Sustainable Buildings

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Vienna
19.06.2020

1

What is Sustainability?

Sustainability

Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

World Commission on Environment and Development

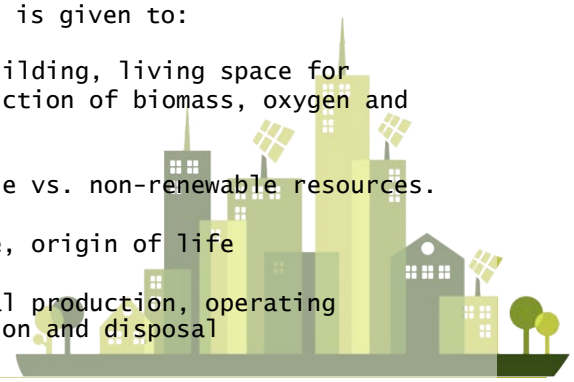
2

Sustainable Design

Reduces the negative impact on the environment and human health, thus improving the performance during a building's life cycle.

Careful consideration is given to:

- **Soil:** ground for building, living space for organisms and production of biomass, oxygen and drinking-water
- **Resources:** renewable vs. non-renewable resources.
- **Water:** living space, origin of life
- **Energy:** for Material production, operating buildings, demolition and disposal



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"The most sustainable energy is saved energy"

- Energy itself not of particular interest
  -but is a means towards desired ends
- Clients desire the services which energy can deliver - *comfort, illumination, power, transportation...*
- The architectural challenge: ensure energy services are delivered in a sustainable manner
  -with maximum efficiency, and minimal environmental impact
- *Holistic perspective*: integrated, contextual, whole life cycle, socially aware, economic solution

Professor J Owen Lewis
UCD Energy Research Group
EURIMA Congress, Budapest June 2007

4

Sustainability

Historical Development:

The term originates in **German** language from the **forest industry**. First mentioned in 12th century.

1144: Forest arrangement of the alsatian cloister Mauermünster – „*not to cut more wood than it can grow back again*".

1480: Requirement - „*to preserve the forest, because the progeny will once also need it*".

1713: Saxony Captain Hans Carl von Carlowitz demanded in „Sylvicultura Oeconomica", „*that a continuing sustainable use should become indispensable*".

5

1992: **Earth Summit in Rio de Janeiro** defined the sustainable development as a *development, that can be continued over the whole earth without affecting the natural balance and the society in their functionality*.

1997 and 1998 the EN ISO 14.040 and 14.041 were published, handling the Ecobalancing, replacing the simple SETAC Scheme.

1999 **Contract of Amsterdam**: Sustainability is and intangible part of the European Union.

2001 **Göteborg**: European council adds the environmental dimension to the social and economic dimension.

2016 **Paris Agreement:** dealing with greenhouse-gas-emissions mitigation, adaptation, and finance

[Quelle: GRAUBNER, C.-A., HÜSKE, K. 2003]

6

Principles of Sustainability in Architecture

- **Economy of Resources** - Reduce, recycle, and reuse natural resources
- **Humane Design** - Harmony between humans and nature
- **Life Cycle Design** - Structured methodology for the building process

7

Principles of Sustainability in Architecture

- **Economy of Resources** - Reduce, recycle, and reuse natural resources

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Principles of Sustainability in Architecture

- **Humane Design** - Harmony between humans and nature

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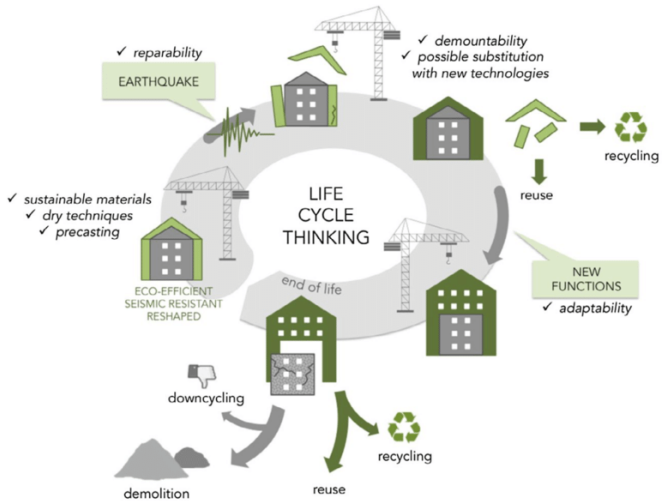
Principles of Sustainability in Architecture

- **Life Cycle Design** - Structured methodology for the building process



10

Evaluation methode: Lifecycle analysis (LCA, Ökobilanz)

„Lifecycle analysis is important with relevance to the realisation of sustainable developement in the construction sector as the basis for decision-making in the design and planning stage“

Prof. Graubner, TU Darmstadt, Inst. F. Massivbau

11

Sustainable Building Life Cycle

- Pre-Building
- Building
- Post-Building

12

Pre-Building Phase

Site selection, building design, and building material processes, up to but not including installation.

Examine the environmental consequences of the structure's design, orientation, impact on the landscape, and materials used.

13

Building Phase

- Construction and operation processes reduce the environmental impact of resource consumption
- Long-term health effects of the building environment on its occupants are considered

14

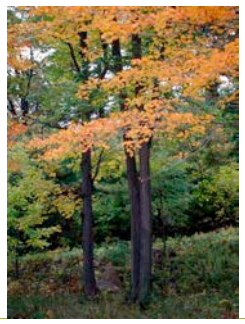
Post-Building Phase

Old materials become resources for other buildings or waste to be returned to nature. The sustainable design strategy focuses on reducing construction waste by recycling and reusing packaging and excess material.

15

Preservation of Natural Conditions

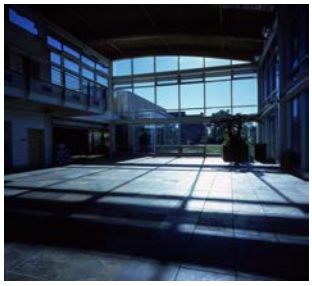
An architect should minimize the impact of a building on its local ecosystem (e.g., existing topography, plants, and wildlife).

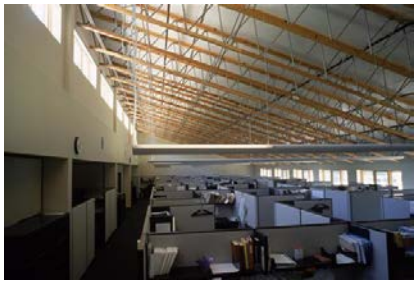


16

Human Comforts

A building's design should enhance the work and home environments. This can improve productivity, reduce stress, and positively affect health and well being.





17

Sustainable Refurbishment

Existing buildings can remodel and install improved mechanical components and update operating systems to make a building green.

18

Indoor Environmental Quality

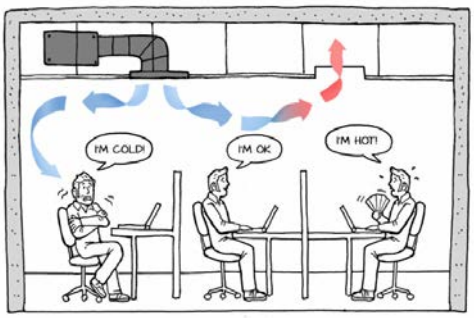
Low Emitting Materials
- Adhesives and Sealants
- Paints and Coatings
- Composite Wood

Indoor Chemical and Pollutant Source Control
- Controllability of Systems
  - Perimeter Spaces
  - Non-Perimeter Spaces

19

Indoor Environmental Quality

- Thermal Comfort
- Daylight and Views



20

Development of sustainable architecture

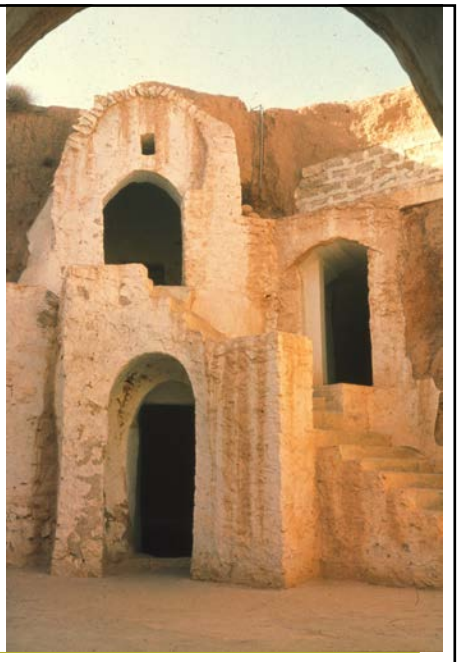
21

Rock and Earth Caves: the earliest forms of human housing

Advantage: Living temperature in the cave = constant middle-year temperature of the surrounding, Summer – cool, winter –warm

Examples:

- in the valleys of Dordogne and Vézére (F),
- Göröme (Turkey),
- Matmata (Tunisia),
- Loyang (China),
- Montezuma Castle (Arizona),
- Mesa Verde (Colorado),
- Matera (Apulien).



Matmata, Tunisia

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Matera, Italy

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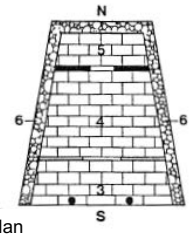
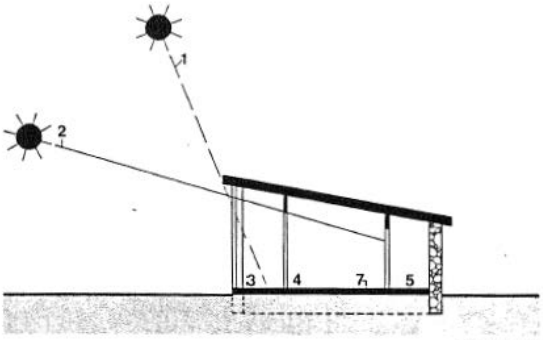
Matera, Italy

24

Sunhouse of Socrates (469 – 397 v. Chr.)



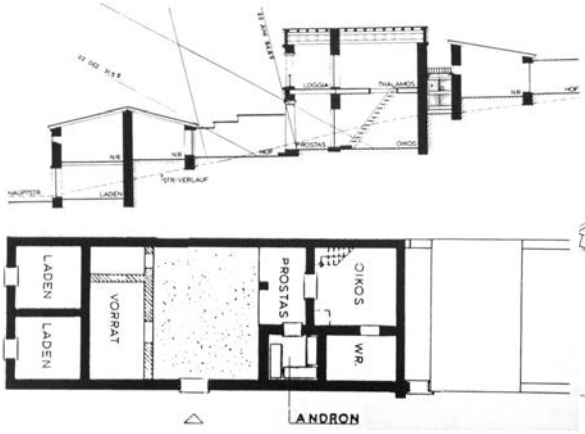
Floor plan

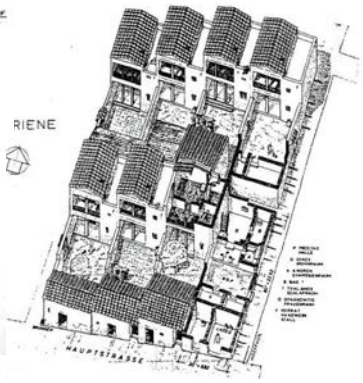


Cross section

Legend:
3 Terrace, Forecourt
4 Living space
5 Storage room, also buffer zone
6 Massive Wands for accumulation of heat
7 Stonefloor, also heat accumulation

25





Atriumhouse in Priene

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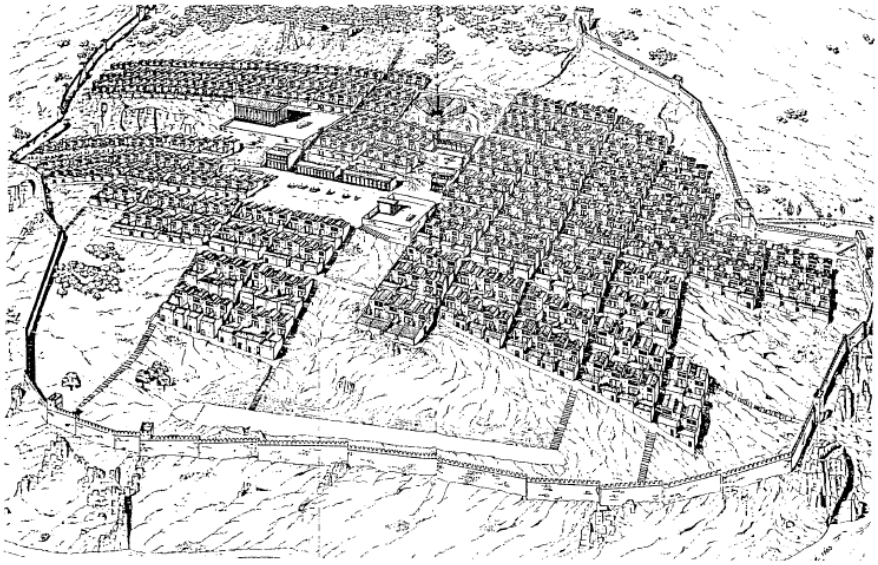
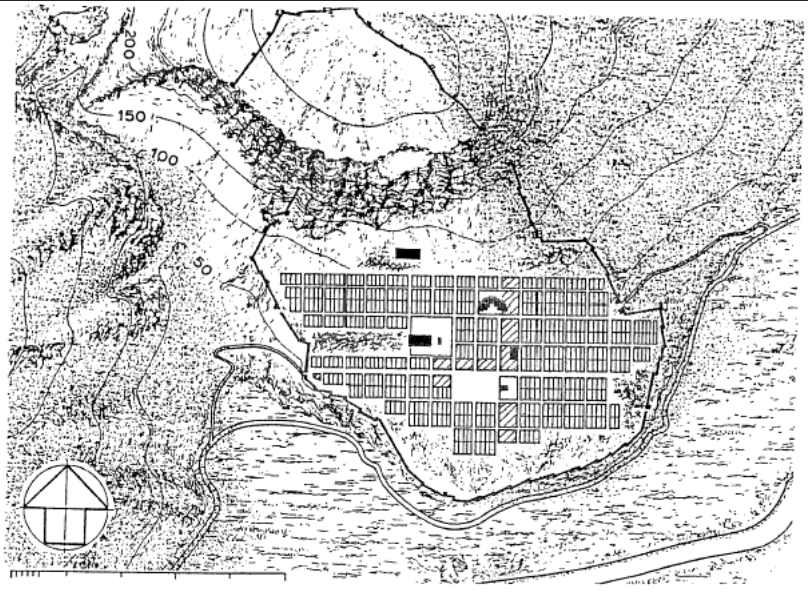


Reconstructed View of the Priene City (300 B.C)

27



Streetplan of Priene

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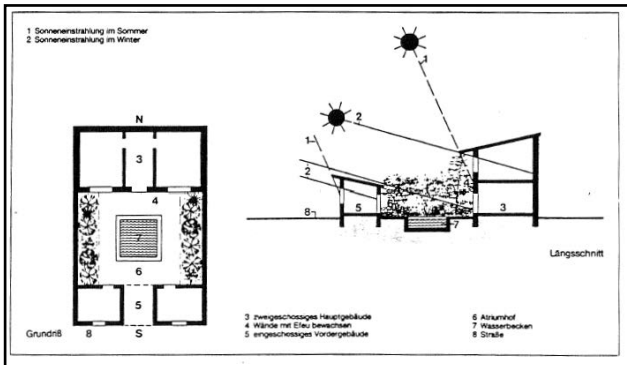
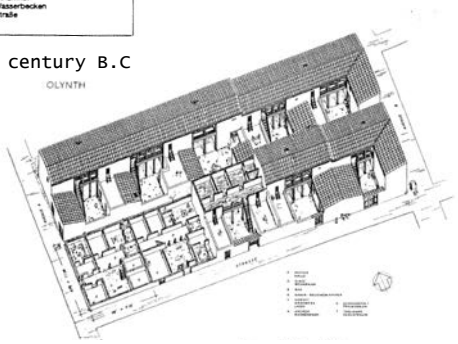


Atrium house of the ancient time (from 2nd century B.C



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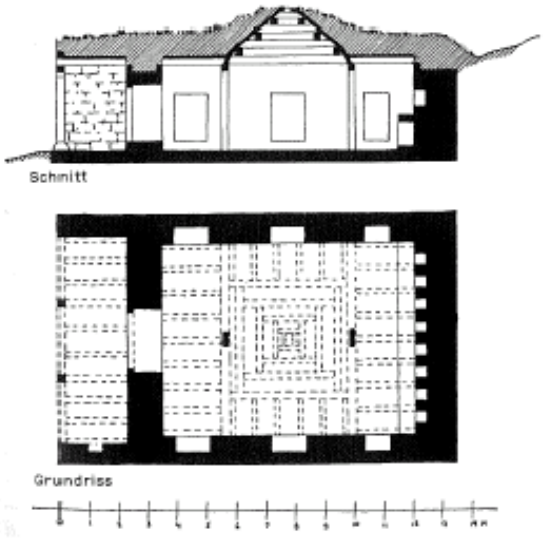

