ENEF2017, Banja Luka, 3. - 4. 11. 2017.

Projekti i ostvarenja visoko energetski učinkovite arhitekture

Projects and realizations of high energy efficient architecture

Full Prof. Art. **Ljubomir Miščević**, Mag. Eng. Arch. Urb.

Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

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ENEF 2017

III naučno-stručni simpozijum
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[PREDAVANJA PO POZIVU]

PROJEKTI I OSTVARENJA VISOKO ENERGETSKI UČINKOVITE ARHITEKTURE

Red. prof. art. Ljubomir Miščević

Univerzitet u Zagrebu
Arhitektonski fakultet
Zagreb, Hrvatska

Biografija

Predavanje objašnjava i prikazuje projekte i ostvarenja visoke energetske učinkovitosti i održivosti. Od prve obiteljske kuće izvedene 2005. godine kao pasivne kuće (energetski razred A+), do projekta višestambene zgrade sa 27 stanova.

Uvodno će se prikazati i komentirati iskustvo tri pasivne sunčane kuće iz osamdesetih godina koje su ostvarene među prvima u regiji i dvadesetak projekata i ostvarenja obiteljskih kuća, uključujući prvu svjetsku implementaciju fasadnog ventiliranog sustava koji je rezultat europskog znanstveno istraživačkog projekta iz programa Eco-innovation EU. To je obiteljska kuća s tri stambene jedinice izvedena u Koprivnici u sustavu državnog programa poticane stanogradnje.

Autor će govoriti na temelju osobnog iskustva i o sinergiji edukacije, istraživanja, inovacije, modela financiranja, projektiranja i izvedbe arhitekture koja je koncipirana kao samodostatna,

Energetska efikasnost u zgradarstvu

Savremene tehnike građenja. Pametni gradovi i pametne zgrade.

Regulatorni okvir i energetska politika

Aktuelno stanje u zakonodavstvu na polju energetske efikasnosti i alternativnih izvora energije. Sistemi podsticaja. Strateški ciljevi energetske politike. Energetski menadžment.

Investicioni aspekti poboljšanja energetske efikasnosti

Načini finansiranja projekata za poboljšanje energetske efikasnosti. Isplativost i analiza rizika.

Obrazovanje u sferi energetske efikasnosti

Razvoj studijskih programa, pojedinačnih kurseva, savremenog edukativnog materijala i laboratorijske infrastrukture za obrazovanje u oblasti energetske efikasnosti.

Projekti i ostvarenja visoko energetski učinkovite arhitekture

Projects and realizations of high energy efficient architecture

Sažetak /Abstract

Predavanje objašnjava i prikazuje projekte i ostvarenja visoke energetske učinkovitosti i održivosti. Od prve obiteljske kuće izvedene 2005. godine kao *pasivne kuće* (energetski razred A+), do projekta višestambene zgrade sa 27 stanova.

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Full Prof. Art. LJUBOMIR MIŠČEVIĆ, M: Arch.
University of Zagreb, Faculty of architecture

miscevic@arhitekt.hr
Head of Passive House Consortium Croatia

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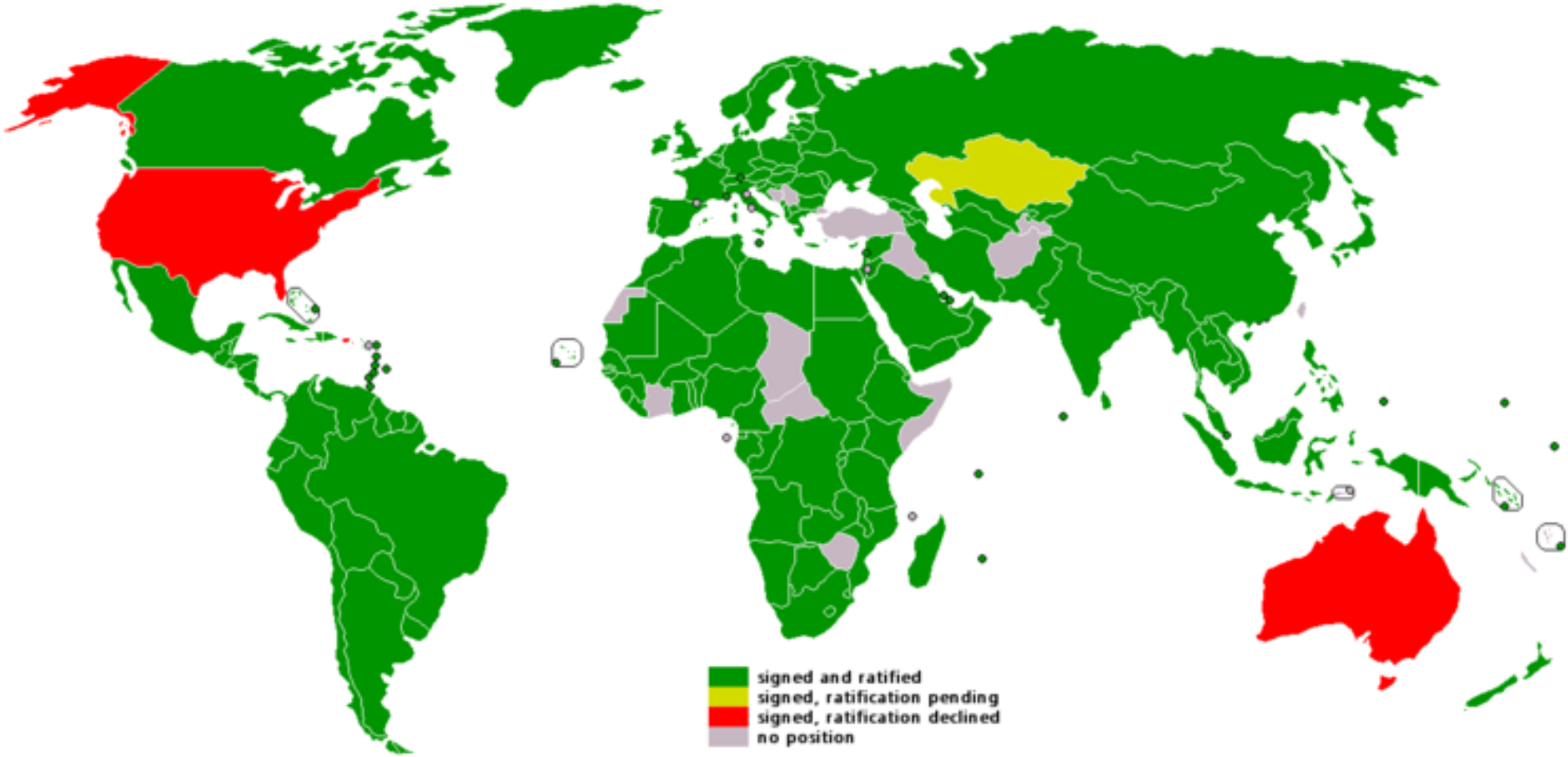
OCTOBER

Kyoto sporazum 7.2007.




SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

The Geneva UN Charter on Sustainable Housing

Ensure access to decent, adequate, affordable and healthy housing for all

UNITED NATIONS

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Pasivne kuće
Prvih dvadeset zgrada energetskog standarda pasivne kuće u Hrvatskoj

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EKSPERTIZE
A qualitative study on the state of climate change policy in Croatia
Are we ready for climate policy?

EKSPERTIZE
Globalno zatopljenje je globalni problem

12.03.2015.

Prvih dvadeset zgrada energetskog standarda pasivne kuće u Hrvatskoj

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Priopćenje o davanju primjedbi u sklopu javne rasprave o Strateškoj studiji utjecaja na okoliš Okvirnog pla

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Novi dijagram energetske učinkovitosti zgrada

Energetski učinkovite zgrade

12.03.2015. | Prof. Ljubomir Miščević

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Slažem se

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29.5.2015.

France decrees new rooftops must be covered in plants or solar panels

All new buildings in commercial zones across the country must comply with new environmental legislation.

Rooftops on new buildings built in commercial zones in **France** must either be partially covered in plants or solar panels, under a law approved on Thursday. Green roofs have an isolating effect, helping reduce the amount of energy needed to heat a building in winter and cool it in summer.

Friday, 20 March 2015

EU Targets

2020: 20% reduction in CO2 (1990) and 20% renewables

2050: 80-95% reduction in CO2

2030 Targets (27th March 2014)

GREEN PAPER
A 2030 framework for climate and energy policies

Reducing greenhouse gas emissions by 40%

Increasing the share of renewable energy to at least 27%

Continued improvements in energy efficiency

The Federal State of Upper Austria covers more than 40 % of its heating demand with renewable energy.

Source: ESV

The »Energiepass«

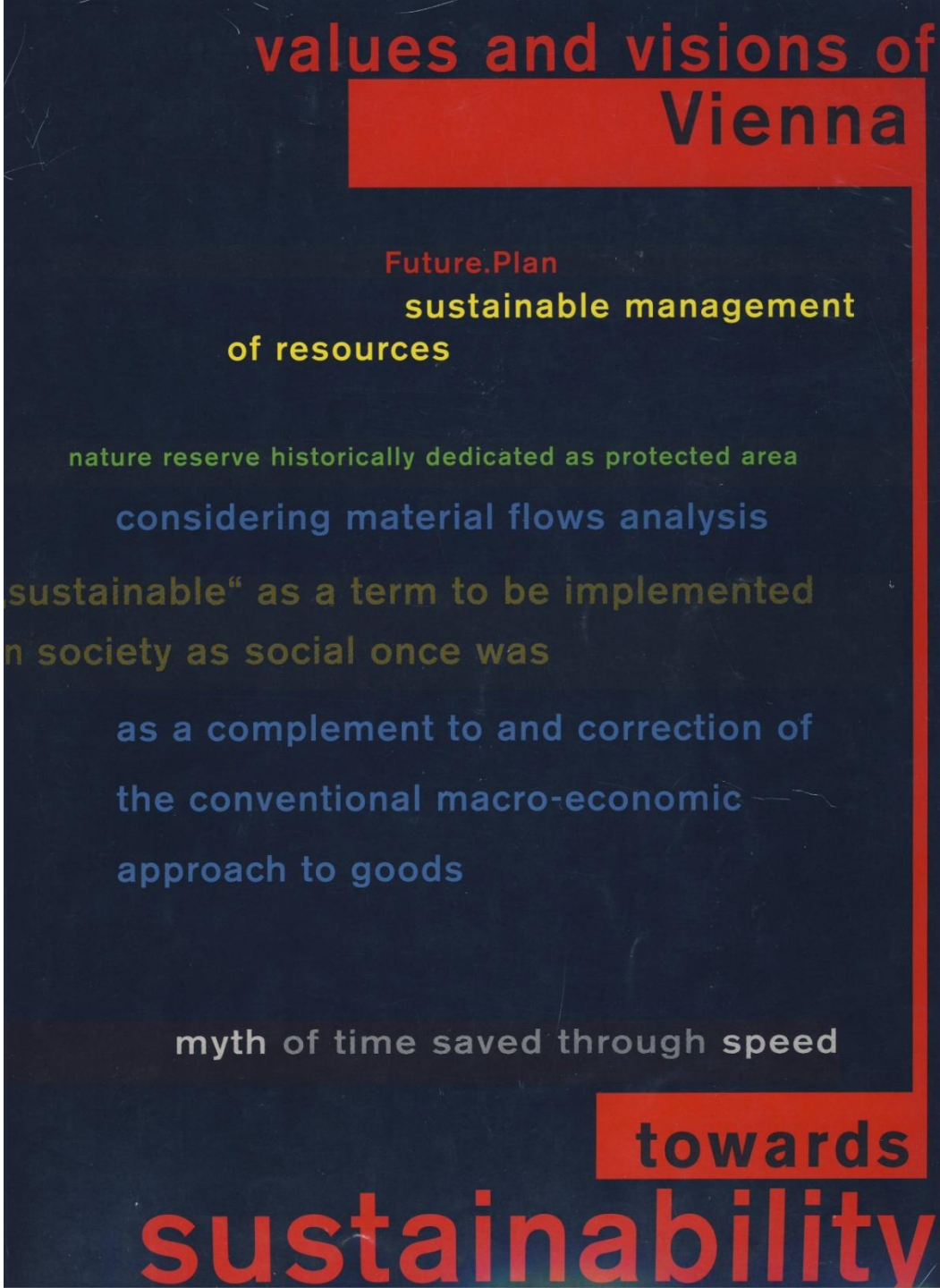
Good insulation costs money. It also saves a great deal, but consumers do not see this by looking at the building. For that reason, the member states of the European Union are supposed to ensure that the energy demand of the building is visible to the consumer. That is the purpose of the »Energiepass«. Like the labels on electronic appliances, the certificate shows via colour coding – green to red – whether the building's energy demand is good or bad.

By means of injection pipelines the waste wood (swarf and sawdust) from the neighbouring parquet factory is injected directly into the silo, from where it is taken automatically for combustion in the heating plant. To the right, a 27 kW_p PV system can be seen that feeds electricity into the grid.

Photos (2): European Centre For Renewable Energy Güssing (EEE) GmbH

Wood-fired power plant: With 2 MW_{el} and 4.5 MW_{th} the power plant in Güssing, Austria, is the supporting leg of the first energy self-sufficient city in Europe.

Vienna as sustainable city
1996



UNECE
United Nations Economic Commission for Europe

24th Session of the Committee on Sustainable Energy (CSE)

United Nations, Geneva, 18 - 20 November 2015
Salle VII, Palais des Nations

Group of Experts on Energy Efficiency (GEEE)

Best practices for energy efficiency
Sucessful national initiatives

Full Prof. **Ljubomir Miščević**, Mag. Eng. Arch. Urb.

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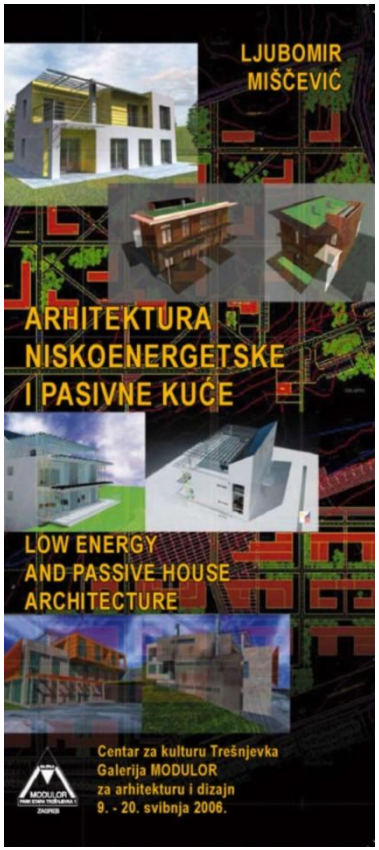
e x h i b i t i o n s

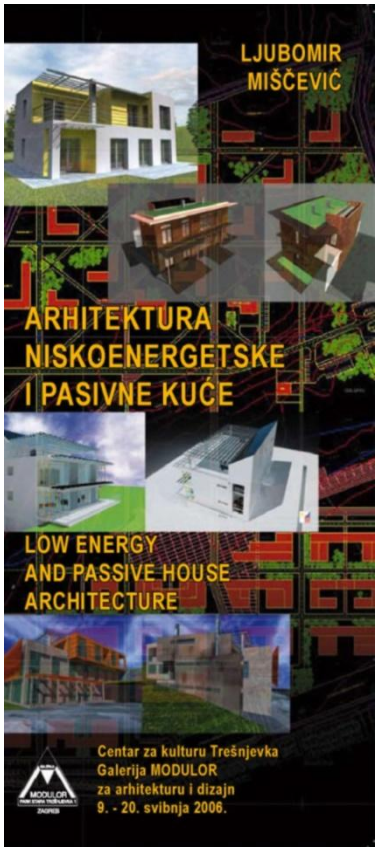
Solar Architecture, 2001

e x h i b i t i o n s



Low Energy and Passive House Architecture, 2006

e x h i b i t i o n s



Architecture as a Power Plant, 2009

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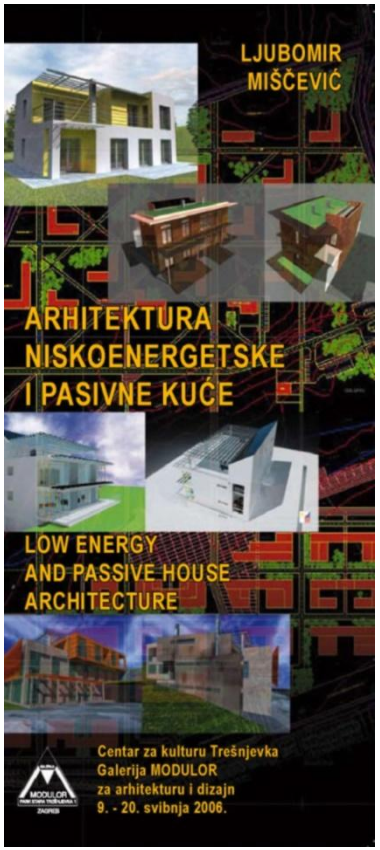

Nearly Zero Architecture, 2013

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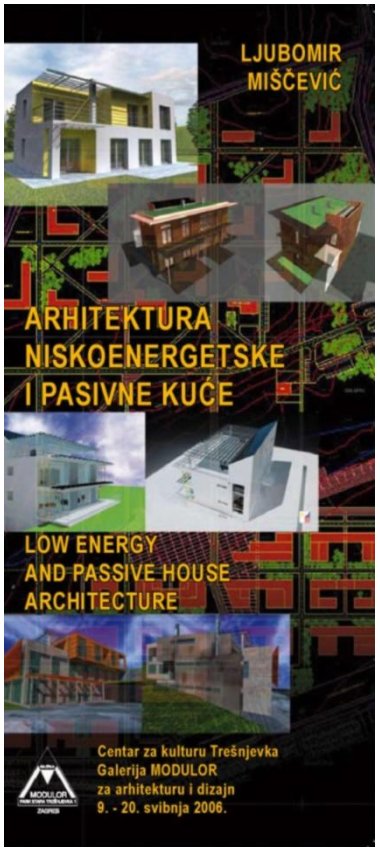

Architecture as Industrial Design, 2016

Af

Sveučilište u Zagrebu
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University of Zagreb
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www.arhitekt.hr

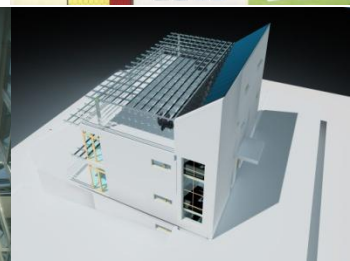
Četiri Katedre i Zavoda za profesionalnu djelatnost. Prostorno planiranje, urbanizam, arhitektonsko projektiranje svih funkcionalnih tipova arhitekture. Vodeća institucija u Republici Hrvatskoj za istraživanje, projektiranje i savjetovanje energetski učinkovite i održive arhitekture - rješenja za **EU scenarij 3x20!**

Međunarodni projekti iz programa Intelligent Energy Europe od 2011.: PASS-NET, PERFECTION, IDES-EDU, INTENSE, ... Projekti i ostvarenja najviše energetske učinkovitosti. Prve *pasivne kuće* u Hrvatskoj i regiji. Novogradnja i energetska obnova do učinkovitosti **“faktor 10”**.

Intelligent Energy Europe





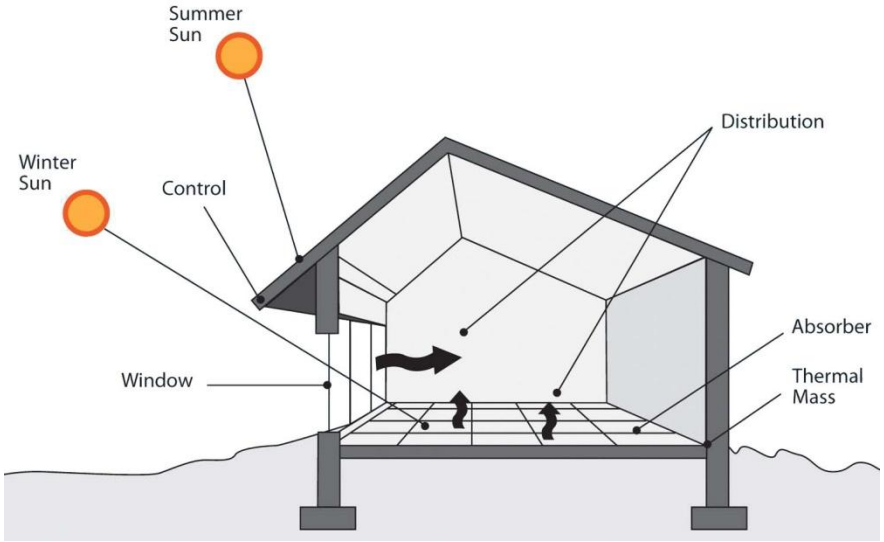
p a s s i v e s o l a r h o u s e s

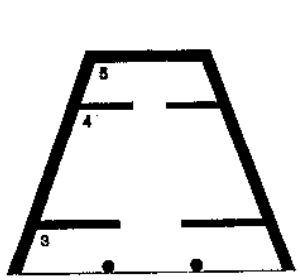
In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer.

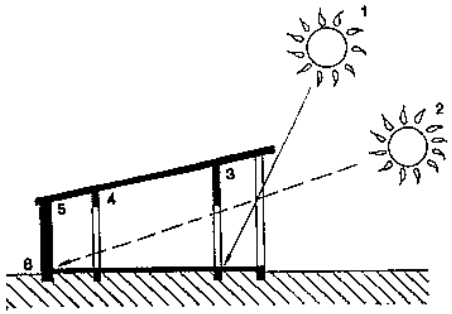
Unlike active solar heating systems, it does not involve the use of mechanical and electrical devices.

The key to design a passive solar building is to best take advantage of the local climate performing an accurate site analysis. Elements to be considered include window placement and size, glazing type, thermal insulation, thermal mass, and shading.

Passive solar design techniques can be applied most easily to new buildings, but existing buildings can be adapted or ″retrofitted″.



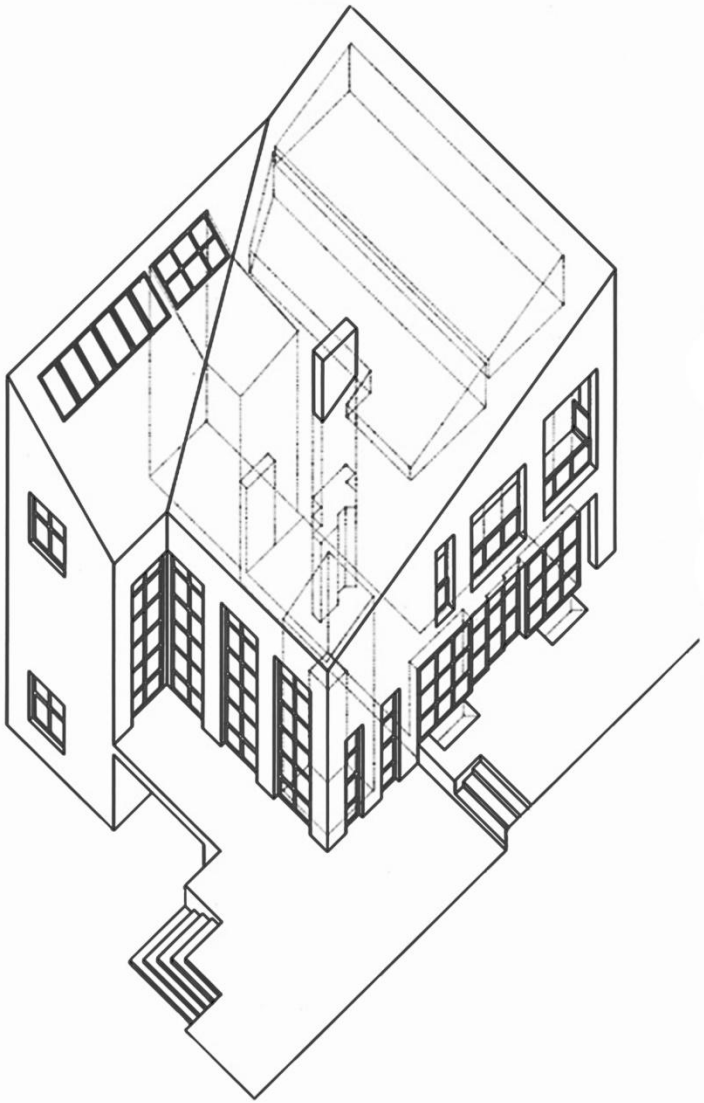


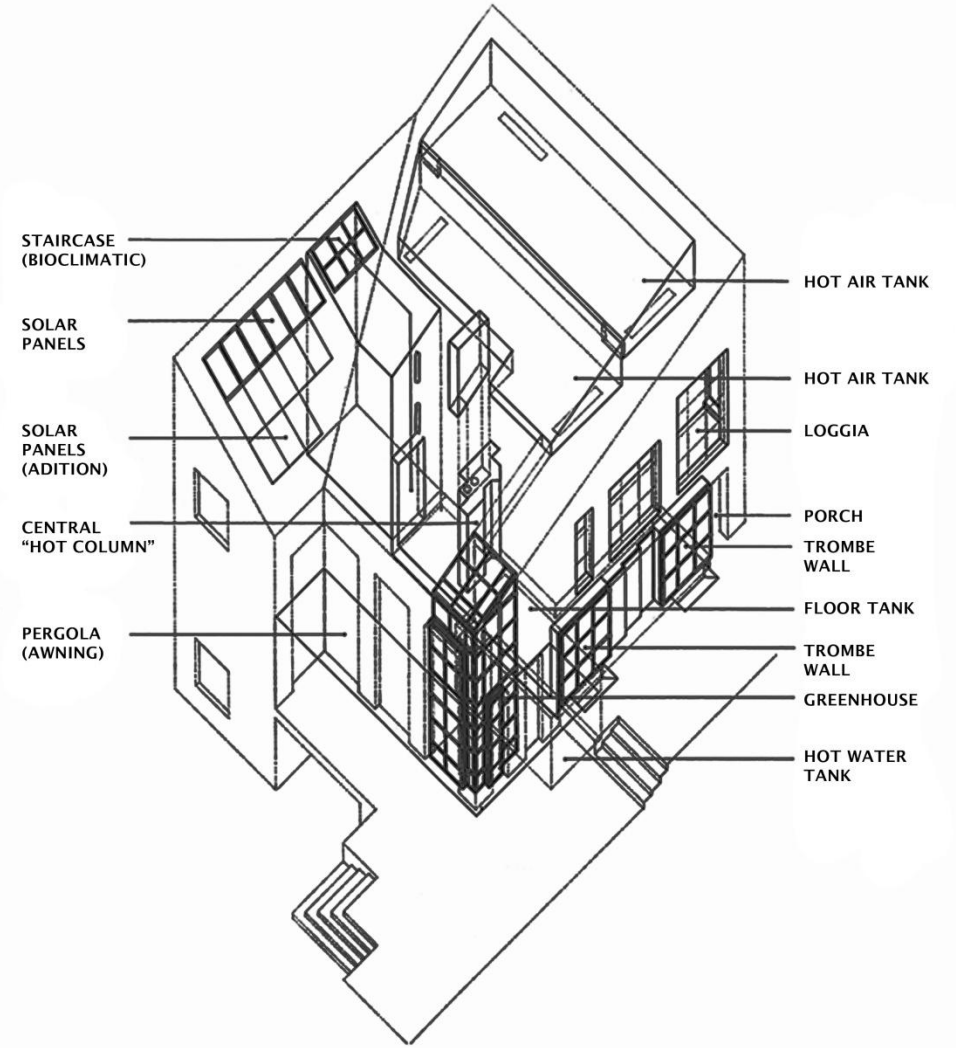


e x h i b i t i o n s

Solar Architecture, 2001

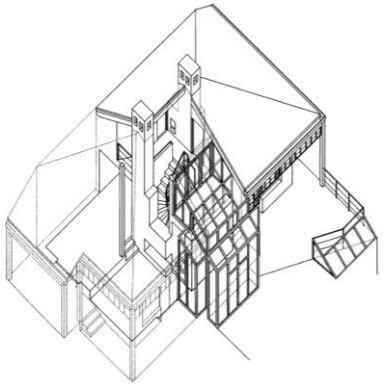
p a s s i v e s o l a r h o u s e G1, project, 1982.

