PRESS KIT 3
MOR

TU Delft

INTRODUCTION

The MOR team represents Delft University of Technology, The Netherlands, in the Solar Decathlon Europe 2019. MOR is a collaboration of students, professors and experts working in the fields of energy, circularity, product development, innovation in technology, finances and architectural design.

The Delft University of Technology is the largest and oldest Dutch public technical university, located in Delft, the Netherlands, providing technical education for the last 175 years. Known for its high quality of education and research, the university was ranked 3rd for the Architecture and the Built Environment curriculum and 4th for Civil Engineering curriculum in 2018[1]. The TU Delft being an internationally oriented university is reflected well in the MOR team, since its members originate from 21 different countries. Across the campus, a large pool of talented students and employees contribute to the conception and implementation of technological solutions for actual environmental and social challenges, from the local to the global level.

With the aim of creating solutions for a future that is socially and environmentally conscious, MOR presents this project manual as part of the third deliverable for the competition.
It is our team's vision to create a future-proof built environment, that gives back to its surroundings more than it takes away from it.

In the quest to make our vision a reality, MOR, or Modular Office Renovation, has committed itself to develop a strategy for renovating underperforming office buildings into net positive multi-purpose buildings. Our mission is to renovate these inefficient office buildings into net positive and affordable rental housing for starters. In order to make our design future-proof, we propose an adaptable and modular solution with multiple functions within the building. Our solutions are able to react to the change in user needs as well as the continually changing market conditions. We are convinced that this type of intervention will have a positive local and global impact on the long-term viability of our surroundings.

MOR aims to create a renovation proposal focused on net-positivity in five aspects: energy, air, water, biomass, and materials. Only through holistically addressing these five net-positivity aspects we can hope to achieve social, economic and environmental prosperity as the pillars of sustainability.

It is worth noting that the TU Delft already has a record of participating and supporting the teams competing in the Solar Decathlon competition, such as the Pret-a-Loger team of 2014 in Versailles. However, a novelty in this Deliverable is that the MOR team has been granted a Dream Team status, which shows TU Delft's commitment to fostering continuous generations of teams that strive towards a more sustainable and habitable built environment.

Footnote 1 : According to the QS World Universities ranking 2018.

CONTENT

"THERE IS A GREAT NEED FOR THE INTRODUCTION OF NEW VALUES IN OUR SOCIETY, WHERE BIGGER IS NOT NECESSARILY BETTER, WHERE SLOWER CAN BE FASTER AND WHERE LESS CAN BE MOR"

MOR TEAM

Team officers

Project Architect	*Anna Tsagalou*
Project Engineer	*Soujanya Krishnaprasad*
Project Manager	
Student Team Leader	*Francesco Longo*
Contest Captain	*Ivan Avdic*
Communication Coordinator	*Nienke Scheenaart*
Sponsorship Manager	*Siem van Sluijs*
Instrumentation Contact	*Okan Türkcan*
Health and Safety Coordinator	*Kosmas Spanidis*
Safety officers	
Site Operations Coordinators	

8

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Architecture
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Energy and Process Technologies
Strategic Product Design

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Ing. Peter de Jong	Faculty of Architecture, Design & Construction Management
Faculty advisors:	
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Prof. ir. Peter Luscuere	Faculty of Architecture, Architectural Engineering
Dr. ir. Ad Straub	Faculty of Architecture, Housing Quality & Process Innovation
Dr. ir. Martin Tenpierik	Faculty of Architecture, Architectural Engineering & Technology
Dr. ir. Pirouz Nourian	Faculty of Architecture, Design Informatics
Dr. Olindo Isabella	Faculty of Electrical Engineering, Photo-voltaic Material and Devices
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Ir. Leo van den Burg	Faculty of Architecture, Urbanism
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Ir. Mo Sedighi	Faculty of Architecture, Architecture
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Ir. Minyoung Kwon	PhD candidate
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TOGETHER WE CAN DO MOR.

PROJECT DESCRIPTION

Currently in the Netherlands, around 34.6 million square meters of office space has an energy label worse than C, which equates to 44% of the total Dutch office stock, or the area of 4,845 football fields.This alarming number of buildings fail to meet European legislation regarding efficiency in energy, water, materials etc. and contribute negatively to the efforts of reaching the sustainability goals of 2050 in Europe. The energy inefficiency phenomenon is present in large urban landscapes with a lot of economic activity such as the Hague, Rotterdam, and Amsterdam, in which 1.4M, 1.16M, and 2.5M square meters of office space respectively have an energy label lower than C[3]. In addition, according to the newly amended Building Decree (Bouwbesluit) no office stock with an energy label worse than C can be used for that purpose from the year 20235.

From an ecological standpoint, these office buildings are unfavorable, being unable to meet the new stricter European legislation regarding the energy consumption, water use, embodied materials etc. as well as rising energy prices. In this state, these buildings are
not positively contributing to the goal of reaching lower energy consumptions and CO2 emissions within the built environment. This means that the existing stock of old office buildings will have to be upgraded to stay useful, attractive and lettable.

