11.04_PH-SUMMER SCHOOL

EXAMPLES OF SPECIAL FEATURES
PH and Phase Change Materials

Composition: Ernst HEIDUK
Language support: William GALLAGHER
Date: 2009-07-11

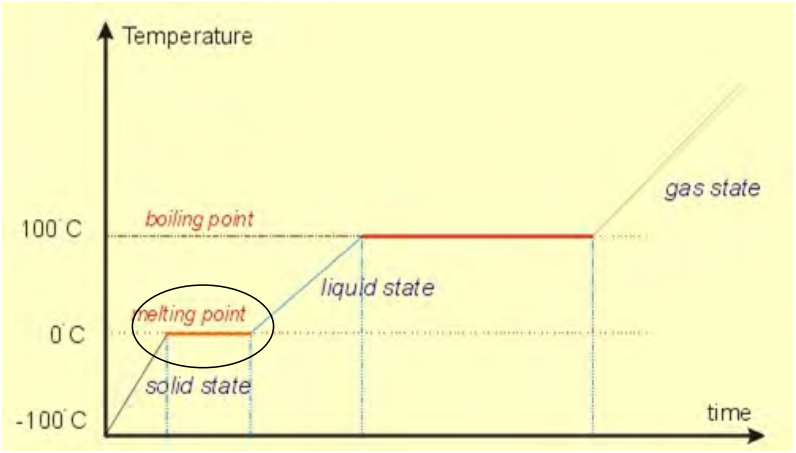
CONTENT OF THIS PRESENTATION:

Source:

Phase Change Materials

Sensible and latent heat

Temperature gradient of water with continuous heating

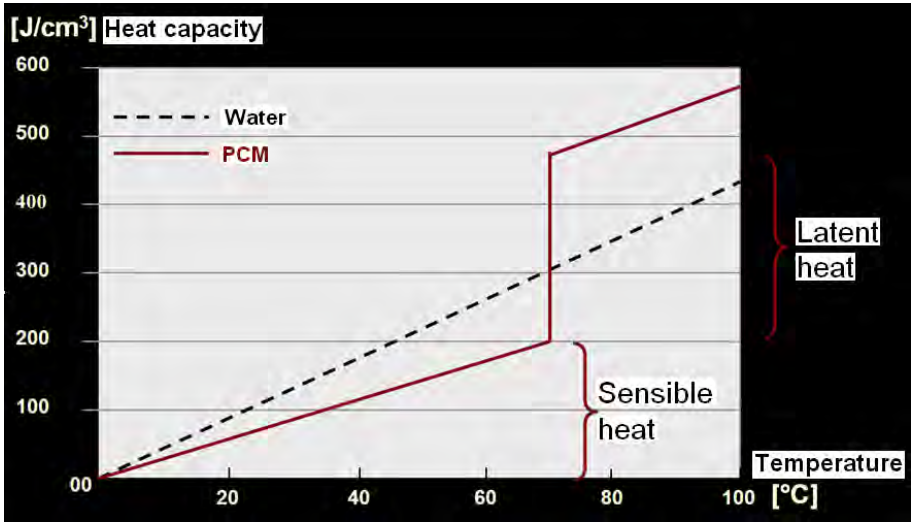


Beginning in the solid state (Ice), those increases Temperature up to the phase change, until thus the so-called " melting temperature" is reached.
Then the supplied energy is needed for the phase change.
Only if all ice is transferred into the liquid condition, the temperature continues to rise. The same pattern repeats itself with the further energy input. The liquid is warmed up, until those characteristic temperature of the boiling point is reached.
The sequential supply of Energy converts the liquid without temperature change in gas.

Source: www.lepla.edu.pl/de/modules/Activities/m18/files/m18.pdf

Phase Change Materials

A **P**hase **C**hange **M**aterial (PCM) is a substance with a high latent heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa; thus, PCM´s are classified as latent heat storage (LHS) units.



Source: http://en.wikipedia.org/wiki/Phase_change_material

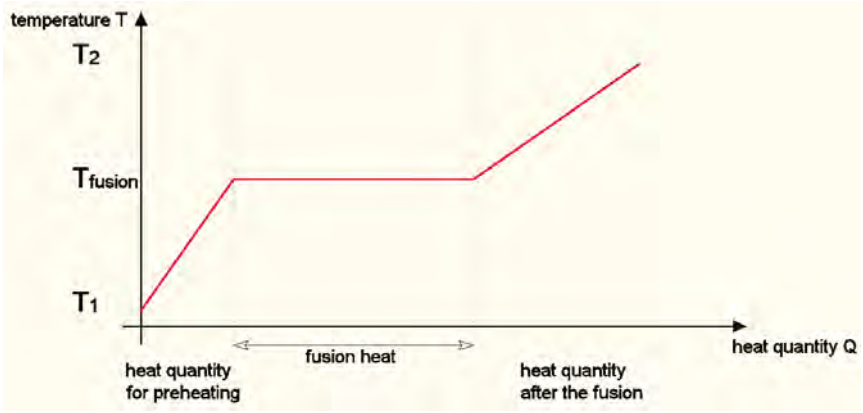
Phase Change Materials

Sensible and latent heat

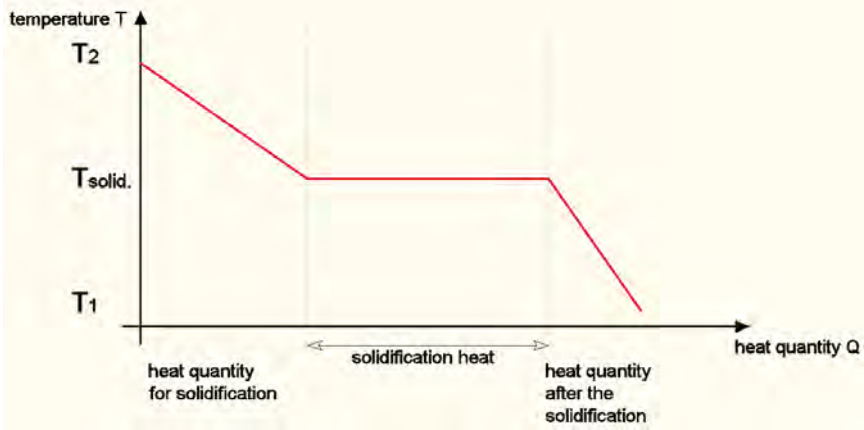
Phase Change Materials (PCMs) store energy by changing phase from solid to liquid (i.e. melting) and releasing heat by changing phase from liquid to solid (i.e. freezing).

Phase change materials provide a large heat capacity over a limited temperature range.

They act a little like an isothermal reservoir of heat.



Heating up (melting)



Cooling down (freezing)

Source: Text: http://solar-thermal.anu.edu.au/low_temp/phase_change/index.php

Phase Change Materials

Some useable PCM – Materials and their melting point:

- Organic PCM´s: (Flammable)
  - Paraffin

Hexadekane	18 °C
Nonadekane	32 °C
LWSM-Paraffin	30 °C

  - and Fatty acids

Capric acid	31 °C
Palmitic acid methyl ester	30-39 °C
Palmitic methyl ester	29-35 °C

- Inorganic PCM´s: (Non-flammable)
  - Salt hydrates

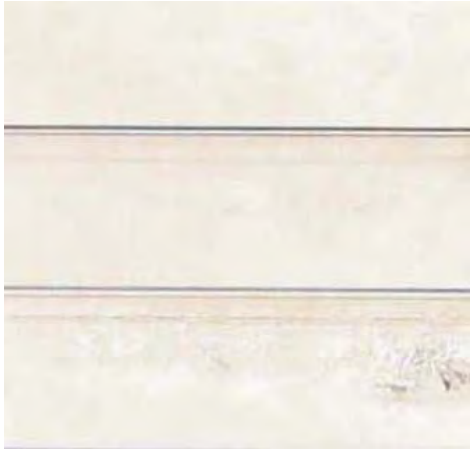
$CaCl_2$. $6H_2O$	27 °C
$CaBr_2$. $6H_2O$	34 °C
NA_2So_4. $10H_2O$	32 °C

Source: http://en.wikipedia.org/wiki/Phase_change_material

Phase Change Materials

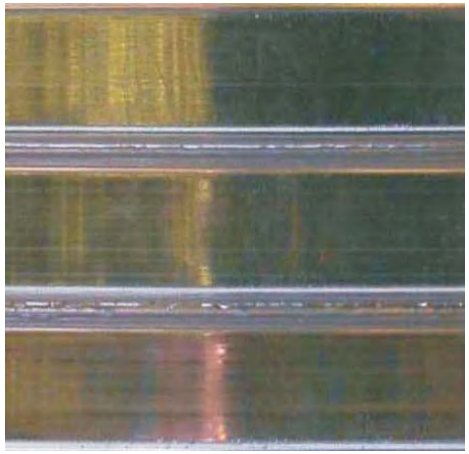
The change of the phase in the translucent “GlassXcrystal” element with a salt hydrate

cooling down



crystal state

change phase



liquid state

heating up

Source: Fotos: GlassXcrystal www.glassx.ch

11.04.01

Senior Residence, Domat/Ems (CH)

Architecture:

Dietrich Schwarz
Via Calundis 8
CH 7013 Domat/Ems, Switzerland
www.schwarz-architektur.at

Source:

Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Architectural concept

South view

- Optimised thermal shell
- Ventilation system
- Special translucent glazing with a phase change material

20 small apartments

- Compact form
- Orientation to the sun

North view

Source: Fotos: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Architectural concept

The snow increases the solar gains by reflection of the solar radiation.

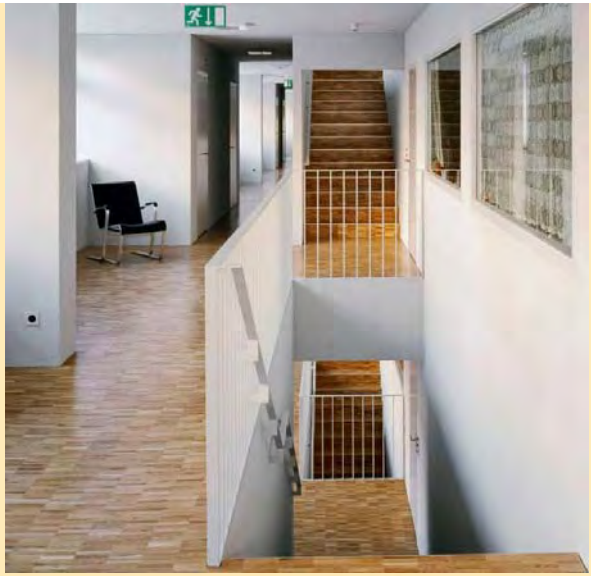
South view

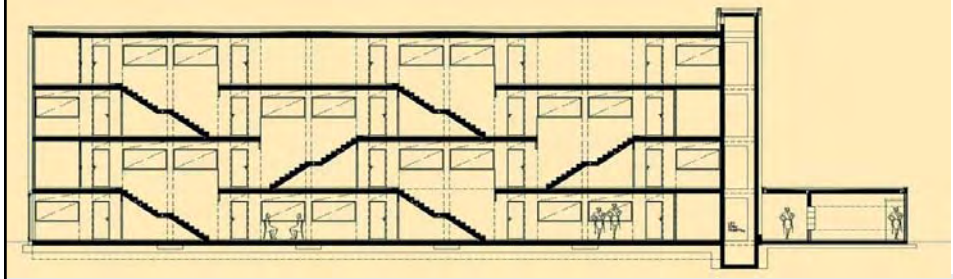
Source: Foto: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Architectural concept





