solar decathlon 21»22 europe

WUPPERTAL GERMANY ...goes urban!

exhibition handbook

message of greeting

Dear Participant,

Retrofitting the building stock to improve energy efficiency plays a key role in achieving our climate targets. It is particularly important that we meet these targets in a way that is both effective and socially acceptable. As Minister with responsibility for climate action and the energy transition, I therefore have great expectations for the Solar Decathlon Europe in Wuppertal.

This event consists of 18 teams from eleven nations who share one common vision: to achieve the best in energy efficiency, sustainability and design. With participants from a broad array of fields, the Solar Decathlon is not only a showcasing event, but also sends an important signal for strong international cooperation. The students' buildings show in different ways how our cities can be modernised around energy use and how they can continue to be built sustainably, avoiding the use of fossil fuels.

Participants of the competition worked together on their projects over a period of three years, from the idea right up to the finished building. Thanks to their dedication, the Solar Decathlon Europe makes the energy and resource transition tangible for a wider public. The best-practice solutions presented in Wuppertal and the inclusion of academia, companies, government and civil society create space for cooperation, the transfer of expertise, and innovation.

I am delighted that the competition is being held in Germany this year for the first time in its 20-year history. Let yourself be inspired and take advantage of the various opportunities to come into contact with the energy transition in the buildings sector.

I wish you a great time at this event and many new insights.

Sincerely yours,

Dr Robert Habeck
Federal Minister for Economic Affairs and Climate Action

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neue/effizienz

STADT WUPPERTAL

UTOPIASTADT

WSW.

Wuppertal Institut

solar decathlon europe

The Solar Decathlon Europe (SDE) is the most significant university-level competition in the world. Students are challenged to design, build, and operate high-performance, low-carbon buildings that mitigate climate change and improve our quality of life through greater affordability, resilience and energy efficiency.

The award-winning event comes to Germany for the first time. The SDE 21/22 in Wuppertal will gather architects, engineers, and multidisciplinary sustainability experts to communicate and showcase cutting-edge research and technologies in architecture, renewable energy, water, waste, and food systems. The ultimate goal is to catalyse the transition toward a socially inclusive and ecologically regenerative future.

The SDE 21/22 Organisation is comprised of the University of Wuppertal's School of Architecture and Civil Engineering and the Energy Endeavour Foundation, a Netherlands-based non-profit business entity endorsed by the U.S. Department of Energy to administer the SDE.

The project is funded by the German Federal Ministry of Economic Affairs and Climate Action.

BERGISCHE UNIVERSITÄT WUPPERTAL

energy endeavour FOUNDATION
GOVERNING BODY OF THE SOLAR DECATHLON EUROPE

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

solar decathlon – a worldwide movement

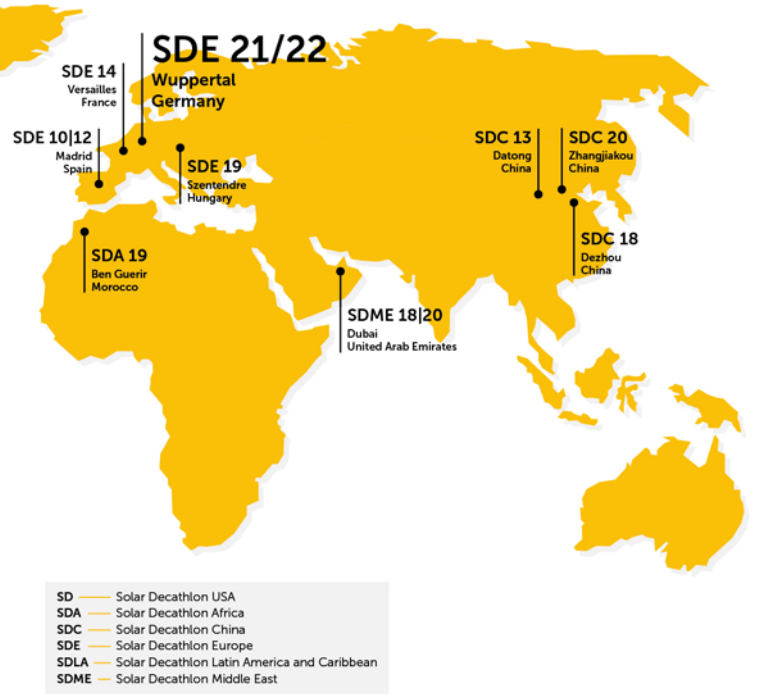
Initiated by the United States Department of Energy, the first Solar Decathlon was held in Washington in 2002. The competition quickly attracited international interest. Today, beyond the U.S., competitions take place in Europe, China, the Latin America, the Middle East, Africa and India. Each Solar Decathlon Competition is shaped to address specific regional characteristics, economic conditions and evolving technologies for energy efficiency and renewables.

Thus far, the Solar Decathlon Europe has welcomed visitors twice in Madrid, Spain (SDE10 and SDE12); in Versailles, France (SDE14); and in Szentendre, Hungary (SDE19).

The upcoming SDE25 Call for Cities has been announced by the Energy Endeavour Foundation (EEF); providing the structure and framework for the SDE, custodian of the SDE rules and brand, the EEF designates host cities through European SDE Calls for Cities and international SDE Calls for Teams. The EEF transfers strategic tools, best practices, and project knowledge to SDE host cities, ensuring the quality and evolution of the SDE.

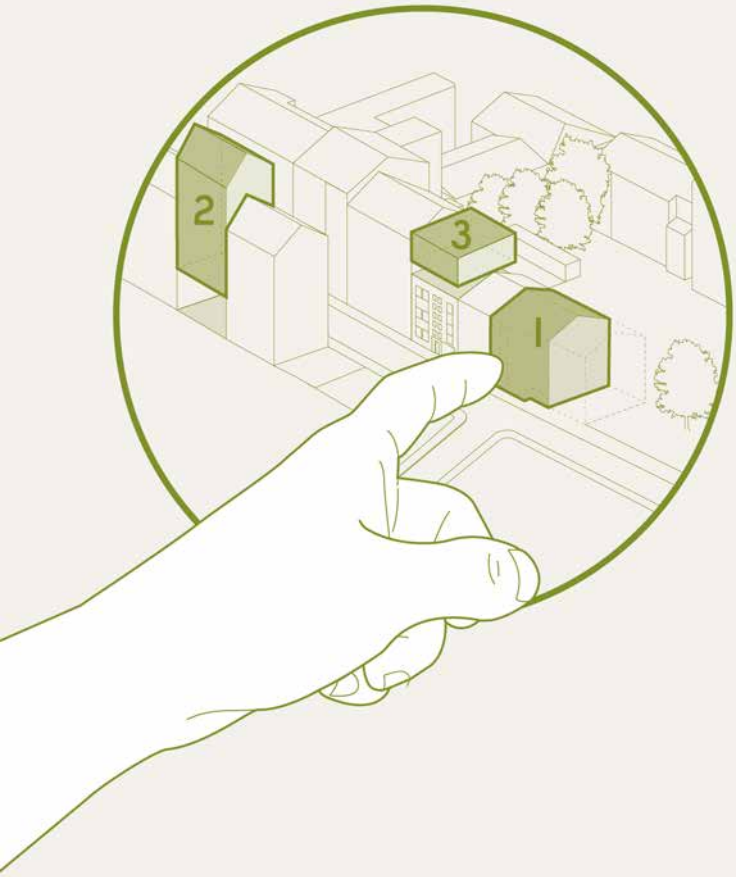
More information on the SDE25 Call for Cities can be found at **www.solardecathlon.eu/sde25_-call-for-cities**

More information on previous events is available at **www.building-competition.org** and at **www.solardecathlon.eu**



SD — Solar Decathlon USA
SDA — Solar Decathlon Africa
SDC — Solar Decathlon China
SDE — Solar Decathlon Europe
SDLA — Solar Decathlon Latin America and Caribbean
SDME — Solar Decathlon Middle East

solar decathlon europe 21/22 goes urban



The SDE 21/22 in Wuppertal features a unique new concept, where the focus is dedicated to the extensions of existing buildings and multi-storey residences. All teams address real tasks related to an existing building stock: building extensions, adding storeys, or closing gaps between buildings.

The stress is always on improving the existing building stock. The SDE 21/22 demonstrates all facets of the potential and the technical feasibility of climate-neutral buildings in cities. Holding the Competition in Germany is part of the country's efforts to achieve a climate-neutral building stock by 2045.

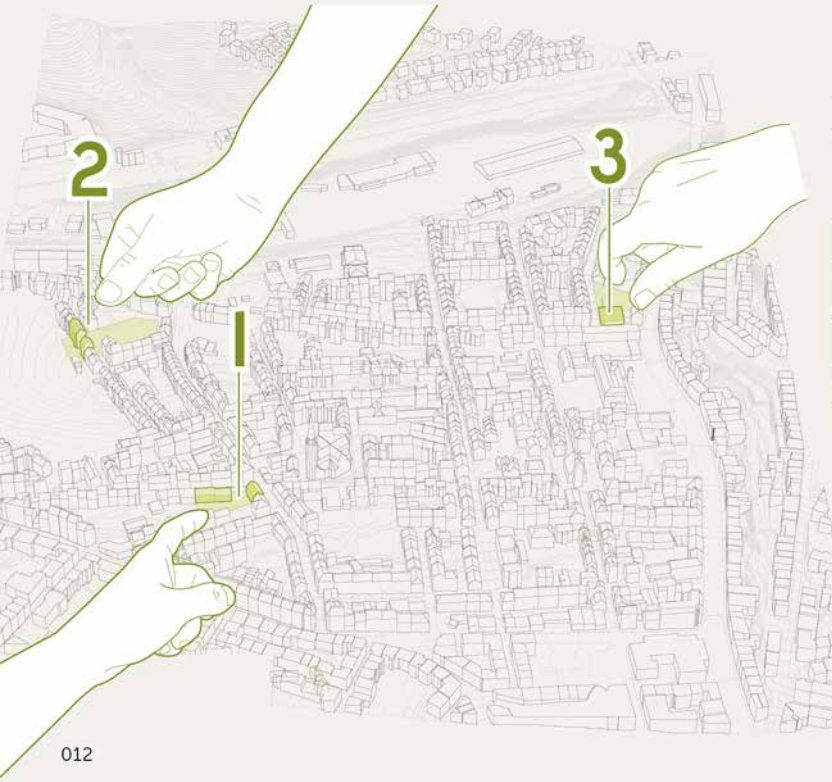
how the competition works

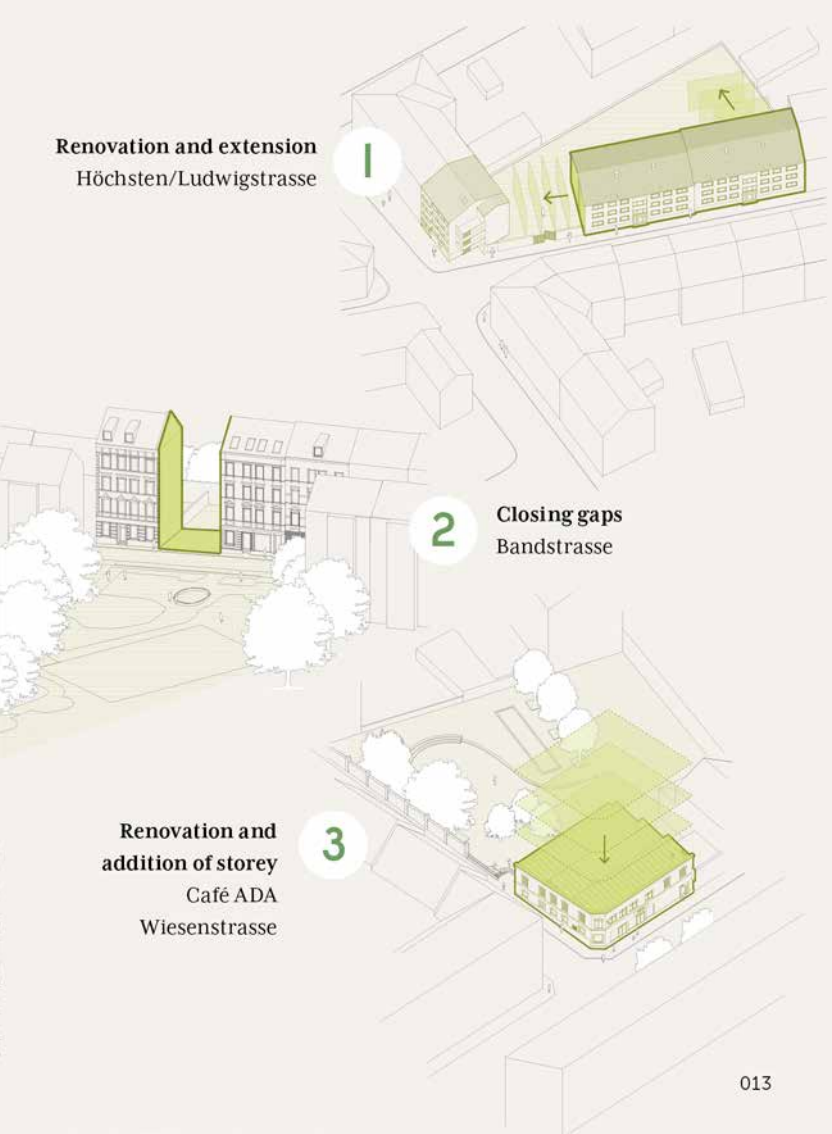
Taking existing buildings as their starting point, the eighteen SDE 21/22 Teams chose one of three urban situations, all of which reflect the rea-life challenges of our urban building stock.

1. renovation and extension
2. closing gaps
3. renovation and addition of storeys

wuppertal, an exemplary city in Europe

Wuppertal is not only the venue of the SDE 21/22 but also a source of inspiration for the ideas generated during the Competition. Each of the three urban situations represents a particular urban development challenge found in Wuppertal's Mirke district. Alternatively, Teams were free to choose a comparable urban situation in their country of origin.




1
Renovation and extension
Höchsten/Ludwigstrasse
2
Closing gaps
Bandstrasse
3
Renovation and
addition of storey
Café ADA
Wiesenstrasse

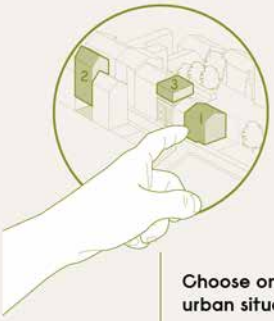
from design to building

“Design-build-operate” is both the principle and the unique characteristic of the Solar Decathlon Europe. The Competition format involves two challenges:

In the **Design Challenge**, the Teams create a design and energy concept for a complete building, including its urban context, putting principles of climate neutrality into practice.

In the **Building Challenge**, the Teams construct a representative full-scale demonstration unit (HDU) on the event site in Wuppertal. The results are fully functional one to two-storey demonstration units with apartments of up to 110 m^2 of living space that combine outstanding architecture with high-quality construction and building technology. While the Teams are free to choose the most representative part of their building design, architecturally integrated solar systems must be included.

explanation of the competition mode



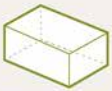
Choose one
urban situation

Handle both Challenges

Design Challenge + Building Challenge

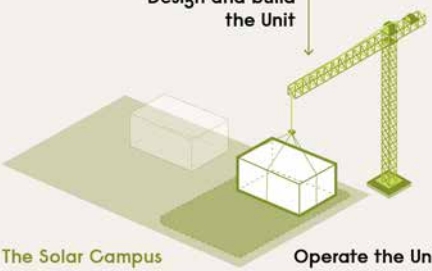
Design and energy concept
for the whole building

Choose
representative
Unit



Demonstration Unit

Design and build
the Unit



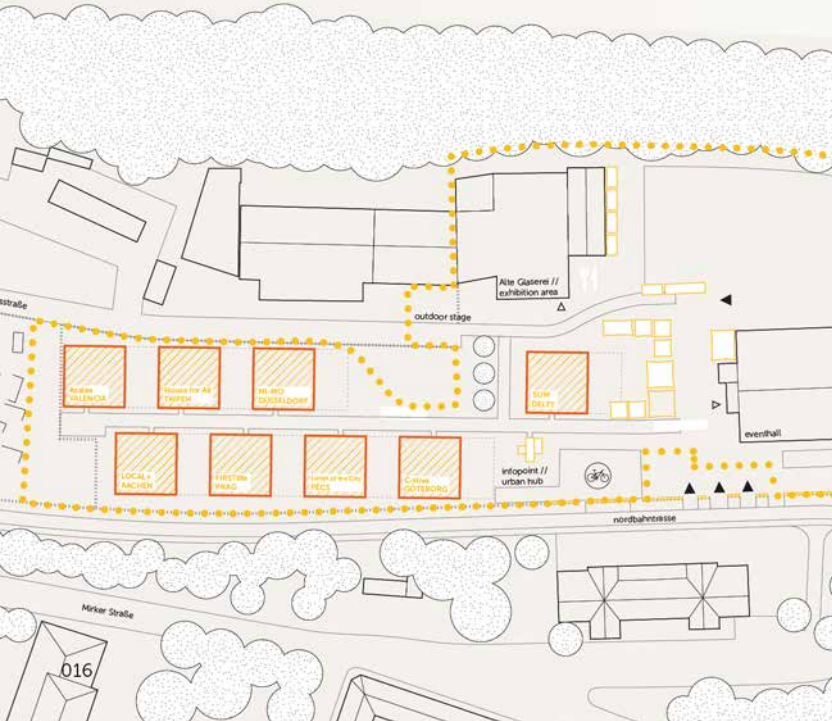
The Solar Campus

Operate the Unit

Contest in
ten disciplines

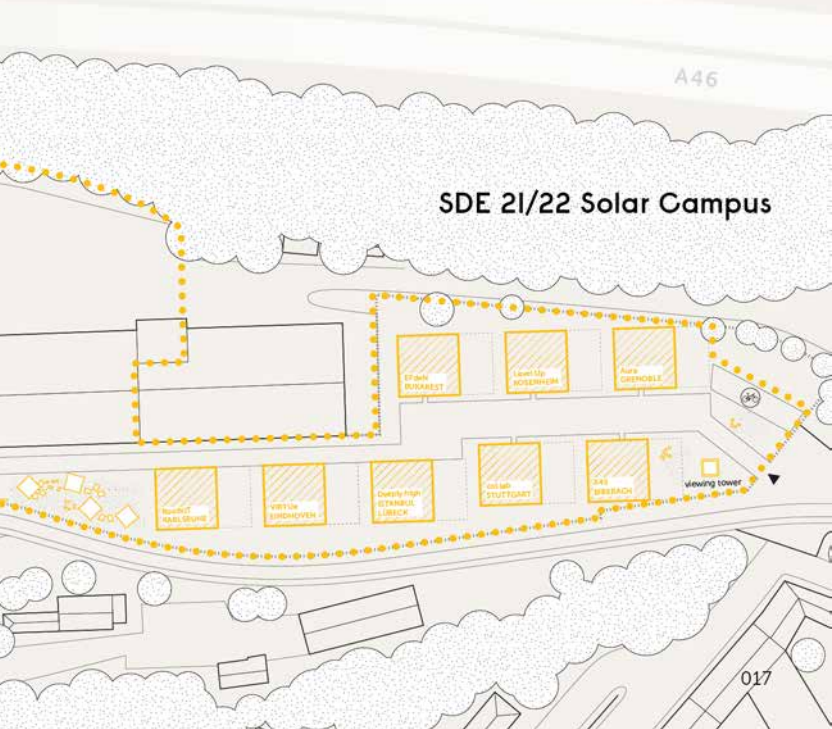
our solar campus in wuppertal

The approximately 50,000 m² event site, the Solar Campus, is located in the heart of Wuppertal. It lies in the Mirke district near the Nordbahntrasse cycle and footpath in the Elberfeld quarter. The Solar Campus is an engaging place of collective participation and discovery. Guided tours of the Demonstration Units raise awareness of sustainability in housing. The supporting programme, with culture and country days, activities for schools and universities, conferences and symposia, offers exchanges and inspiration for professionals as well as the general public.



living lab nrw

The Living Lab NRW (North-Rhine-Westphalia) is a central research and educational institution funded by the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of NRW. As a follow-up project to the Solar Decathlon Europe 21/22, it concerns the development of a real-life laboratory consisting of eight of all demonstration buildings. The Living Lab will stimulate research, information, and dissemination of innovation in climatefriendly, energyefficient buildings and city living.



ten contests

1 • architecture

2 • engineering & construction

3 • energy performance

4 • affordability & viability

5 • communication, education & social awareness

6 • sustainability

7 • comfort

8 • house functioning

9 • urban mobility

10 • innovation

In the energy performance, comfort and house functioning contests, the quality assessment is carried out by means of measurements.

