Franciscan Monastery, Graz, Austria

1. INTRODUCTION

PROJECT SUMMARY

- *first parts 1239*
- *main parts from 1250 to 1650*
- *protected monument*

SPECIAL FEATURES

Mission of the Franciscans: conservation and preservation of the Creation.
Technical implementation through:

- *solar thermal panels*
- *component heating*
- *heat pump*

Economic improvement from less consumption

PLANNER

HoG architektur ZT GmbH
Architekt DI Michael Lingenhöle
TB Köstenbauer & Sixl GmbH

OWNER

Convent of the P.P. Franciscan Graz

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IEA SHC Task 47
Renovation of Non-Residential Buildings towards Sustainable Standards

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

2. CONTEXT AND BACKGROUND

BACKGROUND

- *Medieval building structure, parts of the historic city walls*
- *Franciscan monastery (living areas of the friars, meeting rooms, seminar rooms, library,..)*

OBJECTIVES OF THE RENOVATION

- *Mission of the Franciscans: conservation and preservation of the Creation*
- *reduce heating costs in order to save operating costs*
- *New urban functions (meeting rooms, conference center, event rooms)*

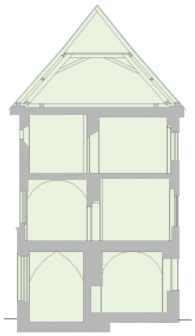
SUMMARY OF THE RENOVATION

- *Installation of a solar power plant*
- *Installation of heat pumps*
- *Floor partially insulated with foam glass gravel*
- *Installation of a component heating*
- *Attic conversion*
- *Energy performance before retrofit: 183.10 kWh/m²a*