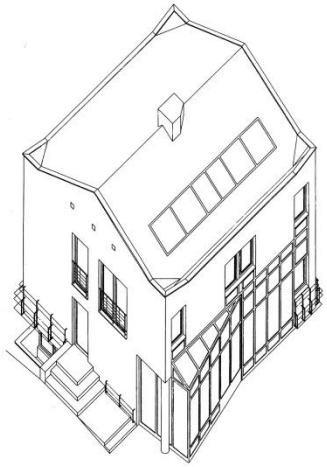




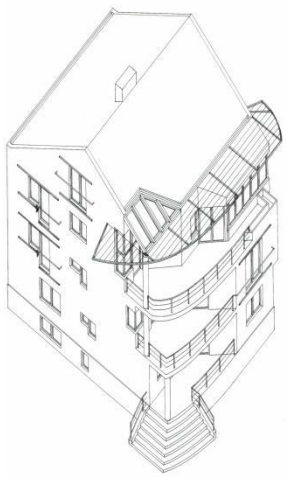
p a s s i v e s o l a r h o u s e s

Š1, 1979
P3, 1992

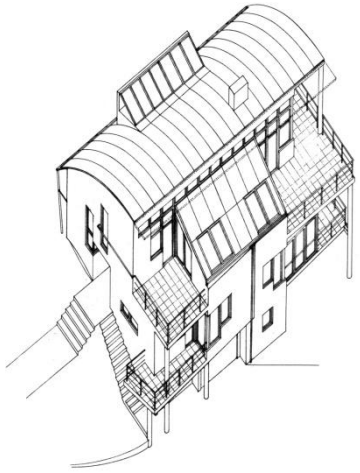




P2, 1985



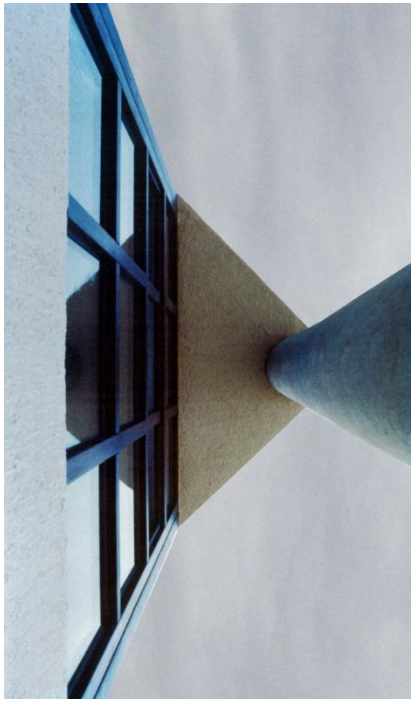
V2, 1986



M2, 1988

realisations, 1979 –1992

Š1, 1979

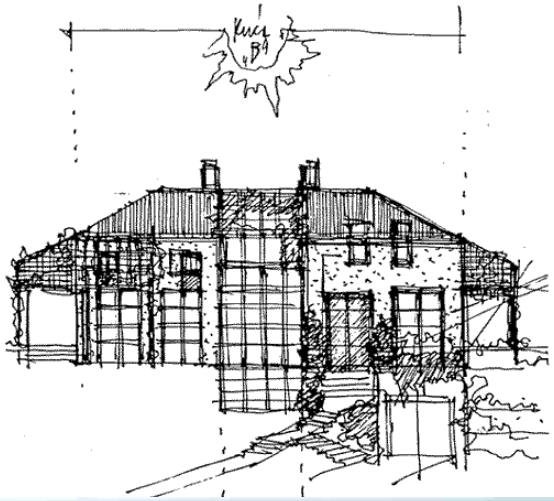


Zagreb, Croatia

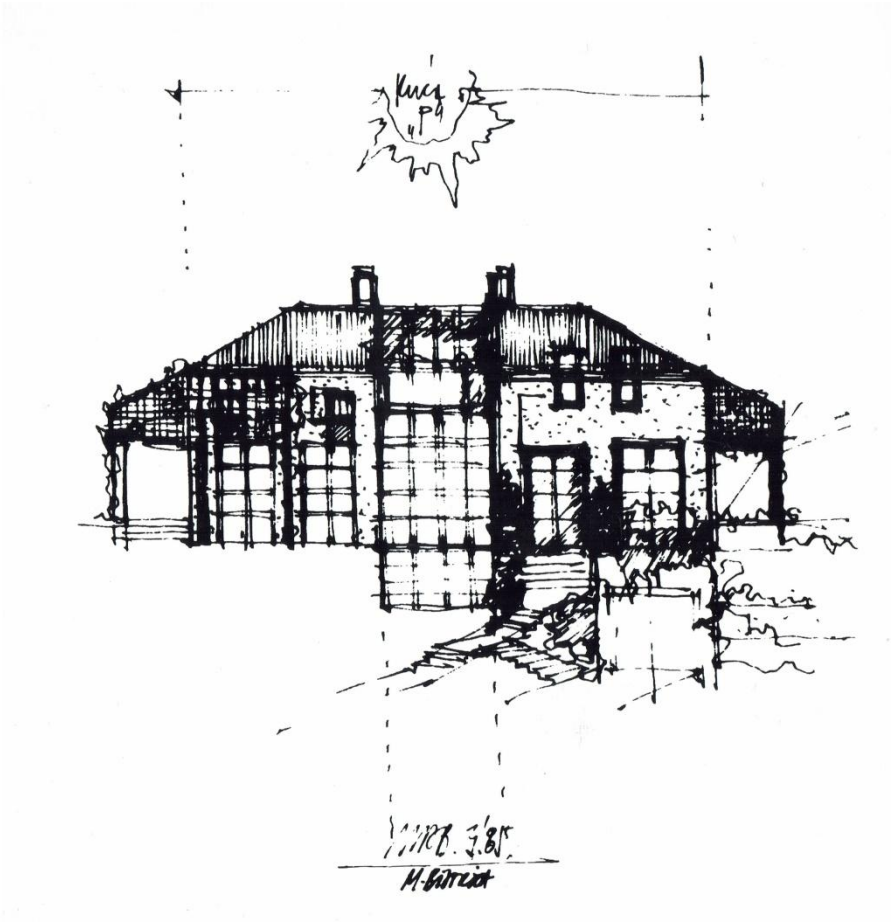
Passive solar house P2 built in 1985

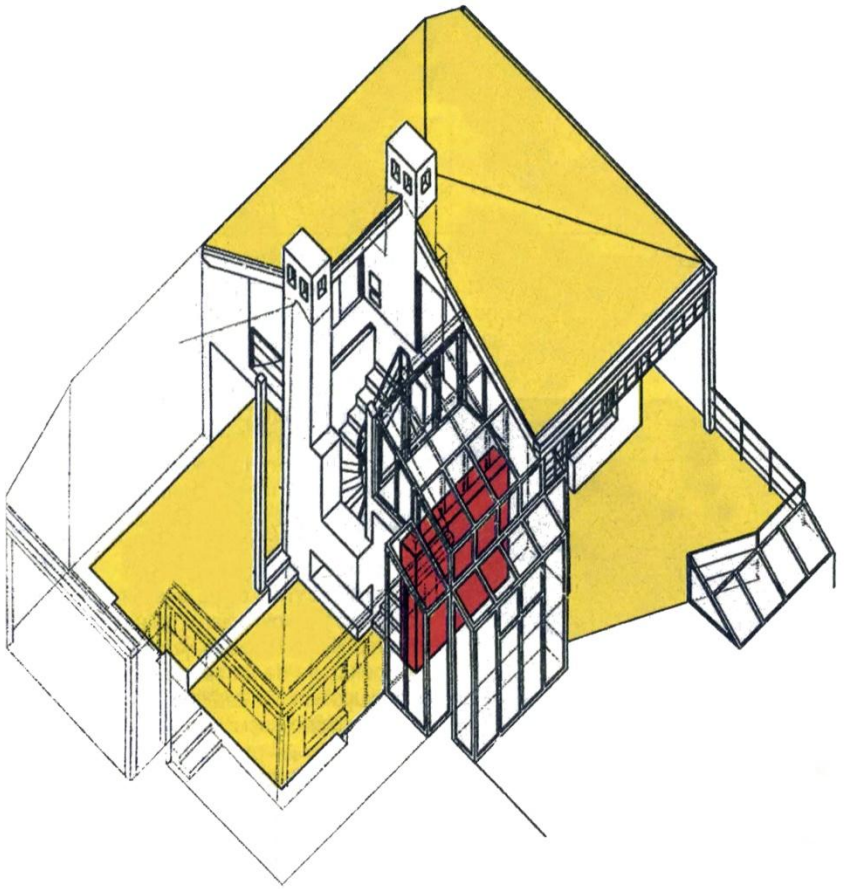
Marija Bistrica, Croatia

Author: Ljubomir Miščević



P2, 1985





Marija Bistrica, Croatia

P2, 1985

Marija Bistrica, Croatia

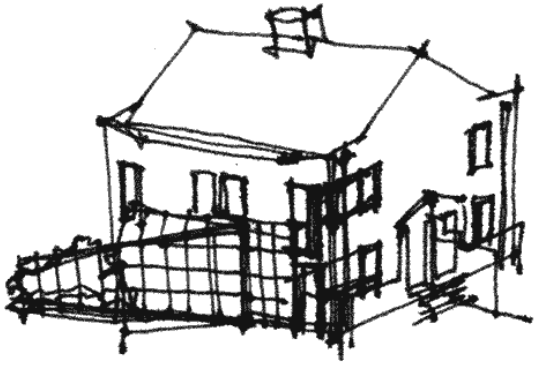
P2, 1985

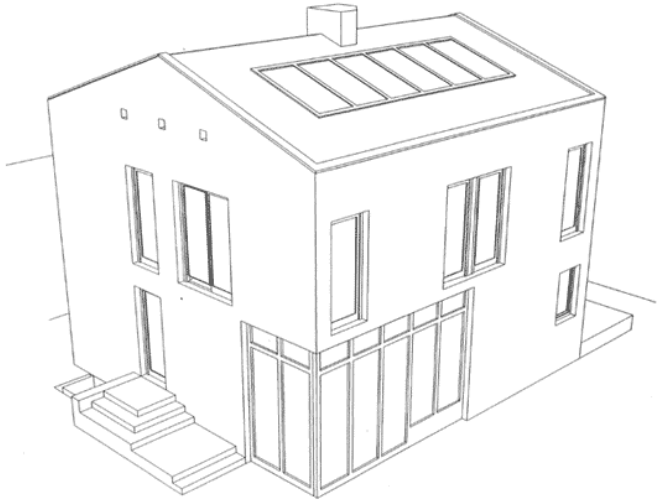
Marija Bistrica, Croatia

Passive solar house V1 built in 1986

Koprivnica, Croatia

Author: Ljubomir Miščević





V1, 1986

Koprivnica, Croatia

M2, 1988

Zagreb, Croatia

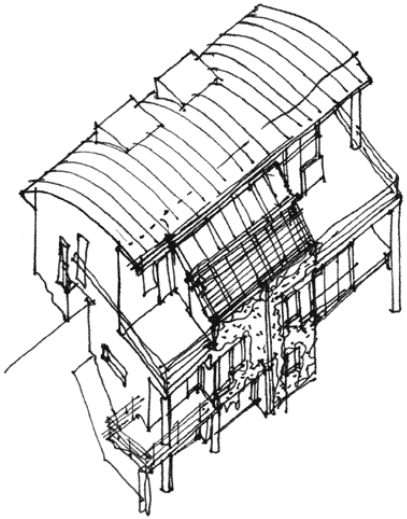
M2, 1988

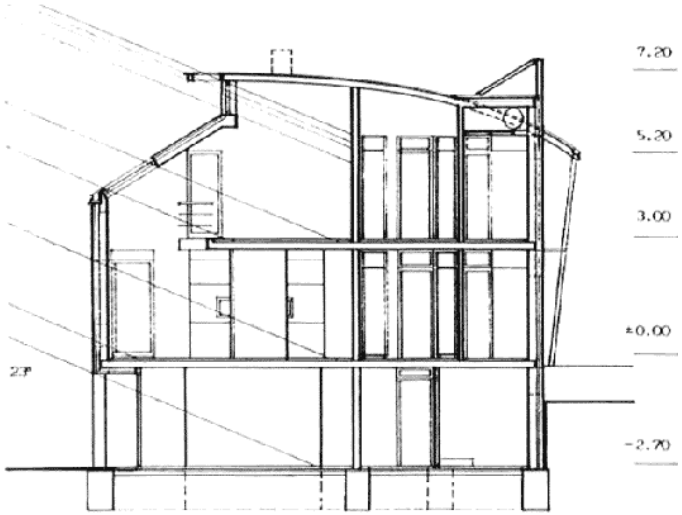
Zagreb, Croatia

Passive solar house P3 built in 1993

Zagreb, Croatia

Author: Ljubomir Miščević





P3, 1992

Zagreb, Croatia

BUILDING AND SOCIAL HOUSING FOUNDATION

Memorial Square, Coalville
Leicestershire LE67 3TU
UNITED KINGDOM

Director
Mr Peter Elderfield

World Habitat Awards '93
Final submission

Ljubomir Miscevic

PASSIVE SOLAR FAMILY HOUSES
Croatia

Energy Efficient Housing

November 1993

T2, 2004 (realised)

Bjelovar, Croatia

Tipska niskoenergetska kuća Y1 - korak do pasivne kuće

This project for a low-energy („3 litre“) type family house is designed for a typical four to five persons family. Construction is of porous concrete blocks. Ceilings are of half mounted patented structure „White ceiling“. It will be redesigned into passive house energy standard building. Energy consumption for space heating is 40 kWh/m^{2}a.

Low-energy house Y1, 2005. Redesign to passive house in 2008.
Author: Lj. Miščević (Protected design & Copiright)

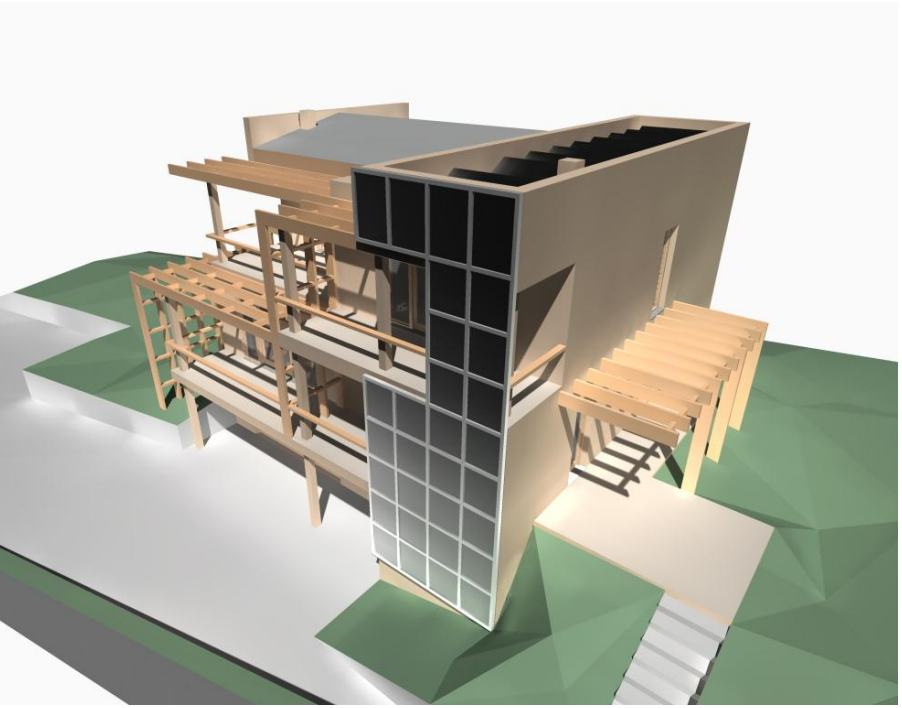
Y, 2005

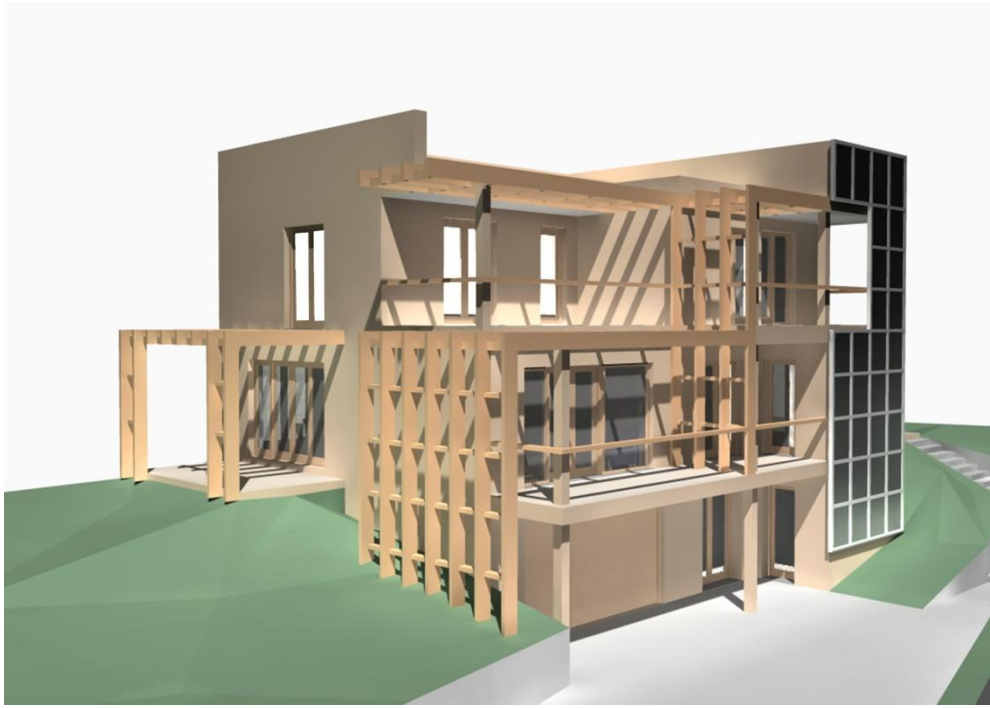
Sveta Nedelja, Croatia

Kuća M5, Poreč, project 2006-08

Author: Lj. Miščević

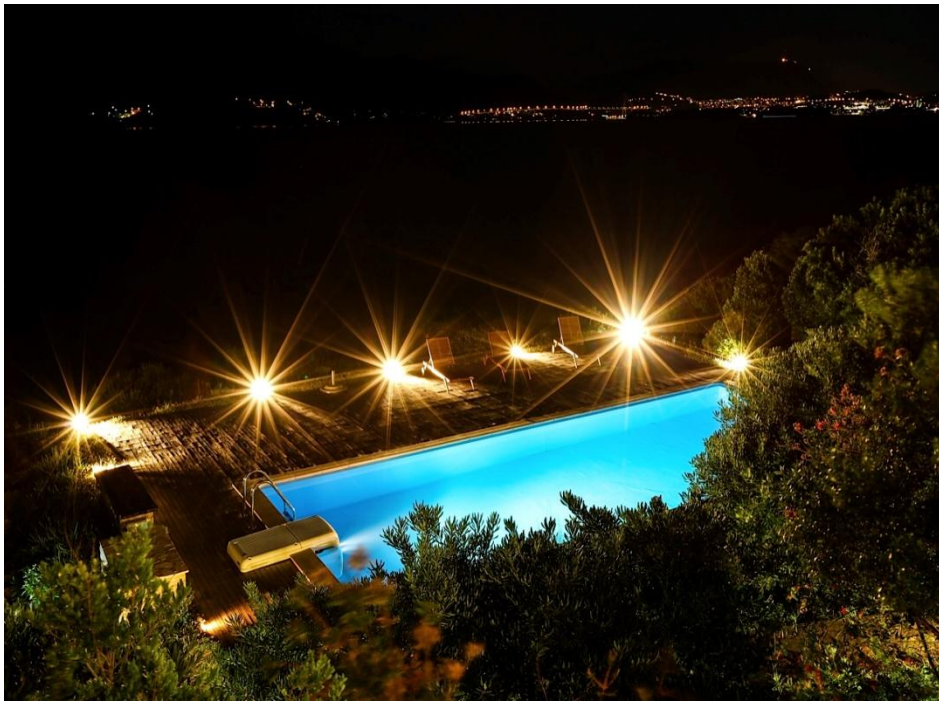
M5, 2006





Poreč, Croatia

J2, 2006

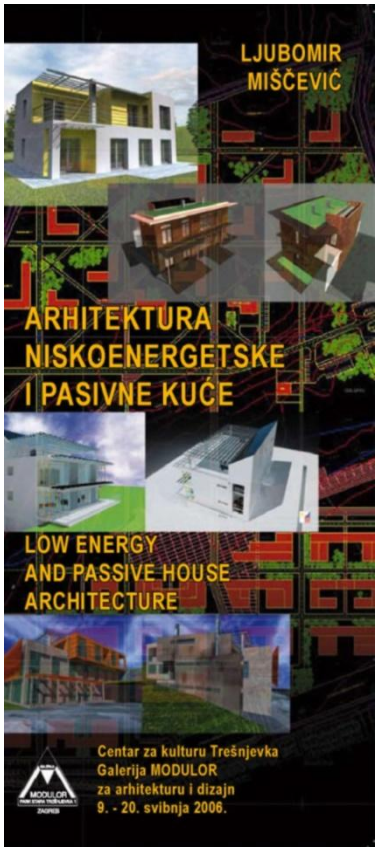


Koločep Island, Croatia

J3, 2007

Sveta Nedelja, Croatia

e x h i b i t i o n s

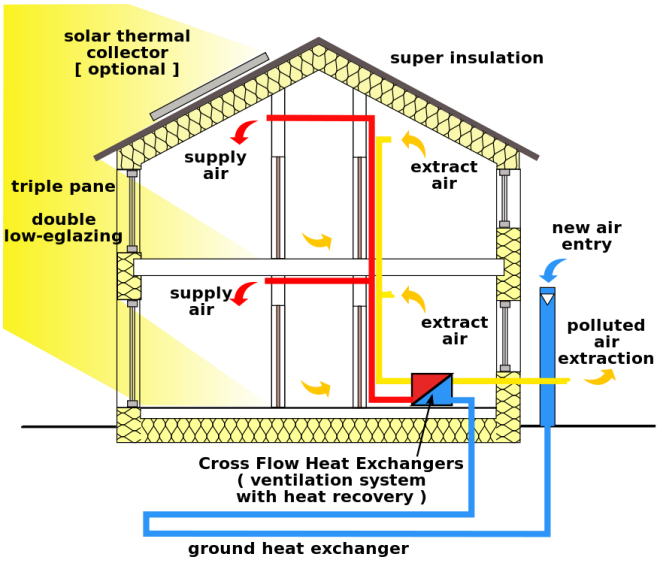


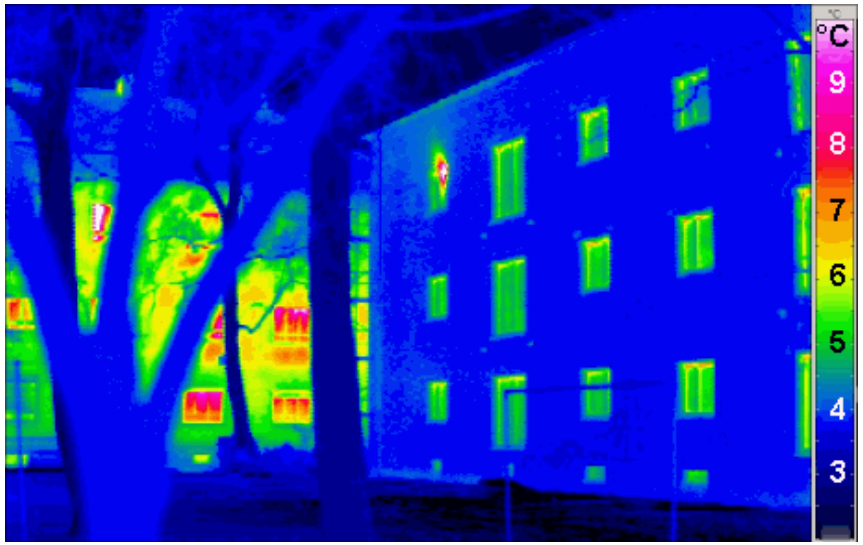
Low Energy and Passive House Architecture, 2006

low - energy houses
passive houses (A+)

Passive house (German: Passivhaus) is a standard for energy efficiency in a building, reducing its ecological footprint. It results in ultra-low energy buildings that require little energy for space heating or cooling.

Passive design is not an attachment or supplement to architectural design, but a design process that is integrated with architectural design. Although it is mostly applied to new buildings, it has also been used for refurbishments.



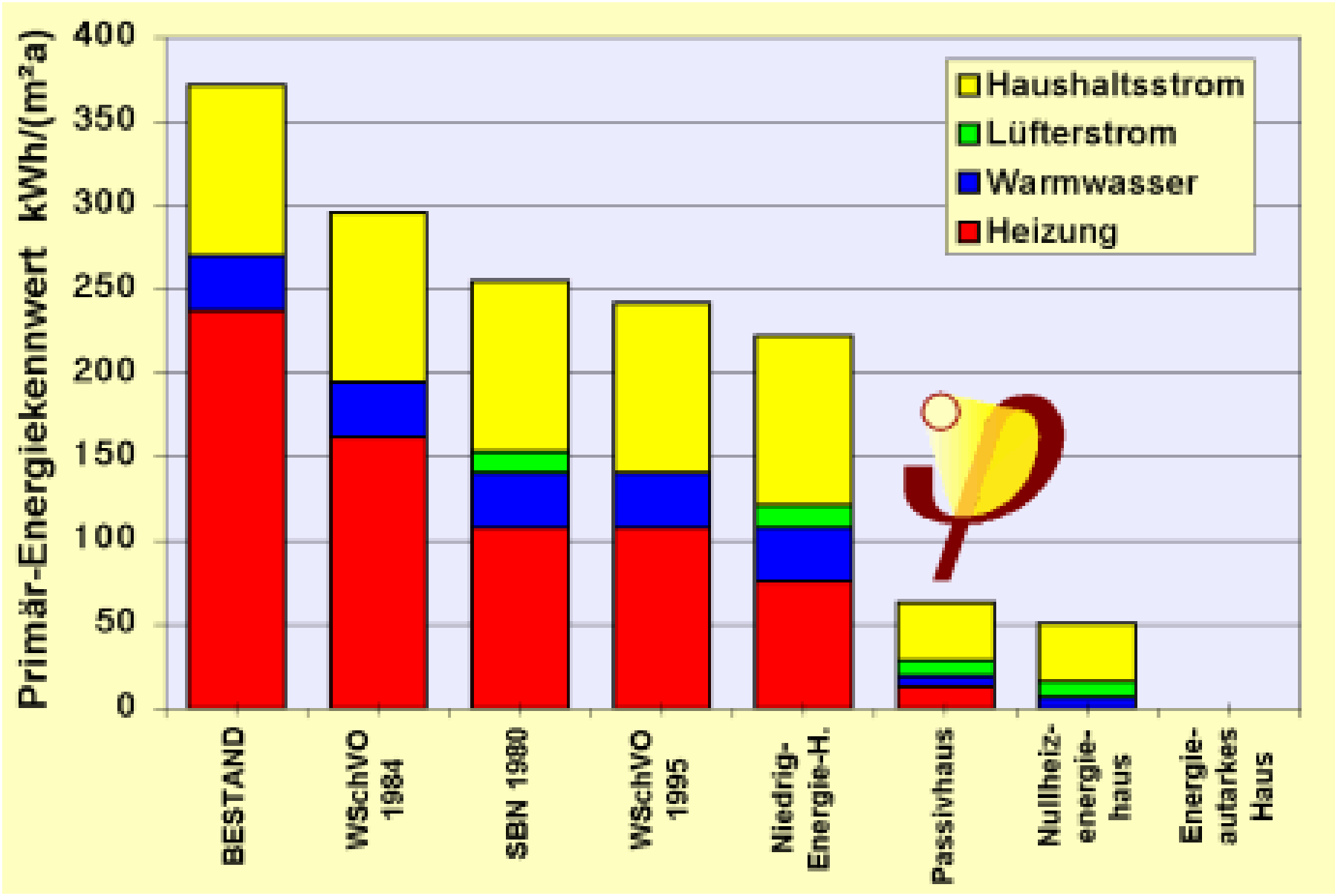


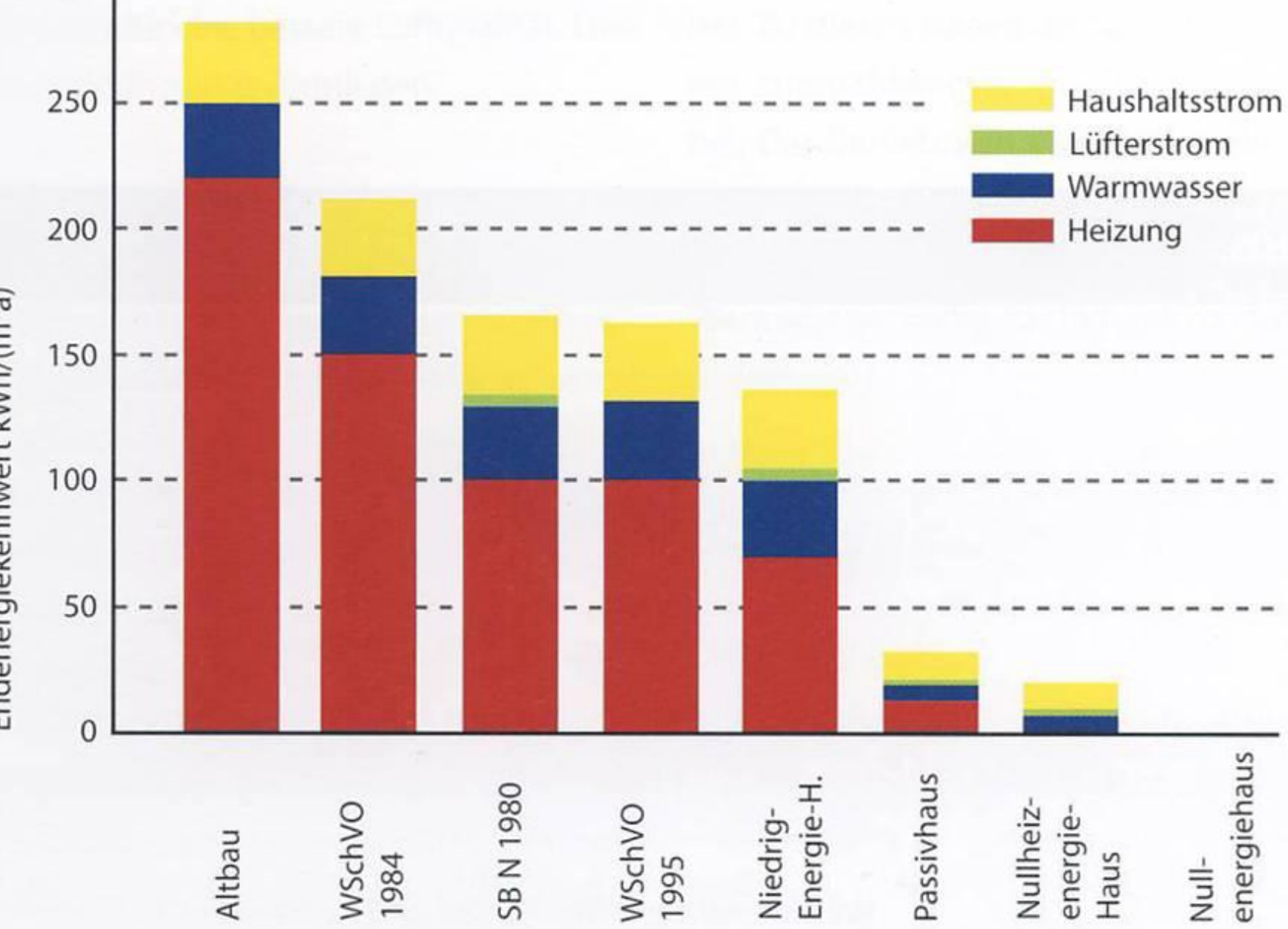
selected projects, 2000 - 2017

Passive House is not only energy efficient - it is affordable for the broad market, very comfortable and it leads to highconstruction quality and so to long lasting buildings. All these points are important for sustainability. And: It is already proven in practice - and thereby can be fully implemented.

The foundation for energy-efficient construction, rewarded *the passive house concept* with the first "Award for Sustainable Construction". The award was handed to the initiators of the standard Prof. em. Bo Adamson and Wolfgang Feist.

Lund, 2014-09-18

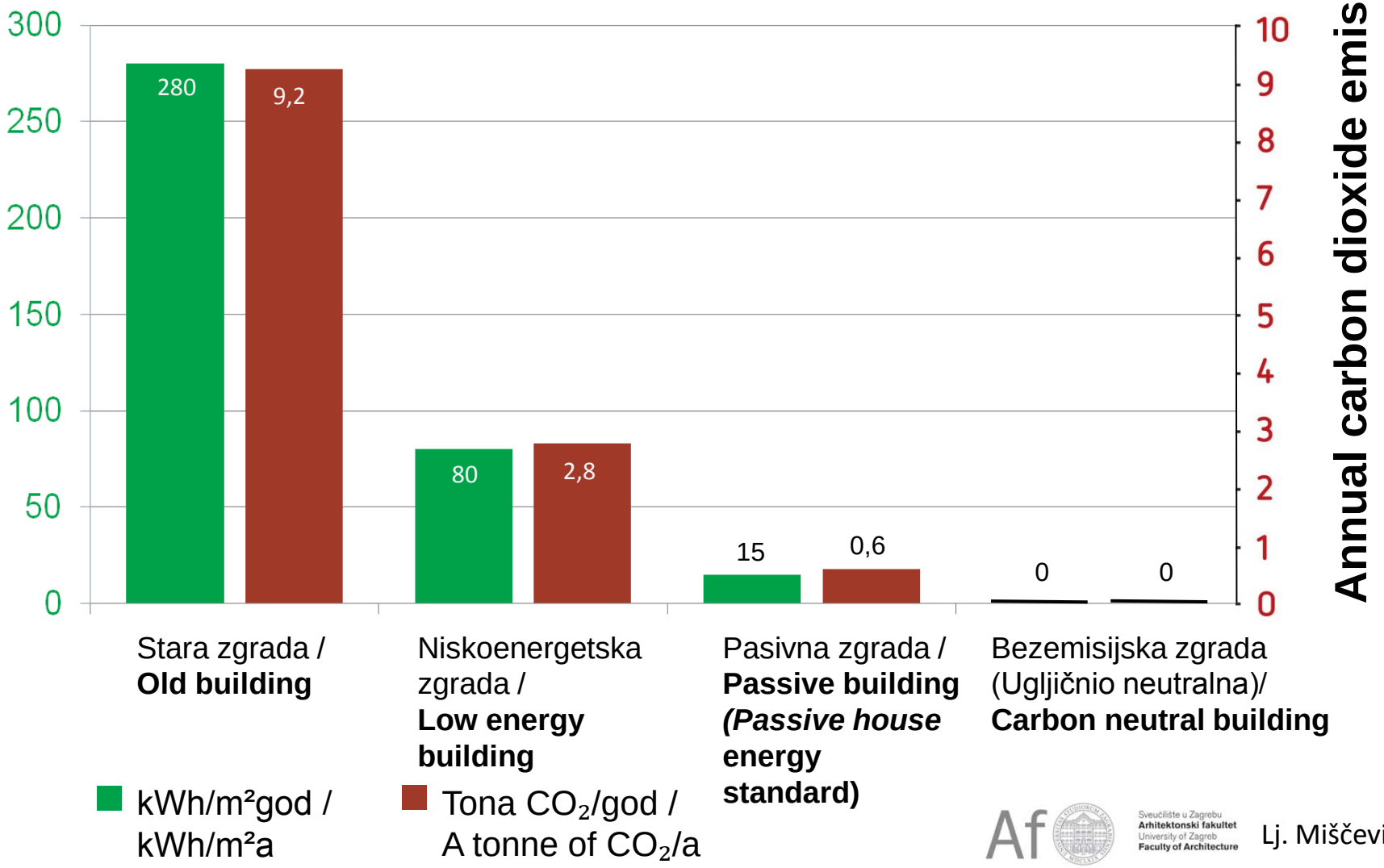

Primär-Energiekennwert kWh/(m²a)
400
350
300
250
200
150
100
50
0
Haushaltsstrom
Lüfterstrom
Warmwasser
Heizung
BESTAND
WSchVO 1984
SBN 1980
WSchVO 1995
Niedrig-Energie-H.
Passivhaus
Nullheiz-energie-haus
Energie-autarkes Haus



lung 1: Endenergiekennwert und Verteilung des Energieeinsatzes
terschiedlichen Wärmeschutzstandards und Baukonzepten

Quelle: Passivhaus Institut

Annual required thermal energy for heating



Sveučilište u Zagrebu Arhitektonski fakultet University of Zagreb Faculty of Architecture

Treća radionica – izrada i provedba Strategije niskougljičnog razvoja Republike Hrvatske za razdoblje do 2030. i s pogledom do 2050.

Hotel International Zagreb, 29.5.2015.

Radionica ZGRADARSTVO

Perspektive energetski gotovo nulte gradnje (Nearly Zero Energy Buildings – NZEB)

Red. prof. **Ljubomir Miščević**, dipl. ing. arh.