In all other contests, a jury evaluates the projects. The SDE 21/22 jury is comprised of eighteen renowned international experts from science and practice. The jury evaluates the Demonstration Unit built on the Solar Campus (Building Challenge) in the context of the Teams' overall building design (Design Challenge). The focus is on a holistic view of the energy transition – from affordability and sustainability to sector coupling with mobility. The team that scores the most points and thus presents the most convincing concept for climate-friendly building and living in our cities wins the overall Competition award of the SDE 21/22.

our jury

The jury consists of three members per contest. They award their points based on inspections of the buildings, project presentations by the Teams and documents submitted by the Teams in the Competition.

The points in the Innovation contest are awarded for each of the disciplines by the jury members of the Architecture, Engineering & Construction, Sustainability, Affordability & Viability and Urban Mobility contests.

The public award ceremonies for the winning teams in each discipline are one of the highlights of our event programme. They will occur on the Solar Campus between 12 and 24 June 2022. Expert presentations from jury members will introduce each ceremony.

Architecture

Prof. Dietmar Eberle
Baumschlager Eberle
Architekten
Austria

Jette Cathrin Hopp
Snøhetta
Norway

Fuensanta Nieto
Nieto Sobejano
Arquitectos
Spain

Engineering & Construction

Dr-Ing. Markus Lichtmess
Institute for Building
Energy Research
Germany

Prof. Dr-Ing. Nathan Van Den Bossche
Ghent University
Belgium

Prof. Dr-Ing. Maria Wall
Lund University
Sweden

Affordability & Viability

Anne Lacaton
Lacaton & Vassal
France

DI Bahanur Nasya
Eutropian
Austria

Prof. Dr Guido Spars
Bundesstiftung
Bauakademie
Germany

Sustainability

Dr Anna Braune
German Sustainable
Building Council (DGNB)
Germany

Prof. Andrea Klinge,
Dipl.-Ing. Architecture,
University of Applied
Sciences Northwestern
Switzerland

Søren Nielsen
Vandkunsten Architects
Denmark

Communication, Education & Social Awareness

Richard King
Founder of the
Solar Decathlon
United States

Jakob Schoof
DETAIL
Germany

Asst. Prof. DI
Dr Karin Stieldorf
TU Wien
Austria

Urban Mobility

Dr Jörg Beckmann
Mobility Academy
Switzerland

Prof. Dr-Ing.
Heather Kaths
University of Wuppertal
Germany

Prof. Dr John Whitelegg
University of York
United Kingdo

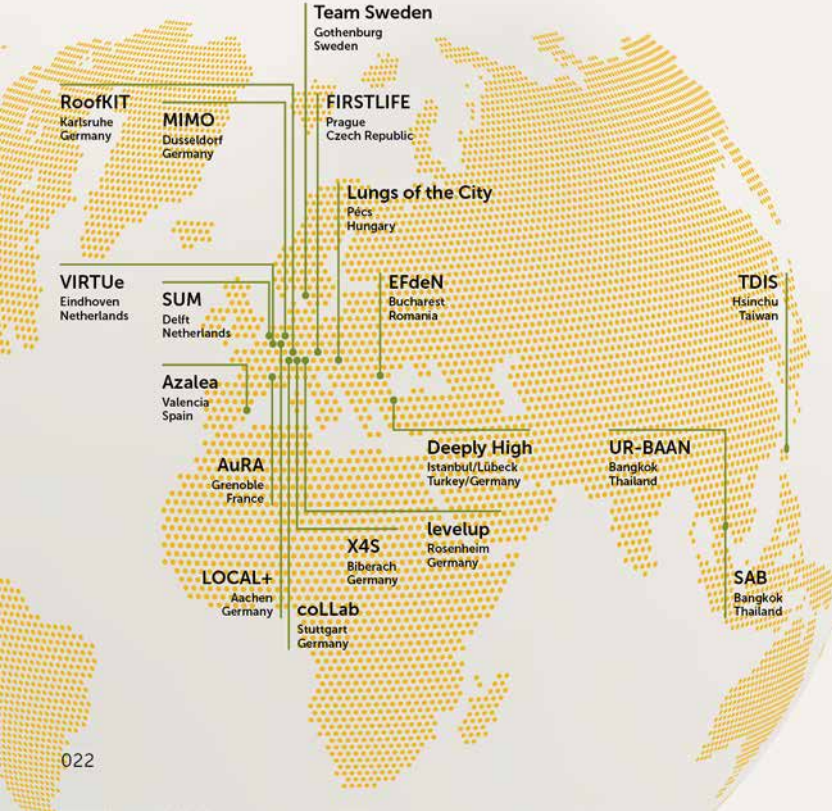
out of competition awards

In addition, the teams have a chance to win eleven Out of Competition Awards. Most of these were developed in cooperation with institutions and associations from building practices. The special awards aim to promote knowledge transfers between research and application.

- The **Applied Mobility Sciences Award** by the European Platform of Transport Sciences – EPTS Foundation e.V.
- The **Building for Future Award** by the Local Council of Skilled Crafts Solingen-Wuppertal and the Chamber of Crafts Düsseldorf
- The **German Sustainable Housing Award** by the Federal Association of German Housing and Real Estate Companies (GdW)
- The **Green BIM Award** by the Association of German Engineers (VDI), buildingSMART Germany and the BIM-Institute of the University of Wuppertal
- The **Human Centered Interior Architecture Award** by the Association of German Interior Architects (bdia)
- The **Indoor Air Quality Award** by the Association for Air-Conditioning and Ventilation in Buildings (FGK)
- The **Mirke Choice Award**, awarded by the Mirke District (Wuppertal)
- The **People's Choice Award**, Audience award
- The **Solar Award** by the International Solar Energy Society (ISES) and the Solar Heating and Cooling Programme of the International Energy Agency (IEA SHC)
- The **Sustainable Architectural Lighting Award** by the Deutsche Lichttechnische Gesellschaft e.V. (LiTG)
- The **Timber Construction Award** by the cooperation of Timber Construction Associations

our teams and their projects

Eighteen Teams from eleven countries are participating in the Solar Decathlon 21/22. Sixteen of them have assembled their House Demonstration Unit (HDU) for the Competition final at the Solar Campus in Wuppertal.



ID	TEAM NAME	INSTITUTION
BKU	SAB	Bangkok University
CHA	Team Sweden	Chalmers University of Technology Gothenburg
CTU	FIRSTLIFE	Czech Technical University in Prague
FHA	LOCAL+	Aachen University of Applied Sciences
GRE	AuRA	Grenoble School of Architecture
HBC	X4S	Biberach University of Applied Science
HFT	coLLab	Stuttgart University of Applied Sciences
HSD	MIMO	Düsseldorf University of Applied Sciences
ION	EFdeN	Ion Mincu, University of Architecture and Urbanism Bucharest
ITU	Deeply High	Istanbul Technical University / Technical University of Applied Sciences Lübeck
KIT	RoofKIT	Karlsruhe Institute of Technology
KMU	UR-BAAN	King Mongkut's University of Technology Thonburi
NCT	TDIS	National Yang Ming Chiao Tung University
ROS	levelup	Rosenheim Technical University of Applied Sciences
TUD	SUM	Delft University of Technology
TUE	VIRTUe	Eindhoven University of Technology
UPH	Lungs of the City	University of Pécs
UPV	Azalea	Polytechnic University of Valencia

You can find more information about the projects of the SDE 21/22 teams here:
www.sde21.eu/de/competition/teams-projects

context, strategies and technologies – overview

	BKU Bangkok	**CHA** Gothenburg	**CTU** Prague	**FHA** Aachen	**GRE** Grenoble	**HBC** Biberach	**HFT** Stuttgart
URBAN SITUATION							
Renovation & extension					●		
Closing gaps	●			●			
Renovation & addition of storey		●	●			●	●
Location Wuppertal (Design Challenge)	●			●		●	
Other location (Design Challenge)		●	●		●		●
Living Lab participant		●	●	●			
ARCHITECTURE (HDU)							
Common space	●	●	●	●	●	●	●
Green roof			●	●		●	●
Green façade	●		●	●			●
Passive House building standard	●	●				●	
Buffer space					●		
Solar chimney/trombe wall							●
Passive cooling	●	●		●	●	●	●
Advanced thermal mass activation	●			●	●	●	
Recycled or reused building materials	●	●	●	●	●	●	●
Experimental building materials	●	●	●		●		●

	HSD Düsseldorf	**ION** Bucharest	**ITU** Istanbul	**KIT** Karlsruhe	**KMU** Bangkok	**NCT** Hsinchu	**ROS** Rosenheim	**TUD** Delft	**TUE** Eindhoven	**UPH** Pécs	**UPV** Valencia
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	BKU Bangkok	**CHA** Gothenburg	**CTU** Prague	**FHA** Aachen	**GRE** Grenoble	**HBC** Biberach	**HFT** Stuttgart
SOLAR SYSTEMS (HDU)							
Additive PV (elevated)			●	●	●	●	●
Building integrated PV		●		●		●	
Hybrid solar systems (PVT)	●		●	●	●	●	
Solar thermal systems		●		●			
Battery storage	●		●	●	●	●	●
MECHANICAL INSTALLATIONS (HDU)							
DHW heat recovery				●		●	●
Heat pump	●		●	●		●	
Reversible heat pump				●	●	●	
Mechanical ventilation		●	●	●	●	●	
Ventilation heat recovery	●	●	●	●	●	●	
Grey water treatment	●		●				
Rain Water utilization	●	●	●		●		
INNOVATIVE INSTALLATIONS (HDU)							
Smart controls	●	●	●	●	●	●	
Experimental service systems	●	●	●			●	
Recycled service systems		●					

HSD Düsseldorf	**ION** Bucharest	**ITU** Istanbul	**KIT** Karlsruhe	**KMU** Bangkok	**NCT** Hsinchu	**ROS** Rosenheim	**TUD** Delft	**TUE** Eindhoven	**UPH** Pécs	**UPV** Valencia
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Explanation of icons for following pages

DC design challange

HDU (house) demonstration unit

total net floor area

number of floors

net floor area per person

	2553 m²	64 m²
	5	1
		28 m²/p

Team Name | Team Identity

AuRA | GRE

University

grenoble school of architecture grenoble, france

Task | Location of DC

renovation & extension (château-bernard)

Refer to page 24 for design features

Our vision

The greatest challenge of the 21st century will be sustainable development with room for all forms of life. Objective indicators keep revealing an advanced and growing state of degradation of the planet, the effects of which must be limited.

Our team has decided to take up this challenge by proposing a project in the Vercors region in the French Alps. The project opens up a vision for the region of belief in our collective capacity to change the course of events.

What are the alternatives to metropolises and megacities? We believe that there is a real balance to be established between overpopulated urban areas and less densely populated areas in France. A better balance would increase the whole country's resilience in the face of energy, health, and climate stresses which are set to increase in number and intensity in the coming decades. Rather than the densification of the city, distributed urbanism is the best way forward.

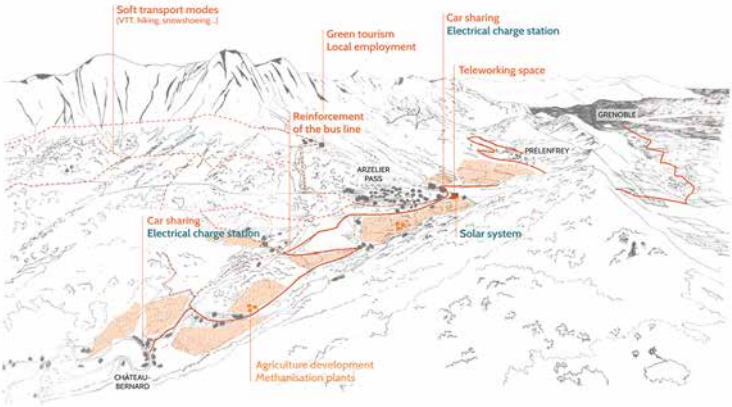
We have set out to create a community project that can serve as a lever for resilience. Our project proposes to accompany the transformation of the tourist model of a former ski resort by launching a raft of action projects taking their cue from the rehabilitation of existing buildings. These relate to:

- The new tourism of mid-mountain, and the seasonal habitat;
- Care and health as levers of social and economic development;
- Education and leisure facilities;
- Food resilience based on a sustainable agricultural system;
- The transformation of existing buildings into permanent housing.

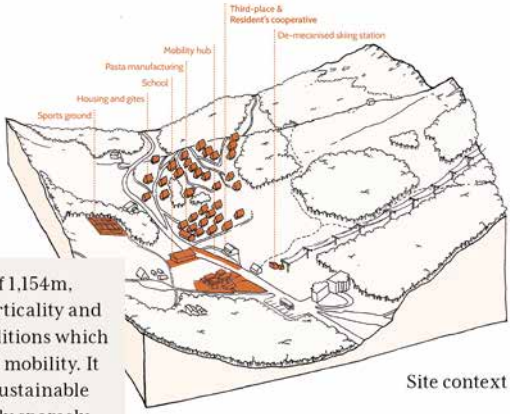
The project brings together the ambitions of our team, incorporating architecture, urbanism and landscape in its concerns. Through collaboration with local protagonists, the project seeks to attract new populations and activities to the area.

HDU

urban context and mobility



Mobility plan

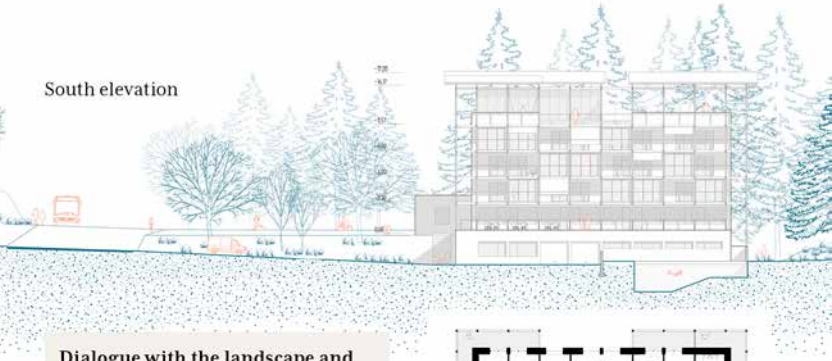


Site context

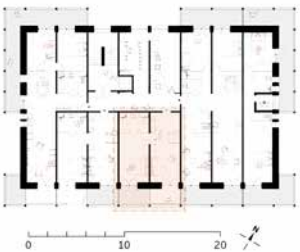
Perched at an altitude of 1,154m, the site is marked by verticality and mountain weather conditions which are an obstacle to active mobility. It is aimed at promoting sustainable mobility in this relatively sparsely populated area.

design challenge (dc) overview

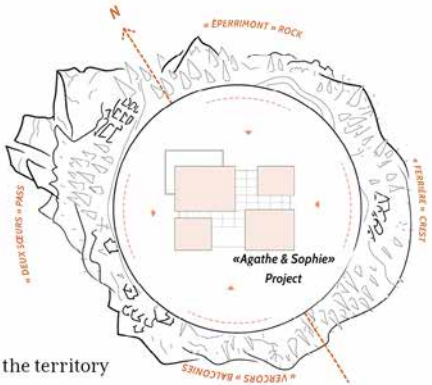
South elevation



Dialogue with the landscape and the region: the space on the roof affords an incredible view of the surrounding landscape. The design of the roof was conceived as a dialogue with the environment.

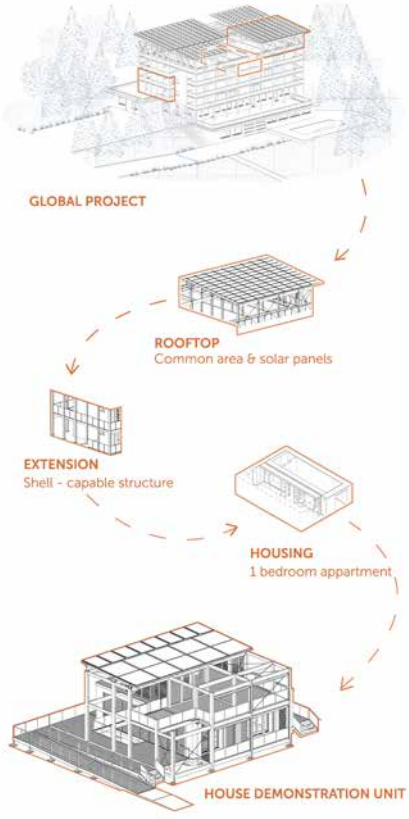


Floor plan

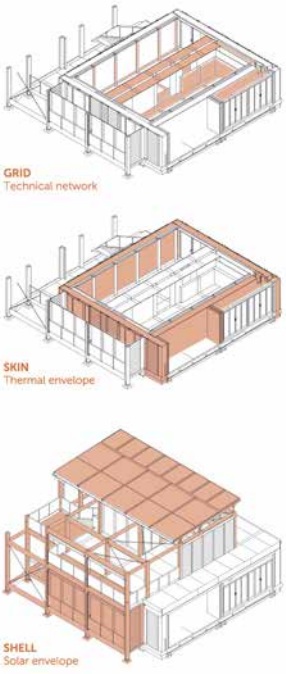


Relation with the territory

house demonstration unit (hdu)



Transformation of the Design Challenge
into House Demonstration Unit



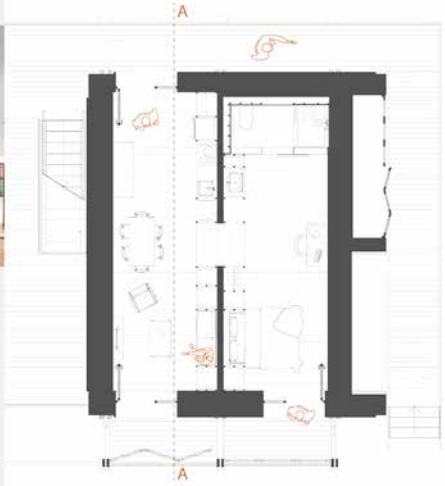
Core Skin Shell Diagram

The architectural and bioclimatic tool of Grid, Skin, Shell

The Grid, the building services network, is inserted into the existing gridded structure, making it easier to anticipate changes and facilitating maintenance.

According to local construction traditions, the Skin, the thermal envelope added to the building, is made of straw insulation.

The Shell is a wooden extension to the building that can support new uses and protect and capture solar gain.



Ground floor plan

Section AA

Web

Video

DC

	1716 m²	57 m²
	4	1,5
		32 m²/p

Team Name | Team Identity

Team Sweden | CHA

University

chalmers university of technology gothenburg gothenburg, sweden

Task | Location of DC

renovation and addition of storey (gothenburg)

Refer to page 24 for design features

The C-Hive project is divided into two main parts – the Design challenge (DC) and the (HDU).

The DC building is a commercial space with a high footfall containing a grocery store and a second-hand shop. By using lightweight cellulose-based and 3D printed constructions on the rooftops, the urban area can be densified in areas where space is limited yet valuable. 3D printing technology could also be employed in-situ allowing for customizable solutions and minimizing impacts from shipping.

Extra floors would also be a way of financing the upkeep of the original building. Moreover, this would enable more people to live close to nodes where public transport, shops and services are more available. Inside the DC building, we suggest a collective living space where spaces are shared with neighbours while still keeping the option of having private space. Living close to neighbours can have many benefits. Spaces like a gym, library, aquaponic garden or community kitchen could be shared and enjoyed by all residents.

Resources could be shared, especially those the residents do not regularly use, like workshop tools, cars or electric vehicles. Likewise, access to emergency services would be better. The same goes for exchanges of services. By sharing spaces, being alone becomes a choice and not something forced upon you by the conditions of the environment.

The interior of the module.

