Efficiency of heat recovery η_{hr}

Heat recovery system	η_{hr}
no heat recovery	0,00
heat exchange plates or pipes	0,65
two-elements-system	0,60
loading cold with air-conditioning	0,40
heat-pipes	0,60
slowly rotating or intermittent heat exchangers	0,70

In case of series connection of heat recovery units the highest efficiency of the applied heat recovery appliances from table 6 may be taken.

When contrary to this provision an other value for η_{hr} is demonstrated, this value shall be rounded downwards to a multiple of 0,05.

NOTE
The value mentioned for loading cold by air conditioning is a conservative value. Contrary to this value the benefit of loading cold can also be determined according to appendix D.

6.5.2.2 *The time fraction of operation of ventilation per energy sector*

Determine per energy sector the usable area weighed average time fraction that the ventilation is operational with:

$$f_{vent;sec} = (f_{vent;1} * A_{g;1} + f_{vent;2} * A_{g;2} + ...) / A_{g;sec}$$

where:

$f_{vent;sec}$ is the usable area weighed average time fraction that the ventilation is operational in the energy sector;
$f_{vent;1,2,..}$ is the time fraction that the ventilation is operational for building type 1,2,.., taken from table 5;
$A_{g;1,2,..}$ is the usable area of the part of building type 1,2,.. in the energy sector, in m^2;
$A_{g;sec}$ is the usable area of the energy sector, in m^2.

6.5.3 *Determination $u_{v;m;e}$ and $u_{v;n}$*

6.5.3.1 *Principle*

The specific air flows due to mechanical ventilation ($u_{v;m;e}$) and natural ventilation ($u_{v;n}$) of direct entering fresh outside air to be heated depends on the way the staying areas in the considered energy sectors fresh outside air is supplied to. Starting point is a minimum average air flow of direct entering fresh outside air is required. In case of only natural ventilation this minimum should be taken. In case of (partly) mechanical ventilation a flow has to be taken belonging to the class (according to table 7) of the air flow of the considered energy sector eventually corrected for the influence of flow reduction control to reduce the amount of fresh air. This class depends on the maximum air flow capacity of the mechanical ventilation system.
In an energy sector with only natural ventilation $u_{v;m;e}$ and $u_{v;n}$ should be determined according to 6.5.3.2. In an energy sector in which mechanical ventilation occurs whether or not in combination with natural ventilation $u_{v;m;e}$ and $u_{v;n}$ should be determined according to 6.5.3.3.

NOTE
For long lasting compliance with the energy performance requirements in the Building Decree properties of installation appliances or systems, that can be replaced during lifetime, are placed in classes. By placing the air flows that are deduced from the fan capacity in classes, for example fans can be replaced new fans with a slightly larger or smaller capacity, without resulting in an other EPC.

6.5.3.2 *Only natural ventilation*

In an energy sector with only natural ventilation the following applies for $u_{v;m;e}$ and $u_{v;n}$:

$$u_{v;m;e} = 0$$
$$u_{v;n} = u_{v;min}$$

where:

$u_{v;m;e}$ is the specific air flow of direct entering fresh outside air due to mechanical ventilation, in liter/(s* m^2);
$u_{v;n}$ is the specific air flow of direct entering fresh outside air due to natural ventilation, in liter/(s* m^2);
$u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s* m^2).

6.5.3.3 *Mechanical ventilation or a combination of mechanical and natural ventilation*

In the case of facilities for mechanical ventilation in the considered energy sector, the specific air flows should be determined as follows:

Share natural ventilation ($u_{v;n}$)

- If $u_{v;m}$ is smaller than $u_{v;min}$ the following applies for $u_{v;n}$:

  $$u_{v;n} = u_{v;min} - u_{v;m}$$

  where:

$u_{v;n}$ is the specific air flow of direct entering fresh outside air due to natural ventilation, in liter/(s∗m^2);
$u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s∗m^2);
$u_{v;m}$ is the computation value of the specific air flow of direct entering fresh outside air due to mechanical ventilation belonging to the class of the specific air flow by mechanical ventilation, determined according to 6.5.3.4, in liter/(s∗ m^2).

- If $u_{v;m}$ is larger or equal to $u_{v;min}$, the following applies:

  $u_{v;n} = 0$

Share mechanical ventilation ($u_{v;m;e}$)

Determine $u_{v;m;e}$ as follows:

- If $u_{v;min}$, determined according to 6.5.3.5., is smaller or equal to ($f_{cntrl;vent}$ * $u_{v;m}$) :

  $u_{v;m;e} = f_{cntrl;vent} * u_{v;m}$

  where:

  $u_{v;m;e}$ is the specific air flow of direct entering fresh outside air due to mechanical ventilation, in liter/(s∗m^2);
  $f_{cntrl;vent}$ is the weighing factor for control facilities for reduction of the supply of fresh air, as determined in 6.5.3.7;
  $u_{v;m}$ is the computation value of the specific air flow of direct entering fresh outside air due to mechanical ventilation belonging to the class of the specific air flow by mechanical ventilation, determined according to 6.5.3.4, in liter/(s∗m^2).

- If $u_{v;min}$, determined according to 6.5.3.5, is larger than or equal to ($f_{cntrl;vent}$ H $u_{v;m}$) and $u_{v;m}$ is larger than or equal to $u_{v;min}$:

  $u_{v;m;e} = u_{v;min}$

  where:

  $u_{v;m;e}$ is the specific air flow of direct entering fresh outside air due to mechanical ventilation, in liter/(s∗m^2);
  $f_{cntrl;vent}$ is the weighing factor for control facilities for reduction of the supply of fresh air, as determined in 6.5.3.7;
  $u_{v;m}$ is the computation value of the specific air flow of direct entering fresh outside air due to mechanical ventilation belonging to the class of the specific air flow by mechanical ventilation, determined according to 6.5.3.4, in liter/(s∗m^2);

  $u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s∗m^2).

- If $u_{v;min}$, determined according to 6.5.3.5, is larger than or equal to ($f_{cntrl;vent}$ H $u_{v;m}$) and $u_{v;m}$ is smaller than $u_{v;min}$:

  $u_{v;m;e} = u_{v;m}$

  where:

  $u_{v;m;e}$ is the specific air flow of direct entering fresh outside air due to mechanical ventilation, in liter/(s*m^2);
  $f_{cntrl;vent}$ is the weighing factor for control facilities for reduction of the supply of fresh air, as determined in 6.5.3.7;
  $u_{v;m}$ is the computation value of the specific air flow of direct entering fresh outside air due to mechanical ventilation belonging to the class of the specific air flow by mechanical ventilation, determined according to 6.5.3.4, in liter/(s*m^2);
  $u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s*m^2).

6.5.3.4 *Computation values of the specific air flow due to mechanical ventilation (*$u_{v;m}$)

In case of systems with natural supply and mechanical exhaust the following applies:

$u_{v;m} = u_{v;min}$

where:

$u_{v;m}$ is the computation value for the specific air flow due to mechanical ventilation, in liter/(s*m^2);
$u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s*m^2).

Take in all other cases of mechanical ventilation the value for the specific air flow, $u_{v;m}$, from the class in table 7, into which $u_{v;m;max}$, determined according to 6.5.3.6, falls.

Table 7: Classification maximum air flow due to mechanical ventilation, $u_{v;m;max}$

$u_{v;m;max}$ liter/(s∗m²)	$u_{v;m}$ liter/(s∗m²)	$u_{v;m;max}$ liter/(s∗m²)	$u_{v;m}$ liter/(s∗m²)
from 0,0 to 0,2	0	from 3,2 to 3,6	3,4
from 0,2 to 0,4	0,3	from 3,6 to 4,0	3,8
from 0,4 to 0,6	0,5	from 4,0 to 4,5	4,2
from 0,6 to 0,8	0,7	from 4,5 to 5,1	4,8
from 0,8 to 1,2	1,0	from 5,1 to 5,7	5,4
from 1,2 to 1,6	1,4	from 5,7 to 6,4	6,0
from 1,6 to 2,0	1,8	from 6,4 to 7,2	6,8
from 2,0 to 2,4	2,2	from 7,2 to 8,0	7,6
from 2,4 to 2,8	2,6	from 8,0 to 8,8	8,4
from 2,8 to 3,2	3,0	from 8,8 to 9,6	9,2
		9,6 and more	10

6.5.3.5 *Minimum specific air flow* $u_{v;min}$

Determine the minimum specific air flow of direct entering fresh outside air to be heated for the considered energy sector with:

$$u_{v;min} = \frac{q_{v;min}}{A_g}$$

where:

$u_{v;min}$ is the minimum for the specific air flow of direct entering fresh outside air, determined according to 6.5.3.5, in liter/(s∗m²);

$q_{v;min}$ is the required minimum air flow of direct entering fresh outside air in the energy sector, in liter/s;

A_g is the usable area of the energy sector, in m².

NOTE
The required minimum air flow is the ventilation capacity for staying areas prescribed in the Building Decree depending on the building type and (in several cases) on occupancy density.

6.5.3.6 *Maximum specific air flow due to mechanical ventilation*

Determine the maximum specific air flow due to mechanical supply or balanced ventilation with:

$$u_{v;m;max} = \frac{q_{v;m;max}}{A_{g;sec;1,2,...}}$$

where:

$u_{v;m;max}$ is the maximum specific air flow due to mechanical ventilation, in liter/(s∗m²);

$q_{v;m;max}$ is the maximum supply capacity of the mechanical ventilation system as far as serving ventilation flows within the energy sectors simultaneously, in liter/s, determined according to 5.1 of NEN 1087*;

$A_{g;sec;1,2,...}$ is the usable area of the energy sector 1,2,..., in m^2.

NOTE
In case the specifications about the capacity of the mechanical ventilation system are not available yet, a safe value should be used within which the definite capacity can be realized.

6.5.3.7 *Factor for the reduction control of the supply of fresh air*

Account for control facilities to reduce the amount of direct entering fresh outside air in case of mechanical supply systems by:

- In case of facilities to mix direct entering fresh outside air with recirculation air, in the case that at least 20% of the exhaust air can be recirculated or in the case of flow control reducing the air flow by the central air conditioning installation by flow control to 80% of the maximum capacity or less, as determined in 6.5.3.6, the following applies:

  $f_{cntrl;vent}$ = 0,8

- In case of facilities to mix direct entering fresh outside air with recirculation air, in the case that at least 40% of the exhaust air can be recirculated or in the case of flow control reducing the air flow by the central air conditioning installation to 60% of the maximum capacity or less, as determined in 6.5.3.6, the following applies:

  $f_{cntrl;vent}$ = 0,6

- In case of facilities to mix direct entering fresh outside air with recirculation air, in the case that at least 60% of the exhaust air can be recirculated or in the case of flow control reducing the air flow by the central air conditioning installation to 40% of the maximum capacity or less, as determined in 6.5.3.6, the following applies:

  $f_{cntrl;vent}$ = 0,4

- In all the other cases applies:

  $f_{cntrl;vent}$ = 1.

NOTE
$f_{cntrl;vent}$ values reduction control of the amount of direct entering fresh outside air when this takes place in usual operation during usual operation times.

6.6 **Heat gain per energy sector per month**

6.6.1 *Principle*

Heat gain results from a contribution from internal heat sources Q_i in the building, consisting of

* For the correct edition of this standard, see appendix A

persons, lighting, fans and the remaining appliances, and a contribution from solar heat Q_{sun}. As these contributions cannot be totally subtracted from the heat demand of an energy sector, they are multiplied by an utilisation factor $\eta_{b;heat}$.

6.6.2 *Calculation rule*

Determine the utilized heat gain per energy sector per month according to:

$$Q_{gain} = (Q_i + Q_{sun}) * \eta_{b;heat}$$

where:

Q_{gain} is the utilized heat gain, in MJ;
Q_i is the internal heat production, determined according to 6.6.3, in MJ;
Q_{sun} is the solar heat gain, determined according to 6.6.4, in MJ;
$\eta_{b;heat}$ is the utilisation factor for heat gain, determined according to 6.6.5.

6.6.3 *Internal heat production Q_i*

6.6.3.1 *Calculation rules*

Determine the internal heat production per energy sector per month according to:

$$Q_i = ((q_{i;pers} * f_{vent;sec} + q_{i;app}) * A_g * 2{,}63 + Q_{i;li} + Q_{i;vent}) * a$$

where:

Q_i is the internal heat production in MJ;
$q_{i;pers}$ is the specific internal heat production in the considered energy sector by persons in W/m2, taken from table 8;
$f_{vent;sec}$ is the usable area weighed time fraction that the ventilation is operational in the energy sector, determined according to 6.5.2.2;
$Q_{i;li}$ is the internal heat production in the considered energy sector through lighting in MJ, determined according to 6.6.3.2;
$Q_{i;vent}$ is the internal heat production in the considered energy sector by fans in MJ, determined according to 6.6.3.3;
$q_{i;app}$ is the specific internal heat production in the considered energy sector by the average capacity of other appliances in W/m□, taken from table 9;
a is an auxiliary factor for which the next values should be taken:
- for the calculation of the heating energy: 0,8;
- for the calculation of the cooling energy: 1;

A_g is the usable area of the considered energy sector in m^2.

NOTE
The numerical value 2,63 is explained in appendix C.3

Table 8: Internal heat load by persons $q_{i;pers}$

class of occupation density	$q_{i;pers}$ W/ m^2

I	15
II	10
III	5
IV	3
V	2

NOTE
The numerical values are explained in C.5.

Table 9: Internal heat load of appliances $q_{i;app}$

Building type	Internal heat load of appliances $q_{i;app}$ W/ m^2
office building	3
health care building, not clinical	3
educational building	1
health care building, clinical	4
catering building	3
shop building	3
assembly building	1
accommodation building	2
cell and penitentiary building	2
sports building	1

NOTE
The numerical values are explained in C.5.

6.6.3.2 *Specific internal heat production through lighting*

Determine the internal heat production by lighting per month per energy sector with:

$Q_{i;li} = f_{i;li} * Q_{prim;li;sec} * \eta_{el} / 12$

where:

$Q_{i;li}$ is the internal heat production by lighting in MJ per month;
$f_{i;li}$ is a reduction factor for which has to be taken:

- 0,3 when the energy consumption for lighting is determined according to 8.2 (agreed values for specific energy consumption);
- 0,5 when at least 70% of the lighting appliances, weighed for the installed capacity, are exhausted;
- 1,0 in all other cases;

$Q_{prim;li;sec}$ is the primary energy consumption for lighting per energy sector in MJ, determined according to 8.2 or 8.3;
η_{el} is the efficiency of power generation, taken from 5.2.3.2.

6.6.3.3 *Specific internal heat production by fans*

Determine the internal heat production by fans per month per energy sector with:

$$Q_{i;vent} = f_{i;vent} * Q_{prim;vent} * \eta_{el} / 12$$

where:

$Q_{i;vent}$ is the internal heat production by fans in MJ per month;
$f_{i;vent}$ is a reduction factor for which has to be taken:
- 0 when only mechanical exhaust occurs;
- 0,6 when mechanical supply and exhaust occur;
- 0,8 when recirculation or heat recovery occurs;
- 0,3 when mechanical air is supplied and the capacity of fans is determined according to 7.3.2 (agreed values);
- 0,5 in other cases;

$Q_{prim;vent}$ is the primary energy consumption for fans per energy sector in MJ, determined according to 7.2;
η_{el} is the efficiency of the power generation, taken from 5.2.3.2.

6.6.4 *Solar heat gain Q_{sun}*

6.6.4.1 *Calculation rule*

Determine the solar heat gain per energy sector per month as the sum of the solar heat gain through transparent constructions which are part of the external separation constructions and the solar heat gain through solar collectors, excluding solar collectors for domestic hot water, with:

$$Q_{sun} = Q_{sun;t} + Q_{sun;ses}$$

where:

Q_{sun} is the solar heat gain, in MJ;
$Q_{sun;t}$ is the solar heat gain through transparent construction parts of the external separating constructions of the energy sector, determined according to 6.6.4.2, in MJ;
$Q_{sun;ses}$ is the solar heat gain through solar energy systems, determined according to 6.6.4.3, in MJ.

6.6.4.2 *Solar heat gain through transparent construction parts of the external separation constructions, $Q_{sun;t}$*

Determine the solar heat gain per energy sector per month through transparent construction parts of the external separating constructions as follows:

$$Q_{sun;t} = q_{sun;1} * r_1 * f_{sun;1} * g_1 * A_{r;1} * 0{,}75 + \\ + q_{sun;2} * r_2 * f_{sun;2} * g_2 * A_{r;2} * 0{,}75 + ...$$

where:

$Q_{sun;t}$	is the solar heat gain through transparent constructions, in MJ;
$q_{sun;1,2,...}$	is the quantity of solar radiation on the planes in MJ/m2, taken from table 10;
$r_{1,2,...}$	is the shading correction factor, determined according to 6.6.4.4;
$f_{sun;1,2,...}$	is the reduction factor for moveable solar protection, taken from table 11;
$g_{1,2,...}$	is the total solar energy transmittance, adopted from 6.9.3 of NEN 5128*;
$A_{r;1,2,...}$	are the window areas 1,2,.. in m□ including frame, that are formed by the smallest plane that links the edge frames of the window.

NOTE
0,75 is the computation value for the frame factor.

Table 10: Gross-heat gain q_{sun} in MJ/m^2 through solar radiation per month, depending on the orientation

	q_{sun} MJ/ m^2								
Month	Vertical								Hori-zontal
	South	South-east	East	North-east	North	North-west	West	South-west	
January	41	40	39	39	39	39	39	41	43
February	143	105	58	48	48	49	73	126	117
March	265	199	130	93	89	100	167	243	254
April	307	256	194	139	123	161	244	305	373
May	309	302	275	213	184	269	353	355	503
June	315	319	297	236	229	343	417	381	574
July	290	285	261	209	192	277	348	339	504
August	366	349	287	196	161	238	334	374	489
September	273	212	153	110	107	162	248	294	295
October	203	152	87	65	64	66	104	175	166
November	73	58	36	33	33	33	40	64	63
December	22	22	22	22	22	22	22	22	35

* For the correct edition of this standard, see appendix A

NOTE
During the months January - April and October - December the monthly amount of insulation is corrected for a fixed obstruction of 20E above the horizon as to relate as much as possible to the figures in NEN 5128* which are also corrected for an obstruction of 20E.

For interjacent orientations the value belonging to the nearest orientation has to be chosen; if the orientation is exactly in the middle between two orientations indicated in the table the highest adjacent value can be chosen.
At an average elevation smaller than 45E take the value for a horizontal plane. At an average elevation between 45E and 180E take the value for a vertical plane (see figure 5).

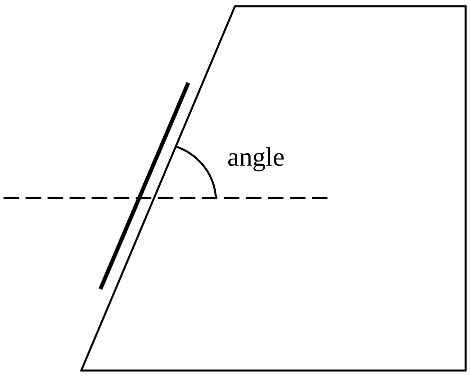


Figure 5: Elevation angle

Table 11: Reduction factor f_{sun} for moveable solar protection devices

Shading system	f_{sun} heating season okt. up to and including dec. jan. up to and including April	f_{sun} summer May up to and including Septem-ber
external solar protection, user-moveable	0,5	0,5
external solar protection with automatic control	0,5	0,35
all other cases	1	1

6.6.4.3 *Solar heat gain through solar collectors for space heating* (Q_{ses})

Calculate the solar heat gain through solar energy systems for space heating per energy sector per month with:

$Q_{ses} = 0,5 * q_{sun;hor} * A_{ses}$

where:

Q_{ses} is the solar heat gain due to solar energy systems for space heating in MJ;
$q_{sun;hor}$ is the amount of solar radiation on a horizontal plane in MJ/m^2, taken from table 10;
A_{ses} is the area in m^2 of the collector.

NOTES
1 0,5 is the computation value for the average collector efficiency.
2 In this standard for non-residential buildings solar systems for space heating are dealed with in a largely simplified manner. Such systems are hardly applies in the Netherlands en if applied mostly in the form of air solar collectors, that deliver the heat at the same moment as the other solar gains.

6.6.4.4 *Shading correction factor (r)*

The shading reduction factor has to be determined according to 6.10 of NEN 5128*.
Contrary to this the shading correction factor also can be determined according to 6.3.1 of NEN 1068*.

For windows with an average elevation between the smallest plane that connects the window edges and the adjacent floor within the building larger than 90E, an imaginary extra overhang width should be taken as large as the horizontal distance between the upper side and the bottom of the window (see figure 6).

NOTE
For instance overhanging facades.

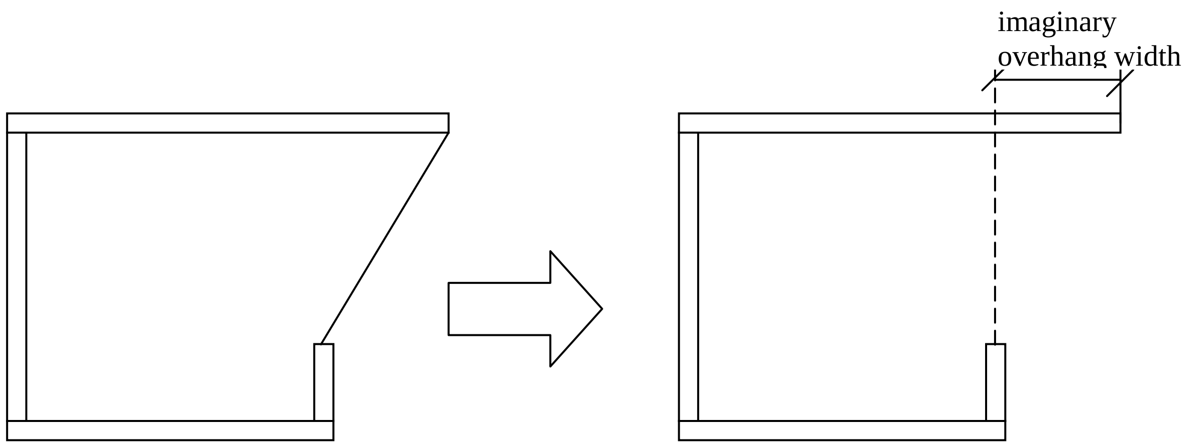


Figure 6: Angle between window and adjacent floor

6.6.5 *Utilisation factor for heat gain* ($\eta_{\mathrm{b;heat}}$)

6.6.5.1 *Principle*

The utilisation factor for heat gains is determined per month on basis of the internal thermal inertia and the gain-loss ratio.