Sveučilište u Zagrebu, Arhitektonski fakultet
www.arhitekt.hr

Tel./fax: +385 1 4639394

miscevic@arhitekt.hr

Af

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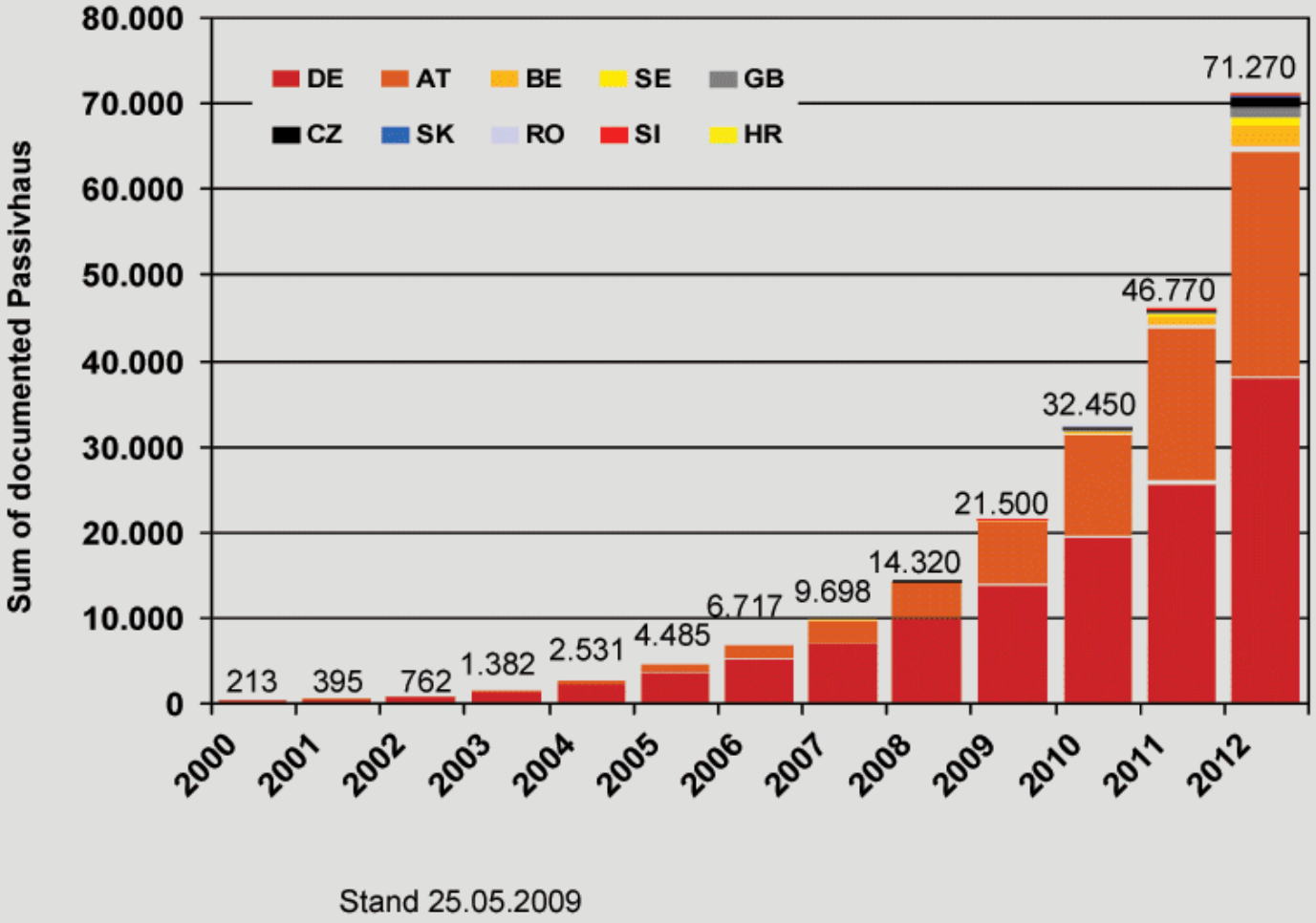
PassREg

Intelligent Energy Europe Programme of the European Union

KONZORCIJ PASIVNA KUĆA HRVATSKA

www.kpk.hr

Passivhaus trends in the 10 PASS-NET countries



Stand 25.05.2009

www.passivehousedatabase.eu Croatia / Hrvatska

Detail search
Quick search
Geographical search
Statistics

Options
Refine search parameters
Show marked only
Show all

Search result summary

Search parameters: Country: Croatia
Result details: **10** match(es)

Single-family detached house: **9**
Two-family house | single family house + seperate apartment: **0**
Semi-detached house: **0**
Terraced house: **0**
Multi-family-dwelling | apartment house: **0**
Residential- and commmercial building: **1**
Nursing home | retreat home: **0**
Residential school | hall of residence: **0**
Hotel | hostel | holiday dwelling: **0**
Urban settlement | housing colony: **0**
Model house | example house: **0**
Kindergarten | day care: **0**
School | campus | university: **0**
Sports centre | recreation centre: **0**
Public swimming pool: **0**
Public building | church: **0**
Office | administration building: **0**
Office | comercial building: **0**
Factory | industrial building: **0**
Archive: **0**
Fire station: **0**
Hospital: **0**
Workshop | atelier | garage | depot: **0**
Others (please note in field: "project description"): **0**

Search result list

Sort by: Country | Postcode | Town | Type | Construction period | Construction | Floor area || Rev. order

mark

HR-10257 Kupinečki Kraljevec (Zagrebačka županija) — **HR-0001**
ČV1 | Architect: Ljubomir Miščević, dipl. ing. arh
Single-family detached house | Timber construction | m²
Construction period: 2006 - 2009
Number of apartments: 1 | Number of units: 1

mark

HR-10437 Bestovje (Zagrebačka županija) — **HR-0002**
M4 | Architect: Ljubomir Miščević, dipl. ing. arh
Single-family detached house | Masonry construction | m²
Construction period: 2004 - 2005
Number of apartments: 1 | Number of units: 1

mark

HR-42000 Varaždin (Varaždinska županija) — **HR-0003**
Ilčić | Architect: Lidija Ilčić, dipl. ing. arh.
Single-family detached house | Masonry construction | m²
Construction period: 2005 - 2007
Number of apartments: 1 | Number of units: 1

mark

HR-51315 Begovo Razdolje (Primorsko-goranska županija) — **HR-0004**
L2 | Architect: Ljubomir Miščević, dipl. ing. arh
Single-family detached house | Timber construction | m²
Construction period: 2006 - 2009
Number of apartments: 1 | Number of units: 1

11 th INTERNATIONAL CONFERENCE ON PASSIVE HOUSES

Bregenz, 14 th April 2007

Passive houses in Croatia - projects and realizations

Ljubomir Miščević

University of Zagreb
Faculty of Architecture
Kačićeva 26, HR-10000 Zagreb +385 1 4639394, fax: +385 1 4828079
miscevic@arhitekt.hr www.arhitekt.hr www.sunarh.hr

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University of Zagreb
Faculty of Architecture

CROATIAN SOLAR HOUSE (CSH)
www.solar-house.hr

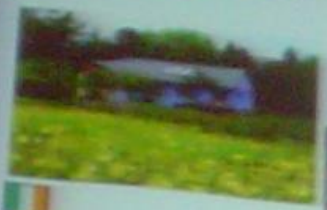
CENTRE FOR RENEVABLE
ENERGY SOURCES (CERES)

First Passive House in Croatia M4, 2005

Bestovje, Croatia

11. INTERNATIONALE PASSIVHAUSTAGUNG 2007

Fortschritte in Europa



www.sei.ie

Sverige / Ulla Janson

www.lavenergiboliger.no

www.altompassivhuse.dk
Henrik Tommerup WG 8

www.passiefhuisplatform.be
Roel De Caninck WG 16

Ljubomir Miscevic WG12

www.passive-on.org/it/
Franzelin WG 7 Schmitt WG 16

13 th INTERNATIONAL PASSIVE HOUSE CONFERENCE

Frankfurt, 17 th April 2009

Experience in architectural design, construction and utilization of passive houses and a start of PASS-NET IEE project in Croatia

Prof. **Ljubomir Miščević**, M.Arch

University of Zagreb

Faculty of Architecture

Kačićeva 26, HR-10000 Zagreb +385 1 4639394, fax: +385 1 4828079

miscevic@arhitekt.hr www.arhitekt.hr www.sunarh.hr

pass-net@arhitekt.hr

CROATIAN SOLAR HOUSE (CSH) www.solar-house.hr

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Intelligent Energy Europe

Croatia

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HRVATSKA CERES

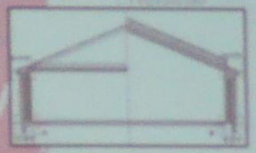
13. INTERNATIONALE PASSIVHAUSTAGUNG 2009

Europe

www.sei.ie

www.lavenergiboliger.no

Sverige / Ulla Janson WG VII
http://www.passivhuscentrum.se/



http://passivhus.dk/
Søren Pedersen WG VII

http:// www.passivhus.fi

www.passiefhuisplatform.be
Christophe Marrecau WG VIII

Ljubomir Miscevic WGVIII

lamaison
passive.fr
E. Vekemans
WG VIII

Michael Tribus AG XV
www.casepassive.it

14 th INTERNATIONAL PASSIVE HOUSE CONFERENCE
Dresden, 28-29 May 2010

Passive House in South-Central Europe

Prof. **Ljubomir Miščević**, M.Arch

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miscevic@arhitekt.hr pass-net@arhitekt.hr
www.arhitekt.hr www.sunarh.hr www.oegut.at
CROATIAN SOLAR HOUSE (CSH) www.solar-house.hr
CENTRE FOR RENEVABLE ENERGY SOURCES (CERES)

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with the support

Croatia

Intelligent Energy Europe

passnet

16 th INTERNATIONAL PASSIVE HOUSE CONFERENCE
Hannover, 4-5 May 2012

Working Group VII: Costs and cost efficiency

The first ten realizations of passive houses in Croatia

Prof. **Ljubomir Miščević**, M. Arch

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miscevic@arhitekt.hr pass-net@arhitekt.hr
www.arhitekt.hr www.sunarh.hr

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Faculty of Architecture

CENTER FOR RENEVABLE ENERGY SOURCES (CERES)

Supported by INTELLIGENT ENERGY EUROPE

perfection passnet

intense energy efficiency

IDES-EDU
MASTER AND POST GRADUATE EDUCATION AND TRAINING IN MULTIDISCIPLINARY TEAMS

18 th INTERNATIONAL PASSIVE HOUSE CONFERENCE
Aachen, 25-27 April 2014

The first twenty passive houses in Croatia

Prof. **Ljubomir Miščević**, Mag. Eng. Arch. Urb.

University of Zagreb, Faculty of Architecture
Kačićeva 26. HR-10000 Zagreb, Croatia

Sveučilište u Zagrebu
Arhitektonski fakultet
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miscevic@arhitekt.hr pass-net@arhitekt.hr ides-edu@arhitekt.hr
www.arhitekt.hr www.sunarh.hr www.pass-net.net www.ides-edu.eu

Supported by INTELLIGENT ENERGY EUROPE

EU PASS-NET (IEE) projekt

Lj. Miščević

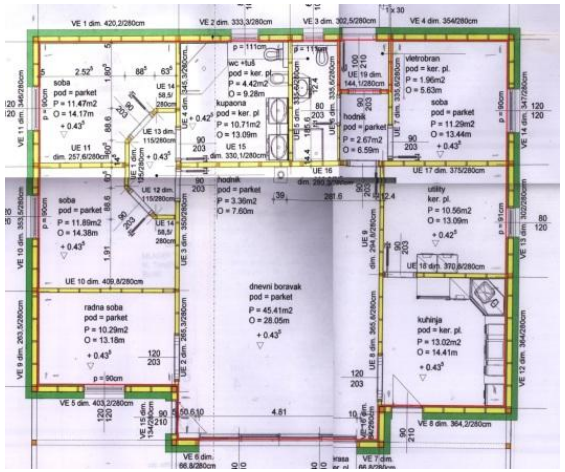
Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

KONZORCIJ PASIVNA KUĆA HRVATSKA

The first 10 passive houses till the end of 2011

The first 20 passive houses till the end of 2013

Passive family house Vilić in Buzet, Istria, Croatia



The author of energy concept, consultant and construction works supervisor Mladen Vilić, Mag.Eng.Elec. Is the owner of the house.
Author: V. Bralić, Mag.Eng.Arch.Urb. The plan shows airtight zone marked with red line. Photograph shows a Blower-Door testing of the house.
It is **in the process of certification in Passive House Institut in Darmstadt** (PHI), 2011-2012.
The price for m^2 netto surface is about **600,00 €**

Energy concept and certification consultant Lj. Miščević Mag.Eng.Arch.Urb.

Single-family passive house “L2” in Čazma, Croatia

Single-family detached house “L2” in Čazma (Bjelovarsko – Bilogorska County) is **developed from type “Y” house project for “three litres house”** (40,0 kWh/m^{2}a) energy consumption.
The price for m^2 netto surface is about **700,00 €**

This is the first example of increasing of type project for low-energy standard house to passive house energy efficiency level.

Author: prof. Ljubomir Miščević, Mag.Eng.Arch.Urb. Design 2009, realized in 2011

Single-family passive house “L2” in Čazma, Croatia

Single-family detached house “L2” in Čazma (Bjelovarsko – Bilogorska County) is **developed from type “Y” house project for “three litres house”.**

In the final phase when the house will be supplied with active thermal and photovoltaic system **it will achieve zero or passive plus energy standard**.
The price for m^2 netto surface is about **700,00 €**

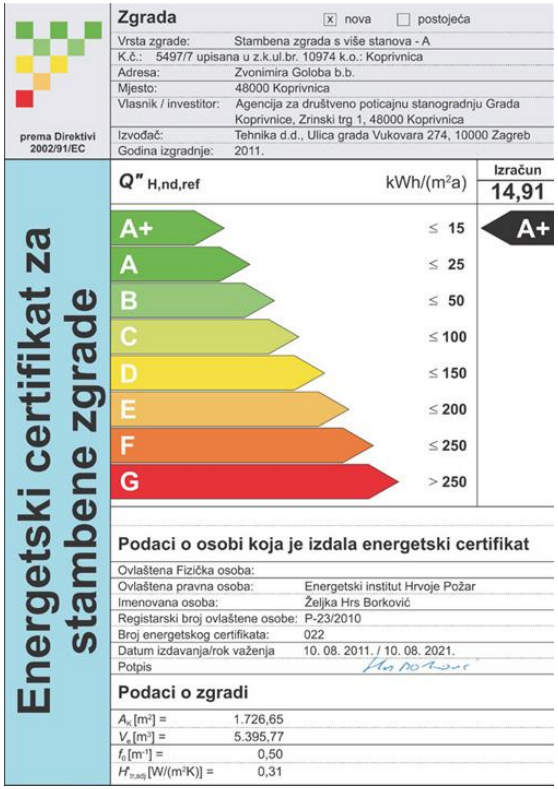
North-west view.

Author: prof. Ljubomir Miščević, Mag.Eng.Arch.Urb. Design 2009, realized in 2011

The first residential building from the social housing program (POS) in Koprivnica, Croatia, 2011

Energy certificate for A+ class. Author: Tehnika d. d.

Residential building in Koprivnica is the second realized passive house residential building in Croatia. **The first one financed in the frame of the Social housing programe** so called POS. The price for m^2 netto surface is **897,00 €**



prema Direktivi 2002/91/EC

Zgrada [x] nova [ ] postojeća

Vrsta zgrade:	Stambena zgrada s više stanova - A
K.č.:	5497/7 upisana u z.k.ul.br. 10974 k.o.: Koprivnica
Adresa:	Zvonimira Goloba b.b.
Mjesto:	48000 Koprivnica
Vlasnik / investitor:	Agencija za društveno poticajnu stanogradnju Grada Koprivnice, Zrinski trg 1, 48000 Koprivnica
Izvođač:	Tehnika d.d., Ulica grada Vukovara 274, 10000 Zagreb
Godina izgradnje:	2011.

Energetski certifikat za stambene zgrade

$Q''_{H,nd,ref}$ kWh/(m^2a) — Izračun 14,91

A+	≤ 15
A	≤ 25
B	≤ 50
C	≤ 100
D	≤ 150
E	≤ 200
F	≤ 250
G	> 250

A+

Podaci o osobi koja je izdala energetski certifikat

Ovlaštena Fizička osoba:	
Ovlaštena pravna osoba:	Energetski institut Hrvoje Požar
Imenovana osoba:	Željka Hrs Borković
Registarski broj ovlaštene osobe:	P-23/2010
Broj energetskog certifikata:	022
Datum izdavanja/rok važenja	10. 08. 2011. / 10. 08. 2021.
Potpis	

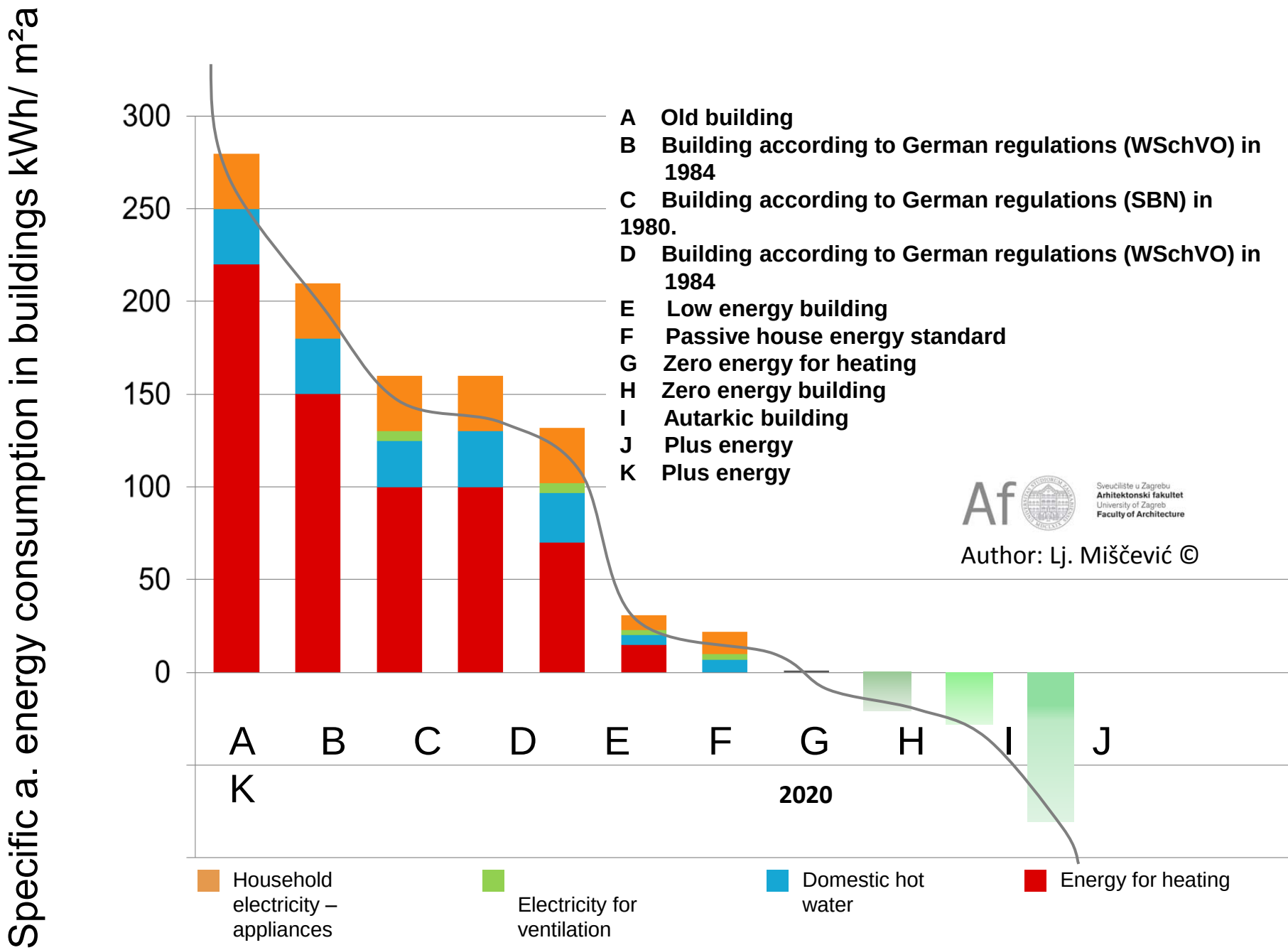
Podaci o zgradi

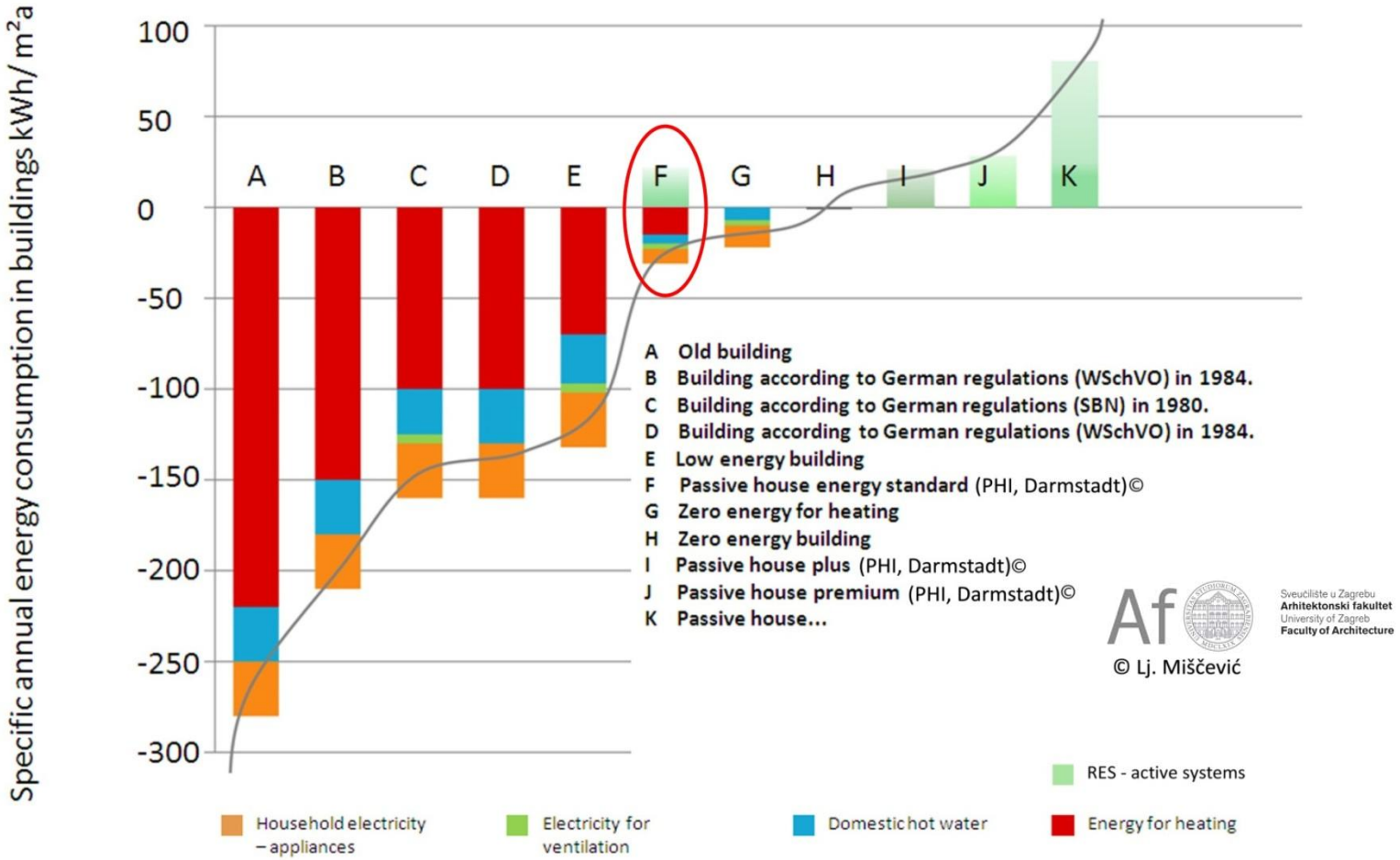
A_k [m^2] =	1.726,65
V_e [m^3] =	5.395,77
f_0 [m^{-1}] =	0,50
$H'_{T,adj}$ [W/(m^2K)] =	0,31

The first office - residential passive house in Croatia

Žminj, Istria. Completed in 2014

The first office-residential passive house, Rudan d.o.o. Author: Darijan Čekada, M. Arch-, AGM PROJEKT d.o.o., consultatnt prof Ljubomir Miščević, M. Arch.


Specific a. energy consumption in buildings kWh/ m²a
300
250
200
150
100
50
0
A
B
C
D
E
F
G
H
I
J
K
2020
A Old building
B Building according to German regulations (WSchVO) in 1984
C Building according to German regulations (SBN) in 1980.
D Building according to German regulations (WSchVO) in 1984
E Low energy building
F Passive house energy standard
G Zero energy for heating
H Zero energy building
I Autarkic building
J Plus energy
K Plus energy
Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture
Author: Lj. Miščević ©
Household electricity – appliances
Electricity for ventilation
Domestic hot water
Energy for heating



The new perception diagram with addition of plus energy buildings

Author: Lj. Miščević, 2013

Columnne „F“ on diagram shows passive house data with addition of RES where is a huge amount of solar radiation as in south region of Croatia (according to REHVA it is in zones 1 & 2 for nZEB) that easily secure the jump over zero level and becomes „+ energy“ or „Passive house plus“ or „Passive house Premium“ as it is defined by Passive House Institute in Darmstadt.

Old or new? | *Alt oder neu?*

Passive House Institute

PHI introduces a new rating system for passive houses. It will be still possible to certify Passive Houses according to the old system.
It is your choice!

Das PHI führt ein neues Bewertungssystem für Passivhäuser ein.
Zertifiziert werden kann weiterhin nach dem alten System.
Sie haben die Wahl!

Old system | *Altes System*

Heating, cooling demand: 15 kWh/(m²a),
Heating, cooling load: 10 W/m²,
Air tightness: 0,60 1/h

Overall energy demand:
Primary energy, not renewable (PE)
120 kwh/(m²a)

New system | *Neues System*

Overall energy demand:
Primary energy, renewable (PER)

Energy generation

It is your choice! | *Sie haben die Wahl!*

The new Passive House Classes

Passive House Institute

Premium

120

Renewable energy generation
[$kWh_{PER}/(m^2_{ground}*a)$]

Plus

60

Classic

Zertifiziertes Passivhaus Passivhaus Institut premium

30

Zertifiziertes Passivhaus Passivhaus Institut plus

45

Zertifiziertes Passivhaus Passivhaus Institut classic

total PER-demand
[$kWh_{PER}/(m^2_{TFA}*a)$]

60

Die neuen Passivhausklassen

EPHPROMO

KUĆA KOJA GRIJE ZA SVEGA 200 KN MJESEČNO

Profil Ytong kuće
Lokacija: Čazma
Projekt kuće: individualni
Vanjski zidovi: Ytong termoblokovi
Unutarnji zidovi: Ytong blokovi
Krov: Ytong krov
Info: Iskop temelja 9. srpnja 2011. godine, useljena 7. siječnja 2012.

„Postoji li osoba koja ne bi željela za dvoetažnu kuću od 150 m² neto kvadrature izdvajati svega 200 kuna mjesečno za režije?“

Možda u prvi tren zvuči nevjerojatno, ali za obitelj Lipovec iz Čazme to uskoro postaje realnost i jedna od blagodati življenja u njihovom novom domu. Pitanje kako je to moguće postavljaju i brojni poznanici mlade obitelji, na što Slađan Lipovec odgovara kako je riječ o pametnom izboru gradnje niskoenergetske kuće, a da cijela tajna leži u investiranju u kvalitetne zidove, izolaciju i stolariju, investiciji koja se po njegovu mišljenju polagano isplaćuje.

Cijela ideja o gradnji, koja u sredini u kojoj živi obitelj Lipovec uistinu spada u kategoriju alternativnog načina razmišljanja, započela je sasvim spontano. Ideju je inicirala Slađanova supruga Helena te je povezana s njenom ljubavlju prema zelenoj boji.

- Nehotice sam lansirala cijelu ideju, izjavivši kako želim kuću sa zelenim krovom, misleći pod time na zeleni krov od šindre. Suprug je tada počeo istraživati i jedna od prvih internetskih pretraga kuća sa zelenim krovom bila je niskoenergetska kuća, koju je projektirao profesor Mišćević za Ytong. Budući da nam je izgled i sama arhitektura bila jedna od najvažnijih stavki prilikom gradnje, kuća nam se svidjela već na prvi pogled te je tako započela naša četverogodišnja priprema i upoznavanje s potpuno novim idejama gradnje - izjavila je Helena, a Slađan je dodao kako su uslijedile mnogobrojne konzultacije i sastanci s profesorom Mišćevićem te iscrpno proučavanje svih odlika niskoenergetske i pasivne izgradnje.

Posebno je zanimljiva činjenica da iako u početku laici, Slađan kao književnik i lektor po struci te Helena koja je završila hungarologiju i povijest, ovi mladi intelektualci mogu se trenutno svojim tehničkim znanjem o niskoenergetici i pasivi ravnopravno mjeriti sa stručnjacima u tom polju.

U tri dana bez grijanja temperatura u kući je pala samo dva stupnja, sa 22 na 20 stupnja Celzijeva dok je vani bilo 17 stupnjeva ispod ništice - ispričao je Slađan.

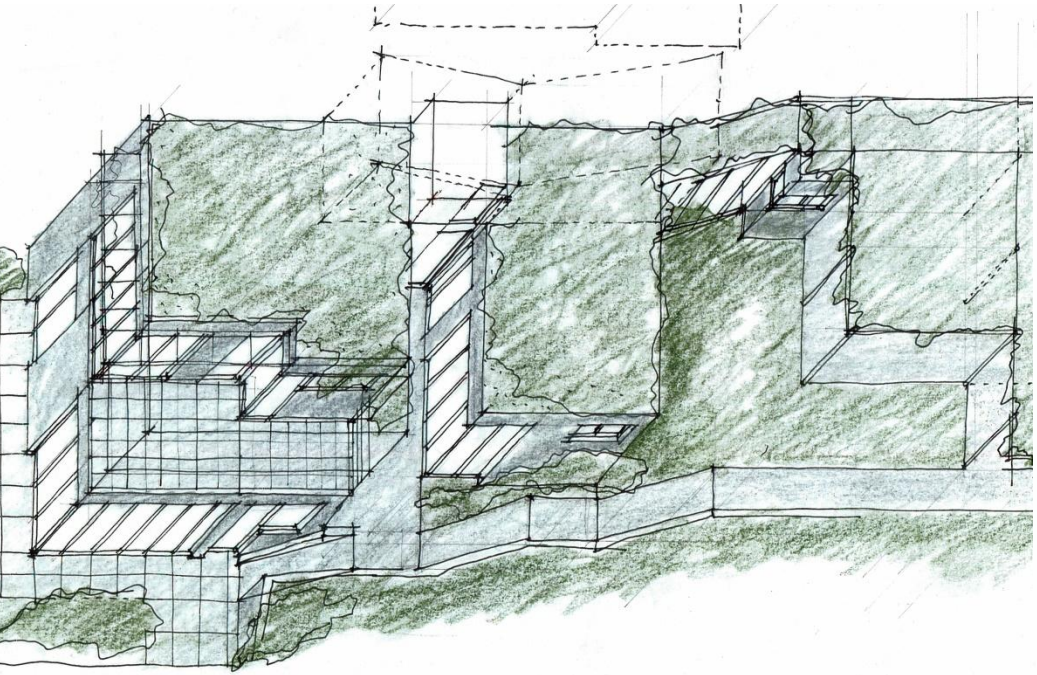
Odabir niskoenergetske kuće tako se u potpunosti poklopio sa životnom filozofijom i vrijednostima obitelji Lipovec. Naime, osim što kao ekološki osviješteni intelektualci pridonose manjem zagađivanju i zdravijem životu, izgradnja Ytong konstrukcije njihove niskoenergetske kuće omogućila im je i brzo preseljenje iz stanova za koje ih vežu loše uspomene i iskustva.

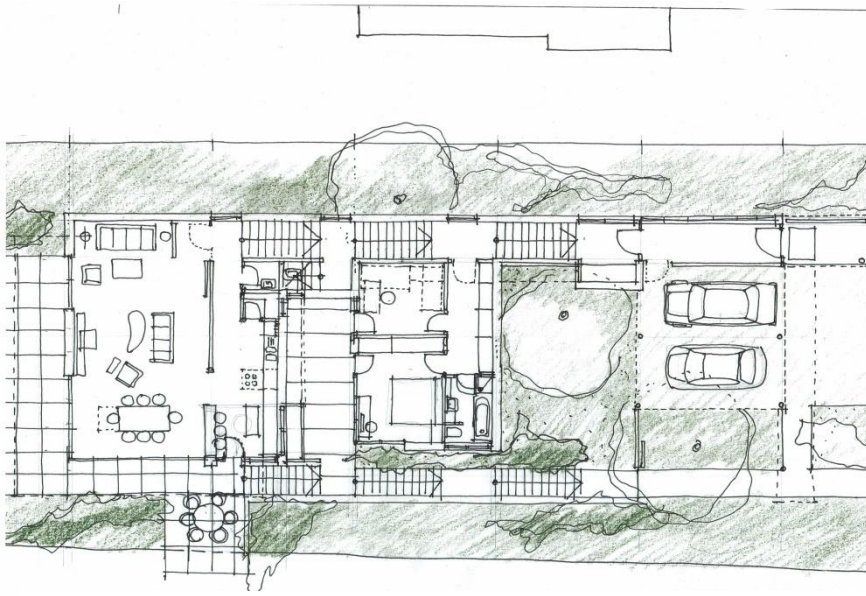
Ona grije i kada „ne grije“

Obitelj Lipovec itekako je zadovoljna, a koliko im znači ugodna mikroklima u njihovom domu, pogotovo za njihovo dvoje male djece, dvogodišnju Mirnu i tromjesečnog Vanju, od neprocjenjive je važnosti.

- Sada možemo ostaviti svoje tromjesečno dijete na podu, kraj prozora, bilo gdje u domu, a da se pritom ne moramo bojati prehlade ili pothlađivanja. Nema nikakvog strujanja zraka ni temperaturnih razlika, kroz cijelu godinu održavamo istu temperaturu u domu bez obzira na godišnje doba i vanjske temperature - objasnio je Slađan te dodao kako će naknadnom ugradnjom rekuperatorske jedinice dodatno pridonijeti ravnomjernoj cirkulaciji zraka, što će posebice biti bitno kako se ne bi osjetio dim od cigareta u kući, s obzirom na to da su oba supružnika pušači. Najveći test kroz koji je obitelj Lipovac prošla, a koji im je dokazao da je njihov dom siguran i jedinstven, dogodio se tijekom najžešće prošlogodišnje zime.