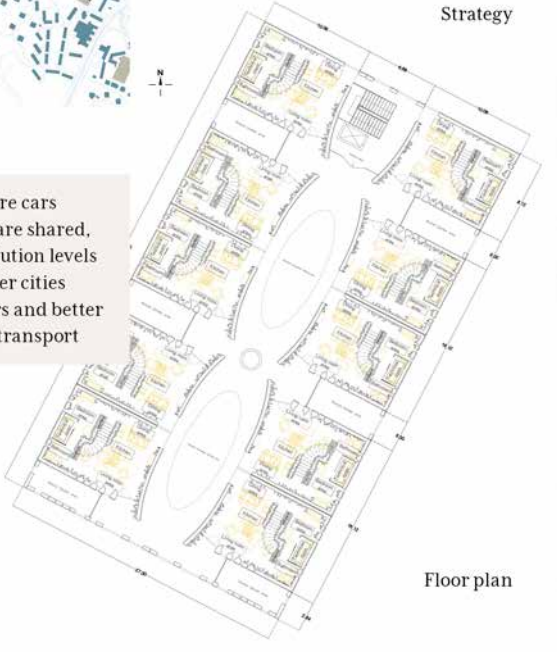
HDU

urban context and mobility

Site context

Sharing is caring. If more cars and transport vehicles are shared, parking spaces and pollution levels could be reduced. Denser cities means less need for cars and better possibilities for public transport

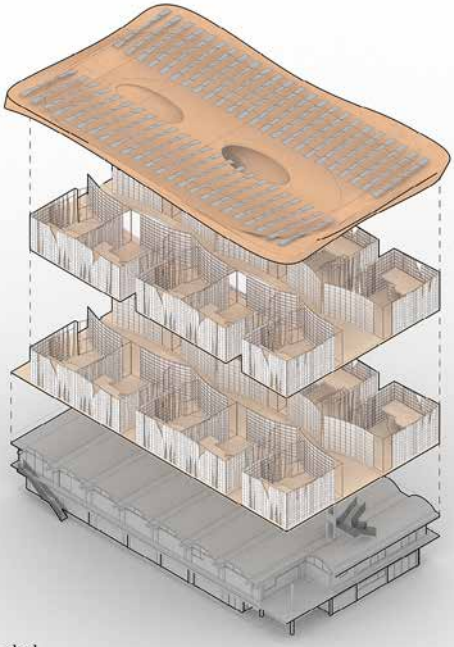
Strategy



Floor plan

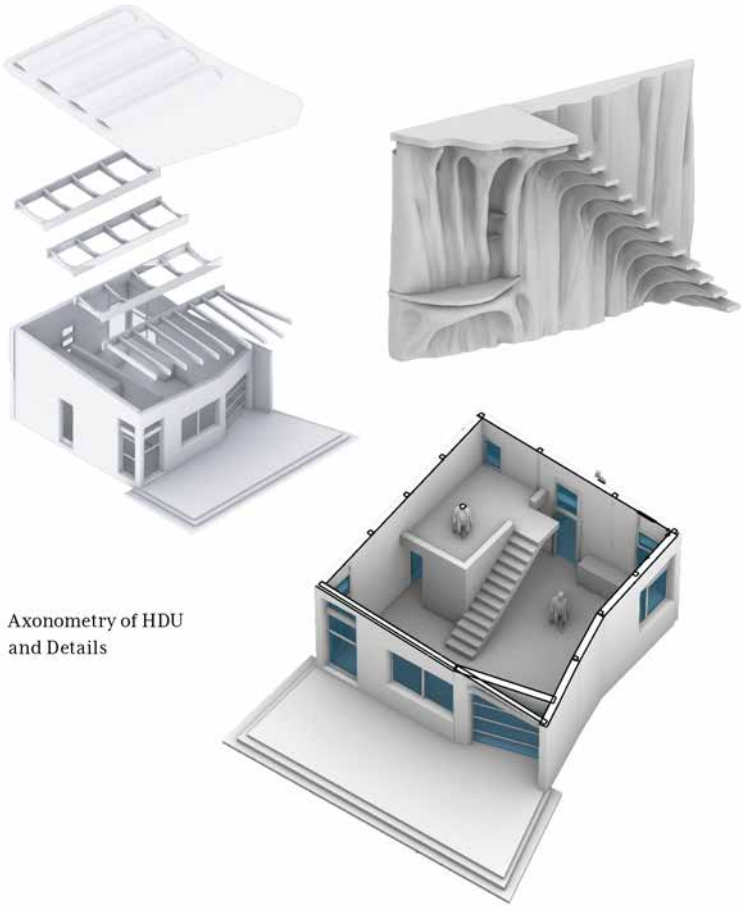
design challenge (dc) overview

Sections



Full building exploded

house demonstration unit (hdu)

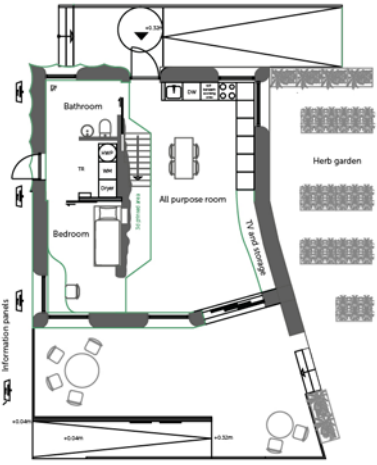


Axonometry of HDU
and Details

The HDU design has two main s tand-outs. The first is an innovative use of cellulose and the second is wthe reuse and circular design.

Engineered timber is used for the structure employing a newly developed construction method. 3D-printed cellulose will for the first time be used as both a facade material and a material for interior building elements. Green wood is used in the east facade in the interest of saving energy and making a double-curved facade which would be impossible with traditionally dried wood.

Many elements of the building are reused. This goes for the windows, doors, kitchen and flooring. All parts of the building are made with disassembly in mind so that the building elements can be reused.



Floor plan

Detail construction

DC

	8252 m²	68 m²
	7	1
		66 m²/p

Team Name | Team Identity

FIRSTLIFE | CTU

University

czech technical university in prague prague, czech republic

Task | Location of DC

renovation and addition of storey (prague)

Refer to page 24 for design features

Highlight the problem, offer the solution, and educate the public. These are a few of the main goals of our FIRSTLIFE project, which is targeting the adverse situation of the cost and condition of dormitory buildings in the Czech Republic.

We are planning to add extra storeys to an existing dormitory building, called Větrník. Why did we pick this exact building? Because it is not unique at all. There are several dormitory buildings, and buildings with different functions but more or less the same construction systems. And that it's the advantage. The vision of our modular student building extension is to be universal. It is meant to be an extension for the type of building, not just one site. The unique base of FIRSTLIFE can, with dimensional adjustments, fit the structure of different buildings.

The design of the extension itself has its own rules. It has to be more than just a place to sleep. It has places to meet, think and have fun. The building itself is not in a vacuum. It is part of the city. Therefore, it should be in keeping with the outside urban situation while improving it.

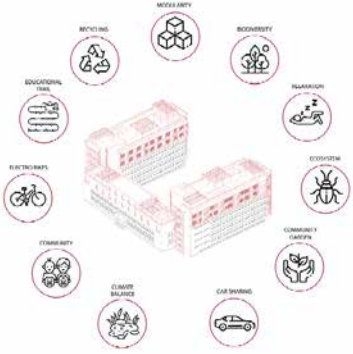
It has to be as sustainable as possible. We are using recyclable and recycled materials. Upcycling of materials is not just a word for us. We designed our systems to deal with wastewater and power the building with renewable electricity. We are using the natural benefits of vertical greenery and a green roof. Carbon neutrality and the fight against the climate crisis are reflected in our project decisions.

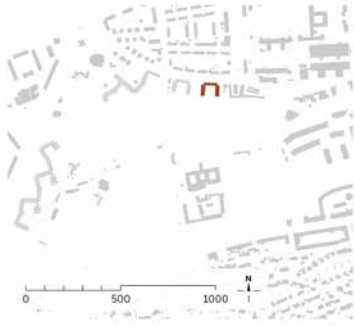
Increasing numbers of students, decreasing the overall quality of living, the low energy efficiency of dormitory buildings, and sleeping quarters with no communal spaces: this mosaic of problems is the motivation for our project. We know them. We lived (or are currently living) there. We have therefore decided to offer a vision of modern student living for the 21st century.

HDU

urban context and mobility

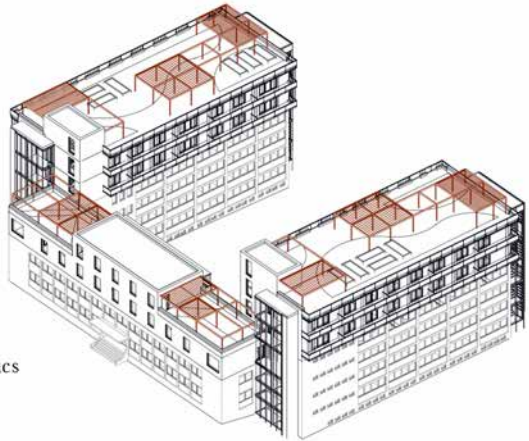
Site plan





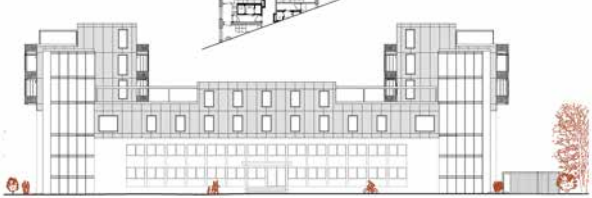
Site context

design challenge (dc) overview



Concept isometrics

Floor plan
first floor addition

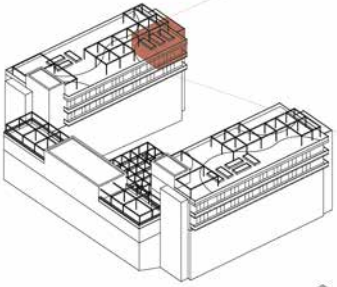


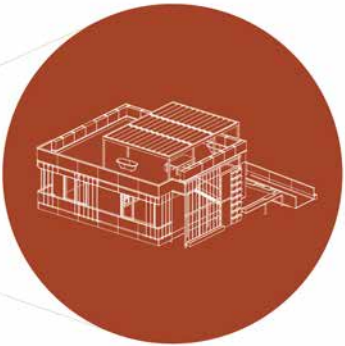
Building elevation - north

0 10 20

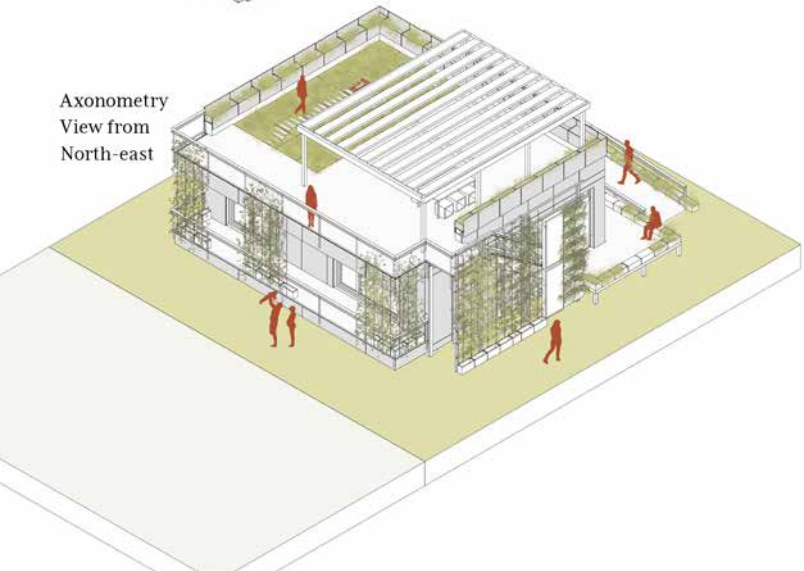
house demonstration unit (hdu)

Transformation of the Design Challenge into House Demonstration Unit





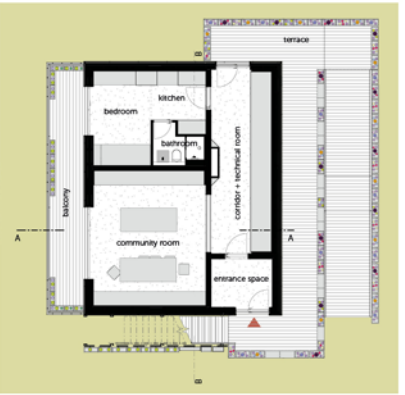
Axonometry
View from
North-east



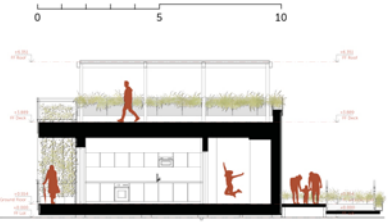
The house demonstration unit includes a student room with facilities and a common room with kitchen equipment, both rooms have access to the balcony. Building services are placed in a cabinet along the corridor. The barrier free first floor is accessible by a ramp. On the flat roof accessible by metal staircase there is a relaxation zone with vegetation and sitting under a pergola with shading photovoltaic lamellas. Nature based and recycled materials are preferable used: wooden elements, insulation from wood fibres and cellulose, interior cladding with boards coming from beverage cartons. The house is equipped with floor heating, a heat pump and mechanical ventilation with heat recovery.

Instagram

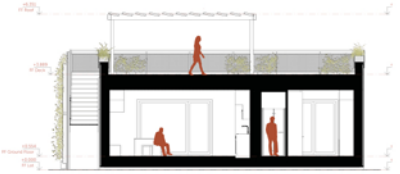
Web



Floor plan ground floor



Section A-A



Section B-B

DC

	2004 m²	60 m²
	6	1
		30 m²/p

Team Name | Team Identity

X4S | HBC

University

biberach university of applied sciences biberach, germany

Task | Location of DC

renovation and addition of storey (wuppertal)

Refer to page 24 for design features

Our team is creating urban solutions to combat climate change. We must rethink our view of cities and change the built environment in order to achieve greater sustainability whilst also addressing social and economic demands. The Cafe Ada extension is an example of a transferable approach.

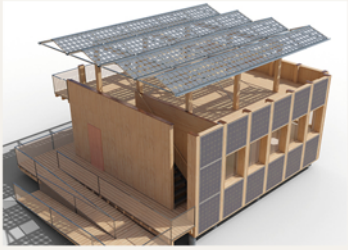
Densification addresses urban issues such as excessive land use, increased traffic due to urban sprawl and social isolation. With floor plans of different sizes, the building provides living space to meet the growing demand for one or two-person households as well as homes for families of up to four people. This is realised by reducing the floor area per person and providing common areas for flexible use.

Cost-effective and rapid constructions are achieved by solid timber elements. A high degree of prefabrication, minimal loads and separable components are advantages of this form of construction.

The engineering and construction concept are designed to reduce heat losses by adopting a highly insulated building envelope which is optimized for solar passive gains. This approach is combined with the active use of solar energy on façade and roof to produce heat and electricity.

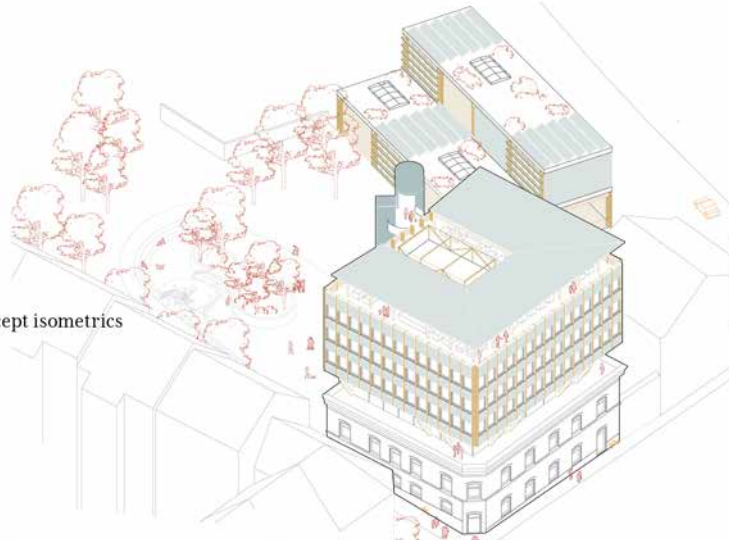
To make sustainability affordable, we make use of existing efficient technologies integrated in a highly efficient and resilient system design. The components of the system are used multifunctionally wherever possible.

Our sustainability concept is based on sufficiency, efficiency, consistency and resilience. These ideas are pursued in the three sub-areas Architecture, Energy and Construction.



HDU

urban context and mobility



Concept isometrics

Site context

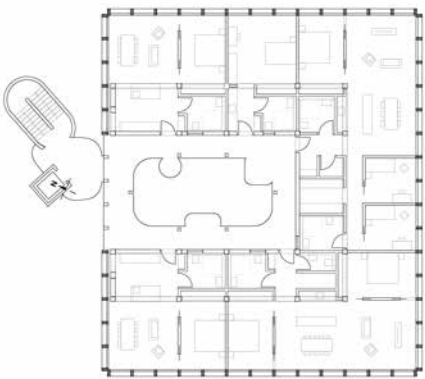
0 50 100 N

- Mobility hub
- E-bike/Cargobike rental
- Car-sharing
- Charging staion
- Sustainable energy production
- Producer market
- Urban gardening
- Childcare area
- Sound barrier
- Bicycle lane with motor traffic
- Micro depot

design challenge (dc) overview

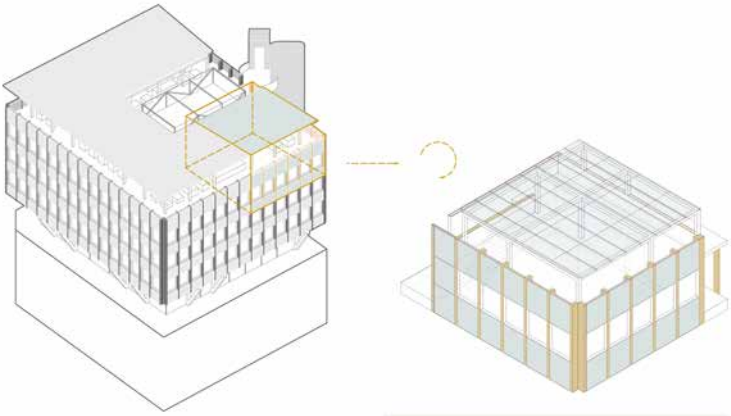
Elevation west

0 5 10



Floor plan 4

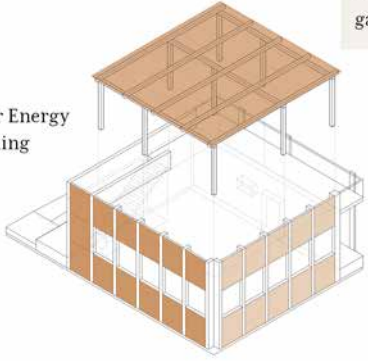
house demonstration unit (hdu)



Transformation
of Design Challenge into
House Demonstration Unit

The House Demonstration Unit represents our building design and is extracted as a two room apartment from the top floor. In addition, the entrance situation and the roof garden are representatively displayed.

Solar Energy
Gaining

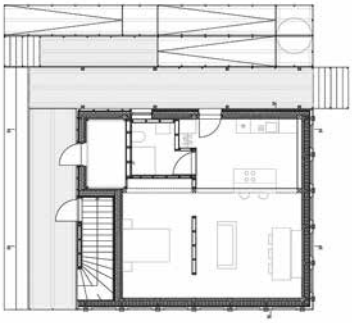


Like the Café Ada extension, the unit is divided into layers. The service layer includes the kitchen, the bathroom, the entrance area and the building utilities.

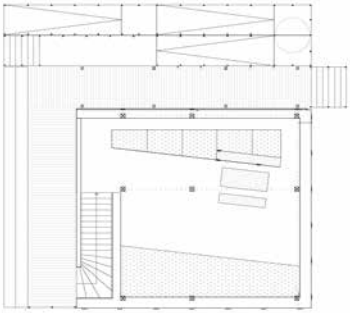
The service layer is complemented by the open living area, including the living space and the bedroom. Its spacious, light-filled interiors create a pleasant atmosphere.

In addition to the transparent solar panels on the roof, PVT panels are built into the eastern and southern facade. The western facade is painted black to highlight the fact that the building design continues in this direction. The other wall surfaces are covered with wooden panels.

