Bolig for livet - Home for life

- energi, æstetik, komfort - med mennesket i centrum

Hansen, Ellen Kathrine; Lildholdt, Rikke

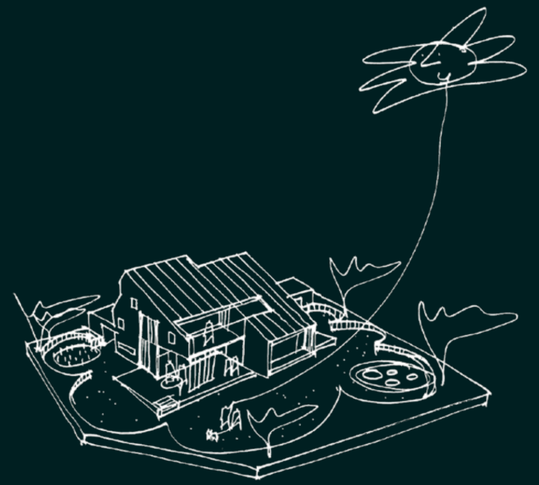
Publication date:
2009

Document Version
Tidlig version også kaldet pre-print

www.VELFAC.dk/boligforlivet

VELFAC®

HOME FOR LIFE



Energy, aesthetics and comfort
– with humans in the centre

HOME FOR LIFE

»One test is worth more than 1000 expert assumptions«

Villum Kann Rasmussen

Therefore we are building real houses and trying things in practice. The purpose is to develop new knowledge about energy efficiency, comfort and aesthetics of future houses. The houses will therefore be tested by a family for a period of one year.

CO_2 emissions shall be reduced

Scientists have confirmed that in 40 minutes, there is enough sun energy on the earth's surface to cover the world's energy use for a whole year; good information in a time where climate changes develops faster than until now expected. But it requires that we are able to »harvest« the sun – and on a much bigger scale develop and make use of new technologies.

The way we build and live has a large meaning for saving the environment in our everyday lives. Energy use for construction and operation of buildings in the West makes up about 40% of the total energy use – energy that is primarily based on coal and in that way is connected to high CO_2 emissions. There is a large challenge in developing the future building structure in such a way that it optimizes the use of sun energy and decreases the CO_2 emissions.

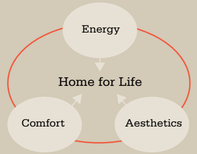
Table of contents

With humans in the centre

In the middle of 2007 when we began to develop Home for Life, we quickly agreed to start with people. Our proposal for the house of the future should not just be well insulated and self-sufficient with CO_2 natural energy. It should also be pleasant to live in. With a lot of daylight and fresh air, flexiblily with space for both reflection and being together. And not least should life, light and air be reflected in the architecture of the house.

Existing know-how put together in a new way

The Home for Life has been created through 10 interdisciplinary workshops, where experts from the construction industry, research institutes, architects, engineers and other leading specialists have worked together and developed a model (opposite side), where energy, aesthetics and comfort makes up one axis and objectives and means makes up the other.



Idea

Through development, building and documentation, Home for Life demonstrates how daylight and warmth can create a balance between energy, aesthetics and comfort – with humans in the centre.

Facts

Home for Life is developed by VELFAC and VELUX in conjunction with Aart Architects and Esbensen Consulting Engineers. Other participants in the project group are: The Engineering College of Aarhus, the Alexandra Institute, Aarhus School of Architecture, Danish Building Research Institute and the Municipality of Aarhus. KFS-Boligbyg is behind the constructing of the building.

Time plan

- First project meeting — September 2007
- First ground breaking — September 2008
- Official opening — April 2009
- Open house — 25 April – 28 June 2009
- Test period — 1 July 2009 – 30 June 2010

Address

Elmehaven 1
8520 Lystrup
(approx. 10 km north of Århus)

Active House

VKR Holding, which is the mother company for VELUX and VELFAC, has initiated the construction of eight demonstration houses in a number of European countries following the active house principle. The houses produce energy themselves and are built as examples of intelligent buildings with low energy use, a good indoor climate and an exciting architecture.

An active house contributes to a sustainable development in connection to:

- Creating balance between energy use and production.
- The life being lived in the house, indoor climate, function and health.
- Creating experiences in and around the house.

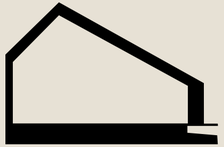
Home for Life will be ready as the first of eight active houses. The next example in Denmark will be Green Light House. The project is carried out by the Minicipality of Copenhagen, the University of Copenhagen, the Danish University and Property Agency, VELFAC and VELUX.