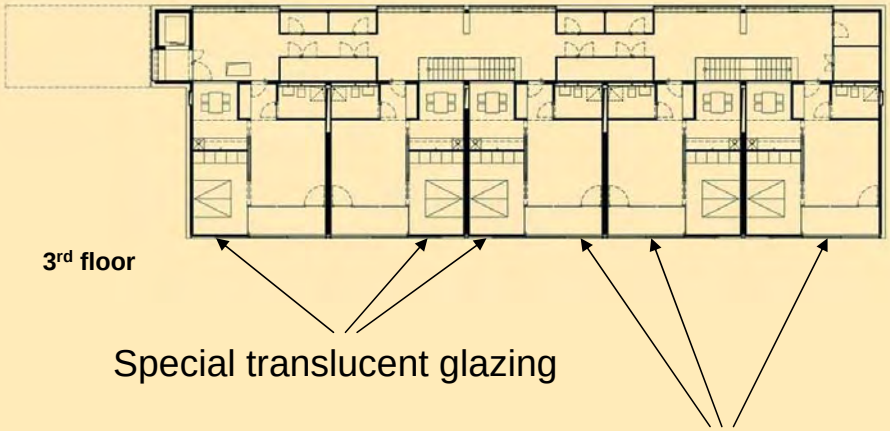
- Staircase supports social contacts
- Lighting of kitchen via staircase
- Differently mirrored floor plans
- Spatial references within the flat
- Solar cladding with interior windows

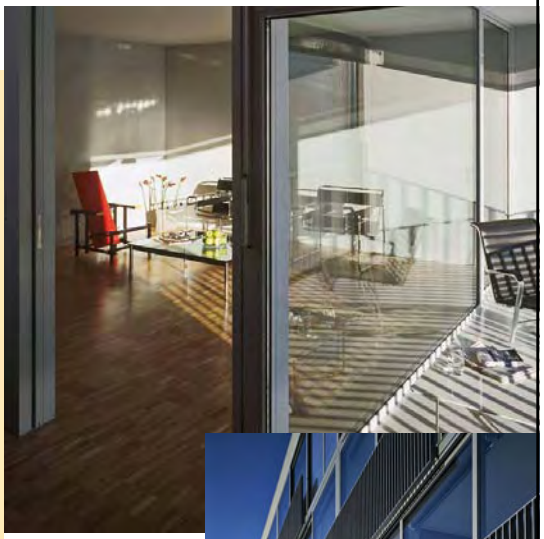
Source: Plan and fotos: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

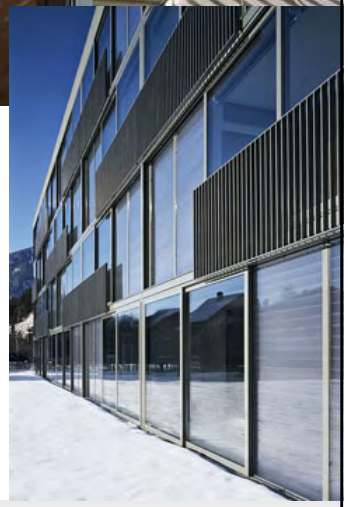
Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Architectural concept







Source: Plan and fotos: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Architectural concept – Universal design

Universal design for kitchen and bathroom.

Source: Fotos: SchweizerBauJournal – SBJ 2/05

Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Building / Energy concept

South glazing with PCM
(Phase Change Material)

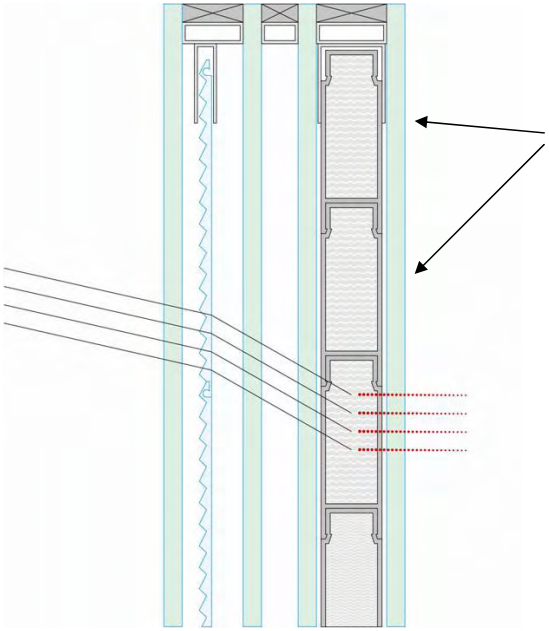
GLASSX®crystal
www.glassx.ch

Source: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Energy concept - PCM



South glazing with PCM (Phase Change Material) a Salt hydrate - melts at 26°C

- **TRANSPARENT HEAT INSULATION** with **Insulation glass with multiple low-E coating and inert gas filling**
- **OVERHEATING PREVENTION** with **Prism glass**
- **HEAT-STORAGE** with **Latent storage with PCM**

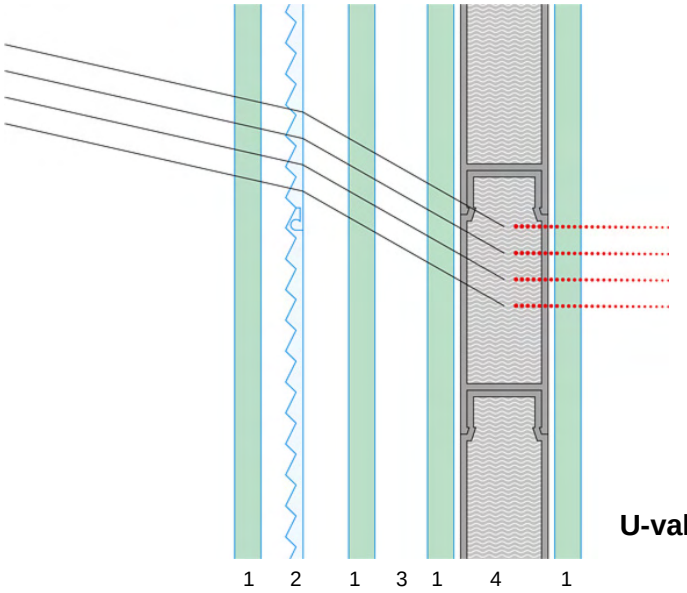
Source: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

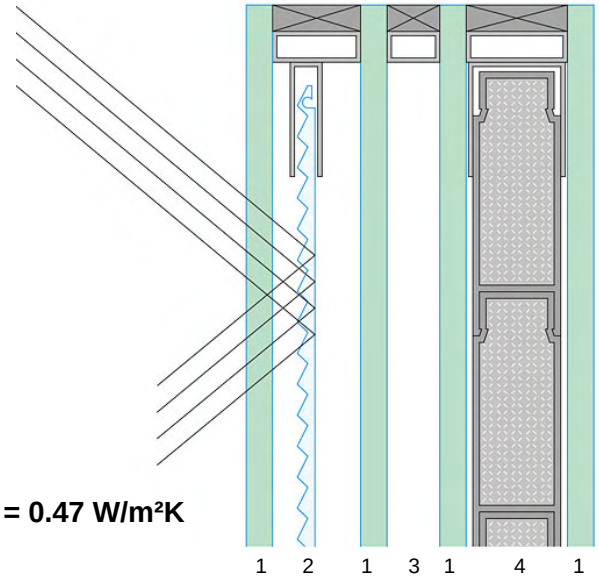
Energy concept - PCM

Flat winter sun < 35°
Passage of the direct irradiation without loss

High summer sun > 40°
Total reflection of the direct irradiation



U-value = 0.47 W/m²K



1: Four safety glasses, each 6 mm thick
2: Prisms panel of 6 mm in double-glazing cavity (20 mm) with inert gas filled
3: double-glazing cavity (12 mm), filled with inert gas
4: double-glazing cavity (22 mm) with PCM-Panel and a storage capacity of 1185 kWh/m²

Source: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Energy concept - PCM

GLASSX®crystal integrates 4 system components in a functional unit:

- transparent heat insulation,
- protection from overheating,
- energy conversion and
- thermal storage.

A 3-ply insulating glass construction provides excellent heat insulation with an U-value of less than 0.5 W/m2K.

A prismatic glass implemented in the space between the panes reflects sun rays with an angle of incidence of more than 40° (in summer, when the sun is high in the sky). On the other hand, the winter sun passes through the sun protection at full intensity.

The central element of GLASSX®crystal is a heat storage module that receives and stores the solar energy and, after a time, releases it again as pleasant radiant heat. PCM (Phase Change Material) in the form of a salt hydrate is used as the storage material. The heat is stored by melting the PCM; the stored heat is released again when the PCM cools. The salt hydrate is hermetically sealed in polycarbonate containers that are painted grey to improve the absorption efficiency.

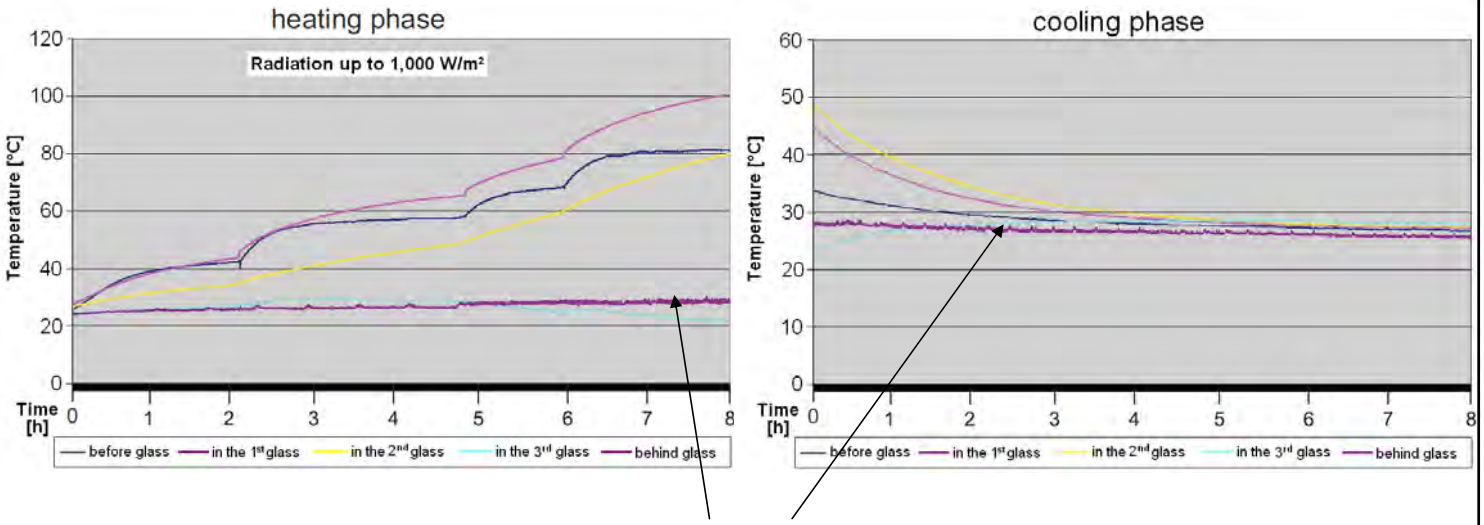
On the interior side, the element is sealed by 6 mm tempered safety glass that can be printed with any ceramic silk-screen print.