6.6.5.2 *Calculation rule*

Calculate the utilisation factor per month with:

$$\eta_{\mathrm{b};heat} = \frac{1-\gamma^{a}}{1-\gamma^{a+1}}, \; at \;\gamma \neq 1$$

$$\eta_{\mathrm{b};heat} = \frac{a}{a+1}, \; at \;\gamma = 1$$

* For the correct edition of this standard, see appendix A

in which:

$$\gamma = \frac{Q_\mathrm{i} + Q_\mathrm{sun}}{Q_\mathrm{tr} + Q_\mathrm{vent}}$$

and $a = c_1 + c_2 * \tau$

where:

γ is the gain-loss ratio;
Q_i is the internal heat production, determined according to 6.6.3, in MJ;
Q_sun is the solar heat gain, determined according to 6.6.4, in MJ;
Q_tr is the transmission heat loss, determined according to 6.4, in MJ;
Q_vent is the ventilation heat loss, determined according to 6.5, in MJ;
a is an auxiliary variable;
c_1 is the constant, taken from table 12;
c_2 is the constant, taken from table 12, in h^{-1};
τ is the time constant in h, determined according to 6.6.5.3.

NOTE
The utilisation factor indicates the capability of the building of utilizing the solar heat and the internal heat in such way that this will lead to a reduction of the heat demand which without these sources would have to be supplied by the heating installation.

If more than one building types with various values for c_1 respectively c_2, occur within a single energy sector, than the values belonging to the lowest value for c_1 should be adopted.

Table 12: Factors c_1 and c_2 for the determination of the utilisation factor of the heat gain.

Building type	c_1	c_2 h^{-1}
office building educational building health care building, not clinical catering building shop building accommodation building cell and penitentiary building	0,81	0,013
health care building, clinical	1,46	0,018
assembly building sports building	0,56	0,015

6.6.5.3 *Time constant τ, heat demand calculation*

Determine the time constant with:

$$\tau = \frac{3,6 \ x \ C}{H_{\mathrm{tr}} + H_{\mathrm{vent}}}$$

where:

- τ is the time constant, in h;
- C is the effective thermal capacity, determined according to 6.6.6, in kJ/K;
- H_{tr} is the transmission heat loss coefficient of an energy sector, determined according to 6.4.2, in W/K;
- H_{vent} is the ventilation heat loss coefficient of an energy sector, determined according to 6.5, in W/K.

NOTE
3,6: dividing the effective thermal mass by 3,6, converts the units from kJ to Wh.

6.6.6 *Effective thermal capacity*

6.6.6.1 *Principle*

The effective thermal capacity has to be determined according to 6.6.6.2, based upon the specific thermal capacity per m^2 usable area of the energy sector, unless it can be demonstrated that a calculation according to 6.6.6.3 will result in a higher value.

6.6.6.2 *Effective thermal capacity based upon floor mass*

Determine the mass of the floor construction per m□ usable area of the energy sector by the construction volumes and the average density of the materials which are indicated in the application of the building permit.

Determine the effective thermal capacity based upon the floor mass with:

$$C = D * A_{\mathrm{g;sec}}$$

where:

- C is the effective thermal capacity of an energy sector, in kJ/K;
- D is the specific effective thermal capacity, in kJ/(m^2AK), in the case that at least 15% of the area of a free hanging ceiling in the staying area is open and these openings are evenly distributed, taken from the second column of table 13 (no - or open ceilings)and in all other cases taken from the first column of table 13 (closed ceiling),
- $A_{\mathrm{g;sec}}$ is the usable area of the energy sector, in m^2.

Table 13: Specific effective thermal capacity *D* per m^2 usable area of the energy sector

Mass of the floor construction per m□ usable area of the energy sector kg/ m^2	*D* kJ/(m^2∗K)	
	Closed ceiling	no - or open ceiling
less than 100	55	55
from 100 up to and including 400	110	180
more than 400	180	360

6.6.6.3 *Effective thermal capacity based upon a calculation*

Calculate the effective thermal capacity of an energy sector as the sum of the effective mass of all construction parts in an energy sector or enclosing an energy sector, provided that the constructions within a staying area, not being structural or enclosing (see note 3), should be excluded, according to:

$$C = \frac{\rho_1 \times c_1 \times d_1 \times A_1 + \rho_2 \times c_2 \times d_2 \times A_2 + ...}{1000}$$

where:

C is the effective thermal capacity of the energy sector in kJ/K;
$c_{1,2,...}$ is the specific heat of the materials in construction component 1,2,... in J/(kg∗K);
$d_{1,2,...}$ is the effective thickness of the materials, in m, determined as the thickness of the construction component as far as the heat resistance of the construction component seen perpendicularly from the inner surface amounts less than 0,25 (m^2∗K)/W, provided that *d* does neither amount more than 100 mm nor more than half of the total thickness of the construction and that for the determination of the heat resistance of the construction component, seen from the inner surface, for free hanging ceiling constructions, of which at least 15% of the ceiling is open, this ceiling may be ignored;
$\rho_{1,2,...}$ is the voluminous mass of the materials in kg/m^3;
$A_{1,2,...}$ are the areas in m^2 of construction parts within the energy sector or enclosing the energy sector, provided that the construction parts in a staying area, not being bearing or enclosing constructions, like a non-bearing internal partition wall, are ignored.

NOTES
1. Only uncovered construction components of stone like materials substantially contribute to the effective thermal capacity.
2. For internal separating constructions, like walls and floors, the active mass is determined for two sides
3. Internal walls which are no part of the building permit defined building construction are not taken into account for calculation of the thermal capacity.
4. 1000 is the numerical value for the conversion of J to kJ.

6.7 Efficiency of distribution of heat and cold per energy sector

6.7.1 *Principle*

The efficiency for the distribution of heat and cold is a measure for the waste of energy because of simultaneous heating and cooling in an energy sector and the not usable heat and cold losses from ducts and pipes within an energy sector.

6.7.2 *Calculation rule*

Determine for all indoor climate control systems the efficiency for heat distribution, $\eta_{sys;heat}$, based upon a waste factor and the proportion of heat demand to cold demand with:

$$\eta_{sys;heat} = \frac{1{,}0}{1{,}0 + a_{heat} + f_{waste} / f_{dem;heat}}$$

Determine for all systems with cooling the system efficiency for cold distribution, $\eta_{sys;cool}$, based upon a waste factor and the proportion of the heat demand to the cold demand with:

$$\eta_{sys;cool} = \frac{1{,}0}{1{,}0 + a_{cool} + f_{waste} / f_{dem;cool}}$$

in which:

f_{waste}	is the factor for waste of energy because of simultaneous cooling and heating, taken from table 14;
$f_{dem;heat}$	is the fraction of the heat demand with regard to the total demand of heat and cold, determined according to 6.7.3.2;
$f_{dem;cool}$	is the fraction of the cold demand with regard to the total demand of heat and cold, determined according to 6.7.3.1;
a_{heat}	is the factor for the pipe losses, duct losses and temperature control of the distribution system for heating, taken from table 14;
a_{cool}	is the factor for the pipe losses, duct losses and temperature control of the distribution system for comfort cooling, taken from table 14.

Round the thus determined system efficiency downwards to two decimal places.

For systems that create the required air supply temperature by mixing a heated and cooled air flow the following applies:

f_{waste} = 0,4
a_{heat} = 0
a_{cool} = 0

For local systems the following applies:
f_{waste} = 0
a_{heat} = 0
a_{cool} = 0

NOTE
Electrical heating in an energy sector which is not cooled, may be considered as a local system even if it does not fulfil the condition that the energy sector consists of one space for over 90%.

Adopt for all other systems the factors f_{waste}, a_{heat} and a_{cool} from table 14.

Table 14: Waste factors, f_{waste}, and distribution losses a_{heat} and a_{cool} for heating respectively cooling in the case of central generation

System number	Heat distribution by	Cold distribution by	Individual control heating	Waste factor f_{waste}	Weighing factor pipe and duct losses	
					Heating a_{heat}	Cooling a_{cool}
1	water	n.a.	yes	0	0,08	n.a.
			no	0	0,25	n.a.
2	or	water	yes	0,04	0,13	0,06
3			yes	0	0,13	0,06
		air	no	0	0,25	<u>0,06</u>
4	water and air	water and air	yes	0,04	0,13	0,07
5		n.a.	yes	0	0	n.a.
			no	0	0,30	n.a.
6		water	yes	0,1	0,05	0,06
7	air	air	yes	0	0	0,01
			no	0	0,35	0,01
8		water and air	yes	0,1	0,05	0,07
Individual heating control means that on space level the flow or the temperature of the supplied heat distribution medium can be controlled by a thermostat per room.						

NOTE
Individual heating control per space can occur with for instance thermostatic radiator valves or by thermostatic controlled air valves in air systems. An air conditioning unit serving just one space is also considered as an individual heating control.

With systems that belong in the summer situation to another system number than in the winter, the waste factors belonging to the system number have to be handled in the winter situation

NOTES
1. By "heat distribution through water" is meant:
   On space level (additional)heating takes place through a heater in the air supply duct to the room, heaters in circulation air (fancoils, induction units), radiators in the room or otherwise (Electrical (additional) heating is also reckoned to this).
2. By "heat distribution through air" is meant: The central air conditioning installation has a heater to heat the supply air (as practically always applies to mechanical ventilation).
3. By "cold distribution through water" is meant:
   At room level (additional) cooling takes place through coolers in the air supply duct, coolers in circulating air (fancoils or induction units with cooler), water operated cooling ceilings or otherwise. Air induced cooling ceilings do not belong to this.
4. By "cold distribution through air" is meant: In a central air conditioning installation is a cooler present to chill and/or dry the supply air.
5. In practice (new buildings) commonly used systems are:
   Buildings without cooling: system number 1;

Buildings with limited cooling demand: system number 3;
Buildings with large cooling demand: system numbers 3 and 4.

6. Examples at table 14:

System	System number
Building with natural ventilation	
- radiator heating	1
- fancoil-unit or cooling ceiling for comfort cooling; heating by radiators or fancoil unit	2
Building with mechanical ventilation	
- no cooling, heating only with central heated air, without radiators of additional heaters	5
- no cooling, heating only with radiators or additional heaters	1
- central chilling of ventilation air and heating by radiators or additional heaters (VAV-system)	3
- 4-pipes-induction system or 4-pipes fancoil-units with central pre-chilled/dried air	4
- cooling and heating with only central chilled/heated air, without radiators, additional heaters, and the like	7
- 2-pipes-induction system, change-over	3
- 2-pipes-induction system, non change-over	6
- Water operated cooling ceilings in combination with:	
* only central heated air	6
* only central heated and chilled/dried air	8
* central heated and chilled/dried air and radiators or additional heaters	4
- cooling: fancoil unit of cooling ceiling, heating: by radiators, additional heaters or fancoil units without central chilled/dried supply air	2

6.7.3 *Fractions heat demand and cooling demand*

6.7.3.1 *The fraction of cooling demand*

Determine for the considered energy sector the ratio of the yearly cooling demand to the sum of the heating demand and the cooling demand, according to:

$$f_{\mathrm{dem;cool}} = (1 - f_{\mathrm{dem;heat}})$$

where:

$f_{\mathrm{dem;cool}}$ is the fraction of the cooling demand with regard to the total demand of heating and cooling;

$f_{\mathrm{dem;heat}}$ is the fraction of the heat demand with regard to the total demand of heating and cooling, determined according to 6.7.3.2.

If $f_{\mathrm{dem;cool}} < 0,1$, then applies $f_{\mathrm{dem;cool}} = 0,1$.

6.7.3.2 *The fraction of heating demand*

Determine for the energy sector the fraction of the yearly heat demand with regard to the sum of the heating demand and the cooling demand, according to:

$$f_{\text{dem;heat}} = \frac{Q_{\text{dem;heat;room}}}{Q_{\text{dem;heat;room}} + Q_{\text{dem;cool;room}}}$$

In which:

$Q_{\text{dem;heat;room}} = Q_{\text{dem;heat;1;room}} + Q_{\text{dem;heat;2;room}} + ... + Q_{\text{dem;heat;12;room}}$

where:

$f_{\text{dem;heat}}$ is the fraction of the heat demand with regard to the total demand of heating and cooling;
$Q_{\text{dem;heat;room}}$ is the heat demand at space level per year, in MJ;
$Q_{\text{dem;heat;1,2,..;room}}$ is the heat demand in month 1,2,... at space level, determined according to 6.3.2.4, in MJ;
$Q_{\text{dem;cool;room}}$ is the cooling demand per year, in MJ, determined according to 10.3.4.

If $f_{\text{dem;heat}} < 0{,}1$, then applies $f_{\text{dem;heat}} = 0{,}1$.

6.8 Generation efficiency for heating per energy sector

6.8.1 *Principle*

For the efficiency of heat generation in an energy sector the generation efficiency of the installation which provides heat in the energy sector applies. For a combination of various kinds of heat generation, the expected individual contributions are weighed.

6.8.2 *Calculation rules*

6.8.2.1 *Determination* $\eta_{\text{gen;heat}}$

At the presence of one heat generator or a combination of heat generation appliances with equal efficiency according to 6.8.3, for $\eta_{\text{gen;heat}}$ applies the efficiency according to 6.8.3.

In all other cases applies:

$$\eta_{\text{gen;heat}} = \frac{1}{\dfrac{(1 - f_{\text{pref}})}{\eta_{\text{gen;heat;npref}}} + \dfrac{f_{\text{pref}}}{\eta_{\text{gen;heat;pref}}}}$$

where:

$\eta_{gen;heat}$ is the generation efficiency of the heating installation;
f_{pref} is the year averaged fraction of the total heat supply, that is supplied by the preferential operated heating appliance, determined according to 6.8.2.2;
$\eta_{gen;heat;pref}$ is the generation efficiency of the preferential operated heat generation appliances, according to 6.8.3;
$\eta_{gen;heat;npref}$ is the generation efficiency of the remaining heat generation appliances, according to 6.8.3.

NOTES
1. Electrical heating can for this clause be considered as one separate generation appliance.
2. In case of co-generation and heat pumps the preferential operated system is not per definition the system with the highest performance.

6.8.2.2 *Share preferential operated heat generation appliances*

Take the share of preferential operated heat generation appliances in the heat supply, f_{pref}, from table 15.

Table 15: Share of with the preferential system generated heat, f_{pref}, as function of the ratio of capacities β_{heat}

β_{heat}	f_{pref}		
Preferential system	co-generation	heat pump	other
from 0 to 0,1	0	0	0
from 0,1 to 0,2	0	0,48	0
from 0,2 to 0,3	0,6	0,79	0
from 0,3 to 0,4	0,6	0,93	0,8
from 0,4 to 0,6	0,6	0,97	1,0
from 0,6 to 0,8	0,6	0,98	1,0
equal to or larger than 0,8	0,6	1,0	1,0
β_{heat} is the fraction of the nominal capacity of the applied preferential generation appliance with regard to the nominal capacity of all present generation appliances, determined according to 6.8.2.3.			

For intermediate values of β_{heat} the adjacent lower value has to be taken.

6.8.2.3 *Proportion nominal capacities*

Determine the proportion of the nominal capacities of the preferential heat generation appliances, $\eta_{gen;heat;pref}$, to the nominal capacities of all heat generation appliances with:

$$\beta_{heat} = \frac{P_{gen;\ heat;\ pref}}{P_{gen;\ heat;\ npref} + P_{gen;\ heat;\ pref}}$$

where:

β_{heat} is the ratio of the nominal capacity of the preferential generation appliances to the nominal capacity of all generation appliances for the considered energy sector;
$P_{gen;heat;pref}$ is the total nominal capacity of the preferential heat generation appliances, in kW;
$P_{gen;heat;npref}$ is the total nominal capacity of the non-preferential heat generation appliances, in kW.

NOTES
1. The nominal capacity for boilers is the nominal capacity as meant in NEN-EN 677* (up to and including 70 kW) respectively the "quality criteria for gas appliances, Gaskeur '97 (Dutch)"**.
2. For co-generation the nominal capacity should be determined in according to the method for boilers.
3. The thermal capacity of heat pumps is determined according to NEN-EN 255*, taking the following conditions which are stated in that standard:

Heat source	Temperature level of the heating appliances	
	θ_{supply} < 35 °C	35 °C < θ_{supply} < 55 °C
outside air	A2(1,5)/W35	A-7(-8)/W50
ground	B0/W35	B0/W50
exhaust air	A20(12)/W35	A20(12)/W50
free floating water/ground water/aquifer	W10/W35	W10/W50

where:
θ_{supply} is the design supply temperature of the heat generation system for space heating.
A is air as medium, at the mentioned temperature level during testing;
B is the ground with the mentioned figure for the temperature level of the ground during testing;
W is water as medium, at the mentioned temperature level during testing.

4. Electrical heating can for this clause be considered as one separate generation appliance.

In case of co-generation in combination with one or more other heat generation appliances, co-generation is the preferential operated heat generation appliance.

In case of a heat pump in combination with one or more other appliances, not being a co-generation, the heat pump is the preferential operated generation appliance.

In all other cases the applied generation appliance with the, determined according to 6.8.3, highest efficiency is the preferential operated generation appliance.

6.8.3 *Computation values*

For the generation efficiency $\eta_{gen;heat}$ of the individual heat generating installations the computation values have to be adopted from 6.8.3.1 respectively 6.8.3.2.

6.8.3.1 *Generation efficiency heat pumps*

In case of application of gasmotor operated heat pumps, adopt the generation efficiency from table 16. In case of electrical heat pumps the generation efficiency has to be determined as the multiplication in table 16 of the efficiency of power generation with the numerical value mentioned (being the average COP) and after that rounded downwards to a multiple of 0,025.

If a from the table differing value is presented the final result has to be rounded downwards to a multiple of 0,025 as well.

* For the correct edition of this standard, see appendix A

** For the correct edition of this standard, see appendix A

NOTE
Values differing from the table have to be based on determination of the performance according to NEN-EN 255* under test conditions as mentioned in remark 3 of 6.8.2.3, and converted to a year averaged performance, based upon imposed operation conditions (user behaviour) and temperature levels, see the background report.

Table 16: Generation efficiency heat pumps

Heat sources	Temperature level of the heating system					
	θ_{supply} < 35 °C		35 °C < θ_{supply} < 45 °C		45 °C < θ_{supply} < 55 °C	
	EHP	GMHP	EHP	GMHP	EHP	GMHP
ground/outside air	3,4 * η_{el}	1,6	3,1 * η_{el}	1,5	2,8 * η_{el}	1,4
heat from exhaust air	6,1 * η_{el}	2,6	5,1 * η_{el}	2,2	4,4 * η_{el}	2,0
groundwater/aquifer	4,7 * η_{el}	2,1	4,2 * η_{el}	1,9	3,6 * η_{el}	1,8
free floating water	4,1 * η_{el}	1,9	3,7 * η_{el}	1,8	3,3 * η_{el}	1,7

where:
η_{el} is the efficiency of power generation, taken from 5.2.3.2;
EHP is an electric heat pump;
GMHP is a gasmotor driven heat pump;
θ_{supply} is the design supply temperature of the heat generation system for space heating.

The design supply temperature, θ_{supply} is the outgoing water temperature from the heat generation system for space heating under design conditions. Where in the table is discriminated between performances as a function of θ_{supply}, the higher performances apply only as long as the indicated upper limit, θ_{supply}, not will be exceeded. For in floor or wall integrated heating with direct flow, without mixing control, a design supply temperature of at most 55 °C applies.

NOTES
1. The performance for the heat pumps with the ground as source applies for a parallel operation. The other performances apply for an alternating operation
(Source temperature > 0 EC).
2. A heat pump using the heat from exhaust air of a building can in general not to fulfil the total heat demand of the building.

3. The discrimination on basis of design supply temperature is based on the influence, the temperature level has on the performance, taking account of the usual engineering of heating installations.
Examples of design supply temperature:
- floor or wall heating, directly streamed through: # 55 EC;
- floor heating, with mixing control: > 55 EC;
- low-temperature radiators or - convectors: 55 EC;
- radiators/convectors, general: 70 EC to 90 EC.

An indication for the temperature level of the heating appliances is the ratio $TO_{30}/(H_{vent} + H_{tr})$, where:

* For the correct edition of this standard, see appendix A

TO_{30} is the sum of the thermal outputs of the heating appliances in the considered zone at a temperature difference of 30 K between the heating appliance and the room, determined according to chapter 6 of NEN-EN 442-2*, and

$H_{vent} + H_{tr}$ is the sum of the ventilation heat loss coefficient and the transmission heat loss coefficient.

If:	then:
$TO_{30}/(H_{vent} + H_{tr})$	θ_{supply} (°C)
> 85	< 35
50-85	< 45
35-50	< 55
< 35	other

Floor or wall, directly streamed through: meant is floor or wall heating of which the entering water temperature (beside occasional pipe losses) is equal to the outgoing water temperature of the heat generator. The mentioned design conditions refer to the required minimum heating power of the heat delivery system (heating appliances).

6.8.3.2 *Generation efficiency other heat generators*

In case of heat generators other than heat pumps adopt the generation efficiency from table 17.

