Cost-effective Low-energy
Advanced Sustainable Solutions
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Newsletter 2

An operational guideline for very low- energy buildings and the Class 1 requirements for Stenlose Syd (Dk) available on the Class 1 web site

Low energy houses and low energy Class 1

The definition of low energy houses is bound to be dependent on the country and climate which it concerns. Generally, a low energy house is a house that uses considerably less energy to maintain comfort conditions than a house built according to the standard that is current practice at the location in question. For example four low energy house definitions are currently in use in Denmark and, according to the Danish Building regulation, a dwelling can be classified as **a low energy class 1 house if the needed energy for heating, ventilation, "cooling" and hot water use (as defined in the energy frame) does not exceed 35+1100 kWh/A kWh/m²/year** (where A is the heated floor area).

After the reminder of some definitions of a low energy house, such as for example the “Passive house”, the deliverable 21 deals with the Class 1 guideline.

Example of the Passive house: The so-called "Passive house" - concept has achieved widespread use in several countries in Europe. The term passive refers to the overall idea that the houses do not need a conventional heating system. The complete definition and much more about passive houses can be found at http://www.passivhus.dk/. The key technical requirements are:

- Net space heating demand: below 15 kWh per year per m² net area
- Total primary energy: below 120 kWh per year per m² net area
- Infiltration: air change rate below 0.60 h^{-1} by pressure test with 50 Pa.

Synthesis on the Guideline for low energy buildings

The deliverable 21 gives **an operational guideline for such low – energy buildings** and it is possible to download this deliverable 21 on the Class 1 web site. It has been worked out by Marco Citterio (Enea – IT), Ove Christen Morck (Cenergia – DK) and Kirsten Engelund Thomsen (SBi – DK).

The project has a special focus on the Indoor Environmental Quality (IEQ) to make sure that the energy savings are met without reducing the IEQ standards set out in the design specification phase. The IEQ focus is one of the areas in which the Class 1 project involves partners from other EU countries who are experts in respectively lighting and thermal comfort issues. Also trans-national cooperation is introduced for the socio-economic research part of the project, which deals with the user point of view (priorities, etc.) in the participating countries.

The Class 1 project demonstrates improvements to 6 individual technologies (windows, slab and foundation insulation systems, bio-mass gasification, local district heating distribution networks, ventilation heat recovery combined with heat-pumps and BEMS) and an innovative integration of these technologies (with solar heating) which lead to improved cost effectiveness.

These guidelines are the reference documents for the Stenlose Syd project and aim to build low energy houses.

The Low energy houses definition depends on the country's climate and these different guidelines have been developed for the Danish conditions. The document is composed of seven items:

- **the thermal envelop** with the planning and designing phases (for buildings as well as for ventilation with heat recover) and the work in progress,
- **airtightness**,
- **heating systems** with: the planning and design phase (for gas boiler and hot water tank, heating pipes and domestic water pipes, floor heating, radiators, the combination of radiators and floor heating) and for execution.
- **indoor environmental quality** with: positioning of the building and exterior influence, building design and arrangement, building construction and materials, ventilation systems, heating systems, apparatus, operation and maintenance, the building and the plot (for the positioning and orientation of the building, for outer walls, for windows and solar shading, for heating systems and for the choice of ventilation systems).
- **thermal comfort** with main chapters: fundamentals and design planning
- **daylight and visual comfort** in residential houses,
- **the user's influence**: the Class 1 Guideline suggests a list of content for the user guide: Introduction - on the importance of energy efficient behaviour, your energy efficient home - concept and technologies, how to run your house and the use the Building Energy Management System (MEMS) for energy intelligent automatic control of your home.

First, the document reminds of the already high standard requirements in the Danish Buildings Regulations (DBR) and the Low Energy Houses definitions according to the DBR.

Energy consumption for heating, ventilation, cooling and hot water must be less than:

- For Low energy class 2 : 50 + 1600/A in kWh/m².year where A is the heated floor area
- For Low Energy class 1 : 35 + 1100/A in kWh/m².year where A is the heated floor area

Passive House and Dwelling+ Houses (energy neutral) are also other low energy solutions.

For each item, a specific guideline reminds of:

- The reasons why this item must be taken into account in the building planning and design,
- Danish building regulations,
- Topics for planning and design,
- Checklist – demands for an efficient design related to the item,
- The measuring and execution process.

In summary, the guidelines focus on the double objective of Low Energy Houses: low energy consumption and high comfort level for users. These two items are always analysed together because it is not acceptable to have a very low energy house which does not allow a good comfort for their inhabitants.

The guidelines present all the focus points which must be taken into account in the construction and operation process. In the following, we will concentrate on the main points.

In the design phase, the focus is on the necessary cooperation between architect and engineer, choice of a compact shape of construction, the prevention of thermal bridges, a high level of insulation (in order to minimise energy demand), the use of solar energy, and the use of ventilation with heat recovery.

Low Energy Buildings particularly require very high efficiency boilers (labelled), an efficient airtight layer (in relation to the reduction for air renewal in order to avoid any moisture).

The indoor environmental quality participates to the greater comfort in the dwellings and eventually to the users' quality of life. A good indoor climate depends on many parameters which must be included in the building planning and design: exterior factors (air pollution, noise), building design and layout, building materials, ventilation systems, heating system, and apparatus (in offices). These factors also imply an efficient maintenance in order to avoid creating discomfort and potential health risks. The guideline focuses on the positioning and orientation of the building which have also an impact on daylight, views and the orientation of rooms for occupancy.

Among the innovative technologies which contribute to the indoor environmental quality, the guideline focuses on the new generations of glazing and also on solar shading systems.

In the residential houses guideline, glazed surfaces, solar shading and ventilation are key factors.

For the Stenlose project, shading and ventilation systems have been calculated by mean of dynamic simulation performed with TRNSYS code. Results show that the reference building presents good winter thermal comfort conditions and a moderate risk of overheating ($Ti > 27.5$ °C) during summer (11 % in the living room and 13 % in the kitchen). Improving the ventilation rate and the solar shading (up to 80 % when the indoor temperature exceeds 24 °C) reduces this risk to respectively 0.6 % and 3.6 %. Detailed calculations are presented in the appendix of the guideline document.

The daylight guideline proposes six principles in order to optimise the comfort related to daylight, i.e. to provide gentle and uniform light, to avoid creating sources of glare, to allow the control of daylight by the users, to plan the layout of the interior to take advantage of daylight conditions. Electric lighting system is only considered as a complement to daylight.

Finally, the document presents a guideline for users, because they have a strong influence on the building energy performance. The guideline focuses on the necessity for the users to have a good understanding of their building and on the opportunity to use BEMS system in Stenlose Syd.