Home for Life – development model

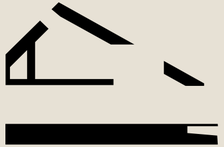
Program	Energy	Aesthetics	Comfort
Goal	Home for Life produces more energy than it uses. Energy surplus will pay back material energy costs over about 40 years. Energy consumption is covered by renewable energy sources and will be evaluated in the overall perspective and attempted to be minimized through optimized building design.	In Home for Life energy optimizing and high comfort are achived through beautiful solutions appealing to our senses and creating impression of presence, identification and significance. The artistic experience is created by spaciousness, which emphasizes energy optimized solutions, integration of renewable energy, the special characteristics of the place and the potential of daylight.	In Home for Life functional surroundings and a good indoor atmosphere shall ensure a comfortable and healthy life in the house. Comfort and indoor atmosphere are optimized through the building's design with a focus on good daylight conditions, access to fresh air, good contact between indoors and outdoors and flexible plan composition in consideration for the choice of materials and maintenance.
Artistic effects			
Life	Energy consumption and production is a natural and integrated part of life in and around the house.	Life in the house and interaction with nature reflects in the expression of the 5 active facades and the spacious composition.	Functions and relations between the flexible rooms is a common theme.
Light	Optimization and active regulation of daylight to reduce the use of electric lights.	Synchronizing between light, materials and space. The active facades are dimensioned and oriented for optimal utilization of the aesthetic potential of light.	Light intake is shaped around the »light stories« which supports living in and around the house.
Air	The facade and building volume is optimized for natural ventilation which is complemented by mechanical ventilation controlled according to needs, and heat recirculation.	The building's design reflects natural air flow, passive heating and integration of renewable sources of energy externally on the southern exposure of the house.	High thermal comfort requirements. Plenty of fresh air and no draught.
Windows			
Profiles	New energy optimized windows with slim profiles of new heat insulating material. The slim profile ensures large heat and light access.	Slim profiles give a light and elegant impression. Light couplings and fixing details where profiles are not visible from inside. Facade coverings and flashings harmonize the material of the sash profiles.	The slim profiles give a good spatial coherence between inside and outside, together with no maintenance.
Lining	The linings improve the linear thermal transmittance and transmit the daylight deep into the room.	The linings optimize the intake of daylight and create a good spatial transition between in and out.	The linings make a room within the room and function as a piece of furniture for seating recesses.
Shields/Screens	External automatic sun screens optimize the light and warmth intake. Interior screening functions as night insulation.	Screening creates different expressions on the active facade depending upon need and climate. Screening allows optimal daylight intake in proportion to heat.	Screening supports the life that is taking place in the house's flexible and active rooms
Glass	Energy optimizing glass. 3-layer glass with argon.	Natural daylight.	No down-draught from the glass.
Control	Cordless, intelligent and integrated control for optimization of energy consumption via passive warming and screening of facades, control of light, ventilation and heating system.	Hidden.	Automatic control with possibility for manual operation via extended user interface. Control operates in conjunction with other functions to optimize comfort and usability.

From archetype to active house

1 *We use the archetype of a 1½ story saddle roof house with traditional insulation.*

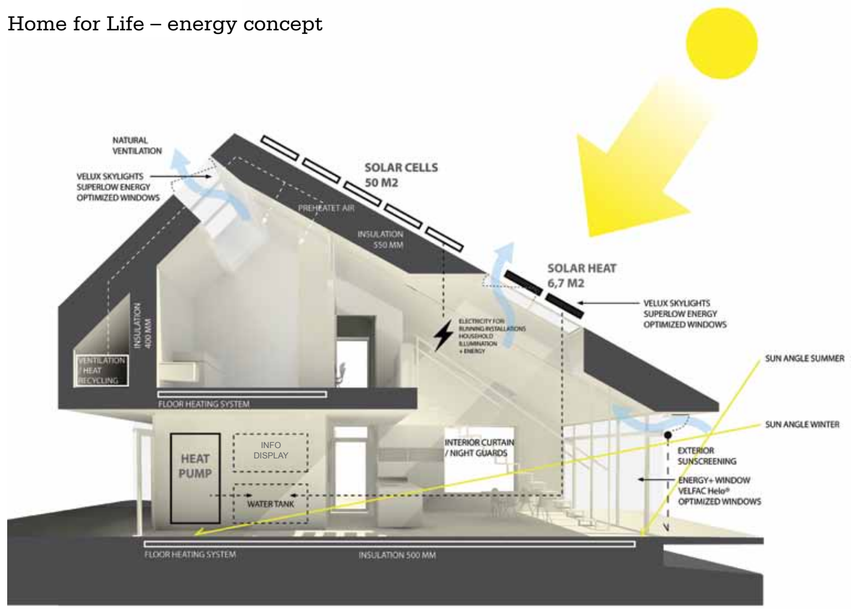


2 *We stagger the peak to make space for a big energy producing roof surface facing south. The house is well insulated and air sealed.*



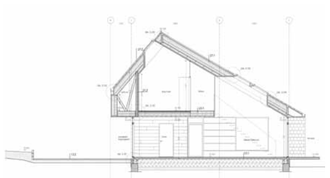
3 *We open up for daylight, fresh air and view. The area of the windows is 40% of the floor area.*

Home for Life – energy concept

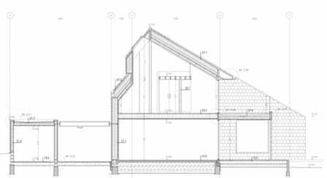


- Solar cells, solar heating and heat pump produce electricity, hot water and room heating.
- About 50% of the room heat consumption is covered by the passive sun heat from the energy optimized windows.
- Natural and mechanical ventilations as well as in- and outside sun screens ensure fresh air and a good room temperature.
- The control system for the house reduces the energy consumption and ensures a good indoor climate.