Source: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Energy concept - PCM

Measuring results of GLASSX®crystal elements



Important is the inside temperature behind the glass

Source: www.glassx.ch GLASSXcrystal

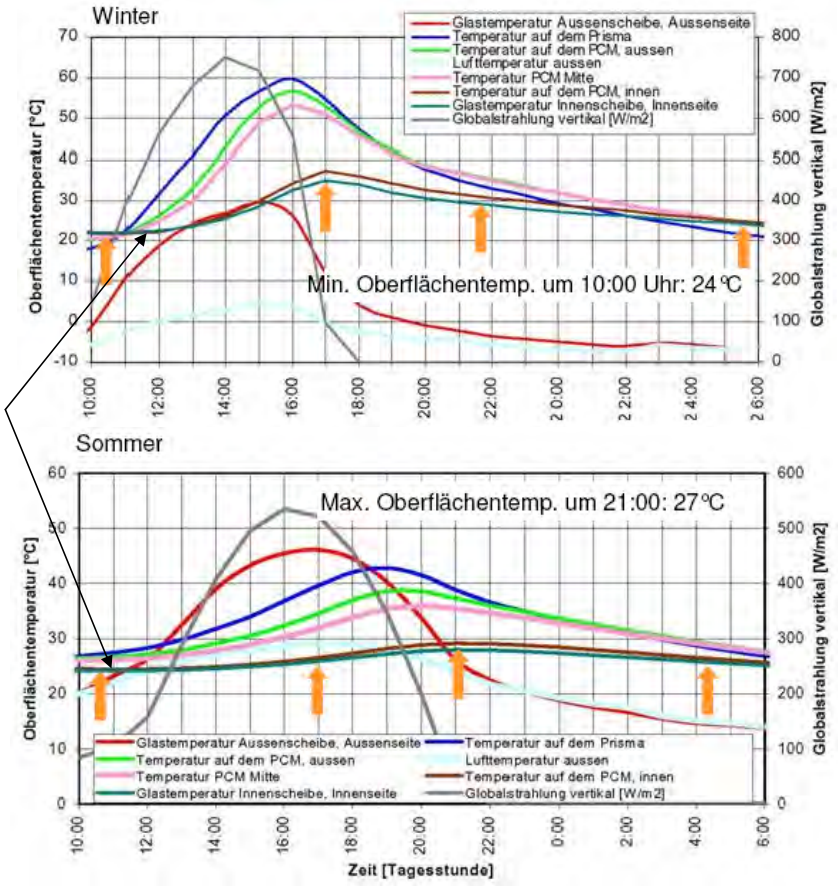
Senior residence, Domat/Ems (CH)

Architecture: Dietrich Schwarz

Energy concept - PCM

Diagram of summer and winter temperatures

Temperatures inside behind the glass

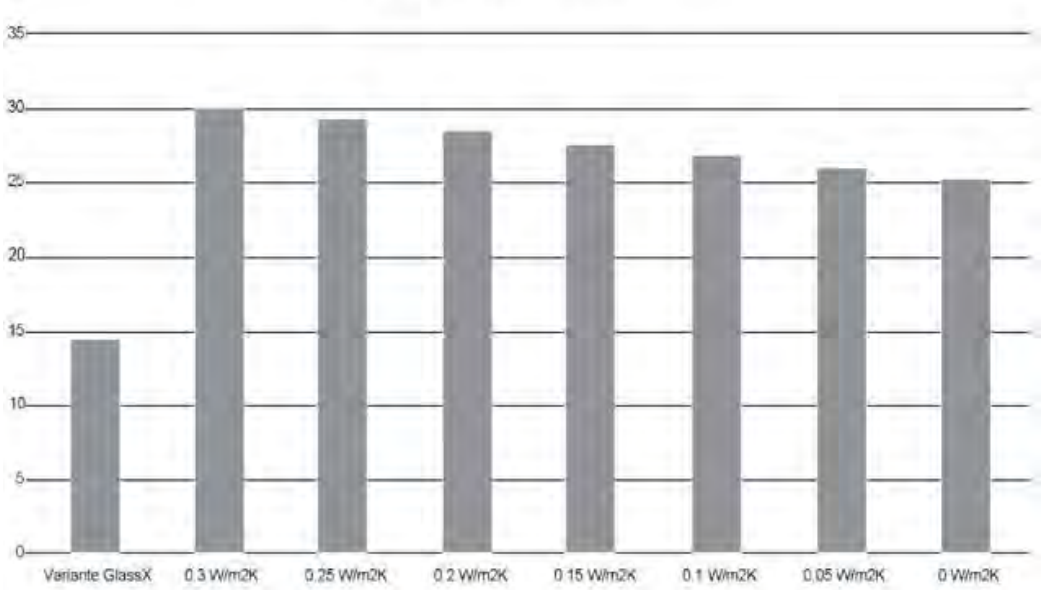


Source: GlassX - Energieeffizienz und erneuerbare Energien in der Architektur

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Energy concept - PCM

Comparison of the effective heating need $Q_{h,eff}$



Variations – GlassX and different thermal qualities (u-value) of the opaque building shell

This comparison shows that the PCM element enables the builder to reduce the thickness of the necessary heat insulation of the building.

Source: GlassX - Energieeffizienz und erneuerbare Energien in der Architektur

Senior residence, Domat/Ems (CH) **Architecture: Dietrich Schwarz**

Energy concept

Domestic hot water with heat pump and solar heat collector.

Central ventilation system with heat recovery

Source: Fotos: SchweizerBauJournal – SBJ 2/05

11.04.02

Apartment building “Im Bächli”, Teufen, Aargau (CH), 2006

Architecture:

Dietrich Schwarz
Via Calundis 8
CH 7013 Domat/Ems, Switzerland
www.schwarz-architektur.at

Source:

Apartment house „Im Bächli“, Teufen (CH) **Architecture: Dietrich Schwarz**

Architectural concept

A row house with 4 units in a small Swiss village.

PV and solar collector modules are integrated surface-concisely into the roof.

Source: Architect Dietrich Schwarz, Zürich CH www.glassx.ch

Apartment house „Im Bächli“, Teufen (CH)

Architecture: Dietrich Schwarz

Architectural concept

- Orientation to the sun
  - Solar windows
  - PCM´s
- Compact form
- High quality building shell
- Ventilation system with heat recovery

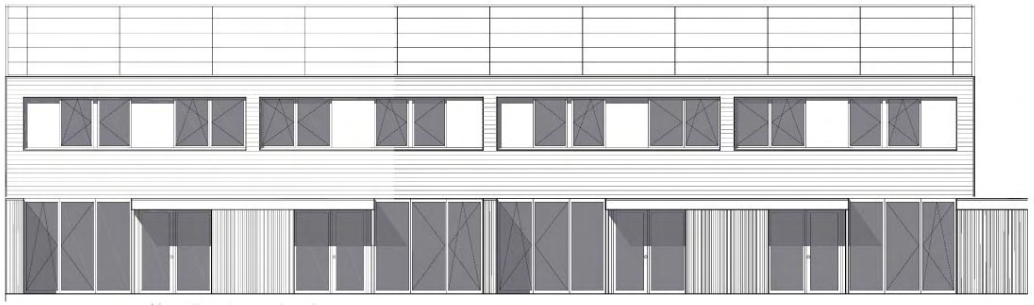
Source: www.glassx.ch/index.php?id=157 , (2008-04-28,13:20)

Apartment house „Im Bächli“, Teufen (CH)

Architecture: Dietrich Schwarz

Architectural concept

Southern façade



Northern façade

Source: www.glassx.ch/fileadmin/pdf/Isofloc.pdf

Apartment house „Im Bächli“, Teufen (CH)

Architecture: Dietrich Schwarz

Building concept

Construction:

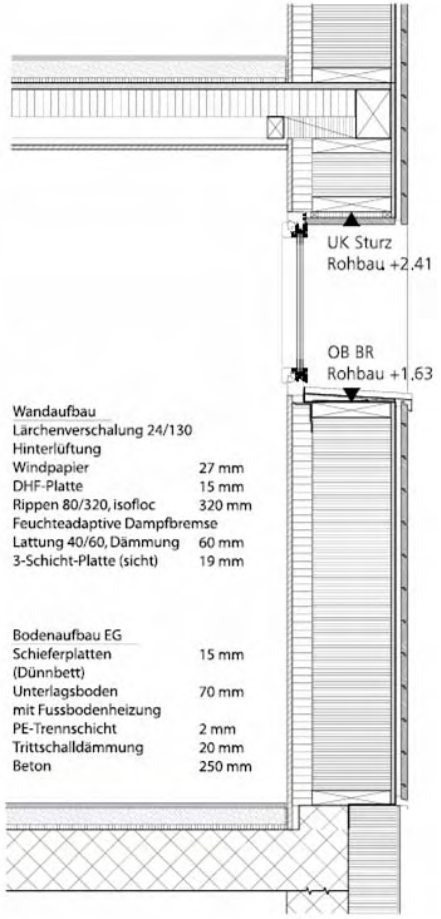
timber element construction with cellulose insulation

U-value: 0,11W/m²K

exterior wall covering: larch planking pre-greyed

interior walls and ceilings: 3-layer slabs

floor: cement slate or parquet



Source: Foto: dsc - St.Galler Tagblatt

http://www.glassx.ch

Apartment house „Im Bächli“, Teufen (CH) **Architecture: Dietrich Schwarz**

Energy concept

Building services:
(Amstein & Walthert AG, Zurich)
- compact unit with controlled ventilation with heat recovery
- 6 m² solar collector
- 63 m² photo voltaic unit

Special aspect:
- heat storage element: GLASSX®crystal

MINERGIE-P

- Energy reference plane (gross): 776 m²
- Heating demand: 12,2 kWh/(m²a)
- energy index heat: 22,5 kWh/(m²a)
- Pressure test result: 0,35 – 0,50 h^{-1}

Source: www.glassx.ch/index.php?id=157 , (2008-04-28,13:20)

Apartment house „Im Bächli“, Teufen (CH) **Architecture: Dietrich Schwarz**

Energy concept – PCM elements

Source: www.glassx.ch GLASSXcrystal

11.04.03

Apartment house Eulachhof, Else-Züblin-Strasse, Winterthur (CH), 2006

Architecture: GLASSX AG
Technoparkstraße 1
CH 8005 Zürich, Switzerland
www.glassx.ch

Source:

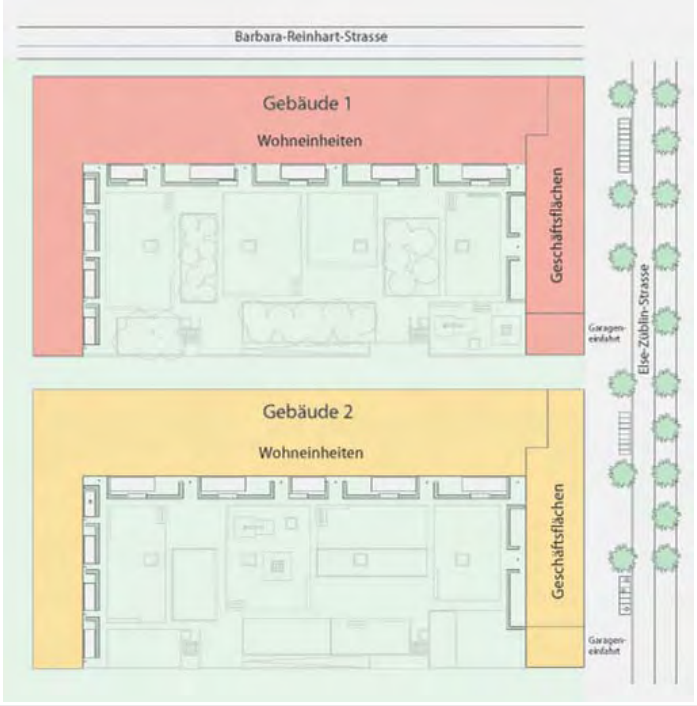
Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Swiss Solar Award 2007

132 apartments with a zero-heating energy concept at the place of an old factory.