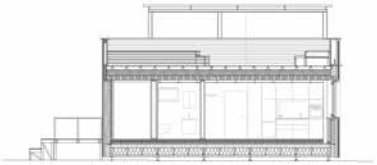
The rooftop garden is used for urban gardening and energy production to supply the whole building with vegetables and energy.



Floor Plan, Ground Floor



Floor Plan, Roof Garden



Section East-West

DC

	8382 m²	123 m²
	7	2
		23 m²/p

Team Name | Team Identity

coLLab | HFT

University

stuttgart university of applied sciences stuttgart, germany

Task | Location of DC

renovation and addition of storey (hft campus stuttgart)

Refer to page 24 for design features

"coLLab" refers to a collaborative laboratory which seeks to offer new forms of living collectively in urban situations in restricted spaces. CoLLab also stands for an extension that enters into a symbiosis with the existing building and adapts to existing structures. The project is not only aimed at having a positive impact on the environment but also adopts the human as its scale and focuses on the importance of common space and social networks.

Architectural concept
The main architectural concept of coLLab stands for a minimal and smart private living space and a maximised common space. In addition, the room itself should offer the residents space to adjust individually and also to let their creative freedom unfold in their own four walls. Another important feature of the design is its transferability to other existing buildings.

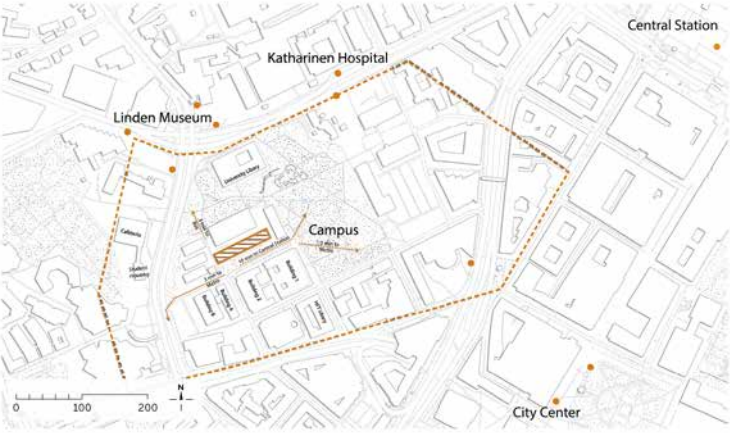
Mobility concept
Due to its structure, the existing building selected is considered representative of its period and offers great potential for transferable solutions.

The goal is to overcome the isolated and island situation by revitalising the area and connecting it to surrounding neighbourhoods including the city centre and Stuttgart West. For the mobility concept this implies promoting and supplementing the existing public transport network by active mobility. By reducing motorised personal transport, the space given over to parking will become available for livable public spaces or lacking amenities.

Exterior facilities concept
The aim is to turn this uninviting area into an area with a strong urban identity. It is to turn spaces devoted to transportation into places for communication and dwelling. This also means changing the appearance of some buildings and opening up some of the ground floor to the public space, or creating other forms of transparency and connections. Moreover, there is a need to transform the unappealing public spaces, which lack weather protection and seating, into a varied space. The latter should be linked to the university facilities and create a campus atmosphere without leading to isolation. Located quite centrally, the planned building would be well placed to solve some problems and contribute to upgrading the area.

HDU

urban context and mobility

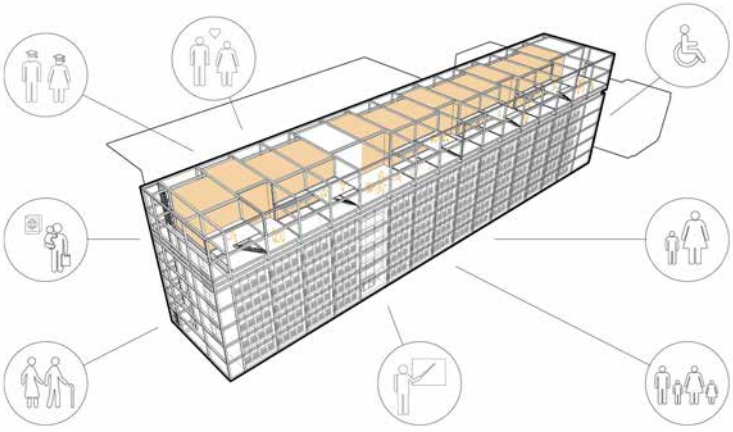


Campus distances

The HFT campus can be described as an arrangement of different buildings, some of which create good urban planning situations while others are separated by oversized streets and car parks.

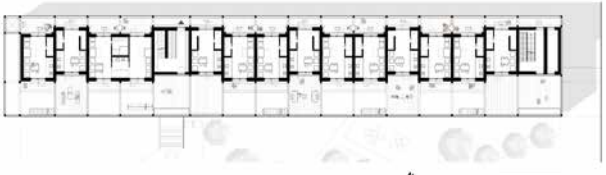
Site plan

design challenge (dc) overview

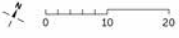


Concept isometrics

Floor plan ground floor (existing building)

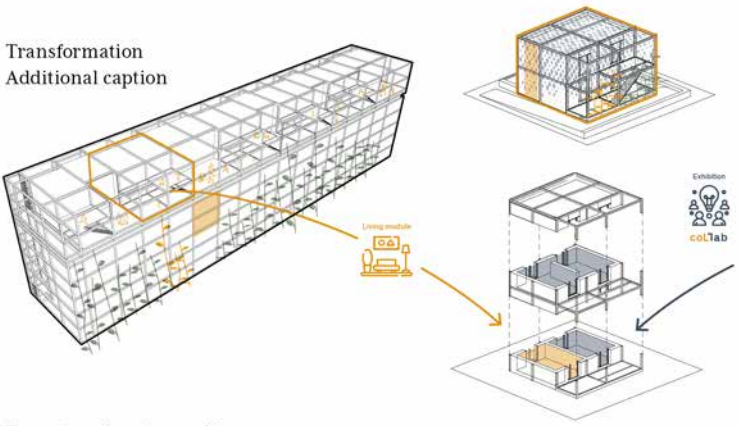


Floor plan addition fifth floor

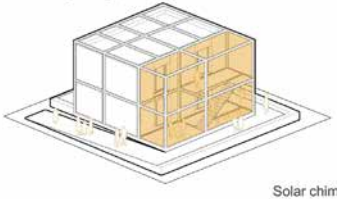


house demonstration unit (hdu)

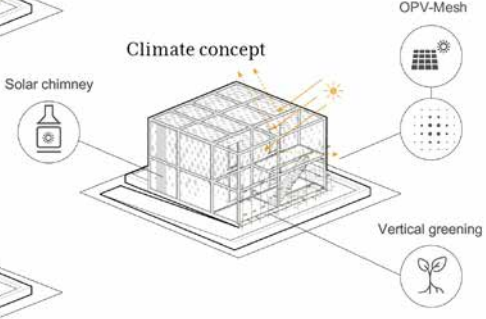
Transformation
Additional caption



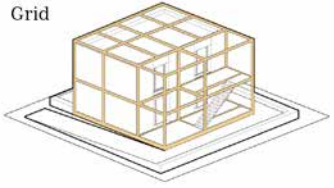
Two-storey housing unit
with open space

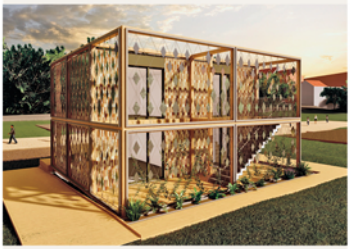


Climate concept



Grid



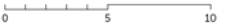


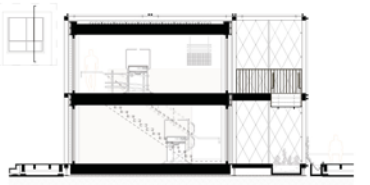
The reinforced concrete skeleton structure makes it possible to open up the dark corridor in the existing building and divide it into three open zones. The part on the left will be used as a greenhouse, the PflanzBar, where hydroponics will be applied.

The planned addition is seen as an extension of the existing building, which is not intended as a foreign body but is to be integrated into the existing building and the social environment of the campus. An architectural concept will hence be developed that permits students to live in a confined space. Private space requirements are kept as small as possible, and flexible, spacious areas are available for communal use.

Floor plan ground floor

Floor plan first floor





Sections A-A

DC

	2268 m²	115 m²
	6	2
		21 m²/p

Team Name | Team Identity

MIMO | HSD

University

düsseldorf university of applied sciences düsseldorf, germany

Task | Location of DC

renovation and addition of storey (wuppertal)

Refer to page 24 for design features

Our vision
MIMO is an interdisciplinary team drawn from all seven faculties of Hochschule Düsseldorf (HSD), which has developed a concept for resource-efficient urban redensification. Guided by the principle of "Minimum Impact Maximum Output" (MIMO), the usage concept, including the living space and the technical approaches, focuses on generating local value added by achieving maximum benefit at the cost of minimum interference.

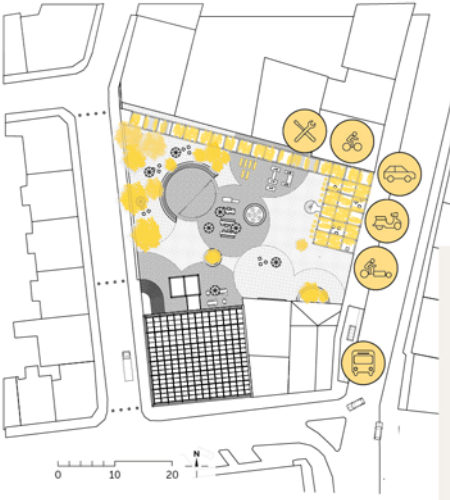
The task addressed by Team MIMO is the renovation and addition of a storey to a warehouse dating from 1905 in Wuppertal's Mirke district, which is used by the Café Ada and its dance centre. The renovation is hallmarked by cautious interventions and preservation of the external appearance, as well as functional and energy optimisation. In addition to architectural and technical challenges, the team also faces that of integrating the social space with the surrounding district. The key aim is to create alternative living spaces for the quarter.

Living modules
A total of 15 stacked, glue-free solid wood residential modules on three floors provide private living space for one to four people each. The space per unit is greatly reduced. The gaps between the individual modules are mainly used as communal living space, which makes room for informal encounters and social interchange: "the more you share, the more you have". The urban garden, reached via the outer stair tower, forms a semi-public greenhouse for leisure and vegetable growing. The roof terrace takes on the role of a village square.

Climate shell
The "climate shell" is fundamental to the design. It surrounds the living modules as well as the spaces between them and thus produces the outer layer of the rooftop extension. Through glass skylights and louvre windows, it permits natural ventilation, lighting and passive cooling of the common areas. A coordinated arrangement of PV cells in the partially transparent shell generates electricity throughout the day, providing shade and passive heat input without blocking the view.

HDU

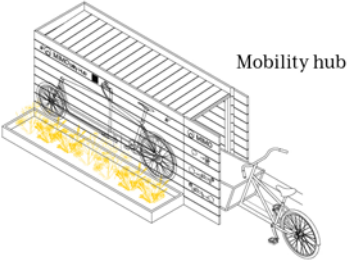
urban context and mobility



Location map
rooftop view

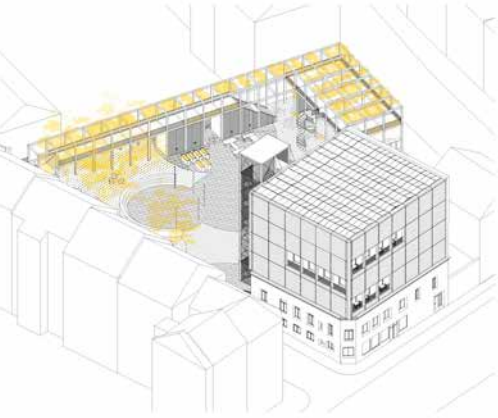
The overarching goal of our mobility concept is a major reduction in private car traffic through the expansion of existing alternative transportation systems and the establishment of new sharing systems. An on-site mobility hub offering access to e-cars, e-scooters, e-bikes and free cargo bikes serves as a base camp. Transferring a bus stop directly to Café Ada improves public transport links and helps make the building a lively meeting point.

Ground plan



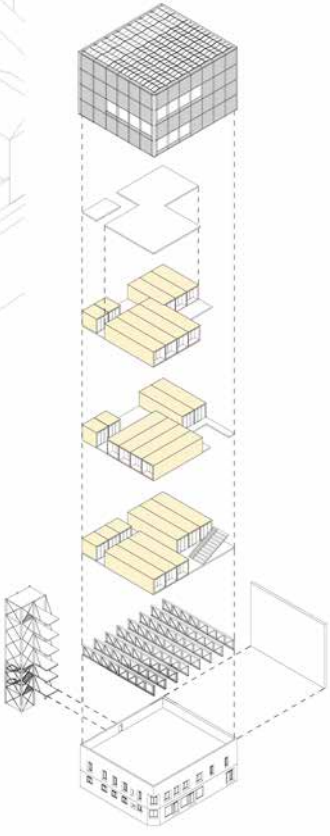
Mobility hub

design challenge (dc) overview



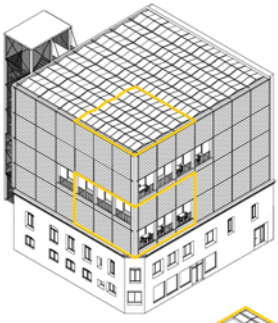
Concept isometrics

Floor plan second floor (addition)

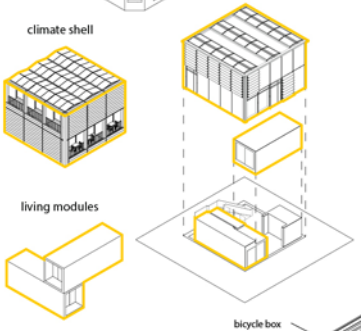


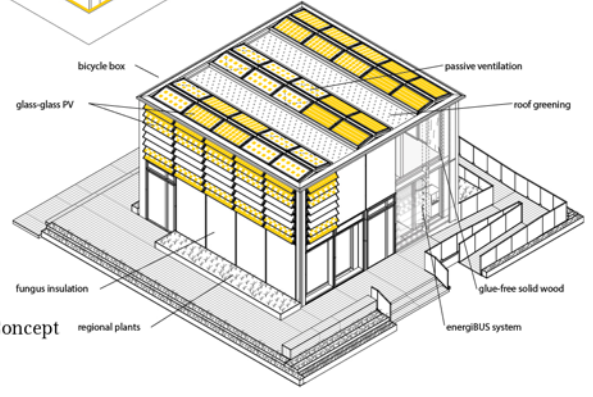
Exploded isometry

house demonstration unit (hdu)

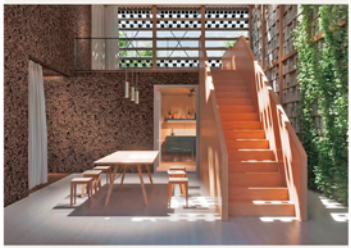


Transformation DC to HDU –
Two living modules surrounded by a climate shell. The addition will be presented as an HDU with two stacked, compact solid wood residential modules and a communal area within a climate shell. The intelligently controlled facade with roof windows and slats that can be opened and fitted with PV is also being transferred.





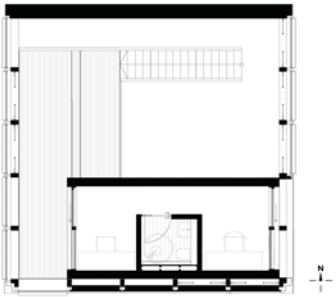
Isometry HDU - Concept



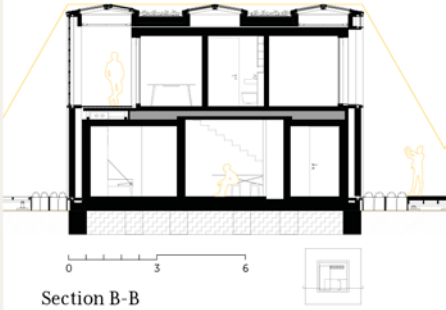
The modular approach of the DC and prefabricated components supports the transferability of the overall concept and the goals of reduced local emissions and construction time, as well as efficient use of materials. Our HDU represents one of the many possibilities for assembling the living modules and thus tailored to residents' needs and site conditions.

Two stacked solid wood residential modules and a communal area, within a fully functional climate shell, form the demonstration unit. Multifunctional furniture permits flexible usage of space within the modules, which are complemented by communal space with a roof terrace. The energiBUS system on the ground floor regulates heat supply and load management. A small outdoor mobility hub with a free cargo bike represents the mobility concept.

Floor plan ground floor



Floor plan first floor



Section B-B

DC

	2835 m²	140 m²
	3	1
		43 m²/p

Team Name | Team Identity

EFdeN | ION

University

ion mincu university of architecture and urbanism bucharest bucharest, romania

Task | Location of DC

renovation and addition of storey (wuppertal)

Refer to page 24 for design features

EFdeN VATRA aims to create a sustainable and affordable housing model that will empower singles by forming a community. The intervention is intended to be easy to design and adaptable to a variety of urban scenarios and usage cycles, whilst featuring a close connection between humans and nature.

In the face of worsening resource scarcity across Europe, VATRA is a design strategy for single dwelling housing that would make use of the existing urban housing stock and minimise resource consumption.

The design aims to maximise the number of living units whilst providing adequate and similar comfort for each resident. The principles that guided all of the design decisions were scalability and resource efficiency.

As the revitalisation of urban building stocks is the key focus of the SDE 21/22, the VATRA design strategy consists of four different modules that could be combined to suit the three typical European urban scenarios, also present in Wuppertal and Mirke: renovation and extension; gap closing or renovation; and rooftop extensions.

The three typological modules are single apartments. To regain the connection with nature and enable residents to grow fresh produce, one is a private greenhouse module to be attached to each individual living unit.

With assistance from computer science students, we hope to transform the design into an AI algorithm.

Optimisation of the design phase makes for faster project development. The method makes it possible to adapt the architecture to all kinds of urban scenarios. This phase will be conducted by the architects who work on the internal configuration of the modules, who will study the context and the structures within the city. Developers can conduct multiple projects with local teams, using the design algorithm as a starting point. Moreover, integration of other design phases can be a great asset, facilitating larger-scale projects at multiple locations. For example, cost estimation, prefabrication mapping and ordering of materials would be cheaper.

HDU

urban context and mobility

Functions

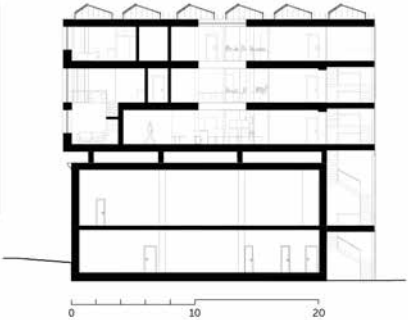
Site plan

0 25 50 N

Besides designing an intervention to suit the characteristics and needs of the target group, our project seeks to make a contribution to the community and the city. To provide interaction spaces for the neighbourhood, we designed the outdoor public space to meet the needs of all the users in the district: somewhere for kids to play and adults to meet or just enjoy an evening in the sun.

design challenge (dc) overview

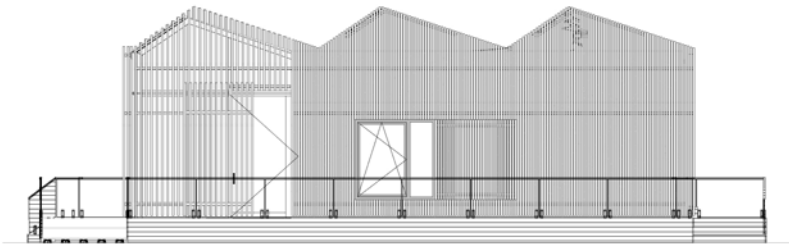
The shape of the roof has a functional role, supporting the bifacial photovoltaic panels at the optimal angle (35 degrees) and height, and a formal one, conserving the image of an industrial building roof in the collective memory.