House in Digomi, Afghanistan

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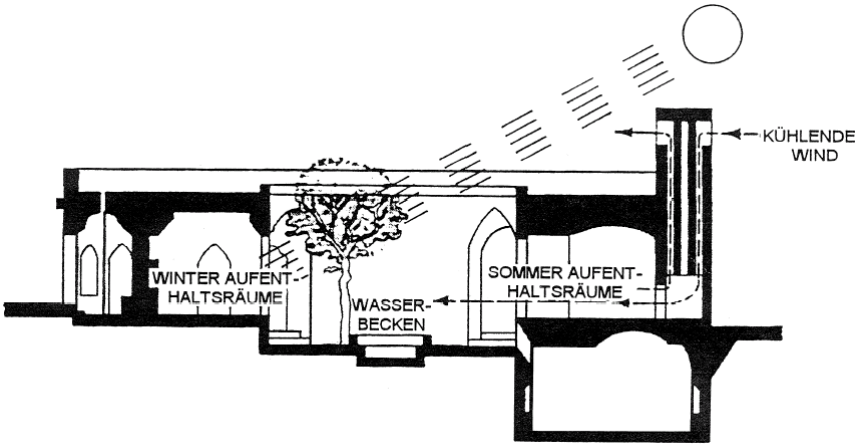
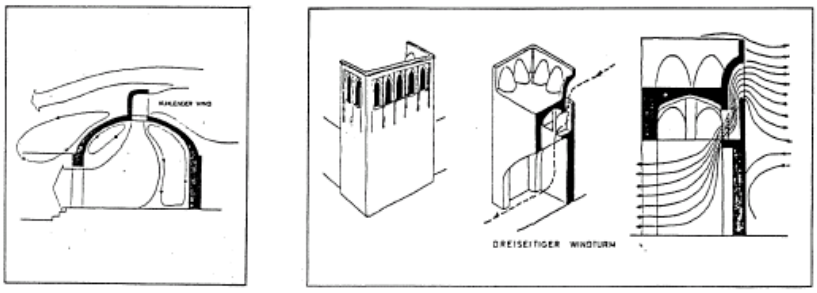


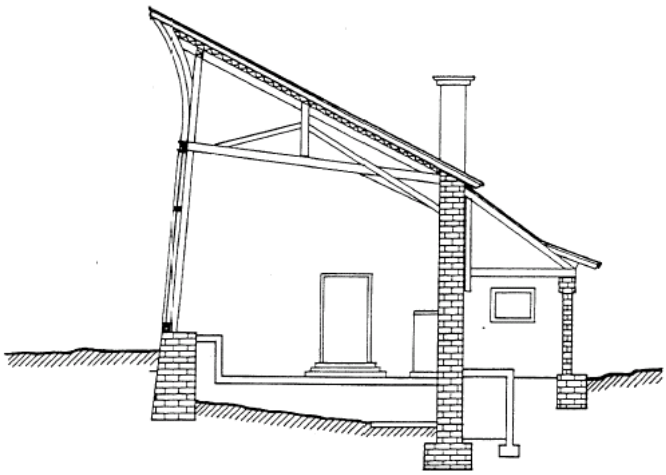
Persian House with sunloggia and wind tower

31



Natural air conditioning in building of persian times

32



Baroque greenhouse

33

Greenhouse in Telc, Czech Republic

34

Orangery Castle Schönbrunn, Vienna, 1755

35

Orangery Castle Schönbrunn, Vienna, 1755

36

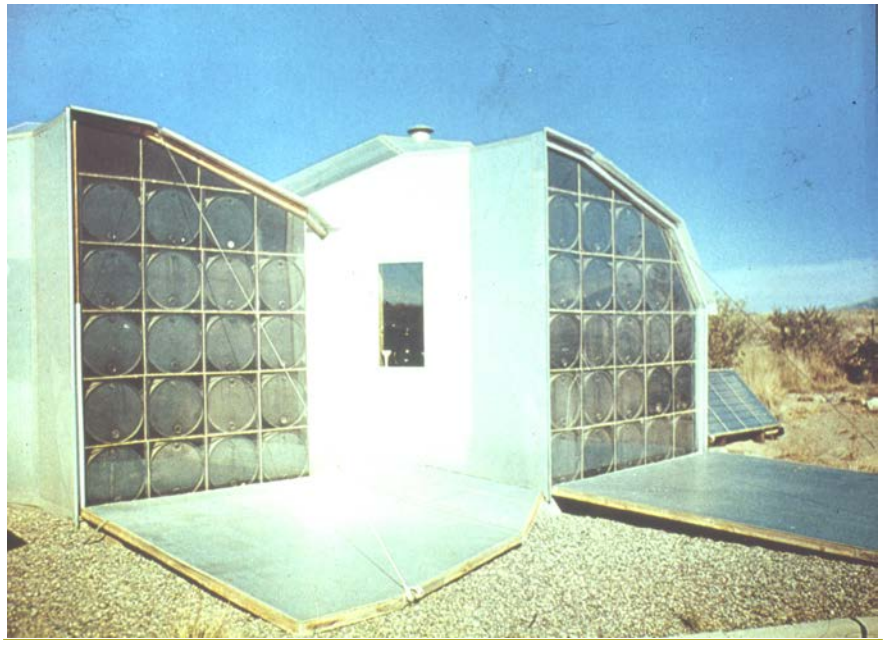
Steve Baer Haus

Corrales – New Mexico, 1972, Drumwall (oildrums filled with water)

Hippie-culture the 60´s as countermovement to consumerism, escape from Vietnam-war military duty, dropouters and consume deniers in the desert, pacifism and extensive energy self-sufficient housings

Geodetic domes, Houseboats, Shelters, idiosyncratic building forms

37



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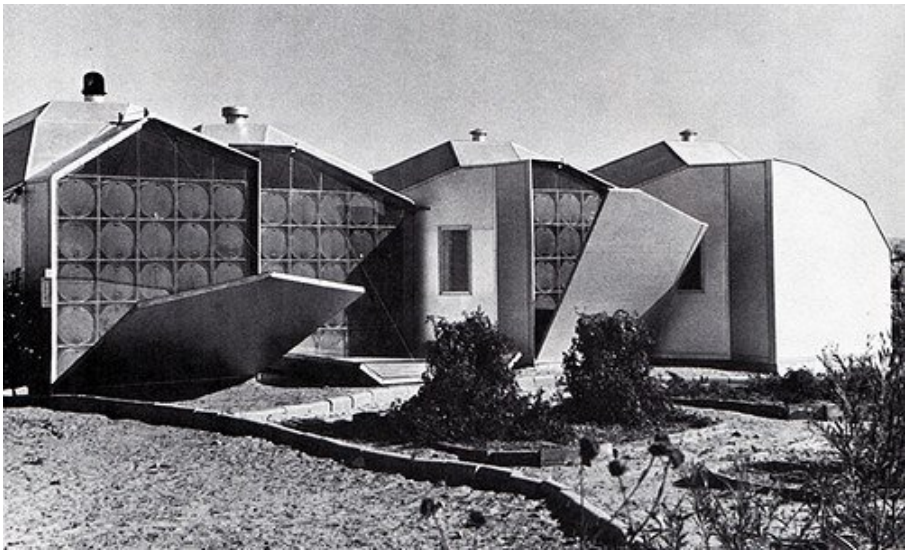
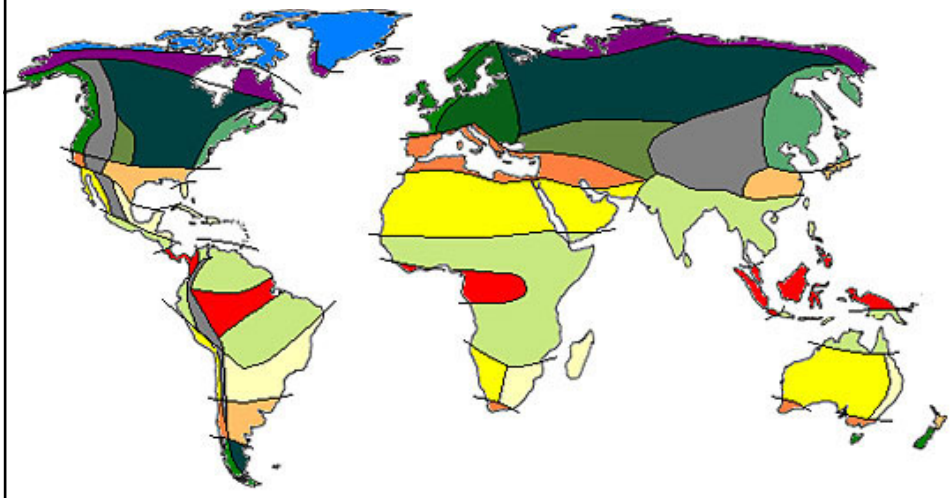


39

ENVIRONMENTALY-FRIENDLY CONSTRUCTION

40

CLIMATE ZONES



Climate regions based on Ernst Neef (1954); www.klima-der-erde.de/klimazonen.html

41

42

43

ENVIRONMENTALY-FRIENDLY CONSTRUCTION

Example 1: Mediterranean climate

Mild winters, warm + not to wet summer

- solid construction
- atrium houses
- flexible transition inside / outside
- water surfaces

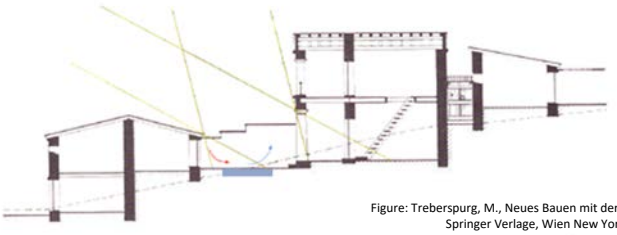


Figure: Treberspurg, M., Neues Bauen mit der Sonne, Springer Verlage, Wien New York, 1994

Source: Österreicher, D. (2015). GEBÄUDEPHYSIK, 1. Presentation, FH Campus Wien

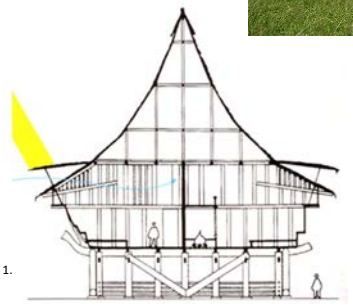
44

ENVIRONMENTALY-FRIENDLY CONSTRUCTION

Example 2: the Tropics

Very hot, very humid, heavy rainfall

- lightweight construction
- air circulation
- lifted off the ground
- large shading surfaces



Source: Österreicher, D. (2015). GEBÄUDEPHYSIK, 1. Presentation, FH Campus Wien

Figure: Behling S und Behling S, Sol Power, Prestel, München-New York, 1996

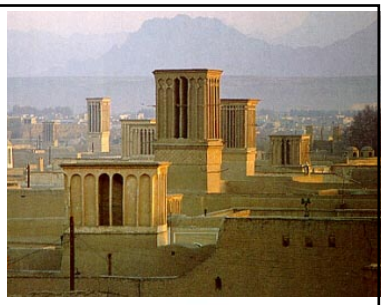
45

ENVIRONMENTALY-FRIENDLY CONSTRUCTION

Example 3: Prairie

Very hot, very dry, strong winds

- o solid construction
- built in the earth
- natural ventilation systems (wind catcher)
- nested assembly



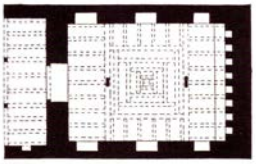


Figure: Treberspurg, M., Neues Bauen mit der Sonne, Springer Verlage, Wien New York, 1994

Source: Österreicher, D. (2015). GEBÄUDEPHYSIK, 1. Presentation, FH Campus Wien

46

ENVIRONMENTALY-FRIENDLY CONSTRUCTION

Target

identify relevant parameters for an energy-efficient design

- Temperature: minimum, maximum, frequency, year / day distribution
- Humidity (minimum, maximum, frequency, year / day distribution)
- Temperature in connection with humidity
- Wind (direction, frequency, speed)
- Solar radiation (direct, diffuse, intensity)

Source: Österreicher, D. (2015). GEBÄUDEPHYSIK, 1. Presentation, FH Campus Wien

47

Urbanization

48

Global development of urbanization

- In 1985, 41.2% of the global population lived in cities
- Today, there are more than 50%
- For the year 2050 a further increase to 75% is expected[1]
- High urbanization rates in Asia and Africa[2] -> The focus of world urbanization has long been shifted to the developing and emerging countries
- Today there are twice as many people living in urban conurbations as in industrializations, with 2.3 billion inhabitants
- In 2030, it will be four times as many as 3.9 billion people[3]
- Urbanization development in Europe and the USA completed: e.g. Germany: 73.8% in cities and metropolitan areas (1800 - 25%)

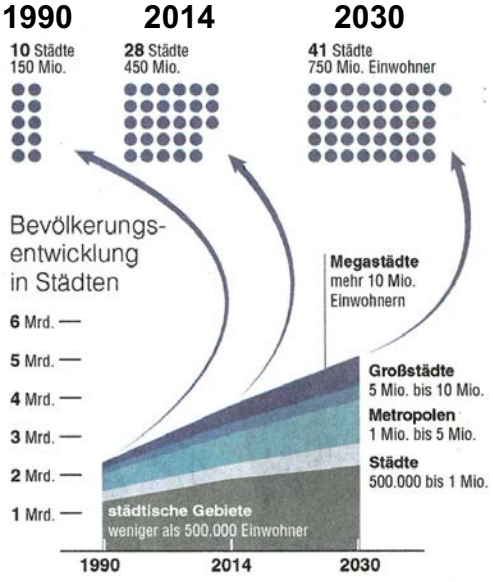
1) UN HABITAT (Hg.): State of the World's Cities 2010/2011. Nairobi, United Nations Human Settlements Programme 2007. S. 12.
2) United Nations (Hg.): World Urbanization Prospects: The 2007 Revision Population Database. New York 2008
3) Bundeszentrale für politische Bildung: Prognose der städtischen Bevölkerung. Internet: www.bpb.de/themen/WL9MSS,0,Staedtische_Bevoelkerung.html, 12.05.2011.

49

Number of cities with over 10 million inhabitants

Growth of population 2015-2035

- India +220 Mio
- Nigeria +70 Mio
- Pakistan + 60 Mio
- Ethiopia +40 Mio
- Bangladesch + 30 Mio
- Indonesien +30 Mio
- **China – 90 Mio**



50

Climate change and biodiversity

- Cities are **involved in decisions about global climate change** and have a **significant**, sometimes **negative** impact on ecosystems
- Occupy only **2 percent** of the surface of the earth,
- Cities **need 75% of the energy** and **emit 80% greenhouse gases** -> thus bear responsibility for global climate change
- Are partners and players in international climate policy and increasingly play a pioneering role
- At the same time, they are **directly exposed** to the **dangers of climate change**, with their population density, building fabric, and infrastructure (near-coastal typhoons, heat waves, mud slides ...)
- Urbanization is linked to **population growth**, **resource depletion** and climate **change**
- Problems: drinking water supply, nutrition and energy

Source: The Worldwatch Institute (Hg.): State of the World. Our Urban Future. New York (W.W. Norton & Company) 2007

51

51

Urban Food - Vertical Farming

- By 2050 about 9.7 billion people will live on Earth
  (World population January 2017: 7.473.690.000 (2016 increase of 83 million))
- In order to ensure sufficient food production, while maintaining the eating habits of today, additional areas of size of Brazil[1] will be needed
- This area is available, but would be accompanied by an immense destruction of rainforests and natural areas
- The ecological footprint - the area necessary to cover the lifestyle and living standard of a person in under modern production conditions in Vienna in the longer term is about the land area of the Burgenland
- New developments in urban food production: City-Farming, Vertical-Farming, Aquaponics, etc.

[1] Daniel Podmirseg: Mythos Marchfeld und Vertical Farming

53

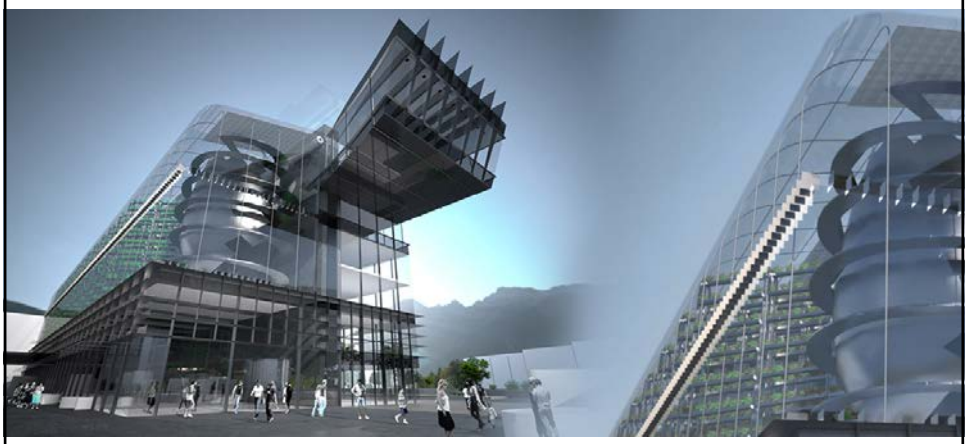
Vertical Farming

Food production in vertical farms:

- Is independent of climatic conditions (no flood or drought hazards).
- Takes place 365 days a year.
- Reduces the demand for oil due to transport reduction.
- Does not require pesticides or fertilizers.
- Reduces food imports.
- Reduces the need for fossil fuels.
- Works with recycled water. The closed water cycle reduces water consumption by up to 500 times compared to conventional agriculture.
- Is simultaneously accompanied by the generation of electrical current through the use of decomposed by-products (e.g., biogas).