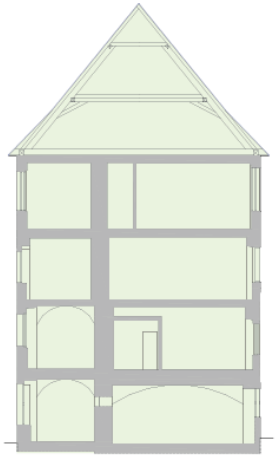
Non-renovated patio

Patio (non-renovated left wing) with solar plant

Section



central wing



south wing

south-west wing

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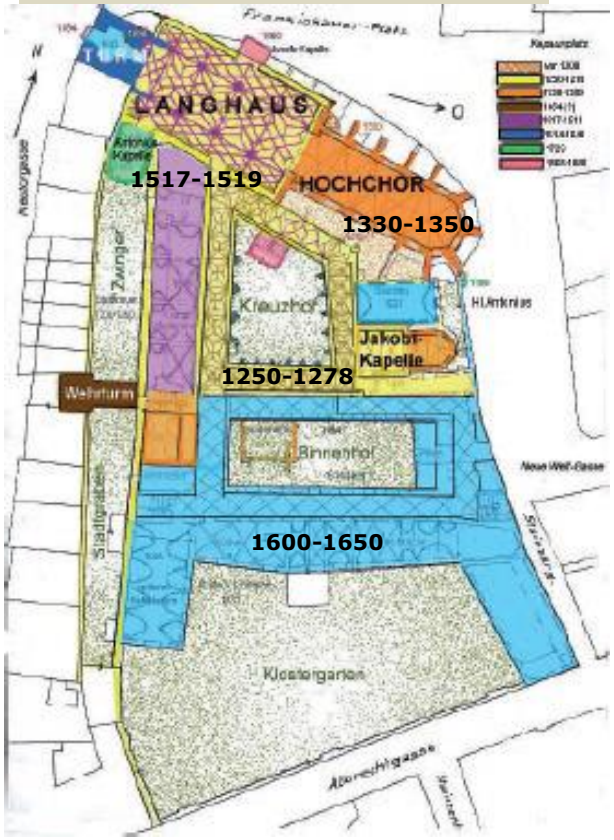
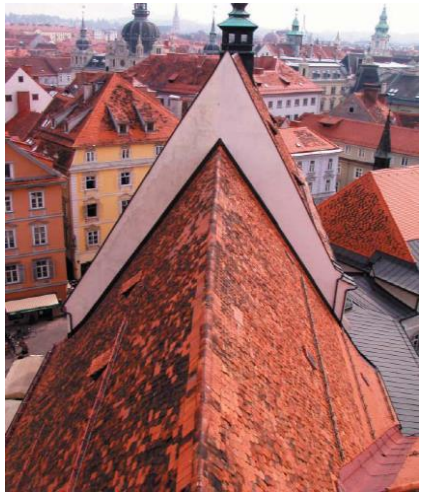
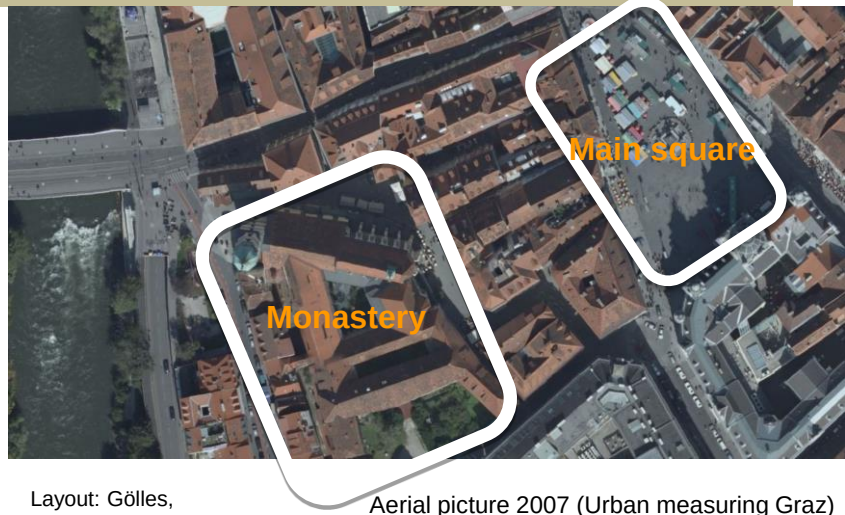
2. CONTEXT AND LOCATION

Plan of the building stages - main parts from 1250 to 1650 (Franciscans, Graz)





Above: Typical pitched roof shape of the monastery and other historic buildings in Graz (Franciscans, Graz)



Layout: Gölles, www.gams4.com

Aerial picture 2007 (Urban measuring Graz)

The Franciscan Monastery – part of the Urban City Life

- Public use and parts open to the public
- Church, monastery yards, meeting rooms, library, harborage, emergency accommodation
- Centre for pastoral care
- Enclosure for 13 friars and students of theology

C

MASTER PLAN FOR THE RENOVATION

The brothers together with the architect Michael Lingenhöle worked out the master plan from 2001 to 2007. It was entitled *'Ort der Begegnung / Place to Come Together'*. The value of the monastery was described and what it should be in the future. The parts of the buildings were divided in 11 thematic priorities of the monastic work like library, culture, sacral rooms, social activities etc. Since then the modernizing process in every part of the monastery has been implemented successively.

CONFERENCE CENTER
lectures, symposium, meetings, ...
(rooms already renovated)
→ access
Franziskanerplatz-Kreuzhof

CONVENT LIFE CREATIVE
→ access Neutorgasse-church and Franziskanerplatz-cloister

SACRED ROOMS
building system with church, Jakobi-chapel, oratory, Kreuzhof, cloister
- „place of silence"
→ access Neutorgasse-church and Franziskanerplatz-cloister

MONASTERY GUESTHOUSE
hostel in which are to be renovated cloister wing (northern westwing second floor)
→ access Franziskanerplatz-cloister-westwing and cloister-northwing

YOUTH
double use of cultural hall (reconstruction and rehabilitation) and to be adapted
Youth project rooms: encounter room, communal bunks
→ access cloister