Source: www.eulachhof.ch/lage.html (2009-05-17, 21:00)

www.eulachhof.ch/ansicht.html (2009-05-17, 21:00)

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

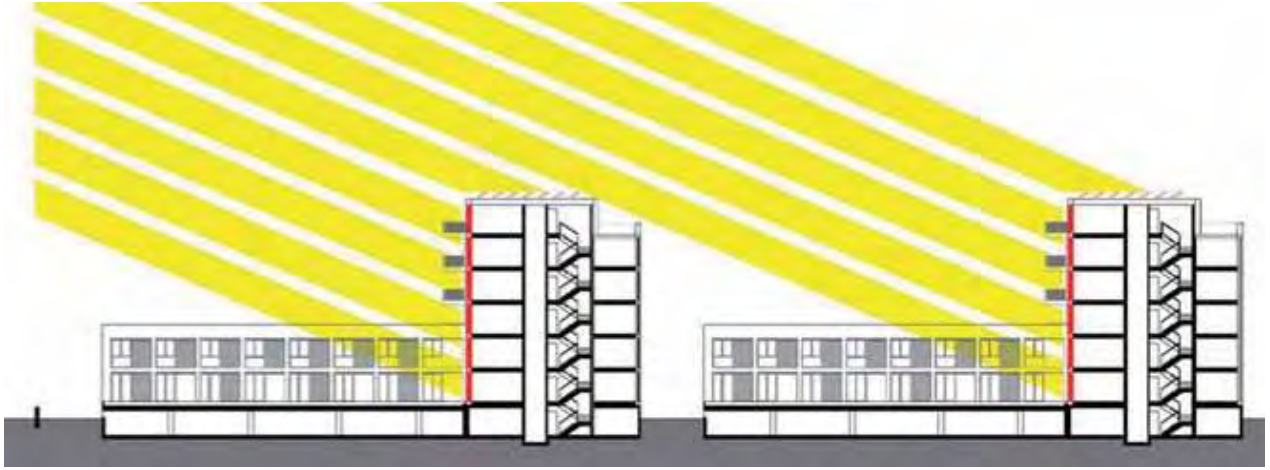
- Compact volume
- Optimal orientation of the building
- Optimized solar gains
- Use of PCM-panels
- PV – panels on the roof
- Low running costs
- A wheelchair-friendly area

Source: Fotos: www.minergie.ch/tl_files/download/Referat_Rolf_Mielebacher_04.12.2007.pdf

Apartment houses Eulachhof, Winterthur (CH) **Architecture: GlassX AG**

Architectural concept

Optimized orientation of the building



- The distance of the two main buildings was calculated to enable the sunlight to come into the ground-floor apartment of the second building even in winter.
- 20% of the solar radiation is used by the PV roof (active-solar energy use) and 80% on the south facade (passive-solar energy use).

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, FH Nordwestschweiz,

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Sun protection (summer time)

- the balconies are the shading for southern glass
- the PCM-panels have the prism reflection

Source: Foto: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf

Apartment houses Eulachhof, Winterthur (CH) **Architecture: GlassX AG**

Architectural concept

Internal aspects

- optimized day-light
- open and transparent flats
- high comfort temperatures

- free cross ventilation
- comfort ventilation system
- very low indoor pollution
- good noise protection

Source: Foto:www.minergie.ch/tl_files/download/Referat_Rolf_Mielebacher_04.12.2007.pdf Foto: Manuel Pestalozzi Architektur & Technik 4-08

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Floor plan - 5th floor with terraces on the north side

Source: www.eulachhof.ch/grundriss.php

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Floor plan – 1st to 4th floors

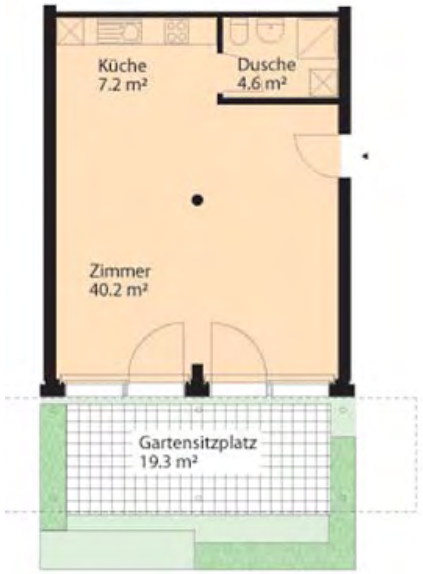
Source: www.eulachhof.ch/grundriss.php

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Floor plan - Ground floor / special types



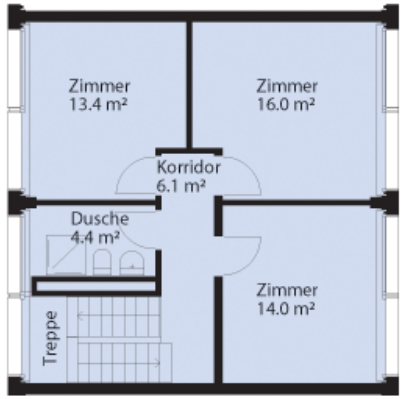
Source: www.eulachhof.ch/grundriss.php

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Architectural concept

Floor plan – Ground and 1st floor / maisonette



Source: www.eulachhof.ch/grundriss.php

Apartment houses Eulachhof, Winterthur (CH) **Architecture: GlassX AG**

Building concept

Concrete structure

Optimized building shell with prefabricated wooden lightweight elements with very high thermal quality:

- Roofs < 0.10 W/m²K
- Facades < 0.15 W/m²K
- Windows < 0.80 W/m²K
- Minimized thermal bridges
- Air-tight building shell

Source: www.hastag.ch/de/_pdf/Jobrep_Eulachhof.pdf (2009-05-17, 21:30)

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Building concept

Material aspects

- high percentage of reused materials, use of recycling-concrete granulate
  - for construction concrete 50%
  - for lean concrete 100%
- materials with low environmental stress, wood and wood fibre for the external walls
- simple de-construction (demolition)

Source: www.hastag.ch/de/_pdf/Jobrep_Eulachhof.pdf (2009-05-17, 21:30)

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Building concept

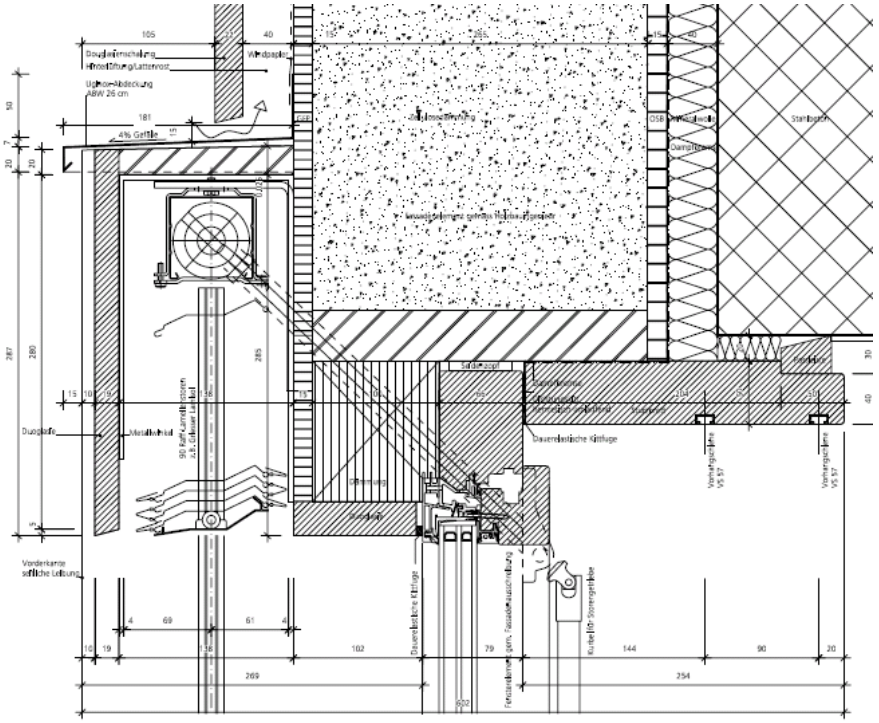
Prefabrication and transport of the light-weight façade elements

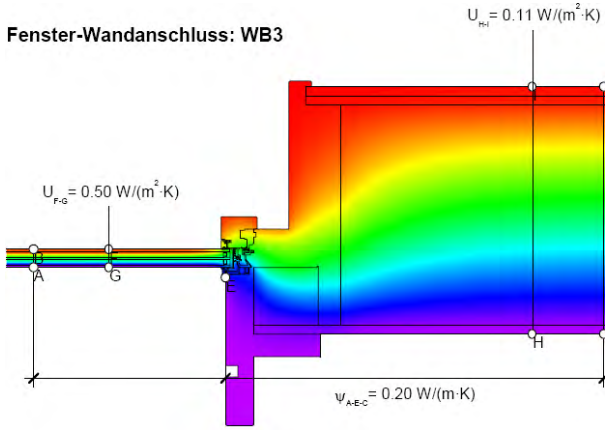
Source: www.erne-gruppe.ch ERNE fenster + fassaden und HUSNER AG Holzbau

Apartment houses Eulachhof, Winterthur (CH) **Architecture: GlassX AG**

Building concept

Construction detail – wooden façade element with window and sun shutter





An
- air-tight and
- thermal bridge free

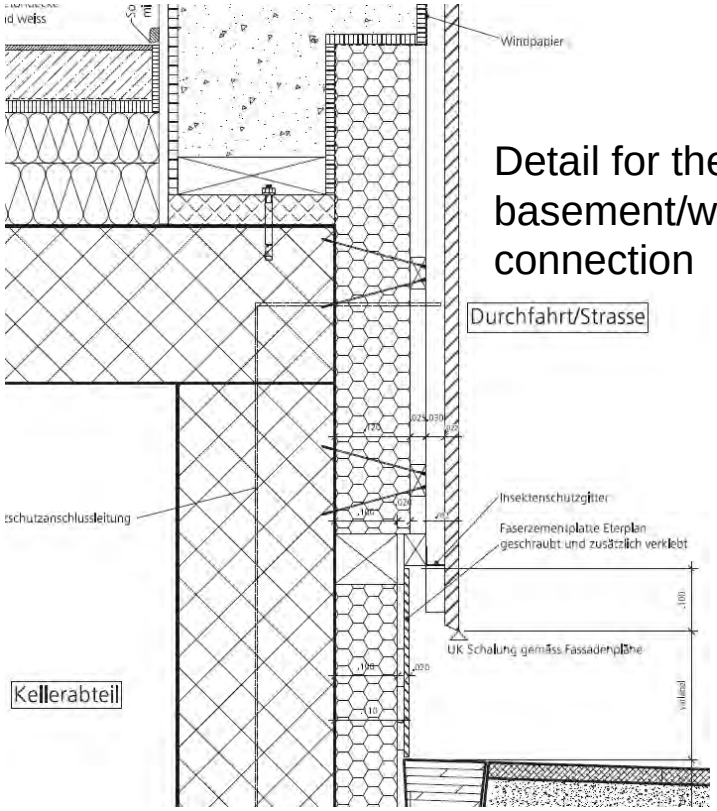
construction.