54

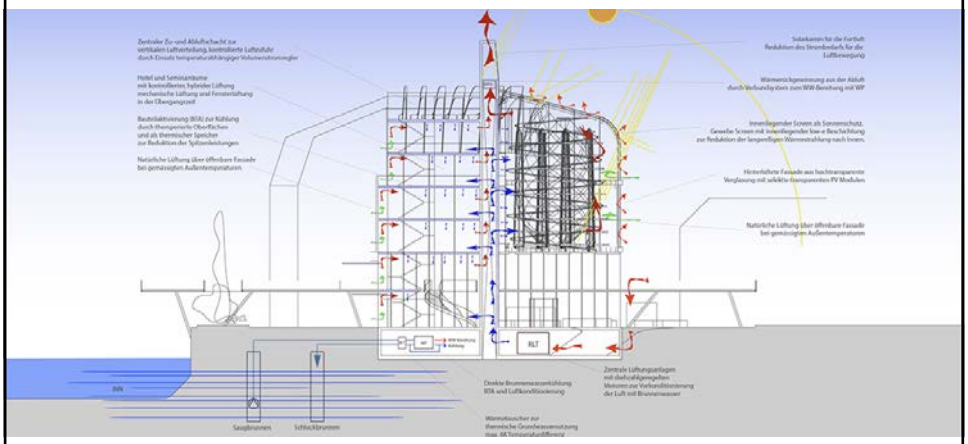
Vertical Farm Innsbruck



VFI - Vertical Farm Institute
http://www.verticalfarminstitute.org/

55

Vertical Farm Innsbruck



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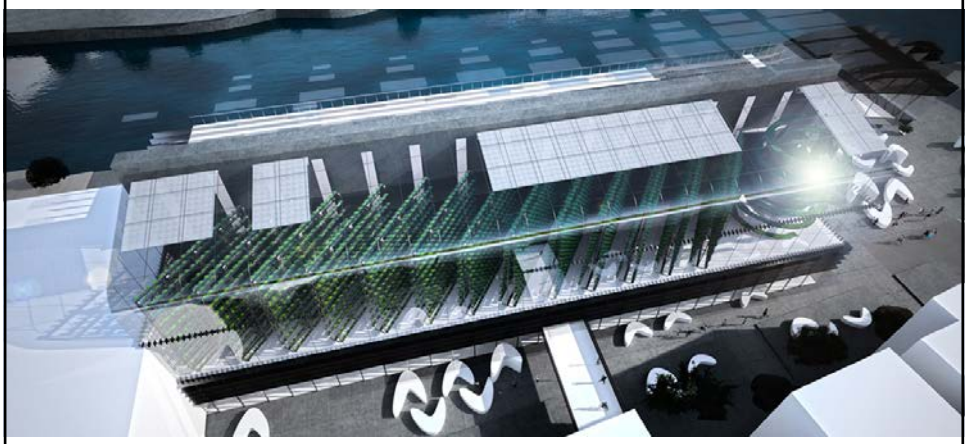
56

Vertical Farm Innsbruck



VFI - Vertical Farm Institute
http://www.verticalfarminstitute.org/

57

Renovation

58

Renovation, energy efficiency and building culture

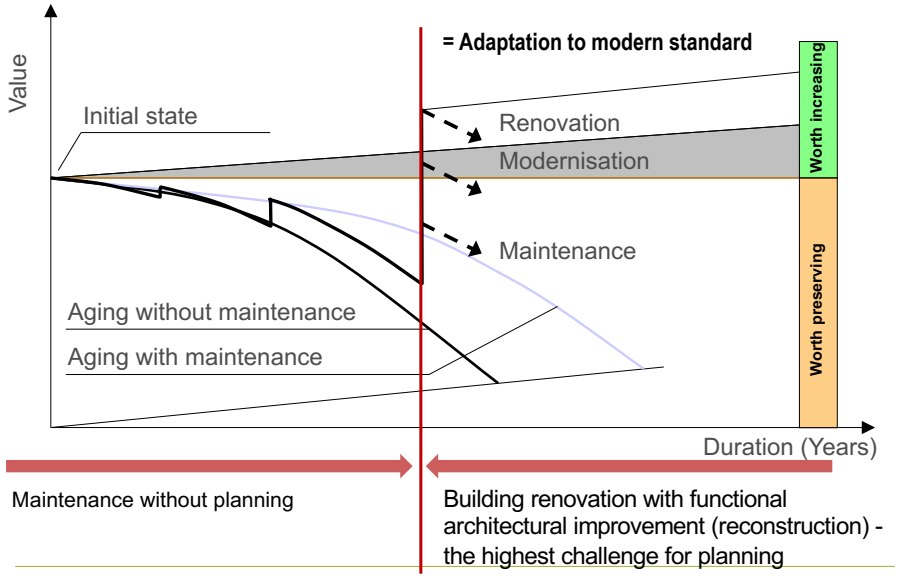
Building renovation as an important building-cultural task that combines energy efficiency and value preservation.

“A renewal that is not an improvement is a deterioration. "

Adolf Loos

59

Value preservation and renewal



60

Three Ways of Building Modernization

There are no general recipes for the right building renovation.

Best practice examples for rehabilitation in three categories:

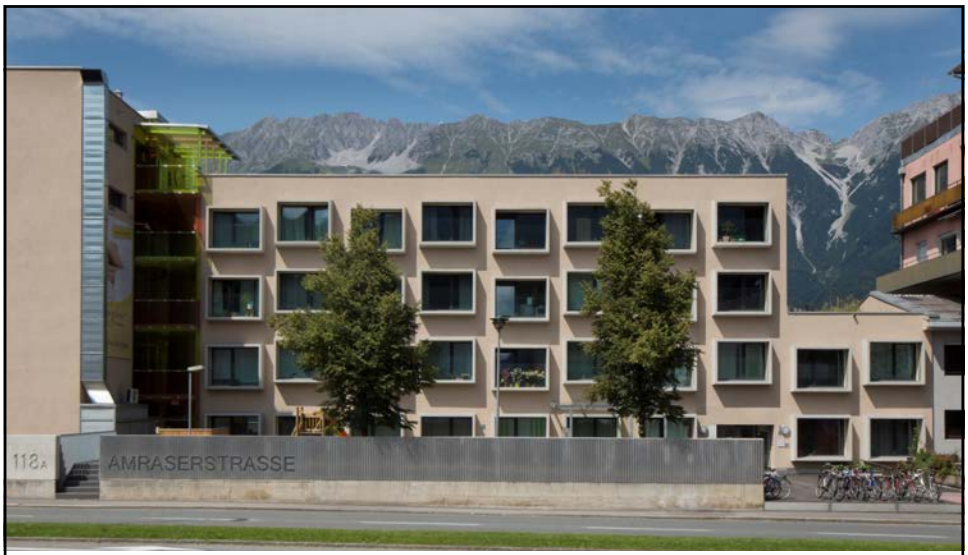
- The Total building renovation
- The Hidden Building renovation
- Dialogue Old and New

61

1. The total building renovation

- Renovation of the old building to such an extent that only a new building is recognizable.
- Modern new building quality with advantageous use of old building elements (eg. storage room, cellar, etc.)
- More ecological and economical than demolition and new construction, but a much higher planning effort

62



Dormitory ETHOUSE-Award 2015
Projekt: Trientlgasse 44, Innsbruck | Baujahr/Sanierungsjahr: 1960/2013
Architektur: U1 Architektur, Innsbruck | Bauherr: Ärztekammer Tirol
HED vor/nach: 354 / 21 kWh/m²a | Energy savings: 94%

63

Before

After

Bestand

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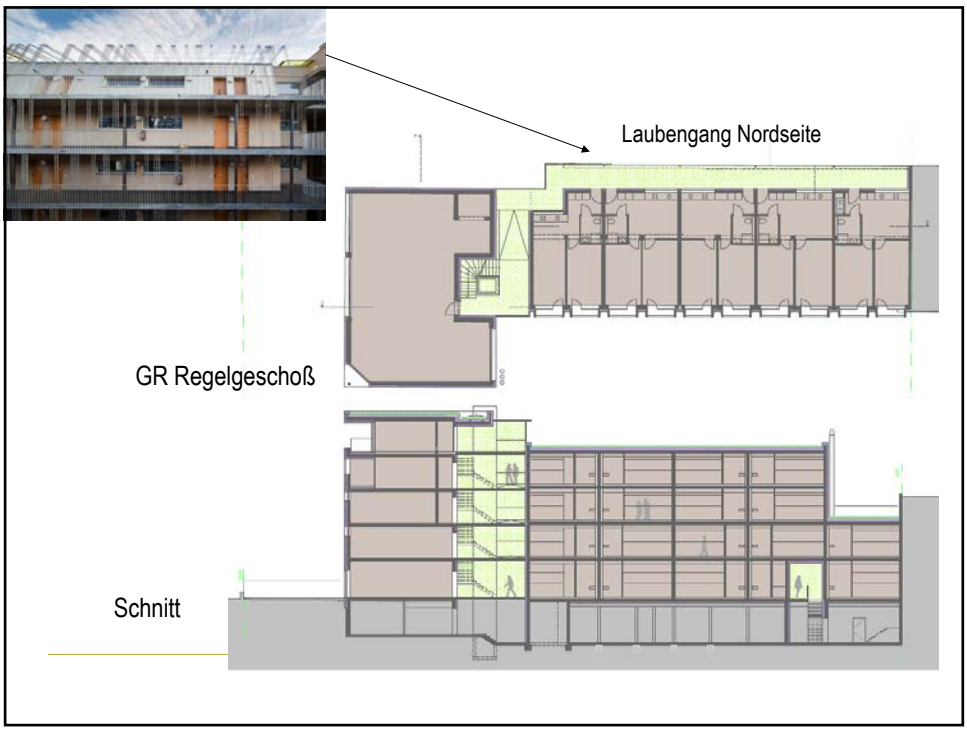


66

Betriebsgebäude ETHOUSE Award 2011

Projekt: **Betriebsgebäudes MCM Klosterfrau GmbH** | **Baujahr/Sanierungsjahr:** **1977/2010**

Architektur: **gaupenraub +/- Architekturbüro** | **Bauherr:** **MCM Klosterfrau Healthcare GbmH**

HED: 233 / 39 kWh/m²a | **Energy savings: 83 %**

67

Before **After**

68

69

Bezirkshauptmannschaft ETHOUSE Award 2012

Projekt: BH Weiz | Baujahr/Sanierungsjahr: 1964/2011

Architektur: Kaltenegger + Partner Architekten | Bauherr: Land STMK

HED: 136 / 14 kWh/m²a | Energy savings: 90%

70

Bestand

71

Wohnhaus Innsbruck

Projekt: **Hochhaus Kajetan-Sweth-Straße 54** | **Baujahr/Sanierungsjahr:** **1976/2011**

Architektur: **Gsottbauer Architekten** | **Bauherr:** **WEG Kajetan-Sweth-Straße 54**

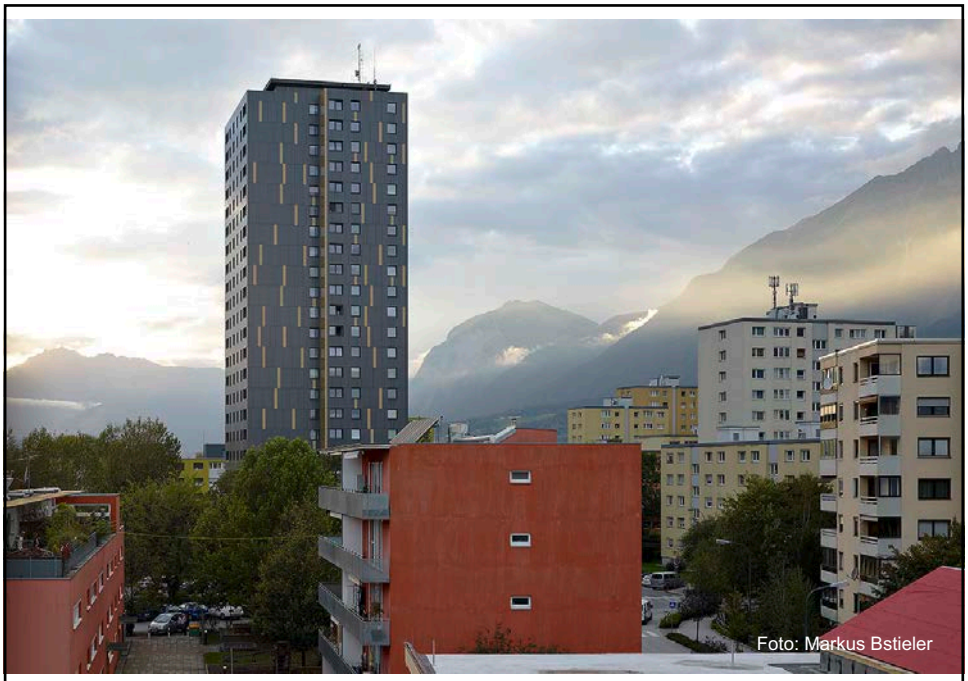
HED: 77 / 20 kWh/m²a | **Energy savings : 74%**

72

Before, 1976

Fotos: Markus Bstieler

73



74

Wohn- und Bürohaus eines Architekten – ETHOUSE Award 2013

Projekt: Energieautonomes Stadthaus Wels | Baujahr/Sanierung: 1965/2013

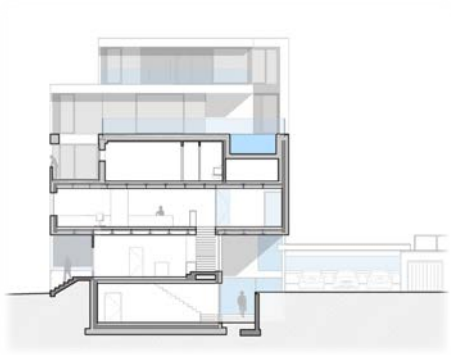
Architektur: PAUAT Architekten ZT GmbH | Bauherr: Privat

HED: 150 / 8 kWh/m²a | Energy savings : 95%

75

Building before, during and after Renovation

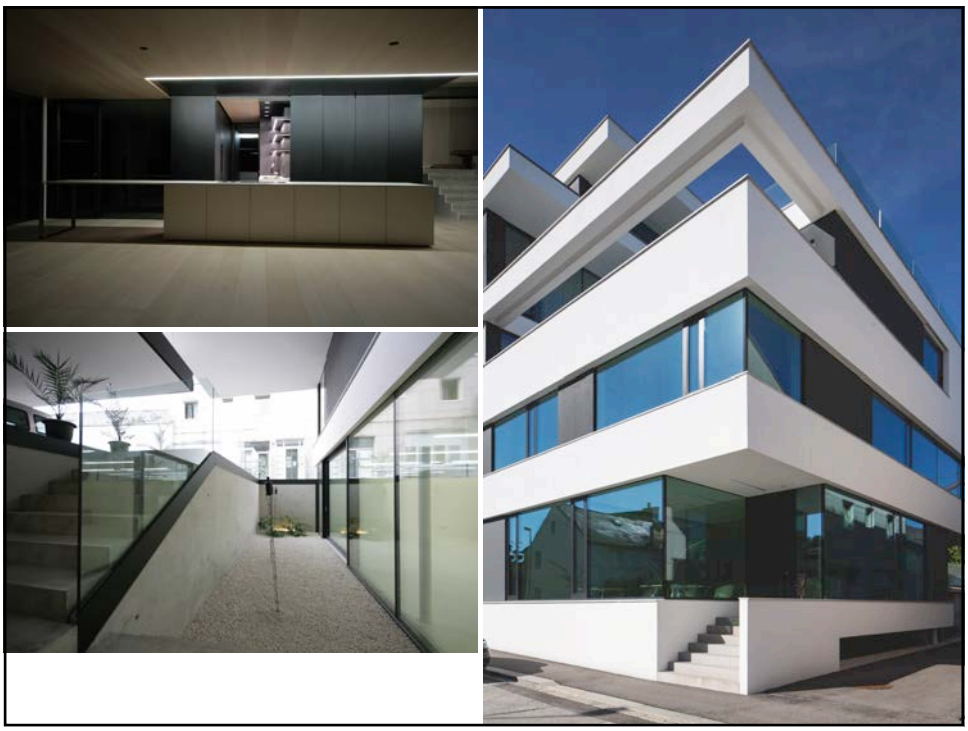
Längsschnitt



Querschnitt [Quelle: PAUAT Architekten]