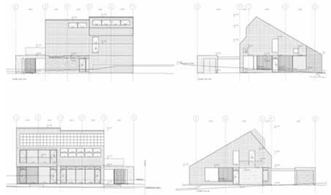
Section A-A



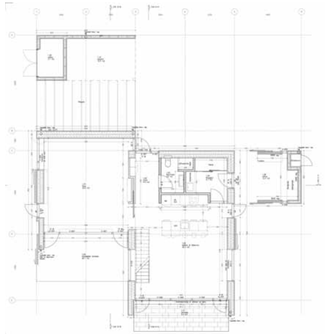
Section B-B



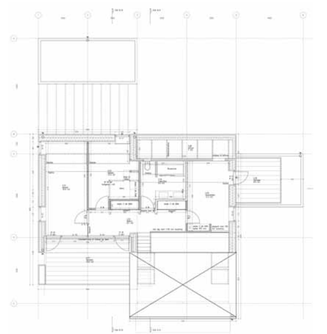
Facades



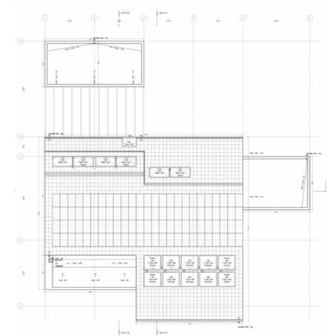
Main floor plan



First floor plan



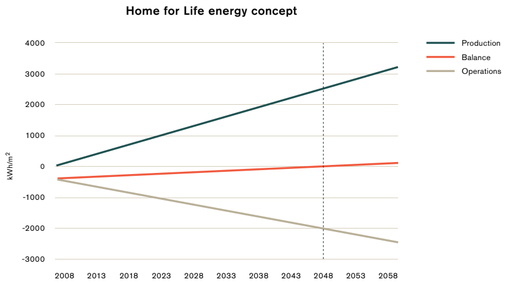
Roof plan

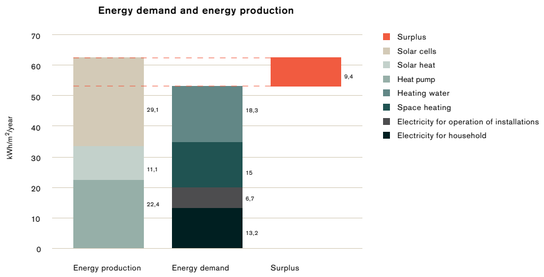


In Home for Life more energy is produced than consumed – and all energy is renewable

Energy

The energy goal for Home for Life is that the house is self-sufficient with energy. It produces more energy than consumed, and calculated according to Beat 2002, the energy for erecting the house will be paid back within a 30-50 year period. The graph below shows that the house will be paid back over approximately 40 years.





The graph shows that Home for Life produces an annual energy surplus. The energy surplus is calculated at 9.4 kWh/m²/year.

Energy production

All energy that is produced in Home for Life comes directly from the sun:

- The solar collectors produce hot water for household use.
- The heat pump produces room heating and supplements hot water for household use.
- The solar cells generate electricity for the house.
- Energy efficient windows with low u-value ensure the supply of passive heat.

Electricity production

50 m² of poly-crystalline solar cells are placed on the southern exposure of the roof surface of the house, integrated into the roof surface so that it appears as a unified whole. The solar cells cover the use of the electricity for the house both to operate the technical installations and household needs.

Room heating

About 50% of the room heating needs are covered by the passive solar heating. The rest is coming from a combination of floor heating and radiator heating. Floor heating is used in all common rooms and radiator heating in the bedrooms, so that the heat in these rooms can be regulated quickly. The heat circulates around the house by energy saving pumps. In general the design is made in such a way that the transmitting pipes are made as short as possible to avoid heat and pressure loss. The inlet temperature is kept as low as possible to ensure high efficiency of respectively the solar panels and the water pump heating; this is also to ensure lowest possible heat loss in the installations.

Household hot water heating

The solar collectors cover 50-60% of the yearly household hot water heating. In addition, solar collectors are also used as a supplement to room heating. Solar collectors make up an area of 6.7 m² and are integrated in the lowest part of the roof surface. The heat pump construction supplements the remaining parts. The heat pump functions by absorbing energy directly from the surrounding air by an air module that is placed outside the house. The heat pump is an interesting solution in connection with solar collector systems because it is more energy efficient and has a lot less CO_2 escape than e.g. oil or electric heating. The installed system is able to combine the energy from the solar collector system with the heat pump in an optimal way and by this, reduces the annual system expenses.

Daylight

The intake of daylight is optimized to reduce consumption of electric light. The window area amounts to 40% (against normal 20-25%), and the windows are placed in all 4 facades as well as on the roof to ensure a good natural light, distributed deep into all rooms. The daylight intake is modulated via simulations in VELUX Daylight Visualizer and model studies in a light lab.

In Home for Life the energy-optimized windows of the future with slim profiles are used; big light intake and good coupling and fixing possibilities, installed with 3-layer energy glass. The linings improve the linear thermal transmittance and transmit the light deep into the rooms. The house's active facades regulate the light and heat intake. The roof overhang facing south makes shade for a high summer sun and gives access for a low winter sun. Shutters and sun blinds regulate heat, light intake and privacy when needed.

Control of the house reduces energy use

The house is managed in such a way that the use of electricity and heat is minimized. In the summer the automatically controlled natural ventilation is used for airing the rooms. During the heating season mechanical ventilation with heating recovery is used so the cold air can be heated without the use of additional energy. Intelligent controls regulate the outdoor and indoor solar screening for optimizing warmth and light intake as well as putting off the lights when the room is not in use.

Material energy

Material energy is estimated in the estimation programme Beat 2002. Data has been collected for use in Beat (data processing according to UMIP method) for the components where it was possible. For other components, corrected producer's data has been used along with data for similar components.