* For the correct edition of this standard, see appendix A

Table 17: Generation efficiency for heating otherwise than by heat pumps

Heating installation	Generation efficiency $\eta_{gen;heat}$	
Electric installation	η_{el}	
Local gas- or oil fired heating	0,65	
Co-generation	$\varepsilon_{cog;th}$	
District heating	η_{dh}	
Direct fired air heater	0,80	
level supply temperature	θ_{supply} < 55 °C	θ_{supply} # 55 °C
one or more central heating generators (hot water) which deliver(s) heat for an usable area A_g less than 500 m□		
conventional boiler	0,75	0,75
VR-boiler	0,80	0,80
HR-100 boiler	0,925	0,90
HR-104 boiler	0,95	0,925
HR-107 boiler	0,975	0,95
one or more central heating generators (hot water) which deliver(s) heat for an usable area A_g equal to or larger than 500 m□		
conventional boiler	0,70	0,70
VR-boiler	0,75	0,75
HR-100 boiler	0,875	0,85
HR-104 boiler	0,90	0,875
HR-107 boiler	0,925	0,90
All other cases	0,50	

where:

η_{el}	is the efficiency of power generation, taken from 5.2.3.2;
$\varepsilon_{cog;th}$	is the thermal conversion efficiency for co-generation, taken from table F.1 of appendix F;
η_{dh}	is the equivalent generation efficiency for district heating, taken from 5.2.3.3;
θ_{supply}	is the design supply temperature of the heat generation system for space heating, see table 16.
conventional	is a gas fired boiler according to NEN-EN 677* without label, or an oil fired boiler;
VR	is a gas fired boiler with a full load efficiency of at least 88,7% with respect to the lower calorific value;
HR-100, 104, 107 boiler is a	gas fired boiler with a part load efficiency of at least 100%, 104% respectively 107% with respect to the lower calorific value.

If a value deviating from the values in table 17 is presented, this value should be rounded downwards to a multiple of 0,025. The measurement conditions for the determination of such an alternate value, should be representative for the temperature level on which the installation is operated.

* For the correct edition of this standard, see appendix A.

NOTES
1. Appliances at least have to fulfil the requirements of the Boiler Efficiency Decree, the Dutch implementation of the European Boiler Efficiency Directive.
2. VR: meant is a gas fired boiler with a full load efficiency of at least 88,7% at lower calorific value, measured according to NEN-EN 677*.
3. HR-boiler or HR-100 boiler: meant is a gas fired boiler with a part load efficiency of at least 100% at lower calorific value, measured according to NEN-EN 677* and/or a boiler having the HR-100 quality label according to the test requirements for gas appliances (Gaskeur CV-HR**).
4. HR-104 boiler: meant is a gas fired boiler with a part load efficiency of at least 104% at lower calorific value, measured according to NEN-EN 677* and/or a boiler having the HR-104 quality label according to the Testing requirements for gas appliances (Gaskeur CV-HR**).
5. HR-107 boiler: meant is a gas fired boiler with a part load efficiency of at least 107% at lower calorific value, measured according to NEN-EN 677* and/or an appliance having the HR-107 quality label according to the Testing requirements for gas appliances (Gaskeur CV-HR**).
6. The definition of co-generation in this standard only covers building bound combined generation of heat and power. For not-building bound co-generation, see 5.2.3.3.

Take for the generation efficiency of the heat generators, which have to be considered as non-preferential, the efficiency of the appliance with the highest efficiency, excluding the preferential heat generating appliance(s).

6.8.4 *Auxiliary energy consumption*

Determine the auxiliary energy consumption as the product of the number of pilot flames in generation appliances which supply heat to heated zones in a building and the imposed energy use per pilot flame with:

$$Q_{\text{aux}} = 2500 * a$$

where:

Q_{aux} is the auxiliary energy consumption of heat generation appliances destined for heat supply to the heated zones in MJ;
a is the number of heat generation appliances without an electric ignition.

NOTE
2500 is the average energy consumption per pilot flame in MJ, tuned to NEN 5128*.

* For the correct edition of this standard, see appendix A
** For the correct edition of this publication, see appendix A

7 Energy consumption of fans for ventilation and air circulation

7.1 Principle

The energy consumption of fans for ventilation and circulation of air in the building is determined as the product of the operation time in a year, the effective (electric) power, in which the control is valued. The effective power is determined based upon the air flow $u_{v;m}$ according to 6.5.3.4, unless it can be proven by the real connected power of fans that a lower value for the effective power applies.
Calculate the yearly energy consumption for fans according to 7.2.

7.2 Calculation rule

Determine the primary energy consumption for fans with:

$$Q_{prim;vent} = 3{,}6 * 8760 * P_{eff} * f_{vent;tot} / \eta_{el}$$

where:

$Q_{prim;vent}$ is the primary energy consumption for fans in MJ;
8760 is the maximum operation time per year in hours;
P_{eff} is the computation value of the effective power in kW, determined according to 7.3.3.1 or the agreed value for the power $P_{eff;agr}$ determined according to 7.3.2.2;
$f_{vent;tot}$ is the for the whole building averaged time fraction that the fans are operational, determined according to 7.4;
η_{el} is the efficiency of power generation, taken from 5.2.3.2.

NOTE
3,6 is the factor for the conversion from kWh to MJ.
8760 is the maximum operational time in hours per year.

7.3 Effective power, P_{eff}, of fans

7.3.1 *Principle*

The effective power is determined as the sum of the effective power per energy sector based on the air flow due to mechanical ventilation $u_{v;m}$, determined according to 6.5.3.4, unless it can be proven by the real connected power of fans in the building that a lower effective power results.

7.3.2 *Effective power based upon the air flow $u_{v;m}$*

7.3.2.1 *Agreed value for power of fans*

Determine for the whole building the agreed effective power of fans as the sum of the agreed effective power of fans for individual energy sectors according to:

$$P_{eff;agr;tot} = P_{eff;agr;1} + P_{eff;agr;2} + ...$$

where:

$P_{\text{eff;agr;tot}}$ is the agreed value for the effective power of fans for the whole building, in kW;
$P_{\text{eff;agr;1,2,..}}$ is the agreed value for the effective power of fans of energy sector 1,2,..., determined according to 7.3.2.2, in kW.

7.3.2.2 *Agreed power of fans per energy sector*

Determine per energy sector the agreed value for power of fans with:

$$P_{\text{eff;agr}} = \frac{c_{\text{sys}} \text{ x } u_{\text{v;m}} \text{ x } A_{\text{g;sec}}}{1000}$$

where:

$P_{\text{eff;agr}}$ is the agreed value for the effective power of fans of the energy sector, in kW;
c_{sys} is a constant depending on the indoor climate system of the energy sector, in (WAs)/l, adopted from 7.3.2.3;
$u_{\text{v;m}}$ is the specific air flow by mechanical ventilation of the energy sector, in liter/(s∗m^2), determined according to 6.5.3.4;
$A_{\text{g;sec}}$ is the usable area of the energy sector, in m^2.

NOTE
1000 is the factor for the conversion from W to kW.

7.3.2.3 *Factor c_{sys}*

For a ventilation system with only mechanical exhaust applies:

c_{sys} = 1,2 (W∗s)/l

For a ventilation system with mechanical supply, eventually in combination with mechanical exhaust, without mechanical cooling:

c_{sys} = 2,0 (W∗s)/l

In all other cases applies:

c_{sys} = 3,0 (W∗s)/l

7.3.3 *Effective power based on real connected power for fans*

7.3.3.1 *Distribution real connected power per energy sector*

Determine the effective power for fans per energy sector with:

$$P_{eff} = \frac{P_{eff;connect} \text{ x } P_{eff;agr}}{P_{eff;agr;tot}}$$

where:

P_{eff} is the computation value of the effective power in the energy sector, in kW;
$P_{eff;connect}$ is the real connected effective power of the fans in the whole building, in kW;
$P_{eff;agr}$ is the agreed value of the effective power of fans of the energy sector, determined in relation to the air flow by mechanical ventilation, according to 7.3.2.2, in kW;
$P_{eff;agr;tot}$ is the agreed value of the effective power of fans for the whole building, determined according to 7.3.2.1 in kW.

NOTE
P_{eff} is only determined as an input variable for the determination of the internal heat load.

7.3.3.2 *Real connected effective power for fans in the whole building*

Determine which fans installed in the building, are destined for ventilation and circulation of air in heated zones.

For the determination of the energy performance coefficient a mechanical exhaust in a kitchen, limited to the temporarily exhaust of damp due to cooking, should be neglected. The same applies for mechanical exhaust of a toilet or bathroom when that exhaust is only meant for a temporary accelerated removal of reeking or humid inside air and when that removal is not necessary to comply with the required ventilation capacity.

Determine $P_{eff;connect}$ as

$$P_{eff;connect} = 0{,}8 \text{ x} \left(\frac{P_{shaft;1} \text{ x } f_{cntrl;1}}{\eta_{elm;1}} + \frac{P_{shaft;2} \text{ x } f_{cntrl;2}}{\eta_{elm;2}} + \ldots \right) \text{x} \left(\frac{u_{v;m;1} \text{ x } A_{g;sec;1} + u_{v;m;2} \text{ x } A_{g;sec;2} + \ldots}{u_{v;m;1} \text{ x } A_{g;sec;1} + \ldots + 0{,}55 \text{ x } A_{g;res;vent}} \right)$$

where:

$P_{eff;connect}$ is the connected effective power of the fans in the whole building, in kW;
$P_{shaft;1,2,...}$ is the shaft capacity of the electromotor of fan 1,2,.. in kW;
$f_{cntrl;1,2,...}$ is the reduction factor for control of fan 1,2,..., determined according to 7.3.3.2;
$\eta_{elm;1,2,...}$ is the efficiency of the electromotor 1,2,..., determined according to 7.3.3.3;
$u_{v;m;1,2,..}$ is the specific air flow due to mechanical ventilation in energy sector 1,2,... in liter/(s*m^2), determined according to 6.5.3.4;
$A_{g;sec;1,2,..}$ is the usable area of energy sector 1,2, ... in m^2;
$A_{g;res;vent}$ is the usable area in m^2 of the residential part of the building, that makes use of the relevant fans.

NOTES
1. 0,8 is a reduction factor for over sizing the fan.
2. 0,55 is the specific air flow due to any form of mechanical ventilation of that residential part of the

building that makes use of the relevant fans, in liter/(s*m^2), adopted from 6.8.3 of NEN 5128*.

Determine the computation value of $P_{eff,connect}$ by rounding upwards the calculated $P_{eff;connect}$ according to table 18.

Table 18: Significant numbers for classification of electrical power

Significant numbers for classification		
10	22	48
11	24	52
12	26	56
13	28	60
14	30	65
15	32	70
16	34	75
17	36	80
18	38	85
19	40	90
20	44	95

NOTE
To prevent marginal modifications in the design of installations having direct influence on the energy performance, the installation performances are, where possible, divided in classes. For power/capacities of installation components this classification is realised by rounding upwards of the real capacity/connected power.
Rounding upwards at two significant numbers according to table 18 implies that a calculated result is rounded upwards as in the following examples:
0,33 becomes 0,34
3,3 becomes 3,4
33 becomes 34
332 becomes 340
3327 becomes 3400
0,82 becomes 0,85
8,2 becomes 8,5
82 becomes 85
822 becomes 850
8227 becomes 8500

* For the correct edition of this standard, see appendix A

7.3.3.3 *Reduction factor for applied flow control*

The value of f_{cntrl} for the considered fan has to be taken from table 19.

Table 19: Reduction factor f_{cntrl} for the flow control of fans

System number according to table 14	Type of flow control		
	No control of throttle control	Inlet blade adjustment or fan blade adjustment	Speed control
1, 2, 4, 5, 6, 8	1	0,75	0,65
3, 7	1	0,65	0,50

NOTE
An air flow control can only be considered as such as long as during operation of the control, the required air flow for direct entering fresh outside air during normal operating hours is guaranteed.

7.3.3.4 *Efficiency electromotor*

For the efficiency of the electromotor the value from table 20 should be taken, unless the real efficiency of the electromotor to be installed is higher.

Determine the real efficiency with:

$$\eta_{elm} = \frac{1000 \text{ x } P_{shaft}}{U_{elm} \text{ x } I \text{ x } e}$$

where:

η_{elm} is the efficiency of the electromotor considered;
P_{shaft} the shaft power of the electromotor, in kW;
U_{elm} is the electric voltage, in V;
I is the electric current, in A;
e is a factor depending on the type of electromotor, for which the following applies:
- direct current motor: e = 1;
- single phase alternating current motor: e = cos ν;
- rotary current motor: e = %3 H cos ν;
in which cos ν is the power factor for alternating current motors.
 * The power factor cos ν is a property of AC-Devices which should be specified by the manufacturer

NOTE
The voltage, current and power factor are the values belonging to the maximum allocated capacity during continuous operation.

The thus determined efficiency has to be rounded downwards to a multiple of 0,05 for smaller results than 0,85. For larger results than 0,85 must be rounded downwards at multiples of 0,025.

Table 20: Efficiency of electromotors η_{elm}

Shaft capacity kW	η_{elm}
less than 1	0,65
from 1 to 2	0,70
from 2 to 4	0,75
from 4 to 10	0,80
from 10 to 30	0,85
from 30 to 60	0,87
from 60 to 120	0,89
120 and larger	0,90

7.4 The time fraction of fans operating

For the time fraction that fans are in operation applies:

- if in the whole building the building type cell or penitentiary building, accommodation facility and/or clinical health care building occurs:

$$f_{vent;tot} = \frac{f_{vent;1} \text{ x } A_{g;1} + f_{vent;2} \text{ x } A_{g;2} + ...}{A_{g;tot;heatz}}$$

where:

$f_{vent;tot}$ is the area weighed time fraction that the fans are operational;
$f_{vent;1,2,...}$ is the time fraction that the fans in building type 1,2,... are operating, taken from table 5;
$A_{g;1,2,...}$ is the usable area of building type 1,2,... , in m^2;
$A_{g;tot;heatz}$ is the usable area of the heated zone in the non-residential part of the building, in m^2.

- in all other cases applies:

$f_{vent;tot} = 0,30$.

8 Energy consumption for lighting

8.1 Principle

The energy consumption for lighting should be determined for each energy sector based upon the connected power of the installed lamps, the lighting hours and lighting control appliances according to 8.3. Contrary to 8.3 the energy consumption for lighting can also be determined according to 8.2 by a per energy sector determined agreed value of the specific electricity consumption per year per m^2 usable area.
The calculation is as follows:

- take the division into energy sectors as meant in 13.3;
- determine the energy consumption for lighting according to 8.2 or 8.3.

8.2 Energy consumption for lighting based upon agreed values of the specific electricity consumption

8.2.1 *Principle*

Determine the energy consumption for lighting based upon agreed values for the specific energy consumption for lighting per m□ usable area of all energy sectors, by multiplication of the usable area with that specific energy consumption for lighting and a factor that values lighting control systems.

8.2.2 *Calculation rule*

Determine the primary energy consumption for lighting for the non-residential part(s) of the whole building for which parts an *EPC*-requirement applies, with:

$$Q_{\mathrm{prim;li;sec;}i} = (e_{\mathrm{li;sec;}i} * A_{\mathrm{g;sec;}i} * f_{\mathrm{cntrl;artlight;sec;}i}) * 3{,}6 / \eta_{\mathrm{gen;el}}$$

where:

$Q_{\mathrm{prim;li;sec;}i}$	is the primary energy consumption for lighting in energy sector *i*, in MJ;
$e_{\mathrm{li;sec;}i}$	is the specific electricity consumption for lighting of energy sector *i*, in kWh/m^2, determined according to 8.2.3;
$A_{\mathrm{g;sec;}i}$	is the usable area of energy sector *i*, in m^2;
$f_{\mathrm{cntrl,artlight;sec;}i}$	is the factor for the lighting control system in energy sector *i*, which sector has to be considered completely as artificial lighting sector for this calculation, taken from table 23;
$\eta_{\mathrm{gen;el}}$	is the efficiency of power generation, taken from 5.2.3.2.

NOTE
3,6 is the factor for the conversion from kWh to MJ.

8.2.3 *Specific energy consumption for lighting*

Determine the computation value for the specific energy consumption for lighting per energy sector with:

$e_{li;sec} = (e_{li;1} * A_{g;1} + e_{li;2} * A_{g;2} + ...) / A_{g;sec}$

where:

$e_{li;sec}$ is the specific electricity consumption for lighting of the energy sector, in kWh/m^2;
$e_{li;1,2,..}$ is the specific electricity consumption for lighting of the part of building type 1,2,...within the energy sector, taken from table 21, in kWh/m^2;
$A_{g;1,2,..}$ is the usable area of the part of building type 1,2,..., within the energy sector, in m^2;
$A_{g;sec}$ is the usable area of the energy sector, in m^2.

Table 21: Specific energy consumption e_{li} for lighting per year

Building type	Specific electricity consumption for lighting e_{li} kWh/m^2
office building health care building, not clinical assembly building catering building sports building	40
educational building	30
health care building, clinical accommodation building penitentiary building shop building	85

NOTE
The values in this table are based on assumptions for burning hours per year and specific connected power for lamps given in table C.2

8.3 Energy consumption for lighting based upon the real connected load

8.3.1 *Principle*

Determine the energy consumption for lighting as the product of the installed lighting capacities and the lighting time per year, allowing for the presence of lighting control systems. The contribution of daylight can, if the zone at the facade can be switched separately, be valued, depending on the glass area in the facade and the light transmission value (*LTA*-value). Divide therefore the energy sectors into an artificial lighting sector and a daylight sector. In the daylight sectors several lighting control systems are valued. The calculation proceeds as follows:

- take the division in energy sectors according to 13.3;
- divide the energy sectors into lighting sectors according to 8.3.2;
- determine the primary energy consumption for lighting according to 8.3.3.

8.3.2 *Division into lighting sectors*

8.3.2.1 *Principle*

Divide each energy sector into a daylight sector and an artificial lighting sector.

- Determine the area of the daylight sector per energy sector according to 8.3.2.2;
- Determine the area of the artificial lighting sector per energy sector according to 8.3.2.4.

Deviating from 8.3.2.2 it is also allowed to consider the daylight sector as an artificial lighting sector by nullifying the area of the daylight sector.

8.3.2.2 *Daylight sector*

Principle

The determination of the area of a daylight sector is as follows:

- distinguish between the contribution of vertical projection on a horizontal plane (among other things roof lights) and the contribution of the horizontal projection on a vertical plane (windows in facades);

  NOTES
  1. The contribution of the vertical projection is limited to the part of the floor included in the determination of the usable area. The contribution of the horizontal projection depends on the height of the window above the linking floor and the light transmission value (*LTA*-value) and is expressed in a floor area along the facade with a certain width.
  2. In an energy sector more than one daylight sector can occur. A division into more daylight sectors is recommended when there are more lighting control systems according to table 23.

- determine the areas due to the contributions of the vertical projections according to 8.3.2.3 or appendix E;
- determine the areas due to the contributions of the horizontal projections according to 8.3.2.4 and
- summon the areas due to the contributions of vertical and horizontal projection(s), excluding once the area included in both contributions (the overlap).

Conditions

To a daylight sector within an energy sector only that area belongs that contributes to the usable area in that energy sector, and as far as the lighting above that floor area is separately controlled, in order to value the contribution of daylight in the energy consumption.

For the determination of the upper level and the bottom level of the light transmission area of vertical windows, the conditions as shown in figure 7 should be fulfilled.

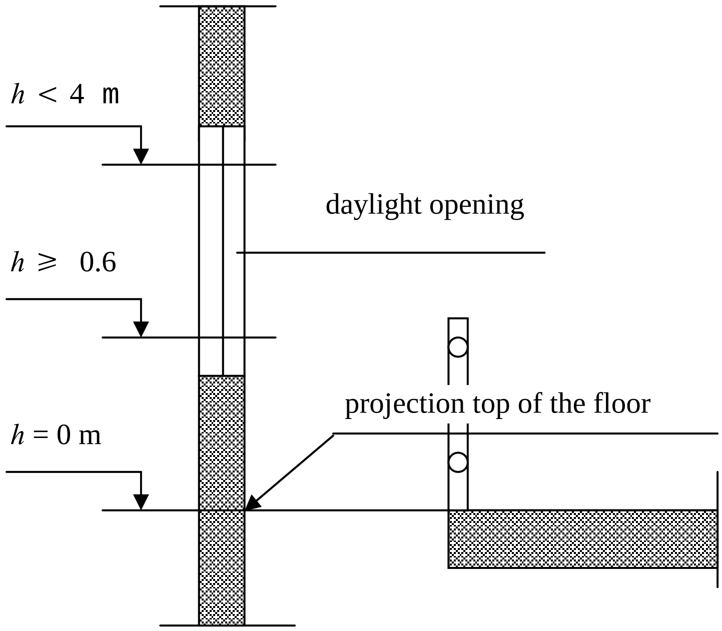


Figure 7: Projection of top of the floor on the facade (for example at vides)

Calculation rule

Determine the area of the daylight sector, $A_{daylight}$,in an energy sector in m² with:

$$A_{daylight} = A_{daylight;vert} + A_{daylight;hor} - A_{overlap}$$

where:

$A_{daylight;vert}$ is the area due to the contribution of the vertical projections of daylight openings, determined according to 8.3.2.3, in m²; deviating from 8.3.2.3 this area may also be determined according to appendix E;

$A_{daylight;hor}$ is the area due to the contribution of the horizontal projections of the daylight openings, determined according to 8.3.2.4, in m²;

$A_{overlap}$ is the area that satisfies both the conditions under 8.3.2.3 as the ones under 8.3.2.4, in m².

8.3.2.3 *Daylight area due to the contribution of vertical projection of daylight openings*

NOTE
The contribution of the vertical projection of daylight openings means especially the contribution of roof lights and windows, which are tilted to the sky, brought about by projection straight downwards.

The contribution of the vertical projection of the daylight openings to the area of the daylight sector consists of the sum of the areas of the vertical projections of the daylight openings on the floor, as far as situated within the usable area of the energy sector, see figure 8.