76

77



78

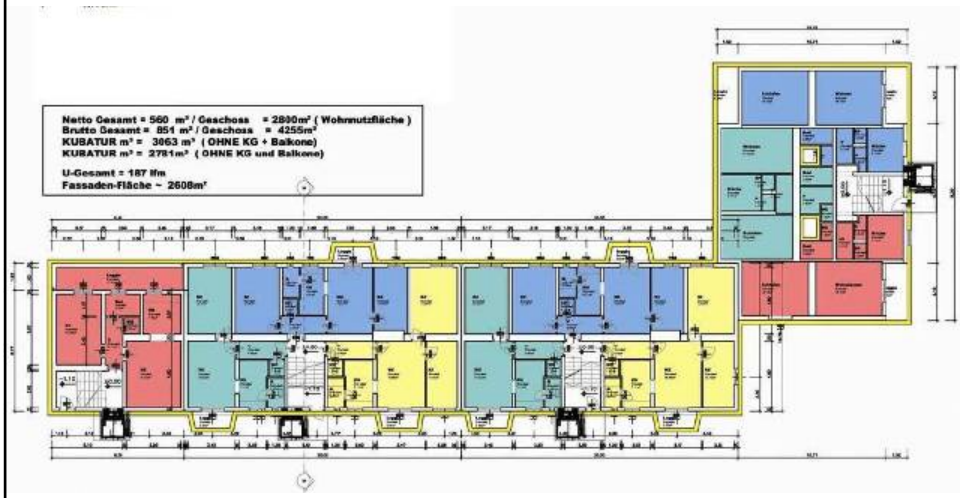
Wohnhausanlage Linz

Projekt: Makartstraße, Linz | **Baujahr/Sanierungsjahr:** 1957/2006

Architektur: Architekturbüro ARCH+MORE | **Bauherr:** GIWOG

HED: 179 / 14 kWh/m²a | **Energy savings:** 94%

79



Quelle: HdZ-Bericht: in Arbeit; Projektleiter: Hr. Bmst. Ing. Willensdorfer Alfred, GIWOG Gemeinnützige Industrie-Wohnungs-AG

Grundriss Regelgeschoss

80

81

Schulzentrum ETHOUSE Award 2011

Projekt: Schulzentrum Neumarkt | Baujahr/Sanierungsjahr: 1978/2011

Architektur: Arch+More ZT GmbH | Bauherr: Marktgemeinde Neumarkt

HED: 196 / 15 kWh/m²a | Energy savings: 92%

82

Bestand

Sanierung

83

84

2. The Hidden Building renovation

- Old buildings are preserved in their exterior design; modernization is hardly visible from the outside.
- Use in high-quality buildings in protected areas, conservation

85

WHA der Stadt Wien, ETHOUSE Award 2015

Projekt: Breitenfurterstrasse 242 | Baujahr/Sanierungsjahr: 1928/2014

Einreicher: Treberspurg & Partner ZT GmbH | Bauherr: Wiener Wohnen

HED: 204 / 22 kWh/m²a | Energy saving; 92%

86

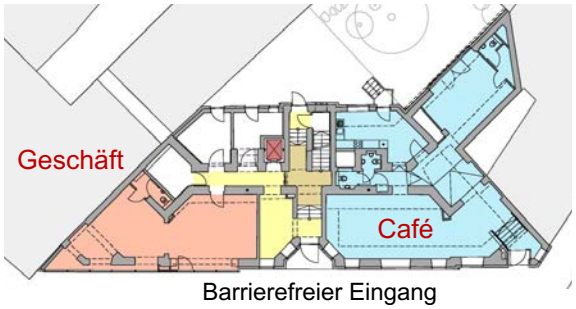
87

Sanierungsarbeiten

Fertigstellung

88

ERDGESCHOSSZONE

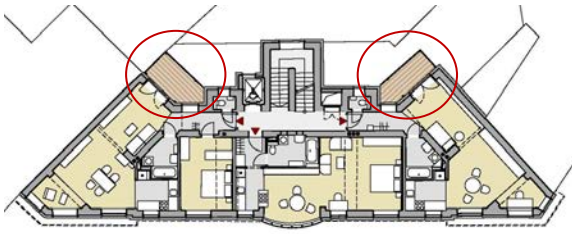


Barrierefreier Eingang

- vorgesetztes Geschäftsportal
- Cafe „Naschen und Lesen“
- Neuorganisation des Grundrisses
- Zubau Küche
- einheitliche Auslagenfenster

89

HOFSEITIGER LOGGIENZUBAU

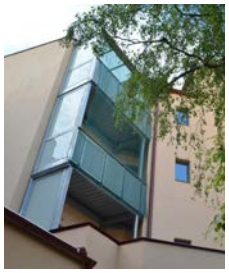


Stahlkonstruktion

thermisch getrennt

seitlich verglast






vorher nachher

90

EFH eines Architekten, Kärnten – ETHOUSE Award 2011

Projekt: Energie Plus Haus Weber | **Baujahr/Sanierungsjahr:** 1900/2011

Architektur: Architekten Ronacher ZT Gmbh | **Bauherr:** Arch. Ronacher

HED: 145 / 10 kWh/m^{2}a | **Energy savings:** 93%

91

Altbestand vor Beginn der Baumaßnahmen

Baustellenfoto

Abbrucharbeiten des alten Dachstuhles

Neuer Dachstuhl samt neuer Dachdeckung

92

93

Gründerzeitvilla in Wien 14

Projekt: Herzmanskystraße 1 | **Baujahr/Sanierungsjahr:** 1878/2010

Architektur: Architekt Kronreif & Partner | **Bauherr:** Andreas und Bruno Spangl

94

Bestand

Sanierung

95

96

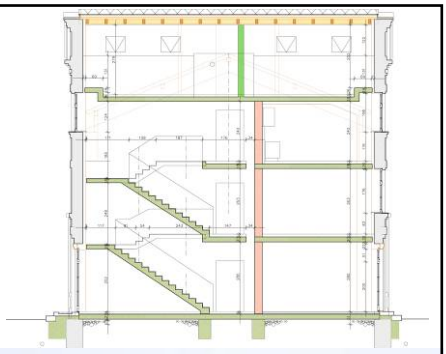
WHA Felixdorf, ETHOUSE Award 2009
Projekt: **Tschechenring, Felixdorf** | **Baujahr/Sanierungsjahr:** **1878/2010**
Architektur: DI Günter Spielmann, Stadtbau GmbH | **Bauherr:** **Wien Süd**
HED: **198 / 32 kWh/m²a** | **Energy savings:** **62 %**

97

Bestand

Sanierung

98



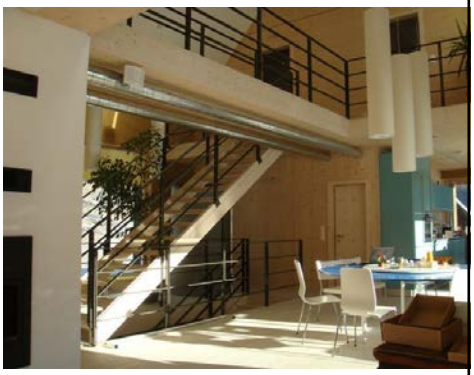
99

Passivhaus-EFH, Palfau, Steiermark

Projekt: Einfamilienhaus | **Baujahr/Sanierungsjahr:** 1940/2008

Architektur: Architekturbüro Georg W. Reinberg | **Bauherr:** Privat

100



101

3. Dialogue Old and New - the third way of the building renovation

- A design dialogue between the original parts of the old building and the new parts of the buildings, which have been added in modern architectural design.
- Royal Route of the Old Building
- Greatest planning and design challenge
- Interesting results, which can result in a higher building value as a replacement building.

102

Wohnhaus Wien 17
Projekt: Klopstockgasse 47 | Baujahr/Sanierungsjahr: 1890/2015
Architektur: Architekt DI Martin Wurnig | Bauherr: Privat
HED: 144 / 10 kWh/m²a | Energy savings: 93%

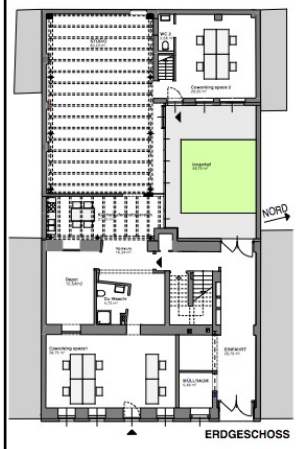
103

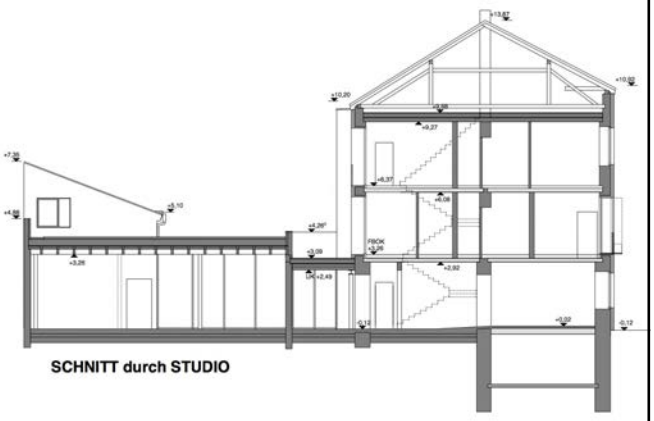
Bestand

Sanierung

104

105





106

Einfamilienhaus Eichgraben – ETHOUSE Award 2012

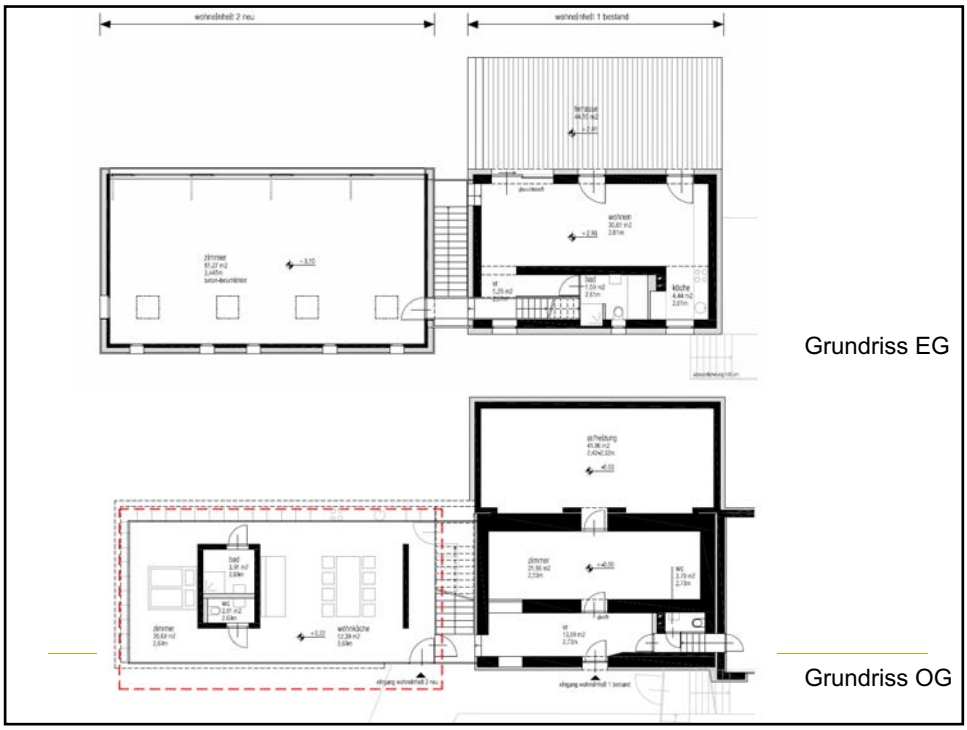
Projekt: EFH Eichgraben, Sankt Pölten | Baujahr/Sanierungsjahr: 1930/2011

Architektur: Franz ZT Gmbh | Bauherr: Privat

HED: 321 / 47 kWh/m²a | Energy savings: 86%

107

108



109

Wohnbau Wien 7 – ETHOUSE Award 2014
Projekt: Kaiserstrasse 7, Wien | **Baujahr/Sanierungsjahr:** 1904/2014
Architektur: Kronreif_Trimmel & Partner Architektur
Bauherr: Kongregation der Mission vom heiligen Vinzenz von Paul
HED: 132 / 26 kWh/m²a | **Energy savings:** 80%

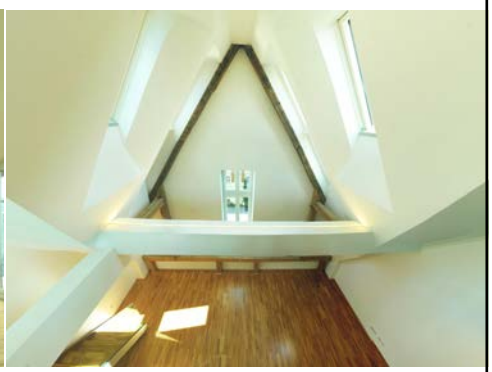
110

Bestand

Sanierung

111

112



Dachgeschoss

113

Rathaus Ottensheim (OÖ) – Denkmalschutz Restaurierung und Zubau
Projekt: Das offene Amtshaus Ottensheim | Baujahr/Sanierungsjahr: 1500/2010
Architektur: Sue Architekten ZT KG | Bauherr: Verein zur Förderung d. Infrastruktur der Marktgemeinde Ottensheim & CO KG (Ulrike Böker, Bürgermeisterin)

114

Bestand

Sanierung

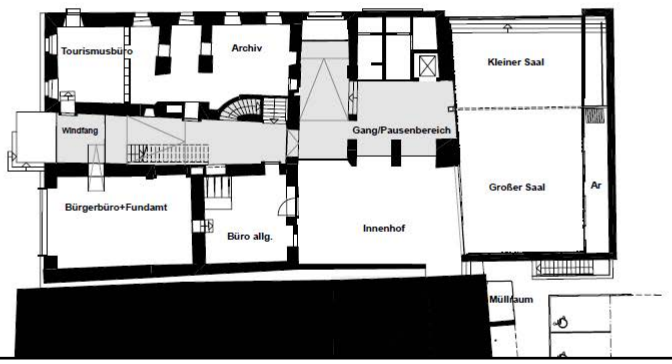
115

Bestand

Sanierung

116

Schnitt



Grundriss

117


Hof (Bestand), neuer Veranstaltungsraum (Zubau)

118

The overall refurbishment concept

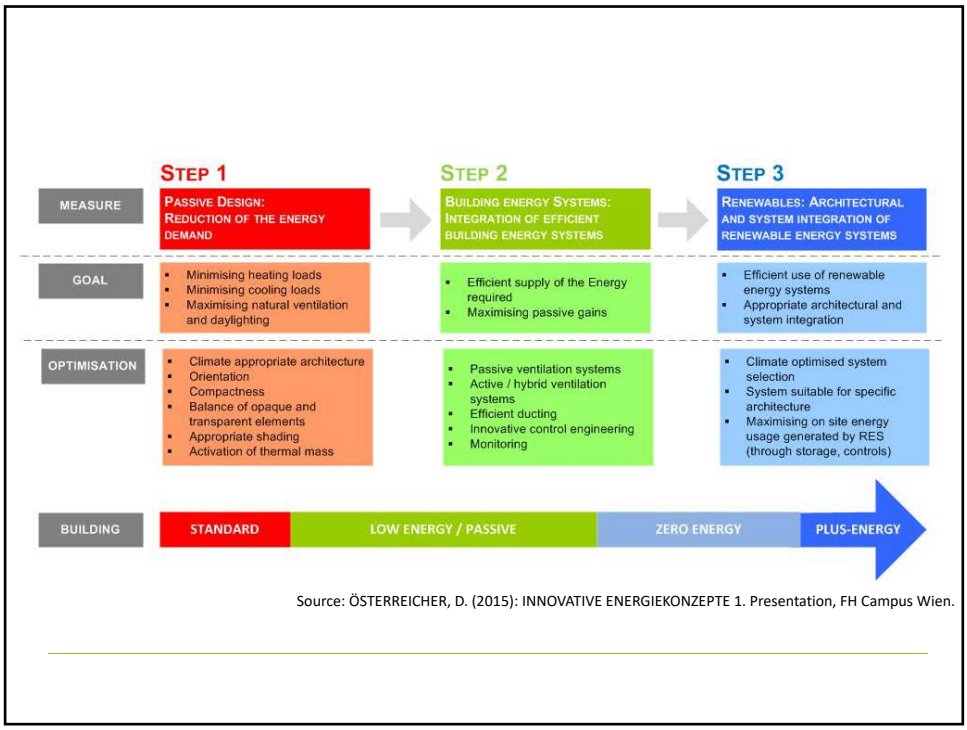
- For cost reasons it is not always possible to refurbish a building in its entirety optimally -> step-by-step coordinated renovation plan
- The renovation plan should include:
  - Improvement of the building use
  - Possible redensification potentials
  - Thermal improvement taking into account renewable energy sources
  - A financing concept including possible subsidies

The overall restructuring plan represents a great effort and should be performed by experienced qualified planners uniformly.

119

Smart structures and efficient buildings

120



Source: ÖSTERREICHER, D. (2015): INNOVATIVE ENERGIEKONZEPTE 1. Presentation, FH Campus Wien.