Window area

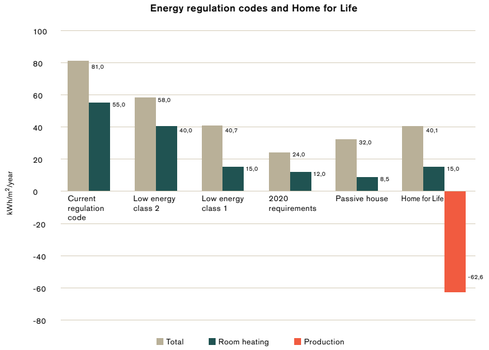
Total window area:	75 m²
Total floor area:	190 m²
Percentage of window area in relation to floor area:	40%

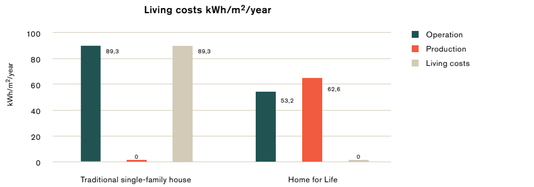
Differences between Home for Life and a traditional single family house

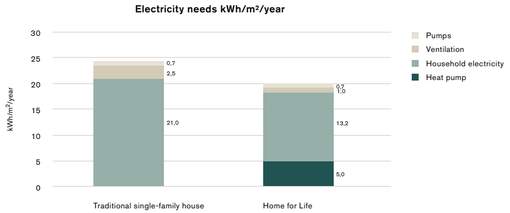
In Home for Life, there is more daylight, fresh air and contact between inside and outside, because the window area is almost double the area of that of a single family house. The house produces the energy that is consumed and therefore there is no energy expense or impact on the environment. In Home for Life there is a healthy and comfortable indoor climate and the interaction between energy, comfort and aesthetics creates an architectural composition. Since several of the energy technologies and energy optimising building components are not yet on the market, Home for Life is more expensive to build than a traditional house today.

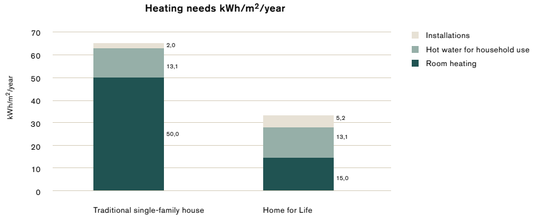
Energy regulation codes

Energy use in Home for Life conforms to a low energy class 1. But in contradiction to other regulation codes Home for Life produces it's own energy.









Energy use for heating in Home for Life is about 50% of the energy use in a normal newly built house following the Danish requirements for new buildings in BR2008.

Plenty of natural daylight, fresh air and good materials ensure that the house is healthy and comfortable to live in

Comfort

The house of the future shall be pleasant to live in and around. It must not be too warm in the summer and not too cold in the winter. It should be flexible so that it gives space for both togetherness and for peace and quiet. And it should be easy to maintain and use.

Ventilation

There is a lot of fresh air in Home for Life. In the winter the air enters in via the mechanical ventilation system that at the same time ensures that the warmth from the exhaust is reused. The equipment is programmed so that it adapts to the ventilation needs in the room. The air is circulated into the »clean« rooms (bedrooms and living rooms) and exhausted from the utility rooms (kitchen, bathroom, laundry room).

In the summer fresh air enters through natural ventilation that is controlled by a sensor in the house so that it is not ventilated more than necessary and at the same time, maintains a good indoor climate. The natural ventilation replaces the mechanical system with the result of energy savings.

Natural ventilation regulates the indoor climate of the building with the help of controlled air exchange through the windows in the facade and the roof. This is done by using the natural power that is created by the temperature difference between inside and outside, the thermal lift in the building together with the wind around the building. The ventilation takes place by a control opening and closing of the windows depending on the outdoor and indoor climate together with the need for fresh air.

Draught in connection with the air inflow from the mechanical ventilation equipment is avoided by intake with slow air flow in the residential areas. The ventilation system has built-in heating surfaces to avoid the intake of unintended cold air. The air intake for the natural ventilation is placed at a height to ensure the incoming air can be mixed with the room air before it reaches the living area.

Room heating and cooling

The temperature in each room can be regulated independently so it adjusts to the activities in the room.

The house can shield itself from the sun in the summer time, so it is not getting too warm indoors. The screening is designed to fit the conditions of the facade and its orientation; and is automatically regulated in such a way that the inside temperature remains stable.

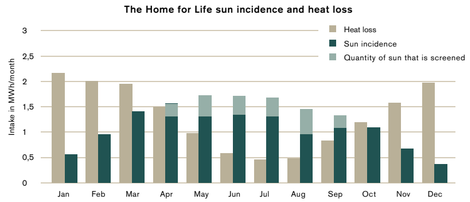
Home for Life is designed to make use of as much passive energy as possible. Passive energy in the form of high daylight levels, passive heat from the sun together with ventilation via thermal lift and wind influence on the facades.

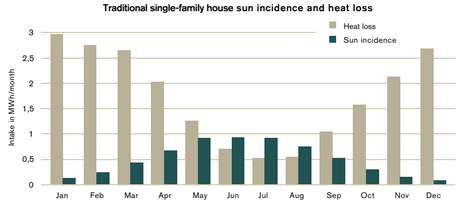
The active facade

In Home for Life comfort is obtained by the help of an active facade. An active facade:

- Regulates itself how much light and warmth comes in through the windows.
- Airs out itself, so there is always a healthy indoor climate in the house.