FOOD PASS, OVERNIGHT SHELTER
space conversion with flexible dual use next to the main entrance and gate: rebuilding
→ access Franziskanerplatz

CULTURE
culture hall and adjoining rooms
preservation of the cultural creation in the monastery (support architecture, sculpture, painting, music...)
→ access cloister

GATE, INFORMATION, MONASTERY LOAD
reconstruction of the gate in flexible areas:
secreteriat, „fast pastoral",
reception, information
→ access Franziskanerplatz

LIBRARY, LITERATURE
existing valuable library,
new library development, exhibition reception in the refurbished ballroom
research center in the northern werst wing first floor
→ access Albrechtgasse: along old city wall or cloister

SOCIAL ACTION
social facilities for disabled or kids, physicians counseling center, integration workshop, cross-cultural facility, consultation in new buildings Albrechtgasse
→ access Albrechtgasse

MONASTERY - CITY HISTORY EXPERIENCE
monastery site with hist. moat, tower and to be rehabilitated hist. valuable monastery - modern architecture
→ access Franziskanerplatz cloister or Albrechtgasse

Masterplan (Architect DI Michael Lingenhöle)

A FOUR-LEVEL ENERGY VISION was developed on the basis of the MASTERPLAN

1. Step: ***Energy efficiency measures***

- Desiccation of the walls
- Insulation where possible
- Rooms used as buffers
- Renovation of box-type windows
- "Warming" tints

Savings after the first step up to 25%!

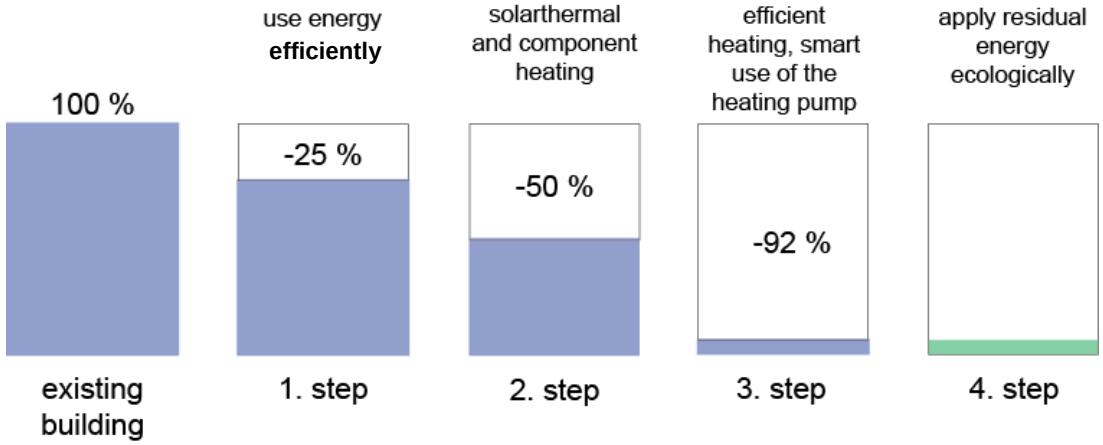
2. Step: ***Solar thermal energy use***

- For hot water and heating
- Component heating (to dry and pre-temperate the walls)
- Low temperature heating
- Supply of adjacent buildings

Savings after the second step up to 50%

"Insulation where it makes sense, measures with as low technical input as possible"

Matthias Maier – Guardian of the Franciscan Monastery Graz



The energy concept of the 4 steps to reach the zero emission monastery (AEE INTEC)

3. Step: ***Heating system, heat pump***

- Solar- and water-coupled heat pump
- Annual use efficiency > 5
- 3 storage tanks with together 15 m³
- Central heating room *inside* the building
- Two pipes distribution (flow/return flow)
- Three decentralized tiled stoves

Savings after the third step up to 92%!

4. Step: ***Power generation***

- Photovoltaics (at buildings - planned)
- Or green power investments
- Or green power (wind, PV) purchase

Rest: Around 8% of the original consumption!