121

Passive houses

- Basic Principles of the Passive House
- Projects from Austria from Treberspurg & Partner Architects ZT GmbH
- The Design of the Austria House

122

Principles of the Passive House Concept

Definition (Passivhouse Institute Darmstadt - Dr. Feist):

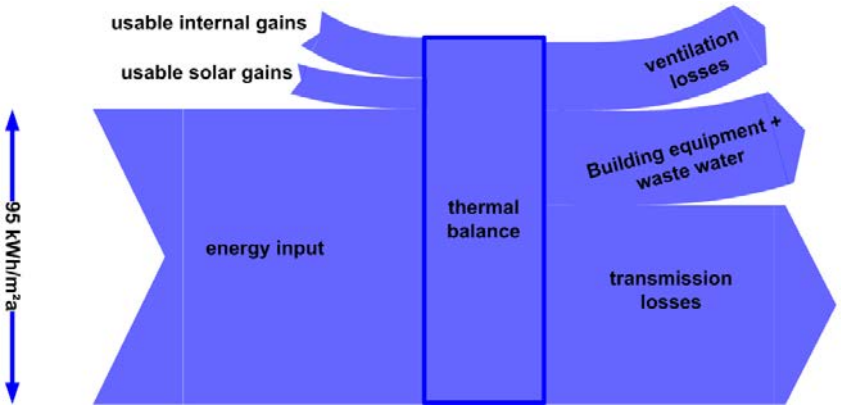
A Passive House is a building, for which thermal comfort can be achived solely by postheating or postcooling of the fresh air mass, which is required to fullfill sufficient indoor air quality conditions - without a need for recirculated air.

- ► Optimizing the building shell
- ► Loss minimizing before Profit Maximizing

123

Comparison of PH with conventional buildings

Net final energy for space heating and hot water

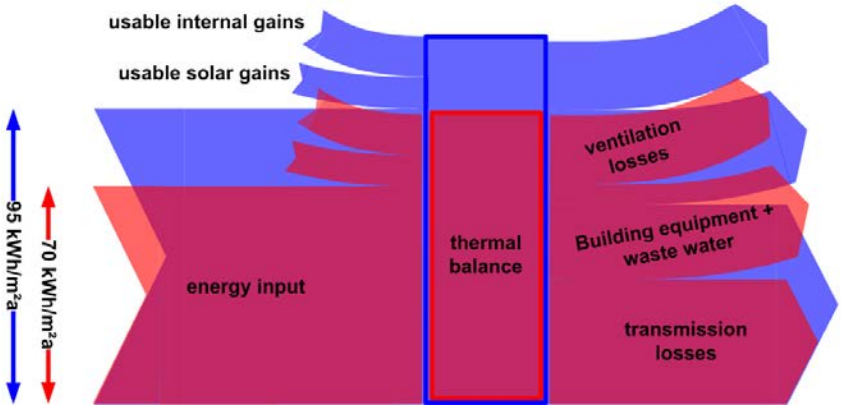


20.10.2011, SB11-Helsinki, Roman Smutny, Christoph Neururer BOKU Vienna

124

Comparison of PH with conventional buildings

Net final energy for space heating and hot water

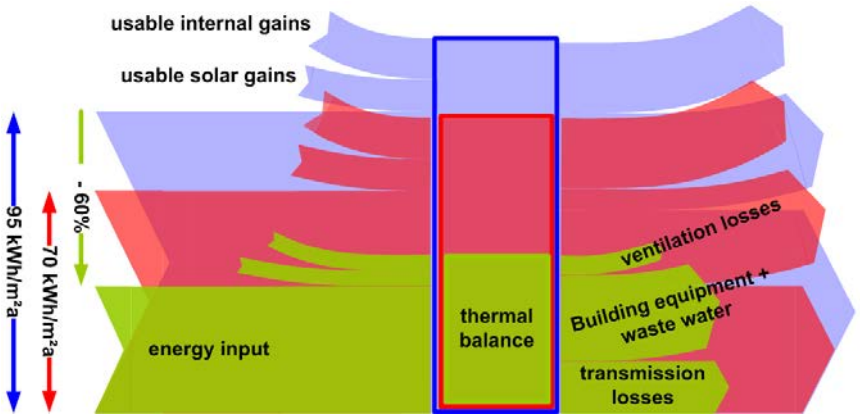


20.10.2011, SB11-Helsinki, Roman Smutny, Christoph Neururer BOKU Vienna

125

Comparison of PH with conventional buildings

Net final energy for space heating and hot water

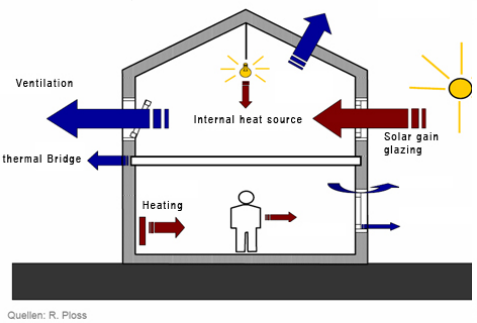


20.10.2011, SB11-Helsinki, Roman Smutny, Christoph Neururer BOKU Vienna

126

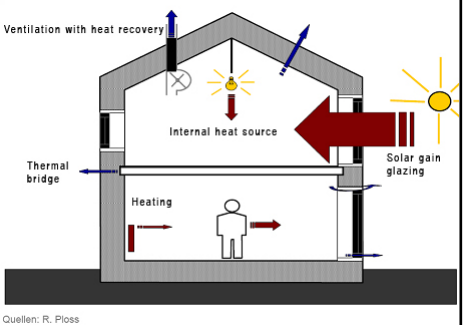
Conventional House VS Passive House

Building Standard



Quellen: R. Ploss

Passive House:



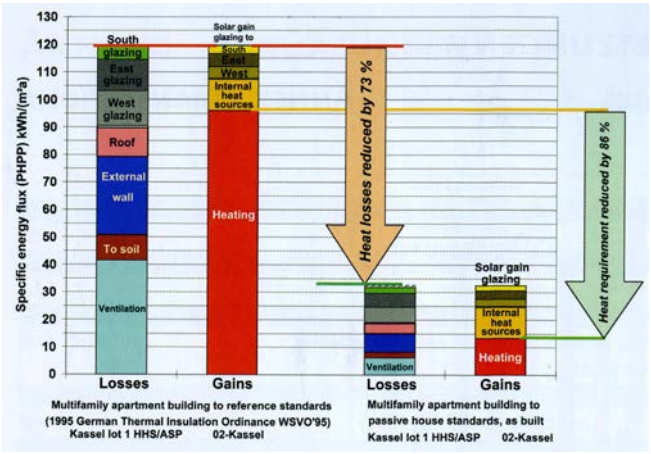
Quellen: R. Ploss

Losses – Gains
= Heating energy requirement

[source: HdZ - Passivhaus Schulungsunterlagen, 1.3 Ressourcenverbrauch im Gebäudebetrieb]

127

Energy Saving!



Energy saved on heating is 86% compared to conventional standards of new buildings.

[source: CEPHEUS]

128

Definition of kWh

- 1l heating oil ≈ 10 kWh
- 1l gas ≈ 7 kWh

129

Definition of kWh

- **Conventional house** before year 1990
  -> 200 kWh / m2a
- 100 m2 -> 20 000 kWh -> 2000 liter oil

- **Passive house** -> max 15 kWh /m2a
- 100 m2 -> 1500 kWh -> 150 liter oil

130

131

Evolution

„1-Liter House" = Passivhaus:

Since 1991

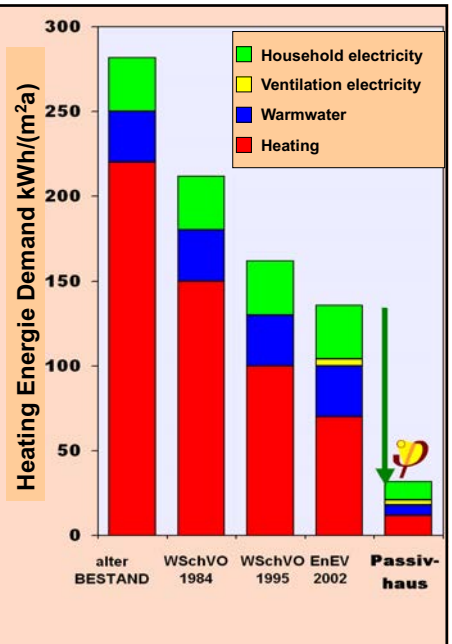
Over 90% Energy savings

„1-Liter Car"

Over 80% Energy savings

132

Factor 10 is possible



133

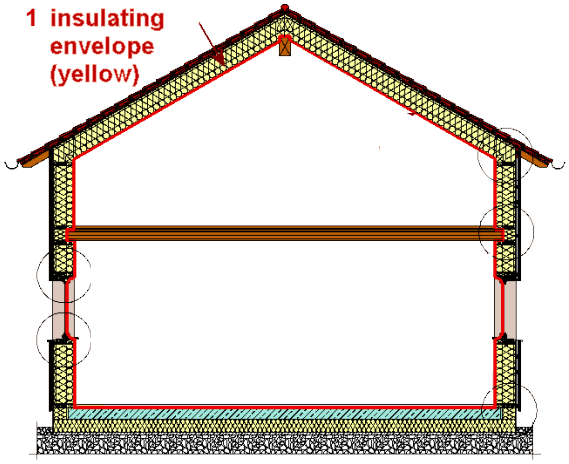
Principles of the Passive House Concept

Passive Houses require superior design and components with respect to:

- Insulation
- Comfort windows
- Design without thermal bridges
- Air-thightness
- Ventilation with heat-recovery
- Innovative heating technology

134

Building Envelope: High Thermal Insulation



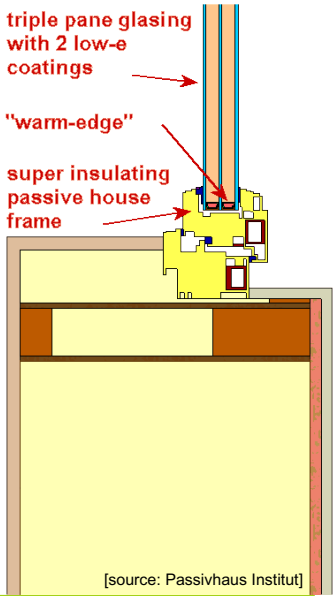
[source: Passivhaus Institut]

135

Building Envelope: Comfort Windows

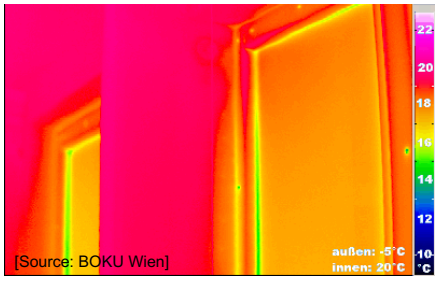
Example of triple pane glasing window

Window ≤ 0,8 W/(m²K) (R-7.1)



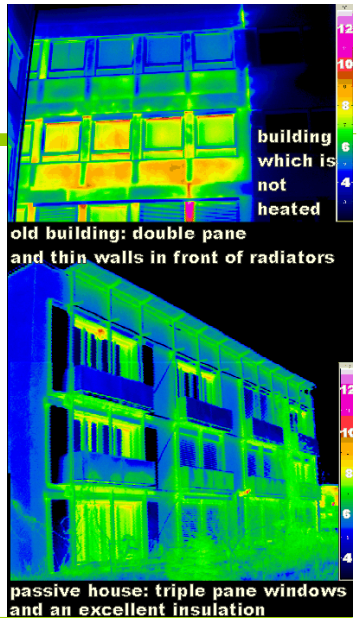
136

Building Envelope: Comfort Windows



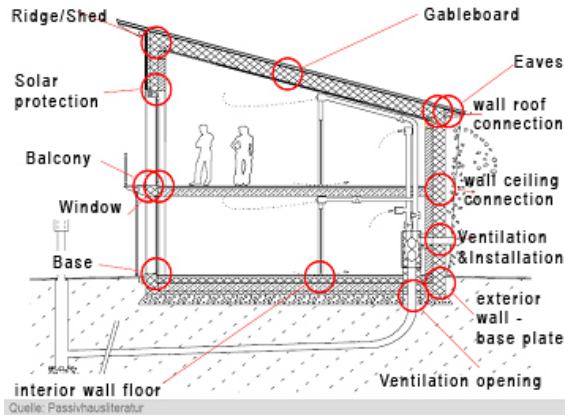
Passive House Window, Interior

Infrared pictures of an old building and a passive house (at the bottom) for comparison (photos: PHI)



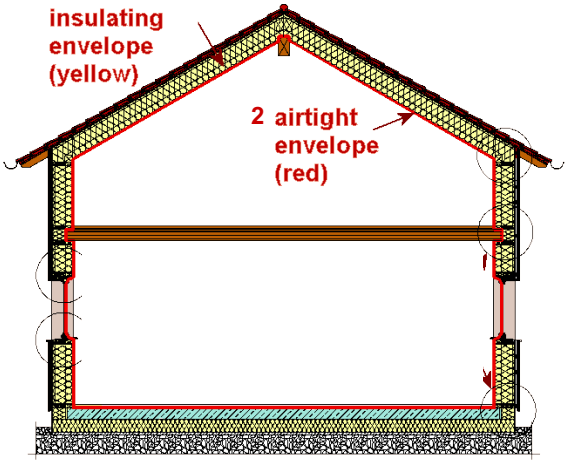
137

Building Envelope: Avoiding Thermal Bridges



138

Building Envelope: Airtight Construction



An envelope can be airtight only if its consists of ONE undisturbed airtight layer enwrapping the whole volume.

[source: Passivhaus Institut]

139

Building Envelope: Airtight Construction

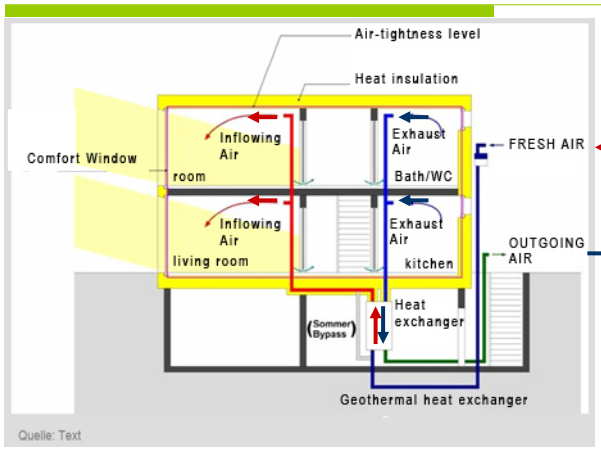
Quelle: Energie und Umweltzentrum (EUZ)

Quelle: Passivhaus Institut Darmstadt

- avoid damage caused by condensation of moist, room warm air penetrating the construction
- reduce losses through building envelope and ventilation

140

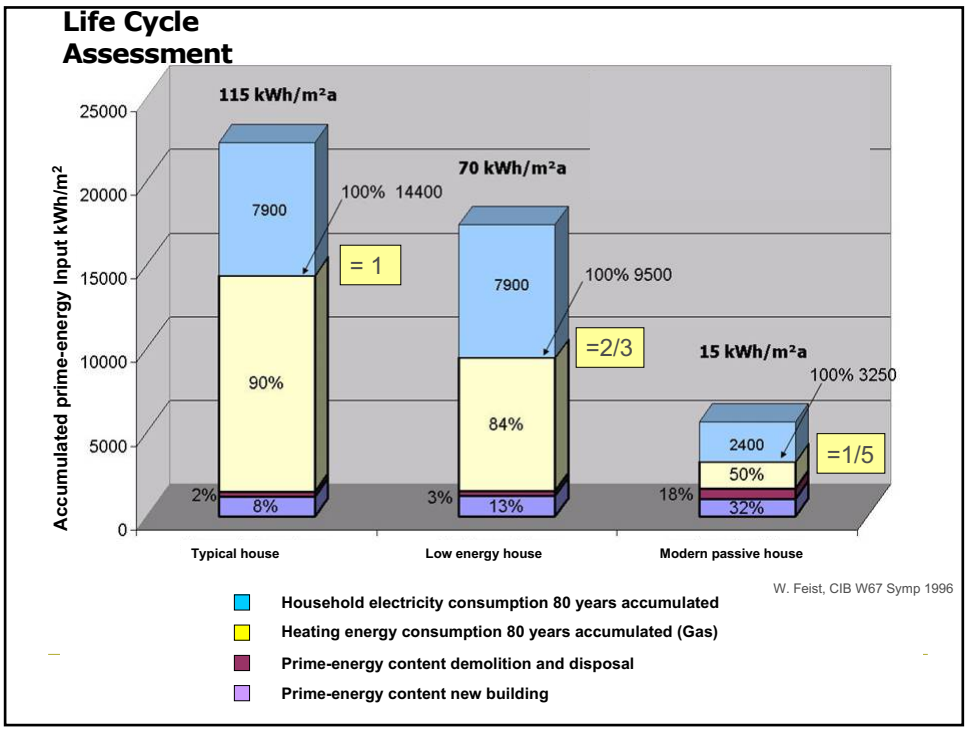
Innovative Heating Technology: Ventilation with heat recovery