The active facade changes according to the seasons and needs. It can either be open to let the light and warmth in, or it can be closed to screen against the sun and maintain warmth during the night.





Life, light and air reflected in the architecture

Aesthetics

The principal architectural idea in Home for Life is to unite single-family house requirements to experience, functionality and energy consumption in an integrated design. It is the light incidence, the active facade, the relationship between in and out and the flexibility of the house that gives the high architectural quality.

The arrangement of the house

Home for Life is designed with good space for both togetherness and peace and quiet. Emphasis is placed on creating special places for active experiences and flexible utilisation. The house is located on the north-west part of the lot to give the best possible space for gardens as well as utilize the height of the lot against north. The building appears as a total, sculptured building body where the carport and outbuilding are integrated. The house makes use of the zoning plan's possibility for building in 1½ story which also contribute to optimize the view from the lot.

The Facade

The choice of slate covering on the facade and roof reflects both the wish for durability, low CO_2 influence and minimal maintenance, but also the wish to integrate the dark surfaces of the solar cells, the solar panels and the windows' in a sculptural composition. The wood covering and wood flooring, with their feeling of natural warmth, give a contrast to the hardness and cold expression of the slate.

Dissolution of borders between inside and outside

In the Home for Life the borders between inside and outside are dissolved. The windows and patio doors that reach to the floor make inside and outside flow together so the room appears larger and more airy, while the windows that go completely to the ceiling together with the skylights, ensure that the daylight comes deep into the rooms.

The relation between inside and outside is maximized and related to several activities in the house, From the laundry room there is a direct entrance to the covered and semi-insulated »multi-house« where vegetables can be stored, clothes can be dried under a roof and bicycles repaired.

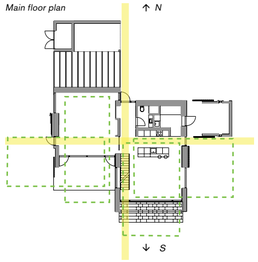
From the kitchen/family room, there is direct access to both the patio with morning sun to the east, the covered patio facing south and the active climate zone to the west. Also from the rooms on the first floor there is access to the outside. From the large south-facing patio there is a clear view over the Aarhus Bay. From the bedroom facing east there is an access to a smaller east-facing patio over the »multi-house«.

Daylight

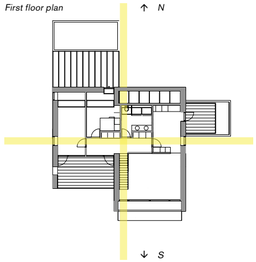
The use of light as sensory and ambient elements is the foundation for the composition in Home for Life. The house is organized around a »light cross« which provides light from all four sides. The main part of the rooms in the house have windows that face in at least two directions which besides being a source of light, also functions as an exit, ventilation opening, seating recesses, work place or as a frame around a view.

The placement and the size of the windows are harmonious with the position of the sun in the sky, seasons, energy optimization and the needs of the residents in the house. The large insulation thickness and the pitch of the roof create a natural overhang facing south that provides comfortable sun screening without destroying the view. Besides this, glaring is avoided with integrated screening both inside and outside.

Main floor plan



First floor plan



Light creates space

Kitchen/family room

The facade is open towards the south with a common window section that is vertically divided into five sections. The small upper window sections provide automatic ventilation via the WindowMaster control system. Two of the windows function as patio doors and provide access to the south-west patio. Because the window section reaches from the floor to ceiling, it seems that the room continues out to the patio. The horizontal cut-off of the roof overhang creates a shadow for the southern sun and prevents overheating. Two very large square window sections are placed opposite each other facing to the east and west.

Two skylights are placed in the kitchen/family room, one in each corner of the slant south-facing ceiling. The windows are placed so far out to the sides that the walls of the room facing east and west go the whole way up in the light funnel without crossing the ceiling. When standing on the balcony or the top of the stairs on the first floor, the skylights provide a view over the bay in the distance.

The southern facade windows and skylights generate a large amount of passive solar heat, which contributes to the positive energy balance of the house. In order to avoid overheating on a warm summer day it is important that the windows can be screened. The skylights are therefore fitted with outer electric sun-blinds that can reduce the heat accumulation from the sun by up to 90% and also contribute to improve the insulation value of the windows. Electric window blinds are mounted on the interior which makes it possible to adjust the quantity of daylight in the room and further improves the insulation value. Sun-blinds and curtains are operated electronically by io-homecontrol which also controls the climate comfort and thereby ensures that it is not too warm in the room. The skylights, sun-blinds and curtains are operated by solar cells and generate the energy themselves which is necessary for operation.

From the room it is possible to see the skylights facing north in the bedrooms and bathroom on the first floor. This view along the large characteristic sloped ceiling surface together with the north light in the room from here contributes to the fact that the room has a very diversified and differentiated daylight impression where there is light from all four corners of the world and from the sky.

Living room

The room opens facing south with a glass facade consisting of four window sections, of which two function as patio doors to the large covered patio. Over the doors there are smaller ventilation windows that open automatically and draw in fresh air as needed. The windows extend from floor to ceiling which makes the patio outside seem to be a part of the room. The covered patio protects against the warm southerly sun.