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

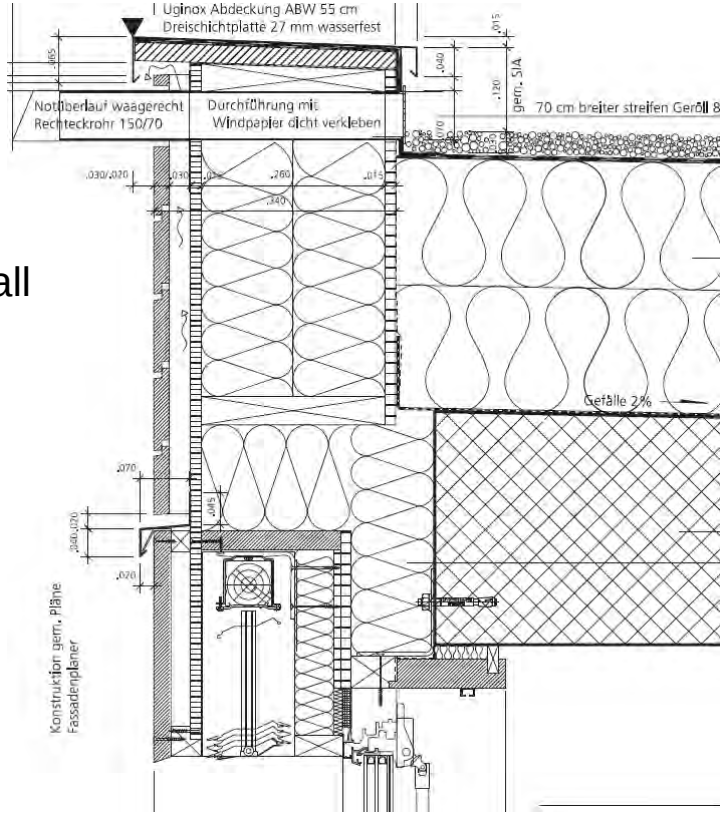
Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Building concept



Detail for the basement/wall connection



Detail for the wall/roof connection

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

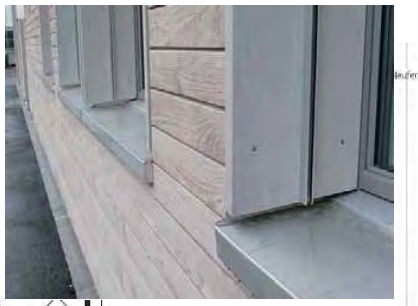
Apartment houses Eulachhof, Winterthur (CH)

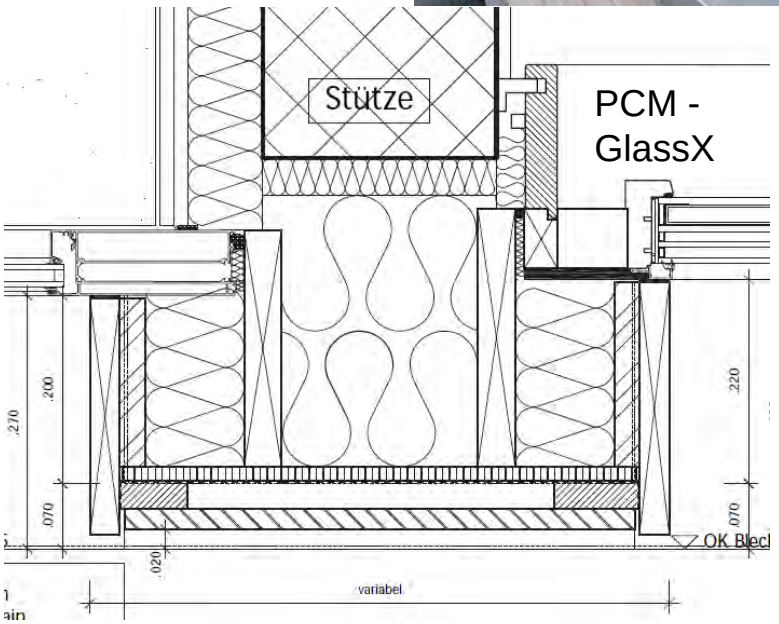
Architecture: GlassX AG

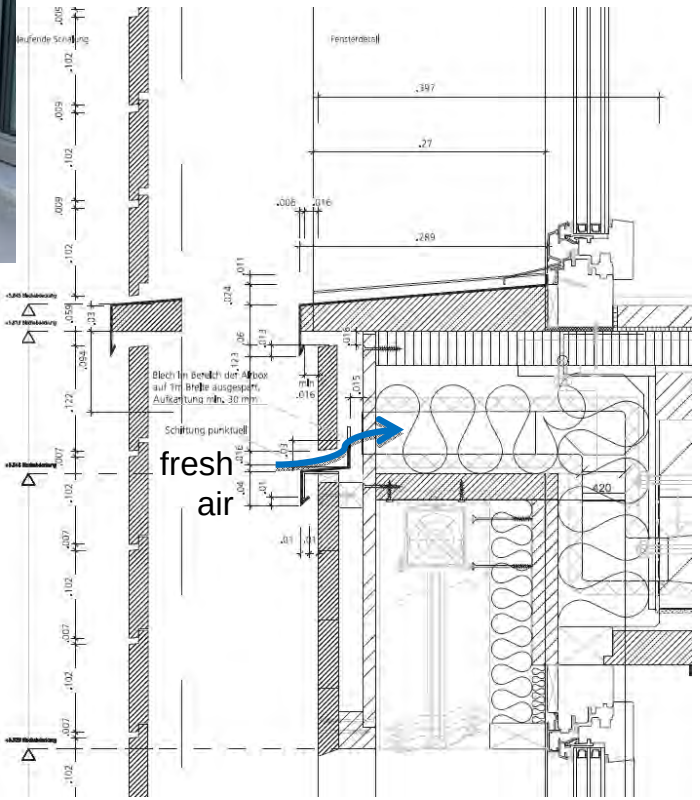
Building concept

Details for the window/wall connection

horizontal







vertical

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Building concept

Horizontal cladding (Douglas fir) – rough/unplaned wood

Pre-greying with “Pento-Fluid Silver wood”

Source: Foto: www.erne.net/aktuelles/FF-Newsletter_Januar09_wattdOr.pdf

www.pentol.ch/default.asp?code=12010806

Apartment houses Eulachhof, Winterthur (CH) **Architecture: GlassX AG**

Energy concept

The energy concept is based on established and usual techniques like:

- ventilation system with heat recovery
- heat pumps
- district heating
- floor heating
- Photovoltaic

Combined is the result a Residential building with Swiss zero-energy-standard of MINERGIE-P-ECO® and

- No dependence on fossil energy sources
- CO2 – emissions minimised

Source: http://www.allreal.ch/weballreal/index/main/presse/presse-medienmitteilungen/presse-medien-separator/05-09-28-medien-eulachhof.htm

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept

- use of high efficient technologies for all appliances, engines, lighting, building services
- efficient ventilation system with DC-vents
- heat pumps with high efficiency factor
- household appliances with classification A to A+++
- maximal use of waste heat by heat recovery from waste water and reusable materials

=> Full recovery of energy need with renewable energies (incl. exergy-need)

Source: www.minergie.ch/tl_files/download/Referat_Rolf_Mielebacher_04.12.2007.pdf

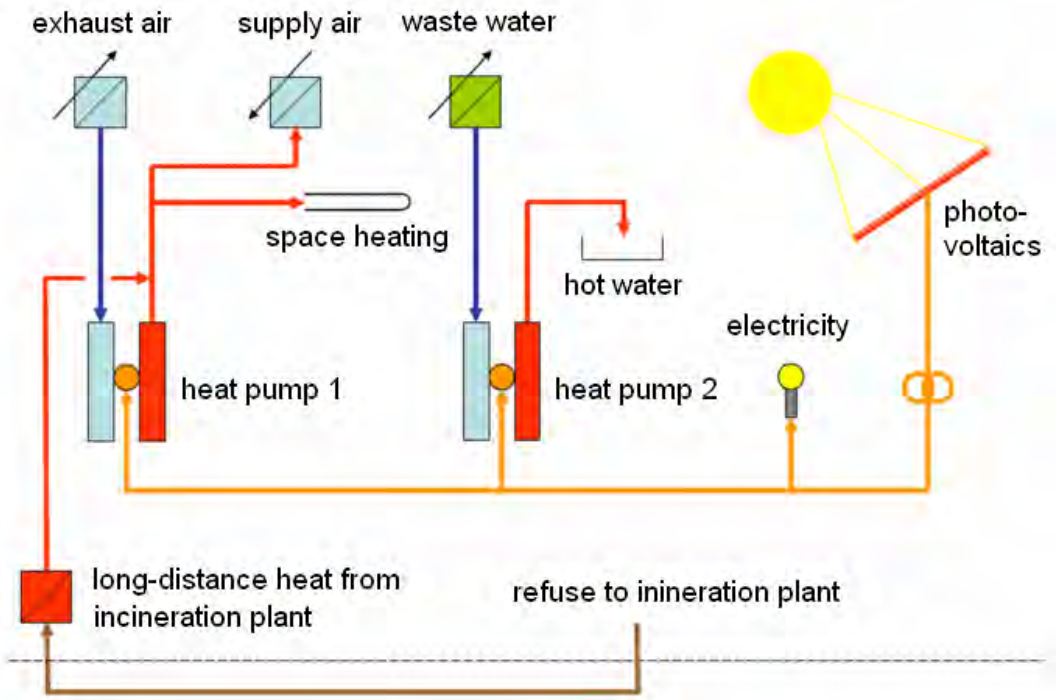
Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept

Heat exchanger

Heat pumps



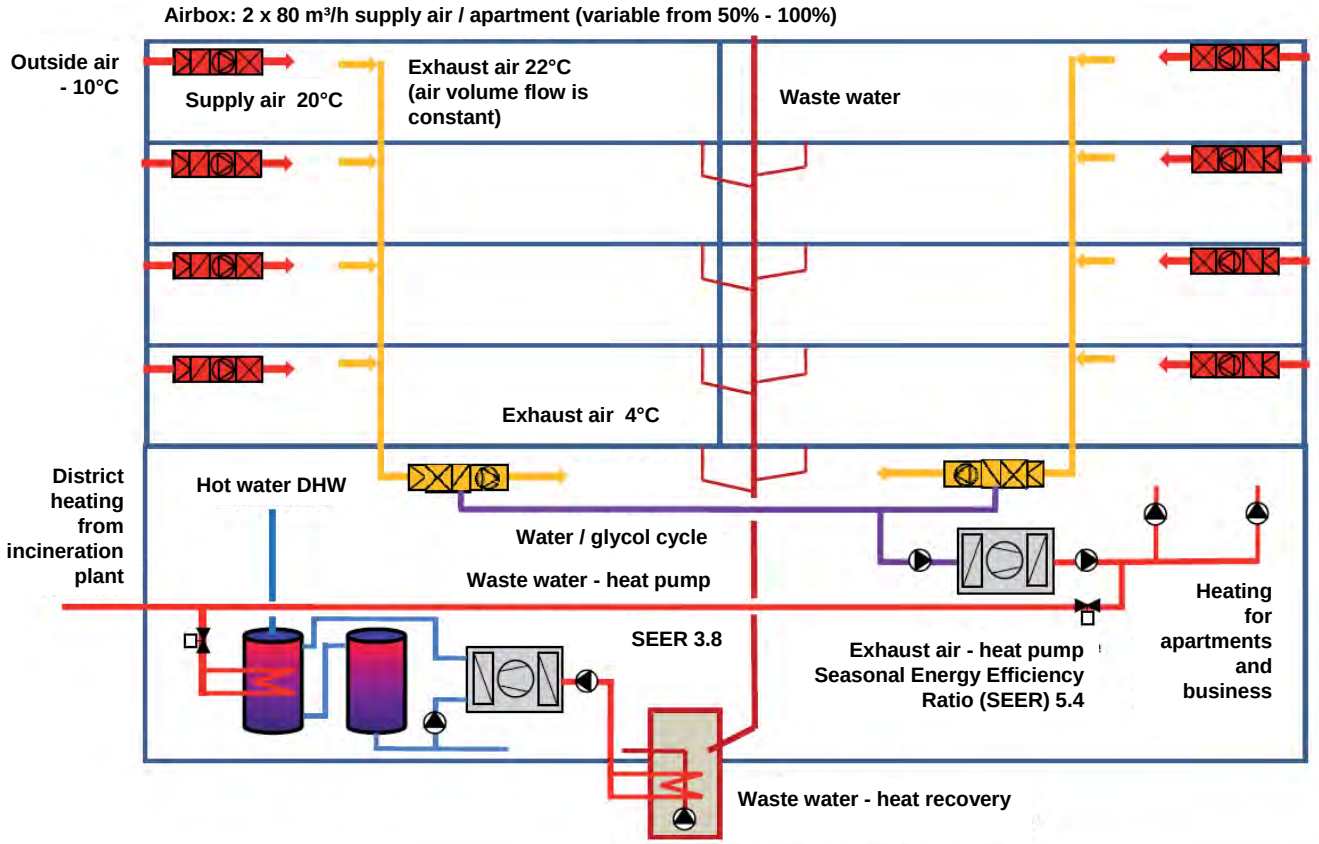
With the thermal reuse of the refuse in the incineration plant, the apartment house is fully self-supported with energy.