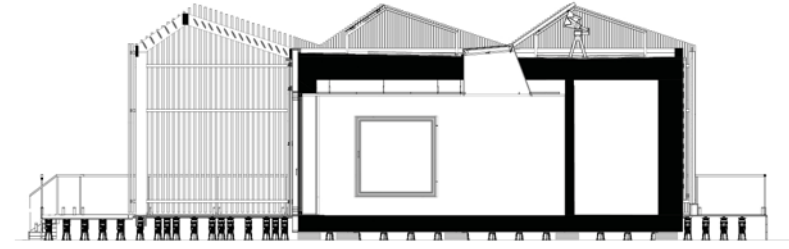
A vertical South-North section

Level 1 of the intervention at Cafe Ada

house demonstration unit (hdu)



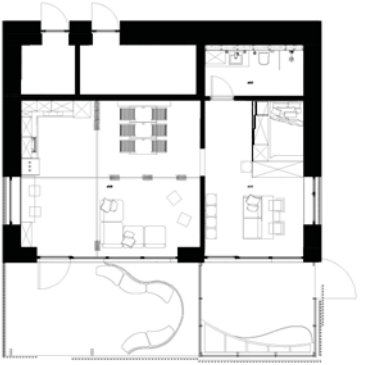
A vertical South-North facade of the House Demonstration Unit.
We can see the eastern face of the prototype with the apartment's window and the secondary exit.



A vertical South-North section through the House Demonstration Unit.
We can see the apartment module with the bathroom, and the attached greenhouse which can be opened into the interior of the house.

To determine the viability of our solution, we are to build, test and optimize a site-independent prototype (HDU) - EFdeN VATRA Prototype. The objective is to incorporate all of our main ideas in one prototype and to research and test the relationships between the spaces we imagine.

EFdeN VATRA HDU consists of one living unit module, one greenhouse, a space emulating the common room presented above and one technical room. For the roofing, the facade system and the constructive solution for the HDU, the same systems (as the ones implemented in the renovation and addition of storey) are used.



EFdeN VATRA prototype integrates into its plan the most important features from the Design Challenge, so in its composition, we find a one-level apartment module – adapted for people with disabilities, a greenhouse – with the possibility of extension into the outdoor terrace or into the apartment, the electrical and mechanical rooms, and the common room- which can be divided into four different spaces.

A rendering from the outdoor terrace where can be seen the greenhouse, the wood riffle and the main entrance.

DC

	1148 m²	144 m²
	5	1
	40 m²/p	33 m²/p

Team Name | Team Identity

Deeply High | ITU

University

istanbul technical university & technical university of applied sciences lübeck turkey/germany

Task | Location of DC

renovation and addition of storey (kiel)

Refer to page 24 for design features

"Deeply High" is an international, interdisciplinary student group from Turkey and Germany devoted to socially responsible and environmentally friendly residential construction project development. We are deeply committed to highly sustainable building solutions. We therefore aim to develop environmentally friendly, socially inclusive and affordable buildings by combining yesterday's wisdom with today's technology and vision.

Holistic approach

Team Deeply High addresses redensification of the residential urban fabric. Our holistic approach seeks solutions for redensification of the urban periphery: The Design Challenge and House Demonstration Unit involve a vertical extension for the Kiel location, which is a densely populated city, but can also be adapted to other settings.

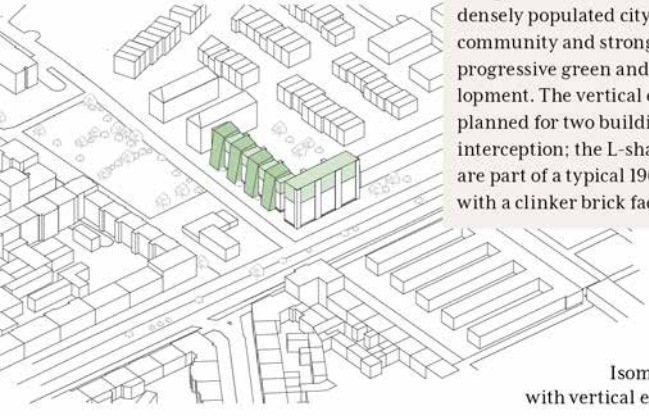
The architectural design accommodates *local traditional building materials* and architectural vernacular, sustainable and *recyclable building materials*, integratable building services and a *modern, socially inclusive concept*. Timber frame construction with straw bale insulation and carbonised façade represents the most sustainable design for a project in Northern Germany to date, but could be modified to geographical conditions and local availabilities in other regions. Our architectural design meets the requirements of barrier-free construction and is wheelchair-accessible. The walls of the interior spaces are designed modularly in the interests of flexibility. The flat rooftop is accessible, *barrier-free* and conceived as a meeting place for residents. We include innovative ideas for *urban rooftop gardening* to preserve biodiversity. We therefore employ an aquaponics system and recycle biological waste through bokashi fermentation and worm boxes. The large winter garden is compatible with the installation of semi-transparent PV modules. Algeatecture (cultivation and use of microalgae in building components or in the façade system) features in the innovative pilot project.

HDU

urban context and mobility

Urban context, mobility and public transportation concept

The project is located in Kiel, a densely populated city with a diverse community and strong potential for progressive green and social development. The vertical extension is planned for two buildings at an interception; the L-shaped houses are part of a typical 1960s building with a clinker brick façade.



Isometry of building with vertical extension in Kiel

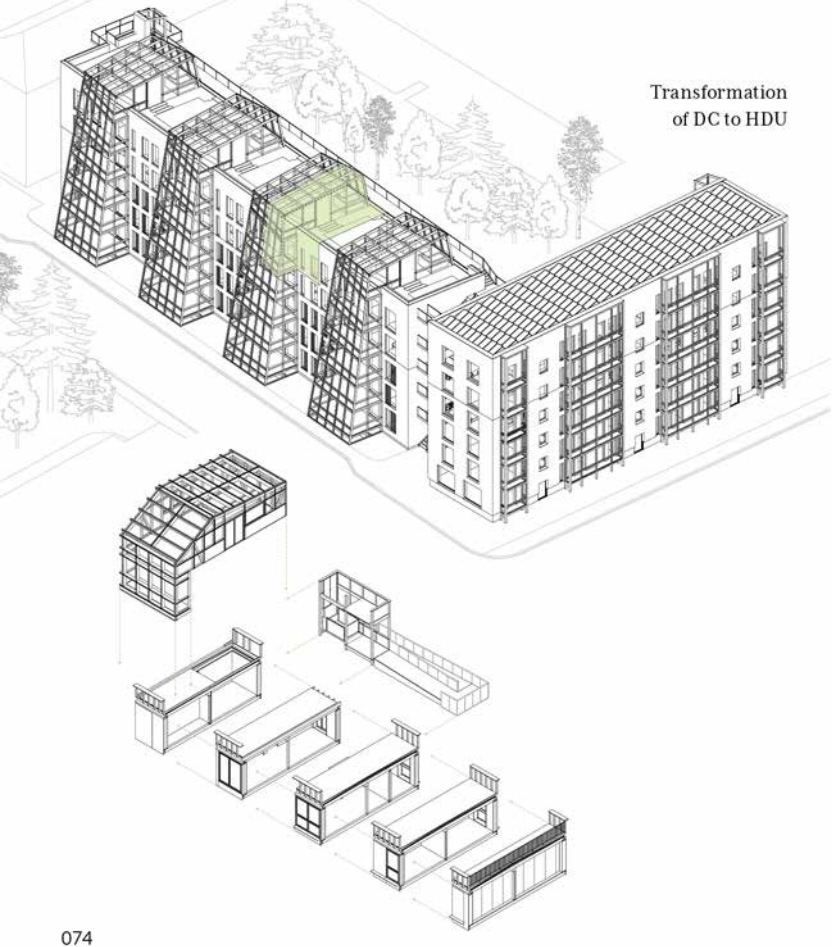
design challenge (dc) overview

Renderings of the Rooftop

The DC consists of an existing, energy renovated building, a two-storey rooftop extension and rooftop gardens with communal spaces. Two storeys are added as a balanced compromise between economic efficiency and structural possibilities. The design of open spaces and a communal rooftop is a particularly high priority.

Floor plan of vertical extension with 4 barrier-free flats

house demonstration unit (hdu)



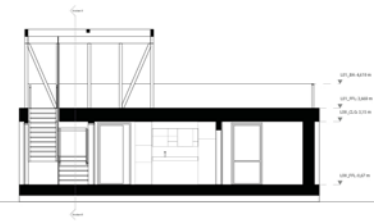
Transformation
of DC to HDU

The HDU design consists of three major components: Living rooms, the Wintergarden and the Rooftop. It is built on a small plateau to represent the connection from the residential building to the vertical extension and includes the second story of the extension, including the Rooftop.

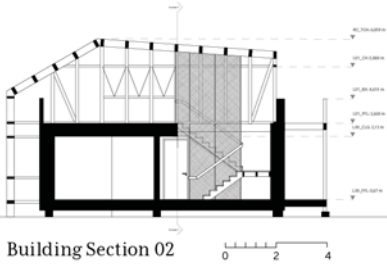
The raw building consists of timber framework with straw bale insulation, carbon flamed façade and façade-integrated algeatecture. The floor plan shows a wheelchair accessible residential unit with two individual rooms, a combined living and dining area and an open kitchen.

An elevator provides barrier-free access to the community rooftop space with a kitchen and urban gardening space. In addition, the greenhouse with integrated semitransparent PV modules can be used as a Wintergarden.

Floor plan



Building Section 03



Building Section 02

DC

	1771 m²	54 m²
	5	1
		27 m²/p

Team Name | Team Identity

RoofKIT | KIT

University

karlsruhe institute of technology karlsruhe, germany

Task | Location of DC

renovation and addition of storey (wuppertal)

Refer to page 24 for design features

We believe that our today cities have a huge, overlooked potential in terms of building land and energy harvesting from rooftops. According to Volkswohnung GmbH in Karlsruhe, rooftops are the biggest asset in its portfolio, and we believe that this is the case in many cities worldwide. It is a resource that we should start to address.

Moreover, we believe that with the current boom in prefabricated houses, those two questions could and should be combined: how to design module-based prefabricated lightweight housing structures for rooftops. Here we see a huge potential for the future and an impact not only in technical but also in social terms: providing housing in inner cities for all social strata. We also see benefits for existing buildings, as these stand to profit from upgrades in service access.

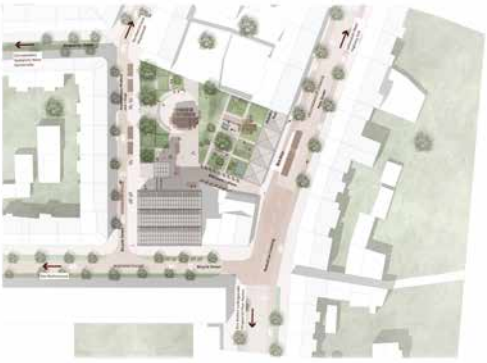
Design
In addition to the renovation of the building, the uses in it are rearranged and supplemented by a hotel and apartments. The current dance hall will be moved from the first floor and will act as a link between the café and hotel in the old building and the residential units on the upper floors. Externally, it will be recognisable as a recessed, glazed mezzanine floor with a surrounding open-air terrace.

Lightweight design
From 60 -70% of the bound CO2 can be found in the supporting structure. For this reason, we continue to use the load-bearing structure of the existing building and add a lightweight modular timber structure. The approach to energy encompasses all the energy resources available on and in the building: solar energy, waste heat and biogas.

Urban mining to material storage
Many materials in the design already had a life cycle: door handles and fittings are reused from old buildings, wooden elements come from demolition sites and metal plates from former roofs. All this is combined with biological recycled products: wood from sustainable cultivation, insulation material made from seaweed and fungal mycelium, as well as other innovative products derived from KIT research.

HDU

urban context and mobility

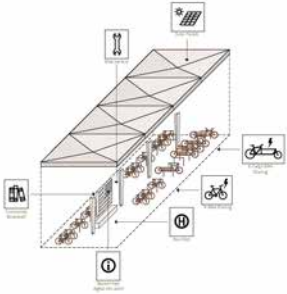


Site plan and urban mobility concept

Design concept

Our main objective is the transformation from an individual to a collective system. We plan to implement a cable car connection between the residential district and the main station. Mobility hubs will establish a network of important points to change the type of transport throughout the city.

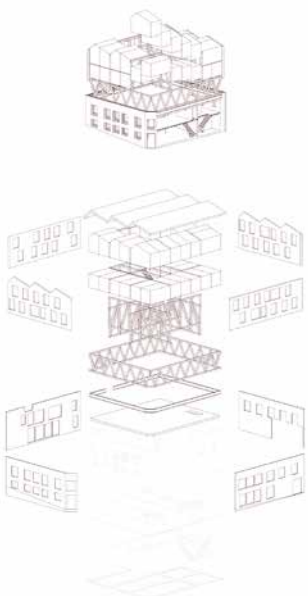
Bus street future



Mobility hub Cafe ADA

design challenge (dc) overview

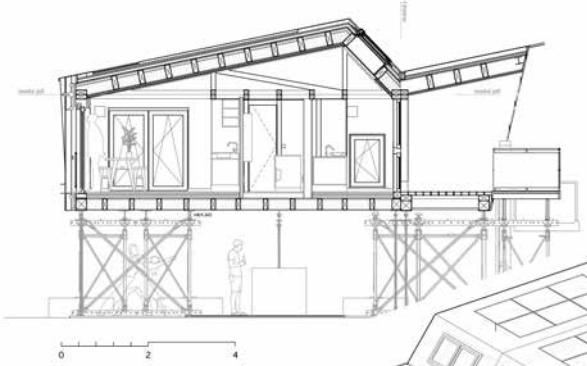
Elevation West



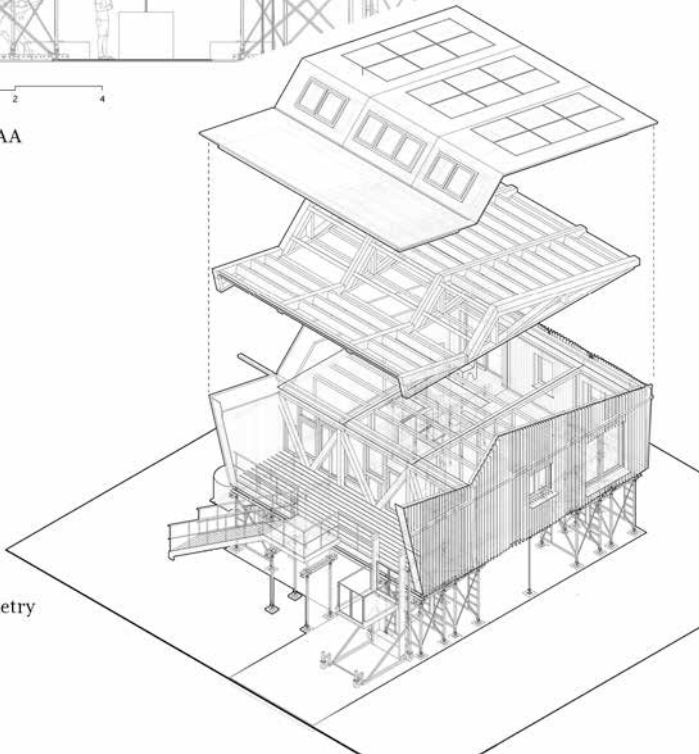
Isometry structure design

Forth floor plan

house demonstration unit (hdu)



Section AA



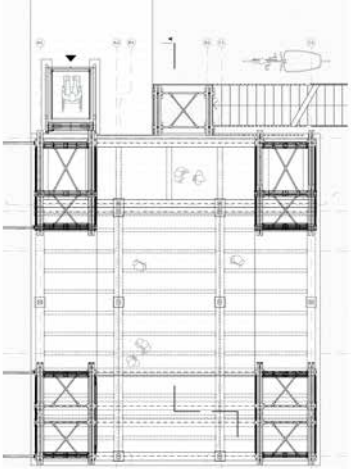
Axonometry

The HDU is perceived as a two-story structure that represents the residential units and the urban gap. The urban gap is portrayed as an exterior area below the HDU. It serves as a waiting area for the tours, a place to relax and interact, but also as a dance floor. As in the overall design, the HDU is built in modular timber construction and consists of four modules.

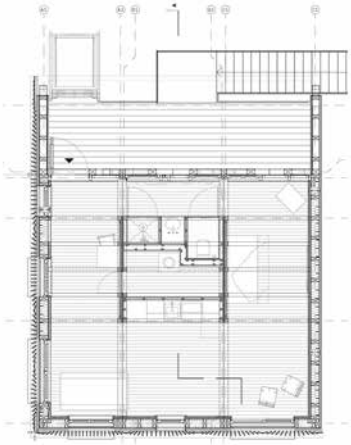
The interior design in the form of custom-made furniture, allows flexibility and is space-saving at the same time. The open floor plan allows high space efficiency since no pure traffic zone exists. A functional core in the centre contains all the sanitary facilities, as well as the technical building equipment to keep the supply lines as short as possible.

Instagram

Web



Floor plan level 0



Floor plan level 1

	441 m²	117 m²
	3	2
		23 m²/p

Team Name | Team Identity

UR-BAAN | KMU

University

king mongkut's university of technology thonburi bangkok, thailand

Task | Location of DC

renovation and addition of storey (bangkok)

Refer to page 24 for design features

“Baan” is a Thai word for “home”. “UR-BAAN”, therefore means “home for the city”.

Team UR-BAAN comprises King Mongkut’s University of Technology Thonburi (KMUTT) and two partnering universities in Bangkok, Arsom Silp Institute Of The Arts and Kasetsart University, with over 70 students from various fields of study, including architecture, engineering, science and communication design who share common interests.

Our vision is to revitalise the most widespread form of building in Bangkok, namely the “shophouse”. Rapid urban expansion over the past few decades, with people migrating to the suburbs where land is cheaper, along with changing lifestyles and shifting trends in the housing market, has left blighted shophouses in old neighbourhoods, which have become less attractive places to live as a result. Project UR-BAAN has therefore selected the Talat Noi neighbourhood, a historic quarter in the heart of Bangkok, as the urban situation to tackle for the Solar Decathlon Europe 2021/2022 competition.

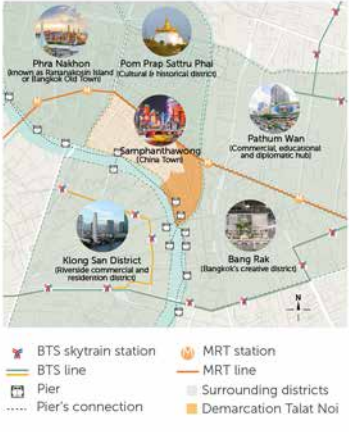
The team has borrowed the notion of the autoparts often sold by local businesses, adopting the methodology of “restomod” (restore + modify). The same approach as with a vintage vehicle that is restored and retrofitted with modern parts is applied to restoring an old building that wishes to keep its original appearance, enabling the residents, the locals and passersby to truly immerse themselves in the untouched setting of the neighbourhood. The new “parts” are not only meant to keep the existing building in shape but also to extend its life and enhance its performance.

HDU

urban context and mobility

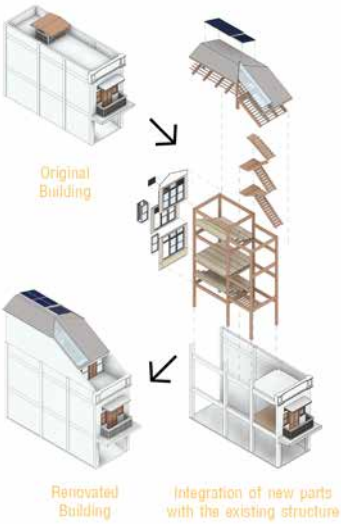
Site map with the proposed mobility concept

Talat Noi is located in the Samphanthawong district, next to the city's main river, Chao Phraya and many other cultural landmarks, accessible via a wide range of forms of public transportation including express boats, buses, and the metro and sky train systems. As a result, pedestrians are truly immersed in the cultural heritage as they channel through the neighbourhood's tiny alleys.