Bedroom 1

The room gets daylight from three different directions: cool north light through the skylight, warm sunlight through the large window sections facing south, together with the high and low placed west windows. The south facing panorama window opens to the view over the Aarhus bay. Facing south the roof overhang provides screening for the high sun in the summer months.

The facade and roof windows have outer solar screens and inner electric curtains.

Bedroom 2

This room has two high placed roof windows facing north and a combined VELUX facade/skylight section built in at a lower height. The facade section goes all the way to the floor and provides for daylight reflection into the room all the way down to the floor level.

The inside glass section above the wall facing south provides light from the kitchen/family room. The skylights are fitted with outer blinds. Black-out curtains are mounted on the inside.

Bedroom 3

This room has two vertical window sections oriented to the east that give the possibility of direct morning sun. The one window functions as a door to the east facing patio. The windows frame the view over the mountains of Mols. An inside window in the work niche ensures light form the large south facing skylight in the kitchen/family room.

Bedroom 1

VELFAC Helo facade windows

- Two fixed lights with linings and internal automatic roller blinds (facing west).
- Two patio doors and two fixed lights with external automatic roller blinds (facing south).

VELUX roof windows

- Two centre-pivot roof lights with solar operators, black-out blinds and awning blinds (facing north).

Bedroom 2

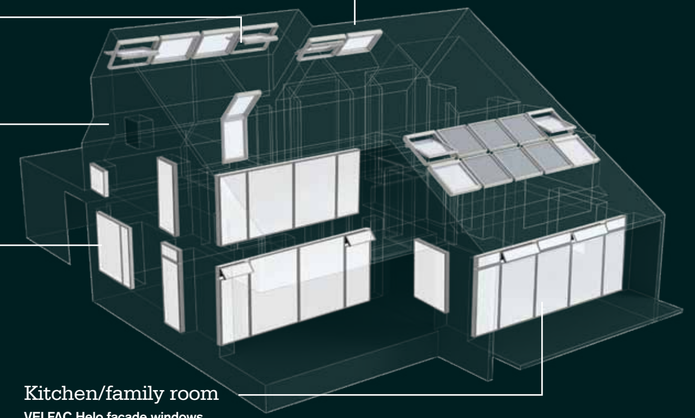
VELUX roof windows

- Two centre-pivot roof lights with solar operators, black-out blinds and awning blinds.
- One facade light and one centre-pivot roof light with manuelly operated black-out blinds (facing north).

Bathroom

VELUX roof windows

- Two centre-pivot roof lights with solar operators and roller blinds (facing north).



Living room

VELFAC Helo facade windows

- One fixed and one opening light with lining and internal automatic roller blinds.
- One patio door with motorised opening light on top and lining with internal automatic roller blind (facing west).
- Two fixed lights (in the middle) and two patio doors with motorised opening lights on top (facing south).

All facade windows in Home for Life are VELFAC Helo energy optimised triple-glazed windows with argon. All roof windows are VELUX triple-glazed.

Kitchen/family room

VELFAC Helo facade windows

- One fixed light with lining and internal automatic roller blind (facing west).
- Three fixed lights (in the middle) with one fixed and two opening lights on top. The two opening lights are motorised. Two patio doors with fixed lights on top. External automatic roller blinds (facing south).
- One fixed light and one patio door with a motorised opening light on top. Linings with internal automatic roller blinds (facing east).

VELUX roof windows

- Four centre-pivot roof lights with solar window operators, awning blinds and roller blinds.

Materials

The materials in the house have been chosen with a focus on them being as least harmful to the environment as possible. A large amount of natural materials are used which have a high durability and require a minimum of maintenance and contribute to a good indoor climate.

Sonnenkraft Solar Complete

Solar Complete is a unique combination of sun heat and heat pump technology where the sun is the driving force in the construction. Solar collectors catch not only the direct sunlight but also the indirect sunlight so it has a good effect even on a cloudy day. If there is a lot of sunlight, warm water will be transferred directly to the tank and the heating is completely free. On the other hand if it is cloudy or only partly sunny, the heat pump comes in function. The heat pump collects energy either directly from the air or from a combination of the air and the warm water from the solar collectors.

It is the combination of the heat sources that makes the system unique. Heat pumps have an operating temperature where they are most effective and by supplementing with solar heat to reach the most optimal temperature, the highest possible effectiveness and the lowest possible cost for heating can be ensured.

WindowMaster

WindowMaster supplies natural ventilation for Home for Life. Natural ventilation regulates the indoor climate of the building with the help of controlled air change through the windows. In Home for Life the air can be utilized optimally, because all rooms have windows in more than one direction and there is a high ceiling in some parts of the house. The height in the house helps to create thermal lift with large energy savings as a result. The WindowMaster system includes advanced motors built into the window profiles, together with intelligent controlling of natural ventilation. Natural ventilation is automatically controlled so the house airs itself out after predetermined time intervals. There is also the possibility to operate the system manually.

External

Roof surfaces:	Kongebro natural slate, Gaia Solar solar cells, VELUX solar panels and roof windows.
Facades:	Kongebro natural slate. Dinesen Douglas slats used as solar screening for windows. VELFAC Helo windows.
Patios:	Kongebro nautral slates. Concrete paving stones with Bornholm mosaic stone mixed.
Carport and multi-house:	Dinesen Douglas planks outside. White covering sheets inside.