Bird`s-eye view of existing monastery (source: bing maps)

3. DECISION MAKING PROCESSES

The monastery friar Matthias and the construction manager initiated the project, which was motivated by the owner.

Other important decision makers in the process: Franciscan Order, National Heritage Agency (BDA) UNESCO World Heritage, Old Town Conservation of Graz (ASVK)

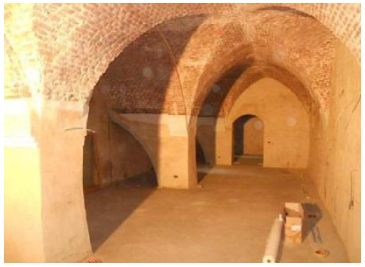
Public funds from the Federal Government of Styria (for thermal insulation, heat pump and solar system), BDA / National Heritage Agency of Austria (monument-related costs), Federal State of Styria (Revitalization Fund), additional funds from BMVIT, Federal State of Styria and City of Graz

There have been several changes in the ambition levels during the process through preservation orders for listed buildings

There was no need for reduced operational cost for payback as mendicant orders – like the Franciscan Order – cannot go into debt

It was a charged negotiation process because of the particularities in the protected building; suitable companies were invited to submit offers

Corridor during and after renovation (AEE INTEC, Lingenhöle)



Event room during and after renovation (IWT)

Timeline for the decision making process

Idea was born
2001 - August 2007 (Masterplan)

First brief project description completed
December 2008 (Masterplan 1. stage)

Detailed project description completed
May 2009 (planning for submission 1. stage)

Tendering process started
n.s.

Signing of contract with main contractor
n.s.

Start renovation
n.s.

Renovation completed
Total renovation still running (06/2014)

Evaluation among occupants
No evaluation yet

4. BUILDING ENVELOPE*

Roof construction : *U-value: 0,18 W/m²K*

plasterboard	*15 mm*
CD-profile between	
KeKelit cooling/heating element	*30mm*
lathing	*35 mm*
transverse lathing	*100 mm*
rafters with insulation	*160 mm*
wooden base planking	*24 mm*
roofing membrane	
counter lathing	*50 mm*
lathing	*35 mm*
roof brick	
Total	*474 mm*

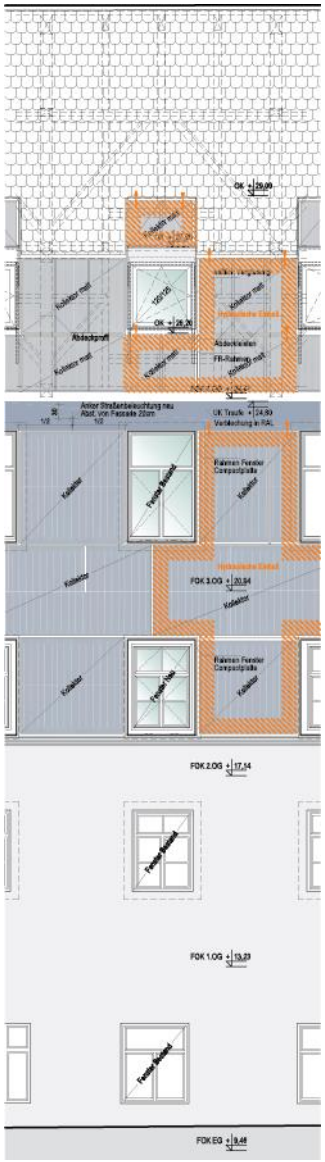
Wall construction : *U-value: 0,30 W/m²K*

brick	*700 mm*
levelling layer	
lathing	*60 mm*
hook profile	*10 mm*
flat-plate collector	*105 mm*
Total	*875 mm*