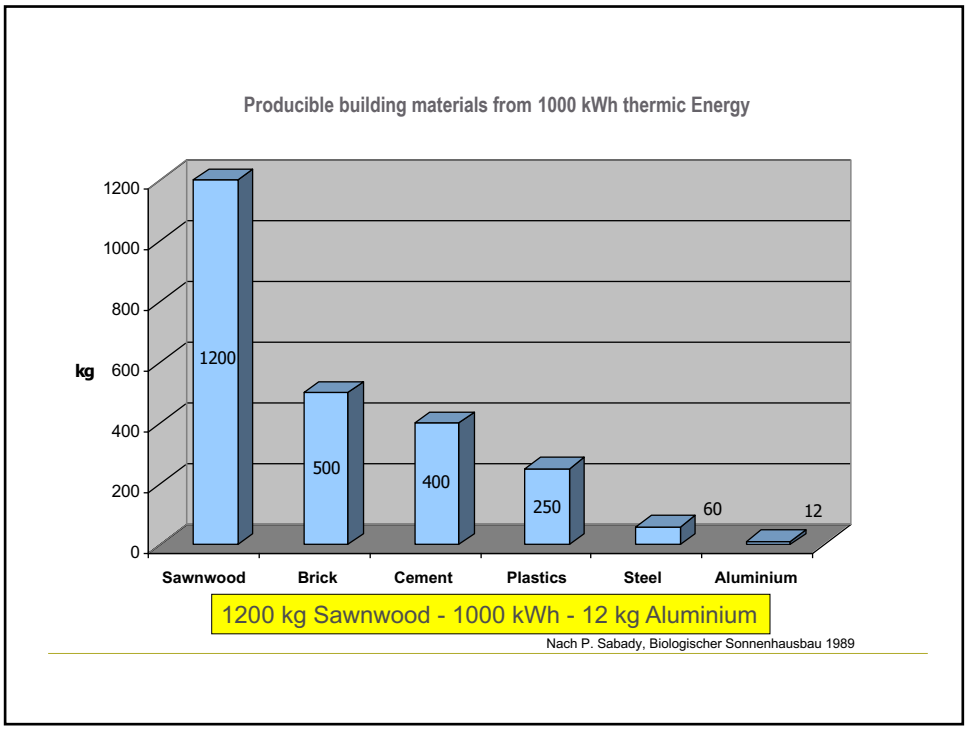
Quelle: Text

[source: CEPHEUS]

141


Life Cycle Assessment
115 kWh/m²a
70 kWh/m²a
15 kWh/m²a
Accumulated prime-energy Input kWh/m²
25000
20000
15000
10000
5000
0
7900
100% 14400
= 1
90%
2%
8%
7900
100% 9500
=2/3
84%
3%
13%
100% 3250
2400
=1/5
50%
18%
32%
Typical house
Low energy house
Modern passive house
W. Feist, CIB W67 Symp 1996
Household electricity consumption 80 years accumulated
Heating energy consumption 80 years accumulated (Gas)
Prime-energy content demolition and disposal
Prime-energy content new building

142

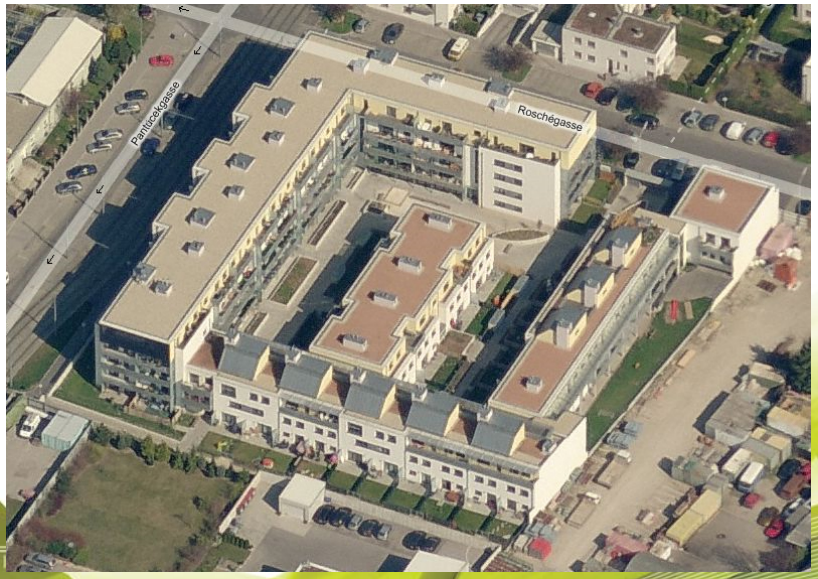

Producible building materials from 1000 kWh thermic Energy
kg
1200
1000
800
600
400
200
0
1200
500
400
250
60
12
Sawnwood
Brick
Cement
Plastics
Steel
Aluminium
1200 kg Sawnwood - 1000 kWh - 12 kg Aluminium
Nach P. Sabady, Biologischer Sonnenhausbau 1989

143

Vienna City Development

144

PH-RESIDENTIAL HOUSING ROSCHEGASSE
Pantucekgasse Roschegasse 20, 1110 Vienna



145

PH-RESIDENTIAL HOUSING ROSCHEGASSE

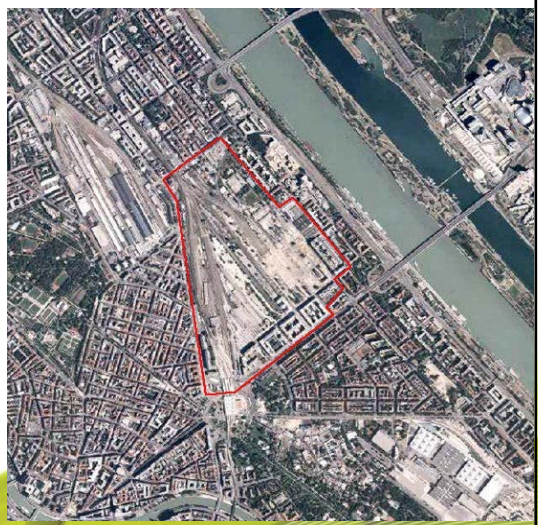
Pantucekgasse Roschegasse 20, 1110 Vienna

Developer:	a:h, gemeinn. Siedlungsgenoss. Altmannsdorf - Hetzendorf
Design&Planning:	Treberspurg & Partner Architekten ZT GmbH
Size:	9.900 m² living space, 114 apartments, common areas
Heating Energy:	7,3 kWh/(m²a) (PHPP); biggest social residential Passive House!
Netto building costs:	1.212 EURO/m² living space; 2006

146

City development Nordbahnhof Vienna

Brownfield Nordbahnhof, 65 ha, 2025: 20.000 Inhabitans, 10.000 jobs



147

City development Nordbahnhof Vienna

Statistically, each of the 1.9 million Viennese has 120 square meters of green space. Or: More than half of the city area are green spaces. This makes Vienna one of the greenest megacity cities in the world!

148

City development Nordbahnhof Vienna

149

PH-RESIDENTIAL HOUSING ‚YOUNG CORNER'
Leystraße 157+159, Nordbahnhofgelände, 1020 Vienna

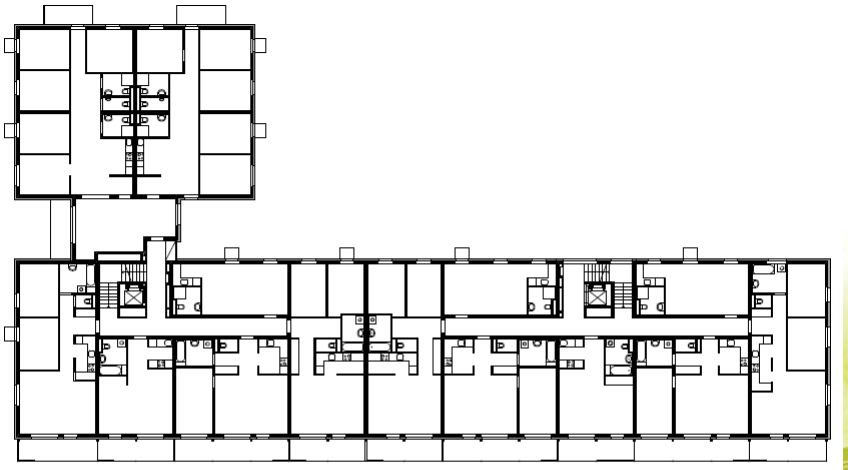
Developer:
Kallco Bauträger GmbH.
Architecture:
Treberspurg & Partner Architects ZT GmbH
Completion:
April 2011
Levels:
8 above, 1 below ground
Useable Area:
6.965 m²
Size:
90 apartments, Kindergarden
Passive House:
Space Heating Demand
13 kWh/(m².a) per treated floor area according to PHPP
6 kWh/(m².a) per gross floor area according to OIB Directive + ÖNORM

Photo: R. Grünner

150

151

Floor plan



Treberspurg & Partner Architekten REGELGESCHOSS - GRUNDRISS

152

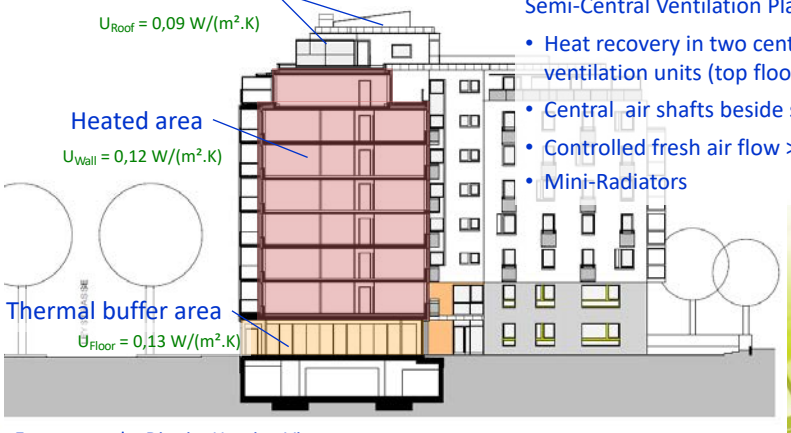
Energy concept

Space Heating Demand: 13 kWh/(m².a) per treated floor area (PHPP)
6 kWh/(m².a) per gross floor area (OIB + ÖNORM)

Ventilation units
U_{Roof} = 0,09 W/(m².K)

Heated area
U_{Wall} = 0,12 W/(m².K)

Thermal buffer area
U_{Floor} = 0,13 W/(m².K)



Semi-Central Ventilation Plant:

- Heat recovery in two central ventilation units (top floor)
- Central air shafts beside staircase
- Controlled fresh air flow > 18 °C
- Mini-Radiators

Energy supply: District Heating Vienna

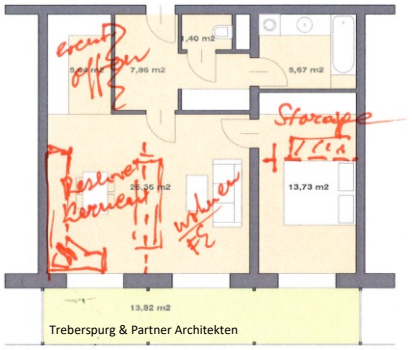
Treberspurg & Partner Architekten QUERSCHNITT

153

Flexible Housing

City-Loft for 2 persons

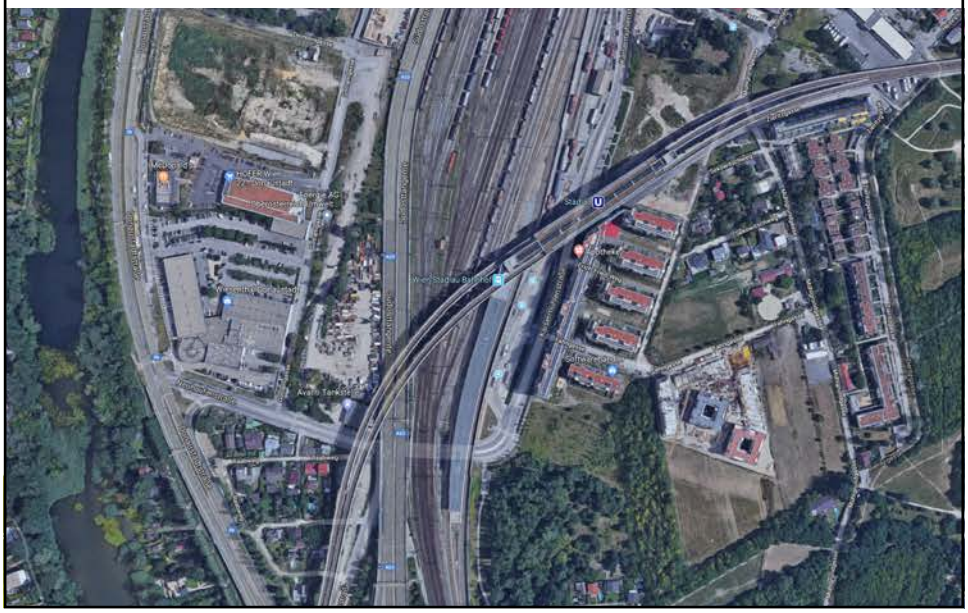
60 m², 3450 € own capital, 300 € monthly rent



154

155

Stadlau



156

Stadlau

157

158

OBJECT DATA

Investor:	BWS Gruppe
General Planning:	Treberspurg & Partner Architekten ZT GmbH
Building physics:	Technisches Büro Hofbauer
Completed:	2014
Area:	24.500 m²
Capacity:	264 Appartments, 4 offices, 4 business units
Netto Building Costs:	34,8 Mio. EURO
Energy performance:	13 kWh/m²a

159

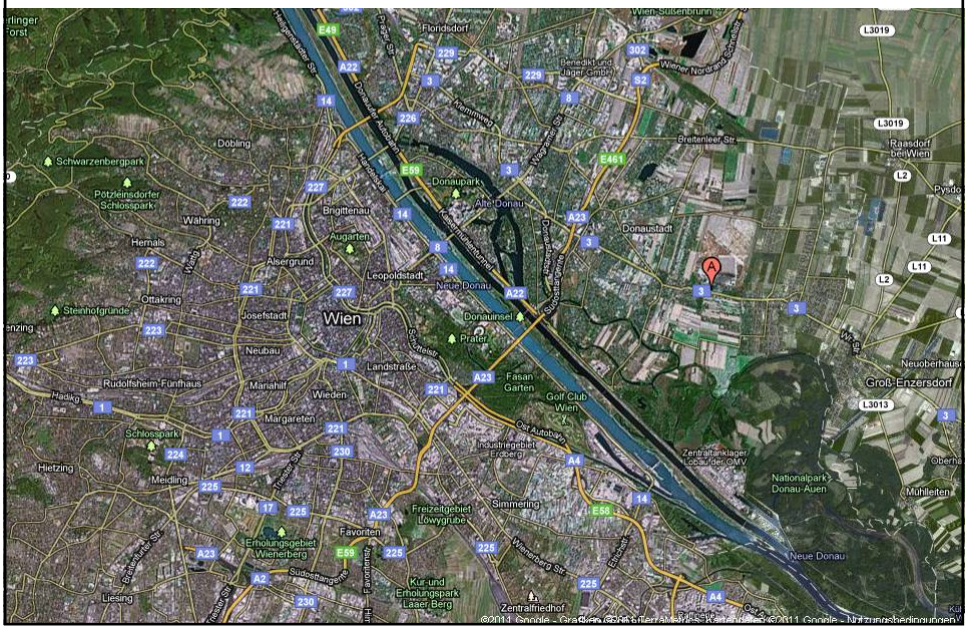
Heavy Traffic

160

161

162

Seestadt Aspern



163

164

Meilensteine - Auszug

1912
Errichtung des Wiener Flughafens, der größte und modernste in ganz Europa.

1. und 2. Weltkrieg
Luftwaffenstützpunkt

Ab 1945
Flugplatz für zivile fliegerische Zwecke genutzt

Ab 1977
Schließung des Flugplatzes durch fortschreitenden Ausbau von Schwechat.
Danach dienten die Pisten noch dem Flugsport, der Pilotenausbildung sowie Autorennen.

1982
Ansiedlung des General Motors Werk

1992
Erstes Stadtentwicklungsprojekt durch starkes Bevölkerungswachstum und Ostöffnung (Architekt Rüdiger Lainer)

2002
Entwicklung neuer Stadtteil am Flugfeld Aspern aufgrund steigenden Bedarfs an neuen Wohn- und Betriebsstandorten. Das ehemalige Flugfeld ist derzeit die größte Stadtentwicklung Wiens und eines der größten Städtebauprojekte Europas. Die Grundstückseigentümer einigten sich mit der Stadt Wien auf eine gemeinsame Projektentwicklung mit anspruchsvollen Zielvorgaben.