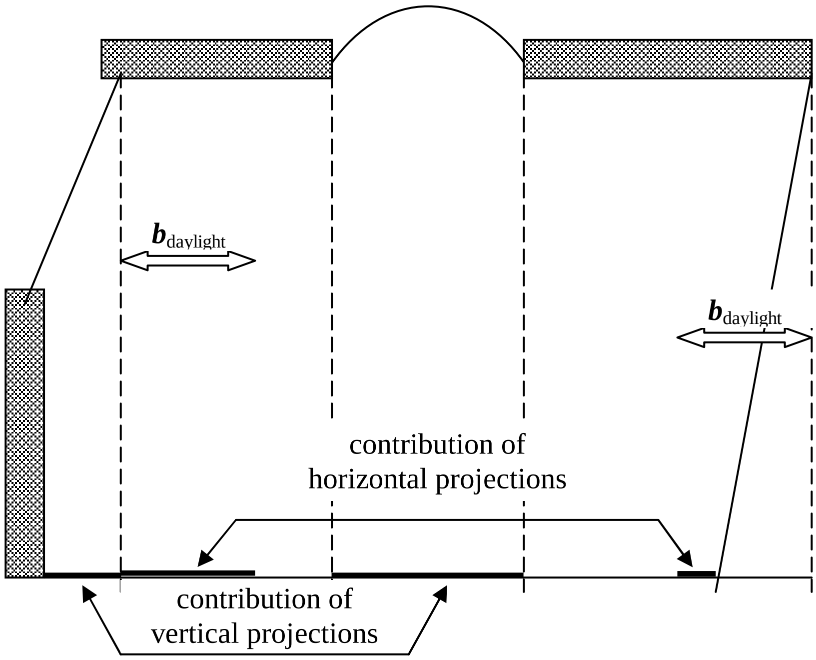


Figure 8: Contributions horizontal and vertical projection

Determine this area per energy sector with:

$A_{daylight;vert} = A_{daylight;vert;1} + A_{daylight;vert;2} + ...$

where:

$A_{daylight;vert}$	is the total daylight sector area within an energy sector due to the vertical projections of daylight openings on the floor lying under these openings, in m^2;
$A_{daylight;vert;1,2,..}$	is the daylight area due to the contribution of the vertical projection of daylight opening 1,2,... as far as coinciding with the usable area, in m^2.

8.3.2.4 *Daylight area due to the contribution of horizontal projection of daylight openings*

NOTE
With the contribution due to the horizontal projection of daylight openings is meant especially the contribution of daylight openings in the facades, at which the contribution of tilted windows for this aspect is valued after projection on a vertical plane.

Determine the area due to the contribution of the vertical window openings from the sum of the areas obtained by multiplication of front length of the daylight sector and width of the daylight sector, as far as situated within the usable area of the energy sector, that complies with the conditions for a contribution of horizontal projection of daylight openings, with:

$$A_{daylight;hor} = l_{daylight;hor;1} \mathrm{H}\ w_{daylight;hor;1} + l_{daylight;hor;2} \mathrm{H}\ w_{daylight;hor;2} + ...$$

where:

$A_{daylight;hor}$	is the daylight area due to the contributions of the horizontal projections of the vertical daylight openings, in m^2;
$l_{daylight;hor;1,2,..}$	is the front length of the part of the daylight sector belonging to daylight opening or group of daylight openings 1,2,..., determined according to 8.3.2.5, in m;
$w_{daylight;hor;1,2,..}$	is the average width over the front length of the part of the daylight sector belonging to daylight opening or group of daylight openings 1,2,..., determined according to 8.3.2.6, in m.

8.3.2.5 *Front length daylight sector $l_{daylight;hor}$*

Take as front length of a (part of a) daylight sector the width of the daylight opening determined according to chapter 5 of NEN 2057*, increased on both sides by maximum 0,5 m. Each part of the front length of a (part of a) daylight sector can only be allowed for at the determination of the area of a (part of a) daylight sector once.

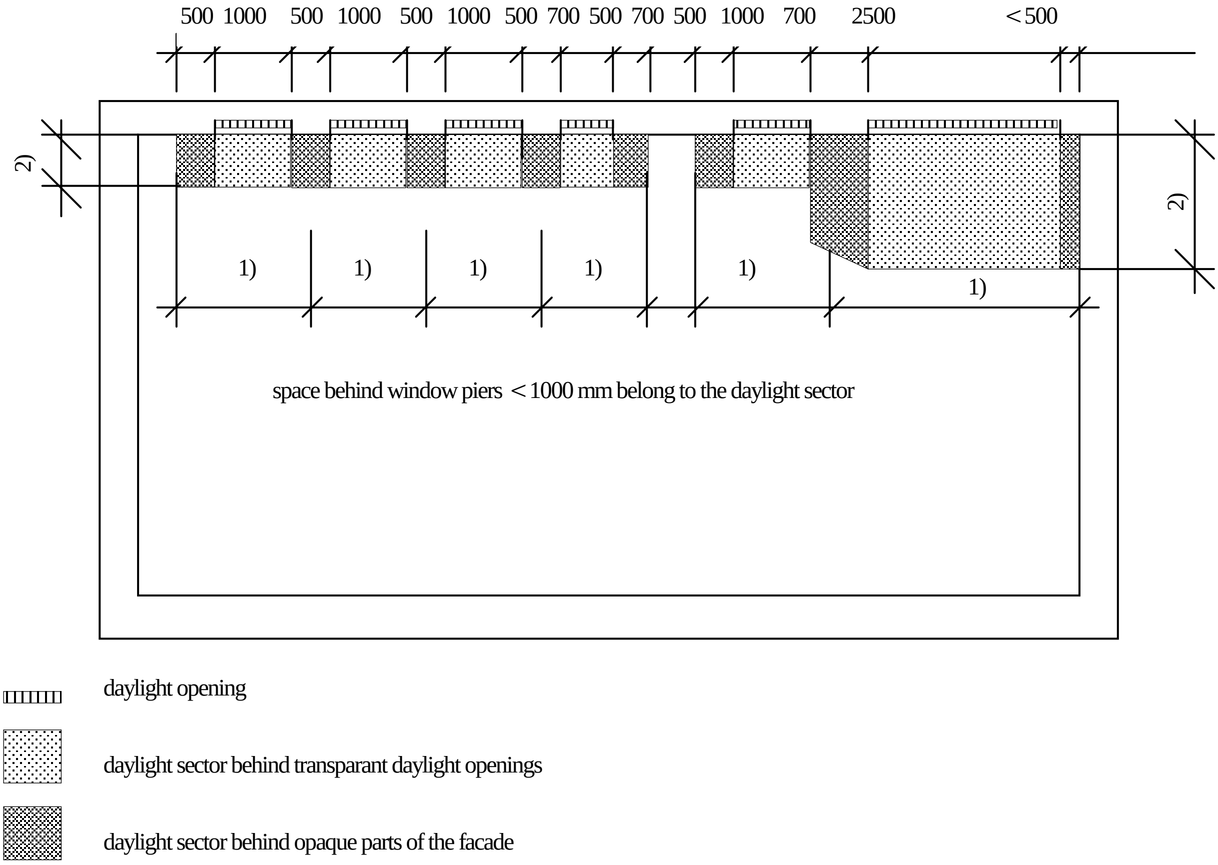


Figure 9: Part of the usable area behind transparent daylight openings and opaque parts in the facade belonging to the daylight sector. (In the figure different widths of daylight sectors are assumed)

8.3.2.6 *Width daylight sector*

* For the correct edition of this standard, see appendix A.

Determine the width of the daylight sector behind each vertical daylight opening, or a part of the facade that will be considered as such, according to appendix A.

Contrary to this the width of the daylight sector behind each vertical daylight opening, or a part of the facade to consider as such, for daylight openings without obstruction and without an overhang may be determined as follows:

If ($h_d * a * LTA$) is smaller than or equal to 0,50 applies:

$w_{daylight;hor} = 0$ m

If ($h_d * a * LTA$) is larger than 0,50 and smaller than or equal to 0,85 applies:

$w_{daylight;hor} = 2$ m

If ($h_d * a * LTA$) is larger than 0,85 applies:

$w_{daylight;hor} = 3$ m

in which:

$h_d = bo_d - o_d$

where:

$w_{daylight}$ is the width of the daylight sector, in m;
h_d is the height of the light transmission opening;
a is an auxiliary variable of which the value amounts to:
- in case of horizontal continuous windows:
  $a = 1$;
- if in case of windowpiers interrupted windows, the side of the light transmission opening of the next window, in horizontal sense, is not at a larger distance than 0,4 x the width of the considered light transmission opening, with a maximum of 1 m:
  $a = 0,71$;

LTA is the light transmittance of the daylight opening determined according to appendix B of NEN 2057* or taken from table 22.
bo_d is the upper side of the light transmission opening according to chapter 5 of NEN 2057*, in m;
o_d is the bottom of the light transmission opening according to chapter 5 of NEN 2057*, in m.

Figure 10 shows graphically the determination of the width of the daylight sector for (groups of) windows without obstructions and without overhangs based on the height of the light transmission opening and the *LTA*-value.

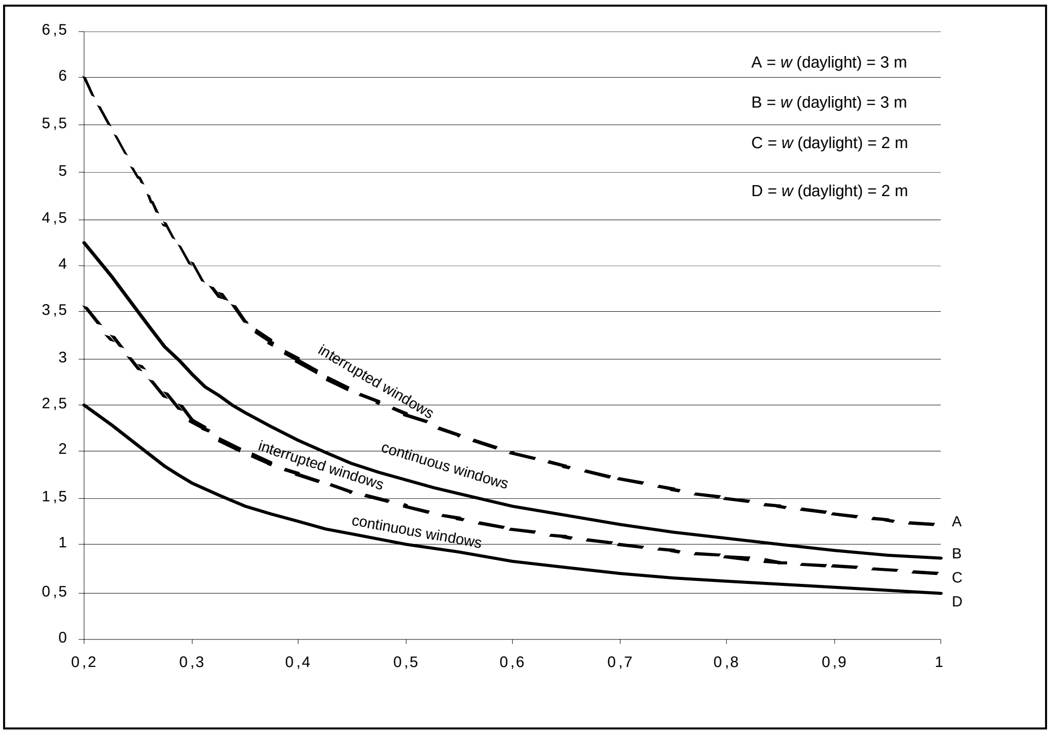


Figure 10: Width of the daylight sector for (groups of) windows without obstructions and without overhangs.

Table 22: Computation values for *LTA*

Type of glazing	Computation value *LTA*
single glazing, double clear glazing with or without low E coating, triple glazing	0,6
sun protection glazing	0,1

8.3.2.7 *Artificial lighting sector*

All parts of the energy sector that do not belong to the daylight sector are considered as artificial lighting sector.
Determine per energy sector the floor area of the artificial lighting sector, A_{artlight}, in m^2 , with:

$A_{\text{artlight}} = A_{\text{g}} - A_{\text{daylight}}$

where:

A_{g} is the usable area of energy sector 1,2,.., in m^2 ;

* Voor de juiste uitgave of deze norm, zie appendix A.

$A_{daylight}$ is the floor area of daylight sectors within in the energy sector, determined according to 8.3.2.2, in m^2.

8.3.3 *Calculation rules*

8.3.3.1 *Primary energy consumption for lighting*

Calculate the primary energy consumption for lighting for all energy sectors in a building with:

$$Q_{prim;li} = Q_{prim;li;sec;1} + Q_{prim;li;;sec;2} + ...$$

where:

$$Q_{prim;li;;sec;i} = E_{li;;sec;i} * 3{,}6 / \eta_{gen;el}$$

$Q_{prim;li}$ is the total primary energy consumption for lighting of the building in MJ;
$Q_{prim;li;sec;i}$ is the primary energy consumption for lighting in energy sector *i*, in MJ;
$E_{li;sec;i}$ is the electrical energy consumption for lighting the energy sector *i*, in kWh, determined according to 8.3.3.2;
η_{el} is the efficiency of power generation, taken from 5.2.3.2.

NOTE
3,6 is the factor for the conversion from kWh to MJ.

8.3.3.2 *Electric energy consumption for lighting in an energy sector*

Determine the yearly electric energy consumption for lighting per energy sector by summation of the total electric energy consumption for the daylight and artificial lighting sectors in the day and in the evening period, with:

$$E_{li} = (E_{li;daylight;1} + E_{li;daylight;2} + ...) + (E_{li;artlight;1} + E_{li;artlight;2} + ...) + E_{li;night}$$

where:

E_{li} is the electric energy consumption for lighting in an energy sector, in kWh;
$E_{li;daylight;1,2,..}$ is the electric energy consumption in the daylight sector 1,2,... of the energy sector in the day period, determined according to 8.3.3.3, in kWh;
$E_{li;artlight;1,2,...}$ is the electric energy consumption in the artificial lighting sector 1,2,... of the energy sector in the day period, determined according to 8.3.3.4, in kWh;
$E_{li;night}$ is the electric energy consumption in the evening period in an energy sector, determined according to 8.3.3.5, in kWh.

8.3.3.3 *Electric energy consumption per daylight sector (day period)*

Determine per daylight sector or group of daylight sectors with an individual lighting control system according to table 23, the yearly electric energy consumption in the day period with:

$$E_{li;daylight} = P_{li;daylight} \text{ x } f_{cntrl;daylight} \text{ x } \frac{A_{daylight}}{A_g} \text{ x } t_{day} \text{ x } f_{present}$$

where:

$E_{li;daylight}$	is the electric energy consumption in the daylight sector(s)s in the day period, in kWh;
P_{li}	is the total installed capacity for lighting, determined according to 8.3.4, in kW;
$A_{daylight}$	is the floor surface of the daylight sector, determined according to 8.3.2.2, in m^2;
A_g	is the usable area of the energy sector, in m^2 ;
$f_{cntrl,daylight}$	is the factor for the lighting control system in the daylight sector(s), taken from table 23;
t_{day}	is the number of burning hours per year in the day period weighed to the usable area of the building types within the energy sector, taken from table 24, in h;
$f_{present}$	is the appreciation factor for presence detection of which the value amounts to: - presence detection present for the benefit of more than 70% of the usable area of the energy sector: 0,8; - all other cases: 1.

Table 23: Factor for the lighting control system f_{cntrl} depending on the kind of control

Type of lighting control system	$f_{cntrl, daylight}$	$f_{cntrl, artlight}$
sweeping switch in combination with daylight switch	0,55	0,7
daylight switch	0,6	0,8
sweeping switch	0,75	0,75
room switch	0,9	0,9
room switch with possibility to switch individually the facade zone	0,75	0,9
central on/of	1,0	1,0

If within one energy sector more than one lighting control system is present that lighting control system may be taken, that is applicable to at least 70% of the floor area of the considered lighting sector.

Table 24: Maximum burning time per year in day periods t_{dag} and in the evenings/by night t_{night}

Building type	Maximum burning time day period t_{day} [h]	Maximum burning time evening/ night period t_{night} [h]
office building	2200	300
educational building	1600	300
health care building, clinical	4000	1000
health care building, not clinical	2200	300
catering building	2200	400
shop building	2700	200
assembly building	2200	300
sports building	2200	300
accommodation building	4000	1000
penitentiary building	4000	1000

8.3.3.4 *Electric energy consumption artificial lighting sector (day period)*

Determine per energy sector the yearly electric energy consumption for lighting for an artificial lighting sector in the day period with:

$$E_{\text{li;artlight}} = P_{\text{li}} \text{ x } f_{\text{cntrl;artlight}} \text{ x } \frac{A_{\text{artlight}}}{A_{\text{g}}} \text{ x } t_{\text{day}} \text{ x } f_{\text{present}}$$

where:

$E_{\text{li;artlight}}$ is the electric energy consumption for lighting in the artificial lighting sector in the day period, in kWh;
P_{li} is the total installed capacity for lighting, determined according to 8.3.4, in kW;
$f_{\text{cntrl,artlight}}$ is the factor for the lighting control system in an artificial lighting sector, taken from table 23;
A_{artlight} is the area of the artificial lighting sector, determined according to 8.3.2.7, in m^2;
A_{g} is the usable area of the energy sector, in m^2;
t_{day} is the number of burning hours per year in the day period weighed to the usable area of the building types within the energy sector, taken from table 24, in h;
f_{present} is the appreciation factor for presence detection of which the value amounts to:
- presence detection available for the benefit of more than 70% of the usable area of the energy sector: 0,8;
- all other cases: 1.

8.3.3.5 *Electric energy consumption for lighting in the evening period*

Determine the yearly electric energy consumption for lighting in the evening period per energy sector with:

$E_{li;night} = P_{li} * f_{li;night} * t_{night}$

where:

$E_{li;night}$ is the yearly electric energy consumption in an energy sector in the evening period, in kWh;
P_{li} is the total installed capacity for lighting, determined according to 8.3.4, in kW;
$f_{li;night}$ is the fraction of the maximum energy consumption (P_{li} H t_{night}) for lighting in the evening/night period;
t_{night} is the number of burning hours per year in the evening/night period weighed to the usable area of the building types within the energy sector, taken from table 24, in h.

For energy sectors in which the usable area of the building types clinical health care buildings catering buildings and assembly buildings form more than 80% of the usable area of that energy sector applies:

$f_{li;night} = 0{,}8$

In all other cases applies:
$f_{li;night} = 0{,}5$

8.3.4 *Computation value for installed capacity per building type and group of general spaces*

Determine the computation value for the total installed capacity of lighting in a building type by rounding of the total installed capacity for lighting according to table 18.

Determine the total installed capacity for lighting by summation of installed capacities of lamps (including chokes) per energy sector with:

$P_{li} = P_{armature;1} + P_{armature;2} + ...$

where:

P_{li} is the total installed capacity of all lamps including chokes (armatures of lighting), in kW;
$P_{armature;1,2,..}$ is the installed capacity of lighting armature 1,2,..., in kW.

9 Energy consumption of pumps

9.1 Principle

The energy consumption of pumps in warm water circuits and cold water circuits for indoor climate control is determined by agreed values for the energy consumption per m^2 , with the possibility to value the correction factor for the application of energy saving pump controls. The determination is as follows:

- schematize the building according to 9.2;
- calculate the energy consumption for pumps according to 9.3.

9.2 Schematization

Determine the sum of the usable areas of the heated zones of building types for which an *EPC* applies and the heated zones of general space belonging to it and determine the usable area of the part of the building for which an *EPC* applies, that has comfort cooling.

NOTE
The maximum usable area of the part of the building that has comfort cooling is equal to the sum of the usable area of the energy sectors.

9.3 Calculation rule

Determine the primary energy consumption for pumps by multiplying the specific energy consumption for pumps with the usable areas of the heated zones of the building types for which an *EPC* applies and the heated zones of general spaces and the part of the building that has comfort cooling, with a correction for flow control according to:

$$Q_{\text{prim;pump}} = 8 * f_{\text{cntrl;heat}} * A_{\text{g;tot;heatz}} / \eta_{\text{el}} + 8 * f_{\text{cntrl;cool}} * \Sigma A_{\text{g;cool;sec}} / \eta_{\text{el}}$$

where:

$Q_{\text{prim;pump}}$ is the primary energy consumption for pumps in MJ;
$A_{\text{g;tot;heatz}}$ is the usable area of the heated zones of the building according to 13.2 in m^2;
$f_{\text{cntrl;heat}}$ is the weighing factor for the type flow control in the heating system according to 9.4;
$\Sigma A_{\text{g;cool;sec}}$ is the sum of the usable areas of the energy sectors that have comfort cooling in m^2;
$f_{\text{cntrl;cool}}$ is the weighing factor for the type of flow control in the cooling system, determined according to 9.4;
η_{el} is the efficiency of power generation, taken from 5.2.3.2.

NOTE
Eight is the numerical value for the specific electricity consumption per year for pumps in buildings for heating respectively cooling in MJ. Eight is derived from or an operational time multiplied by an installed capacity in W/m^2 and the factor for the conversion from kWh to MJ and after that rounded.

9.4 Reduction factors for applied pump control

9.4.1 *Principle*

In case that more than 50% of the installed shaft capacity of the pumps for space heating and/or heating of ventilation air or pumps in cold water circuits for comfort cooling or chilling and drying ventilation air are provided with a flow control as meant in 9.4.3, a reduction factor to value pump controls may be applied for the pumps defined in 9.4.2.

9.4.2 *Conditions*

When assessing the installed shaft capacities of pump motors consider only:

- pumps in hot water circuits for space heating and/or heating of ventilation air;
- pumps in cold water circuits for comfort cooling and/or chilling or drying of ventilation air.

In case of pumps which are dual for spare operation, consider only the shaft capacity of the largest electromotor.

9.4.3 *Calculation values*

9.4.3.1 *Weighing factor for type flow control in warm water circuits*

If more than 50% of the installed shaft capacity in pump motors in warm water circuits is provided with an automatically operating speed control or automatically operating on/off control, then applies:
$f_{\text{cntrl;heat}} = 0{,}5$

If no pumps are present in warm water circuits applies:
$f_{\text{cntrl;heat}} = 0$

In all other cases applies:
$f_{\text{cntrl;heat}} = 1$

9.4.3.2 *Weighing factor for type control in cold water circuits*

If more than 50% of the installed shaft capacity of pump motors in cold water circuits is provided with an automatically operating speed control applies:
$f_{\text{cntrl;cool}} = 0{,}5$

If no pumps are present in cold water circuits applies:
$f_{\text{cntrl;cool}} = 0$

In all other cases applies:
$f_{\text{cntrl;cool}} = 1$

10 Energy consumption for comfort cooling

10.1 Principle

The cooling demand is determined from the solar load and internal loads reduced by the utilized heat losses through ventilation and transmission, the distribution system efficiency and a fixed factor for the latent cooling load.
The electric energy consumption for comfort cooling is determined by the cooling demand and an average performance for cold-generation per energy sector with cooling. The electric energy consumption of the individual energy sectors are added and converted to primary energy consumption.
The calculation proceeds as follows:

- take the division into energy sectors according to 13.3 and exclude the energy sectors without cooling;
- determine per energy sector with comfort cooling the heat gain according to 10.4 and the utilized heat losses according to 10.5;
- Determine per energy sector, based on the heat gain, the utilized heat losses, the distribution system efficiency and the generation efficiencies for cold, the energy consumption for comfort cooling according to 10.3;
- Determine according to 10.2 the energy consumption for comfort cooling for the whole building.