Source: www.cleanenergyawards.com/typo3temp/pics/0a1517f4ad.gif

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept – Ventilation, heating and heat recovery



Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

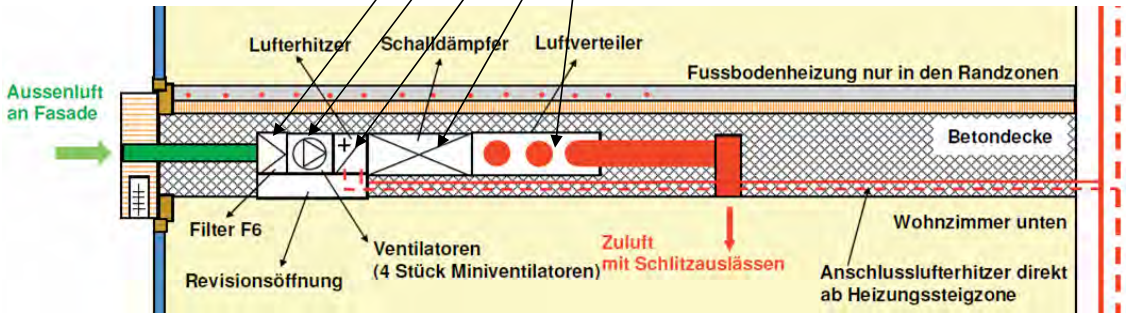
Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept - Ventilation

The special “Airboxes” used in this project have no direct heat exchange. The heat recovery is taken from the exhaust air by a central heat pump. The “Airbox” includes:

- Filter
- 4 Mini-vents
- Air heater
- Silencer
- Air distribution



It is integrated into the concrete ceiling.

Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

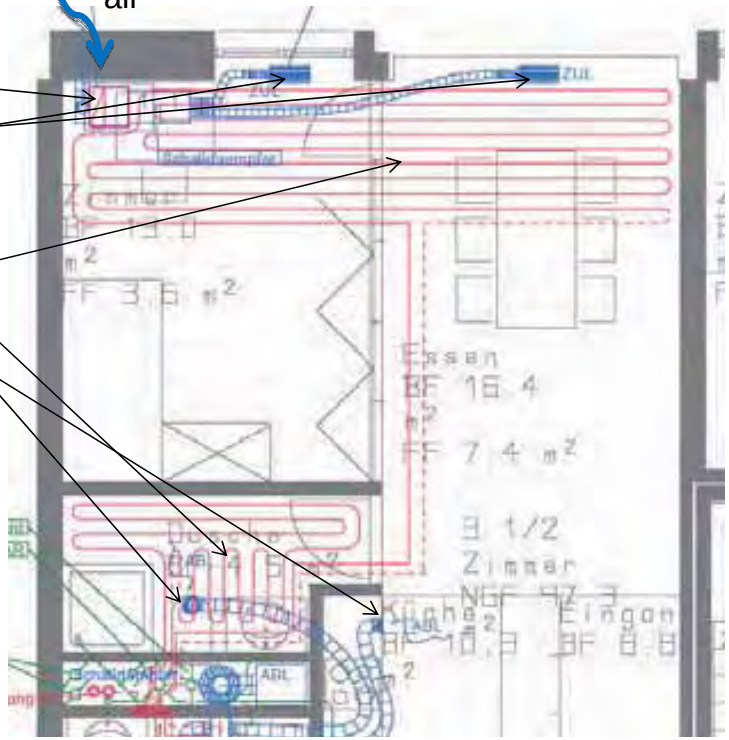
Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept

Floor plan with position of the „Airbox“, the supply air and the floor heating in the edge areas and bathroom. Exhaust air

fresh air



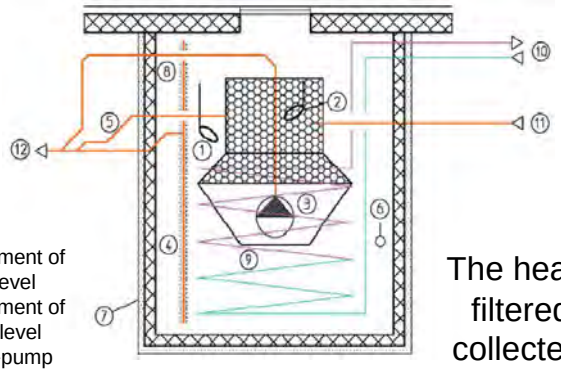
Source: Foto:www.minergie.ch/tl_files/download/Referat_Rolf_Mielebacher_04.12.2007.pdf Allreal, CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule NWSchweiz

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept - **Wastewater heat**

Heat exchanger with 2 heat pumps
Condenser performance: 80 kW (2 x 40 kW) Annual coefficient of performance
COP: 4,2 (at 60°C storage temperature)
Shaft size: 15 m³



1 Measurement of minimal level
2 Measurement of maximal level
3 Flushing-pump
4 Standpipe (isolated)
5 Pipe for overflow
6 Temperature sensor
7 Wastewater shaft (isolated)
8 Ventilation
9 Heat exchanger
10 Pipes to Heatpump
11 Wastewater-inlet from the building
12 Wastewater-outlet

The heat exchanger is installed in a separate shaft where the filtered wastewater from the entire buildings is temporarily collected, cooled and disposed again to the channel system. A filter holds back the collected grunge and sand and disposes it again to the wastewater system.
The shaft is always filled up to a certain level with wastewater to insure the necessary heat transfer. For cleaning purposes the filter is automatic rinsed once a day. Fully cleaning of the shaft takes place every 1 to 2 years.

Source: FEKA Energiesysteme AG

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept - Wastewater heat

By the use of all waste water heat combined with a heat pump an all-season domestic hot warm water (DHW) supply is guaranteed.
It can be completely done without an additional heating system (solar collector).
The electricity comes from the PV-panels.

Source: FEKA Energiesysteme AG - www.feka.ch/pdf/FEKA_Energie_aus_Abwasser.pdf

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept – PCM´s

These multilayer solar crystals (GLASSXcrystal) have the effect of heating during wintertime and cooling in summer.

Source: Foto: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf Text: www.cleanenergyawards.com/top-navigation/nominees-projects/nominee-detail/project/7/?cHash=e16269b74f

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept – PV panels

1,200m² (2 x 600m²)

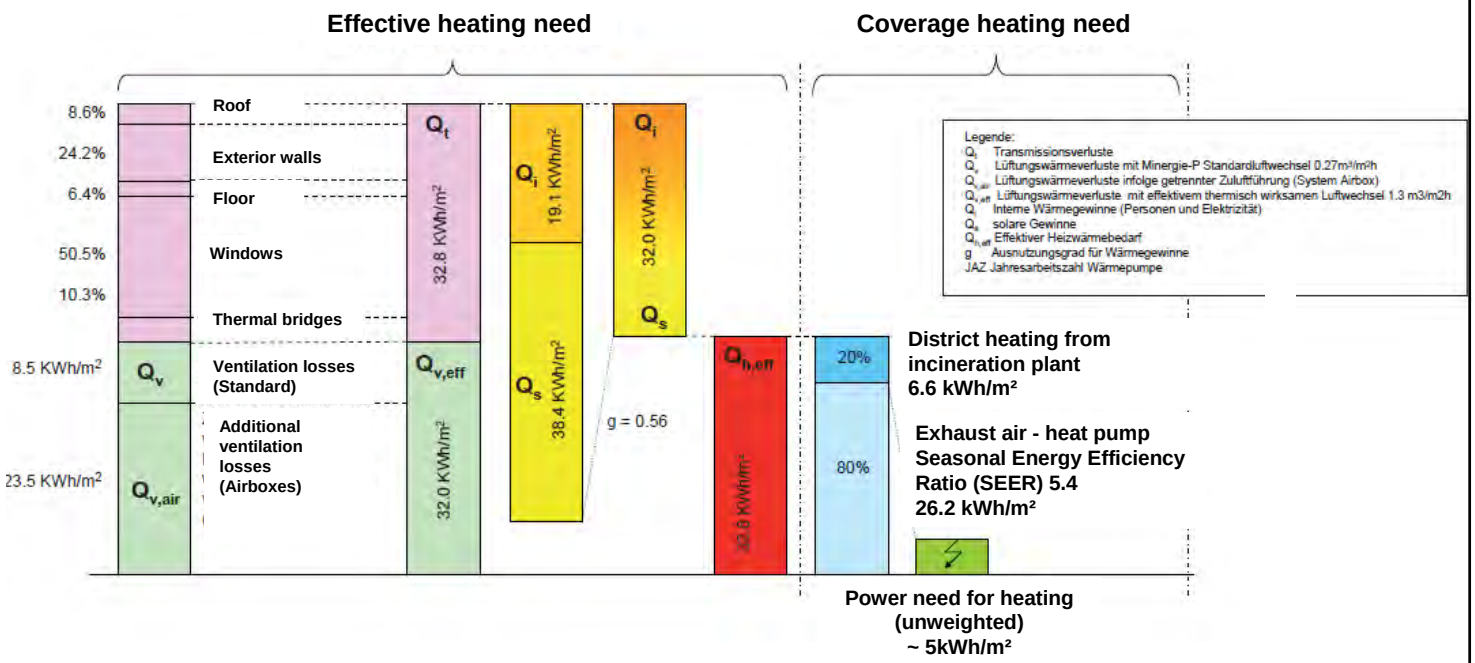
The electricity for the building is provided by photovoltaic cells. Therefore the Eulachhof residents do not need to pay extra for any external energy source. Only the personal electricity use (TV, computer, etc.) is externally supplied.

Source: Foto: http://193.109.216.80/tl_files/download/Referat_Reiner_Gfeller_22.01.2009.pdf

Apartment houses Eulachhof, Winterthur (CH)

Architecture: GlassX AG

Energy concept - Balance



Source: CAS MINERGIE® Zertifikatsarbeit 2008 «Eulachhof» Winterthur, Fachhochschule Nordwestschweiz

11.04.04

Office building - Marché International, Kemptthal (CH), 2007

Architecture: Beat Kaempfen (kaempfen for architecture)
Badenerstrasse 571
CH 8048 Zurich, Switzerland
www.kaempfen.com

Source:

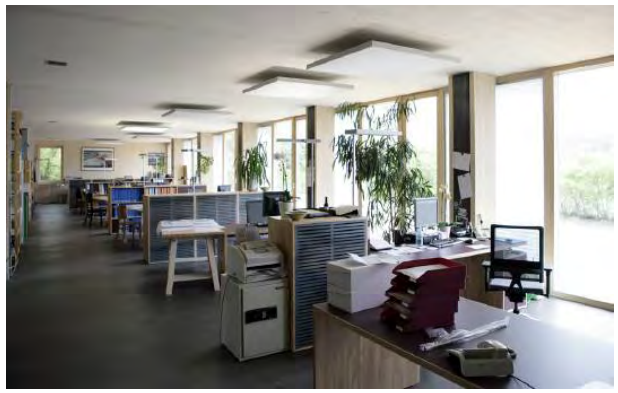
Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Architectural concept

The international company Mövenpick / Marché assigned the Swiss architect Beat Kämpfen to plan the new head office with the guidelines:

- „No luxury“
- A pleasant working environment for the employees
- 12-month time from planning start to completion
- High quality of the building
  - sustainability
  - healthy working environment
- Best economy



Result:

First Swiss Zero-Energy-Office building

Source: Fotos: Schweizer Solarpreis 2007

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Architectural concept

Southern view, photo voltaic panels on the roof

- Passive – solar building concept
- Completely glazed south facade with „GlassX“
- Tight and high thermal quality building shell