K1, 2000





Zagreb, Croatia

B1, 2000

Zagreb, Croatia

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ARHITEKTONSKI FAKULTET SVEUČILIŠTA U ZAGREBU
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HRVATSKA SOLARNA KUĆA

STUDIJA IZVODLJIVOSTI

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FEASIBILITY STUDY

STUDIJA IZVODLJIVOSTI PROJEKTA

HRVATSKA SOLARNA KUĆA

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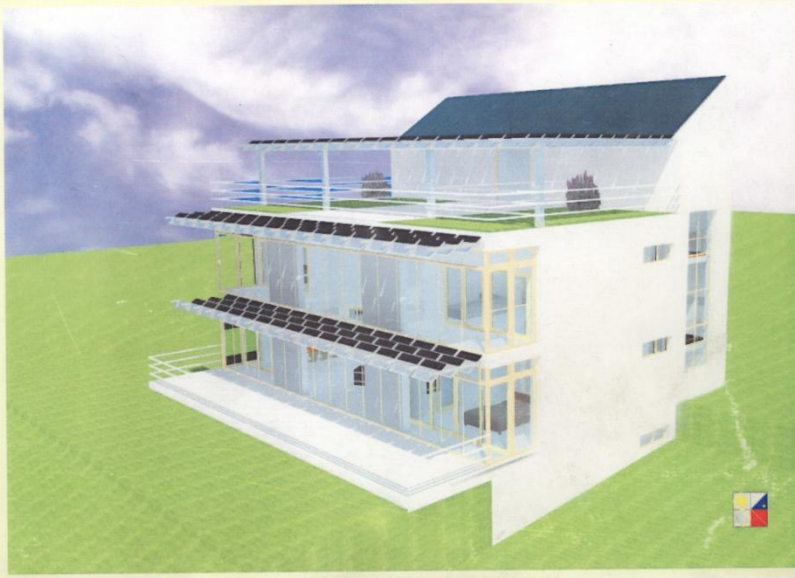
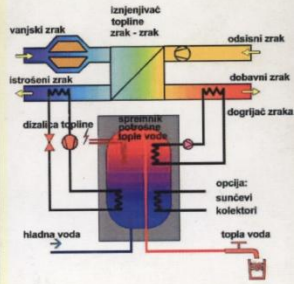
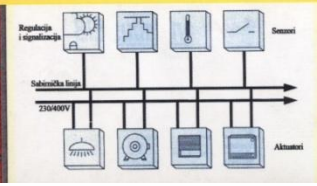


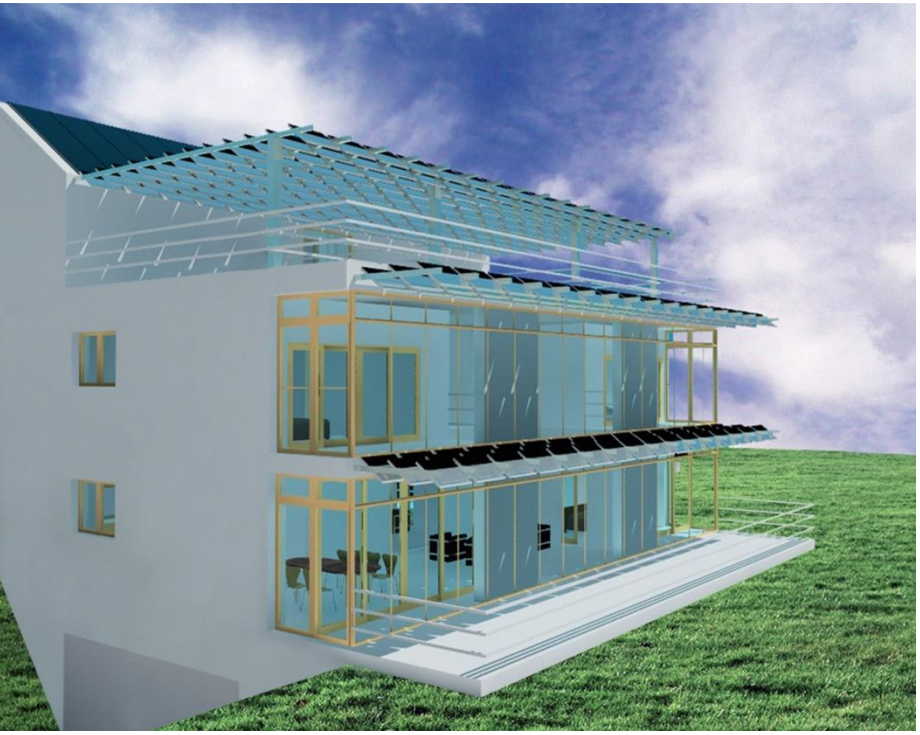


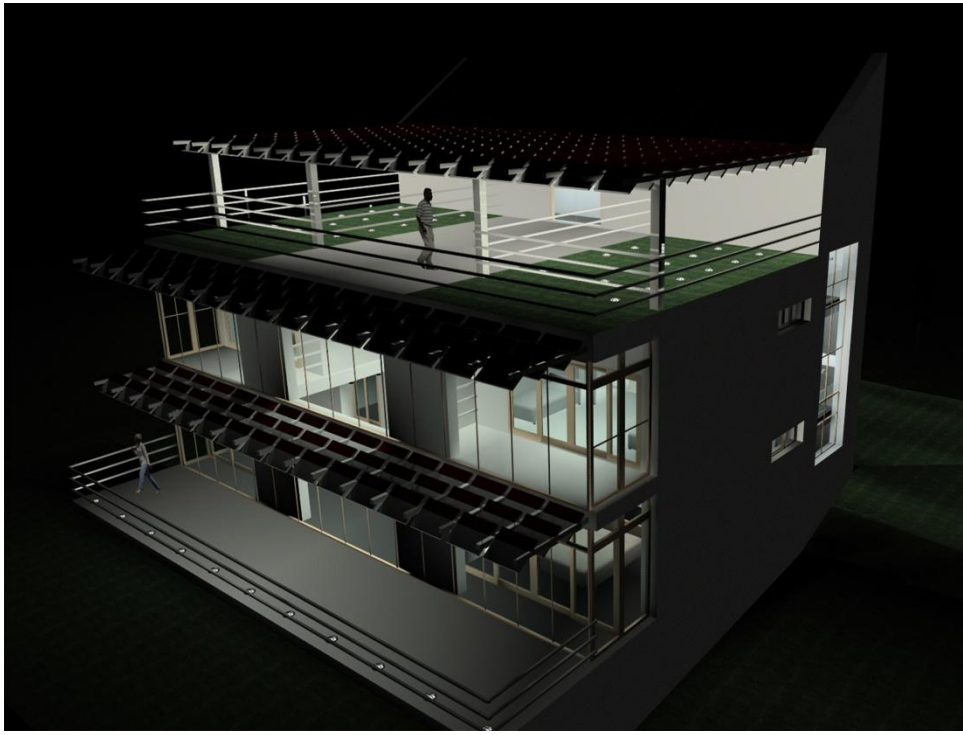
www.solar-house.hr

INSTITUT RUĐER BOŠKOVIĆ
ZAGREB, RUJAN/SEPTEMBER 2002.

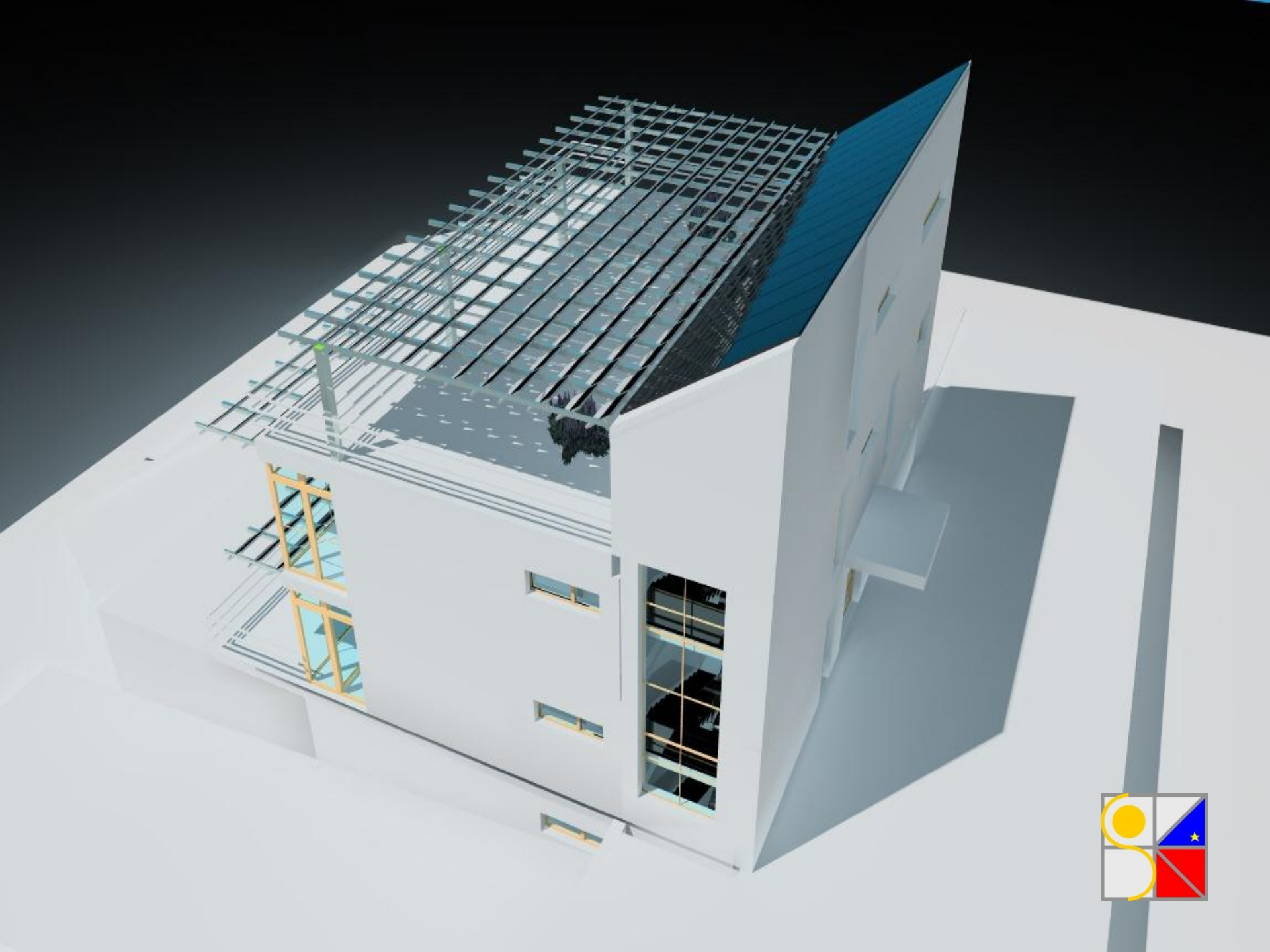


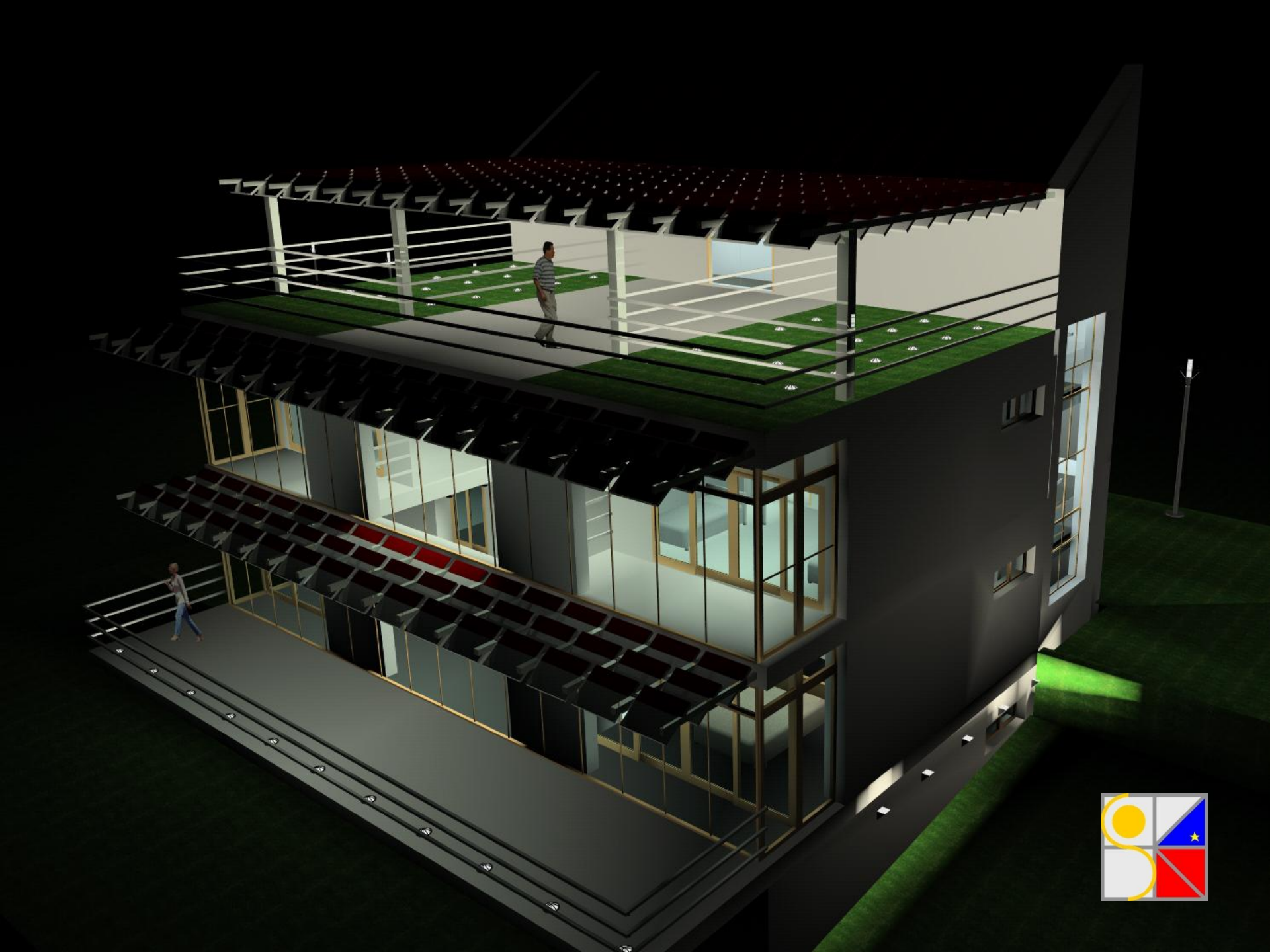
HSK, 2002





Zaprešić, Croatia





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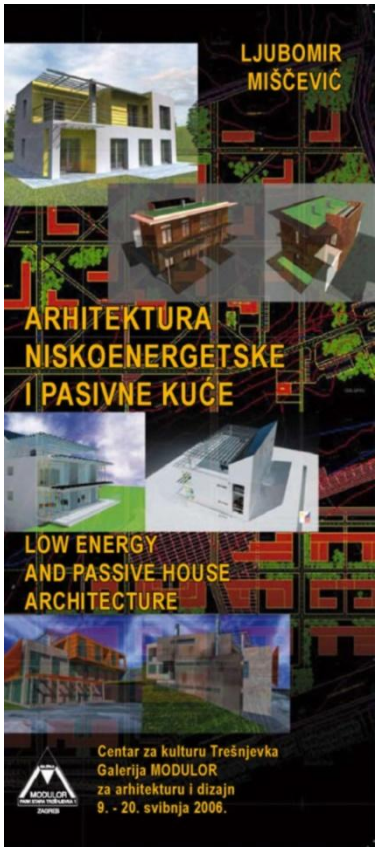
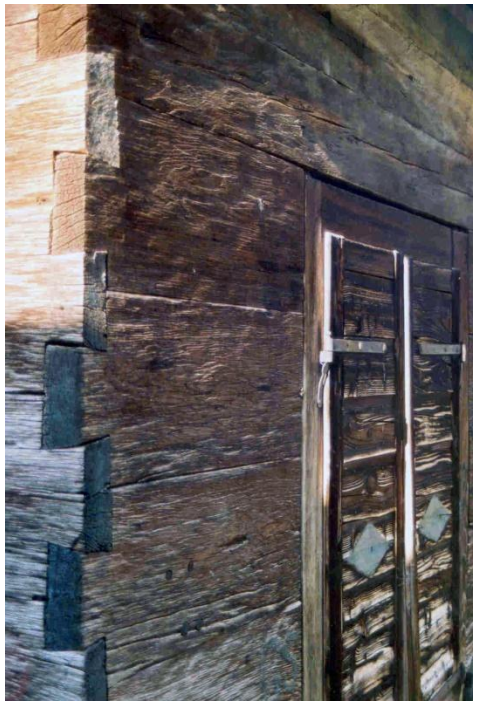
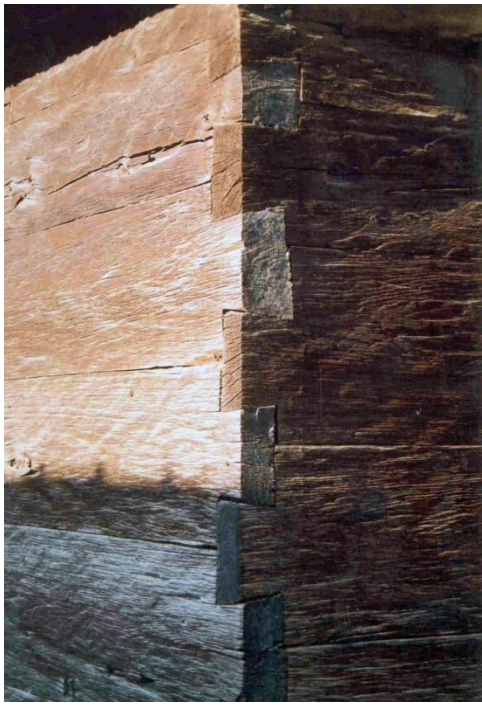


Architecture as a Power Plant, 2009

ČV1, 2003





Kupinečki Kraljevec, Croatia

The first wooden family passive house CV 1 in Croatia

Kupinečki Kraljevec, Zagreb

Wooden family passive house CV1. Project, 2003. Under construction.
Existing state, September 2007
Author: Lj. Miščević

ČV1, 2003

Kupinečki Kraljevec, Croatia

Prva drvena pasivna kuća u Hrvatskoj

Kuća ČV 1, Kupinečki Kraljevec

Constructing of earth collector spring 2008
Izvedba zemnog kolektora

The first wooden family passive house CV 1

Kupinečki Kraljevec, Zagreb. The south-west elevation.

1st Passive house days in Croatia, 8th November 2008.

ČV1, 2003

Kupinečki Kraljevec, Croatia

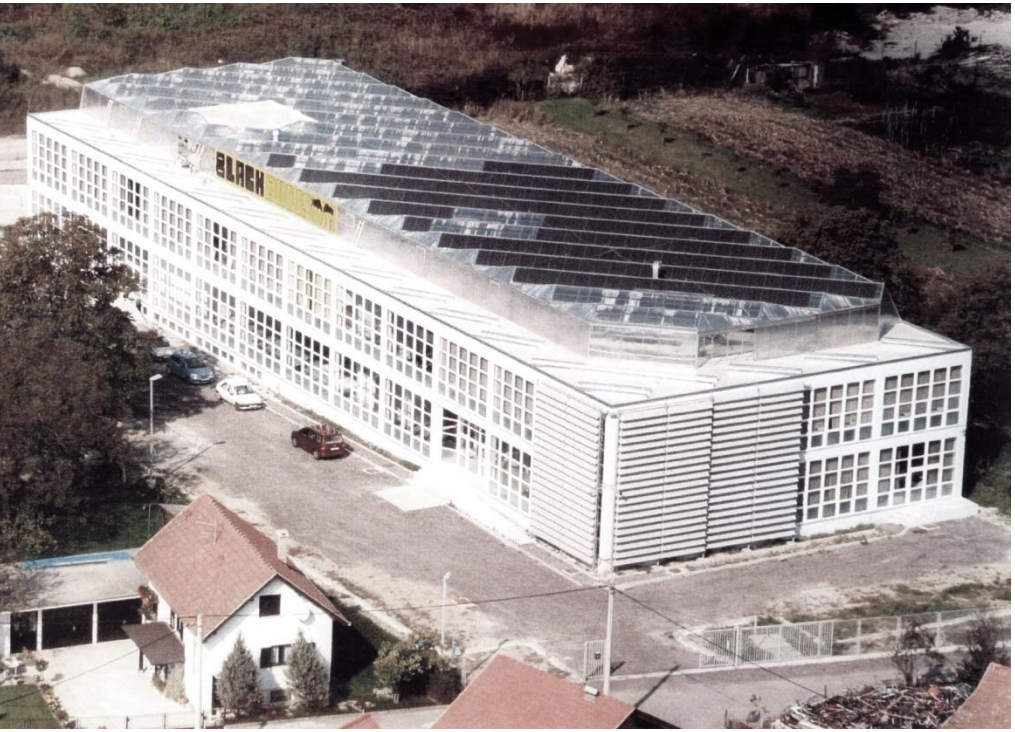
Tvornica konfekcije, Kuća STILIN, d.o.o., Žitnjak, Zagreb

Najveći fotonaponski sustav u Hrvatskoj. Snaga 36,1 kW.
300 m^2 instaliranih fotonaponskih ćelija (avionski snimak).

Autor idejnog rješ.
i glavni projektant:
Lj. Miščević

Projekt: 2000.
Ostvarenje: 2005.

Stilin Office Building, 2005



Zagreb, Croatia

Tvornica konfekcije, Kuća STILIN, d.o.o., Žitnjak, Zagreb



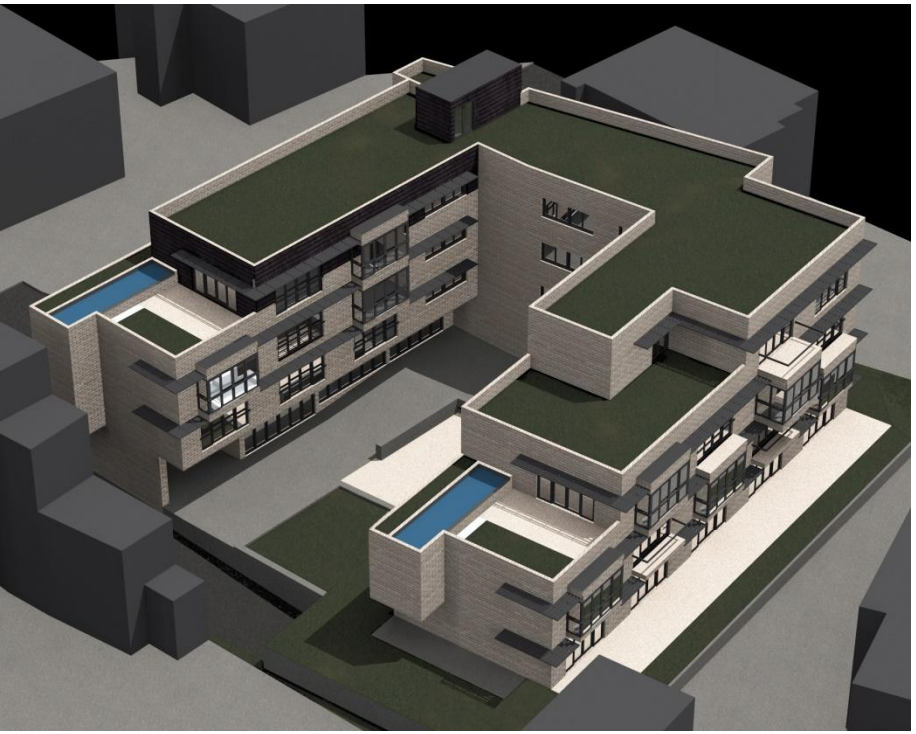



Autor idejnog rješenja i glavni projektant: Lj. Miščević
Projekt: 2000., ostvarenje: 2005.

HOTEL STELLA, 2007

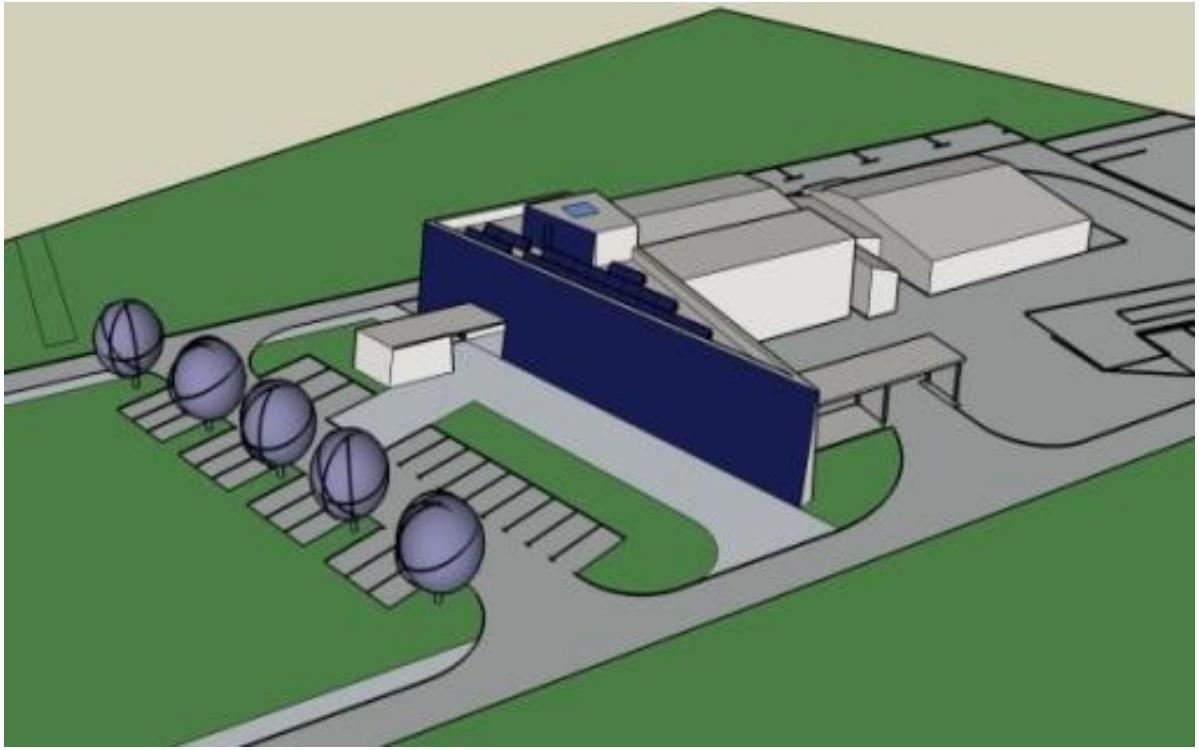
Zagreb, Croatia

Apartment House, 2008



Bjelovar, Croatia

The new projects and realizations



Passive office building A+, ČAKOM, Čakovec, project 2012
Author: Lj. Miščević

PassREg

PassREg

Izgradimo energetsku revoluciju

Regije pasivnih kuća i obnovljivih izvora energije

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End Use Efficiency Research Group, Politecnico di Milano | Italy | www.eerg.it

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Cover photo: Nieuw Zuid development in Antwerpen | Belgium © Studio Associato Secchi-Viganò

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Building for the energy revolution

Passive House Regions with Renewable Energies

An informational pamphlet

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Cover photo: Nieuw Zuid development in Antwerpen | Belgium © Studio Associato Secchi-Viganò

Opportunities and benefits

Getting involved

PassREg offers opportunities to visit demonstration buildings and discuss regional experiences with those involved via international study tours and workshops. Key project findings are being made available online and made public through events such as the International Passive House Conference, the International Passive House Days and a wide variety of regional events. The PassREg project also raises awareness of market opportunities for products that will be key in the delivery of ultra-low energy buildings.

Training

To help upskill designers and construction companies, courses will be tailored by the project partners for local conditions in order to offer training to the architects and engineers who must design the buildings and to the tradespeople or construction site personnel responsible for their implementation, allowing Passive House designs to be achieved in practice throughout Europe.

The International Passive House Conference is the largest, most significant event of its kind and serves as the key platform for the presentation of PassREg findings and the exchange of related ideas and experiences. The Conference reaches out to the entire range of construction experts as well as all those wishing to build in a sustainable and cost-effective way. A variety of side events such as a Passive House basics course, a manufacturers workshop, a component exhibition and Passive House tours round out the framework programme.

PassREg

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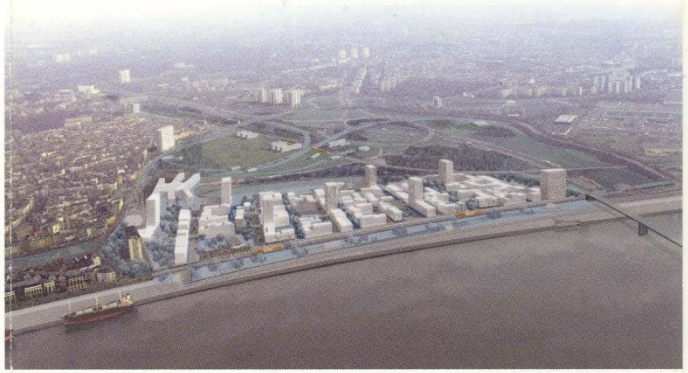
Building for the energy revolution

Passive House Regions with Renewable Energies



An informational pamphlet

Passive House regions

Meeting our energy needs sustainably into the future requires nothing short of an energy revolution. In terms of our built environment, perhaps the greatest opportunity lies in the promotion of an "energy efficiency first" approach to building, supplemented by renewable energies. Several front runner regions across the EU already successfully support this approach on the basis of the Passive House Standard. Many more aspire to get on board.

By investigating what makes front runner regions so successful as well as by making their successes more accessible, the PassREg project helps aspiring regions become front runners themselves. In the examination of both regional mechanisms and individual construction case studies, a wealth of knowledge will be gleaned to support actors in optimising existing models promoting energy conscious construction and inspiring new ones.

Participating regions

Austria	The Region of Tyrol
Belgium	The Brussels Capital Region The City of Antwerp
Bulgaria	The City of Burgas along with the Cities of Gabrovo, Sofia and Varna
Croatia	The City of Zagreb
France	The Region of Aquitaine
Germany	The Cities of Frankfurt am Main, Hanover and Heidelberg
Italy	The City of Cesena and the City of Aglientu, The Regions of Catania, Foggia, Marche, and Pesaro and Urbino The Government of Sicily
Latvia	The Regions of Rezekne and Vidzeme with the City of Ergli
Netherlands	The Regions of Arnhem-Nijmegen and Gelderland The Cities of Arnhem and Nijmegen
United Kingdom	The Region of Wales

Toward EU energy goals

The EU has set ambitious goals for energy performance in buildings. To meet these goals by the 2020 deadline, many are looking to the Passive House Standard for energy performance in buildings.

Passive House is the basis

An internationally recognised building energy standard, Passive House combines maximal comfort with minimal energy use and life cycle costs. Through a focus on careful planning paired with quality building components, Passive House buildings use an average of 90% less energy than typical building stock – in terms of heating, they require less than 1.5 cubic metres of gas or 1.5 litres of oil per square meter annually. Vast energy savings have also been demonstrated in warm climates where conventional buildings typically require active cooling.

Making renewables feasible

The high levels of energy efficiency reached by Passive House buildings mean that the tiny energy demand that remains can be covered, economically, by a wide variety of renewable energy sources. Such efficient buildings can also do more with the renewables placed on small surface areas – a critical aspect in urban areas where buildings often have restricted roof and facade areas.

Many Passive House buildings make use of renewable energies, e.g. through photovoltaic systems, to cover their remaining energy demand.

Quality assurance

Buildings, whether new build or retrofit, must perform as expected if we are to ensure sustainable energy supply into the future and improve our standard of living in so doing. Proper performance, in turn, can only be ensured if quality in design, construction and the materials chosen is taken seriously.

PassREg builds upon existing Passive House design tools as well as quality assurance procedures and certification criteria for both buildings and components. Through PassREg, these criteria are being optimised for application throughout the EU, guided in part by the monitoring results of select case studies. In addition, PassREg strengthens the appropriate quality assurance infrastructure in partner countries while driving increased availability of qualified materials and products on regional markets.

The energy balance and Passive House design tool known as the PHPP or Passive House Planning Package is perhaps the most accurate energy balance program on the market. It stands as the first step in quality planning for low energy buildings.

The Passive House Institute certifies building components in order to provide quality assurance for high performance, Passive House suitable products and make such products visible on the market. This is an example of the seal awarded to transparent components meeting Passive House criteria.