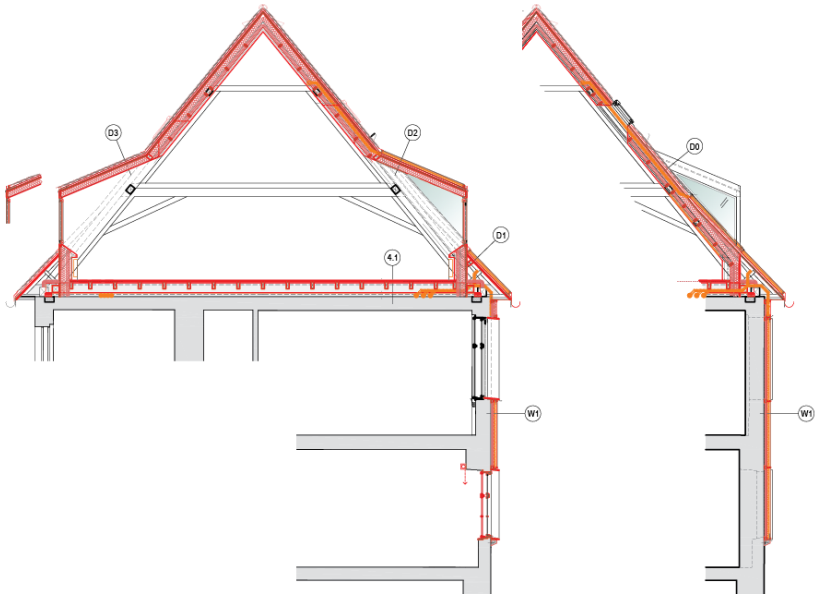
Summary of U-values [W/m²K]

	Before	After
Roof/attic	-	0,18
Floor/slab	0,77	0,18
Walls	1,05	0,30
Ceilings	2,08	0,47
Windows	2,54	1,30

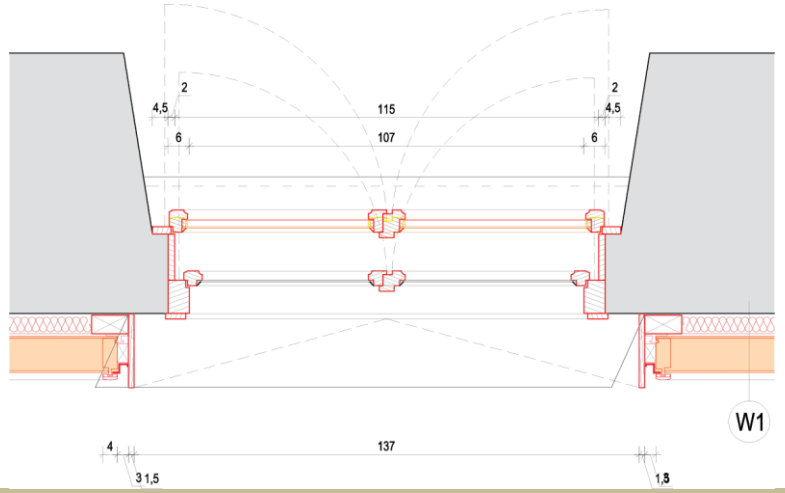
*southwing 2. stage



Exterior view south wing



South wing Section and detail (new solar collectors red) (HoG architektur ZT GmbH)



5. BUILDING SERVICES SYSTEM

OVERALL DESIGN STRATEGY
Conservation and preservation of the Creation

HEATING SYSTEM
Change of high temperature system to low temperature system (component heating and radiators with individual room thermostat control)