Internal

Floors:	Kongebro natural slate in the kitchen/family room, entrance, utility room and in the bathroom on the main floor. Dinesen Douglas planks in the bedrooms and living room. Cast tiles of reused glass from Fliseuniverset on the 1st floor.
Walls and ceiling:	Generally flat white surfaces. Dinesen Douglas planks around the »core« of the main floor.
Kitchen:	Cabinets from Multiform. Appliances from Siemens and Gaggenau. Faucets from Damixa. Mosaic tiles from Fliseuniverset.
Bathroom on the main floor:	Fixtures from Catalano. Kongebro natural slate on the wall in the shower. Faucets from Damixa.
Bathroom on the 1st floor:	Fixtures from Catalano. Mosaic tiles made of reused glass from Fliseuniverset. Faucets from Damixa.
Lighting:	Louis Poulsen

Remainder

Mechanical ventilation:	Nilan
Natural ventilation:	WindowMaster
Solar heat pump:	Sonnenkraft
Playhouse:	Superwood
Indoor blinds:	Faber

Construction

The house is built of a light wood construction with load-bearing I-beams in wood and beams/joists in laminated wood. In special strained areas, steel beams are used where necessary. Stability and slice effects are obtained with the use of plywood mounted on the I-beams on the roof and outer walls. Corbels around the balcony and utility room on the 1st floor are built with laminated wood as load bearing. The corbel over the kitchen/family room is built as a steel frame.

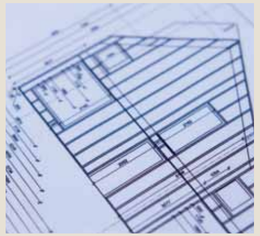
Linear thermal transmittance

To minimize the thermal loss in the best possible way, it was necessary to think in another way regarding the fixing of the windows and doors. It means that the windows were recessed 50 mm back into the facade – and thereby farther into the insulation so that the isotherms are placed as parallel as possible throughout the construction. Furthermore the windows and doors are supplied with lining both externally and internally. In order not to let the cold into the construction, the exterior lining is made of an insulated composite material (Helo). The interior lining gives the possibility of increased insulation behind the lining.

And the last thing is the stud construction around the windows that normally lies parallel to the facade; it is changed in Home for Life so that the necessary regler for fastening are perpendicular to the facade. With this initiative the linear thermal transmittance for Home for Life is as low as 0.02 W/m²*K.

U-values in the construction of the Home for Life

Walls:	0.10 W/m²*K (395 mm insulation)
Roof:	0.07 W/m²*K (540 mm insulation)
Ground level:	0.07 W/m²*K (500 mm insulation)



VELFAC Helo®

The active window of the future

With the vision to develop an energy+ window that supplies the buildings with more heat than disappearing and that complies with the strict energy requirements of the future for both new buildings and renovations, VELFAC Innovation Centre has developed VELFAC Helo.

VELFAC Helo is the window concept of the future where unique insulation properties are compatible with strength, durability, surface finish and design. The window contributes positively to the energy balance with regular 2- and 3- layer glass.

VELFAC Helo supports both the low-energy house concept by using under 15 kWh/m² and the active house concept where the house shall produce more energy than it uses.

The frame and sash of the window are made of a revolutionary new material – Helo-Fibre® that consists of PUR (polyurethane) strengthened with thin glass threads. VELFAC Innovation Centre tested initially more than 200 materials but did not find that the materials were capable of combining the required characteristics. Therefore VELFAC developed Helo-Fibre in conjunction with leading material suppliers in Europe and North America. The material combines for the first time, unique insulation ability with strength, durability and surface finish.

Helo-Fibre is not only particularly suitable for the production of weather resistant low energy windows in high quality; the material is distinguished by the ability to be produced with a uniform beautiful surface. On the basis of its strength the material can be used in a very slim construction and in very large sizes. This gives the possibility to develop unique high-quality windows in a beautiful design with a large unhindered daylight intake.

In 2009/2010 VELFAC Helo will be offered for sale for specially chosen low energy buildings.

VELFAC 200i

In Home for Life VELFAC gives a forecast about active facade windows of the future – VELFAC Helo. But on 1. January 2009 VELFAC introduced two new highly effective energy-packages: VELFAC 200i and VELFAC 400i.

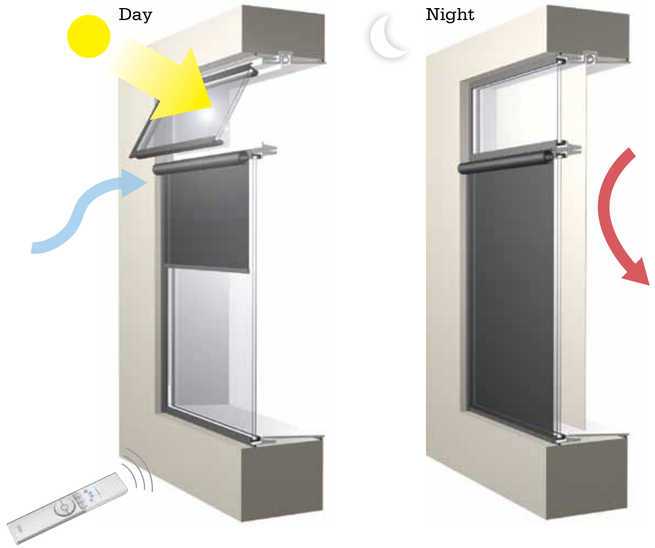
The the new VELFAC 200i and VELFAC 400i windows are energy optimized with:

- Thermal break (composite material) between wood and aluminium
- Warm edge
- Reinforced glass assortment
- Energy glazing bars

In total, the energy-packages provide up to 40% improvement of the energy balance; 15% improvement of the dark U-value (Uw) and 32% improvement of edge-zone temperature on the window.