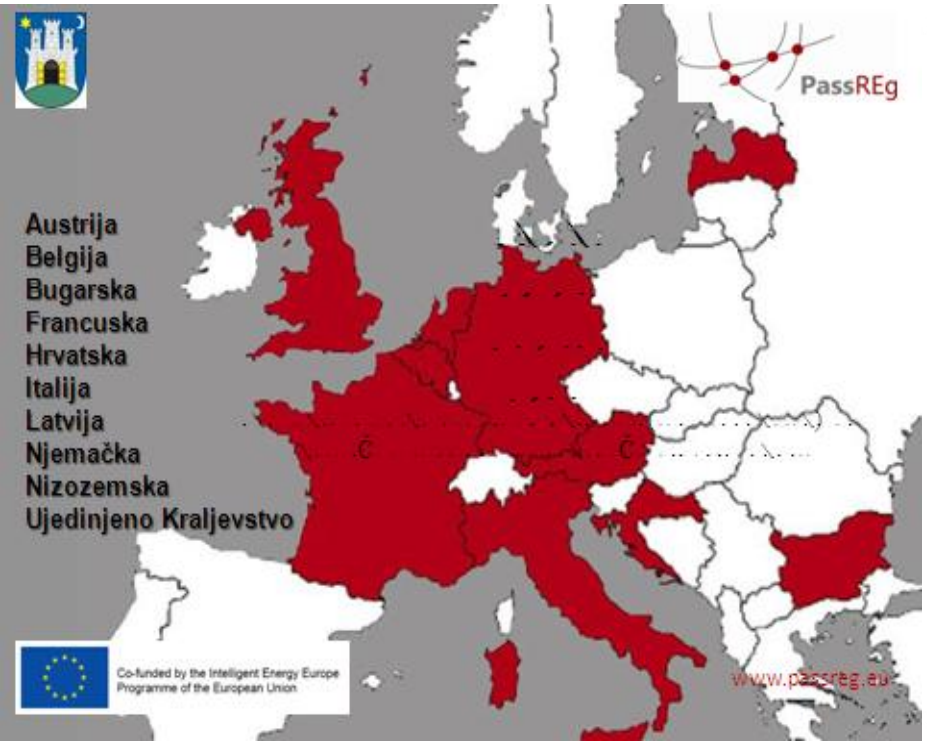
Buildings meeting Passive House energy efficiency criteria can be certified according to international Passive House criteria. For energy retrofits in which the Passive House requirements cannot be met, EnerPHit certification may be awarded. These certifications stand for quality in high performance construction.

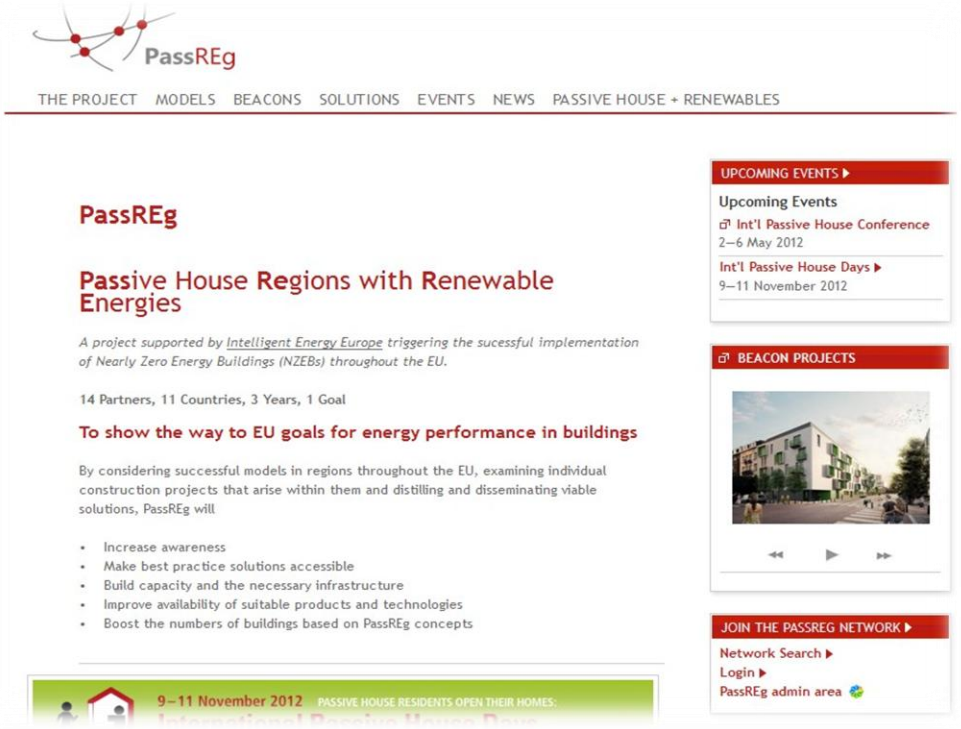
Training and qualification

Qualified architects, engineers and craftspeople are essential in the successful construction of high performance buildings. Such professionals form the basis of the successes seen in front runner regions having successfully implemented Passive House solutions supplemented with renewables on large scales. Indeed, one of the greatest challenges faced in this regard lies not in technical details but in the training of qualified professionals.

Through PassREg, aspiring regions are being supported in the development of long term training strategies based on the successes of front runners. Courses making use of and building on readily available material for designers and tradespeople are being translated and adapted as needed to fit regional requirements. These offerings, supplemented by a range of informational sessions and forums, will serve as the basis for the general uptake of Passive House training by educational systems as well as by the building sector throughout the EU.

Architects and craftspeople in a Brussels Passive House course are working with a 3D model to get familiar with typical features of Passive House buildings such as suitable connections between a solid wall, concrete floor slab and foundation wall. These participants are learning how to apply PU panels to the exterior wall and how to achieve a continuous, uninterrupted insulation layer between the floor (inside) and the wall (outside).





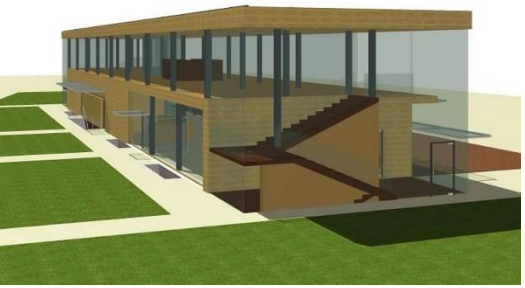
www.passreg.eu

PassREg | Passive House Regions with Renewable Energies

Multi - functional public use passive house "Sunny“
On the Lake Bundek in Zagreb is choosed as referent
Beacon project

2nd phase project, 2009 - 2012

Author: Lj. Miščević



Višenamjenska građevina javne namjene niskoenergetskog standarda ili energetskog standarda pasivne kuće “SUNČICA”

Zagreb, park Bundek uz Veliko jezero
Investitor: Zagrebački Holding d.o.o.
Autor idejnog rješenja i projektant Lj. Miščević

1. faza projekta, 2006.-2007.

2. faza projekta, 2008.

Second International Contest

PASSIVE HOUSE AWARD 2014

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6464 Darmstadt

Co-funded by the Intelligent Energy Europe Programme of the European Union

PassREg

Urban Development

Urban Development

Winner

Passive City District Bahnstadt, Heidelberg, Germany

PassREg

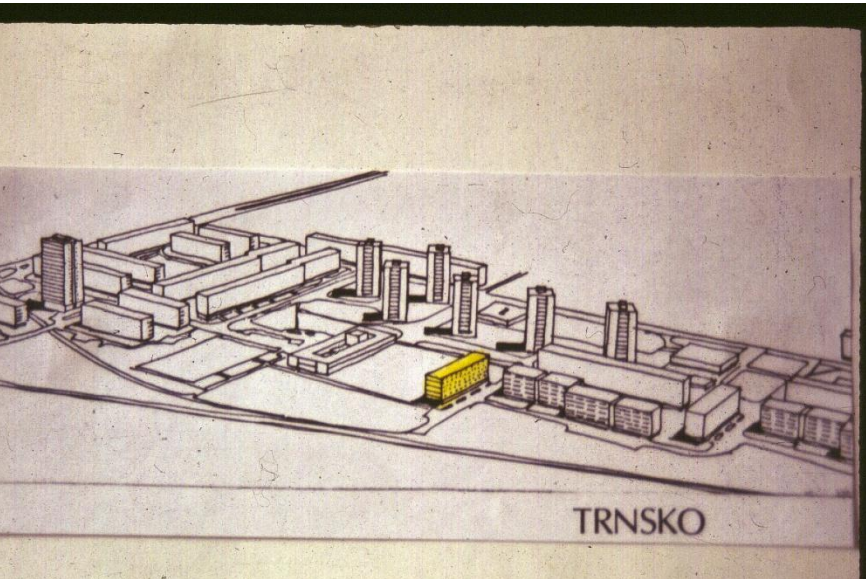
Special PassREg Award

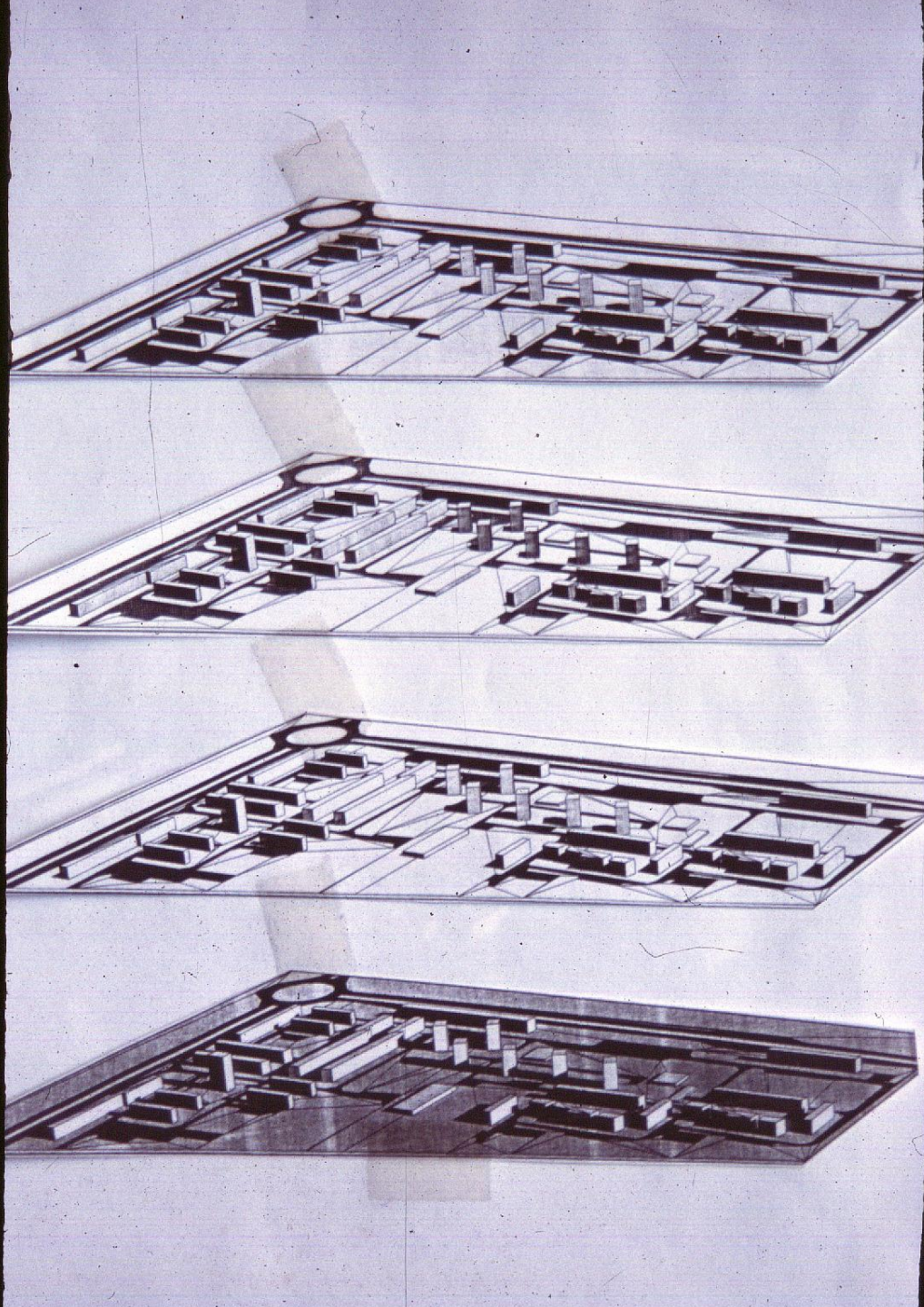
Energy and environmental rehabilitation of dwellings

Trnsko, Zagreb, 1985

International USA-HR project (DOE No. PN 777)

Coordinator: (UNI ZG AF):
Prof PhD Grozdan Knežević, M. Arch
Cooperators: (UNI ZG HR):
Prof. Ljubomir Miščević, M. Arch
Prof PhD Bojan Baletić, M. Arch
Supervisor:
Prof PhD Vladimir Bazjanac, M. Arch
Lawrence Berkeley Nat. Lab, Ca, USA





SUN
AT WORK IN
EUROPE

Vol. 8 No. 3
August 1993

PROJECT REPORTS

Bioclimatic rehabilitation of dwellings in Croatia

Ljubomir Miscevic

University of Zagreb, Faculty of Architecture, Kaciceva 26, 41000 Zagreb, Croatia

Introduction

Croatia is lacking in conventional sources of energy, but at the same time enjoys a virtually optimal climatic predisposition for the utilisation of solar energy through passive design, according to the estimates of the Commission of the European Community (1) and through an active installation system. Typical passive solar architectural elements were investigated: sunspaces, air collectors, heat storage, thermal storage walls of the Trombe-Michel type and so forth, on the basis of computer simulation of original software.

The first generation of contemporary passive solar architecture has confirmed the expected results of energy savings. The gap between applied architectural concepts, elements and systems, investment and execution levels for various functional types of architecture and the settings of locations, climate, urban regulation and research into the values of traditional and contemporary building is a solid foundation for further development, and use in both new building and rehabilitation.

Passive solar family houses

Family housing in Croatia in which there has been practically no control over thermal insulation, takes around 70-80% of the total housing funds of the Republic. In the course of the war, over 220,000 housing units have been destroyed and damaged. Energy rational building, energy efficient architecture, ecological building and rehabilitation, the use of healthy materials and the application of latest technologies are the obligation of each professional which must be accepted, solved and carried out.

The coming rehabilitation and further building requires prompt changes and improvement of the existing regulations concerning thermal insolation and building physics. New instructions, guidelines and regulations must bring thermal storage to the European level of standard for rational use of energy in buildings and must also draw on the experience of passive solar architecture. The present experiences of energy rational and efficient architecture in Croatia, based on professional research, software, architectural and technological solutions, may prove useful in renewal.

The passive solar family houses which are described here were designed by the author between 1985 and 1990. These four houses, identified as "P2", "V1", "M2", and "P3" differ in terms of their location , program and cost. They are situated between 45°48' and 46° 11'N, 15°55' and 16°50'E and between 100 and 175m elevation.

The passive solar performance of the buildings is simulated with computer programs BUMP 1 and BUMP 2. All designs demonstrate an attempt to maximise the benefits from insulation without sacrificing the formal and spatial characteristics of the particular site and the building design.

Fig. 1 House "P2" in Marija Bistrica 1985. South-east elevation and detail of the sunspace with massive stone wall

ments in Zagreb. These developments, known as "first generation" housing, today are nn longer in the city outskirts.

They need a comprehensive redesign approach in order to achieve the urban, energy and environmental quality demanded today. This is a presentation of up to date results and redesign proposals of a three year international scientific research project between the Faculty of Architecture, University of Zagreb and the Centre for Environmental Design Research, University of California at Berkeley (V. Bazjanac).

The title of this project is "Energy and Environmental Rehabilitation in Dwellings".In approach and complexity this project is a pioneering work in Croatia and in concept as total energy bioclimatic and environmental rehabilitation in multi-family dwellings is new and interesting for the American experience as well as the results can be applied to other architectural housing types.

Research methodology is based on extended simulation of building energy performance with DOE-2 1D, and on field verification simulation results (Fig. 4 and 5). Aiming at energy efficiency, many versions of redesign of the building envelope have been made. The rehabilitation version presented is the result of some years of work and a synthesis of professional research and design based on bioclimatic and ecological approach to architecture.

The concept focuses on the energy efficiency of south facing additional sunspaces and thermal storage walls. Maximum solar utilisation on the south facade has been achieved. Also planned is an active solar installation system for heating water through solar collectors, linked to the floor heating system.

This is a model for energy efficient and ecological renewal of (amongst others) apartment housing, buildings, developments and finally - the city. The quality of living is improved by interior interventions in the apartment, the addition of elevators and a storey of mansard apartments which solves the problem of the flat roof and at the same time covers most of the costs of the rehabilitation project by providing new residential space.

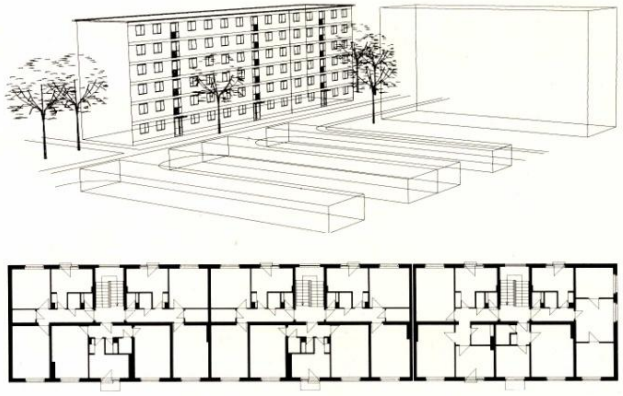


Fig. 4 Bioclimatic and ecological rehabilitation, project 1986-90, existing state

The ecological approach involves certain new ideas. The building collects rainwater for sanitary use and car-washing. Installed within the building is a system for primary selection of waste which is treated as secondary raw material (glass, paper).

Surrounding the building, the green areas are reconstructed and enlarged, streets are partially redesigned into pedestrian parades with access for vehicles, the number of garages is doubled by adding another storey onto existing facilities, thus providing additional space for "green roofs", sports and recreational areas, playgrounds, etc. and also achieving a high level of (micro) environmental articulation. Taking into account recent knowledge on healthy building and appropriate technology, the economic analyses and estimates of various versions and stages of realisation are based on a solid scientific foundation.

Reference

(1) The Commission of the European Communities. Passive Solar Architecture in Europe. Results of the 2nd European Passive Solar Competition 1982. The Architectural Press Ltd. London 1983.

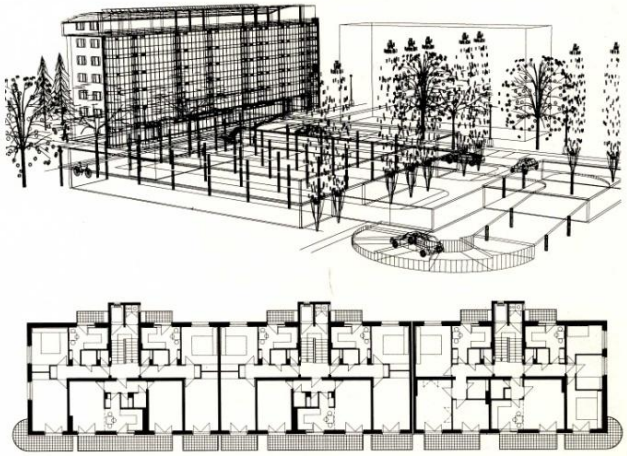


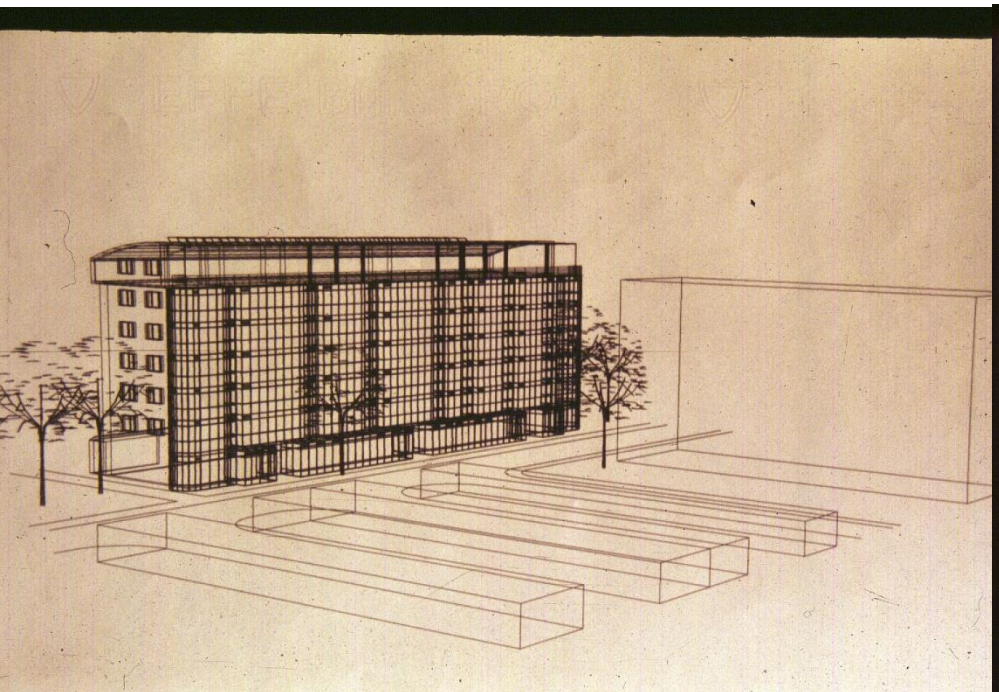
Fig. 5 Bioclimatic and ecological rehabilitation, project 1986-90, rehabilitation design

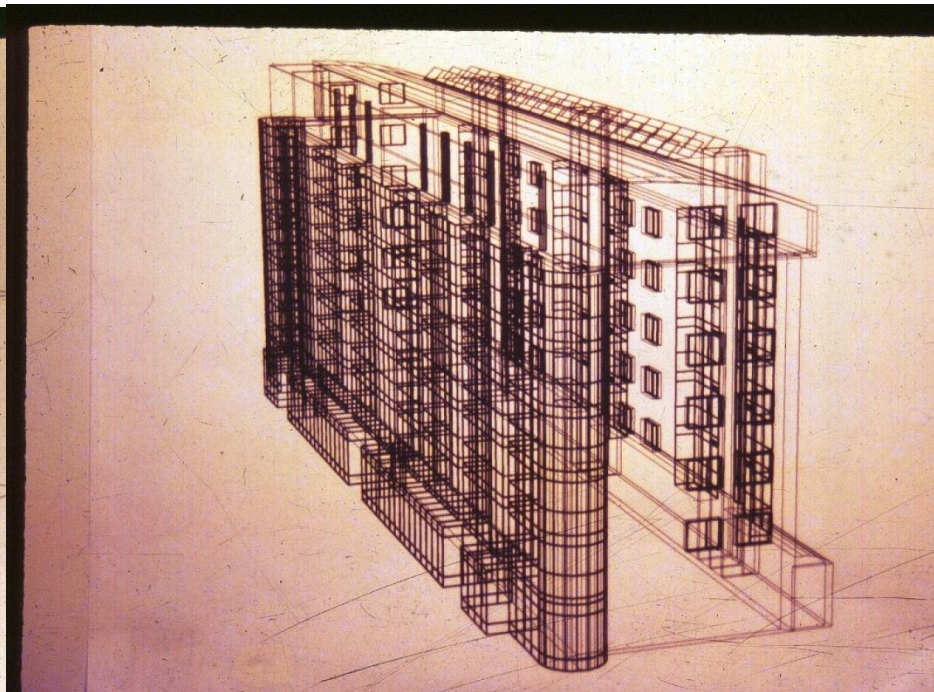
Energy and environmental rehabilitation of dwellings

Trnsko, Zagreb, 1985

International USA-HR project (DOE No. PN 777)

Author of design / autor varijanog rješenja
prof. Ljubomir Miščević, M.Arch





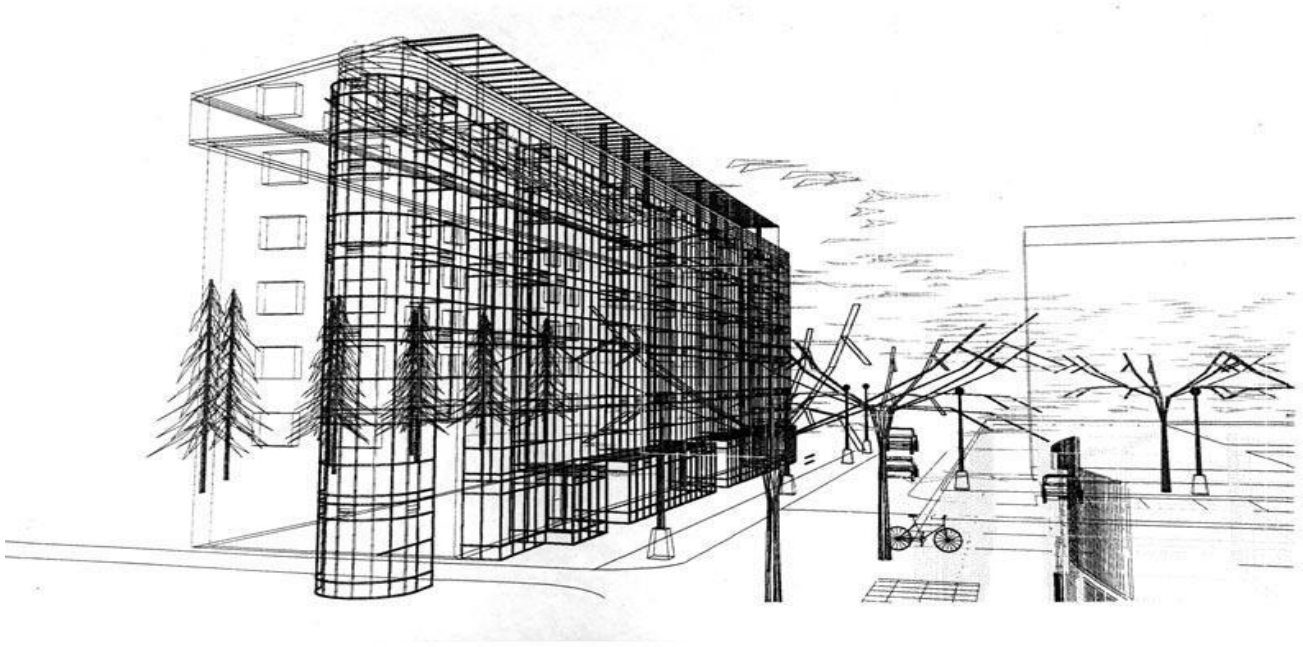
Energy and environmental rehabilitation of dwellings

Trnsko, Zagreb, 1985

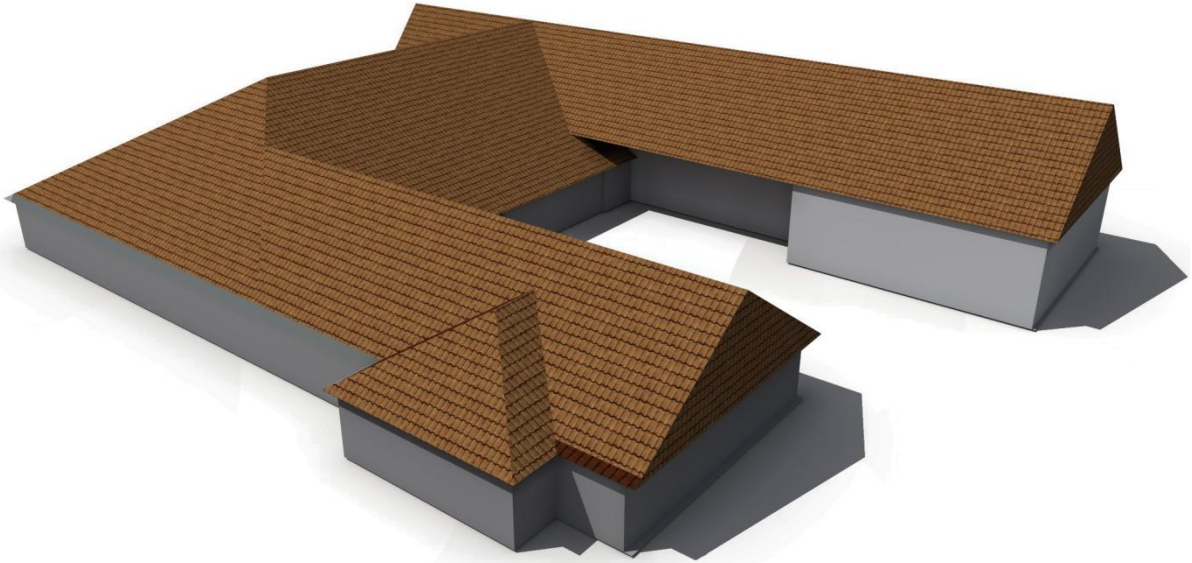
International USA-HR project (DOE No. PN 777)

University of Zagreb, Faculty of Architecture, Croatia &
Lawrence Berkeley National Laboratory, USA,CA

Author of design
prof. Ljubomir Miščević, M. Arch



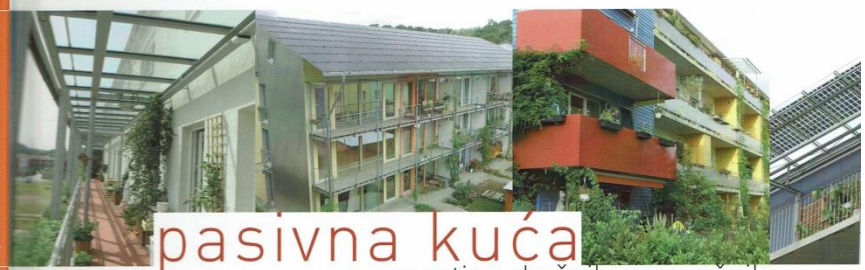
Sveučilišna knjižnica i ogranak knjižnice i čitaonice “Fran Galović”, Koprivnica




HAUPTSCHUL

martina zbašnik senegačnik

pasivna kuća



pasivna kuća

martina zbašnik senegačnik

SUN ARH

- s brtvenom trakom koja je na oba građevna elementa pričvršćena letvom s vijcima: neravnine između letve i betonske konstrukcije riješe se trakom za izravnavanje (filcom, brtvenom cijevi, ekspanzivnom trakom). Ako je brtvena traka tvrdo stiješnjena na beton, spoj je trajno zrakonepropusan;
- s profilom za brtvljenje u pukotini između oba građevna elementa: profil za brtvljenje može se lako pričvrstiti trokutnom letvom.

5.5 Proboji zbog instalacija

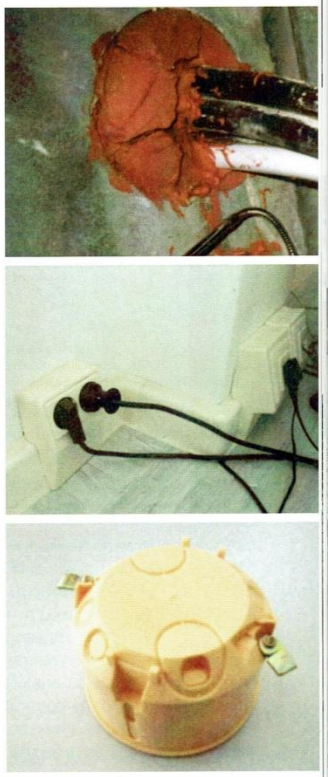
Veliki dio propusnosti vanjskog plašta zgrade donose i proboji građevnih elemenata različitim instalacijama.[33] Slično kao kod ostalih spojeva i ovdje treba osigurati zrakonepropusnost, što je povezano s pažljivim planiranjem i projektiranjem u početnoj fazi. Najjednostavnije je predvidjeti instalacije na unutarnjim konstrukcijama, što nije uvijek moguće. Neke instalacije, npr. kablovi električne struje, cijevi za ventilaciju i vodu itd., neizbježne su i na vanjskome zidu.

Kod **masivne gradnje** zrakonepropusan plašt predstavlja unutarnja žbuka i unutarnja obloga. Utičnice i prekidači znače proboj zrakonepropusne ravnine. Zrakonepropusnost se postiže tako da se potrebna (podžbukna) kutija položi u masu žbuke pri žbukanju. Na tržištu su i zrakonepropusne podžbukne kutije, iako je njihova cijena previsoka. Postoje i prefabricirane podne letve ispod kojih je moguće voditi kabele. Na njih se zatim na proizvoljnom mjestu namjesti kutija.

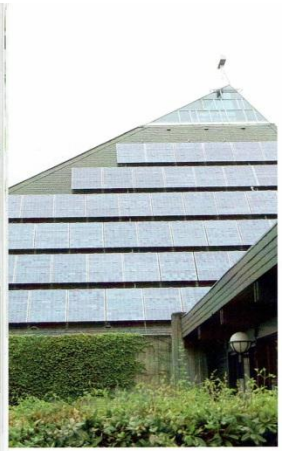
I sanitarne instalacije u kupaonicama, WC-ima i kuhinjama trebaju proboje (vodovod, kanalizacija, podžbukni vodokotlići ...). Najbolje je ako su sanitarne instalacije u sloju ispred nosivog zida, jer je time smanjen broj proboja.

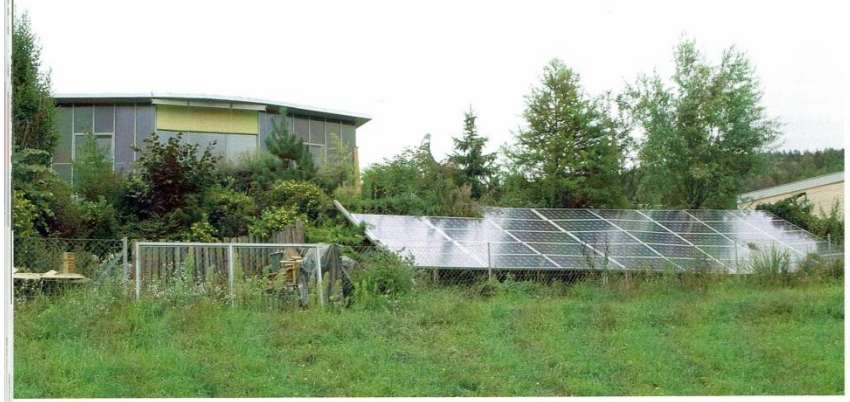
Kod **laganih konstrukcija** treba proboj zrakonepropusnog sloja na unutarnjoj strani pažljivo zalijepiti folijama ili brtvilima.