10.2 Primary energy consumption for comfort cooling

Determine the primary energy consumption for comfort cooling according to:

$$Q_{\text{prim;cool}} = Q_{\text{prim;cool;1}} + Q_{\text{prim;cool;2}} + ..$$

where:

$Q_{\text{prim;cool}}$ is the primary energy consumption for comfort cooling in the whole building, in MJ;
$Q_{\text{prim;cool;1,2,..}}$ is the primary energy consumption for comfort cooling in energy sector 1,2,..., determined according to 10.3.3, in MJ.

10.3 Energy consumption for comfort cooling based upon cooling demand

10.3.1 *Procedure*

The calculation consists of the following steps:

- take the energy sectors as meant in 5.2.1;
- determine for each energy sector whit mechanical cooling the cooling demand according to 10.3.3;
- determine for each energy sector the primary energy consumption for comfort cooling from the cooling demand according to 10.3.2.

10.3.2 *Primary energy consumption for comfort cooling per energy sector*

Determine the primary energy consumption for comfort cooling based upon the cooling demand per energy sector with:

$$Q_{prim;cool} = Q_{dem;cool} \; / \; \eta_{gen;cool}$$

where:

$Q_{prim;cool}$ is the primary energy consumption for comfort cooling for the energy sector with cooling, in MJ;
$Q_{dem;cool}$ is the cooling demand of the energy sector determined according to 10.3, in MJ;
$\eta_{gen;cool}$ is the generation efficiency of the cold generators, determined according to 10.7.

10.3.3 *Cooling demand per energy sector*

Determine the cooling demand per energy sector with:

$$Q_{dem;cool} = \frac{Q_{dem;cool;room}}{\eta_{sys;cool}}$$

where:

$Q_{dem;cool}$ is the yearly cooling demand, in MJ;
$Q_{dem;cool;room}$ is the yearly cooling demand in the energy sector at room level, determined according to 10.3.4, in MJ;
$\eta_{sys;cool}$ is the distribution system efficiency for comfort cooling according to 6.7.

10.3.4 *Cooling demand at room level*

Determine the cooling demand at room level per energy sector with:

$$Q_{dem;cool;room} = 1{,}1 \text{ x } (Q_{cool;1} + Q_{cool;2} + ...)$$

in which:

$Q_{cool;1,2,...} = Q_{gain;1,2,...} - Q_{loss;1,2,...}$, for $\lambda_{1,2,...}$ # 2,5

$Q_{cool;1,2,...} = 0$, for $\lambda_{1,2,...} > 2{,}5$

where:

$Q_{dem;cool;room}$ is the yearly cooling demand in the energy sector on space level, in MJ;
$Q_{cool;1,2,...}$ is the cooling demand in month 1,2,... for the months January up to and until December, in MJ;
$Q_{gain;1,2,...}$ is the heat gain in month 1,2,..., determined according to 10.4, in MJ;
$Q_{loss;1,2,...}$ is the heat loss in month 1,2,..., determined according to 10.5, in MJ;
$\lambda_{1,2,...}$ is the loss-gain ratio in month 1,2,.., determined according to 10.6.1.

NOTE
The factor 1,1 is a correction factor to account for a fixed proportion of 10% for cooling of latent heat.

10.4 Heat gain per month (Q_{gain}); cooling demand calculation

10.4.1 *Calculation rule*

Determine the heat gain for the cooling demand calculation per month with:

$$Q_{gain} = Q_i + Q_{sun;t} + Q_{sun;nt}$$

where:

Q_{gain} is the heat gain per month for the cooling demand calculation, in MJ;
Q_i is the internal heat production, determined according to 6.6.3.1, in MJ;
$Q_{sun;t}$ is the solar heat load through transparent construction parts, determined according to 6.6.4.2, in MJ;
$Q_{sun;nt}$ is the solar heat load through opaque construction parts, in the external separating constructions, determined according to 10.4.2, in MJ.

10.4.2 *Solar heat load through opaque construction parts in the external separating construction*

If a part of the building(energy sector) has a relatively large amount of external walls and roofs(more than 1.2 m2 per 1m2 floor area) then the solar energy transmitted through these opaque elements should be considerd and calculated as follows:

$$Q_{sun;nt} = 0{,}045 * q_{sun;1} * U_{c;1} * A_{c;1} + 0{,}045 * q_{sun;2} * U_{c;2} \text{ H } A_{c;2} + ...$$

In all other cases applies:

$$Q_{sun;nt} = 0$$

where:

$Q_{sun;nt}$ is the solar heat load through opaque construction parts in the external separating construction in MJ;
$q_{sun;1,2,...}$ is the quantity of solar radiation on the surface of construction part 1,2,... in MJ/ m^2, taken from table 10;
$U_{c;1,2,...}$ is the thermal transmittance of construction part 1,2,.. in W/(m^2*K), determined in accordance with 6.6.3 of NEN 5128*;
$A_{c;1,2,...}$ is the projected area of construction part 1,2,.. in m^2 , determined according to 4.2.2 or NEN 1068*.

NOTE
The factor 0,045 consists of an assumed value of 0,9 for the absorption coefficient for solar radiation multiplied by the external surface resistance for which 0,05 m^2AK/W is taken.

10.5 Heat loss per month (Q_{loss}); cooling demand calculation

* For the correct edition of this standard, see appendix A

10.5.1 *Calculation rule*

Determine for the cooling demand calculation the heat loss per month by adding up the (monthly average) transmission heat loss and ventilation heat loss at an imposed computation value for the inside temperature:

$$Q_{loss} = \eta_{b;cool} * (Q_{tr} + Q_{vent})$$

where:

Q_{loss} is the heat loss per month for the cooling demand calculation, in MJ;
$\eta_{b;cool}$ is the dimensionless utilisation factor for heat losses per month, determined according to 10.6.1;
Q_{tr} is the heat loss per month through transmission for the cooling demand calculation, determined according to 10.5.2, in MJ;
Q_{vent} is the heat loss per month through ventilation for the cooling demand calculation, determined according to 10.5.3, in MJ.

NOTE
Although the set point temperature for cooling can deviate from the imposed computation temperature, the method with the utilisation factor for free cold is intrinsic safe: lower inside temperature leads to a lower amount of free cold but to a larger utilisation factor.

10.5.2 *The transmission heat loss* (Q_{tr})*; cooling demand calculation*

Calculate the transmission heat loss per month of an energy sector in order to determine the cooling demand with:

$$Q_{tr} = H_{tr} * (24 - \theta_e) * 2{,}63$$

where:

Q_{tr} is the transmission heat loss per month (cooling demand calculation) in MJ;
H_{tr} is the transmission heat loss coefficient of an energy sector in W/K, determined according to 6.4.2;
θ_e is the outside temperature in EC, taken from table 3.

NOTES
1. Specific deviations of weighing factors to be attributed to the individual separating constructions, as now determined in 6.4.3 for the period with cooling demand, have not been taken into account (e.g. heat loss to the ground)
2. 24 is the value for the inside temperature in EC.
3. The numerical value 2,63 is explained in appendix C.3

10.5.3 *The ventilation heat loss* Q_{vent}*, cooling demand calculation*

10.5.3.1 *Calculation rule*

Calculate the ventilation heat loss per month of an energy sector in order to determine the cooling demand with:

$$Q_{vent} = H_{vent;cool} * (24 - \theta_{e;vent;cool}) * 2{,}63$$

in which:

$$H_{vent;cool} = 1{,}2 * u_{v;cool} * A_{g;sec}$$

where:

Q_{vent} is the ventilation heat loss (cooling demand calculation) in MJ;
$H_{vent;cool}$ is the ventilation heat loss coefficient of an energy sector in a period with cooling demand in W/K;
$\theta_{e;vent;cool}$ is the temperature of the supply air for the calculation of the cooling demand in the month considered, in EC, taken from table 25;
$u_{v;cool}$ is the specific air flow of direct entering fresh outside air in the energy sector in a period with cooling demand in liter/(s*m^2), determined according to 10.5.3.2;
$A_{g;sec}$ is the usable area of the energy sector in m^2.

NOTES
1. $1{,}2 = \rho_l * c_l$
   where:
   ρ_l is the density of air in kg/dm3 (= 0,0012 kg/d m^3);
   c_l is the specific heat capacity of air in J/(kgAK) (= 1000 J/(kg*K)).
2. 24 is the value of the inside temperature in EC.
3. The numerical value 2,63 is explained in appendix C.3.

Table 25: Computation value for the temperature of the supply air $\theta_{e;vent;cool}$ per month for the calculation of the cooling demand

Month	$\theta_{e;vent;cool}$ EC
January	16,0
February	16,0
March	16,0
April	16,0
May	16,0
June	17,0
July	18,5
August	18,3
September	16,0
October	16,0
November	16,0
December	16,0

10.5.3.2 *Specific air flow of direct entering fresh outside air, cooling demand calculation*

Calculation rule

The specific air flow of direct entering fresh outside air in a period with cooling demand is determined with:

$$u_{v;cool} = f_{vent;sec} * (u_{v;n;cool} + u_{v;m})$$

where:

$u_{v;cool}$ is the specific air flow of direct entering fresh outside air, in liter/(s∗m²);
$u_{v;n;cool}$ is the specific air flow of direct entering fresh outside air by natural ventilation in a period with cooling demand, taken from table 26, in liter/(s∗m²);
$u_{v;m}$ is the specific air flow of direct entering fresh outside air by mechanical ventilation, determined according to 6.5.3.4, in liter/(s∗m²);
$f_{vent;sec}$ is the usable area weighed time fraction that the ventilation is operating in the energy sector, determined according to 6.5.2.2.

NOTES
1. Infiltration is ignored. For the determination of the cooling demand no heat recovery for the ventilation air is accounted for.
2. It is assumed that in a period with cooling demand the maximum air flow by mechanical ventilation will be used for ventilation with outside air.
3. The additional heat losses due to night ventilation are not taken into account as free source because night ventilation also requires extra energy for fan's, that is neither accounted for and the most important reason for night ventilation is to improve comfort.

10.5.3.3 *Specific air flow by natural ventilation in a period with cooling demand*

Determine the specific air flow $u_{v;n;cool}$ by conscious natural ventilation in a period with cooling demand through ventilation devices and windows with

$$u_{v;n;cool} = q_v / A_{g;sec}$$

where:

$u_{v;n;cool}$ is the specific air flow of direct entering fresh outside air because of natural ventilation in a period with cooling demand, in liter/(s∗m²);
q_v is the air flow through the facilities for increased airing according to 5.4 of NEN 1087*, in liter/s;
$A_{g;sec}$ is the usable area of the energy sector in m².

NOTE
Ventilation devices can be considered as facilities for increased airing in this calculation as well.

Contrary to this $u_{v;n;cool}$ may also be taken from table 26.

Table 26: Specific air flow $u_{v;n;cool}$ through conscious natural ventilation in a period with cooling demand

* For the correct edition of this standard, see appendix A

Ventilation facility	Specific air flow $u_{v;n;cool}$ liter/(s*m^2)
None	0
ventilation orifices	0,5
tilt windows/top swing windows	1,5
turn windows, tilt&turn windows	2

10.6 **Utilisation factor for cold,** $\eta_{b;cool}$

10.6.1 *Calculation rule*

The utilisation factor for cold, $\eta_{b;cool}$, is calculated according to:

$$\eta_{b;cool} = \frac{1-\lambda^{a}}{1-\lambda^{a+1}}, \; at \; \lambda \neq 1$$

$$\eta_{b;cool} = \frac{a}{a+1}, \; at \; \lambda = 1$$

in which:

$$\lambda = \frac{Q_{tr} + Q_{vent}}{Q_i + Q_{zon;t} + Q_{zon;nt}}$$

where:

$\eta_{b;cool}$ is the utilisation factor for cold;
λ is the loss-gain ratio;
Q_{tr} is the transmission heat loss per month for the cooling demand calculation, determined according to 10.5.2, in MJ;
Q_{vent} is the ventilation heat loss per month for the cooling demand calculation, determined according to 10.5.3, in MJ;
Q_i is the internal heat production, determined according to 6.6.3.1, in MJ;
$Q_{sun;t}$ is the solar heat load through transparent construction parts, determined according to 6.6.4.2, in MJ;
$Q_{sun;nt}$ is the solar heat load through opaque construction parts, in the external separating constructions, determined according to 10.4.2, in MJ;
a is $c_1 + c_2 * \tau$;
c_1 is a constant, taken from table 27;
c_2 is a constant, taken from table 27, in h^{-1};
τ is the time constant, determined according to 10.6.2, in h.

NOTE
The utilisation factor shows the capability of the building to utilize the free available cold, to reduce the cooling demand, that should be fulfilled entirely by the chiller without these contributions.

In case of more building types within an energy sector with different values for c_1 respectively c_2, the values belonging to the lowest value for c_1 should be taken.

Table 27: Coefficients for the determination of the utilisation factor for cold

Building type	c_1	c_2 h^{-1}
office building educational building health care building catering building shop building accommodation building cell and penitentiary building	1,83	0,012
assembly building sports building	1,33	0,037

10.6.2 *Time constant τ, cooling demand calculation*

Determine the time constant τ with:

$$\tau = \frac{C}{H_{\mathrm{tr}} + H_{\mathrm{vent};cool}}$$

where:

τ	is time constant, in *h*;
C	is the effective thermal capacity, determined according to 6.6.6, in Wh/K;
H_{tr}	is the transmission heat loss coefficient of an energy sector, determined according to 6.4.2, in W/K;
$H_{\mathrm{vent;cool}}$	is the ventilation heat loss coefficient of an energy sector in a period with cooling demand, determined according to 10.5.3.1, in W/K.

10.7 Generation efficiency for cold per energy sector

10.7.1 *Principle*

For the efficiency of cold generation in an energy sector the generation efficiency of the installation that supplies the energy sector with cold, applies. In case of a combination of different kinds of cold generators the performance of cold generation is weighed to the expected individual contributions.

10.7.2 *Calculation rules*

10.7.2.1 *Determination* $\eta_{gen;cool}$

If there is just one refrigerating machine use 10.7.3 to calculate te cooling efficiency. When there are more than one efrigeraing machines based on the same principle (e.g. compression) also use10.7.3. When using different types of refrigerating machines, the average cooling efficiency should be calculated as indicated in 10.7.2.1

If applying absorption chiller(s) on district heating or co-generation as heat source than for the generation efficiency for cold, $\eta_{gen;cool}$, the following performance according to 10.7.3 applies.

In all other cases applies:

$$\eta_{gen;cool} = \frac{1}{\left(\frac{\alpha}{\eta_{gen;cool;pref}} + \frac{(1-\alpha)}{\eta_{gen:cool;npref}}\right)}$$

in which

$$\eta_{gen;cool} = (1 - \alpha)\ \mathrm{H}\ \eta_{gen;cool;npref} + \alpha\ \mathrm{H}\ \eta_{gen;cool;pref}$$

where:

$\eta_{gen;cool}$ is the generation efficiency of the cold generators;
$\eta_{gen;cool;pref}$ is the generation efficiency of the preferential switched cold generators determined according to 10.7.3;
$\eta_{gen;cool;npref}$ is the generation efficiency of the non-preferential cold generators, determined according to 10.7.3;
α_{cool} is the proportion of cold delivery through the preferential cold generators to the total cooling demand, taken from table 28.

Round the determined generation efficiency downwards to two decimal places.

Table 28: Proportion cold delivery with more cold generators

Proportion capacities cold generators β_{cool}	relation covering cold demand α
from 0 to 0,1	0,1
from 0,1 to 0,2	0,2
from 0,2 to 0,3	0,5
from 0,3 to 0,5	0,8
from 0,5 up to and including 1,0	1,0
β_{cool} is the proportion of the nominal capacity of the preferential cold generators and the nominal capacity of all cold generators for the considered energy sector, determined according to 10.7.2.2.	

10.7.2.2 *Proportion capacities cold generators*

Determine the proportion of the capacity of the preferential switched cold generator or cold generators to the capacity of all cold generators with:

$$\beta_{\text{cool}} = \frac{P_{\text{gen; cool; pref}}}{P_{\text{gen; cool; npref}} + P_{\text{gen; cool; pref}}}$$

where:

β_{cool} is the relation between the capacity of the preferential switched generation appliances and the capacity of all generation appliances for the considered energy sector;

$P_{\text{gen;cool;pref}}$ is the total capacity of the preferential cold generators in the energy sector determined according to 10.7.2.3, 10.7.2.4, 10.7.2.5 respectively 10.7.2.6, in kW;

$P_{\text{gen;cool;npref}}$ is the total capacity of the non-preferential cold generation appliances in the energy sector determined according to 10.7.2.3, 10.7.2.4, 10.7.2.5 respectively 10.7.2.6, in kW.

In case of an absorption chilling machine in combination with one or more compression chillers, the absorption chiller is considered as the preferential switched cold generator.

In all other cases the applied cold generator with the highest efficiency, determined according to 10.7.3, is considered as preferential switched cold generator.

10.7.2.3 *Thermal capacity of compression chiller*

Determine the thermal capacity of compression chillers with:

$$P_{\text{th;cool;sec;CCM}} = 4 \text{ x } \sum P_{\text{shaft}} \text{ x } \frac{A_{\text{g;sec}}}{A_{\text{g;cool}}}$$

where:

$P_{\text{th;cool;sec;CCM}}$ is the thermal capacity of the chiller(s) per energy sector in kW;

P_{as} is the class of the shaft capacity of the electromotor of the chiller for comfort cooling of the energy sectors, in kW, determined according to table 18;

$A_{\text{g;sec}}$ is the usable area of the energy sector, in m^2;

$A_{\text{g;cool}}$ is the usable area of the part of the building that has comfort cooling, in m^2.

NOTE
4 is the average *COP* of the compression chiller in typical conditions.

10.7.2.4 *Thermal capacity of absorption chiller*

Determine the thermal capacity of absorption chillers with:

$$P_{\text{th;cool;sec;AKM}} = \sum P_{\text{th;cool;AKM}} \text{ x } \frac{A_{\text{g;sec}}}{A_{\text{g;cool}}}$$

where:

$P_{th;cool;sec;ACM}$	is the thermal capacity of the absorption chiller(s) per energy sector, in kW;
$P_{th;cool;ACM}$	is the thermal capacity of the absorption chiller(s), in kW;
$A_{g;sec}$	is the usable area of the energy sector, in m^2;
$A_{g;cool}$	is the usable area of the part of the building that has comfort cooling, in m^2.

NOTE
The thermal capacity of an absorption chiller can be determined according to "1992 STANDARD for ARI: Absorption water chilling and water heating packages".

10.7.2.5 *Thermal capacity of cold storage*

Determine the thermal cooling capacity of cold storage with:

$$P_{th;koel;sec;ko} = 41.800 \text{ x } \sum \phi_{bron} \text{ x } \frac{A_{g;sec}}{A_{g;koel}}$$

where:

$P_{th;cool;sec;cs}$	is the thermal capacity of cold storage per energy sector in kW;
Φ_{well}	is the well water flow, in m^3/s;
$A_{g;sec}$	is the usable area of the energy sector, in m^2;
$A_{g;cool}$	is the usable area of the part of the building that has comfort cooling, in m^2 .

NOTE
The well water flow is the flow that is described in the environmental permit.

10.7.2.6 *Thermal capacity of heat pump with cold storage*

Determine the thermal capacity of a combination of a heat pump with cold storage with:

$$P_{th;koel;sec;WP} = 11 \text{ x } \sum P_{as} \text{ x } \frac{A_{g;sec}}{A_{g;koel}}$$

where:

$P_{th;cool;sec;HP}$ is the thermal capacity of the heat pumps(s) combined with cold storage per energy sector in kW;
P_{as} is the class of the shaft capacity of the electromotor of the heat pump(s), in kW, determined according to table 18;
$A_{g;sec}$ is the usable area of the energy sector, in m^2;
$A_{g;cool}$ is the usable area of the part of the building that has comfort cooling cooled, in m^2.

NOTE
11 is the *COP* of this combination under average conditions.

10.7.3 *Generation efficiency of the cold generators*

Take the generation efficiency for cold, $\eta_{gen;cool}$, of the installed cold generators from table 29.

Table 29: Generation efficiency for cold for comfort cooling

Cold generation	$\eta_{gen;cool}$
Compression chiller	$4 * \eta_{el}$
Absorption chiller	
- at district heating	$0,7 * \eta_{equiv;heat;dh}$
- at co-generation	$1,0 * \varepsilon_{cog}$
Cold storage	$12 * \eta_{el}$
Heat pump in summer operation (in combination with cold storage)	$5 * \eta_{el}$
η_{el} is the efficiency of power generation, taken from 5.2.3.2; $\eta_{equiv;heat;dh}$ is the equivalent efficiency for district heating, taken from 5.2.3.3; ε_{cog} is the generation efficiency for (building bound) co-generation, determined according to appendix F.	

In case of an absorption chiller in combination with one or more other cold generators, the absorption chiller has to be taken as preferential switched cold generator.
Take for the generation efficiency of the non-preferential cold generators, the efficiency of the appliance with the highest efficiency, excluding the preferential cold generating appliance(s).

11 Energy consumption for humidifying

11.1 Principle

Determine the energy consumption for humidifying in a non-residential building or non-residential part of a building, if the building installations contain a facility for humidifying, by the amount of air to be humidified. Possible recovery of moisture from the return air and the way in which the necessary latent heat of vaporization is produced are both considered.
The determination proceeds as follows:
- take the energy sectors as meant in 5.2.1;
- determine the amount of air to be humidified per energy sector according to 11.4;
- calculate the energy consumption for humidifying of the building according to 11.2.