165

Meilensteine - Auszug

2004
Gründung der Asperner Flugfeld Süd Entwicklungs- und Verwertungs AG (heute: Wien 3420 Aspern Development AG)

2005
EU-weiter 2-stufiger städtebaulicher Wettbewerb für die Masterplanung

2007
Genehmigung des Masterplans des schwedischen Architekten Johannes Tovatt

2008
Internationaler Wettbewerb zur Erstellung von Gestaltungsstrategien für den öffentlichen Raum. Gewinner: Gehl Architects aus Dänemark

2009
Spatenstich für die U2

2010

Wettbewerb Technologiezentrum Aspern, 1. Preis: ATP Architekten

voraussichtlich 2011
Bauträgerwettbewerbe für Wohnbau, Wettbewerb Schulcampus

2013 bis 2028 (in Planung)
Fertigstellung der Seestadt Aspern, für 20.000 Bewohner/Innen

166

Zahlen und Fakten

- 2,4 Mio. m² Grundfläche
- 20.000 BewohnerInnen (bis 2028)
- 8.500 Wohneinheiten
- 20.000 Arbeitsplätze:
  - 15.000 Büros und Dienstleistungsunternehmen
  - 5.000 Produktions- und Gewerbebetriebe, sowie Wissenschaft und Forschung

- Naherholungs- und Freizeitgebiet:
  - 5 ha großer See
  - 9 ha großer zentraler Park

- Verkehrsinfrastruktur:
  - U-Bahnlinie U2
  - Schnellbahnanschluss
  - Buslinien
  - Rad- und Fußwegenetz
  - Autobahnanschluss A23

167

Luftbild Seestadt Aspern

[Quelle: Stadtentwicklung Wien, Wien 3420 Aspern Development AG]

168

Luftbild Seestadt Aspern

169

Luftbild Seestadt Aspern

170

FAMILY HOUSE PENKA

3911 Rappottenstein 34, NÖ

OBJECT DATA

Type:	New building of Passive House
Constructor:	Fam. Penka
Planung:	Treberspurg & Partner ZT GmbH
Completed:	2000/2001
Size:	203 m²
Heating energy demand :	14 kWh/(m²a)
Netto Building Costs:	ca. 24.000 EURO

171

172

Ventilation system mit earth collector, heat recovery and fresh air preheating unit

173

THE DESIGN OF THE AUSTRIA HOUSE IN WHISTLER, CANADA

174

What´s the overvalue of the Olympic Austria House?

Symbol for Canada and the world, how the energy issue could be solved and how sustainable development could be realized

- Most energy efficient building in the Olympic history
- Ecological building materials
- Salubrious indoor climate: fresh air quality, natural light and other contributions to raise workplace productivity
- High quality of planning (coordinator Erich Reiner) and workmanship: Sohm Holzbau, Optiwin, drexel&weiss and others

175

176

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

177

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

178

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

From Austria …

… to Canada

179

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

Day 3

Day 5

180

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

Installing windows

Topping out ceremony

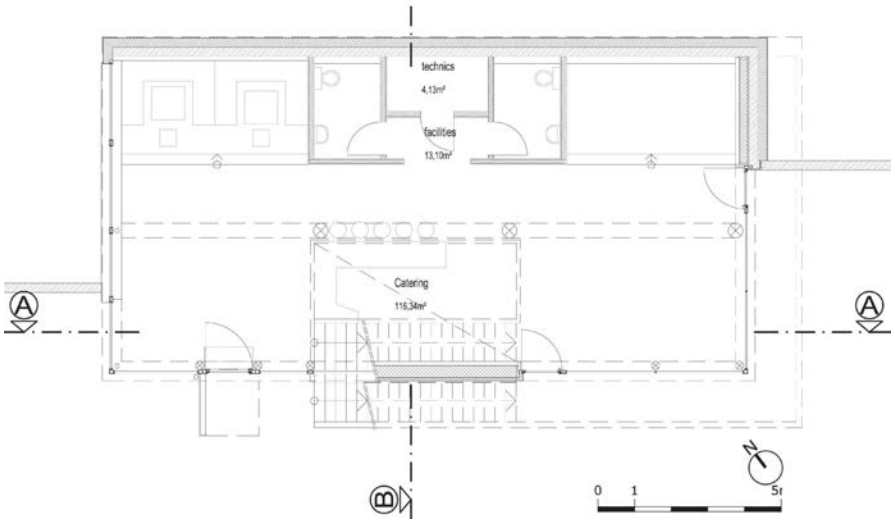
181

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

(credit: Ira Nicolai)

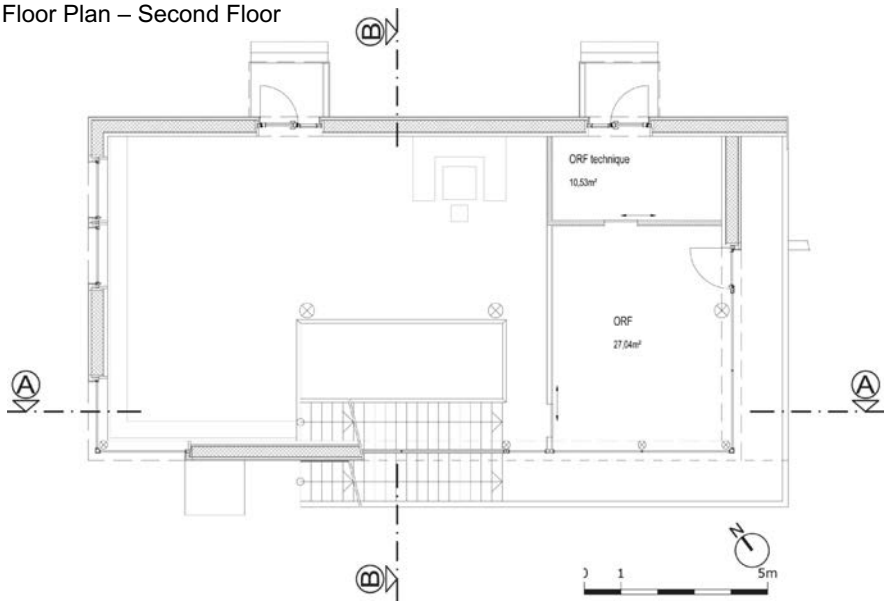
182

Floor Plan – First Floor

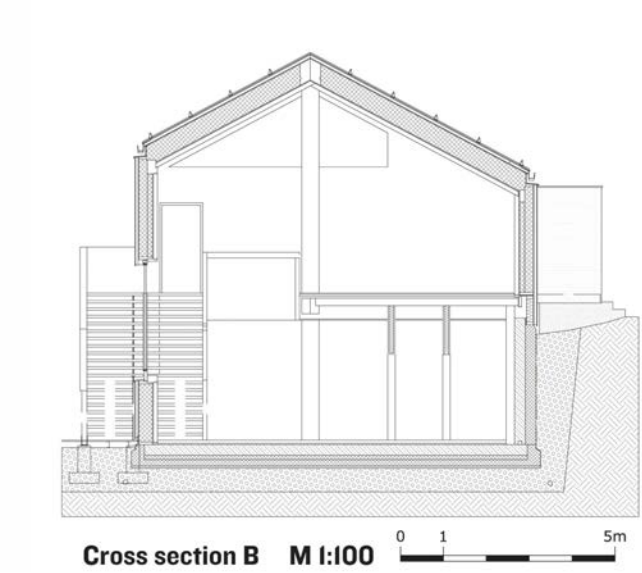


183

Floor Plan – Second Floor



184



185

AWARDS, PRIZES, QUALITY CERTIFICATES

The quality of the Austria House was awarded several times

ENERGY PERFORMANCE: Passive House Planning Package (PHPP). Passive House Institute Darmstadt

KLIMA:AKTIV Awarded by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Manegement for Passive House Quality

DGNB – Pre-Certificate. International seal of quality for sustainable buildings. First building awarded by ÖGNI (World Green Building Council Austria)

186

MOUNTAIN REFUGE USING PASSIVE HOUSE TECHNOLOGY „SCHIESTL-HOUSE“

Hochschwab Mountain, Styria 2154 m

Developer: Austrian Tourist Club, Vienna
Architect: GP-ARGE pos architekten and Treberspurg & Partner Architekten ZT GmbH, Vienna

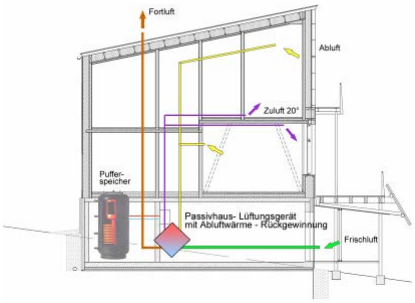
[Treberspurg & Partner Architekten ZT GmbH, Vienna]

187

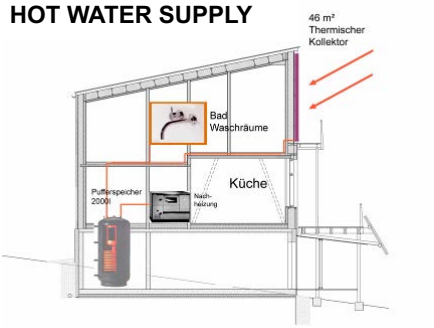
MOUNTAIN REFUGE USING PASSIVE HOUSE TECHNOLOGY „SCHIESTL-HOUSE“

Hochschwab Mountain, Styria 2154 m

HEATING AND VENTILATION



HOT WATER SUPPLY



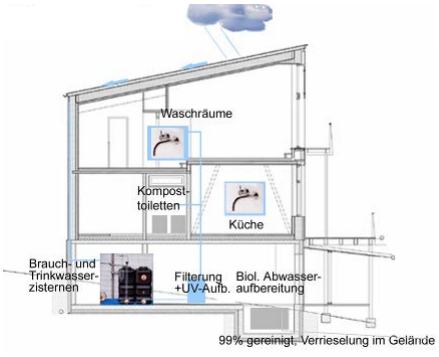
[Treberspurg & Partner Architekten ZT GmbH, Vienna]

188

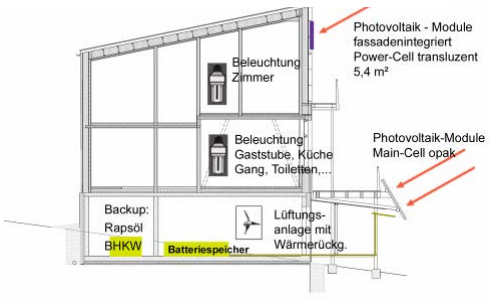
MOUNTAIN REFUGE USING PASSIVE HOUSE TECHNOLOGY „SCHIESTL-HOUSE“

Hochschwab Mountain, Styria 2154 m

WATER SUPPLY (RAIN WATER) AND BIOLOGICAL WASTE WATER SYSTEM

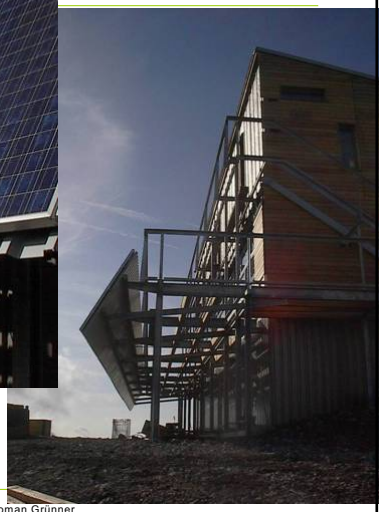


ELECTRIC POWER SUPPLY WITH PHOTOVOLTAIC SYSTEM



[Treberspurg & Partner Architekten ZT GmbH, Vienna]

189



75 m² of photovoltaic cells

190

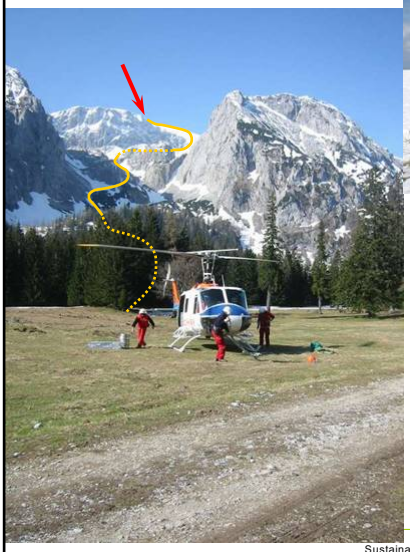
MOUNTAIN REFUGE USING PASSIVE HOUSE TECHNOLOGY „SCHIESTL-HOUSE“

Hochschwab Mountain, Styria 2154 m

[Treberspurg & Partner Architekten ZT GmbH, Vienna]

191

May 2004: Transportation of building site equipment



192

MOUNTAIN REFUGE USING PASSIVE HOUSE TECHNOLOGY „SCHIESTL-HOUSE“

Hochschwab Mountain, Styria 2154 m

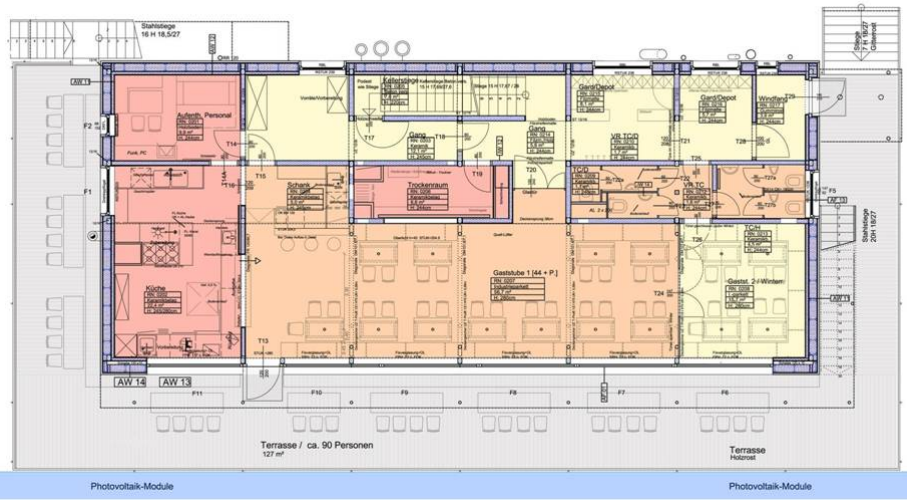
January 2006

[Treberspurg & Partner Architekten ZT GmbH, Vienna]

193

[Treberspurg & Partner Architekten ZT GmbH, Vienna]

194



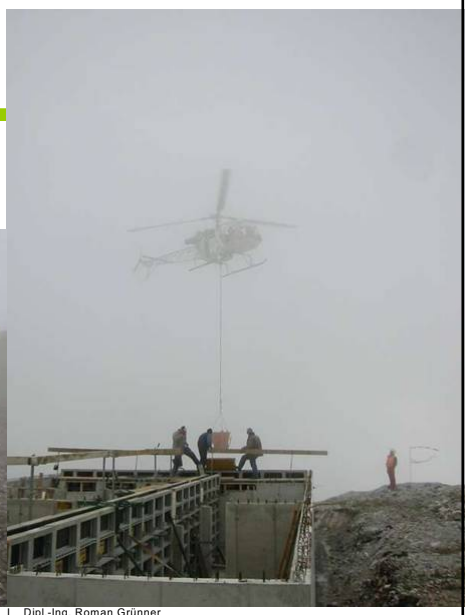
BUILDING DESIGN – ORGANISATION OF FLOOR PLAN

195

The old Schiestlhaus - 120 years old and in a very bad condition.

196

…AGAIN AND AGAIN….
BAD WEATHER!!