COOLING SYSTEM
No cooling system

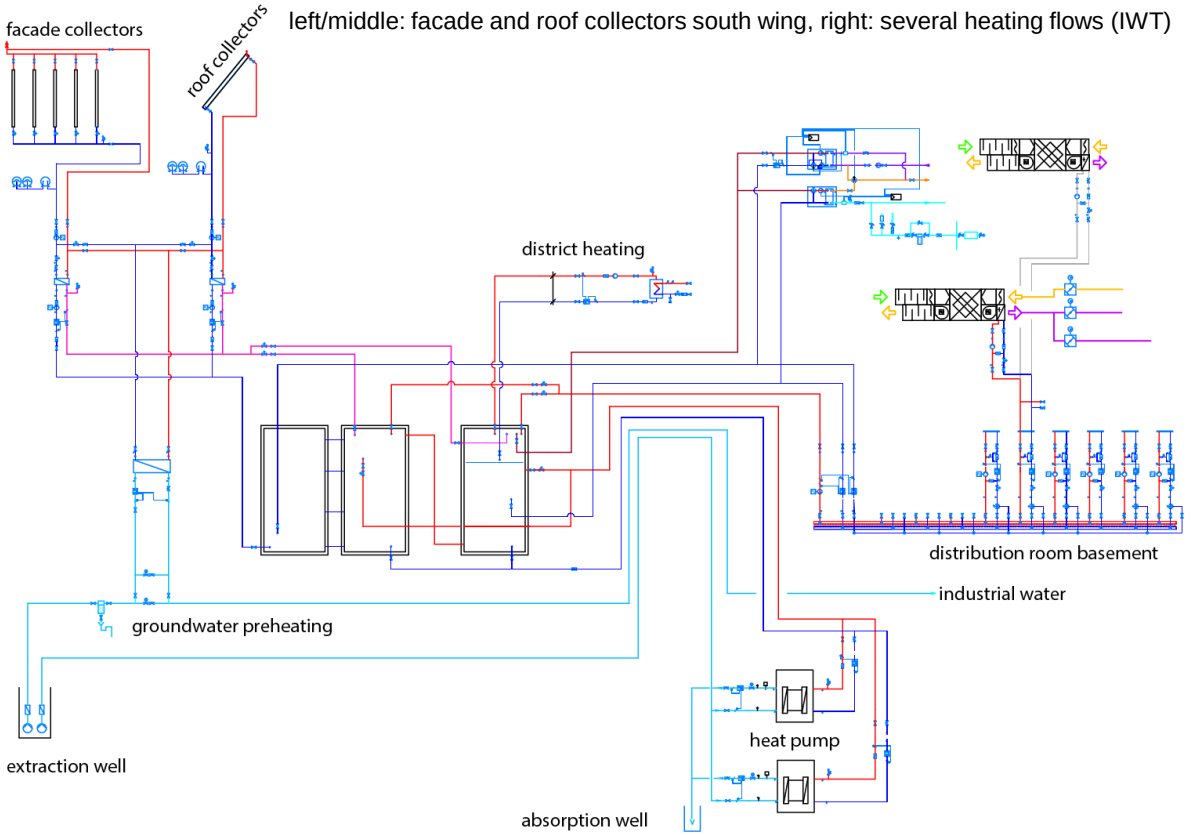
VENTILATION
Ventilation system in the event room

HOT WATER PRODUCTION
Solar plant and heat pump with district heating as backup

RENEWABLE ENERGY SYSTEMS
2 water heat pumps with 200 kW (well water fed)

On the south wing 180 m² roof-integrated flat-plate collectors and 180 m² façade panels were installed for water heating, component heating and to preheat the well water for the heat pump.

left/middle: facade and roof collectors south wing, right: several heating flows (IWT)



Hydraulic system Franciscan Monastery (TB Köstenbauer & Sixl GmbH)

6. ENERGY PERFORMANCES

ENERGY PERFORMANCE

Since the systems are not yet running satisfactorily, a monitoring evaluation has not yet been possible, there is only a calculation

before: *183,1 kWh/m²a*

district heating with radiators

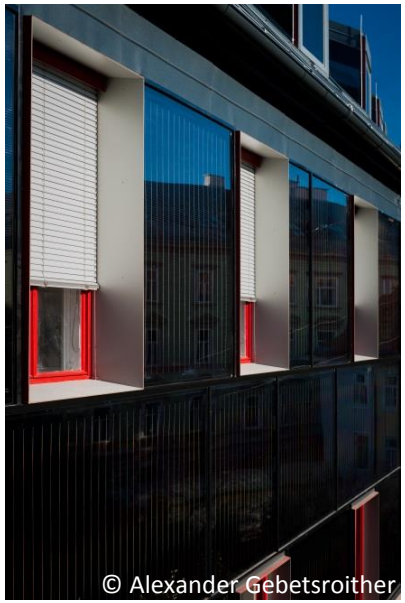
after: *85,4 kWh/m²a*
heating pumps with wall heating and radiators