Pri trenutačnom načinu gradnje, ključni problem proboja plašta zgrade predstavlja ventilator za odvod iskorištenoga zraka iz kupaonice i kuhinje kroz vanjski zid. U pasivnim se kućama iskorišteni zrak iz prostora odvodi isključivo preko sustava za ventilaciju, a ne kroz jednostavne ventilatore u zidu i ventilatore, kao u običnim kućama. Nekontrolirani prodor vanjskog zraka šteti sustavu ventilacije na više načina. Kod ventiliranja kroz takav jednostavan ventilator povećavaju se toplinski gubici jer topli zrak izlazi iz zgrade, a da ne predaje toplinu hladnom ulaznom zraku. Kada ventilator ne radi, kroz njega prodire vanjski zrak što ruši projektirani rad sustava za ventilaciju. Ventiliranje radi na principu tlačnih razlika između dovodnih i odvodnih prostora. Nekontrolirani prodor vanjskog zraka ruši tu planiranu tlačnu razliku. Uobičajeno otvoren ventilator predstavlja najgrublje kršenje načela zrakonepropusnosti.



Slika 121: Ugradnja elektroinstalacijskih razvodnih kutija: brtvljenje proboja (gore), dodana kutija (sredina), zrakonepropusna zidna ugradbena kutija u koju se urežu potrebne rupe (dolje).[33]



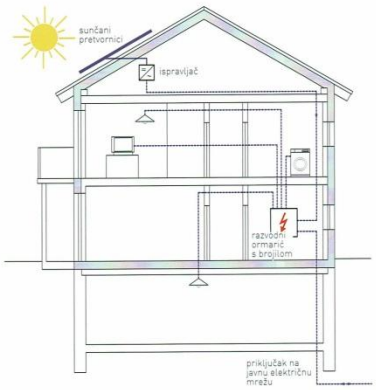


Slika 157: Sunčane elektrane na krovu crkve, pročelju tvornice sunčanih pretvornika, na krovu stambenog naselja (gore), Freiburg, Njemačka

Slika 158: Slobodnostojeći sustav sunčanih modula uz obiteljsku kuću (dolje). Škofiče kod Vrbskog jezera, Austrija.

distribucijom električne energije montiraju sunčane module, a dobivena energija se odvodi neposredno u javnu mrežu.

Dobivanje električne energije sunčanim pretvornicima nema negativnih utjecaja na okoliš. Proizvodnja sunčanih pretvornika zahtijeva vrlo mnogo energije. Energetska amortizacija je 3–5 godina kod prosječne životne dobi od 30–40 godina. Pretvaranje sunčeve energije sa sunčanim pretvornicima trenutačno je najskuplji način dobivanja električne energije. Udio električne energije te vrste u ukupnoj proizvodnji električne energije trenutno je mali, iako svake godine drastično raste.



Slika 153: Sunčani moduli i ispravljači za pretvaranje istosmjernog u izmjenični napon, Schlierberg, Freiburg, Njemačka

Slika 154: Umreženi sustav sunčanih modula, povezan s javnom energetskom mrežom.

Umreženi sustavi sunčanih modula su preko ispravljača priključeni na javnu električnu mrežu. Razdjelnik pretvara istosmjerni napon koji proizvode sunčani moduli, u izmjenični, koje je sinkronizirano s javnom električnom mrežom, priključenom na građevinu. Električnu energiju, koju proizvode sunčani moduli, možemo rabiti za vlastite potrebe. Višak ide preko brojila električne struje u javnu električnu mrežu. (Država Slovenija plaća kvalificiranim proizvođačima električnu energiju dobivenu iz sunčanih pretvornika i predanu u javnu mrežu jedinstvenu jednogodišnju cijenu 0,347 €/kWh (bez PDV-a)).[39]

Većina fotonaponskih sunčanih modula se ugrađuje na krov. Na njemu mogu biti slobodnostojeći ili nadomještaju klasičan pokrov što snižava troškove. Moguća je i ugradnja na pročelja ili kao slobodnostojećih elemenata. Česta je kombinacija dobivanja sunčeve energije s drugim funkcijama, npr. sa zaštitom od sunca.

Montaža sunčanih pretvornika nije uvijek vezana na potrošnju u zgradi. U ekološki razvijenim europskim državama vlasnici zgrade daju u najam krovne površine, na kojima poduzeća koja se bave proizvodnjom i

Slika 155: Krov s pokrovom od sunčanih modula ne treba klasičan pokrov (lijevo). Moduli su montirani na potkonstrukciju iznad sekundarnog pokrova, Schlierberg, Freiburg, Njemačka.

Slika 156: Nadstrešnica s pokrovom od sunčanih modula (desno), Vauban, Freiburg, Njemačka

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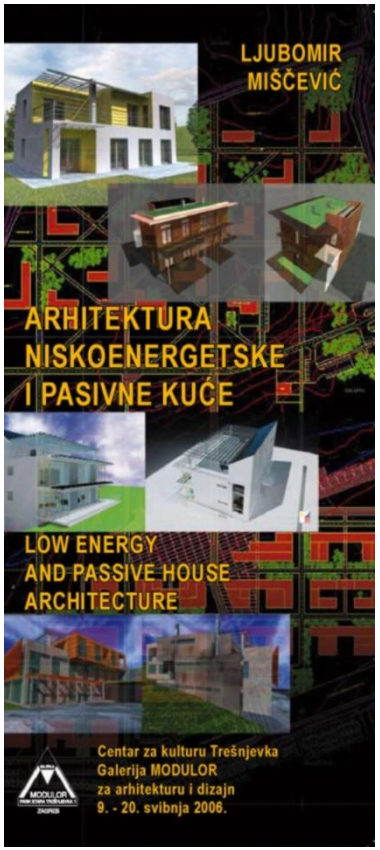


Nearly Zero Architecture, 2013

Energetski gotovo nulta zgrada

Od vrlo niskoenergetske i emisijske do energetski samodostatne i plus-energetske zgrade

Nearly Zero Energy Building

Početak 21. stoljeća obilježavaju nove energetske klasifikacije u graditeljstvu prema kojima su već izvedene pojedine novogradnje, ali i obnove kuća i zgrada različitih namjena. Zajedničko je obilježje svih suvremenih prijedloga energetskih modela vrlo mala – gotovo nulta energetska potrošnja koja je danas tehnološki ostvariva i financijski sve prihvatljivija i isplativija, a rezultati takve gradnje bitno su jamstvo ostvarenja održivog razvoja.

Energetski *gotovo nulta* arhitektura, zbog fizikalno-građevinskih značajki ovojnice zgrade osiguravaju vrlo nisku energetsku potrošnju za zagrijavanje prostora, a preostale energetske potrebe (za rasvjetu, razne kućanske uređaje, hlađenje i dr.) vrlo lako može pokriti iz obnovljivih izvora energije kojih je uporaba zahvaljujući tehnološkom razvoju sve učinkovitija.

Direktiva o energetskim svojstvima zgrada (Energy Performance in Buildings Directive – EPBD) postaje temeljna smjernica razvoja energetske učinkovitosti u graditeljstvu, a prema njoj se vrlo niskoenergetski modeli gradnje i nazivaju gotovo nulti. Svaka će država članica Europske Unije zasebno odlučiti koja je energetska potrošnja granična za taj naziv.

Pridruživanjem Republike Hrvatske Uniji 1. srpnja 2013, scenarij energetske potrošnje EU *3 x 20* do 2020. postaje iznimno važan za energetsku strategiju. Scenarijem su predviđena ostvarenja tri temeljna cilja; smanjenje energetske potrošnje za 20%, smanjenje emisija CO_2 i drugih stakleničkih plinova za 20% te uporaba obnovljivih izvora energije od 20% udjela u sveukupnoj energetskoj potrošnji.

Kako bi se scenarij ostvario u što većoj mjeri do 2020, EU je odredila da se sve zgrade javne namjene od 2018. moraju izvoditi upravo kao gotovo nulte! Štoviše, zgrade koje su predviđene za zahtjevniju obnovu također od 2018. moraju udovoljiti istim energetskim kriterijima. Od 2020. i sve ostale zgrade morat će se izvoditi kao gotovo nulte energetske.

Velika Britanija donijela je odluku po kojoj već od 2016. počinje izvođenje zgrada javne namjene bez emisija stakleničkih plinova.

Uz pojam *energetski gotovo nulte* zgrade, koji je prihvaćen u propisima Europske Unije, danas susrećemo i sljedeće nove modele energetski učinkovite gradnje i primjerene razine zaštite okoliša:

From very low energy and emission buildings to energy self-sufficient and energy-plus buildings

The beginning of the 21st century has been marked with new energy classifications in building construction according to which some new buildings have been built, and houses and buildings used for various purposes have been renovated. The common feature in all contemporary energy model drafts is a very low – nearly zero energy consumption which is now technologically feasible, financially more affordable and cost effective, whilst the results in such construction are an important guarantee in achieving sustainable development. Because of the physical and constructional features of the building envelope which provide very low energy consumption for space heating, *nearly zero* energy architecture can easily cover other energy needs (for lighting, various household appliances, cooling etc.) from renewable energy resources, which can be used more efficiently due to technological development.

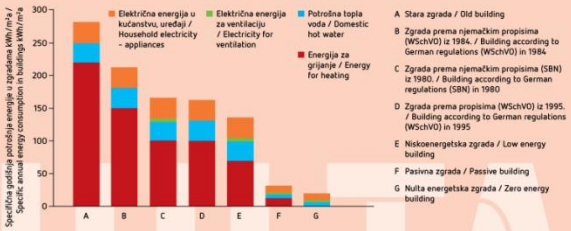
The Energy Performance in Buildings Directive – EPBD, has become a fundamental guideline for energy efficiency development in construction. Very low energy building models are now called nearly zero after the directive's instructions. Each of the EU member states will individually decide on which energy consumption is the borderline for that title.

After the accession of the Republic of Croatia into the European Union on July 1, 2013, the scenario that has been developed for the EU '3 x 20' energy consumption by 2020 will be extremely important for the country's energy strategy. The scenario is designed to achieve three fundamental objectives: a reduction of energy consumption by 20 %, reduction of CO_2 and other greenhouse gas emissions by 20 %, as well as the use of renewable energy resources from the 20 % share of total energy consumption.

In order to achieve this goal by 2020 to the full extent, the EU has decided that as of 2018, all public buildings will have to be built as nearly zero energy buildings! Furthermore, the buildings which have been opted for the more demanding renovations will also have to comply in accordance to the same energy criteria by the year 2018. In addition, from 2020 and on, all other buildings will also have to be run as nearly zero energy.

Great Britain has decided to start building no-emission public buildings as early as of 2016.

Together with the term *nearly energy zero* building which has been adopted in European Union regulations, the following new models of energy efficient construction and their corresponding levels of environmental protection are encountered today:



Gotovo nulta energetska arhitektura (vrlo niskoenergetske i pasivne kuće) / Nearly zero energy architecture (very low energy and passive houses)

Energetski nulta zgrada

Zgrada u kojoj je, kao rezultat vrlo visoke razine energetske učinkovitosti, ukupna godišnja potrošnja primarne energije jednaka energiji (proizvedenoj iz obnovljivih izvora energije) koja je dostavljena zgradi (engl. *net zero energy house*, njem. *Nullenergiehaus*).

Emisijski nulta zgrada (neto ugljičnoemisijski nulta zgrada)

Zgrada koja, na temelju materijala od kojih je izgrađena i činjenice da proizvodi višak energije iz obnovljivih izvora, osigurava da tijekom svog životnog vijeka kompenzira sve ugljične emisije povezane s izgradnjom i uporabom zgrade (*net zero carbon building, Nullemisionshaus*).

Karbonski nulta zgrada

Zgrada s godišnjom nultom neto energetskom potrošnjom i nultom ugljičnom emisijom (*zero carbon building*).

Energetski pozitivna zgrada (plus-energetska zgrada)

Zgrada u kojoj je kao rezultat vrlo visoke razine energetske učinkovitosti ukupna godišnja potrošnja energije manja od energije (proizvedene iz obnovljivih izvora energije) koja je dostavljena zgradi (*positive energy building*).

Zero energy building (Net zero energy house. Nullenergiehaus)
A building in which, as a result of its very high level of energy efficiency, the total annual primary energy consumption is equal to the energy (produced from renewable energy resources) that is distributed to the building.

Zero energy emissions building (Net zero carbon building. Nullemisionshaus)
A building which, based on its building materials and the fact that it produces a surplus of energy from renewable energy resources, compensates all carbon emissions during its life span which are associated with the construction and use of the building.

Zero carbon building
A building with annual net zero energy consumption and zero carbon emission.

Positive energy building (Energy-plus building)
A building in which, as a result of its very low level of energy efficiency, its total annual energy consumption is lower than the energy (produced from renewable energy resources) delivered to the building.

3D-crtež vrlo niskoenergetske kuće drvene i betonske konstrukcije M6 (arhitekt prof. Ljubomir Miščević), Gornji Stupnik, Hrvatska

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3D drawing of a timber-frame and concrete very low energy house M6 (architect Prof. Ljubomir Miščević), Gornji Stupnik, Croatia

Detalj izgradnje vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

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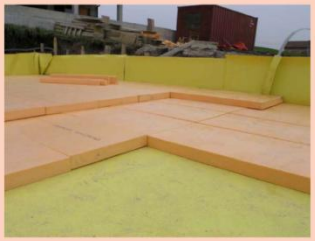
Detail of the construction of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia



Detalj izgradnje vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

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Detail of the construction of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia

Detalj izolacije drvenog zida vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

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Detail of the wooden wall insulation of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia

Vrlo niskoenergetska kuća M6 (arhitekt prof. Ljubomir Miščević) drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska, u izgradnji

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Timber-frame and concrete very low energy house M6, (architect Prof. Ljubomir Miščević) structure in Gornji Stupnik, Croatia, under construction

Defining the Nearly Zero Energy Building

Passive House + renewables

Co-funded by the Intelligent Energy Europe Programme of the European Union

PassREg

PassREg

Municipalities lead the way

Photos: Detached single family house M6 | Ljubomir Miščević | Zagreb | Croatia
© Dubravko Martinic

"In a time of recession and crisis, rational use of energy, energy efficiency, the application of new green technologies and renewable energy sources is an imperative but also a challenge and impulse for economic development, opening new workplaces and a brighter perspective for our young generations."

Marijan Maras, M. Electrical Engineer
City of Zagreb, Head of Office for Energy, Environment and Sustainable

> Beacon: Croatia

M6 House | Zagreb County Area

M6 is a single-detached Passive House building in the Zagreb County Area, designed by architect Ljubomir Miščević. Located in the Gornji Stupnik area, south-west to the city centre of Zagreb, it has a usable floor area (TFA) of 334 square metres.

M6 was one of the first structures built with a reinforced concrete base plate to achieve very high standards of thermal insulation. The basement and ground level floors are made of reinforced concrete. The stairs and all remaining vertical wall constructions were made using layered wooden columns and beams.

The building envelope was conceived as a wooden door system ensuring integration and easy access to the central chambers. This Passive House building is an exemplary project as it demonstrates how well the plan and systems of a building can be adjusted to meet Passive House requirements. M6 already complies with the EU Directive on the Energy Performance of Buildings (EPBD).

	nZEB definition for NEW building				nZEB definition for EXISTING buildings	
	Eprim		share of renewable energy	other indicators	Eprim	
	residential buildings	non-residential buildings			residential buildings	non-residential buildings
austrija	160	170 (od 2021)	u Propisu za sve zgrade	EP, CO"	200	250 (od 2021)
belgium- brussels	45	90 (2)	qualitative	EP, OH	54	108
belgium - flanders	30%PE (5)	40%PE (5)	Quantitative (4)	EP, OH		
belgium - walonia			qualitative	EP		
bulgaria	30-50	40-60	qualitative	EP	30-50	40-60
croatia	30-80 (3)	25-200 (3)	30% Eprim	EP	/	/
cyprus	100	125	qualitative	EP	100	125
chech republic	75-80% (2;5)	90% (5)	qualitative	EP, TS	75-80%	90%
denmark	20	25	qualitative	EP, OH, TS	20	25
estonia	50-100 (2)	90-270 (2)	qualitative			
finland						
france	40-65 (2;3)	70-110 (2;3)	Quantitative (4)	EP, OH, TS	80	60%PE
germany	40% PE (5)			EP	55% PE	
greece						
hungary	50-72 (2)	60-115 (2)	qualitative	EP		
ireland	45	60% PE (5)	Quantitative (4)	CO2	75-100	
italy			qualitative	EP TS		
latvia	95	95	qualitative	EP	95	95
lithuania			qualitative	EP		
luxemburg			qualitative	EP, CO2		
malta	40	60	qualitative	EP		
netherlands	energy performance coefficient=0			EP		
norway				CO2, EP, TS		
poland	60-75 (2)	45-70 (2)				
portugal						
romania	93-217 (2;3)	50-192 (2;3)	qualitative	CO2		
slovakia	32-54 (2)	34-96 (2)	qualitative	EP		
slovenia	45-50 (2)	70		EP	70-90	100
spain				CO2		
sweden	30-75 (2;3)	30-105 (2;3)	qualitative			
UK	44 (2)			CO2, EP, TS		

izvor: nZEB definitions across Europe, BPIE

SDH
solar district heating

Intelligent Energy Europe Programme of the European Union

Rescue
RENEWABLE SMART COOLING FOR URBAN EUROPE

ENERGY INSTITUTE HRVOJE POŽAR
Zagreb, Croatia, 26th May 2015

DISTRICT HEATING & COOLING - SOLUTIONS OF RES USE IN CROATIA

Ending Conference of IEE projects

URBAN PLANNING AND RES

Full Prof. **Ljubomir Miščević**, M. Arch.

University of Zagreb, Faculty of Architecture

Phone/fax: +385 1 4639394

miscevic@arhitekt.hr

Af

Sveučilište u Zagrebu
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KONZORCIJ PASIVNA KUĆA HRVATSKA

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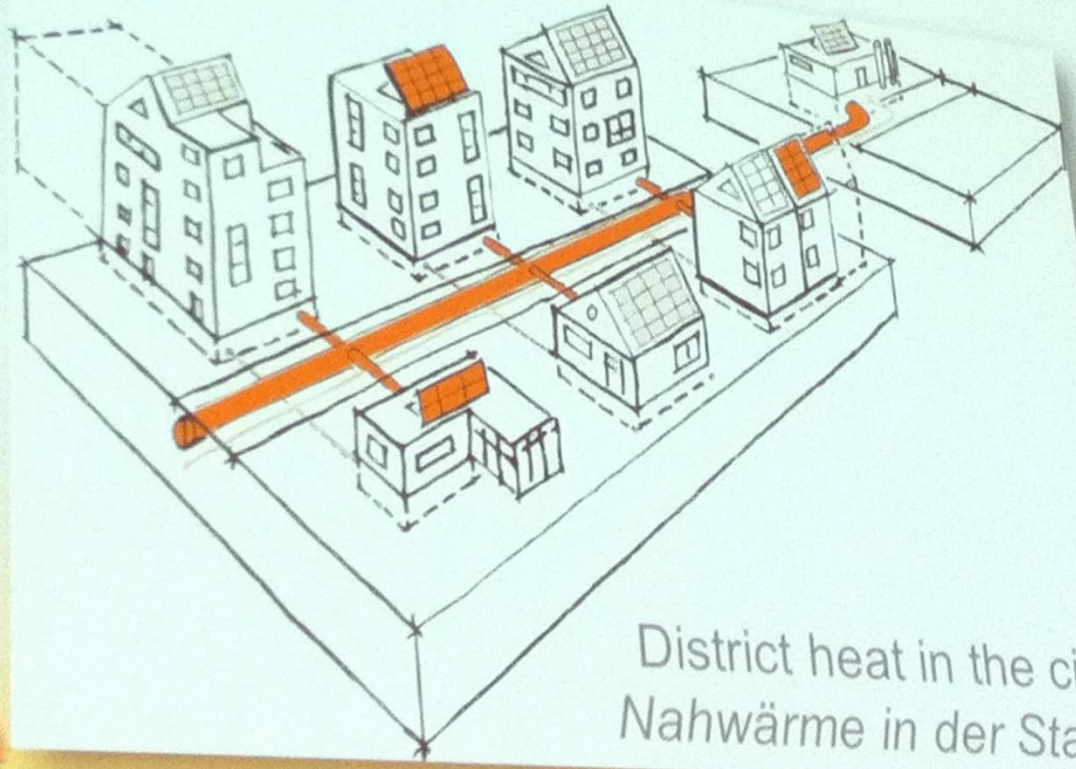
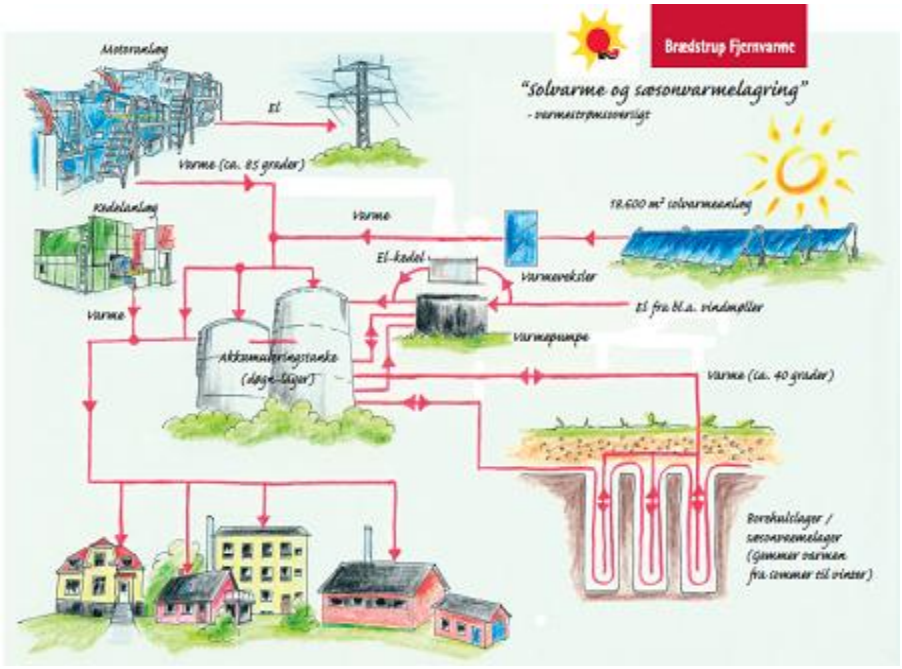
Sustainable supply strategies

Passive House Institute

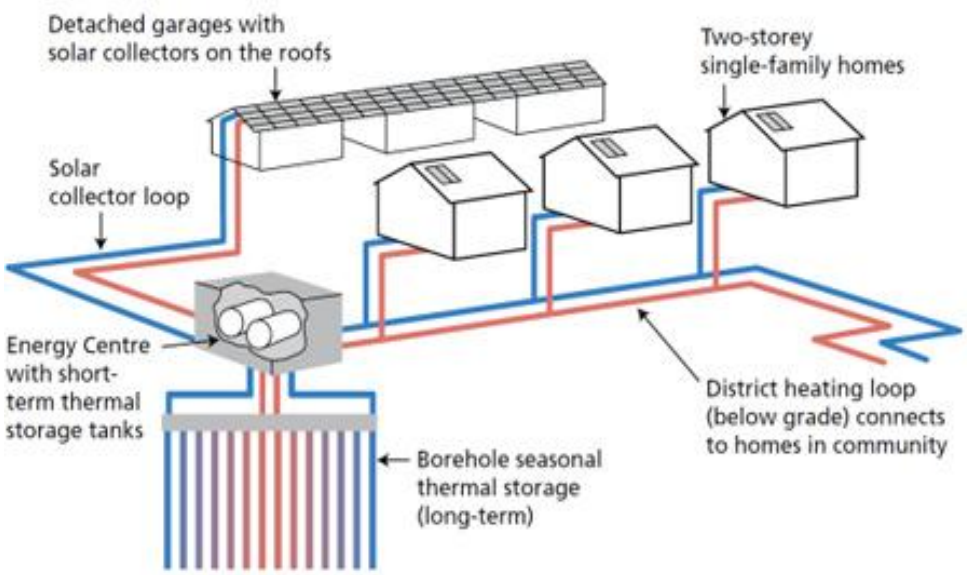


District heat in the city
Nahwärme in der Stadt

Nachhaltige Versorgungsstrategien



Solar Seasonal Storage and District Loop



Geliefert von ARCON Solvarme A/S

Sunčica, 2006

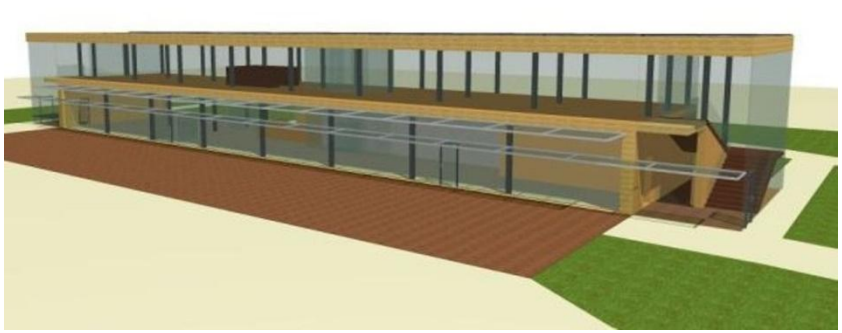
Zagreb, Lake Bundek, Croatia

Višenamjenska građevina javne namjene niskoenergetskog standarda ili energetskog standarda pasivne kuće “SUNČICA”

Jezero Bundek, Zagreb, 2. faza projekta, 2009.

Prva gradska fotonaponska energana

Investitor: Grad Zagreb, Autor idejnog rješenja i projektant: Lj. Miščević



T4, 2009

Sveta Nedelja, Croatia

K-K, 2013

Croatia

M7, 2014

Vienna, Austria

M6, 2015

Zagreb, Croatia

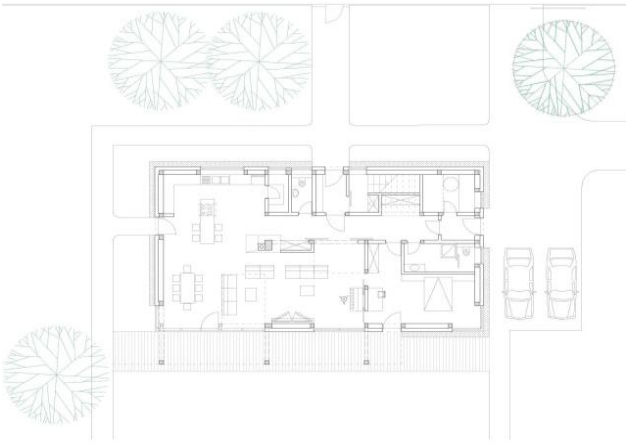

VARIMAT


ISOVER Vario KB 1

Family passive house “V2”

Strizivojna, Croatia

Author: Ljubomir Miščević, project 2011-2012, under construction



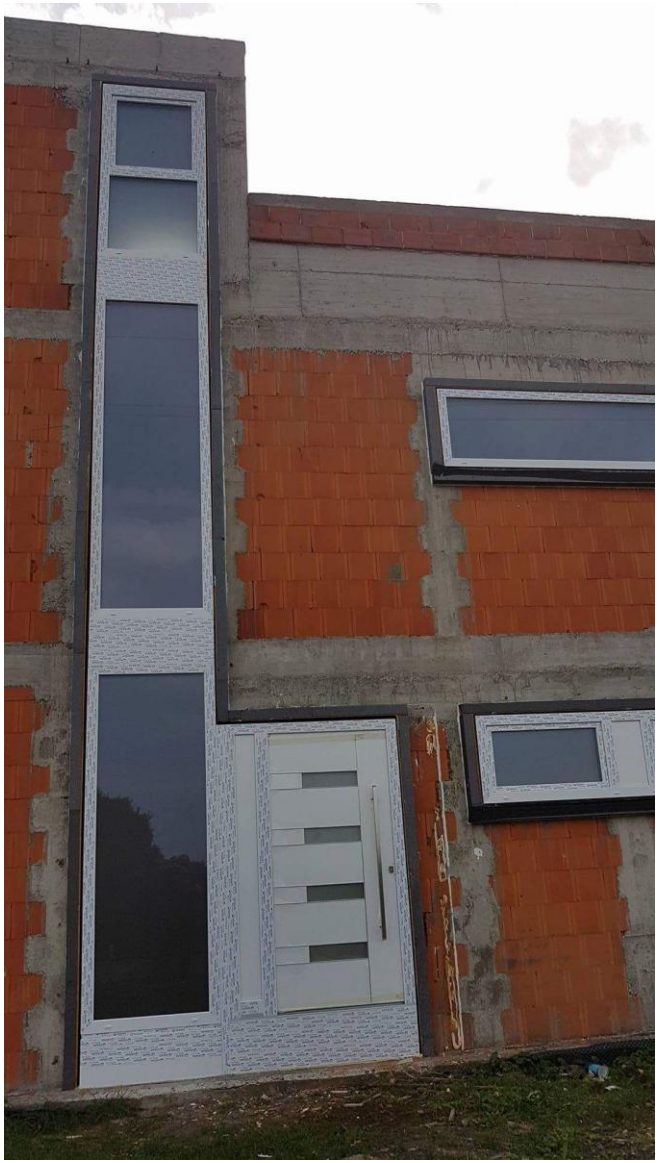
V2, 2016 (in realisation)

Lj. Miščević, Strizivojna, Croatia

V2, 2016 (in realisation)

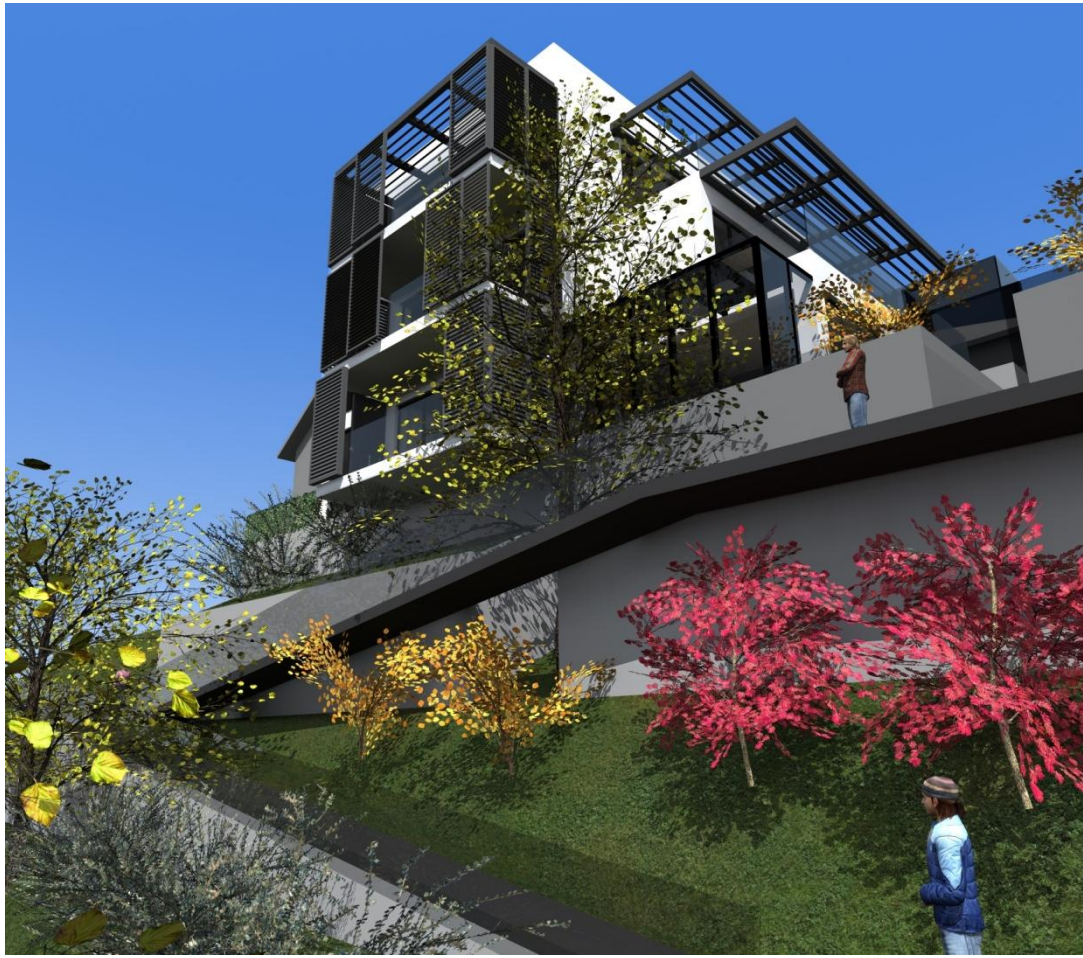
Lj. Miščević, Strizivojna, Croatia

V2, 2016 (in realisation)