11.2 Calculation rules

If the building installations contain a facility for humidifying, determine the energy consumption for humidifying in the non-residential part of the building, excluding building types for which no *EPC*-requirement applies, with:

$$Q_{\text{prim;hum}} = a_1 * q_{\text{v;hum;1}} \varpi X_{\text{h;1}} * f_{\text{vent;sec;1}} + a_2 * q_{\text{v;hum;2}} * X_{\text{h;2}} * f_{\text{vent;sec;2}} + ...$$

where:

$Q_{\text{prim;hum}}$ is the primary energy consumption for humidifying, in MJ;
$a_{1,2...}$ is a weighing factor for the generation efficiency of the required heat and the efficiency of moisture recovery of energy sector 1,2,... in MJAs/(gAh), determined according to 11.3;
$q_{\text{v;hum;1,2,...}}$ is the amount supply air of energy sector 1,2,... to be humidified in liter/s, determined according to 11.4;
$X_{\text{h;1,2,...}}$ is the number of gram-hours moisture to be supplied per l dry air in gAh/l, being the lowest value from table 30 belonging to the building types in the energy sector;
$f_{\text{vent;sec;1,2,..}}$ is the usable area weighed time fraction that the ventilation is operating in energy sector 1,2,..., determined according to 6.5.2.2.

NOTE
A humidifier at which the necessary heat for vaporization of the water is supplied by electricity (for example electric steam humidifier) should be considered as an electrically powered humidifier. Ultrasonic humidifying, water humidifying or steam humidifying on steam boiler (non-electric) must be considered as a non electric powered humidifier.

Table 30: Number of gram-hours moisture X_h to be supplied per year per l air flow capacity

Building type	X_h (g ≅ h)/l
shop building, sports building, catering building,assembly building, accommodation building, cell and penitentiary building	2,0
office building, educational building, health care building	5,0

11.3 **Determination weighing factor** *a*

Derive the weighing factor for humidifying facilities that fit especially for the transport of moisture from the exhaust air to the supply air from column 2 of table 31.

Derive in all other cases the weighing factors from column 3 of table 31.

Table 31: Numerical values for weighing factors *a*

Type humidifier	*a*	
	moisture recovery	no moisture recovery or unknown
electrically fired or unknown	$4 / \eta_{el}$	$10 / \eta_{el}$
not electrically fired	6	14
η_{el} is the efficiency of power generation, taken from 5.2.3.2.		

NOTE
A heat wheel with a moisture absorbing layer may be considered as a device for moisture recovery. In that respect recirculation is not seen as moisture recovery. The effect of recirculation is allowed for in the supply air flow $q_{v;hum}$.

11.4 **Air flow $q_{v;hum}$ to be humidified per energy sector**

The flow of supply air to be humidified per energy sector amounts to:

$$q_{v;hum} = A_{g;hum;sec} * u_{v;m;e}$$

where:

$q_{v;hum}$ is flow of supply air to be humidified per energy sector in liter/s;
$A_{g;hum}$ is the usable area of that part of the energy sector that will get humidified air in m^2;
$u_{v;m;e}$ is the specific air flow of direct entering fresh outside air to be heated, due to mechanical ventilation during operation time in liter/(sA m^2), determined according to 6.5.3.3.

12 Primary energy consumption for preparation of domestic hot water

12.1 Principle

The energy consumption for preparation of domestic hot water is determined for the whole building. Starting point for the determination of the energy consumption is a net heat demand being the heat demand of the used domestic hot water at an efficiency of 100%. This net heat demand is determined for energy sectors provided with taps for domestic hot water, based upon an imposed demand per m^2.
The determination of the final energy consumption accounts for energy losses by the applied distribution system and energy losses by the applied heat generators. These losses are expressed in distribution system efficiency respectively generation efficiency.
The applied installation with most taps in the building determines the system efficiency and generation efficiency.
The determination proceeds as follows:

- take the division of the building in energy sectors according to 13.2.2;
- determine the sum of the net heat demand for the preparation of domestic hot water of the energy sectors according to 12.3;
- determine the distribution system efficiency according to 12.4;
- is case of presence of solar-energy systems determine the energy contribution hereof according to 12.5;
- determine the generation efficiency according to 12.6;
- determine the primary energy consumption for preparation of domestic hot water according to 12.2.

12.2 Calculation rule

Determine the primary energy consumption for the preparation of domestic hot water in the building as follows:

$$Q_{\text{prim;dhw}} = \frac{\dfrac{Q_{\text{dem;dhw}}}{\eta_{\text{sys;dhw}}} - Q_{\text{ses;dhw}}}{\eta_{\text{gen;dhw}}}$$

where:

$Q_{\text{prim;dhw}}$ is the primary energy consumption for domestic hot water preparation, in MJ;
$Q_{\text{dem;dhw}}$ is the net heat demand for domestic hot water preparation, determined according to 12.3, in MJ;
$\eta_{\text{sys;dhw}}$ is the system efficiency for the distribution of domestic hot water, determined according to 12.4;
$Q_{\text{ses;dhw}}$ is the yearly energy contribution of a solar domestic hot water system, determined according to 12.5, in MJ;
$\eta_{\text{gen;dhw}}$ is the generation efficiency of the domestic hot water preparation, determined according to 12.6.

12.3 Determination of the net heat demand for domestic hot water

12.3.1 *Principle*

The net heat demand for domestic hot water is, in case of presence of taps in the considered energy sector, determined by an imposed consumption per m².

12.3.2 *Calculation rule*

Determine the net heat demand for domestic hot water in the building according to:

$$Q_{\text{dem;dhw}} = Q_{\text{dem;dhw;1}} + Q_{\text{dem;dhw;2}} + \ldots$$

in which:

$$Q_{\text{dem;dhw;1,2,..}} = c_{\text{dem;dhw;1}} * A_{\text{g;1}} + c_{\text{dem;dhw;2}} * A_{\text{g;2}} + \ldots$$

where:

$Q_{\text{dem;dhw}}$ is the net heat demand for domestic hot water in the building, in MJ;
$Q_{\text{dem;dhw;1,2,...}}$ is the net heat demand for domestic hot water in energy sector 1,2... , in MJ;
$c_{\text{dem;dhw;1,2,...}}$ is the net heat demand for domestic hot water of the in the energy sector situated part of building type 1,2,... provided with taps for domestic hot water, according to table 32, in MJ/ m²;
$A_{\text{g;1,2,...}}$ is the usable area of the in the energy sector situated part of the building type 1,2,... provided with taps for domestic hot water, in m².

Table 32: the yearly net heat demand for domestic hot water, $c_{\text{dem;dhw}}$

Building type	$c_{\text{dem;dhw}}$ MJ/m²
office building	5
health care building, not clinical	10
educational building	5
health care building, clinical	55
catering building	15
shop building	5
assembly building	10
accommodation building	45
cell and penitentiary building	15
sports building	45

12.4 Determination of the system efficiency for the distribution of domestic hot water

Consider the system with most taps connected. Apply the following efficiency for the system efficiency for distribution of domestic hot water:

- in case that all taps are situated within a radius of 3 m from the heat generation appliance applies:

  $\eta_{sys;dhw} = 1$;

- if one or more taps are situated at a distance of more than 3 m from the generation appliance, the following applies:

  $\eta_{sys;dhw} = 0{,}8$;

- if a circulation system is applied or if the distribution system is unknown, applies:

  $\eta_{sys;dhw} = 0{,}6$.

12.5 Determination of the contribution of a solar energy system

Determine the yearly contribution of a solar energy system according to:

$$Q_{ses;dhw} = 2800 * z_{ses;dhw} * A_{ses;dhw} * 0{,}5$$

in which:

$$Q_{ses;dhw} \leq 0{,}5 \text{ x } \frac{Q_{dem;dhw}}{\eta_{sys;dhw}}$$

where:

$Q_{ses;dhw}$ is the yearly contribution of the solar energy system in MJ;
$z_{ses;dhw}$ is the orientation value, taken from table 33;
$A_{ses;dhw}$ is the area of solar collectors in m^2;
$Q_{dem;dhw}$ is the net heat demand per year for domestic hot water, determined according to 12.3, in MJ;
$\eta_{sys;dhw}$ is the system efficiency for the hot water distribution, determined according to 12.4;

NOTES
1. 2800 is the computation value for total solar radiation on a south oriented vertical plane accumulated over the entire year, in MJ/ m^2;
2. 0,5 is the computation value for the year averaged output of the solar energy system;
3. 0,5 is the maximum utilisation factor, being the fraction of the heat demand for domestic hot water preparation that in the utmost case is covered by the solar energy system.

Table 33: Orientation values for $z_{ses;dhw}$ respectively z_{pv}, dimensionless

Orientation	Inclination angle (degrees from horizontal)						
	90	75	60	45	30	15	0
Z	1,00	1,19	1,33	1,41	1,42	1,36	1,24
ZO,ZW	0,95	1,11	1,24	1,32	1,35	1,32	1,24
O,W	0,77	0,89	1,01	1,10	1,17	1,22	1,24
NO,NW	0,56	0,64	0,74	0,84	0,98	1,12	1,24
N	0,45	0,50	0,58	0,72	0,90	1,08	1,24

For interjacent values of the orientation or inclination chose the value belonging to the nearest orientation or inclination. If the orientation or inclination is exactly between two values in the table the highest value from the table may be taken.

12.6 Generation efficiency of the domestic hot water preparation

12.6.1 *Principle*

The generation efficiency of an appliance for domestic hot water preparation is the representative output of the year averaged conditions, for which the useful heat delivery is determined directly over the appliance and the fuel consumption includes also the stand still losses and an occsional pilot flame. The appliance to be selected for the calculation, is the appliance to which most taps in the building are connected. This means that similar appliances are considered as one appliance.

12.6.2 *Computation values*

The computation value for the generation efficiency of the domestic hot water preparation, $\eta_{gen;dhw}$, should be taken from table 34.
If a differing value is proved, this value shall be rounded downwards to a multiple of 0,025.

Table 34: Generation efficiency of appliances for domestic hot water preparation

Type appliance		$\eta_{gen;dhw}$
boiler direct or indirect fired, direct flow heater/ heat exchanger	electric	0,75 * η_{el}
	VR-boiler with storevessel, VR-combi	0,45
	gasboiler, geyser, HR-boiler with storevessel, HR-combi	0,55
	co-generation	0,9 * $\varepsilon_{cog;th}$
	district heating	0,9 * η_{dh}
	heat pump	1,4 * η_{el}
	steam	0,45
For the definition of VR and HR, see table 17. η_{el} is the efficiency of power generation, taken from 5.2.3.2; $\varepsilon_{cog;th}$ is the thermal conversion efficiency for co-generation, taken from table F.1 of appendix F; η_{dh} is the efficiency for district heating, taken from 5.2.3.3.		

NOTES
1. The definition of co-generation only applies to building bound combined generation of heat and power. See for not-building bound co-generation 5.2.3.3.
2. The value 0,9 as shown for co-generation and district heating is the imposed value for the conversion efficiency of the heat exchanger.

13 Division in zones and energy sectors

13.1 Principle

Take the division into building types, (groups of) general space(s) and classes of occupation density.

NOTE
Classes of occupation density are described in the Building Decree.

Distinguish:
- residential part of the building, for which the calculation of the characteristic energy consumption is executed according to 5.3.1 of NEN 5128*;
- building types for which no *EPC*-requirement applies, and
- remaining building types for which an *EPC*-requirement applies and for which the calculation is executed according to this standard;
- (groups of) general spaces.

Divide that part of the building for which the calculation will be executed into heated zones and adjoining spaces. Divide heated zones into one or more energy sectors with an individual indoor climate system and an individual inside temperature and as far as needed individual minimum specific ventilation flows.

13.2 Division into building types, heated zones and adjoining spaces

13.2.1 *Principle*

Divide the building into building types and general spaces, excluding:

a) building types for which no *EPC*-requirement applies,
b) residential buildings and
c) spaces that are not inside a heated zone as meant in 13.2.4.

Determine of the remaining building types individually the usable area as far as situated within a heated zone.

13.2.2 *Building types*

Take the division into building types and groups of general spaces according to 13.2.1.

NOTES
1. The Building decree distinguishes the building types dwellings, residential buildings, not in an accommodation building situated accommodation facilities, accommodation buildings, cells, penitentiary buildings, health care buildings, catering buildings, office buildings, assembly buildings, industrial buildings, educational buildings, sports buildings, station buildings, shop buildings and general non-residential buildings.
2. General spaces in accommodation buildings are accounted to the building type accommodation building.
3. Common spaces in residential buildings are accounted to the building type residential building.

* For the correct edition of this standard, see appendix A.

4. Central circulation spaces, central entries and technical spaces are examples of spaces that can be considered as general spaces.

Treat one or more enclosed spaces to which a residential building and one or more other building types, are designated, as a group of general spaces.

13.2.3 *Building types for which no EPC*-requirement *applies*

Divide a building type for which no *EPC*-requirement applies and a (group of) general space(s) belonging to it into:

- adjoining heated spaces;
- adjoining unheated spaces (AUS), and
- adjoining strongly ventilated spaces.

13.2.4 *Heated zone and adjoining spaces*

Divide a building type for which an *EPC*-requirement applies or (group of) general space(s) belonging to it into:

- heated zones;
- adjoining unheated spaces (AUS), and
- adjoining strongly ventilated spaces.

A heated zone includes at least the staying areas, staying rooms, toilets and bathrooms, that within are and the toilet and the bathrooms that also belong to a building type for which an *EPC-requirement* applies.

13.3 **Division into energy sectors**

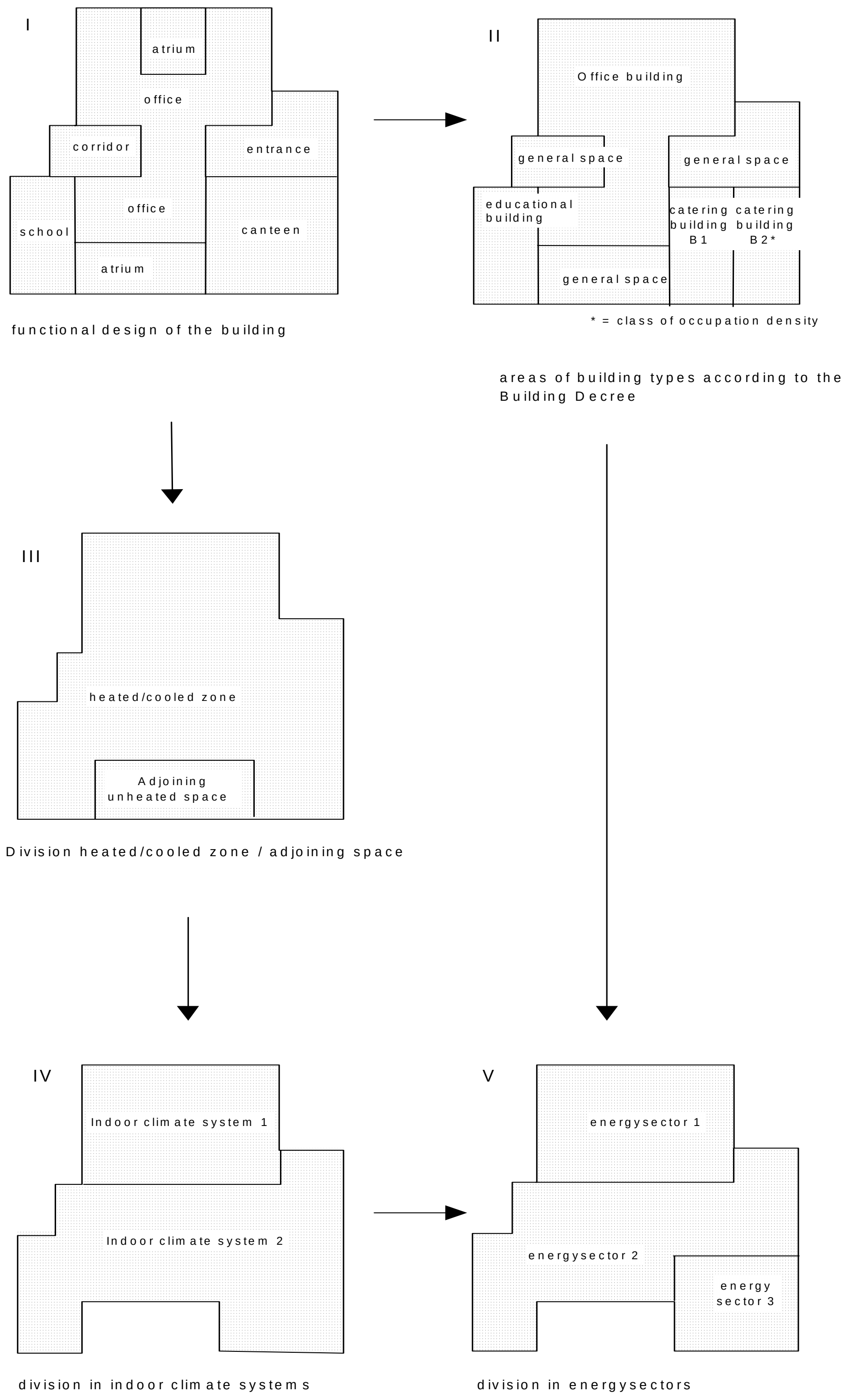
13.3.1 *Principle*

Distinguish per heated zone between (groups of) spaces with a different indoor climate system. Distinguish energysectors subsequently on base of the conditions in 13.3.2.

13.3.2 *Division into energy sectors*

Distinguish within the heated zone between one or more energy sectors, according to the example of figure 11, in order to comply with the following conditions:

a) an energy sector contains only one indoor climate system as meant in 6.7;
b) in more than 80% of the staying areas within an energy sector, one ventilation system according to table 35 is present;
c) all building types within the energy sector have the same inside temperature according to table 2. This condition does not have to be fulfilled if the building type with the largest area includes at least 90% of the usable area of the energy sector;



Scheme II is the classification for a building permit application. The building has to be divided into a heated zone and an unheated zone (diagram III). Distinguished within the heated zone different indoor climate systems and ventilation systems (diagram IV). Based upon the criteria in 13.3.2 is distinguished between one or more energy sectors (diagram V) within an area with one indoor climate system, according to the criteria in 13.3.2.

Figure 11: Example schematization building in energy sectors

d) the required minimum specific ventilation capacity for individual staying areas within an energy sector in m^3 per m^2 floor area differs at the most a factor 4. This condition does not have to be fulfilled if the staying areas have open connections with each other or if for more than 80% of the usable area of that staying areas the same minimum specific ventilation is required.

Table 35: Ventilation systems to distinguish for the division into energy sectors

	Ventilation system
1	natural supply and exhaust
2	natural supply and mechanical exhaust
3	mechanical supply and natural exhaust
4	mechanical supply and exhaust, without heat recovery
5	mechanical supply and exhaust, including heat recovery

13.3.3 *Computation values to be taken*

For the calculation of the energy consumption of energy sectors in which *only one building type* is situated, the computation values should be taken that belong to the considered building type for:
- inside temperature;
- the time fraction that ventilation is operated;
- internal heat production;
- utilisation factors for heat gain and for heat loss;
- agreed specific energy consumption for lighting and lighting burning time and
- gram hours for humidifying.

For the calculation of the energy consumption for energy sectors in which *more than one building type* is situated, take the area weighed calculation values for those factors.

For the calculation of the energy consumption of energy sectors in which the usable area of *one building type is more than 90%* of the usable area of that energy sector, the computation values belonging to the relevant building type should be taken for those factors.

NOTE
As a result the calculation values belonging to the dominant building type may be taken for the entire energy sector.

For the calculation of the energy consumption of energy sectors in which only *(groups of) general spaces* are situated, the calculation values have to be taken of the building type designated to that (group of) general space, with the largest usable area as far as situated within the heated zone, for those.

13.3.4 *Usable area of the part of the building type situated in an energy sector*

Take as usable area of a building type in an energy sector the usable area of the part of the building type within the energy sector, enlarged by a proportional part of (group of) general space(s) within the energy sector.

Appendix A
(normative)

Survey normative and informative references

A.1 Standards to which has been referred directly or indirectly in this standard

In A.1.1 is, for several important entrances for application of the present standard indicated which other standards contain provisions which, by direct or indirect reference, are also part of the reference structure this standard is part of.
Per entrance has been distinguished between the standards at which has been referred in the present standard and the standards at which only in the continuous of the reference structure a reference is to find.

NOTE
These entrances have chosen in connection with their relevance for application of the standard based upon the Building decree.

Behind the standards has continually been indicated between square hooks at which chapters or paragraphs has been referred as entrance for the continue of the reference structure.

The rest of the standards at which is directly referred are summed up in A.1.2. They are no part of the referring paths that start at the important entrances meant for it, but are relevant at the application of the remaining determinations of the present standard.

In A.1.3 are title, date of publication and eventual supply- correction- or modification sheets also being applicable mentioned of the standards referred to.