RENEWABLE ENERGY USE

Solar collectors and heat pump: 2 water heat pumps with 200 kW (well water fed), 180 m² roof-integrated collectors, 180 m² façade collectors.

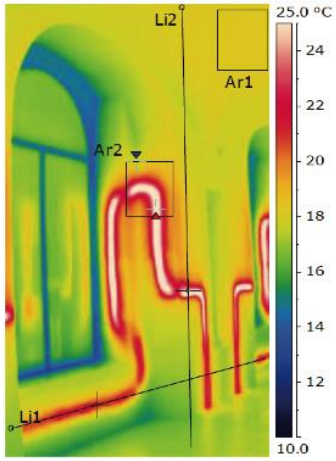
Collectors supply heat for hot water, to warm the walls and to preheat the well water used in two heat pumps. The collectors were fabricated specially for this project; for aesthetic reasons so-called blind collectors (without an absorber) were fabricated and installed in some areas.

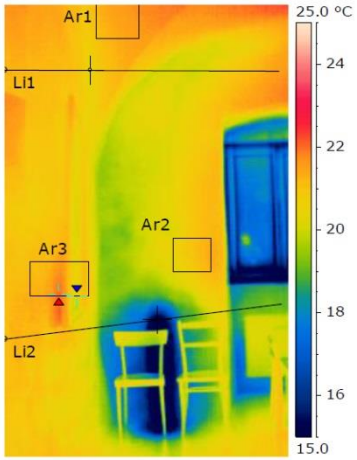
Heated water is stored in 3 tanks with a capacity of 15,000 liters. As the monastery walls can store a great deal of heat, the inflow temperature is a mere 32 to 33 °C. Two heat pumps (rated at 200 kW each, with solar preheating) can deliver any additional energy required for heating and supplying hot water.
As backup, the monastery is connected to the district heating system.



Heating, ventilation and energy strategy
A wall heating facility keeps the masonry dry and improves the indoor climate.

kind of plant	water heating, component heating, preheating the well water for the heat pump
collector area in m²	180 m² roof-integrated flat-plate collectors, 180 m² façade panels
in combination with	2 water heat pumps, each 200 kW, district heating as backup
supply temperature	32-33°
solar fraction	20 % (space + water heating)
storage volume in l	15.000 (3 x 5 m³)
location of the storage	basement





Ar1 average temperature	18,3°C
Ar1 max – min temperature	0,6 °C
Ar2 average temperature	21,1 °C
Ar2 max – temperature	28,1 °C
Ar2 min. temperature	17,8 °C

Interior thermography (Ernst Meissner GEA)

CLARIFICATION: the energy calculations and given energy numbers will be according to the national standards which might vary between countries., i.e. numbers are not always comparable

Foam glass insulation in the hallways (AEE INTEC)

The energy performance certificate was calculated as accurately as possible for such historic buildings with the following results:

	before retrofit	after retrofit
Gross floor area	3.590 m^2	3.585 m^{2*}
A/V-ratio	0,53 1/m	0,36 1/m
Energy performance	183,10 kWh/m^2a	85,38 kWh/m^2a
Energy heating demand	711,307 kWh	329,744 kWh
Heating load	256,4 kW	142,4 kW

Table: Values calculated with HDT = 3,588 Kd and min. outside temperature –10,5 °C before and after retrofit (TB Köstenbauer und Sixl GmbH)

Please note: a detailed calculation method for historic buildings is still missing.