Lj. Miščević, Strizivojna, Croatia

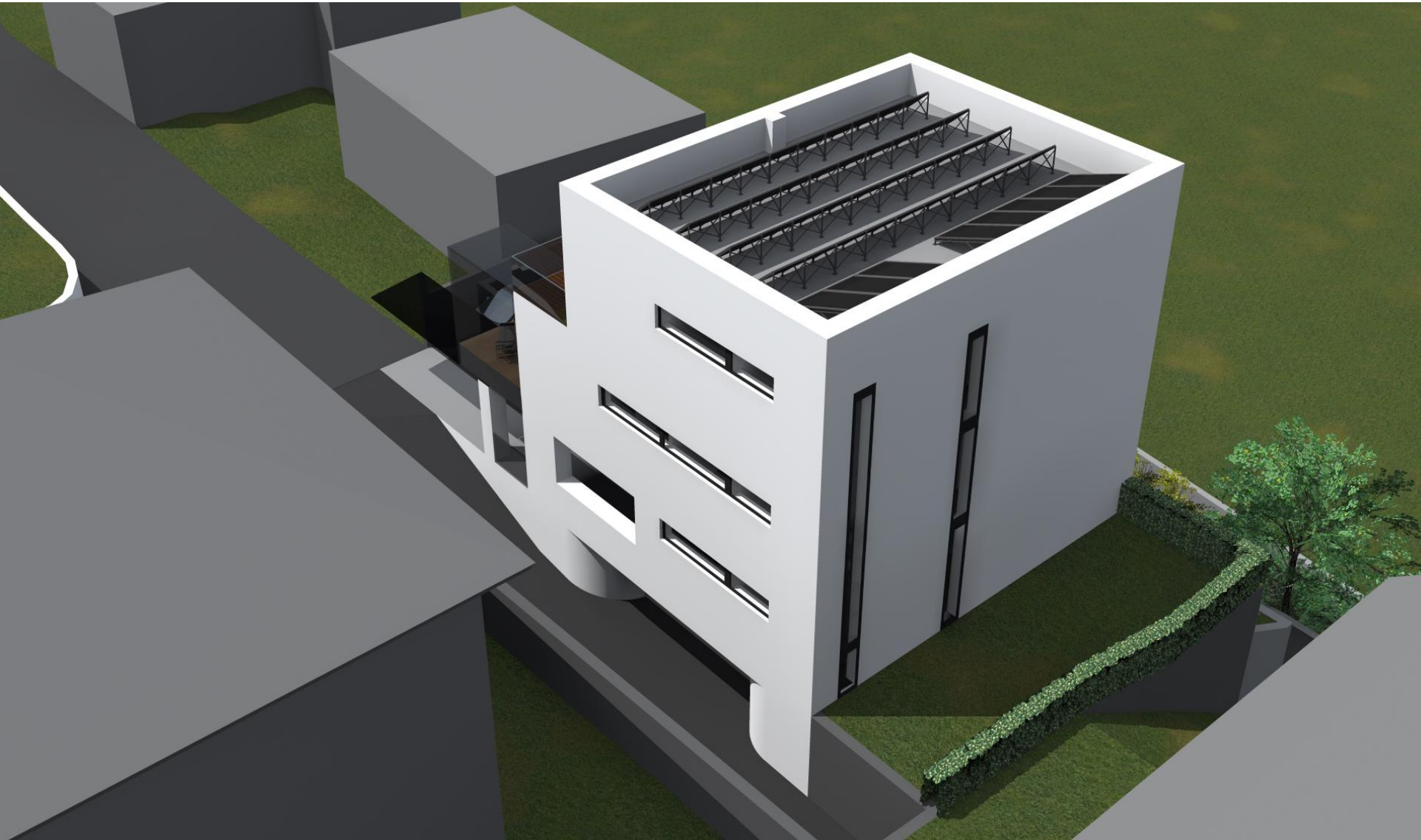
Family passive house plus „H2“, Zagreb, Croatia
Project 2014-2015
Author: Lj. Miščević



Family passive house plus „H2“, Zagreb, Croatia

Project 2014-2015

Author: Lj. Miščević



H2, passive house plus, 2016

Lj. Miščević, Zagreb, Croatia

A+ Apartment house (POS), 2016

Ljubomir Miščević i Mark Miščević, Koprivnica, Croatia

A+ Apartment house (POS), 2016

Ljubomir Miščević i Mark Miščević, Koprivnica, Croatia

F4, passive house plus, 2016

Lj. Miščević, Duga Resa, Croatia

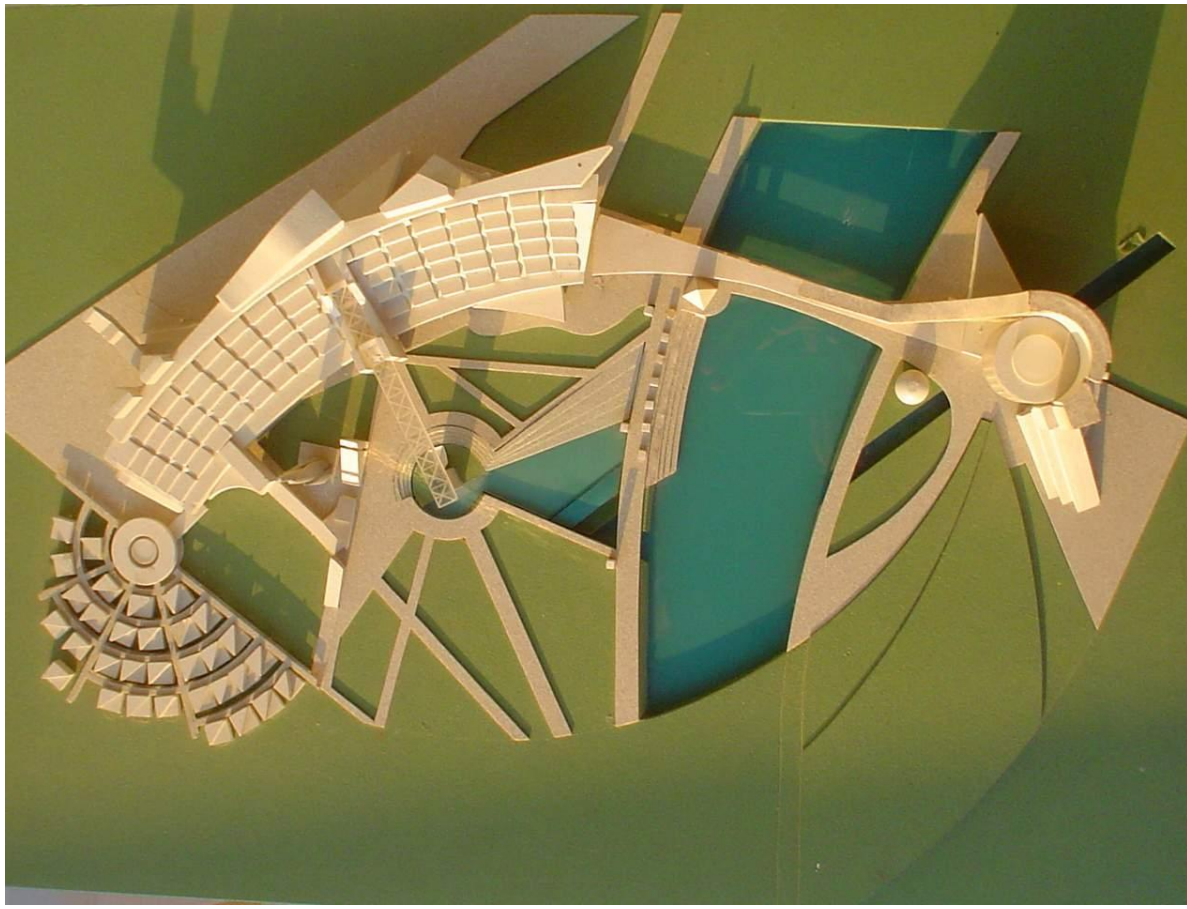
F4, passive house plus, 2016

Lj. Miščević, Duga Resa, Croatia

F4, passive house plus, 2016

Lj. Miščević, Duga Resa, Croatia

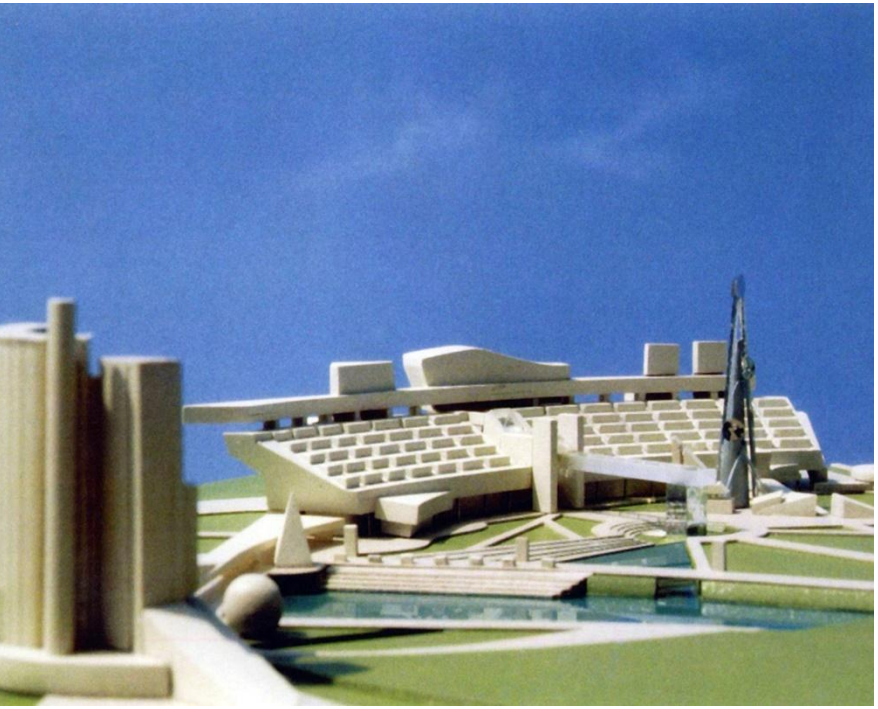
Intelligent and energy self-sufficient sustainable housing and office buildings complex
FUTURA INOVA

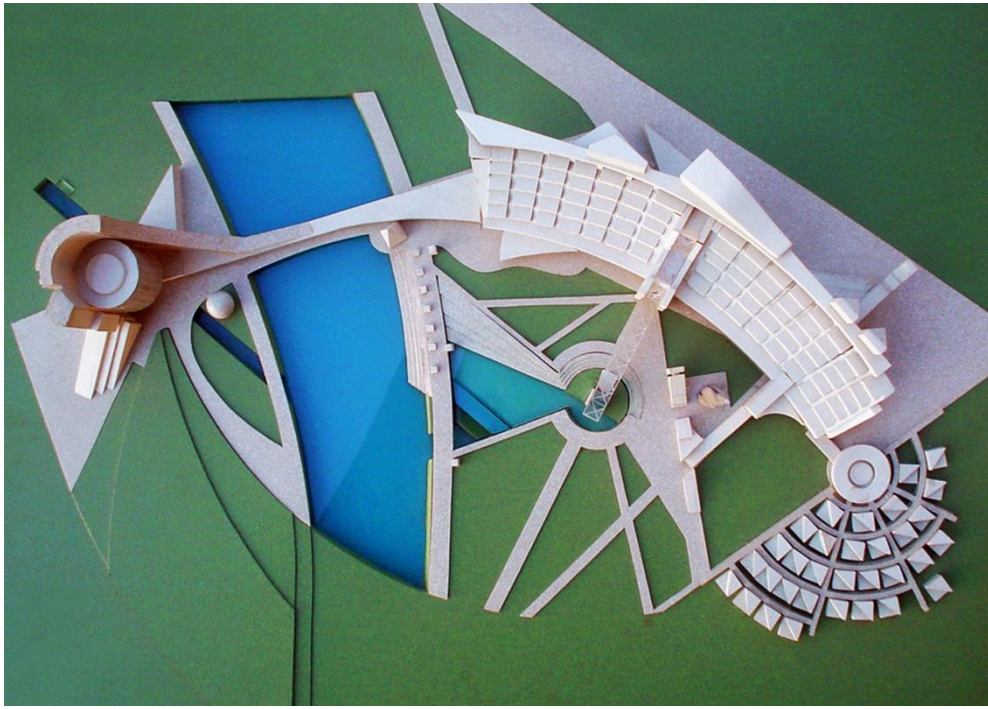


International competition
The sign of the future, Haus der Architektur, Graz, 1993
Authors: Radovan Miščević and Ljubomir Miščević

Futura Inova, 1993.

International competition „The sign of the future”



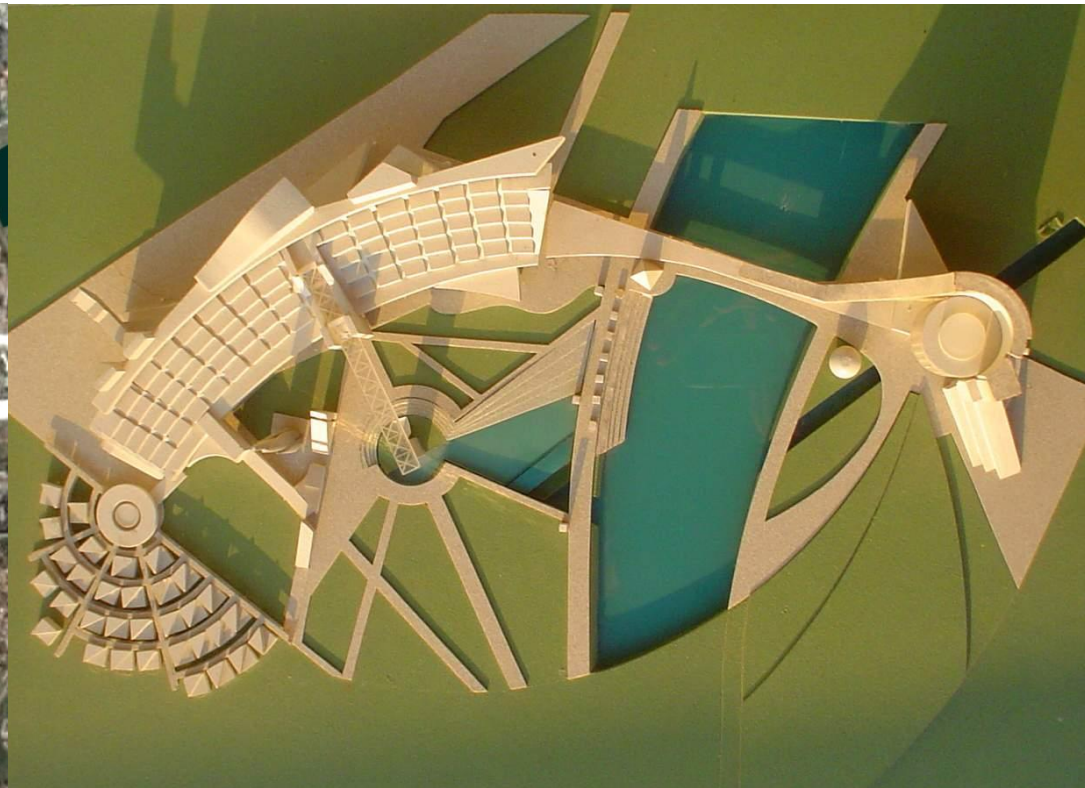


Authors dr. sc. Radovan Miščević and prof. Ljubomir Miščević,
Graz, Austria

Intelligent and energy self-sufficient housing and office use complex FUTURA

International competition / Međunarodni natječaj
The sign of the future / Znak budućnosti,
Haus der Architektur, Graz, 1993., Zagreb 2007.

Authors dr. sc. Radovan Miščević and prof. Ljubomir Miščević

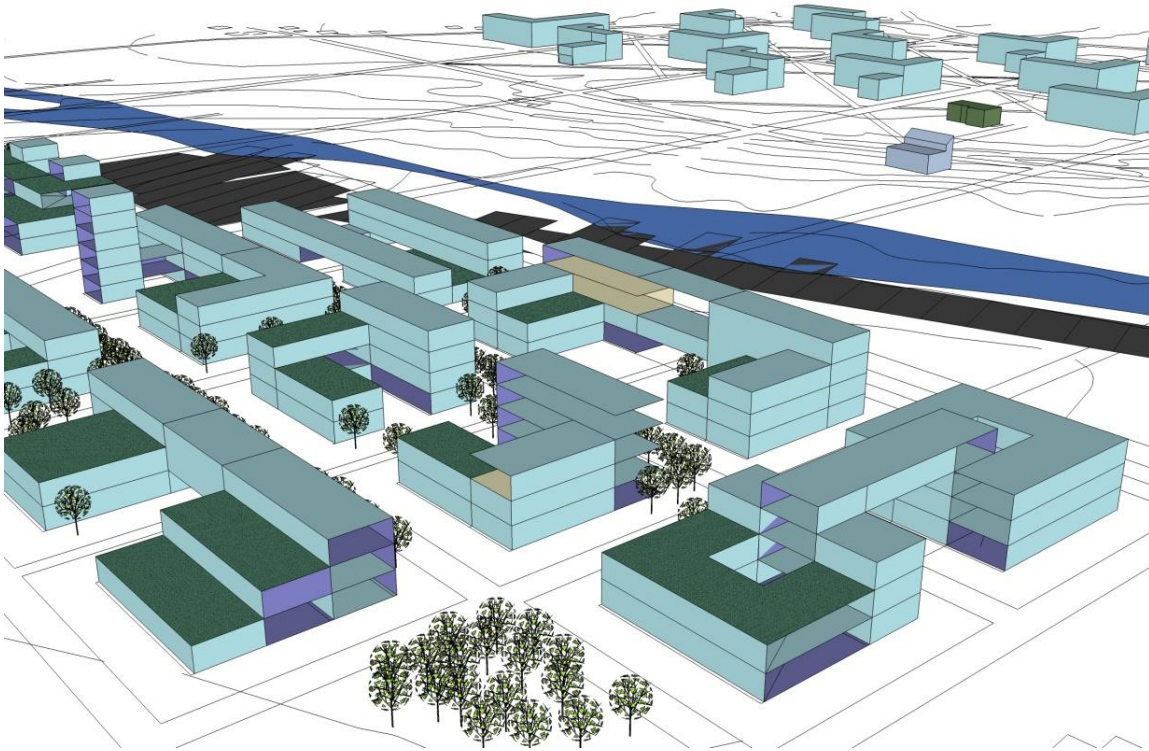


Solar city Zaprešić

Functional complexes are
connected through a network
of communications
in an orthogonal raster.

Zaprešić, Croatia
Project, 2004.
Author: Lj. Miscevic

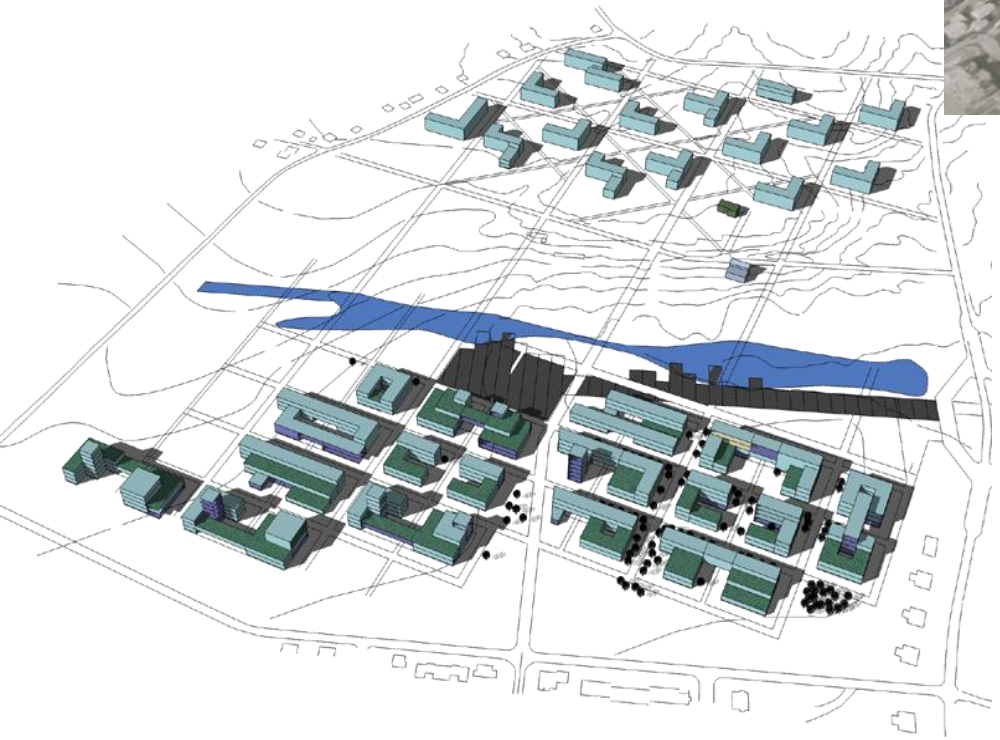
Solar City, 2005

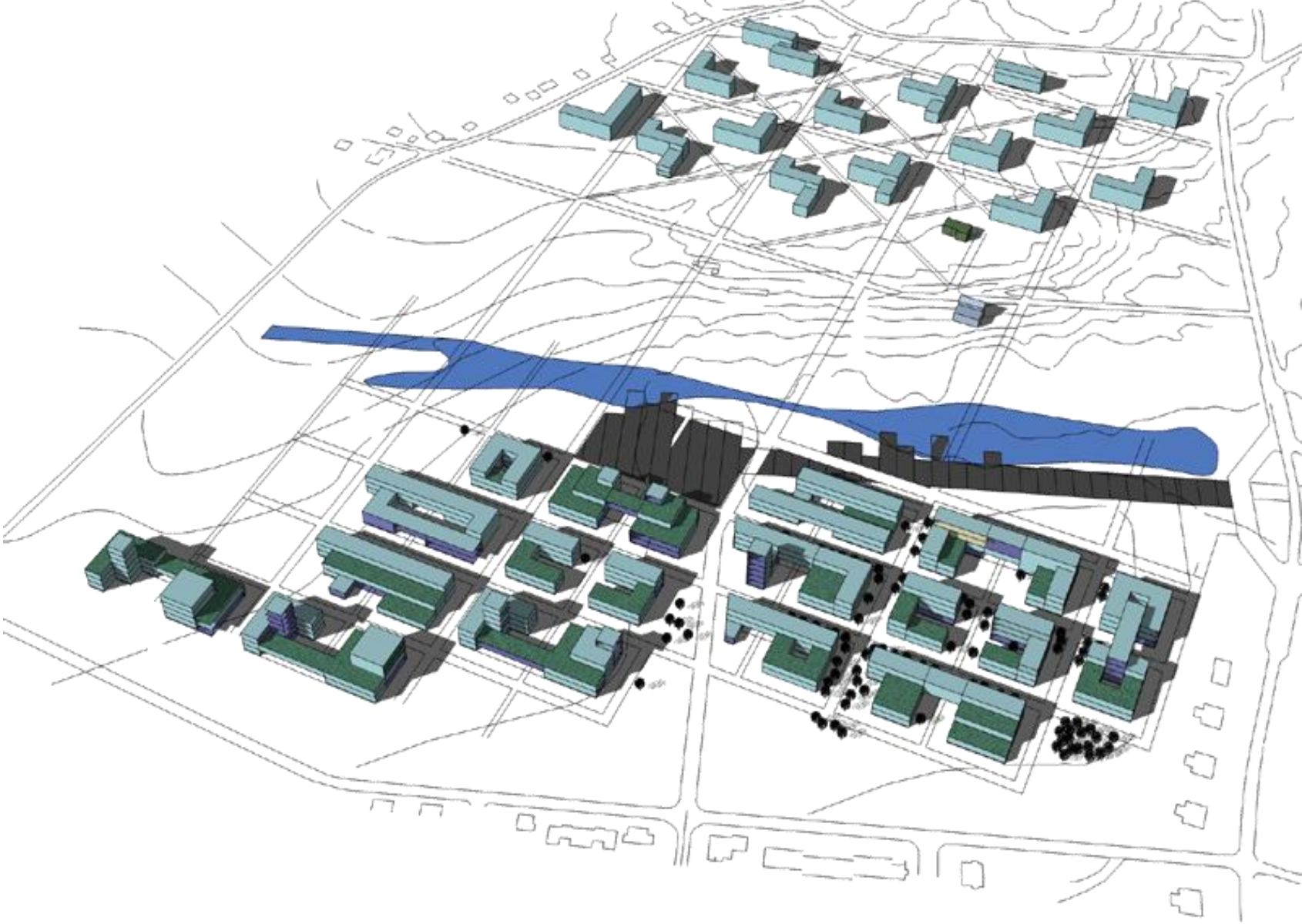


Zaprešić, Croatia

Sunčani grad Zaprešić

Autor urbanističko-arhitektonskog rješenja Lj. Miščević
Projekt, 2004.-2005.





Sunčani grad Zaprešić, pogled s juga
Sveučilišni kampus, tehnologijski park, naselje i “Hrvatska sunčana kuća”
Projekt, 2004., autor Lj. Miščević

Solar city Zapresic

Project 2004 - 2005

Author of urban and architectural project:

Prof. Ljubomir Miščević, M. Arch.


ManagEnergy Local Energy Action Award 2013
European Commission
This is to certify that the
ManagEnergy Local Energy Action Award 2013
has been granted to:
The Bold New Face of Koprivnica
implemented by City of Koprivnica
William Gillett
European Commission, EACI
ManagEnergy
Co-funded by the Intelligent Energy Europe Programme of the European Union
This energy action was selected by a jury comprising representatives of energy agencies, industry and public authorities, as the winning entry from the Good Practices which were submitted by public authorities, energy agencies and other local energy actors from across the EU.
ManagEnergy is an initiative of the European Commission which is supported under the Intelligent Energy-Europe Programme. It promotes sustainable energy in local and regional communities.


SUSTAINABLE ENERGY
WEEK 24 - 28 JUNE 2013
WINNER MANAGENERGY AWARD
THE BOLD NEW FACE OF KOPRIVNICA
CITY OF KOPRIVNICA
European Commission

University Campus in Koprivnica, Croatia

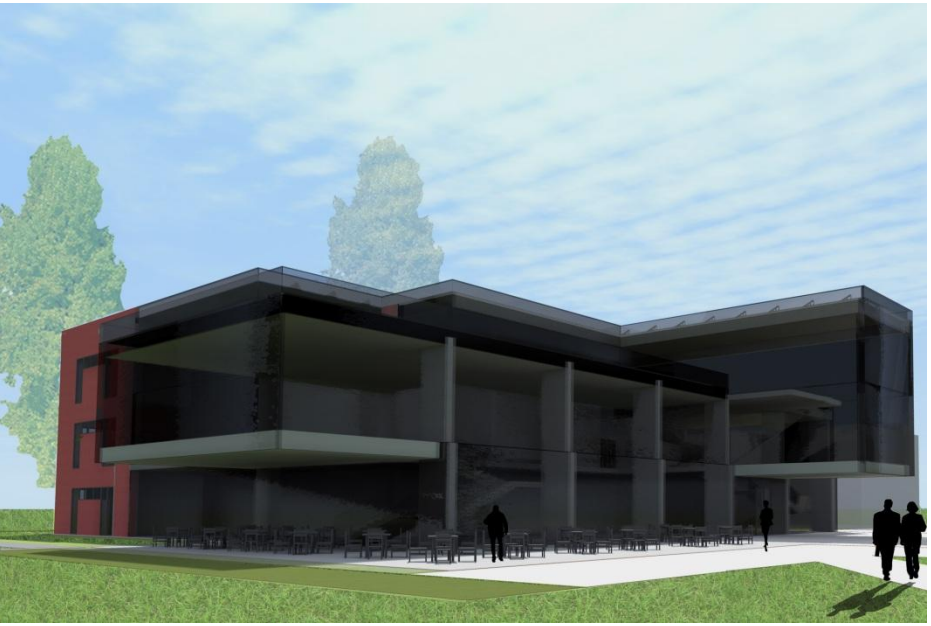
Central Building with Conference Hall

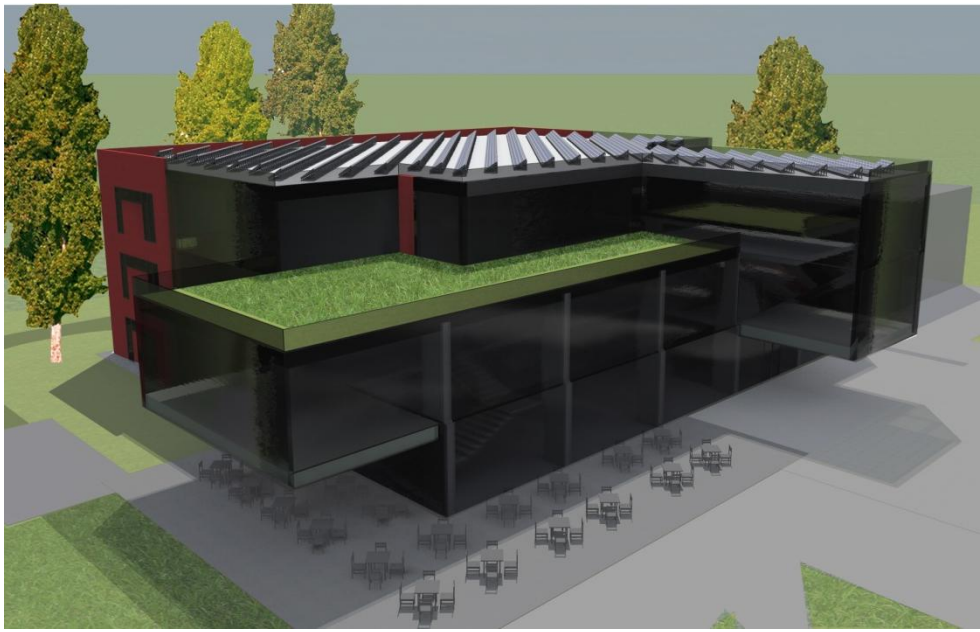
Idea project, author: Ljubomir Miščević, 2013

University Campus in Koprivnica, Croatia

Central Building

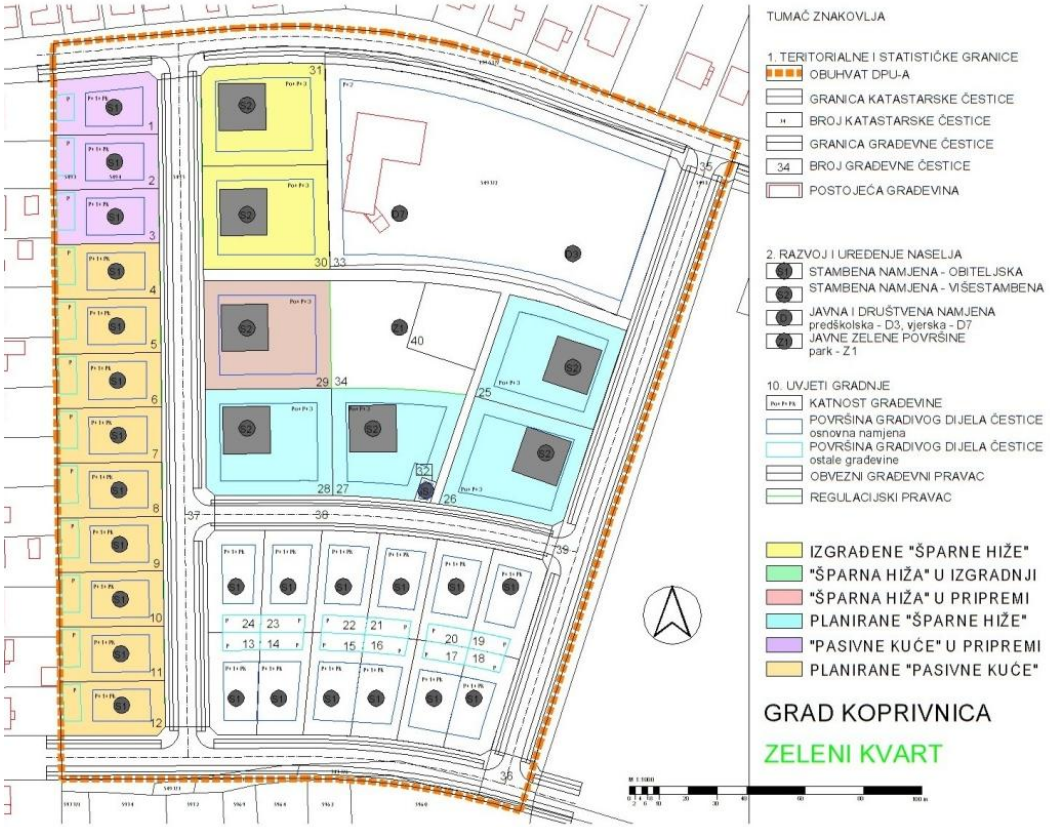
Idea project, author: Ljubomir Miščević, 2013





Green Quartier „Lenišće east”, Koprivnica, Croatia

Housing zone “Lenišće east”



Demonstration project for housing.

The first Green Quartier in the city

Ukupno planirano 7 zgrada višestambene izgradnje i 12 manjih stambenih građevina (2-3 stana) – Agencija za društveno poticanu stanogradnju Grada Koprivnice (APOS)

Green Quartier „Lenišće east”, Koprivnica, Croatia

The first residential building from the social housing program (POS)
Koprivnica, Croatia, 2011

Energy certificate for A+ class. Author: Tehnika d. d., Zagreb

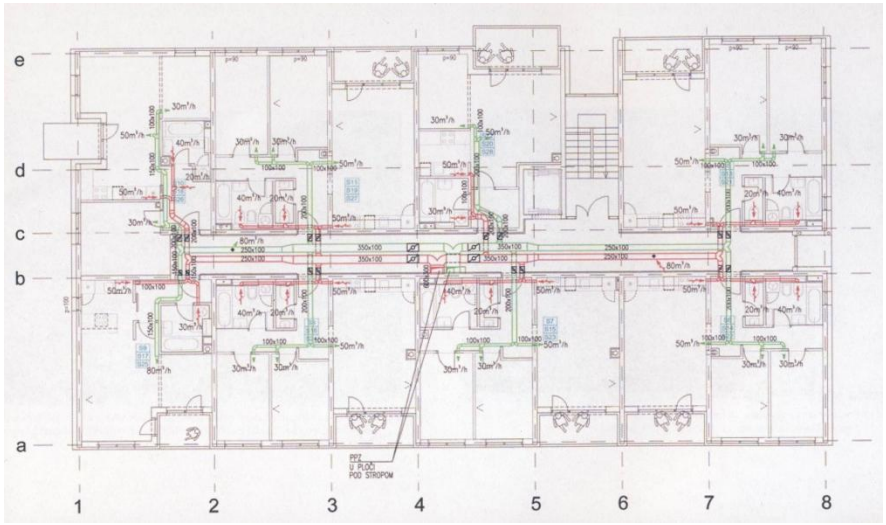
Residential building in Koprivnica is the second realized multy family building in *passive house standard* in Croatia. The first one financed in the frame of the Social housing programe so called POS.