197

Details of the wall-elements:

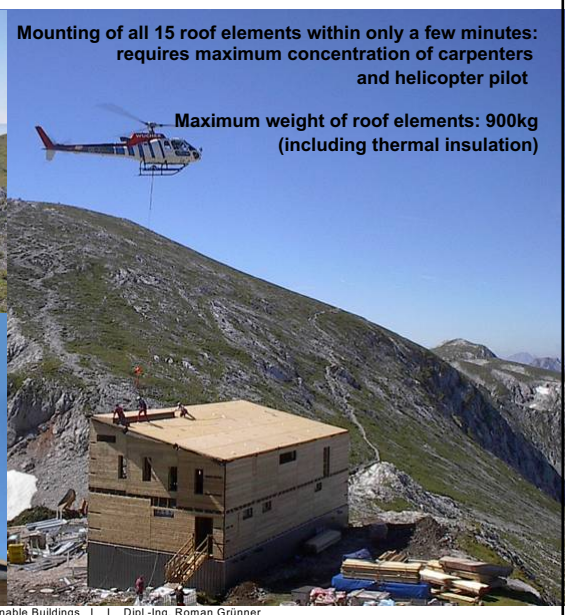
Joints of elements with pre-mounted air sealing and vapor barrier foils

198

Roof assembling September 2004

Mounting of all 15 roof elements within only a few minutes: requires maximum concentration of carpenters and helicopter pilot

Maximum weight of roof elements: 900kg (including thermal insulation)



199

200

201

main guest room with large windows for solar gains

202

view from the north east

snow and ice covering as additional thermal insulation

Exhaust ventilator of the kitchen and radiation measurement units on the roof

203

204

STATE OF THE ART

„1-liter car"

80% energy saving

„1-liter house" = Passivhouse

since 1991

90% less heating energy

205

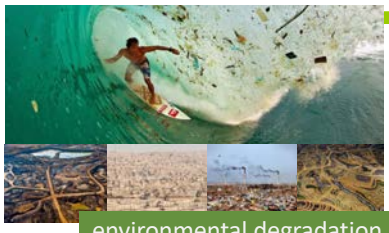
Old Paradigm
Linear Economy

Source:iStock by petovarga

206

Social and environmental problems

Source: Zak Noyle, 2014; MIR TECEN, 2018



environmental degradation

Source: UN DESA, 2015

urbanisation

health impacts

biodiversity loss

Source: gettyimages, 2016

Source: Centro biodiversidad euskadi, 2018

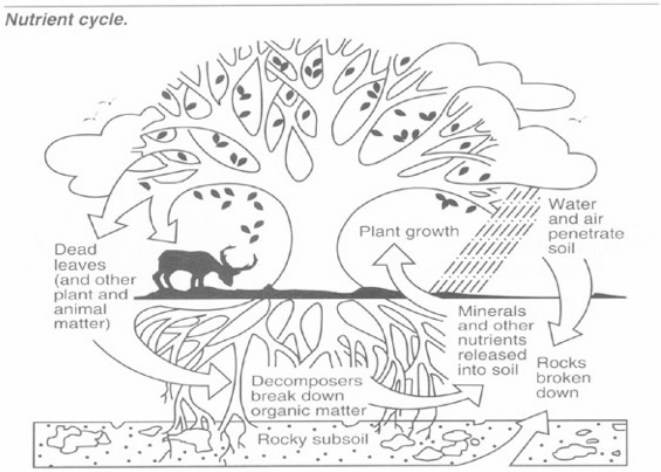
207

New Paradigm
Circular Economy

Take → Make → Regenerate

208

Tree as innovation generator and service provider



Source: nrcs.usda.gov

209

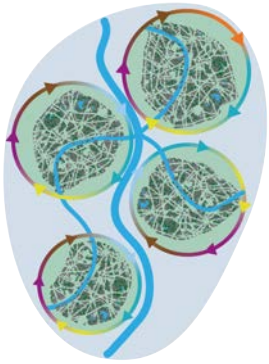
A building like a tree

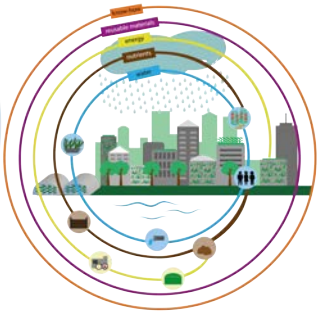
William McDonough's Treescraper Tower of Tomorrow

A city like an ecosystem

Source: Agricultura Urbana (New York)

Cities inspired by nature



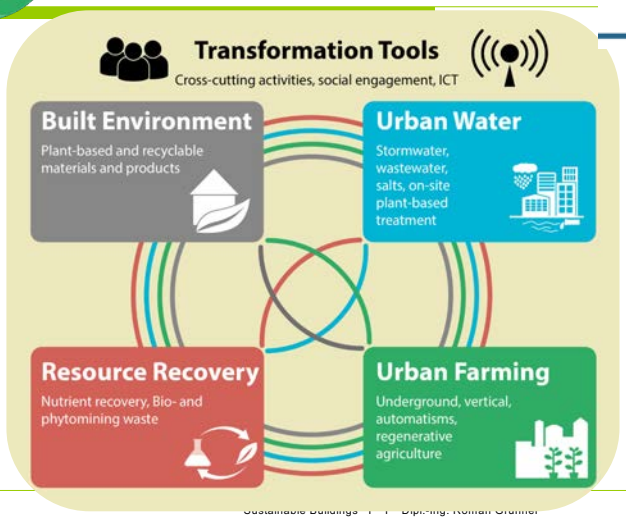


212

Circular City

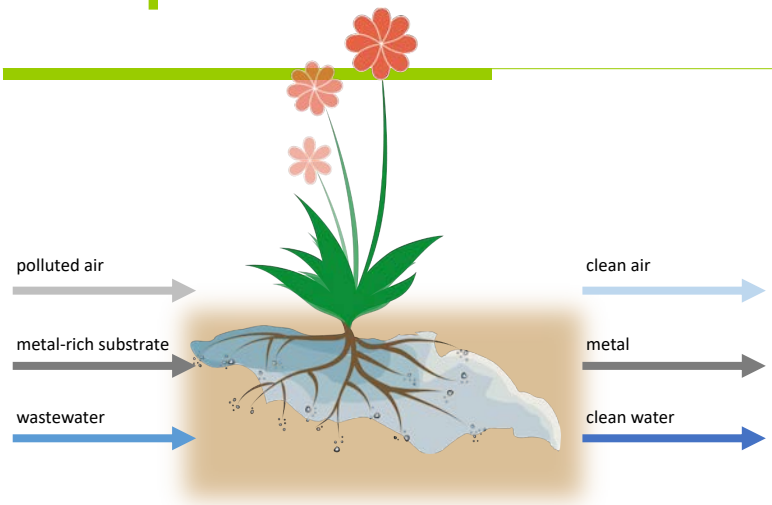
circular-city.eu

cost



213

Plant powers



214

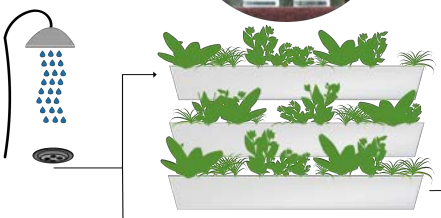
VERTICAL ECOSYSTEM®

215

vertECO® summary of results

greywater:

COD: 209 mg O_2/l
BOD5: 96 mg O_2/l
turbidity: 68 NTU



Legal limits according to **91/271/EC**

COD: 125 mg O_2/l
BOD5: 25 mg O_2/l
turbidity: 2 NTU

COD: 125 mg O_2/l
BOD5: 25 mg O_2/l
turbidity: 2 NTU

COD: 125 mg O_2/l
BOD5: 25 mg O_2/l

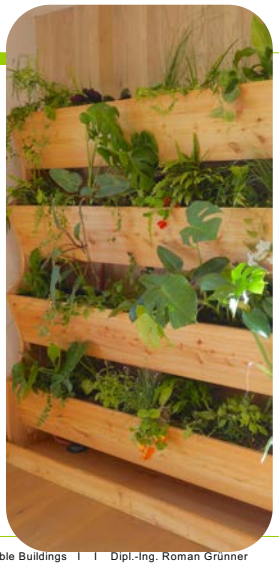
water after vertECO treatment:

COD: 17 mg O_2/l
BOD5: 4 mg O_2/l
turbidity: <2 NTU

analytics by ICRA - data from: 2015-2017

216

Functional green façade

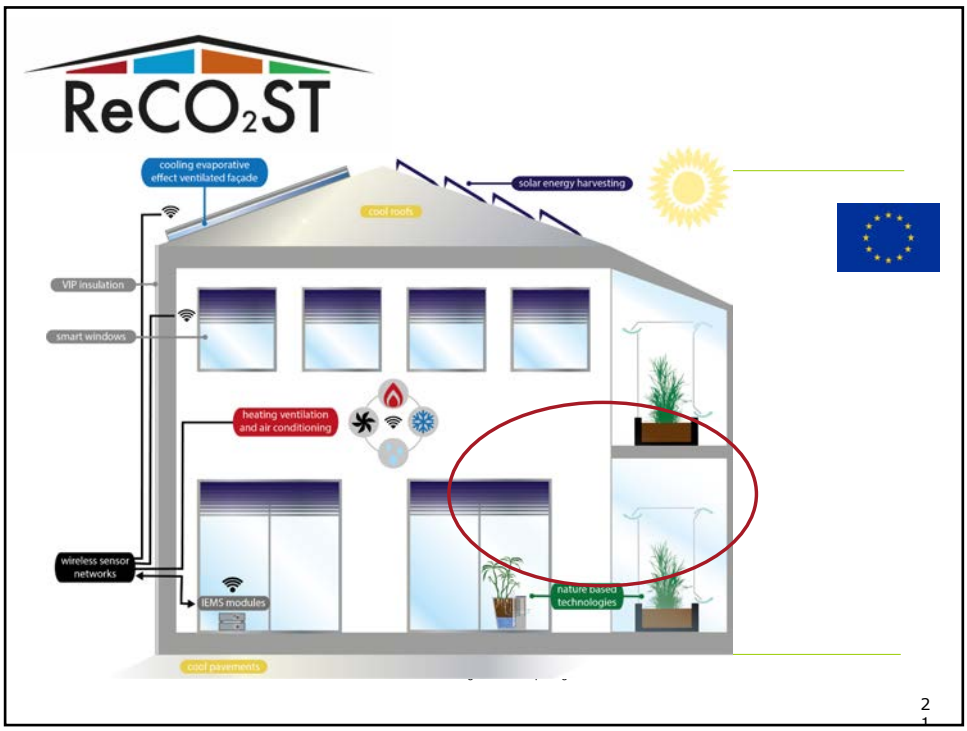


VertECO

Green INSTRUCT

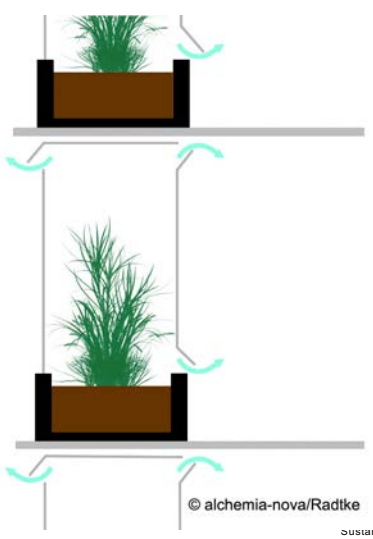
www.greeninstruct.eu

217



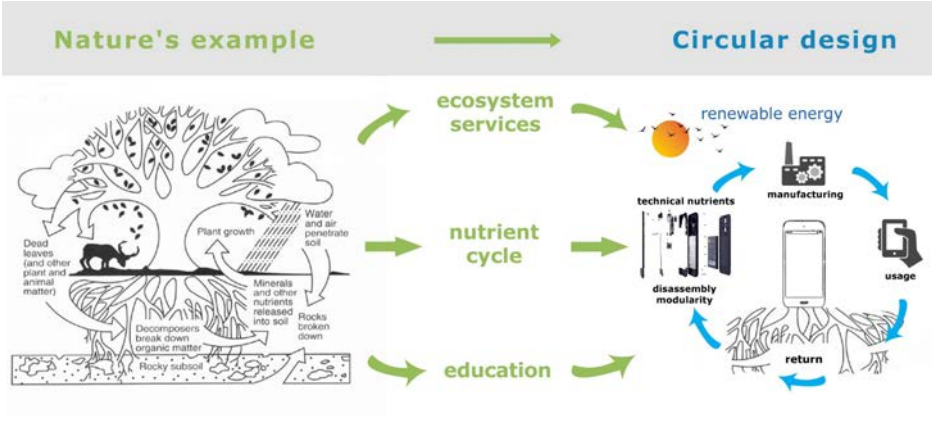
218

Rainwater use in wintergarden & air treatment



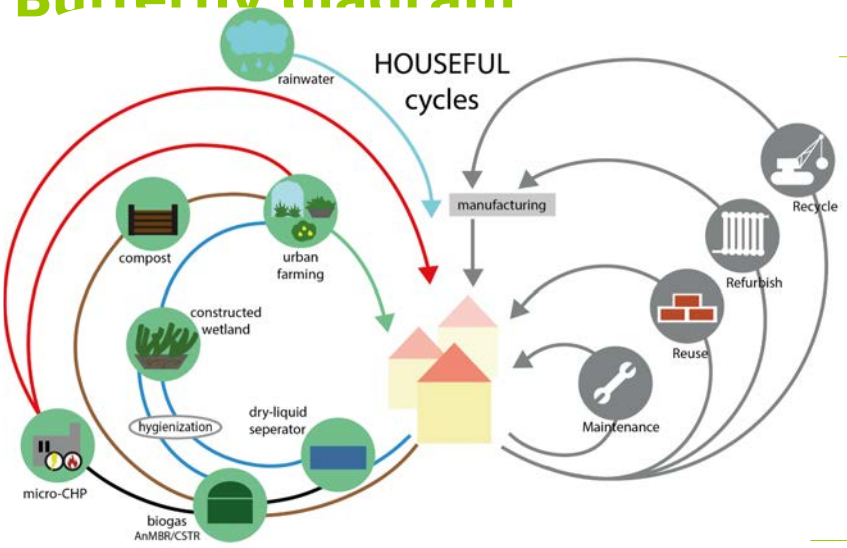
219

Natural technical cycle



220

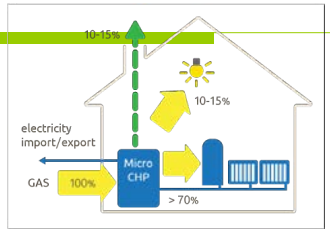
Butterfly diagram

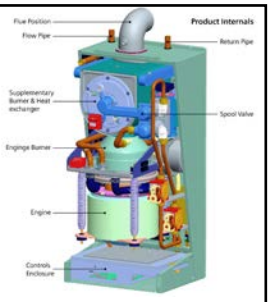


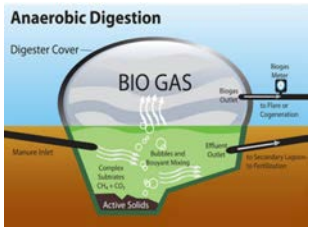
221

Dry anaerobic digestion, biogas storage & CHP Unit

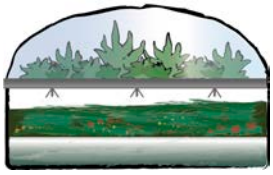
- Production and storage of biogas
- CHP Unit for electricity and heating
- Residual waste to composter for fertilizer
- Biomimicry inspired solutions







compost cultivator

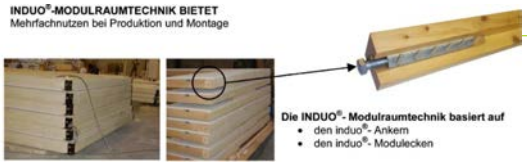


Sustainable Buildings I I Dipl.-Ing. Roman Grünner

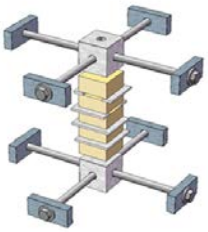
222

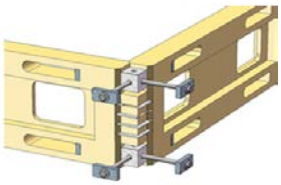
222

Deconstructability



INDUO® wood systems, DE





Wood construction system Cross House, CH

Spinnanker, AT

Sustainable Buildings I I Dipl.-Ing. Roman Grünner

223

223

Green Architecture

224

Examples of green roofs

„Neubau einer Wohnhausanlage“, Wintergasse 53, 3002 Purkersdorf

Planning: DI Georg Reinberg, DI Martin Treberspurg, AusführungsPlanning und Bauaufsicht gemeinsam with Arch. Jörg Riesenhuber

Completed: 1984

- Refurbishment of an old villa inc. new roof (apartment) + 2 new buildings (apartments)
- 10 app. + common rooms
- Grass roofs

[Source: REINBERG]

225

Examples of green roofs

„Neubau einer Wohnhausanlage“, Wintergasse 53, 3002 Purkersdorf




[Source: REINBERG]

226

Spar Supermarket

Engerthstraße 230A, 1020 Vienna
Used space: 684 m2
Green space: 1.105 m2
- 230 m2 for sport

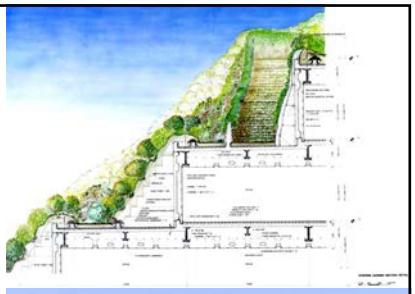
227

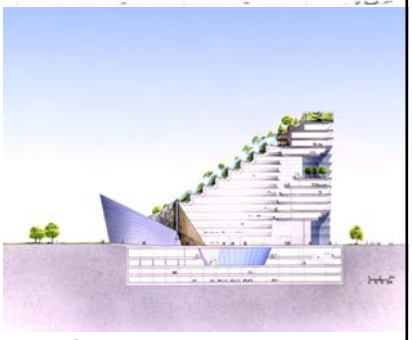
228

229

ACROS Fukuoka, offices under green terraces – Japan

230





ACROS Fukuoka, offices under green terraces – Japan

231

Art and Exhibition Hall roof garden – Bonn, Germany.

232

Chicago City Hall – the coolest place to be, thanks to this $2.5 million rooftop garden (*not* open to the public – the 11-storey drop might have something to do with this).

233

234

Patrick Blanc´s unique vertical garden

235

Musée du quai Branly / **Quai Branly Museum** , Paris

236

CaixaForum, Museum in Madrid

237

J&T Bank Cafee, Bratislava

238

Plants don’t need earth: only water, minerals, light and carbon dioxide”. Based on this simple axiom, Patrick Blanc built his first vertical garden in 1988, specifically in La Villette in Paris.

239

Thank you for your attention !

240