A.1.1 References per entrance

This part of the appendix only serves the national standardization officers

A.1.1.1 *Entrance chapter 5 "Determination energy performance of a building or a part of a building"*

Direct references:
NEN 1068 [4.2.2], [5.3.3], [6.3.1],
NEN 1087 [5.1], [5.3]
NEN 2057 [5], [bijl. B]
NEN 2686 [5]
NEN 5128 [5.3.1], [5.3.1.2], [5.3.2], [5.3.2.3], [5.4.4], [6.10.3.2], [6.10.4], [6.14.7], [tab.7]

Indirect references:
NEN 1068 [4.1.2], [4.4.2], [4.5.1]
NEN 2444 [4]
NEN 2778 [8.2.2.2], [bijl. C]
NEN 2916 [10.7], [11]

A.1.1.2 *Entrance 5.2.2 "EPC of building type"*

Direct references:
NEN 1068 [4.2.2], [5.3.3], [6.3.1],
NEN 1087 [5.1], [5.3]
NEN 2057 [5], [6], [6.1.3], [6.2], [7], [bijl. B]
NEN 2686 [5]
NEN 5128 [5.3.1], [5.3.1.2], [5.3.2], [5.3.2.3], [5.4.4], [6.10.3.2], [6.10.4], [6.14.7], [tab.7]

Indirect references:
NEN 1068 [4.1.2], [4.4.2], [4.5.1]
NEN 2444 [4]
NEN 2778 [8.2.2.2], [bijl. C]
NEN 2916 [10.7], [11]

A.1.1.3 *Entrance 5.2.3 "Characteristic energy consumption"*

Direct references:
NEN 1068 [4.2.2], [5.3.3], [6.3.1],
NEN 1087 [5.1], [5.3]
NEN 2057 [5], [6], [6.1.3], [6.2], [7], [bijl. B]
NEN 2686 [5]
NEN 5128 [5.3.1], [5.3.1.2], [5.3.2], [5.3.2.3], [5.4.4], [6.10.3.2], [6.10.4], [6.14.7], [tab.7]
NEN-EN 442-2 [6.5]

Indirect references:
NEN 1068 [4.1.2], [4.4.2], [4.5.1]
NEN 2444 [4]
NEN 2778 [8.2.2.2], [bijl. C]
NEN 2916 [10.7], [11]

A.1.1.4 *Entrance 5.2.4.2 "Weighing factor for comfort cooling"*

Direct references:
NEN 1087 [5.1]

Indirect references:
none

A.1.1.5 *Entrance 5.3.3 "Contribution photo-voltaic solar energy systems"*

Direct references:
NEN 5128 [14]
NEN 10904-1 [...]

Indirect references:
none

A.1.1.5 *Entrance chapter 11 "Energy consumption for humidifying"*

Direct references:
NEN 1068 [4.2.2], [5.3.3], [6.3.1],
NEN 1087 [5.1], [5.3]
NEN 2057 [5], [6], [6.1.3], [6.2], [7], [bijl. B]
NEN 2686 [5]
NEN 5128 [5.3.1], [5.3.1.2], [5.3.2], [5.3.2.3], [5.4.4], [6.10.3.2], [6.10.4], [6.14.7], [tab.7]

Indirect references:
NEN 1068 [4.1.2], [4.4.2], [4.5.1]
NEN 2444 [4]
NEN 2778 [8.2.2.2], [bijl. C]
NEN 2916 [10.7], [11]

A.1.2 **Remaining direct references**

NEN 2580 [4.5]

A.1.3 Normative references

NEN 1068	Thermal isolation of buildings - Calculation methods (in Dutch), 4th edition, May 1997
NEN 1087	Ventilation of buildings - Determination methods for new estate (in Dutch), 3th edition, May 1997
NEN 2057	Daylight openings of buildings - Abridged determination method for the equivalent daylight area of daylight openings, 1st edition, March 1991, including corrections A1, May 1997
NEN 2444	Determination of the heat resistance and/or heat transfer coefficient for building and insulation materials (in Dutch), 1st edition, May 1991, including corrections NEN 2444/A1, May 1997
NEN 2580	Areas and volumes of buildings - Terms, definitions and methods of determination, 2e edition, May 1997, including corrections C1, Novembre 1997
NEN 2686	Air leakage of buildings - Method of measurement, 1st edition, July 1988, including corrections NEN 2686/A1, May 1997
NEN 2778	Moisture control in buildings - Determination methods, 1st edition, October 1991, including corrections NEN 2778/A1, May 1997
NEN 5128	Energy performance of dwellings and residential buildings - Determination method, 3rd edition, December 1998.
NEN 5138 Ontw.	Heat recovery in residential buildings - Determination method for the energetic efficiency of heat recovery units for individual ventilation systems (in Dutch), design 1997.
NEN 10904-1	Photo-electric devices - Part 1: Measurement of photovoltaic-current-voltage characteristics (IEC 904-1:1998), October 1994.
NEN-EN 255-2	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 2: Testing and requirements for marking for space heating units, 1st edition, March 1997.
NEN-ISO 9050	Glass in building - Determination of light transmittance, solar direct transmittance, total solar energy transmittance and ultraviolet transmittance and related glazing characteristics, 1996.

A.2 Informative references

NEN 3173	Rotating electrical machines - Rating and performance (in Dutch),1991.
NPR 2917	Energy performance of non-residential buildings - Computerprogram (EPU) with manual, 2e edition, March 1999
NEN-EN 255-2	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 2: Testing and requirements for marking for space heating units, 1st edition, March 1997.
NEN EN 442-2	Radiators and convectors - Part 2: Test methods and rating, August 1996
NEN-EN 677	Gas-fired central heating boilers - Specific requirements for condensing boilers with a nominal heat input not exceeding 70 kW, July 1998
NEN-EN 832	Thermal performance of buildings - Calculation of energy use for heating - Residential Buildings, October 1998

NEN-EN 1196	Gas fired air heaters for domestic and non-domestic use - Additional requirements for condensing air heaters, July 1998
NEN-EN-ISO 13370	Thermal Peformance of buildings - Heat transfer via the ground - Calculation methods, October 1998
ISO 15469	Spatial distribution of daylight - CIE standard overcast sky and clear sky, December 1997
Gaskeur CV-1	Criteria for the Gaskeur/basic-label for gas fired central heating appliances, 1996
Gaskeur CV-HR	Criteria for the Gaskeur/HighEfficiency-label for gas fired central heating appliances, 1997
Min. of Economic Affairs	Boiler efficiency decree, 1993
Standard for ARI	Absorption water chilling and water heating packages, 1992
CDC/Deerns/DGMR	Background report NEN 2916, December 1998.
Min. Housing, Planning & Environment	Housing Act, 1991
Min. Housing, Planning & Environment	Building Decree , 1991

Appendix B
(informative)

Determination of the weighing factor for the heat loss to adjoining unheated enclosed spaces

B.1 Method

This appendix offers a non-normative determination of the influence of adjoining not-heated enclosed spaces like conservatories/greenhouses and atria.
The weighing factor for heat loss to adjoining unheated spaces is determined by the average temperature of this space. The following factors play a role: the heat loss coefficient to the outside from the considered adjoining unheated space, the heat loss coefficient from the energy sector to the adjoining unheated space and the utilized solar heat gain (see figure B.1). The utilized solar heat gain is found by multiplying the amount of incoming solar heat by an utilisation factor. This utilisation factor expresses to which extend the solar heat is useful (and will not be discharged by ventilation to prevent overheating).
The air flow to and from the adjoining unheated space is influenced strongly by the weigting factor. As it is not yet possible to determine the air flow unambiguously this determination of the weighing factor is informative.
If the ventilation air to an energy sector is partly supplied via the adjoining unheated space, this weighing factor can also be taken for the determination of the ventilation heat loss coefficient according to 6.5.1 as far as relevant.

B.2 Calculation rule

Determine the weighing factor for the transmission heat loss to an adjoining unheated space and the ventilation heat loss coefficient for supplied air via an adjoining unheated space to an energy sector with:

$$a = \frac{(H_{\mathrm{tr;e}} + H_{\mathrm{vent;e}}) \text{ x } (\theta_{\mathrm{i}} - \theta_{\mathrm{e}}) \text{ x } 732 \ - \ \eta_{\mathrm{a}} \text{ x } (Q_{\mathrm{sun}} \text{ x } 1000) / 3{,}6}{(H_{\mathrm{tr;i}} + H_{\mathrm{vent;i}} + H_{\mathrm{tr;e}} + H_{\mathrm{vent;e}}) \text{ x } (\theta_{\mathrm{i}} - \theta_{\mathrm{e}}) \text{ x } 732}$$

where:

a	is the weighing factor for heat loss to an adjoining unheated space;
$H_{\mathrm{tr;i}}$	is the transmission heat loss coefficient from the considered energy sector to the adjoining unheated space in W/K, determined according to B.4;
$H_{\mathrm{vent;i}}$	is the ventilation heat loss coefficient from the considered energy sector to the adjoining unheated space in W/K, determined according to B.5;
$H_{\mathrm{tr;e}}$	is the transmission heat loss coefficient from the adjoining unheated space to the outside in W/K, determined according to B.4;
$H_{\mathrm{vent;e}}$	is the ventilation heat loss coefficient from the adjoining unheated space to outside air in W/K, determined according to B.5;
Q_{sun}	is the heat gain by entering solar radiation in the adjoining unheated space, determined according to 6.6.4, in MJ;
η_{a}	is the utilisation factor for the solar heat in the adjoining unheated space, determined according to B.3;
θ_{i}	is the inside temperature in the adjacent energy sector in EC, taken from table 2;
θ_{e}	is the outside temperature in the considered period in EC, taken from table 3.

NOTE
732 is the number of hours per month.

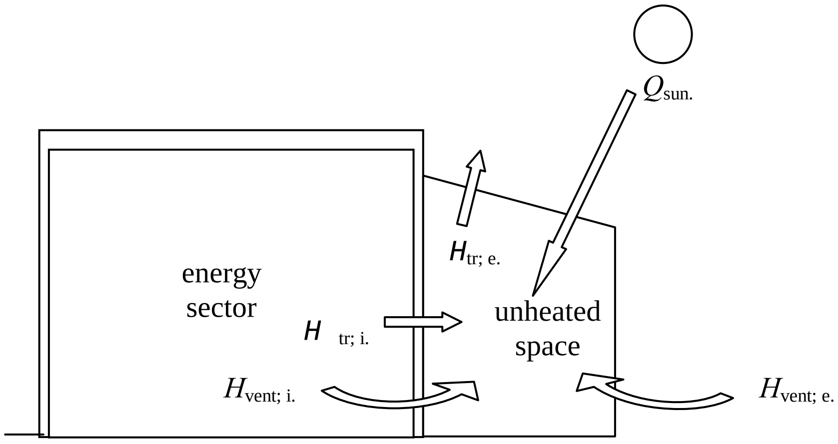


Figure B.1: Scheme heat flows

If the influence of the solar heat gain is not considered, the air flow from inside to the adjoining unheated space is nullified and the ventilation heat loss coefficient $H_{vent;e}$ is assumed equal to (0,5 H $H_{tr;e}$), a simplified form of the above formula originates that is included in 6.4.3.

B.3 Utilisation factor for solar heat

Determine the utilisation factor η_a for solar heat in adjoining unheated enclosed spaces according to table B.1, in which:

$$\gamma_a = \frac{(Q_{sun} \text{ x } 1000) / 3{,}6}{(H_{tr;e} + H_{vent;e}) \text{ x } (\theta_i - \theta_e) \text{ x } 732}$$

where:

$H_{tr;e}$ is the transmission heat loss coefficient of the adjoining unheated space to outside according to B.4, in W/K;
$H_{vent;e}$ is the ventilation heat loss coefficient of the adjoining unheated space by ventilation with outside air, determined according to B.5, in W/K;
Q_{sun} is the heat gain by entering solar radiation in the adjoining unheated space, determined according to 6.6.4, in MJ;
θ_i is the inside temperature in the adjacent energy sector, taken from table 2, in EC;
θ_e is the outside temperature in the considered period, taken from table 3, in EC.

NOTES
1. 732 is the number of hours per month for which the calculation is meant.
2. For the determination of γ_a the same temperature in the adjoining unheated space is assumed as in the adjacent heated space. A conservative (low) value of η_a results.

Table B.1: Utilisation factor η_a for heat gain in adjoining unheated spaces

γ_a	η_a	γ_a	η_a	γ_a	η_a
0,00	1,00	0,50	0,60	1,80	0,32
0,05	0,91	0,60	0,56	2,00	0,30
0,10	0,86	0,70	0,52	2,50	0,26
0,15	0,81	0,80	0,49	3,00	0,23
0,20	0,77	0,90	0,47	4,00	0,18
0,25	0,73	1,00	0,44	5,00	0,15
0,30	0,70	1,10	0,42	10,0	0,09
0,35	0,67	1,20	0,40	20,0	0,05
0,40	0,64	1,40	0,37	>20,0	0,00
0,45	0,62	1,60	0,34		

B.4 Transmission heat loss coefficient of heated zones to an unheated zone and transmission heat loss coefficient of an unheated zone to the outside

Determine the transmission heat loss from and to an unheated zone with:

- for the heat loss from the heated zone to the unheated zone

$H_{tr;i} = U_1 \text{ H } A_1 + U_2 \text{ H } A_2 + ...$

- for the heat loss from the unheated zone to the outside

$H_{tr;e} = U_1 \text{ H } A_1 + U_2 \text{ H } A_2 + ...$

where:

$H_{tr;i}$ is the transmission heat loss coefficient of an energy sector to an adjoining unheated space, in W/K;

$U_{1,2,...}$ are the heat transfer coefficients of the individual constructions, determined in accordance with 6.6.3 of NEN 5128*, in W/($m^{2\cdot}$ K);

$A_{1,2,...}$ are the projected areas of the considered separating constructions, determined according to 4.2.2 of NEN 1068*, in m^2;

$H_{tr;e}$ is the transmission heat loss coefficient of an adjoining unheated space to the outside, in W/K;

NOTES

* For the correct edition of this standard, see appendix A

1. Linear thermal bridges: see the remark in 6.4.2.
2. If thermal bridges would be accounted for than the formulas should be completed with:
   ... + Ψ_1 H l_1 + Ψ_2 H l_2 + ...
   $\Psi_{1,2,...}$ are the linear heat transfer coefficients of linear thermal bridges, in W/(m*K);
   $l_{1,2,...}$ are the lengths of the individual linear thermal bridges, in m.

B.5 Ventilation heat loss coefficient of an adjoining unheated space

In as far as the air exchange is not prohibited or otherwise restricted by the Building Decree, the specific heat loss through air exchange between a heated and unheated zone should be determined according to:

$H_{vent;i}$ = 1,2 H $q_{v;i}$

$H_{vent;e}$ = 1,2 H $q_{v;e}$

where:

$H_{vent;i}$ is the ventilation heat loss coefficient of the considered energy sector to the adjoining unheated space in W/K;
$H_{vent;e}$ is the ventilation heat loss coefficient of the adjoining unheated space with outside air in W/K;
$q_{v;i}$ is the air flow from the energy sector to the adjoining unheated space in liter/s;
$q_{v;e}$ is the air flow from outside to the adjoining unheated space in liter/s.

NOTE
1,2 is the volumetric heat capacity of air in J/(literAK).

At present no unambiguous determination method is available for $q_{v;e}$ and $q_{v;i}$. Therefore in the formula of 6.4.3 the specific losses through infiltration are assumed being 50% of the transmission heat losses.

Appendix C
(informative)

Explanation of some numerical values

C.1 Introduction

This appendix explains the background of several numerical values used in the standard.

C.2 Specific electricity consumption for lighting

The values for the specific electricity consumption for lighting given in table 21 are save (high) values based on assumed specific installed capacities and burning hours per year as stated in table C.1.

Table C.1: Specific installed capacities for lighting and burning hours for the various building types, on the ground of which table 21 is derived

Building type	Burning hours h		Specific power W/m^2	Specific electricity consumption for lighting e_{li} kWh/m□
	day	evening/night		
shop building	2700	200	30	85
office building	2200	300	17	40
educational building	1600	300	15	30
health care building, not clinical	2200	300	17	40
catering buildings	2200	300	17	40
assembly building	2200	300	17	40
sports building	2200	300	17	40
accommodation building	4000	1000	17	85
cell and penitentiary building	4000	1000	17	85
health care building,clinical	4000	1000	17	85

C.3 Numerical value at calculation of transmission and ventilation heat losses

2,63 is a rounding of 732 H 3,6 H 10^{-3} , in which 732 the number of hours per month.

C.4 Backgrounds of the calculation of the contribution of daylight

C.4.1 *Additional symbols and indices*

C.4.1.1 *Symbols*

symbol	quantity	unit
df	daylight factor	[-]
E	illumination	lux
sf	sky factor	[-]
sc	sky component	[-]
irc	internally reflected component	[-]

C.4.1.2 *Indices*

CIE	Commission International the l' Eclairage
hor	horizontal
i	teller

C.4.2 *Method*

The determination of the contribution of daylight is based on a more accurate calculation according to the following method:

- calculate the sky component of the daylight illumination based upon the overcast CIE sky, according to C.4.4.3;
- calculate the sky factor of the daylight illumination by multiplying the sky component with the *LTA*-value according to C.4.4.2;
- calculate the internally reflected component according to C.4.4.4;
- calculate from the sky factor and the internally reflected component the daylight factor according to C.4.4.1;
- determine which area in a space has a daylight factor larger than 0,03 and mark that area as daylight sector.

C.4.3 *Contribution of a daylight opening to the daylight sector*

If in a point at 0,8 m height above the top of the floor the daylight factor (*df*) is larger than or equal to 0,03, determined according to C.4.4.1, this point may be considered part of the daylight sector.

C.4.4 *Daylight factor*

C.4.4.1 *Calculation rule*

Calculate the daylight factor, *df*, according to:

$$df = sf + irc$$

where:

df is the daylight factor at a height of 0,8 m above the top of the floor;
sf is the sky factor, determined according to C.4.4.2;
irc is the internally reflected component, determined according to C.4.4.4.

NOTE
The contribution of the externally reflected component is ignored in the calculations.

C.4.4.2 *Sky factor*

Calculate the sky factor, *sf*, with:

$sf = sc$ H LTA H 0,7

where:

sf is the sky factor;
sc is the sky component, determined according to C.4.4.3;
0,7 is the factor for reduction of the daylight entrance through frames and pollution;
LTA is the light transmittance for the daylight opening determined according to appendix B of NEN 2057* or taken from table 22.

C.4.4.3 *Sky component*

Calculate the sky component, *sc*, according to

$$hc = \frac{E_{\text{CIE;i}}}{E_{\text{hor;vv}}}$$

where:

sc is the sky component, dimensionless;
$E_{\text{CIE;i}}$ is the illumination in a point in the reference plane, due to the visible part of the standard overcast CIE-sky, according to ISO 15469*, in lux;
$E_{\text{CIE;hor;outdoor}}$ is the outdoor illumination on a horizontal plane, under the standard overcast CIE-sky, according to ISO 15469*, in lux.

$E_{\text{CIE;i}}$ has to be calculated at a height of 0,80 m above the top of the floor.

Conditions for the determination of the sky component, *sc*, are:

- reduction of glass of other obstructions in the light opening is ignored;
- internal reflections are not taken into account. All surfaces are considered being mat black;
- light reflections from objects in the surroundings are neglected.

* For the correct edition of this standard, see appendix A.

C.4.4.4 *Internally reflected component*

Adopt the internally reflected component, *irc*, depending on the ratio of the glass area to the floor area from table C.2.

Table C.2: Computation values for the internally reflected component

Glass area per m^2 usable area of the considered space	Internally reflected component *irc*
0,02	0
0,05	0,001
0,07	0,002
0,1	0,003
0,15	0,004
0,2	0,005
0,25	0,006
0,3	0,007
0,35	0,008
0,4	0,009
0,45	0,010
0,5	0,011
glass area is the area of the light transmission opening according to 5.3 of NEN 2057*.	

NOTE
Table C.2 is based on the following reflection factors:

- ceiling: 70%;
- floor: 10%;
- walls: 40%.

For deviating relations between glass area and usable area the nearest value in table C.2 has to be taken.

C.5 Explanation internal heat production by persons and appliances

In the calculation, the heat loads for persons are present 24 hours per day, 30,5 days per month. The values are imposed values and are based on the following assumptions for area per persons and fractions of the time that persons are present:

* For the correct edition of this standard, see appendix A.

Table C.3: Internal heat production of persons during hours that ventilation is operated

Class of occupation density	m^2 per person	simultaneity	$q_{i;pers}$ W/ m^2
I	1	0,15	15
II	2,5	0,25	10
III	5,5	0,27	5
IV	14	0,42	3
V	20	0,40	2

In the calculation, heat loads for appliances are present 24 hours per day, 30,5 days per month. They are imposed values and based on the following assumptions for heat production and fractions of the time that the considered heat load is present:

Table C.4: Internal heat production of appliances

Building type	Heat production appliances during operation time $q_{i;app}$ [W/m^2]	fraction of time present f_{app} [-]	Average heat production through appliances $q_{i;app}$ [W/m^2]
office building, health care building, not clinical	15	0,20	3
educational building	5	0,15	1
health care building, clinical	8	0,50	4
catering building	10	0,25	3
shop building	10	0,25	3
assembly building	5	0,20	1
accommodation building	4	0,50	2
cell and penitentiary building	4	0,50	2
sports buildings	4	0,25	1

Appendix D

(normative)

Ventilation heat loss (Q_{vent}) per energy sector per month in case of loading cold in an aquifer with air conditioning units

This appendix offers a standardized method to determine the ventilation heat loss when cold is loaded in an aquifer with the help of air conditioning.

D.1 Procedure

The specific air flow due to mechanical ventilation is determined and the amount of cold to be stored. Then the temperature of the supply after heat exchange is determined based upon 1, 2, 3, 4, 5 and 6 months loading cold, the average outside temperature in that months, air flow due to mechanical ventilatiom in that months and the amount of cold to be stored.
From the six resulting values, completed with the maximum air temperature after loading cold, the lowest value is chosen. This value has to be taken as the average air temperature after preheating of supplied air as long as this temperature is higher than the average outside temperature.

The heat loss through natural ventilation is, per month, determined by the air flow through natural ventilation and infiltration, the inside temperature and the average outside temperature.
The heat loss through mechanical ventilation is, per month, determined by the air flow through mechanical ventilation, the inside temperature, the air temperature after preheating of the ventilation air and the efficiency of the heat recovery appliance.