Energy performance – VELFAC Helo®

1. **Solar energy**
   Supply of daylight and energy.
2. **Natural ventilation**
   Automatic control of opening/closing functions.
   Good indoor climate is ensured.
3. **External sun screening**
   Solar energy supply is regulated.
   Up to 88% of solar heat is blocked.
4. **Insulation – U-value**
   Good insulation qualities.
   High strength.
   Basis for energy optimizing.
5. **Active window**
   Positive supply to energy balance.
6. **Internal lining**
   Linear thermal transmittance is reduced.
7. **Night insulation**
   Energy loss in night is reduced.
   Sunlight in daytime is controlled.
8. **io-homecontrol**



E_{ref} = 4.6 kWh/m² with double glazing and argon
E_{ref} = 17.7 kWh/m² with triple glazing and argon

U_w = 1.23 W/m²K with double glazing and argon
U_w = 0.89 W/m²K with triple glazing and argon

Glass percentage
F_f = 88%

Night insulation
U_w is improved with 0.1 - 0.3 W/m²K

External sun screening
g_g = ÷88%

Energy data – VELFAC Helo®

Standard size window (1230 x 1480 mm)

Triple glazing	VELFAC Helo®
Heat loss through window	÷86 kWh/m²
Heat gain	+104 kWh/m²
Net heat gain = E_{ref}	+18 kWh/m²

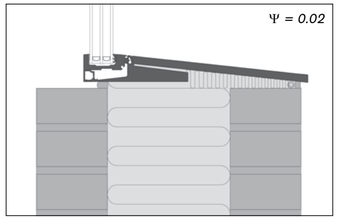
Windows in Home for Life

Triple glazing	VELFAC Helo®
Heat loss through window	÷6123 kWh
Heat gain	+12311 kWh
Total heat gain	+6188 kWh

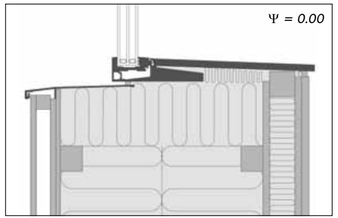
Windows in typical Danish house

Double glazing	VELFAC Helo®
Heat loss through window	÷5025 kWh
Heat gain	+5216 kWh
Total heat gain	+191 kWh

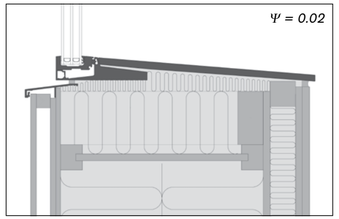
Linear thermal transmittance



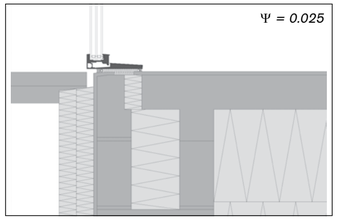
Brick wall.



Window recessed in light construction.



Light construction with intregrated seating.



Floor at doors and patio doors.

Requirements to technical performance

Security against forced entry	SBD (BS 7950 + BS6375-2), RC2 (EN 1627)
Durability	EN 12400 class 3 (>40-50 years (20-30 years for glazing))
Air tightness	EN 12207 class 4 (±600 Pa)
Water tightness	EN 12208 class 9A (600Pa)

Resistance to wind load	EN12210 class C4 (±1600Pa, security test ±2400Pa)
Mechanical test of hardware	600 kg based on EN1628
Life cycle	Life cycle analysis is documented
Easy access	17 mm threshold

One test is worth more...

From 1 July 2009 until 30 June 2010 Home for Life will be tested. There will be a regular family of two adults and two children moving in and living their lives in the house.

Measurement of energy use and production

The one part of the test is a measurement programme that will show how much energy is used and produced in the house. In that way conditions, calculations and assumptions can be examined and subsequently validated. The Engineering College of Aarhus is responsible for the measuring.

Intelligent operation

The second part deals with the integrated control. Intelligent control of the house is necessary to reduce the energy use and increase the comfort together with using the windows as best as possible as sources of light and ventilation openings. Therefore VELFAC has begun cooperation with The Engineering College of Aarhus and the Alexandra Institute with Home for Life as a case. The cooperation has developed into a research project called »Minimum configuration - Home Automation«. The project shall develop and test strategies for the configuration of intelligent operation in the house via user innovation. The purpose of the project is to develop and collect ideas for how cordless operations can be both useful and relevant for users. It shall give the residents a complete entry to operation possibilities of light, heat and energy use as well as consumption data.

Intelligent operation of Home for Life

The following elements in Home for Life are operated automatically but can be manually overridden by remote control:

- Windows on the roof and facade.
- Outside sun screening on the roof and facade.
- Inside blind on the roof.

Additional operations:

- Inside curtain on the facade is operated by pushing a switch.
- Lights operated by pushing a switch and by moving sensors on the ceiling/wall (automatic).
- Heating operated by room sensors on the wall (measures CO^2, humidity and temperature).
- Mechanical ventilation operated by room sensors on the wall (measures CO^2, humidity and temperature).

A part of the operation shall be developed together with the users, such as:

- Time of moving sensors in connection with lighting.
- Standard temperature in the different rooms.
- Opening/closing times for windows.