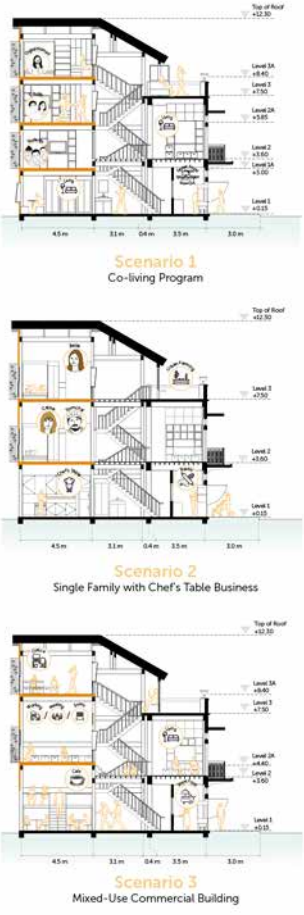
Talat Noi in urban context

design challenge (dc) overview



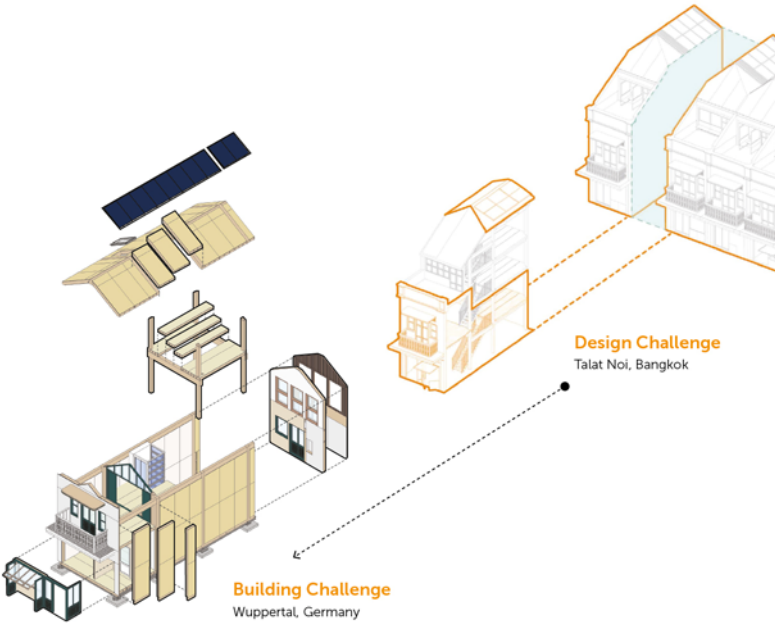
Conceptual diagram of the Design Challenge

The renovated building with its new elements is designed to be capable of modifying its floor level and space configuration as new tenants move into the building. Since a typical shop lease in Thailand usually runs for 10, 20 or 30 years, it makes sense to adopt a new configuration and adapt to new users and scenarios over time.



Building section in 3 different scenarios

house demonstration unit (hdu)

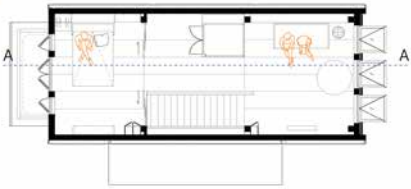


Transformation from Design Challenge to Wuppertal

The context of a shop is demonstrated by taking the existing facade, the first two storeys and the hollow core modules to construct the building envelope representing the existing party walls and the adjustable floors from the design challenge.

The entrance function as a commercial storefront is combined with a buffer room to improve thermal control during cold months in Wuppertal. The communal space on the ground floor is shared by the residents living on the upper floors.

First floor plan



First floor plan

Section A-A

0 3 6

	8610 m²	120 m²
	6	2
	21 m²/p	30 m²/p

Team Name | Team Identity

levelup | ROS

University

rosenheim technical university of applied sciences rosenheim, germany

Task | Location of DC

renovation and addition of storey (nuremberg)

Refer to page 24 for design features

We are developing renovation measures that include adding storeys to an existing building in the Ludwigsfeld district of Nuremberg (Germany). A highly heterogeneous population characterises Ludwigsfeld, and this mixture also reflects the architecture's quality. Above all, residential development in elongated apartment buildings, predominantly unadorned social housing, is often repeated in the neighbourhood. These buildings represent typical examples of most building stock built in Germany between the 1950s-70s.

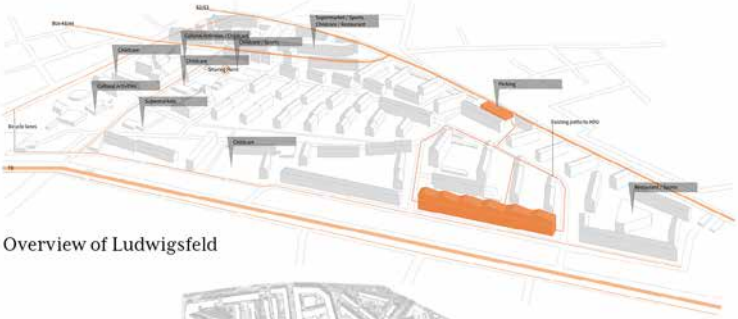
Renovating these buildings is essential because their energy consumption exceeds current standards, and they emit too much CO2. The building sector accounts for 40% of Europe's energy demand, and three-quarters of buildings are classified as energy inefficient. However, the building stock from this period is at the same time statically suitable for multi-story additions due to their solid supporting structures.

For this reason, our team has developed a parametric and adaptable addition of storeys in modular timber construction, which allows for a flexible response to different building widths and lengths. With the transferable solutions of our Design Challenge, more than 1.1 million new apartments in urban areas in Germany can be built. New flats are urgently needed, as 77% of the German population already lives in cities, and the trend is continuing.

The aim is to create new, affordable living spaces for the young and old and contribute to the climate neutrality of our cities. "Level Up" offers an innovative solution for urban redevelopment and upgrading city neighbourhoods without sealing valuable green spaces. As a result, our system contributes to the German government's goals for achieving a climate-neutral building stock by 2045.

HDU

urban context and mobility



Overview of Ludwigsfeld

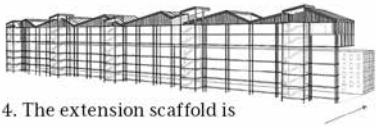
Ludwigsfeld is a district with predominantly large streets, many monotonous buildings, many vehicles and few parking spaces. Therefore, we reduce individual motorised transport, create sharing concepts and improve public transportation. We also focus on cargo bikes and shared e-mobility.

design challenge (dc) overview

1. Existing building

2. Assembly of the new storeys

3. Existing building after renovation with new building envelope



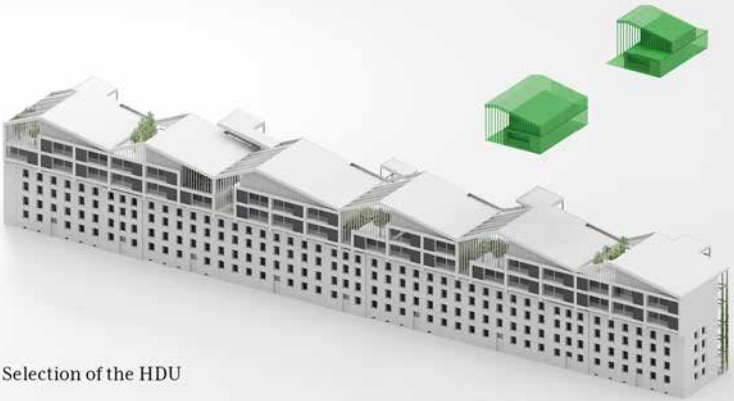
4. The extension scaffold is placed over the existing structure

5. Intensive merging of construction and vegetation

Rear view of the Design Challenge with the connection between the extension and the existing structure

The addition of storey consists of two floors with a roofscape covered with greenery and solar collectors and "crowns" the existing building. We create affordable, barrier-free housing for broad social diversity in modular timber construction.

house demonstration unit (hdu)



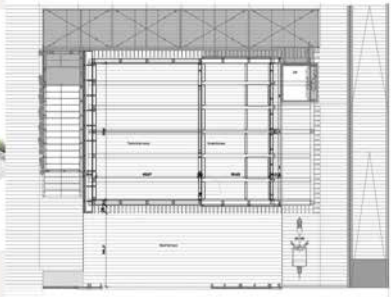
Selection of the HDU

Rendering of HDU

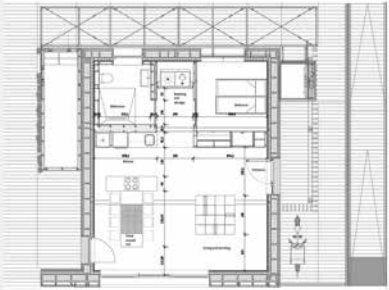
The HDU consists of three wood modules on the ground floor that closely resembles the original design of the rooftop extension.

The first floor adds a large roof terrace, a greenhouse for urban gardening and a technical room. These upper floor elements best represent the level-up concept derived from SDE's Design Challenge, which requires common areas where social interaction can occur among all residents.

Access to the upper floor is via an arcade on the northwest façade or a lift. Our building is made of wood and only recyclable or recycled other materials. We have avoided glueing so that the building can be separated by material type and can also be recycled at the end of its life.



Floor plan first floor



Floor plan ground floor

Section A-A

DC

	3695 m²	102 m²
	7	2
	24 m²/p	23 m²/p

Team Name | Team Identity

SUM | TUD

University

delft university of technology delft, netherlands

Task | Location of DC

renovation and addition of storey (the hague)

Refer to page 24 for design features

SUM has started its journey by examining large societal challenges in the team's home country, the Netherlands. Through literature and field research, SUM has identified 2 national problems that can be tackled by participating in the Solar Decathlon:

1. Housing shortage: The Netherlands has an exponentially growing housing shortage. By 2030, 1 million new homes need to be developed.
2. Energy neutral built environment: The struggle for an energy-neutral building environment by 2050 as agreed in the Paris Agreement in 2016.

In order to select a case study site for the urban and architectural intervention, SUM analysed various urban fabrics in the Netherlands. Based on its open and standardized built environment, SUM's focus narrowed down on the large Dutch post-war building stock.

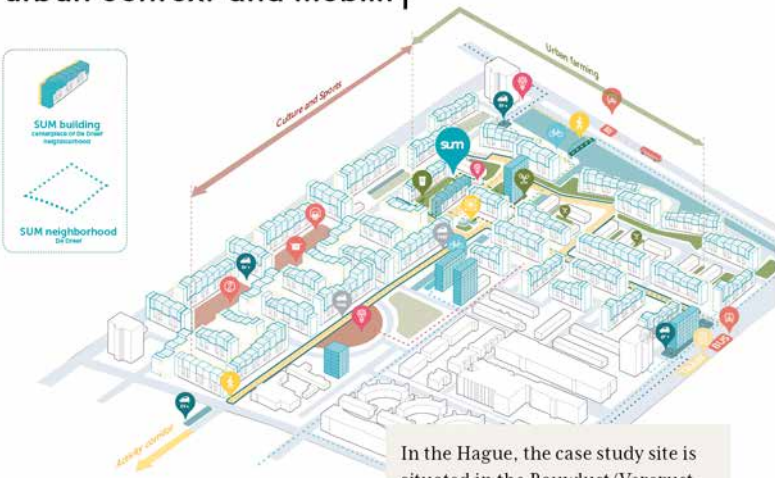
By setting clear urban and architectural goals, the SUM proposal does not only cater to the case study neighborhood in The Hague, but also acts as a wider redevelopment program for post-war neighborhoods around the Netherlands by being able to test design interventions and produce a set of recommendations to bring the post-war neighborhoods to the 21st century.

SUM's proposal is a renovation and densification plan for the 847,000 underperforming tenement flats. With SUM's repurposing strategy for tenement flats, the proposal aims to create a world in which diversity, innovation, and social interaction are stimulated; where social, economic, and environmental challenges across the country can be addressed with smart design solutions.

SUM aims to harness the potential of the existing neighborhood by densifying the tenement flats with modular Top-up additions, while preserving the horizontal character of the buildings. Furthermore, SUM is proposing to create communal gathering spaces for the neighborhood's residents at building and urban scales.

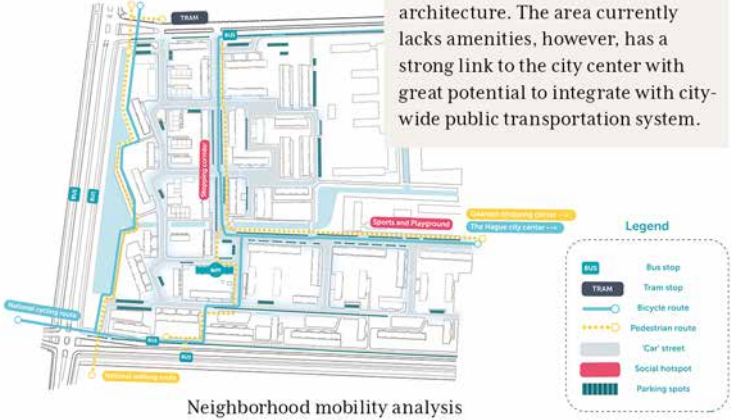
HDU

urban context and mobility



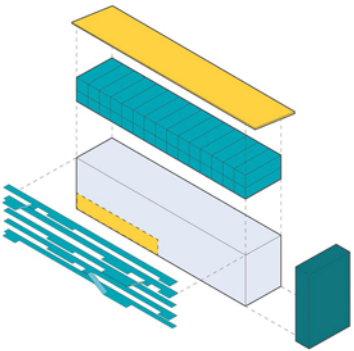
Neighborhood complete transformation – urban scale

In the Hague, the case study site is situated in the Bouwlust/Vererust district, which comprises of post-WWII Dutch urban planning and architecture. The area currently lacks amenities, however, has a strong link to the city center with great potential to integrate with city-wide public transportation system.



Neighborhood mobility analysis

design challenge (dc) overview



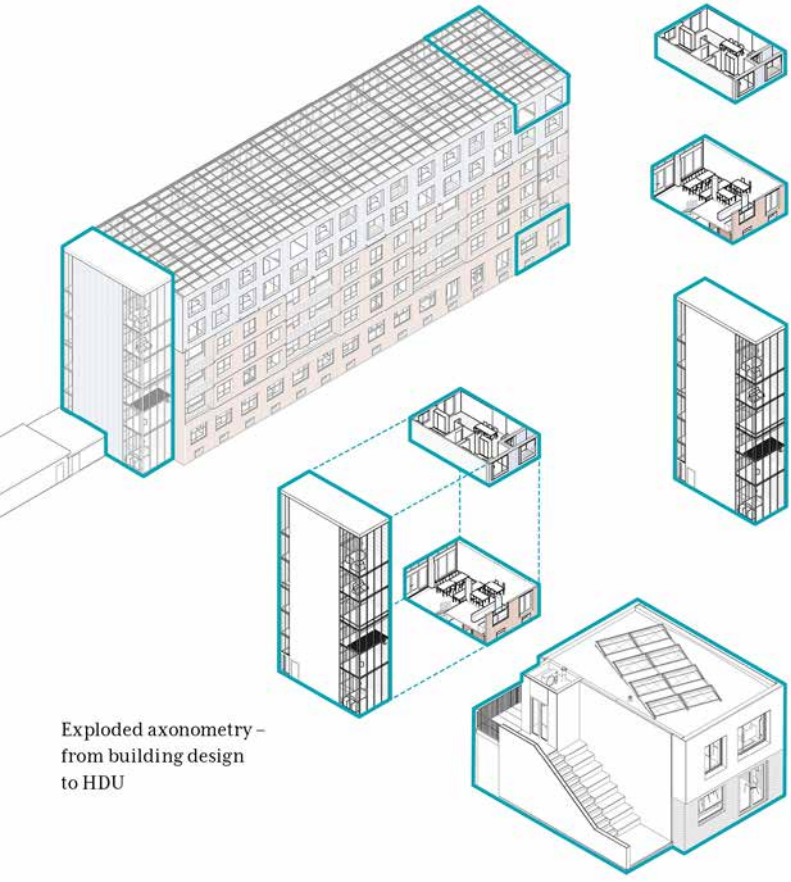
SUM proposes six main elements for the design, which include: ground floor activation with new public functions, multifunctional circulation core, gallery, the renovation of existing units, the addition of modular roof-top extensions, and a productive roof.

Axonometry of building design – 6 aspects

Typical renovation unit floor plan

Typical top-up unit floor plan

house demonstration unit (hdu)



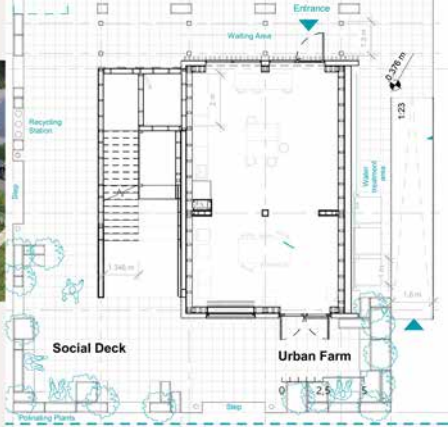
Exploded axonometry – from building design to HDU

The HDU represents 3 components of building design: renovated ground floor, Top-up housing unit, and circulation core.

The ground floor renovation strategy shows a multi-functional community space that enables a variety of social activities.

The Top-up densification strategy is comprised of 2 pre-fabricated modules and showcases a one-bedroom unit layout for a young entrepreneur. The Smart module houses the bathroom and kitchen, while the Standard module is an open living space. Thanks to flexible furniture, the layout can be adapted to cater to various living scenarios.

The HDU's circulation core is a modular wooden staircase that acts as circulation space, public forum, systems core, playground, and urban vehicle storage.



Floor plan ground floor

Floor plan upper floor

East-West section 0 2,5 5

DC

	1135 m²	63 m²
	4	1
		19 m²/p

Team Name | Team Identity

VIRTUe | TUE

University

eindhoven university of technology eindhoven, netherlands

Task | Location of DC

renovation and addition of storey (wuppertal)

Refer to page 24 for design features

VIRTUe is a multidisciplinary student team at the Eindhoven University of Technology, working to drive the transition towards sustainable cities. The construction and operation of buildings are responsible for 39% of the CO2 emissions . While the demand for new homes in the cities keeps growing, the building industry uses obsolete methods and materials. Meanwhile, people consume large amounts of space, power and materials. Humanity is stuck in a destructive loop where neither industry nor individuals give sufficient incentives to each other to change.

VIRTUe aims to break this loop through an integrated approach to sustainable building and living, with the following goals:

1. Future-proof buildings
2. Normalisation of low-impact living

"ripple" is inspired by the ripple effect. Like a drop in the water, the project creates a ripple of influence in buildings with a public function.

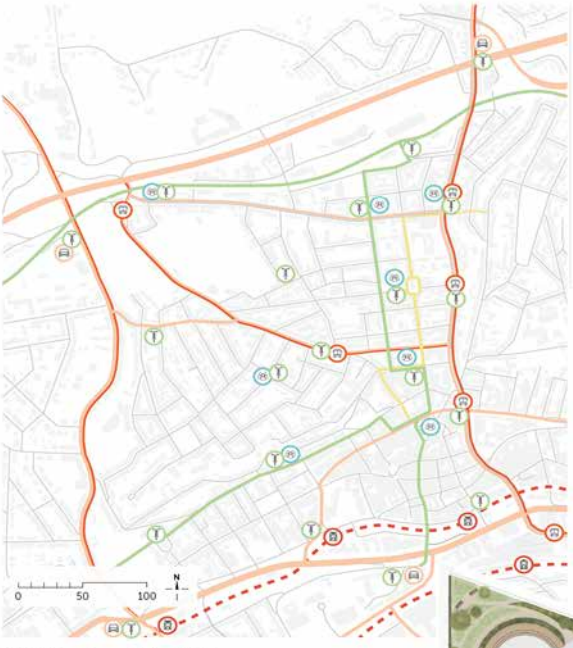
Ripple can be applied universally whilst being tailored to the context of each city and can create a growing impact.

To **future-proof buildings**, the "ripple" philosophy introduces design in three layers: fixed, flexible and free. The fixed structure has the longest lifespan and allows the façade and the bathroom and kitchen modules to be adaptable. The free layer of furniture, bio-based materials and reused wood makes the building circular. The façade has a "solar belt" to accommodate customised PV Thermal panels. Situating solar panels on the façade frees up space on the roof for biodiversity and the residents.

We **normalise low-impact living** by creating smart communities. The "ripple" design approach differs from the typical building block by replacing corridors with communal rooms to share appliances and activities. One modular unit contains two small yet comfortable apartments and a communal room to encourage social interaction among neighbours. This room houses EQUI, an interactive display that bridges the gap between energy production and consumption by running appliances at the optimal time of day.