D.2 Calculation rule

Calculate the ventilation heat loss per month with:

$$Q_{vent} = 2{,}63 \text{ H } (H_{vent;n} \text{ H } (\theta_i - \theta_e) + H_{vent;m} \text{ H } (1 - \eta_{hr}) \text{ H}(\theta_i - \theta_{lc}))$$

in which:

$$H_{vent;n} = 1{,}2 \text{ H } u_{v;heat;n} \text{ H } A_{g;sec}$$

and

$$H_{vent;m} = 1{,}2 \text{ H } u_{v:heat;m} \text{ H } A_{g;sec}$$

where:

Q_{vent} is the ventilation heat loss in MJ;
$H_{vent;n}$ is the heat loss coefficient for infiltration and natural ventilation of the energy sector in W/K;
θ_i is the inside temperature in EC, according to 13.3.3, taken from table 2;
θ_e is the outside temperature in EC, taken from table 3;
$H_{vent;m}$ is the heat loss coefficient for mechanical ventilation of the energy sector in W/K;
η_{hr} is the efficiency of the applied heat recovery appliances other than loading cold, taken

from table 6;

θ_{lc} is the temperature of the direct entering fresh outside air after preheating by loading cold in EC, determined according to D.4.2;

$u_{v;heat;n}$ is the specific air flow direct entering fresh outside air to be heated, in liter/(s∗m^2), due to infiltration and natural ventilation, determined according to D.3.1;

$A_{g;sec}$ is the usable area of the energy sector in m^2;

$u_{v;heat;m}$ is the specific air flow of direct entering fresh outside air to be heated, in liter/(s∗m^2), due to mechanical ventilation, determined according to D.3.2.

NOTES

1. As far as ventilation air (partially) is supplied via a conservatory/greenhouse or an atrium, $H_{vent;n}$ and $H_{vent;m}$ can be multiplied by a factor *a* for that part according to appendix B.
2. 1,2 = ρ_l H c_l,
   where:
   ρ_l is the density of air in kg/liter (= 0,0012 kg/m^3);
   c_l is the specific heat capacity of air in J/(kgAK) (= 1000 J/(kg∗K)).

D.3 Specific air flow of direct entering fresh outside air to be heated ($u_{v;n}$ and $u_{v;m}$)

D.3.1 *Specific air flow infiltration and natural ventilation*

Determine the specific air flow due to infiltration and natural ventilation, to be heated, with:

$u_{v;heat;n} = u_{v;inf} + f_{vent;sec}$ H $u_{v;n}$

where:

$u_{v;heat;n}$ is the specific air flow of direct entering fresh outside air to be heated, in liter/(s∗m^2), due to infiltration and natural ventilation;

$u_{v;inf}$ is the computation value for the specific air flow due to infiltration, taken from table 4, in liter/(s∗m^2);

$f_{vent;sec}$ is the weighed average time fraction that the ventilation is operated in the energy sector, determined according to 6.5.2.2;

$u_{v;n}$ is the specific air flow of direct entering fresh outside air, due to natural ventilation during operation time, determined according to 6.5.3, in liter/(s∗m^2).

D.3.2 *Specific air flow through mechanical ventilation*

Determine in the specific air flow due to mechanical ventilation, to be heated, with:

$u_{v;heat;m} = f_{vent;sec}$ H $u_{v;m;e}$

where:

$u_{v;heat;m}$ is the specific air flow of direct entering fresh outside air to be heated, in liter/(s∗m^2), due to mechanical ventilation;

$f_{vent;sec}$ is the weighed average time fraction that the ventilation is operated in the energy sector, determined according to 6.5.2.2;

$u_{v;m;e}$ is the specific air flow of direct entering fresh outside air, in liter/(s∗m^2), due to mechanical ventilation during operation time, determined according to 6.5.3.

D.4 **Temperature pre-heated air by loading cold**

D.4.1 *Principle*

When in the winter cold is stored through preheating the supply air, the ventilation heat loss will become smaller. To be able to determine the heat conservation through the preheating of supply air, the average temperature of the after heat exchange has to be found. Take for temperature of the ventilation air after preheating through loading cold the outside temperature, from table 3, unless the temperature of ventilation air after preheating through loading cold according to D.4.2 is higher.

D.4.2 *Temperature of the ventilation air after preheating through loading cold*

Take as temperature of the ventilation air after preheating through loading cold the lowest numerical value of $\theta_{lc;1}..\theta_{lc;7}$.

in which:

$\theta_{lc;1} = 9$
$\theta_{lc;2} = 1/6 \text{ H } (26{,}1 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e}))$
$\theta_{lc;3} = 1/5 \text{ H } (17{,}6 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e}))$
$\theta_{lc;4} = 1/4 \text{ H } (11{,}7 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e}))$
$\theta_{lc;5} = 1/3 \text{ H } (6{,}7 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e}))$
$\theta_{lc;6} = 1/2 \text{ H } (3{,}7 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e}))$
$\theta_{lc;7} = 1{,}7 + Q_{lc}/(2{,}63 \text{ H } 1{,}2 \text{ H } A_{g;sec} \text{ H } f_{vent;sec} \text{ H } u_{v;m;e})$

where:

$\theta_{lc;1}...\theta_{lc;7}$	is the temperature of the ventilation air after preheating through loading cold in EC;
Q_{lc}	is the amount of cold to be stored in MJ, determined according to D.4.3;
$A_{g;sec}$	is the usable area of the energy sector in m^2;
$f_{vent;sec}$	is the floor area weighed average time fraction that the ventilation is operated in the energy sector, determined according to 6.5.2.2;
$u_{v;m;e}$	is the specific air flow of direct entering fresh outside air to be heated due to mechanical ventilation during operating time determined according to 6.5.3, in liter/(s*m^2).

NOTES

1. 26,1 is the sum of the outside temperatures in the months November up to and including April, taken from table 3.
2. 17,6 is the sum of the outside temperatures in the months November up to and including March, taken from table 3.
3. 11,7 is the sum of the outside temperatures in the months December up to and including March, taken from table 3.
4. 6,7 is the sum of the outside temperatures in the months December up to and including February, taken from table 3.
5. 3,7 is the sum of the outside temperatures in January and February, taken from table 3.
6. 1,7 is the outside temperature in the month January, taken from table 3.

7. $1{,}2 = \rho_l$ H c_l,
   where:
   ρ_l is the density of air in kg/liter (= 0,0012 kg/m^3);
   c_l is the specific heat capacity of air in J/(kgAK) (= 1000 J/(kg*K)).
8. The value 2,63 is explained in C.3.

D.4.3 *Amount of cold to be stored*

Determine the amount of cold to be stored with:

$$Q_{lc} = 1{,}15 \text{ H } a \text{ H } Q_{dem;cool;room} / \eta_{sys;cool}$$

where:

Q_{lc}	is the amount of cold to be stored, in MJ;
a	is a weighing factor for the share of cold storage in cooling: - for cold storage in combination with other cold generator(s) a = 0,8; - in all other cases a = 1;
$Q_{dem;cool;room}$	is the cooling demand at space level, in MJ, determined according to 10.3.4;
$\eta_{sys;cool}$	is an imposed distribution system efficiency for comfort cooling of which the value, related to the system numbers according to table 15, amounts to: - system 7, with individual control 1,0; - systems 2 up to and including 4, with individual control 0,85; - system 3 without individual control 0,8; - system 7 without individual control 0,75; - system 6 and system 8 0,6; - systems that create the required air supply temperature by mixing a heated and cooled air flow: 0,4.

NOTE
To prevent exhaustion of the cold storage in the ground in the summer, 115% of the cold withdrawn in the summer has to be stored in winter.

Appendix E

(normative)

Width of the daylight sector for daylight openings with obstructions and/or overhangs

Additional indices

d light transmission part
b obstruction
u external reduction

Take the projection plane for vertical daylight openings and for daylight openings inclined to outside according to chapter 5 of NEN 2057[*]. Take for the inclining daylight openings the vertical plane that goes through the highest, most extreme sides of the light transmission opening, however not higher than 4 m above the top of the floor.
Determine the width of the daylight sector at the daylight opening, w_{daylight}, to the inside, perpendicularly from the thus determined projection planes.

Determine the width of the daylight sector for each part of the floor area behind a vertical daylight opening, or behind a part of a daylight opening that can be considered as such, according to:

If (A_d H C_b H C_u H LTA) is smaller than or equal to (0,7 H $l_{\text{daylight;hor}}$) then applies:

$w_{\text{daylight;hor}} = 0$ m

If (A_d H C_b x C_u H LTA) is larger than (0,7 H $l_{\text{daylight;hor}}$) and smaller than or equal to (1,2 H $l_{\text{daylight;hor}}$) then applies:

$w_{\text{daylight;hor}} = 2$ m

If (A_d H C_b x C_u H LTA) is larger than (1,2 H $l_{\text{daylight;hor}}$) then applies:

$w_{\text{daylight;hor}} = 3$ m

where:

w_{daylight}	is the width of the daylight sector, in m;
$l_{\text{daylight;hor;1,2,..}}$	is the front length of the part of the daylight sector belonging to daylight opening or group of daylight openings 1,2,..., determined according to 8.3.2.5, in m;
A_d	is the area of the light transmission part of a daylight opening determined according to chapter 5 of NEN 2057[*], that also complies with the conditions formulated under 8.3.2.2 , in m^2;
C_b	is the obstruction factor determined according to chapter 6 of NEN 2057[*];
C_u	is the external reduction factor determined according to chapter 7 of NEN 2057[*];
LTA	is the light transmittance of the daylight opening determined according to appendix B of NEN 2057[*] or taken from table 22.

* For the correct edition of this standard, see appendix A.

Appendix F

(normative)

Co-generation

F.1 Principle

Application co-generation means that heat, as well as power is generated. The heat generated will be used for heating, domestic hot water and eventually an absorption chiller. The co-generation utility is supposed to be switched as the preferential system. Appreciation of co-generation is limited to the maximum of heat to be utilised in the building. A part of the generated power is utilised for own use. The remaining part is supposed to be delivered to the public net.
The contribution of the co-generation in covering the electricity demand of the building and the electricity delivered back to the public net are both deducted from the characteristic yearly primary energy consumption ($Q_{\mathrm{prim;comp;cog}}$).

F.2 Calculation rule

Determine $Q_{\mathrm{prim;comp;cog}}$ for not-building bound co-generation as:

$Q_{\mathrm{prim;comp;cog}} = 0$;

Determine the diminution of the primary energy consumption for power through application of building bound co-generation,$Q_{\mathrm{prim;comp;cog}}$, with:

$$Q_{\mathrm{prim;comp;cog}} = Q_{\mathrm{dem;heat;gross}} \,/\, (\eta_{\mathrm{el;ref}} \;\mathrm{H}\; \varepsilon_{\mathrm{cog;th}} \,/\, \varepsilon_{\mathrm{cog;el}})$$

where:

$Q_{\mathrm{dem;heat;gross}}$ is the gross heat demand for space heating, domestic hot water and absorption cooling that is covered by co-generation, determined according to F.3.1, in MJ;

$\eta_{\mathrm{el;ref}}$ is the reference generation efficiency for electricity by co-generation, determined according to F.4;

$\varepsilon_{\mathrm{cog;el}}$ is the electric conversion value for co-generation, being the fraction of the used primary energy through a co-generation-installation that is converted into electricity, taken from table F.1;

$\varepsilon_{\mathrm{cog;th}}$ is the thermal conversion value for co-generation, being the fraction of the used primary energy through a co-generation-installation that is converted into useful utilised heat, taken from table F.1.

Table F.1: Electrical- and thermal conversion values, $\varepsilon_{cog;el}$ and $\varepsilon_{cog;th}$, for co-generation

Electrical power	$\varepsilon_{cog;el}$	$\varepsilon_{cog;th}$
mini Co-generation; $5 < P_{cog} < 20$	0,26	0,57
gasmotor; $20 < P_{cog} < 200$	0,27	0,54
gasmotor; $200 < P_{cog} < 500$	0,32	0,50
gasmotor; $500 < P_{cog} < 1000$	0,35	0,44
Co-generation; $1000 < P_{cog} < 25000$	0,36	0,40
P_{cog} is the electric power of the co-generation unit, in kW.		

Deviating values should be rounded downwards to a multiple of 0,01

NOTE
The lower limit of the electrical power of 5 kW should prevent to use, in case of co-generation with relatively a small amount of power generation, optimistic conversion values. For such facilities, amongst them micro co-generation, cannot yet be given adequate values.

F.3 Gross heat demand that is covered by co-generation

F.3.1 *Calculation rule*

Determine the gross heat demand that is covered by co-generation with:

$$Q_{dem;heat;gross} = Q_{dem;heat;gross;heat} + Q_{dem;heat;gross;cool} + Q_{dem;heat;gross;dhw}$$

where:

$Q_{dem;heat;gross}$ is the gross heat demand that is covered co-generation, in MJ;
$Q_{dem;heat;gross;heat}$ is the share of co-generation in the gross heat demand for space heating, determined according to F.3.2, in MJ;
$Q_{dem;heat;gross;cool}$ is the share of co-generation in the gross heat demand for absorption cooling, determined according to F.3.3, in MJ;
$Q_{dem;heat;gross;dhw}$ is the share of co-generation in the gross heat demand for domestic hot water, determined according to F.3.4, in MJ.

F.3.2 *Gross heat demand for heating covered by co-generation.*

F.3.2.1 *Gross heat demand for heating for the whole building covered by co-generation*

Determine the gross heat demand for heating for the whole building that is covered by the co-generation with:

$$Q_{dem;heat;gross;heat} = Q_{dem;heat;gross;heat;1} + Q_{dem;heat;gross;heat;2} + \ldots$$

where:

$Q_{dem;heat;gross;heat}$ is the gross heat demand for heating for the whole building that is covered by the co-generation, in MJ;
$Q_{dem;heat;gross;heat;1,2,...}$ is the gross heat demand for heating for energy sector 1,2,... covered by the co-generation, determined according to F.3.2.2, in MJ.

F.3.2.2 *Gross heat demand for heating per energy sector*

If the heat generation capacity of the co-generation installation for the energy sector is less than 10% of the capacity of all heat generators for the energy sector, take for the gross heat demand for space heating that is covered by co-generation:

$Q_{dem;heat;gross;heat} = 0$

Determinde in all other cases the gross heat demand for space heating per energy sector, that is covered by co-generation with:

$Q_{dem;heat;gross;heat} = Q_{dem;heat;gross;heat;m1} + Q_{dem;heat;gross;heat;m\,2} + ... + Q_{dem;heat;gross;heat;m\,12}$

in which:

$Q_{dem;heat;gross;heat;m} = f_{pref}$ H $Q_{dem;heat;m} / \eta_{distr}$

where:

$Q_{dem;heat;gross;heat}$ is the gross heat demand for space heating in the energy sector, in MJ, covered by co-generation;
$Q_{dem;heat;gross;heat;m1,2..}$ is the gross heat demand for space heating in the energy sector in month 1...12, in MJ;
$Q_{dem;heat;m}$ is the heat demand for space heating per energy sector per month, determined according to 6.3.2.3;
η_{distr} is the distribution efficiency for heating of which the value amounts to:
- heat distribution pipes inside building: 1,0;
- heat distribution pipes (partial) outside building: 0,95;

f_{pref} is the share of co-generation in the primary energy consumption for heating, determined according to 6.8.2.2.

F.3.3 *Gross heat demand for absorption cooling.*

In case of an absorption chiller for which co-generation supplies the thermal energy, determine the gross heat demand for absorption cooling, $Q_{dem;heat;gross;cool}$, in MJ, as:

$Q_{dem;heat;gross;cool} = Q_{dem;cool;1} + Q_{dem;cool;2} + ...$

where:

$Q_{dem;cool;1,2,..}$ is the cold demand for comfort cooling in energy sector 1,2,..., determined according to 10.3.3, in MJ.

In all other cases applies:

$Q_{dem;heat;gross;cool} = 0$

F.3.4 *Gross heat demand for domestic hot water*

If domestic hot water is prepared with heat from co-generation, than applies :

$$Q_{dem;gross;dhw} = 0{,}65 \text{ x } \left(\frac{Q_{dem;dhw}}{\eta_{sys;dhw}} - Q_{ses;dhw} \right)$$

where:

$Q_{dem;heat;gross;dhw}$ is the share of co-generation in the covering of the gross heat demand for domestic hot water preparation, in MJ;

$Q_{dem;dhw}$ is the net heat demand for domestic hot water preparation, determined according to 12.3, in MJ;

$\eta_{sys;dhw}$ is the system efficiency for the warm water distribution, determined according to 12.4;

$Q_{ses;dhw}$ is the yearly energy contribution of a solar energy system, determined according to 12.5, in MJ.

NOTE
0,65 is an imposed value for the share of covering of the gross heat demand for domestic hot water preparation by co-generation, multiplied by the efficiency of the heat exchanger and considering the heat losses between the co-generation unit and the heat exchanger. These losses can not be used within a building in summer.

In all other cases applies:

$Q_{dem;heat;gross;dhw} = 0$

Appendix G
(informative)

System boundaries model

G.1 Background

In the present standard several elements that cannot be influenced by the applicant of a building permit, are valued, like district heating. The development of EPD (Energy Performance of a District) is aimed at the valuation of different options for energy supply to a whole district. The model based on system boundaries offers better possibilities to distinguish between own (heat or power) generation and public heat and power generation on which the building/house owner has no influence. The model based on system boundaries can structure the standard through equal handling of all energy forms.

G.2 Principle

The principle of the model based on system boundaries is the energy performance of building and building services will be determined on several levels:

First, there is the net energy demand of a building, depending on non-services aspects like building form, building use, orientation, for example: $Q_{\mathrm{dem;heat}}$.

These demands will be covered by an indoor climate conditioning installation. Energy distribution within the building and subsequent energy waste will be expressed in the (distribution) system efficiency. The net energy *demand* for the generation appliances will, for example for heating, be expressed as:

$$Q_{\mathrm{heat}} = \frac{Q_{\mathrm{dem;heat}}}{\eta_{\mathrm{sys}}}$$

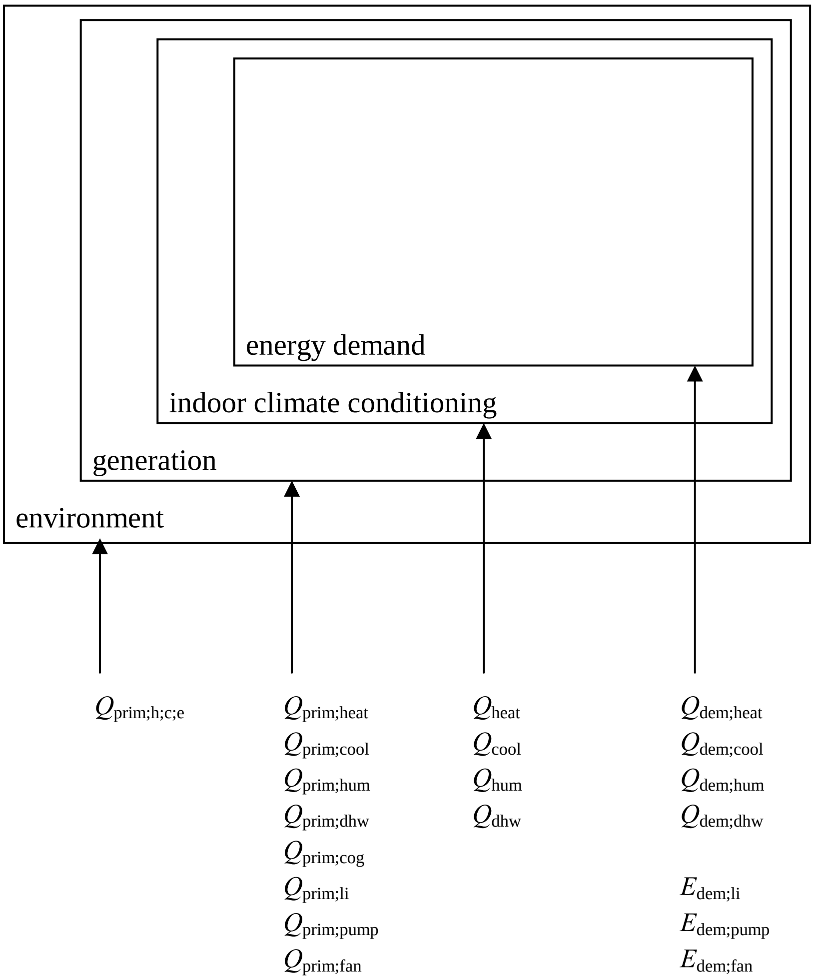
The energy demand can be fulfilled by generation appliances within the building and generation appliances outside the building.

Generation appliances *outside* the building deliver energy in usable form at the building boundary (for instance power or heat from a district heating system). Within the boundaries of the building the generation efficiency is 100% (within the building no energy conversion takes place). The energy conversion takes place elsewhere. The required primary energy can, for instance for power, be calculated as:

$$Q_{\mathrm{prim;el}} = \frac{Q_{\mathrm{building;el}}}{\eta_{\mathrm{EPD;el}}}$$

For generation appliances *within* the building the primary energy needed for conversion to usable energy can directly be determined, expressed with the generation efficiency, for instance for space heating with:

$$Q_{\mathrm{prim;heat}} = \frac{Q_{\mathrm{heat}}}{\eta_{\mathrm{gen;heat}}}$$



in which
h;c;e = heat; cold; electricity

Figure G.1 Scheme of system boundaries model

Generally formulated as:

$$Q_{used} = \frac{Q_{demand}}{\eta_{sys}}$$

$$Q_{building} = \frac{Q_{used}}{\eta_{gen}}$$

$$Q_{prim} = \frac{Q_{building}}{\eta_{EPD}}$$

For EPD applies η_{opw} = 100% in the case that energy is generated/converted outside the building.
For EPD applies η_{epl} = 100% in the case that energy is generated/converted inside the building.

Appendix H
(informative)

Relevance of the standard in the Building Regulations

The standard is especially for the utilisation of solar heat and internal heat and the utilisation of "free" coolness based on well-isolated buildings.
That is why the calculated energy flows give only a good representation of the reality with well isolated buildings, apart from the influence of all other imposed fixed values. Because the used calculation methods for the determination of the energy consumption of heat and cold are intrinsic safe, the use of the calculation method badly isolated buildings will not lead to exorbitant deviations. The instrument remains moreover unequivocal. That is why the application in building regulations can be justified also for existing buildings. If the method is used for choice of energy conservation measures, application of the standard may lead to (economic) not rational decisions, especially for existing buildings.

The requirements for new non-residential buildings (Building Decree, chapter VI and VII) are in power also in case of a total renovation of a non-residential building. In case of partial renovation, changing or enlarging a non-residential building, if it does not concern a building that is built after the introduction of the energy performance standardization, the requirements for new buildings are not in force, based on article 4 of the Housing Act, and the exemptions according to the articles 408 up to and including 410 of the Building Decree play no role.