Swiss Solar Award 2007

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Architectural concept

Southern view with solar windows and 50% translucent PCM-panels

Day and night

Source: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Architectural concept

Inside view with solar windows and translucent PCM-panels

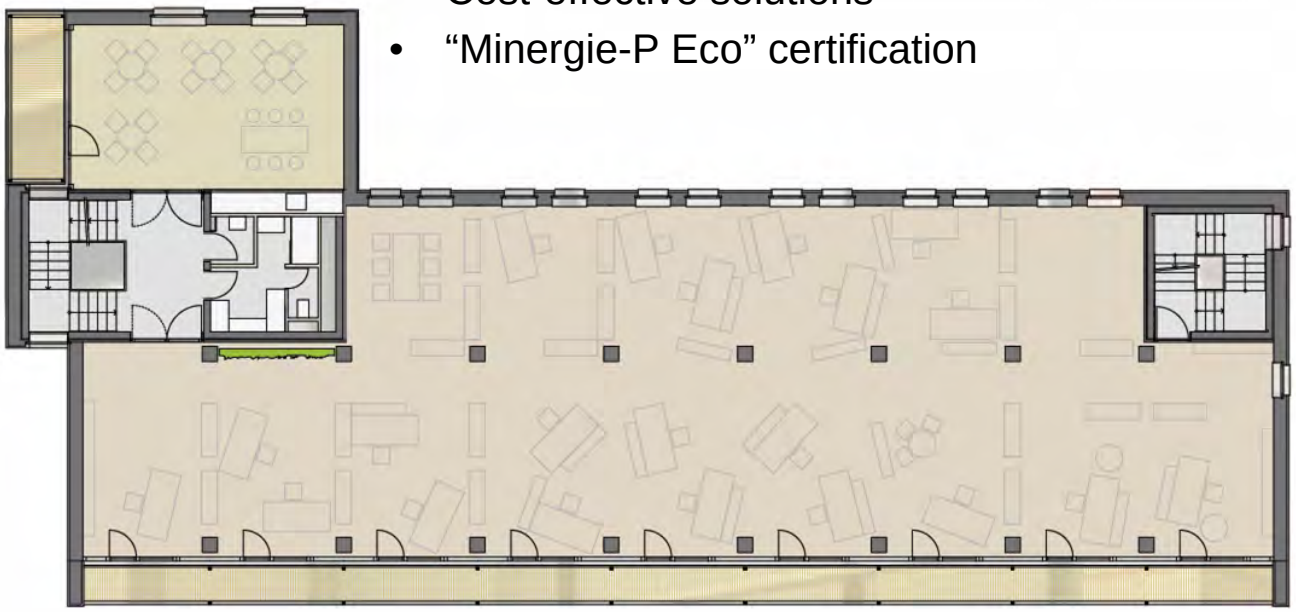
Source: www.glassx.ch/english/GLASSX_AG%20_products_080416_k.pdf

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Architectural concept

Floor plan

- Focus to ecological, environmentally compatible construction
- 3 – level office building with timber construction
- Cost-effective solutions
- “Minergie-P Eco” certification



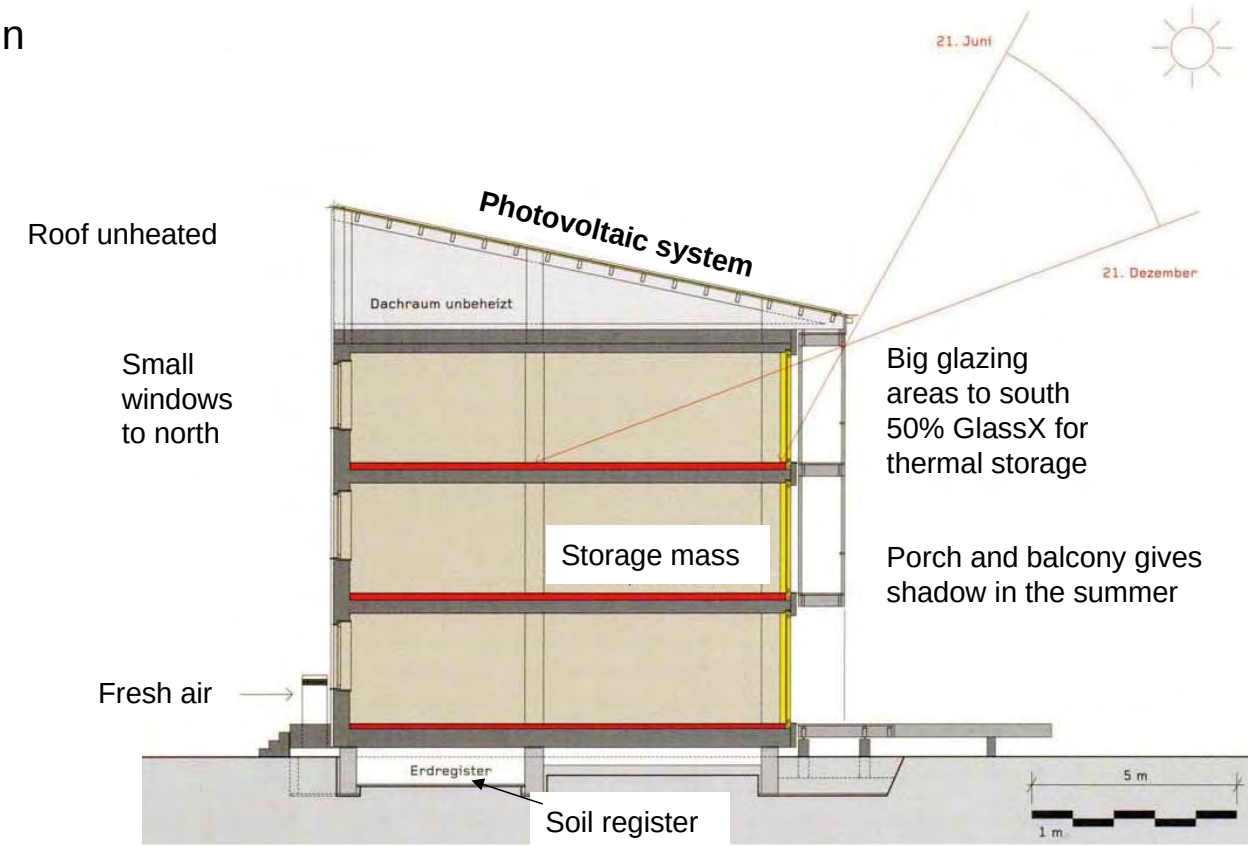
Source: www.kaempfen.com

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Architectural concept

Section



Source: www.kaempfen.com

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Architectural concept

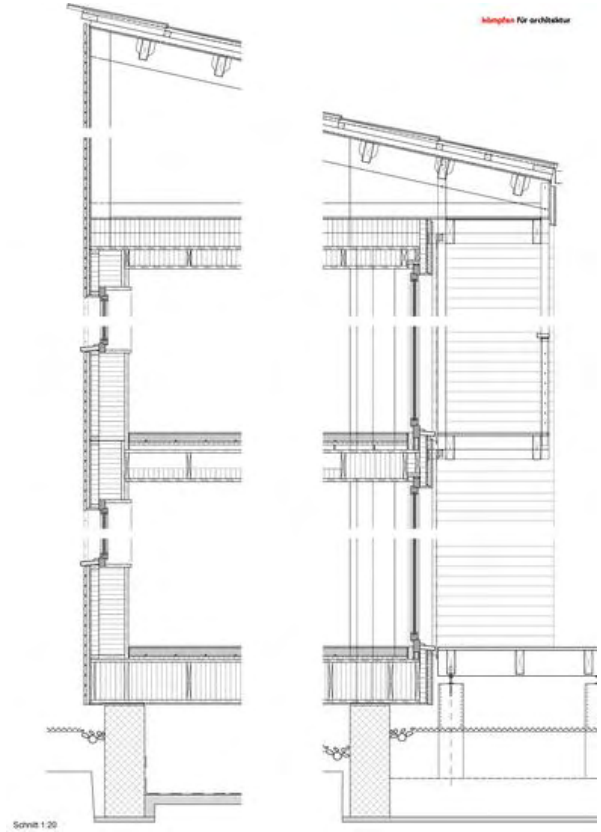
Characteristics:

- Standard / certificate: Zero-energy / Minergie-P-eco
- Energy value: 7.8 kWh/m²a
- Floor area GF: 1,454 m²
- Volume (SIA 416): 5,757 m³
- Costs / m³ BKP 2: 565 CHF/m³ or 2,235.- CHF/m² (1,475.- €/m²)

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Building concept



Timber construction on strip foundation (ventilated)

- built completely with prefabricated wooden panel elements (4.00 x 12.00 m)
- high precision of the construction
- very fast planning/construction time (12 month)

For more thermal mass

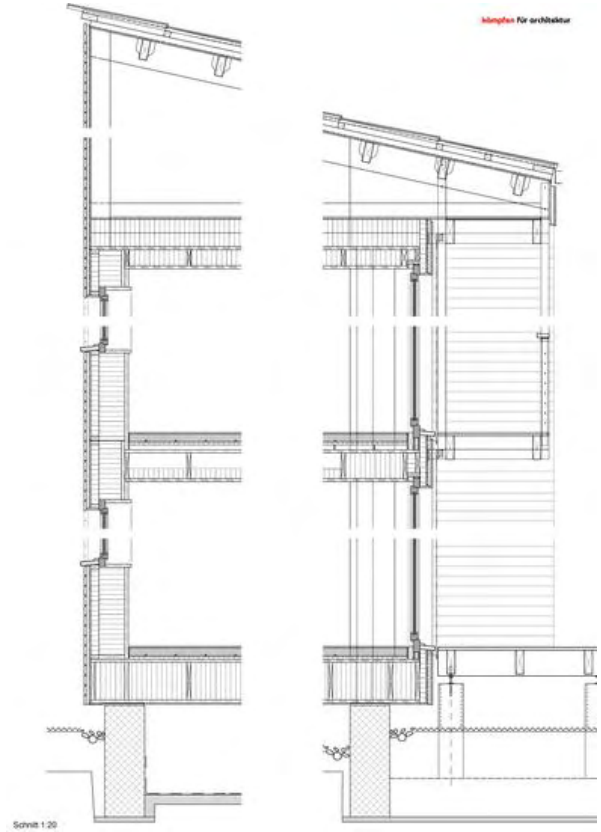
- concrete floor with natural stone coating on timber construction

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Building concept



Building elements:

Floor slope: U-value= 0.095 [W/m²K]

Roof: U-value= 0.084 [W/m²K]

Exterior wall: U-value= 0.104 [W/m²K]

Window: Ug=0.5 [W/m²K], g=54 %

GlassX: Ug=0.46 [W/m²K]

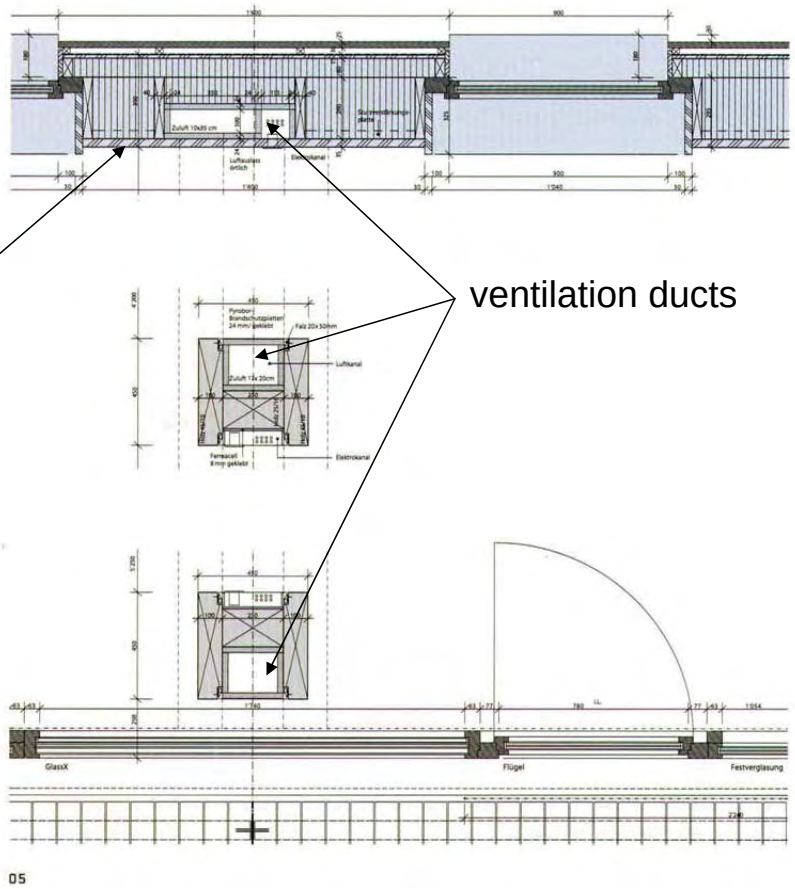
Source: Fact Sheet, Support Office Marché International, Mai 2007

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Building concept

The load carrying structure is a 3.5 cm wooden board on the inside.