HDU

urban context and mobility

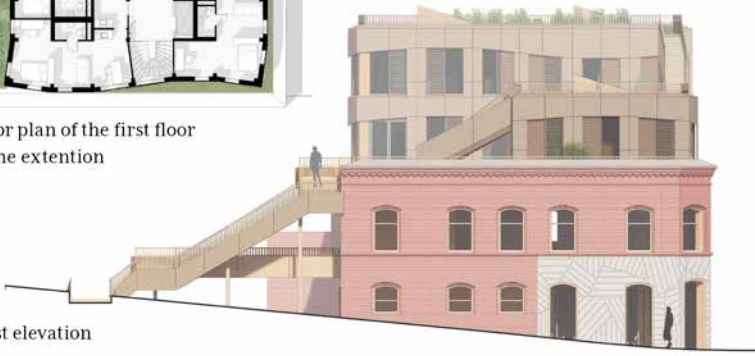


Mobility Map of the Mirke area

Within 20 years, VIRTUe strives to reduce motorized traffic in cities, reclaiming space for active and shared mobility, greenery, animals and people. Streets are made livelier with art routes, mobility hubs, urban farming to increase social interaction.

design challenge (dc) overview

Floor plan of the first floor
of the extention

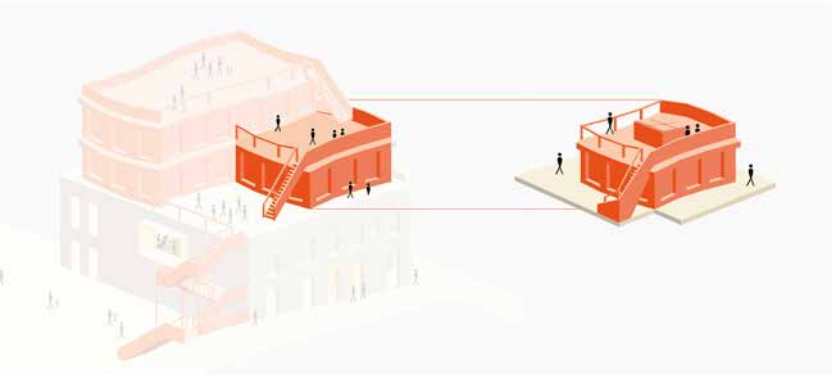


West elevation

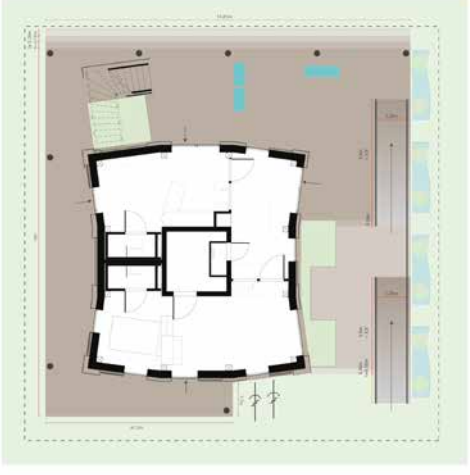
Section east to west

Section north to south

house demonstration unit (hdu)



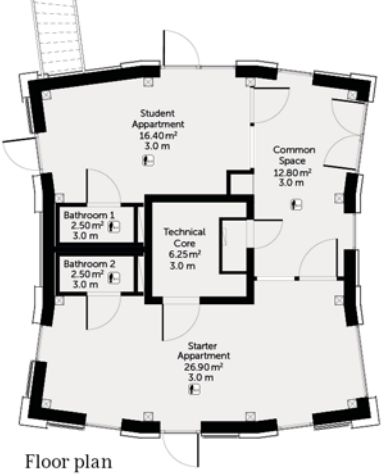
HDU Representation



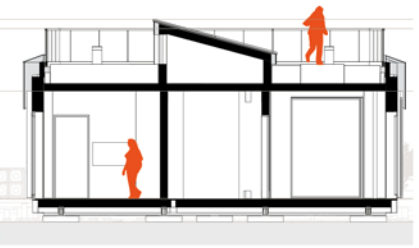
HDU in context of the competition

The ripple concept becomes a reality in the Ripple Demonstration Unit (RDU), a highly efficient living unit for two households, where circularity coexists with innovative technologies.

The RDU is designed in layers to maximise circularity and adaptivity. The residents control the central core containing all the installations through EQUI, a smart interface in the communal room. This shared space and a green roof encourage low impact living by sharing resources and inspiration. The attractive façade is wrapped in a customised solar belt catching the sunlight throughout the day. The urban concept is represented on the platform of the RDU through collective solutions, such as urban farming and shared mobility.



Floor plan



Section A

Section B

		140 m²
	5	2
		36 m²/p

Team Name | Team Identity

SAB | BKU

University

bangkok university bangkok, thailand

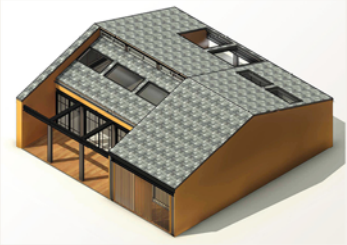
Task | Location of DC

closing gaps (wuppertal)

Refer to page 24 for design features

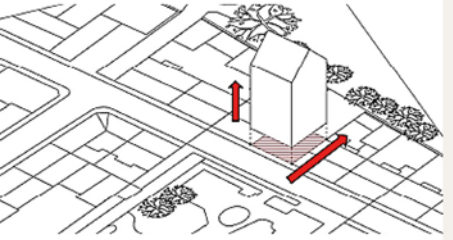
"SAB Adaptive living quarter" under the project objective to propose a solution for waste management issue by using recycling material for building construction. investigate two recycling materials: UHT and Beer brewer's grain board, to analyze the best passive design solutions through building simulation and experimental design and to provide open space for urban connectivity the town vertically and horizontally of Wuppertal, Germany.

The urban mobility and connection for historical cities is chancing lifestyle for outdoor living. As per the existing dwelling for medium densifying cities and issue of in 50% of waste in Germany is mentioned and 40% of EU energy consumption are criteria for solution. The waste management is expected impact in Mirke Quarter area with over 800 building block, the current situation. The challenge No. 2 namely "closing gap" is selected for investigation in "waste reduction- and neighborhood connectivity". The site location is rich with potential for urban mobility and activities with large garden and playground on the opposite. Thus, the concept of this proposal for using recycling material can be influence in reduction of waste in German



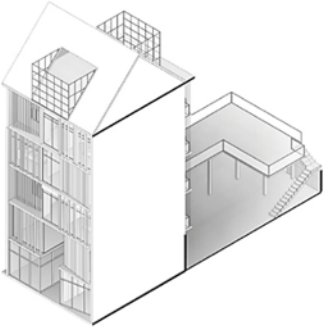
HDU

urban context and mobility



Lift up building design

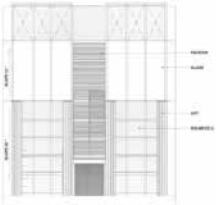
The lift-up space for connecting the two park of Wuppertal is main concern that how we can make people enjoy lifestyle without any borders. After we decided the connecting area, we think more on locals' activities and research that the city of Wuppertal is known for educational with the University of Wuppertal. Therefore, lacking of parking space is still issues. Thus, we design EV charging area and parking underneath the building. Also, we were considering the basement for hidden from some uncomforted climate where people could be gathering and partying with the ground temperature.



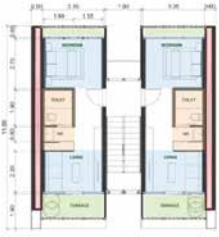
Isometrics of building design

Front

design challenge (dc) overview

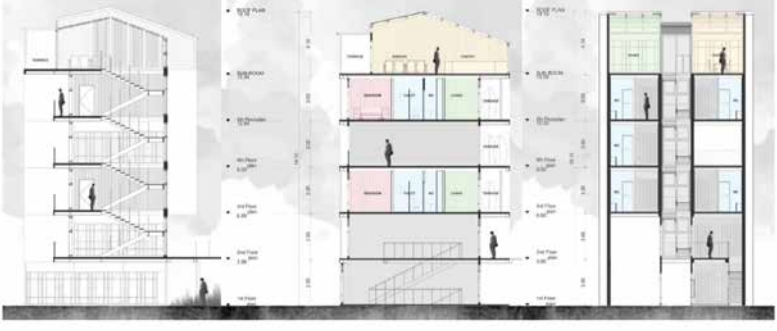


Roof plan



3rd-5th Floor plan

Sunroom



Section A

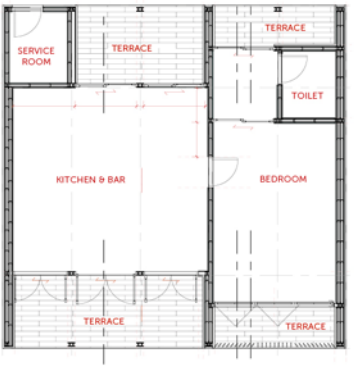
Section B

Section C

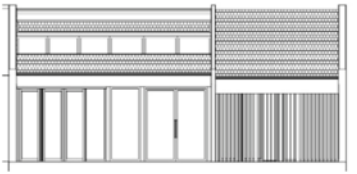
house demonstration unit (hdu)

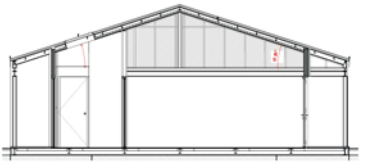
The house demonstration unit (HDU) is selected at the roof top position where sun room is located. The approach the solar heat gain from clean energy of sunlight is applied high-performance glazing. Together with recycling wall and floor material, we expected the heat is collected into the materials for releasing mean radiant temperature at night with naturally ways.

The HDU is consisted of public space for social gathering area that we design as a 'beer bar' for German concept. The space is cozy and chill with sun path comfort bubble chairs. We do not want the kitchen to be typical kitchen, it can be adaptable and moving shelves to anywhere we want. The dinning area is set at the back of the house to emphasize kitchen zone of bar. On the right hand, there is a demonstration of resting area for bedroom with the restroom and private terrace. The service is behind this house for PV systems and invertors. The selected materials are recycling of steel, teakwood vinyl, beer's brewer grain wall tiles, UHT board for floor tiles and thai traditional fabric called 'pa khao ma' that is adaptive clothing for Thai people. The cloth is commonly used in various seasonal here and also it is hand-made craft products.



Floor plan





Section

	482 m²	156 m²
	6	2
	31 m²/p	37 m²/p

Team Name | Team Identity

LOCAL+ | FHA

University

aachen university of applied sciences aachen, germany

Task | Location of DC

closing gaps (wuppertal)

Refer to page 24 for design features

In response to today's challenges, such as climate change, scarcity of resources, urbanisation, and a growing and ageing population, LOCAL+ aims to promote a flexible, sustainable and socially responsible housing solution that keeps pace with the constant changes in everyday life.

For this purpose, the team has chosen a building gap in the Mirke Quarter as the setting. Here, in addition to social differences, age differences, in particular, play a key role. To promote social interaction, the team has developed a living concept for (temporarily) single people like newcomers, students or pensioners who want to be part of a community.

To support social interaction, the building design is based on the idea of keeping individual space to a minimum and thereby offering larger communal areas. In addition, a high degree of flexibility allows an innovative living concept that adapts to the individual needs of a diverse group of residents.

With this in mind, the CUBE was invented to replace traditional rooms. The room units are a central design aspect and an architectural innovation because they are fully movable! The CUBEs create spatial diversity by permitting adaptable zoning of rooms, but mostly serve as personal retreats and workspaces. Their minimised size puts interaction, communication and communal living in the spotlight and reduces the living space used per person.

In addition to social interaction, LOCAL+ aims to create a building that innovatively and intelligently adopts new approaches to energy and sustainability. A clever combination of different means of generating, storing and using energy enables two-thirds of the building's energy needs to be covered.

Furthermore, the circularity of the building is increased by an efficient and sufficient choice of materials and detachable construction. In this way, the goal of reducing the carbon footprint, as well as planning and building in a way that conserves resources, can be achieved.

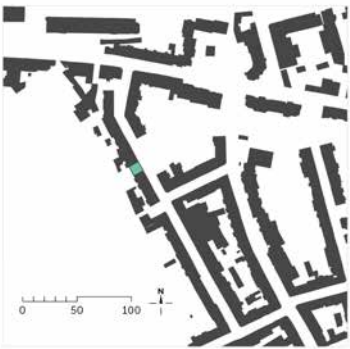
All in all, the building was designed in such a way that the concept can be transferred to other urban situations and can thus serve as a prototype for closing gaps as well as for vacancies or new buildings.

HDU

urban context and mobility

Site plan

Boosting climate-neutral mobility, such as cycling, walking and efficient public transport will create more space for social exchange, ecologic biotopes and beneficial functions. Water-permeable streets, retention areas and generous tree beds also make Wuppertal more climate-resilient.



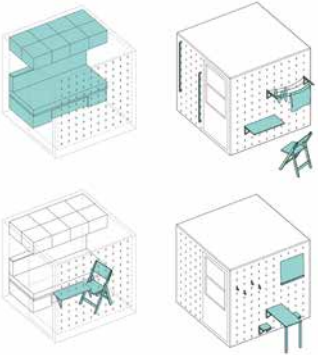
Site context

design challenge (dc) overview

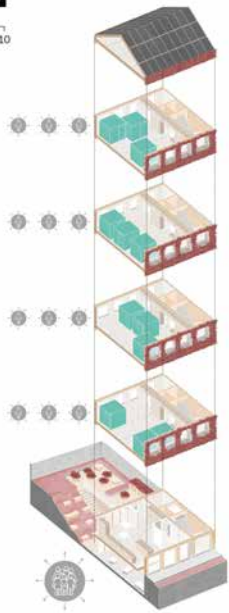
Regular floor

Cross section B-B

While the basement, the ground floor and the attached garden offer communal areas for the entire house, the four upper floors each form a shared apartment for three roommates. On about 60m², they share a bathroom, a pantry-kitchen and a flexible communal area that is constantly changed by the CUBEs.



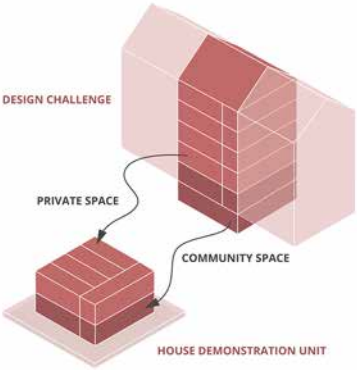
Concept isometrics with CUBEs



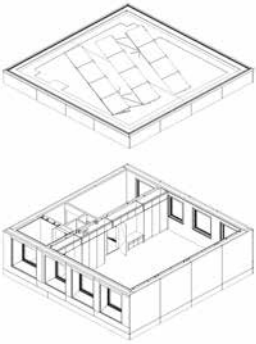
Legend numbers for DC and HDU

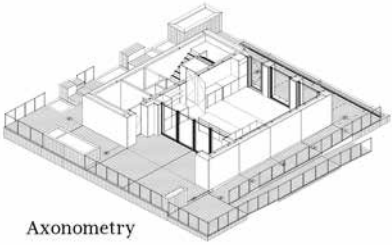
1 community space
2 bathroom
3 corridor
4 technical
5 community kitchen
6 terrace
7 garden
8 recycling area
9 CUBE
10 apartment
11 storage

house demonstration unit (hdu)



Transformation of the Design Challenge into House Demonstration Unit





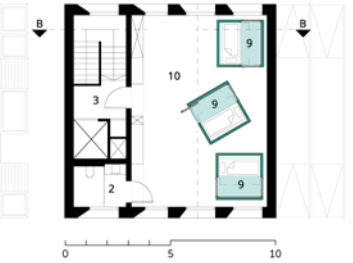
Axonometry

Crossection HDU

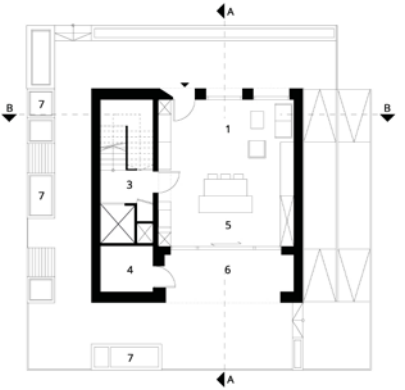
Rendering interior

The HDU is the translation of the DC into an exhibition architecture. While the lower floor combines the communal living room and the kitchen, the upper floor represents one of the four living floors of the DC.

The demonstrator which consists of 10 solid wood modules was built with mostly detachable, reusable and eco-friendly materials and construction methods. The facade picks up on the photovoltaic panels, the wood cladding as well as the plant elements of the DC. In addition, the two outer walls with an air-cleaning textile reflect the neighbouring walls of the building gap. Finally, also the energy concept with the PVT panels, the heat pump, the ice storage and the heating/cooling ceiling were adapted.



Floor plan first floor



Floor plan ground floor

Section B-B

	445 m²	123 m²
	6	2
	32 m²/p	23 m²/p

Team Name | Team Identity

TDIS | NCT

University

national yang ming chiao tung university hsinchu, taiwan

Task | Location of DC

closing gaps (taiwan)

Refer to page 24 for design features

The average building life in Taiwan is 35–40 years. In Taipei there are many old and structurally unsafe buildings built in the 1970s waiting for renewal. However, the process usually lasts more than 10 years. Many narrow gaps have been created in our city. Instead of waiting a long time for urban renewal, team TDIS propose a new concept, which is to build mid-way housing. “1 House for All” is an efficient way to refurbish residential buildings. The goal is to close the gaps of time and space created by the complicated urban renewal process.

"How could we make a change for all?"

"What if...we have a house for all growing all over the city gaps that optimise the existing space and energy?"

Team TDIS believes that good design adds up to a sincere response to people's true needs, and is best done by transdisciplinary teamwork. Team TDIS (Transdisciplinary Design Innovation Shop) is named from the pronunciation of "This", focusing on contemporary (This Moment), local (This Place), and immediate (This Time).

Our students are from different major fields; the professional backgrounds of our faculty are also highly diverse. With transdisciplinary members, we aim to address the increasingly crowded and deteriorating living conditions in Taiwan.

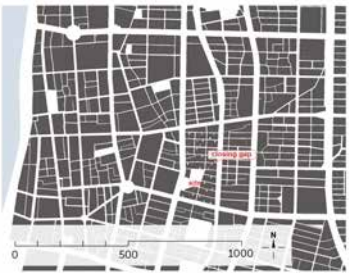
We propose an integrated solution that could be replicated in different site conditions: “1 House for All”.

This is how we imagine housing for the future and innovative measures we want to take. To combat energy wastage, inefficient urban renewal and housing injustice, we propose an integrated sustainable solution that could be replicated everywhere– “1 House for All.” This is not only a nzero mid-way house, but also social enterprise housing, and an energy-efficient sharing station for the city.

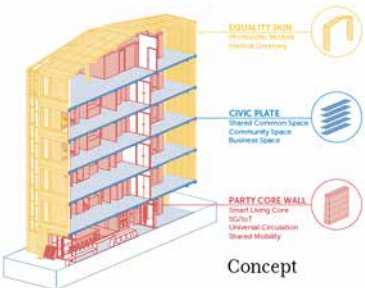
In the era of pandemics, it is our belief that city life should be comfortable, green and affordable. “1 House for All” puts our vision into action.

HDU

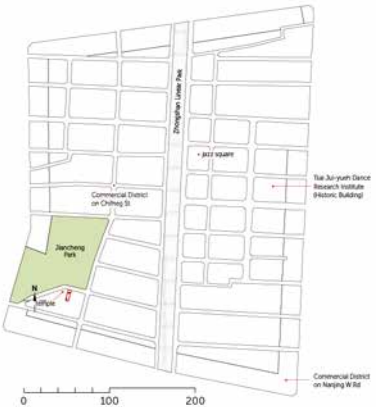
urban context and mobility



Site plan

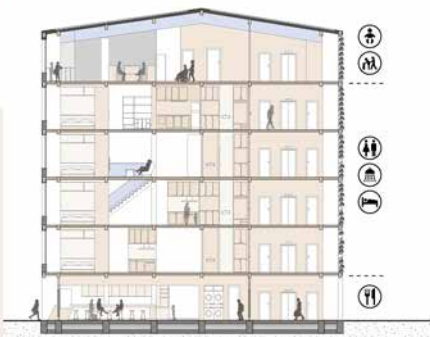


Concept



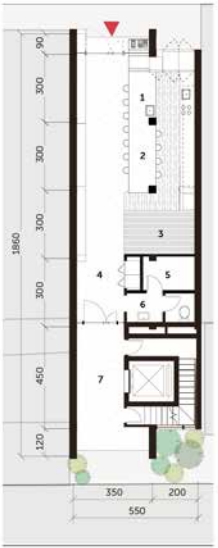
Context and Mobility

Taipei is the most crowded city in Taiwan, with 1.6 times the density and 7.3 times the population of Wuppertal. With 170 years of history, the streets of Datong District are very narrow, leading to traffic congestion. We propose to set up traffic intercept points and readjust the road classifications to deal with the problem.