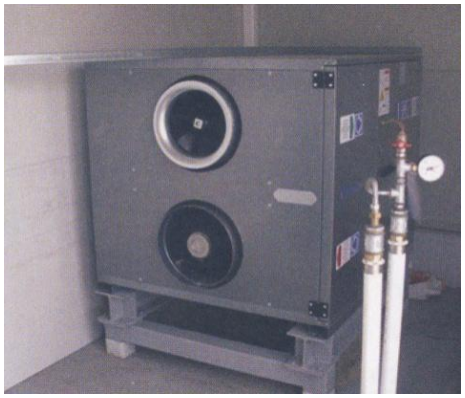
The price for m² netto surface is 897,00 €

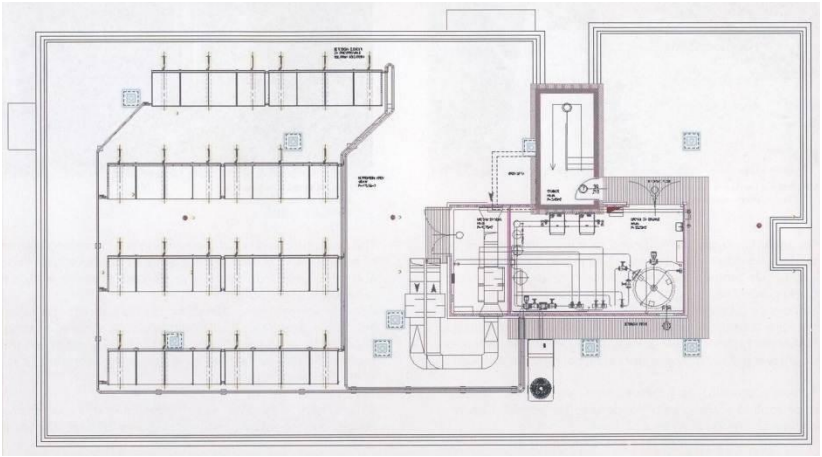
The first residential building from the social housing program (POS) in Koprivnica, Croatia, 2011

Energy certificate for A+ class. Author: Tehnika d. d.

The price for m^2 netto surface is **897,00 €**







E C O – S A N D W I C H® project

ECO-SANDWICH® wall system was developed as a result of cooperation between Croatian scientific institutions (Faculty of Civil Engineering and Faculty of Architecture, University of Zagreb) and industry.

It is a ventilated prefabricated wall panel that utilizes recycled construction and demolition waste (CDW) and mineral wool produced using innovative and sustainable Ecose® technology.

ECO-SANDWICH®tackles four major environmental problems. It reduces greenhouse gas emission by energy efficiency of buildings, it reduces energy consumption in building sector, it increases resource efficiency through the use of construction and demolition waste (50% of total aggregates is obtained from recycled aggregate) and it minimizes the use of regulated chemicals like phenol and formaldehyde from the insulation material production process.

ECO–SANDWICH

Prefabricated ventilated facade pannels of recycled building material ECO-SANDWICH

Author: ECO-SANDWICH Consortium

Production, Beton Lučko d.o.o., Lučko, Croatia

Prefabricated ventilated facade pannels of recycled building material ECO-SANDWICH

Author: ECO-SANDWICH Consortium

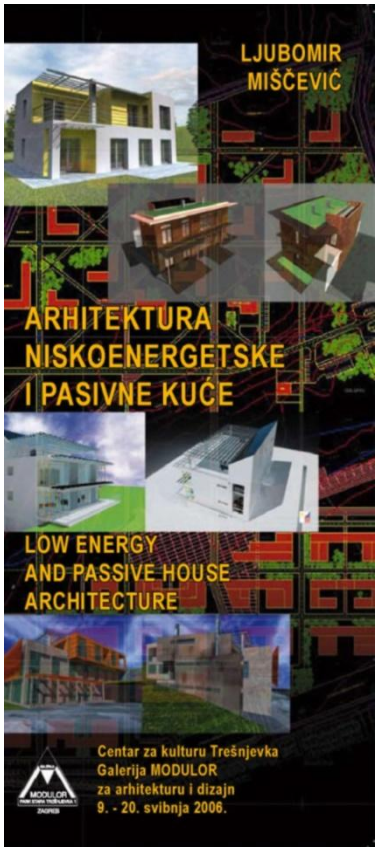
Transportation to the first implementation building site, Koprivnica, Croatia

Prefabricated ventilated facade pannels of recycled building material ECO-SANDWICH

Author: ECO-SANDWICH Consortium

The first implementation building site, Koprivnica, Croatia

e x h i b i t i o n s



Architecture as Industrial Design, 2016

First ECO - SANDWICH® house

Project Name: First ECO-SANDWICH® House
Architect: prof. Ljubomir Miščević, M.Arch.
Architect Firm: University of Zagreb, Faculty of Architecture, Institute for Architecture
Contact Mail: miscevic@arhitekt.hr, mmiscevic@arhitekt.hr
Project Year: 2014.-2015.
Completion Year: 2016.
Area: 393,9 sqm
Location: Zvonimira Goloba 2, 48 000 Koprivnica, Croatia
Photographers: Mark Miščević, Marko Mihaljević

Client: Agencija za društveno poticanu stanogradnju Grada Koprivnice
City of Koprivnica Social Housing Agency
Lead Architect: prof. Ljubomir Miščević, M.Arch.
Collaborators: Tea Beličev, Mark Miščević
Structural Engineering: Mladen Meštrović
Mechanical Installations: Ivan Cetinić
Plumbing and Drainage: Ivan Cetinić
Electrical Engineering: Stipe Mihotić
Facade design: Beton Lučko d.o.o., Leo Gavrić
Main Contractor: Teh-Gradnja d.o.o.

THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

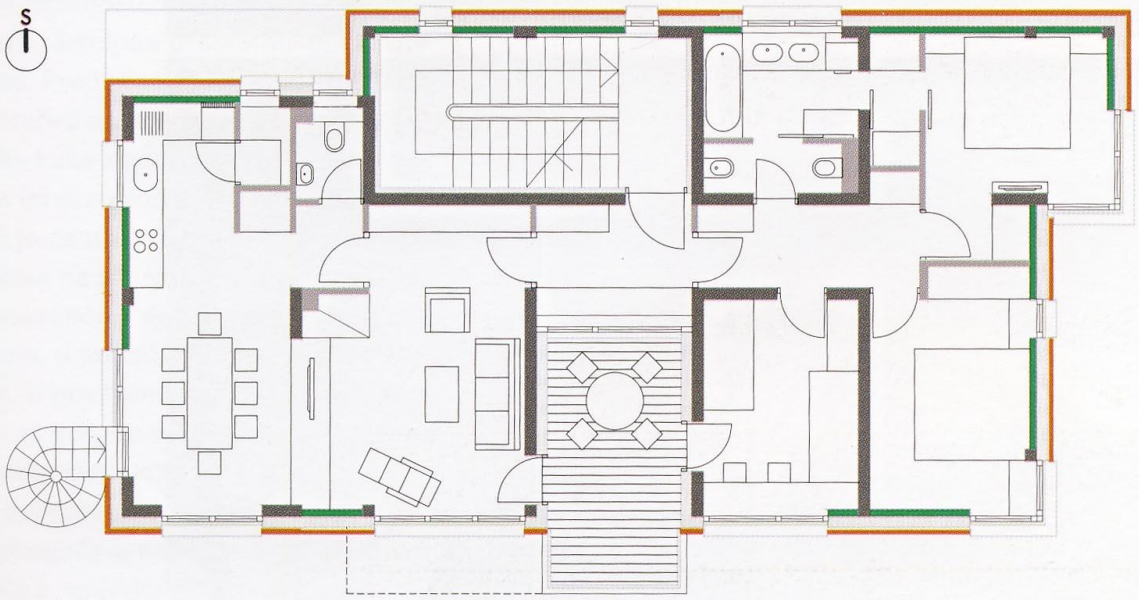
Author: Lj. Miščević

ECO-SANDWICH®

THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

tlocrt kata



ECO–SANDWICH®

THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

ECO–SANDWICH®

THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

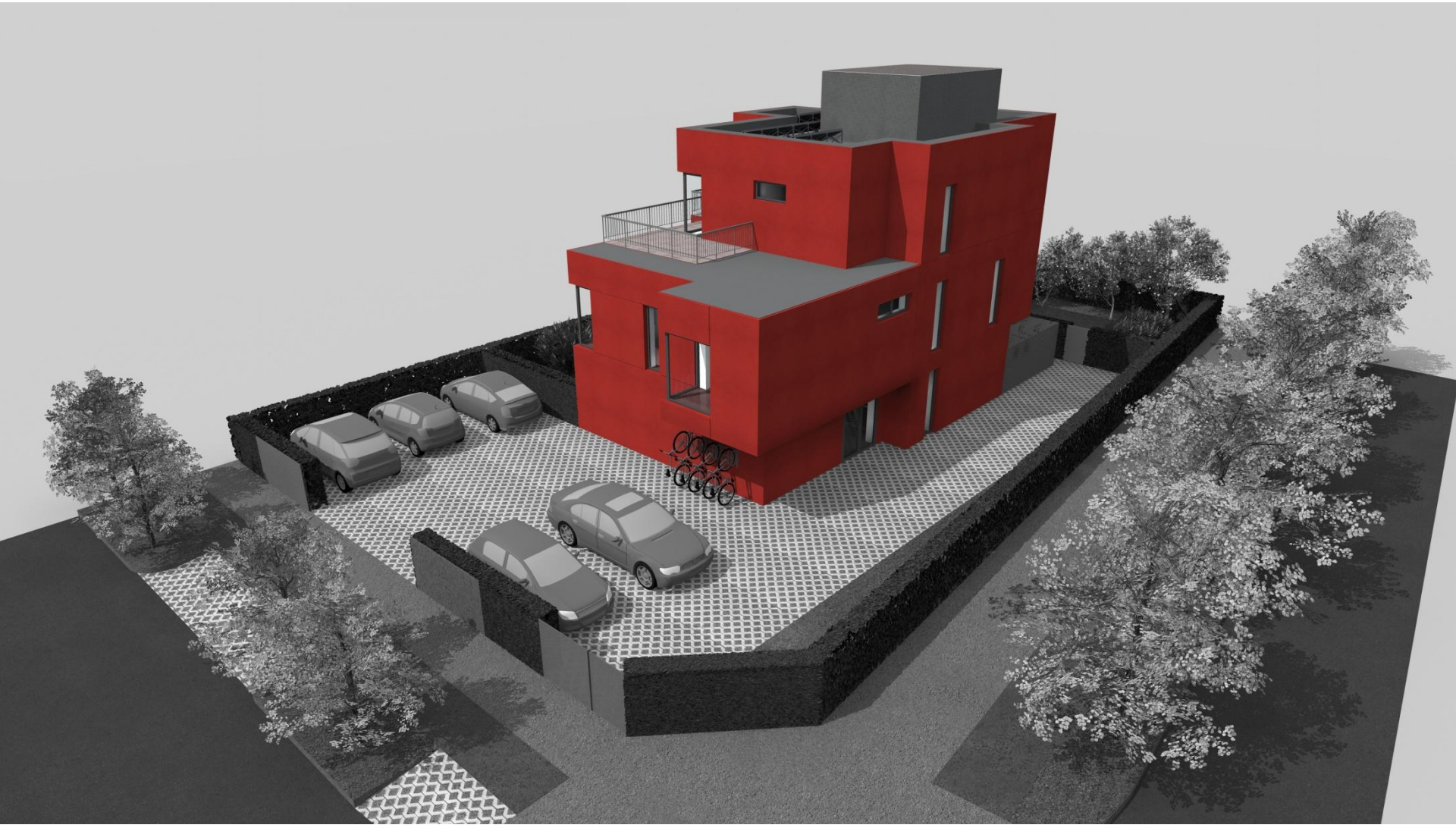
ECO–SANDWICH®

THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

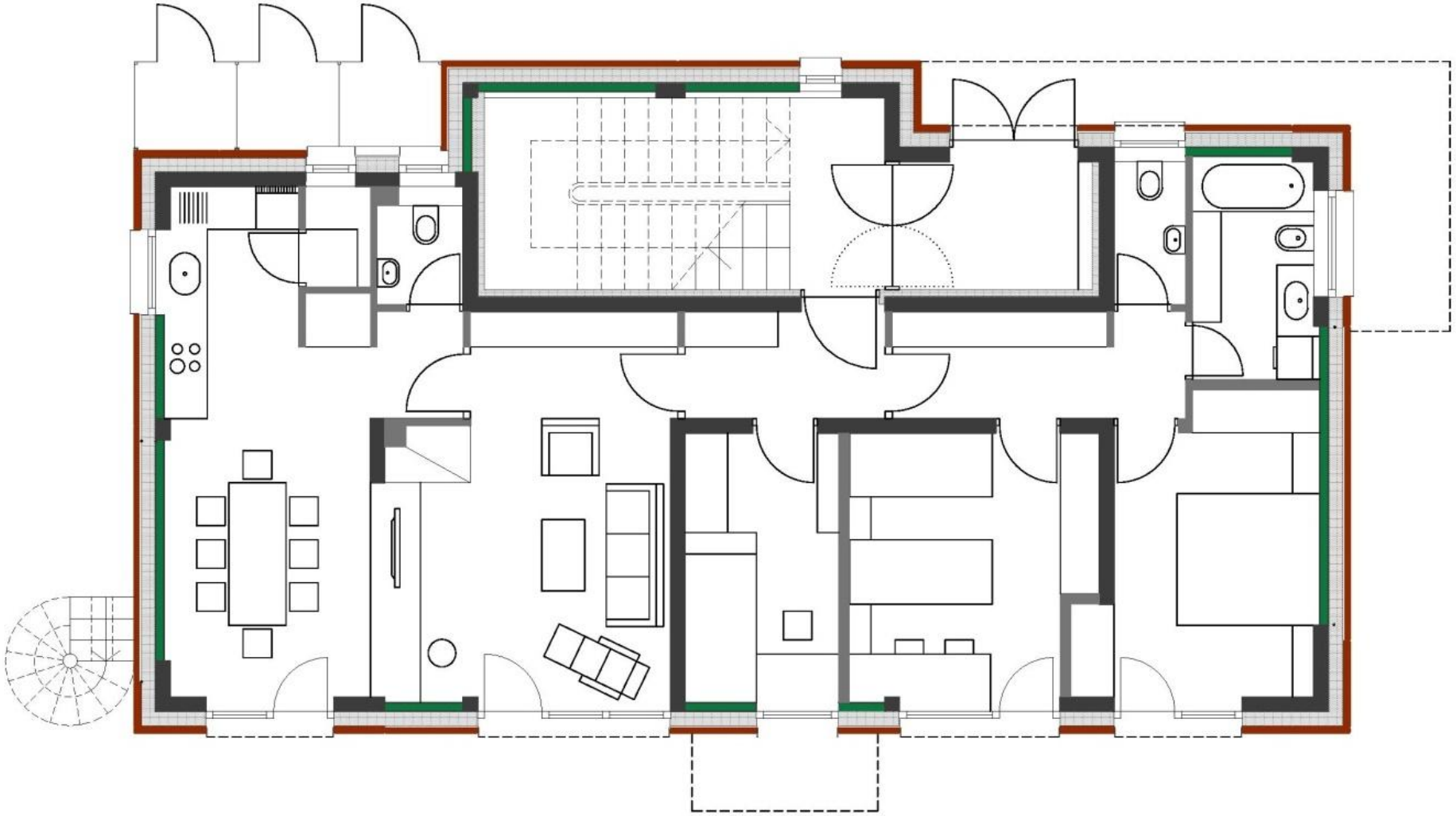
ECO–SANDWICH®

First ECO - SANDWICH® house



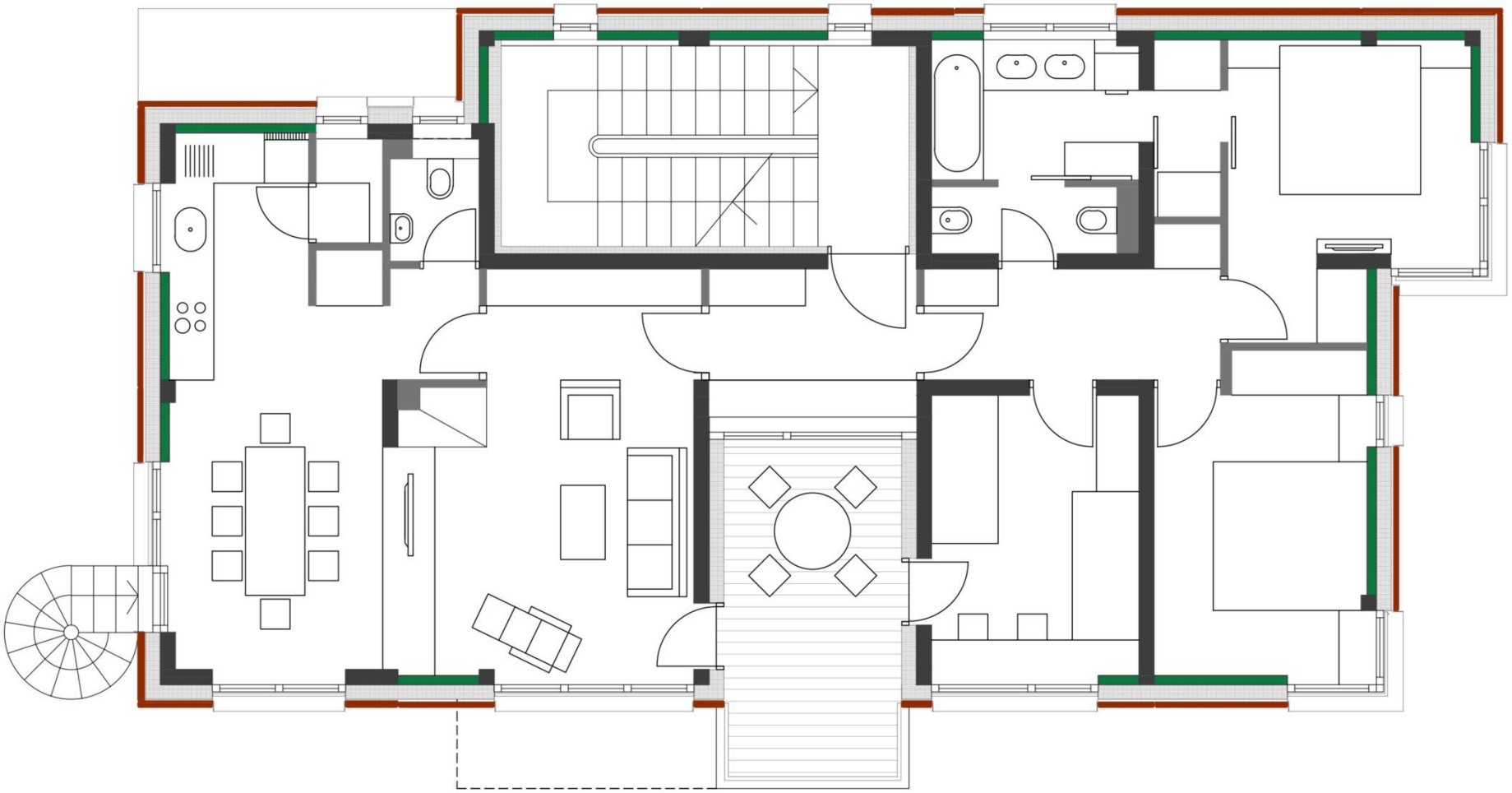
First ECO - SANDWICH® house

First ECO - SANDWICH® house



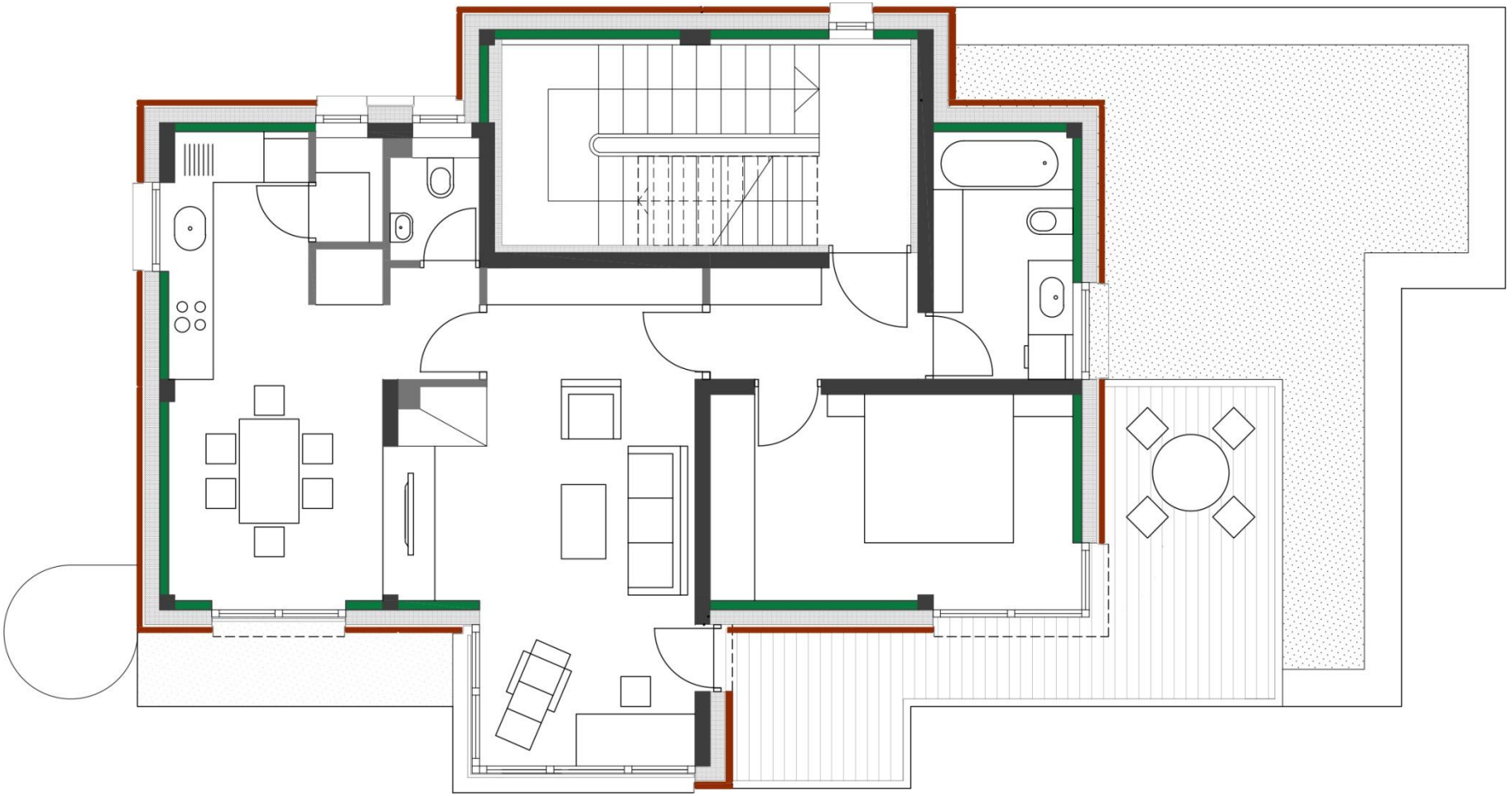
ground floor

First ECO - SANDWICH® house



first floor

First ECO - SANDWICH® house



second floor

THE FIRST ECO-SANDWICH A+ family house

Building site, Koprivnica, Croatia, 13th November 2015, 13:16

ECO-SANDWICH

European Commission

BUILD UP Skills Croatia
CROSKILLS

BUILD UP SKILLS
ENERGY TRAINING FOR BUILDERS

National roadmap
for a lifelong learning of construction workers in the field of energy efficiency

www.buildupskills.eu/hr

INTELLIGENT ENERGY EUROPE

BUILD UP Skills Croatia
CROSKILLS

BUILD UP SKILLS
ENERGY TRAINING FOR BUILDERS

Energy training
for builders

An initiative to boost the energy skills of Europe´s building workforce

www.buildupskills.eu

INTELLIGENT ENERGY EUROPE

CROSKILLS, BUILD UP Skills Croatia

EC funded project, CIP IEE
IEE/12/BWI/457/SI2.623227

Starting date: 7th June 2012
Project duration: 18 months

Coordinator:
University of Zagreb, Faculty of Civil Engineering

Project coordinator:
Prof.dr.sc. Ivana Banjad Pečur

Adress:
Fra Andrije Kačića Miošića 26
HR – 10000 Zagreb

Email:
banjadi@grad.hr

Phone:
+385-1-4639-162

Partners:

University of Zagreb, Faculty of Civil Engineering
Fra Andrije Kačića Miošića 26, HR-10000 Zagreb

Ministry of Construction and Physical Planning
Ulica Republike Austrije 20, HR-10000 Zagreb

Regional Environmental Center
Ferde Livadića 35, HR-10000 Zagreb

Croatian Chamber of Trades and Crafts
Ilica 49/II, p.p.166, HR-10000 Zagreb

School of Building and Crafts
Športska 1, HR-40000 Čakovec

University of Zagreb, Faculty of Architecture
Fra Andrije Kačića Miošića 26, HR-10000 Zagreb

Knauf Insulation Ltd.
Varaždinska 140, HR - 42220 Novi Marof

United Nations Development Programme Croatia
Radnička 41/8, HR-10000 Zagreb

INTELLIGENT ENERGY EUROPE

BUILD UP SKILLS

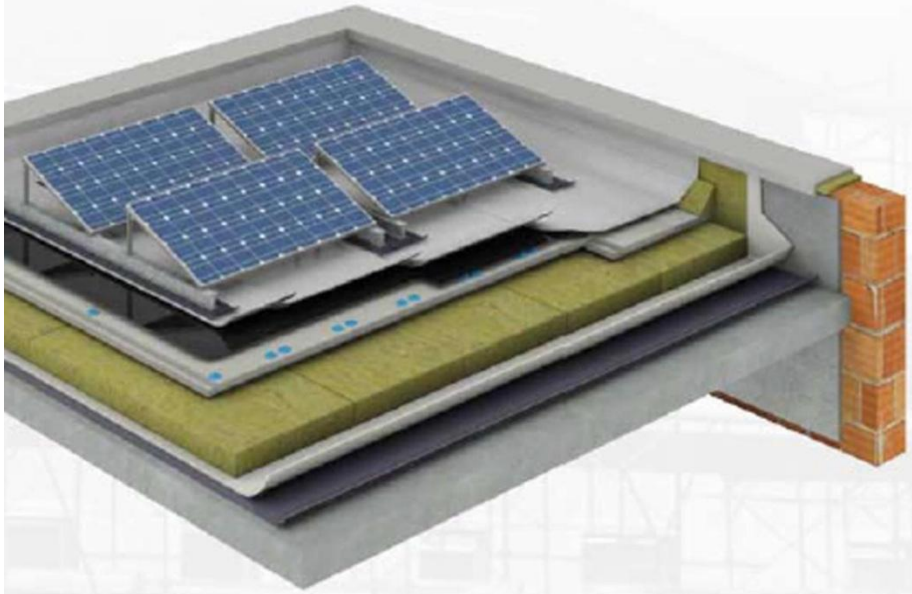
BUILD UP Skills - CROATIA
CROSKILLS

STATUS QUO ANALYSIS OF THE BUILDING SECTOR IN CROATIA AND SKILLS OF CONSTRUCTION WORKERS IN THE FIELD OF ENERGY EFFICIENCY AND RENEWABLE SOURCES OF ENERGY

February 2013

BUILD UP SKILLS

BUILD UP Skills - CROATIA
CROSKILLS



NATIONAL ROADMAP FOR A LIFELONG EDUCATION OF CONSTRUCTION WORKERS IN THE FIELD OF ENERGY EFFICIENCY

June, 2013

UHA - ČIP TALKS

Zageb, 3.10.2009.

HRVATSKA KOMORA ARHITEKATA

SUSTAINABILITY, ARCHITECTURE AND TOWN

Round table - TRANSSOLAR

Prof. **Ljubomir Miščević**, M.Arch

University of Zagreb
Faculty of Architecture
Kačićeva 26, HR-10000 Zagreb
+385 1 4639394, fax: +385 1 4828079
miscevic@arhitekt.hr pass-net@arhitekt.hr
www.arhitekt.hr www.sunarh.hr

Af

Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

CROATIAN SOLAR HOUSE (CSH) www.solar-house.hr
CENTRE FOR RENEVABLE ENERGY SOURCES (CERES)

HRVATSKA CERES

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Intelligent Energy Europe

passnet

3rd International Symposium on Environmental Management

Towards Sustainable Technologies

October 26 – 28, 2011, Zagreb, Croatia

Faculty of Chemical Engineering and Technology

University of Zagreb

From Nanomaterials to Self-sufficient Cities

Prof. **Ljubomir Miščević**, M. Arch.

University of Zagreb
Faculty of Architecture
Kačićeva 26, HR-10000 Zagreb, Croatia
+385 1 4639394, fax: +385 1 4828079
miscevic@arhitekt.hr www.arhitekt.hr

Af

Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

CENTAR ZA OBNOVLJIVE IZVORE ENERGIJE
HRVATSKA
CERES

Fostering public capacity to plan, finance and manage
integrated urban REGeneration for sustainable energy uptake

fosterREG

Jačanje kapaciteta upravnih tijela za planiranje, financiranje i upravljanje integriranom urbanom obnovom za održivo korištenje energije

Osječko-baranjska županija, Osijek, 29.1.2016.

Integration of energy efficiency and urban planning
Integracija energetske učinkovitosti i urbanizma

Full Prof. **Ljubomir Miščević**, Mag. Eng. Arch. Urb.

Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture

KONZORCIJ PASIVNA KUĆA HRVATSKA

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miscevic@arhitekt.hr pass-net@arhitekt.hr ides-edu@arhitekt.hr
www.arhitekt.hr www.sunarh.hr www.pass-net.net www.ides-edu.eu

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Intelligent Energy Europe Programme of the European Union

Sveučilište u Zagrebu
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Faculty of Architecture

KONZORCIJ PASIVNA KUĆA HRVATSKA

Poštovani,

Obavještavamo Vas o održavanju trodnevnog međunarodnog skupa s izložbom i stručnim obilascima. Desetu godinu uzastopno ćemo govoriti o najnaprednijoj energetski visoko učinkovitoj arhitekturi i gradnji energetskog standarda *pasivne kuće*, odnosno energetskog razreda A+ novogradnje i obnove do "faktora 10".

10. dani pasivne kuće u Hrvatskoj su ishodište spoznaja stručno utemeljenih i ostvarenih najboljih praksi novih i obnovljenih zgrada u Hrvatskoj i inozemstvu, usklađenih s definicijama novih tipova *pasivnih kuća*, njihovoj certifikaciji i odnosu prema definiciji energetski gotovo nulte gradnje.

Prikazat će se funkcionalno različiti projekti i ostvarenja, promovirat će se novi građevinski materijali i sustavi, instalacijski sustavi i oprema visoke energetske učinkovitosti. Trajne su i teme zakonskog okvira RH i EU te modeli investiranja uključujući poticaje i potpore.

Izvorna iskustva planiranja, projektiranja i ostvarenja u Hrvatskoj po četvrti put on-line prikazujemo i komentiramo iz regionalnalnih centara.

Pozivamo stručnjake, nastavnike, studente i učenike, projektante, izvoditelje, proizvođače, izlagače, investitore, banke, predstavnike gradova, županija, lokalne uprave, fondova, udruge i institucije te sve zainteresirane građane na aktivno sudjelovanje, kako bi i 10. dani postigli visoku razinu razmjene i stjecanja novih znanja uz kolegijalno druženje.

S poštovanjem,

Za Organizacijski odbor

Red.prof.art. Ljubomir Miščević, dipl.ing.arh.
Voditelj Konzorcija pasivna kuća Hrvatska

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10. DANI PASIVNE KUĆE U HRVATSKOJ

/ 10th PASSIVE HOUSE DAYS IN CROATIA

10.- 12. studeni 2017. / 10th-12th November 2017

Arhitektonski fakultet / Faculty of Architecture, Fra A. Kačića Miošića 26, HR-10000 Zagreb

Prijavnica je na www.kpk.hr

Pošaljite nam Vašu prijavnicu kako bi Vas uvrstili u adresar Konzorcija!

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KONZORCIJ PASIVNA KUĆA HRVATSKA

10.

Af Sveučilište u Zagrebu Arhitektonski fakultet University of Zagreb Faculty of Architecture

10.-12.11.2017.

Pozivamo vas na sudjelovanje!

Deset godina kontinuiteta o energetski najnaprednijoj visoko učinkovitoj novogradnji i dubinskoj obnovi “faktor 10”

- Pasivna kuća *plus* i *premium*
- Projekti i ostvarenja u Hrvatskoj i svijetu
- Regije pasivnih kuća
- Pasivna kuća za sve
- Izložba
- Stručni obilasci

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10

University in Zagreb, Faculty of Architecture
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Sveučilište u Zagrebu
Arhitektonski fakultet
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