The ducts for the ventilation system are built with and integrated in the wooden construction.



Source: www.glassx.ch/fileadmin/pdf/Tec21_Marche.pdf

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Building concept

Prefabricated wooden elements
with cross laminated panels.
The stairs are made of concrete.

Source: Foto: Fact Sheet, Support Office Marché International, Mai 2007

Foto: Beat Kämpfen, Zürich

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Building concept

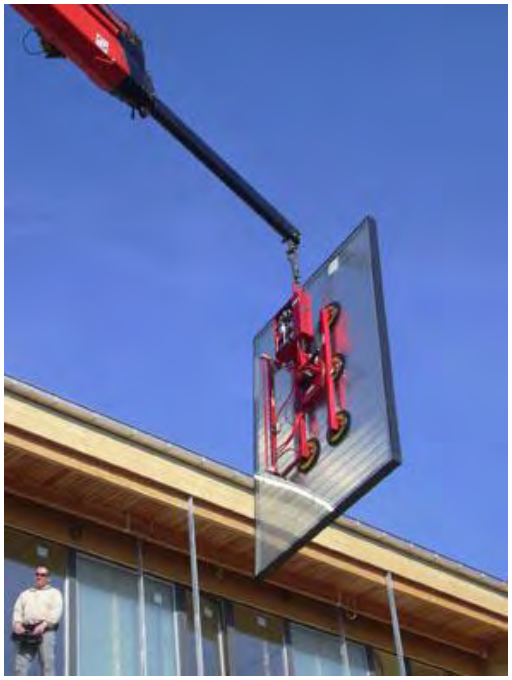
No connection between wooden structure and concrete stairs – for structure-borne and impact sound protection.

Source: Foto: Beat Kämpfen, Zürich

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Building concept

Fixing the PCM-panels



50% of south side glazing - GlassX for thermal storage

Source: Foto: Beat Kämpfen, Zürich

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Energy concept

- Compact volume
- South oriented
- Thermal optimized building envelope
- Ventilation with heat recovery
- Fresh air trough (sub-) soil heat exchanger
- Ground source heat pump
- Thermal storage with PCM´s
- PV-power for domestic technique
- Overall energy consumption 10times lower than an ordinary building

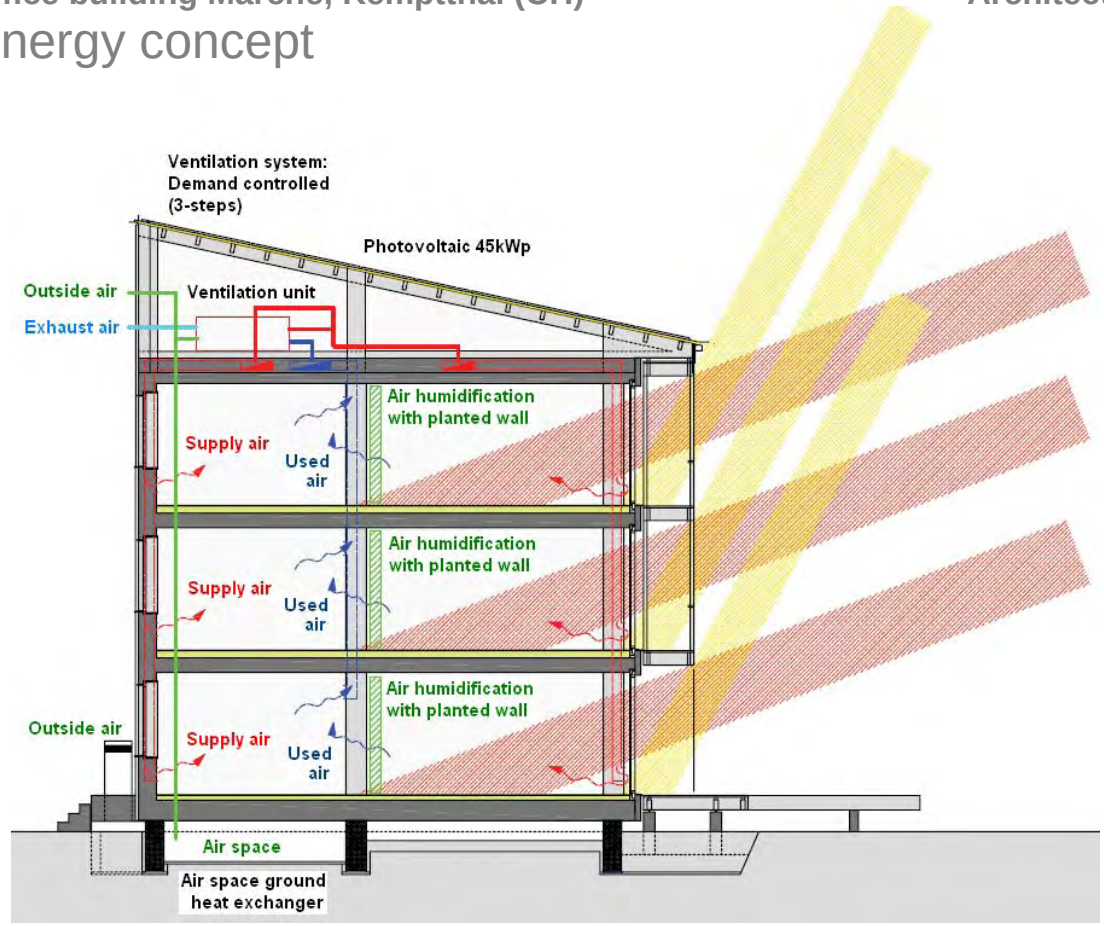
Small windows towards north

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Energy concept



Source: www.kaempfen.com/images/stories/kaempfen/pdf/pdf_bauenfdzukunft-marche.pdf

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Energy concept

Energy characteristics (SIA 380/1)

Treated floor area (TFA)	1.516 m²
Building shell value (A/ TFA)	1.29 -
Qh Annual heating need	28 MJ/m²a
(Minergie-P Standard air chance 0.33m³/m²h)	
Qh Annual heating need	19 MJ/m²a
(Minergie-P Standard air change 0.16m³/m²h)	
Air tightness of the building shell	0.57 h^{-1}

Certificate: Minergie - P -ECO

Source: Fact Sheet, Support Office Marché International, Mai 2007

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Energy concept - Energy balance

Energy need building	Heating	12'000 kWh/a
	Ventilation	4'000 kWh/a
	Warm water	2'000 kWh/a
	Total	18'000 kWh/a
Energy need	Lights	8'000 kWh/a
	Office equipment	12'000 kWh/a
	Others	2'000 kWh/a
	Total	22'000 kWh/a

Energy need total		40'000 kWh/a

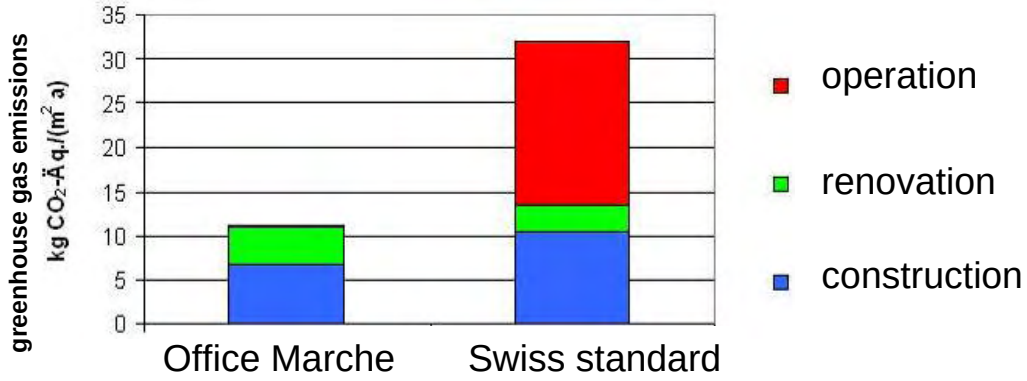
Photovoltaic system: installed power 44'600 kWp /annual production 40'000 kWh/a

Energy production total	40'000 kWh/a
Energy need	**0 kWh/a**

Source: Fact Sheet, Support Office Marché International, Mai 2007

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Energy concept - Eco balance



- Life Cycle Analysis with Eco-indicator
- Calculation for grey energy and material flow:
  - production of construction materials,
  - construction of the building,
  - the running energy over 45 years,
  - demolition of the building with removal

=> A third of the energy of a conventional building

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Energy concept - Eco balance

Technical equipment:

Subsoil heat exchanger - length 25 m
Ventilation system with heat recovery: Cesovent Minair 3000 PH
- Air volume 750m³/h, max. 2'500m³/h
- Heat recovery value 91% bei 2700m³/h (ABL 22°/AUL-10°)

Post heating of supply air only from -3°outside temperature
Ventilation system with heat recovery (relaxation rooms): Renovent 300
- Air volume 60m³/h, max. 250m³/h
- Heat recovery value > 90%

Heating: Heat pump CTA Optiheat 18e
- with 2x180m subsoil probe

Photovoltaic system 485 m²
- First solar thin film cells
- 44'600 Wp installed power

Rain water basin / Biotope ca. 100m³

Source: www.kaempfen.com

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Energy concept - Ventilation

The domestic engineering equipment is located on top of the stairs.

The horizontal ventilation ducts are distributed in the roof and covered with heat insulation.

The vertical ducts are integrated in the wooden structure.

All floors have a 12 m² plant wall.
30 litres of water evaporate daily from each plant wall for a comfortable indoor air humidity.

Source: Fact Sheet, Support Office Marché International, Mai 2007

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Energy concept - Ventilation

Heat recovery with heat exchanger

Source: www.kaempfen.com, (2008-02-11, 0:20)

Office building Marché, Kemptthal (CH)

Architecture: Beat Kaempfen

Energy concept – Heating /Cooling

On top of the wooden box beam elements is a concrete floor screed with a floor heating system. It is supported by the ground source heat pump.
In the summer time it is used for cooling (with 18°C).

Source: Fact Sheet, Support Office Marché International, Mai 2007

Office building Marché, Kemptthal (CH) **Architecture: Beat Kaempfen**

Energy concept - PV

Roof integrated photo-voltaic

485 m² Photovoltaic system:
installed power 44'600 kWp
annual production 40'000 kWh/a

- Pitched roof directly south
- Slope 12°
- Roof skin = shiny anthracite coloured thin film solar panels
- Enough electricity for technical installations and running the office

Source: www.kaempfen.com