*gross floor area after without extension

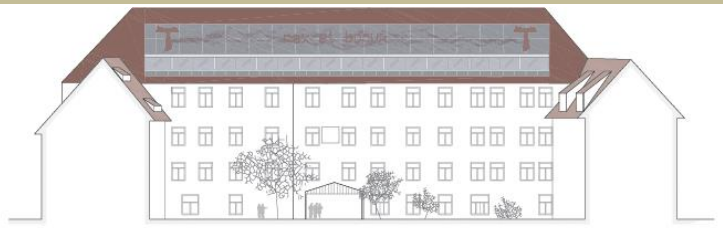
Pipe distribution in the corridor of the monastery for the component low-temperature heating (AEE INTEC)

Variety of proposals for the location of the solar panels

7 ENVIRONMENTAL PERFORMANCE

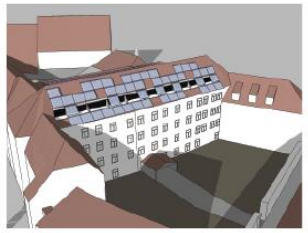
Complete general redevelopment with regard to energy and environmental optimization

- Ecological materials
  as much handcraft of the existing building with as few new materials as possible, top floor ceiling, ground level floors, corridor and vaults ceiling with foam-glass insulation
- Indoor climate
  significant, noticeable improvement by component heating, but no measurement values
- Increasing quality of life
  attic extension: new and very attractive office space created in the city center.
- Lighting quality
  consciously lighter material in interior design seem to be friendlier



May 2010

August 2010



August 2010

September 2010

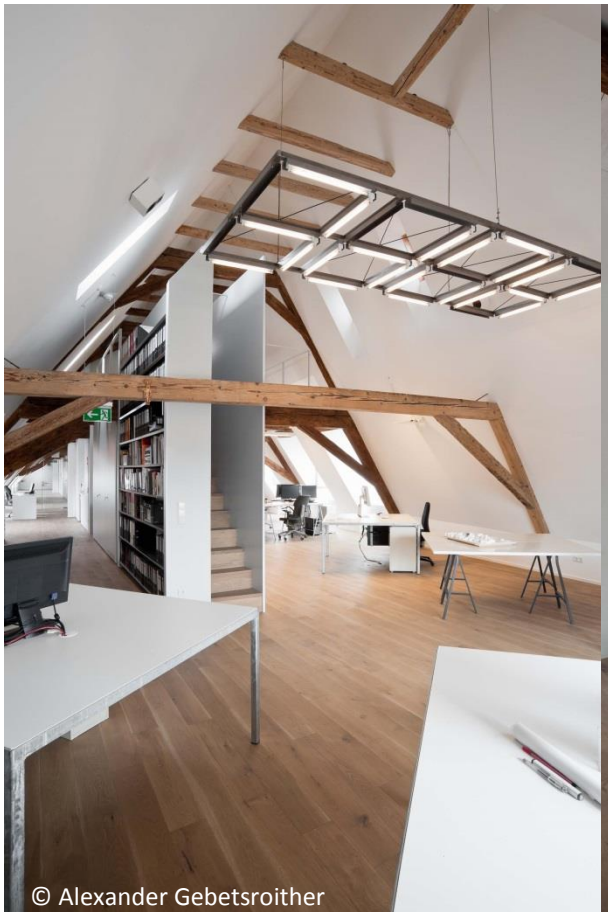
realised variation May 2012

(HoG architektur ZT GmbH)

8. MORE INFORMATIONS

OTHER INTERESTING ASPECTS

Insulating the monastery‘s pitched roofs made a significant contribution to improving energy efficiency. The unheated storage rooms in the attics now function as thermal buffer zones as heat flowing upwards / to the outside. The monastery walls did not need insulating, as thermography revealed only minor heat loss. The top floors were thermally insulated with foam glass granulate. The single-glazed corridor windows were replaced by box-type windows with insulating glazing inside.



Room behind the solar collectors in the attic