Section

design challenge (dc) overview



1 Dining bar
2 Meeting space
3 Reading space
4 Self-served laundromat
5 Storage room
6 W/C
7 Circulation core

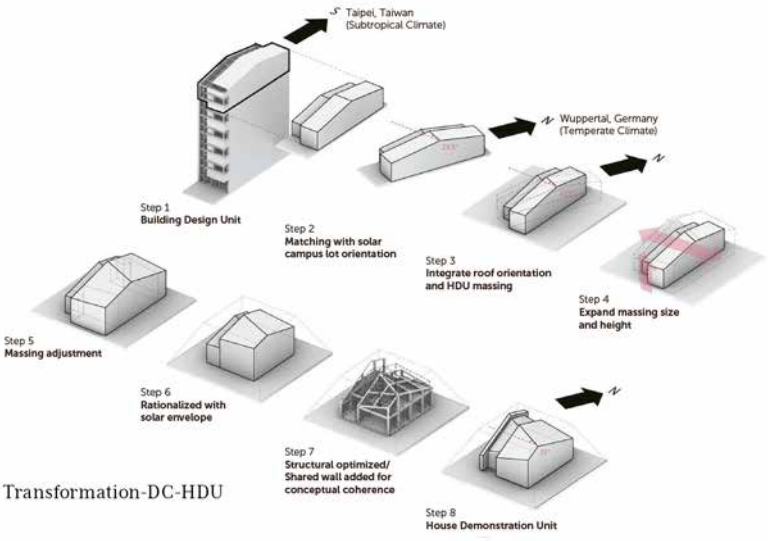
Ground floor plan

1 Bedroom
2 Kitchen
3 Dining space
4 Living room
5 Reading room
6 W/C
7 Bathroom
8 Laundromat
9 Circulation core

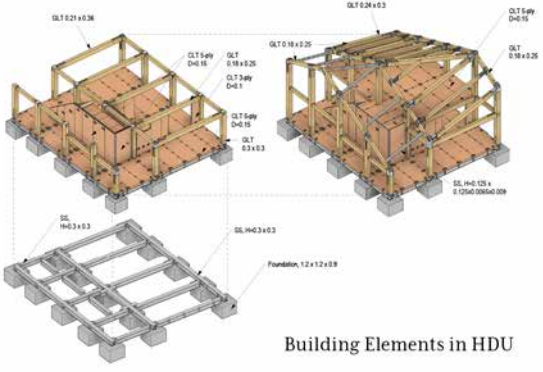
Floor plan

Interior

house demonstration unit (hdu)



Transformation-DC-HDU



Building Elements in HDU

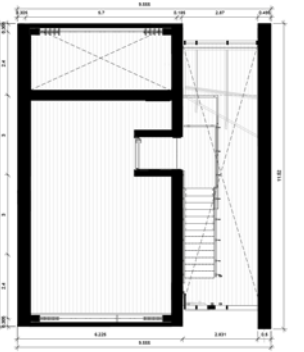
Our HDU presents our vision in action, in three layers of significance, as “1 House for All”:

As a “Net Zero Mid-way House”, it is 100% constructed from local Cryptomeria japonica CLT, with Interactive Thermochromic Thermal Insulation Bricks that show the three primary colours in our logo.

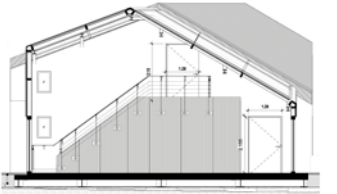
As an “Energy-Efficient Sharing Station”, we have a breathing balcony that shows a green facade of edible plants. The intelligent thermal resistance curtain and party core walls with an IOT system provide flexible inner space.

As “social enterprise-housing”, the HDU offers a profitable business model for the operation of a green building that is suitable for people of all ages.

Ground floor plan



Second floor plan



Section A-A

0 2,5 5

DC

	481 m²	139 m²
	5	2
		12 m²/p

Team Name | Team Identity

Lungs of the City | UPH

University

university of pécs, pécs, hungary

Task | Location of DC

closing gaps (pécs)

Refer to page 24 for design features

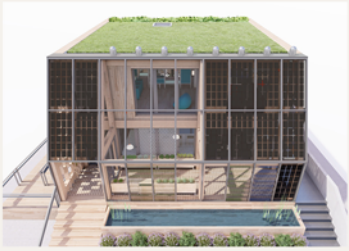
The goal of the Lungs of the City team is to cement Pécs' reputation as a liveable, healthy and developing city, and to maintain the role of the university in the economic, social and environmental life of the town.

At the heart of our design objectives is a simple equation:
minus emission, plus green energy times community interactions.

The solution to this equation is the re-greened blocks project. Its long-term impact is a breathable, green city, a built environment with negative emissions, and an aware society.

Our architectural concept focuses on a sample building named the RGB Gatehouse. Our green strategy has four main thrusts.

1. **Green energy surplus:** Our modular design is open to free rearrangement as residents age. In addition, we have a sunspace on the south side of our building, which contributes to harnessing passive energy through a unique feature of our building – the Trombe wall. Our green facade also serves numerous purposes.



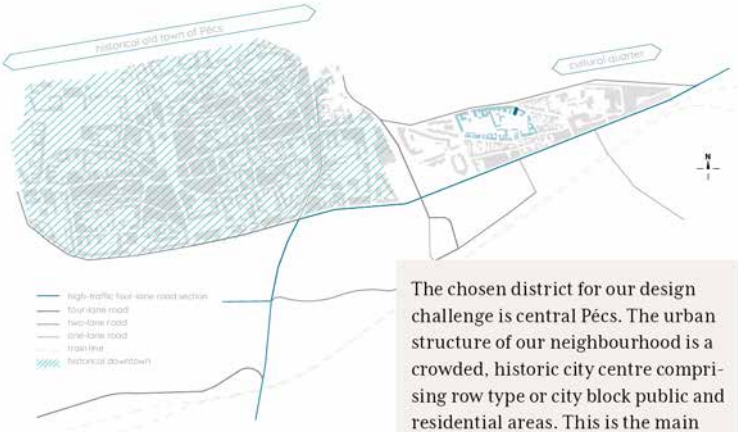
2. **Reduced emissions:** We are changing to renewable energy sources. There is a strong focus on recycling and the RE8 principles (rethink, reduce, reuse, replace, recover, recycle, reunite, regenerate). The building is 95% recyclable. The structure is 85% wood, locally sourced; it does not pollute the atmosphere during its formation but binds CO2. Our steel and aluminium come from recycled metal, our panels are made of recycled timber, and we use partially recycled concrete for the foundations. Gardens also compensate for harmful emissions.

3. **A healthy and affordable living environment:** Our overall design reduces energy costs, travel costs, construction and maintenance costs, and in the future will also cut alteration costs, making the building more affordable.

4. **Creating a cooperative residential community:** We realise this in the building by means of a wide range of initiatives from a communal kitchen and activity space, a club room, laundry room, co-working facilities, educational offerings and workshop, to communal gardening.

HDU

urban context and mobility

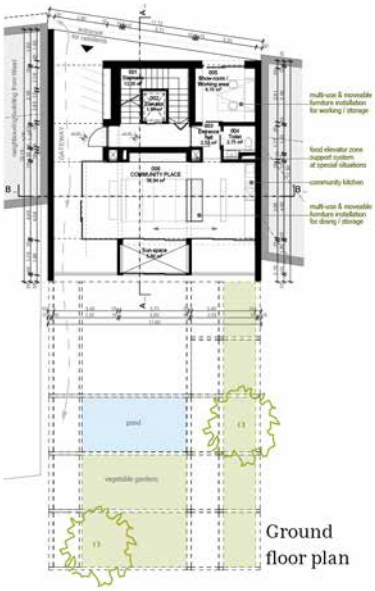


The chosen district for our design challenge is central Pécs. The urban structure of our neighbourhood is a crowded, historic city centre comprising row type or city block public and residential areas. This is the main source and destination of peak traffic.

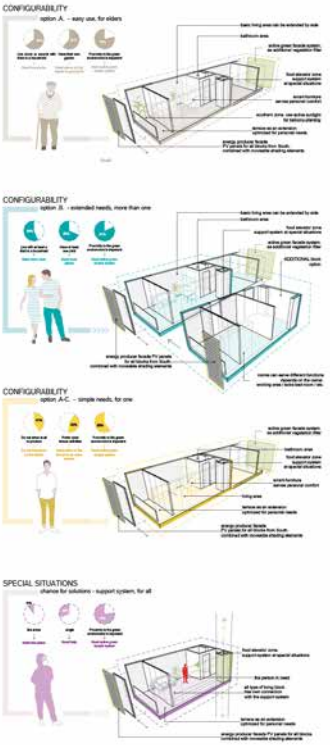
Project city and district connection

Site plan

design challenge (dc) overview



Ground floor plan

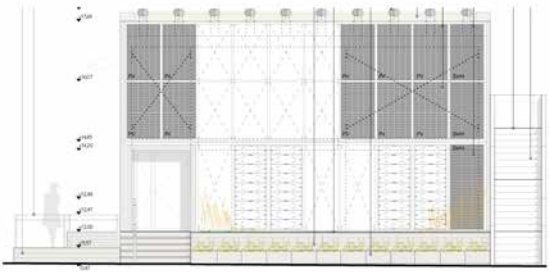


Group of residents

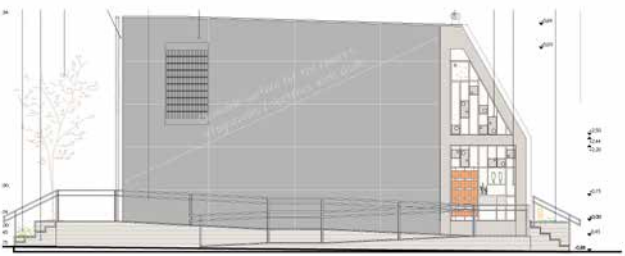
We aim to create breathable cities with healthy housing by closing the gaps with green buildings, and by adopting healthy urban design strategies. We wish to forge cooperative communities by designing functionally diverse neighbourhoods, promoting community activities and embracing green mobility principles.

house demonstration unit (hdu)

northern elevation



southern elevation

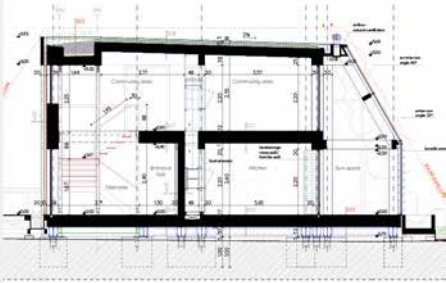


western elevation

The HDU is designed as a combination of the keynotes of our overall concept and ideas. The ground floor of the building serves as a scaled-down sample apartment that will simulate living conditions similar to those of the design challenge building. Meanwhile, the upper floor highlights a vital part of our concept – the communal area.

Exciting features include the green façade system and Sunspace – an energy zone with moveable deciduous vegetation and a Trombe wall made from recycled bottles filled with water, as well as a pond, a weather-resistant spice garden, and a nesting wall.

Ground floor plan



Section AA

	273 m²	71 m²
	3	1
	28 m²/p	38 m²/p

Team Name | Team Identity

Azalea | UPV

University

polytechnic university of valència valència, spain

Task | Location of DC

closing gaps (valència)

Refer to page 24 for design features

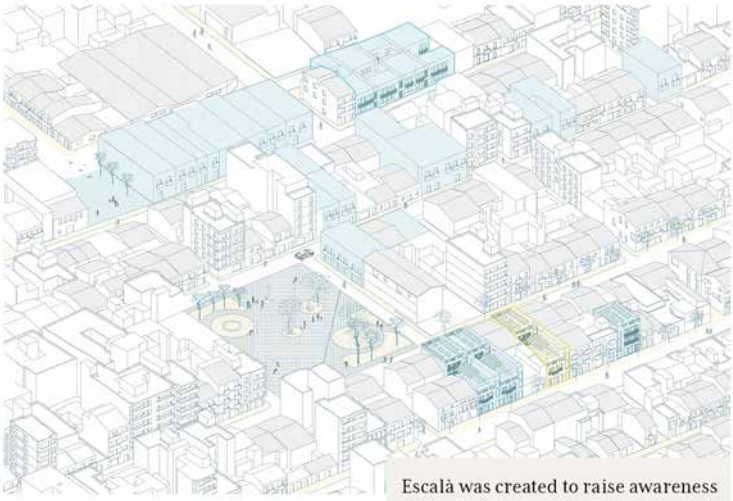
Azalea UPV has set out to unite tradition and innovation to create a unique project, Escalà. That is why they chose El Cabanyal –one of the most historic neighbourhoods in Valencia – as the location for the proposed SDE 21/22. Its relationship with the sea, its way of life and its traditions, make it a unique place in the city.

Due to previous urban planning approaches, the neighbourhood suffered a period of decay, and it now has many vacant lots. For this reason, the team developed a standardised and scalable sustainable housing solution that is appropriate to the entire neighbourhood, respecting the identity and traditions of El Cabanyal.

Escalà is a project that responds to the needs of the residents, working to create a social housing project that can be tailored to their needs, would improve access to housing and provide a solution to the energy poverty suffered by the most vulnerable people in the neighbourhood.

HDU

urban context and mobility



Azalea UPV Design Challenge
in El Cabanyal

Escalà was created to raise awareness of the architectural barriers present in the Cabanyal. The team classified the main problems: pavements in poor condition, isolated steps, crossings without zebra crossings and a lack of cycle lanes.

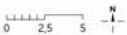
Mobility graphic

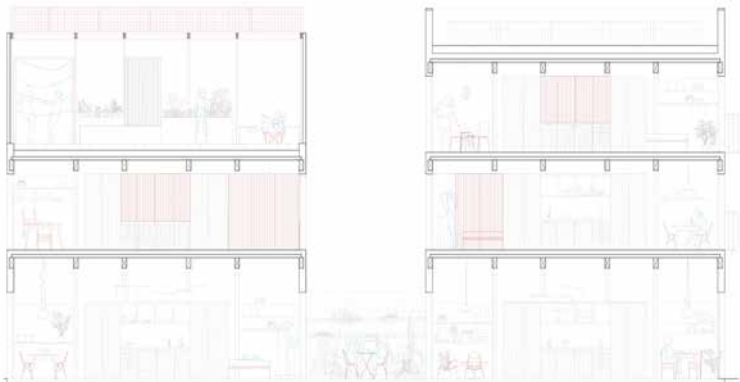
design challenge (dc) overview

Elevation AA

The large number of vacant lots in the neighbourhood led us to develop scalable and adaptable housing. This is facilitated by the neighbourhood's characteristic layout – a unique urban grid that has survived for more than 500 years.

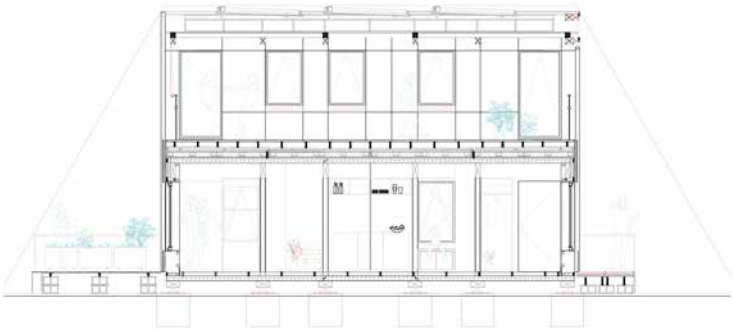
First floor plan



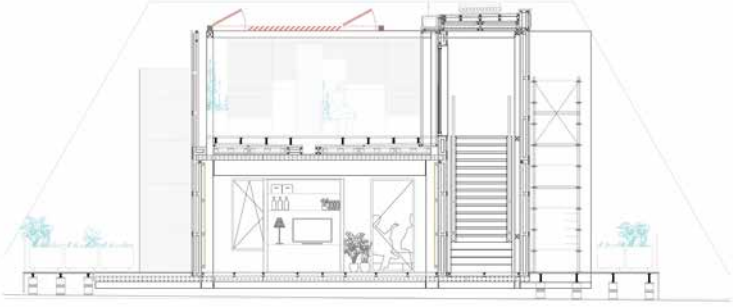


Section AA

house demonstration unit (hdu)



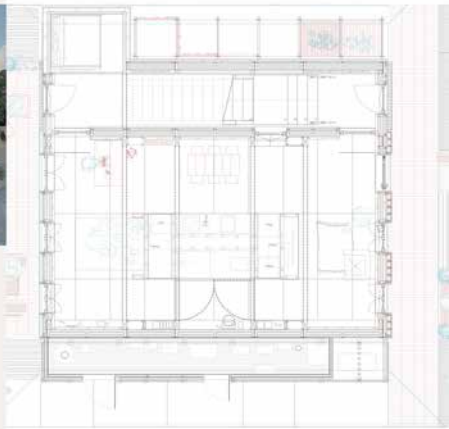
Section AA



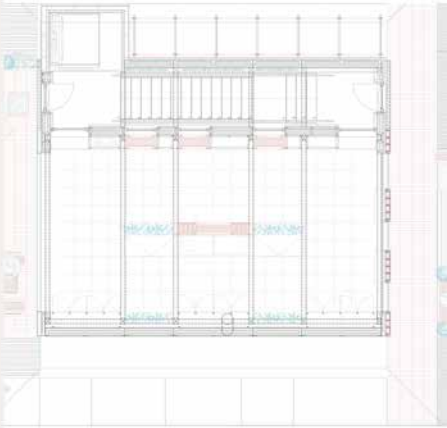
Section BB

Escalà incorporates clean energy, the reuse of resources and passive measures to reduce energy demand.

The building is a single-family house with a walkable roof that allows it to connect with the outside – something very typical of El Cabanyal. In addition, our new heating system, called Caloret, will preserve thermal comfort in cold weather thanks to the capture and accumulation of incident solar radiation. Likewise, in hot weather, it will be used to ventilate the house in a totally passive manner, without the use of any external energy.



Ground floor plan



Roof floor plan

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INTRODUCTION AND GENERAL REPORT

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Thailand	King Mongkut's University of Technology Thonburi
Turkey	Istanbul Technical University

list of abbreviations

DC	Design Challenge
HDU	House Demonstration Unit
m	Meter
m^2	sqm
NRW	North Rhine-Westphalia (Federal State)
EU	European Union
Solar Campus	Event Venue
SDE 21/22	Solar Decathlon Europe 2021/22
CO_2	Carbon Dioxide
PV	Photovoltaic
PVT	Photovoltaic Thermal Collectors
OPV	Organic Photovoltaics
BUS	Binary Unit System/Data Transfer
CLT	Cross Laminated Timber
UHT	Ultra High Temperature
LCA	Life Cycle Assessment
LED	Light-Emitting Diode
BIM	Building Information Modeling
CAD	Computer-Aided Design
2D	Two-dimensional
3D	Three-dimensional
AI	Artificial Intelligence
VR	Virtual Reality
IoT	Internet of Things
MRT	Metropolitan Rapid Transit
BTS	Bangkok Skytrain
PC	here: Private Car
PT	Public Transport
EV	Electric Vehicle
Post-WWII	Aftermath of 2nd World War
RGB	here: Re Greened Block

 **DC**	Design Challenge (DC)
 **HDU**	Consisting of the top floor of the DC
 **HDU**	Consisting of the top floor + typical floor of the DC
 **HDU**	Consisting of the ground floor + typical floor of the DC
	Consisting of the ground floor + top floor of the DC
	Design Challenge
	House Demonstration Unit
	Net floor area
	Number of floors
	Net floor area per person

solar decathlon 21»22 europe

WUPPERTAL GERMANY ...goes urban!

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