Social issues related to the presence of inefficient office buildings become apparent when considering the fact that many of such offices are left vacant. The repercussions of this state of affairs can be summarized by the broken window theory6, which suggests that signs of abandonment, disorder and neglect within the urban environment trigger more disorder and neglect, while at the same time stimulating undesired criminal behavior. Due to this the neighborhood may feel less attractive and unsafe. Therefore renovating these vacant office buildings and making them more attractive and pleasant can aid in the inhibition of these negative behaviors. In addition, making buildings energy and resource efficient can help increase energy access and reduce energy poverty for low-income residents, leading to improved health, productivity and comfort within the entire neighbourhood.

Meanwhile, the Dutch housing market continues to grow stronger, with the average purchase price of all dwellings rising by 7.44% during the second quarter of 2017, the largest rise in more than 16 years7. As the housing prices are rapidly increasing, the available affordable housing stock is dramatically decreasing; most notably in the big cities where the supply does not meet the demand. This shortage of availability can be attributed to the trend of decreasing number of residents per household8. More and more people decide to live individually, and therefore the housing need will rise even more in the coming decades.
The lack of availability and affordability of owner occupied housing has led to the shift in the mindset of this demographic group (starters), who are moving away from that kind of long term financial commitment and are choosing for renting instead. This choice to rent instead of owning a property, is coupled with the new lifestyle choices of starters, who want to remain flexible in their movement and have the ability to change location after a certain period of time due to new job opportunities or other developments in their lives[1]2.

One of the previously mentioned cities facing both problems of inefficient office building stock and skyrocketing increase in housing prices is Rotterdam. We focused on this city as it has one of the lowest energy efficiency rates for office buildings in the Netherlands and an equally unfavorable trend of housing price increases.

With our project, we aim to tackle these two challenges by working towards the renovation of energy inefficient office buildings into affordable housing and flexible work spaces for starters, a group that is highly affected by the current building stock shortage. The building will be transformed from an inefficient office building to a multi-purpose apartment building that is net-positive regarding energy, water, air, biomass and material. The multi-purpose building will be a mix of apartments, communal areas and working spaces. The modular and flexible approach in this project demonstrates itself in four different types of modules that can be rearranged according to the demand and typology. These modules include a facade module, a wall module, a kitchen/bathroom module and a bedroom/workstation module. In accordance to some predictions that the office market will recuperate and office space will again be needed, the project uses a flexible concept that can easily transform the new apartments back to offices. However, it is also possible that a change in the housing stock, tenants living styles, or particular urban conditions may force the typology of housing to change, to which it could be easily adapted with our concept.

Within the concept we present two different types of dwelling typologies: a self-contained apartment and a co-living apartment. The self-contained apartment can host up to three different types of households which we named live, live & grow, and live & work. All of these self-contained apartments include private zones (bedroom/ workspace) and facilities shared with other cohabitants (kitchen and bathroom). The live & grow units additionally contain a private garden, which acts as a buffer zone between inside and outside, but most importantly brings light and air to the building's interior, contributing to a healthier and more pleasant space on a building scale. The live & work unit type is characterized by an addition in the form of a 'work pod' below or above the apartment, which serves as a private workplace within the office floor. It is connected to the living unit above it or below it via an internal staircase. The second typology, the co-living apartments or live & share, aims at providing more affordable dwellings by sharing facilities and living rooms with more than two other occupants: the household varies between four and eight inhabitants. These apartments go beyond living together and sharing space, therefore promoting interaction, a sense of community and shared responsibility.

By introducing our concept, we can mitigate the negative economic, ecological and societal effects of underperforming building stock, while at the same time providing more housing to foster sustainable urban densification. Ultimately, these buildings will shift from being contributors to the problems of unsustainable resource consumption and inadequate urban services to becoming part of the solution.

Buildings are huge consumers of resources. But we think this should be different. In order for future generations to flourish, we envision a future proof built environment that gives back to its surroundings more than it takes away from it. Moving away from being a consumer towards being a contributor.

GOALS

1. Develop a flexible solution for retrofitting of vacant office buildings into net-positive housing.

2. Make the solution modular and industrialized so as to achieve cost-effectiveness with a high market potential to make our sustainable renovation strategy applicable on a larger scale.

3. Raise awareness of the professionals, general public and inspire the public authorities about the necessity for energy renovation, specifically of vacant building stock with an effective working prototype.

4. Provide affordable accommodation and workspaces for starters, who are in need of housing in proximity of their workspaces in large cities.

5. Stimulate sustainable urban densification by vacancy renovation into mixed-use space.

6. Achieve net-positivity in dense urban environments with the smart combination of circular concepts such as urban farming, passive ventilation, grey water recycling, materials reuse and power-generating facade.

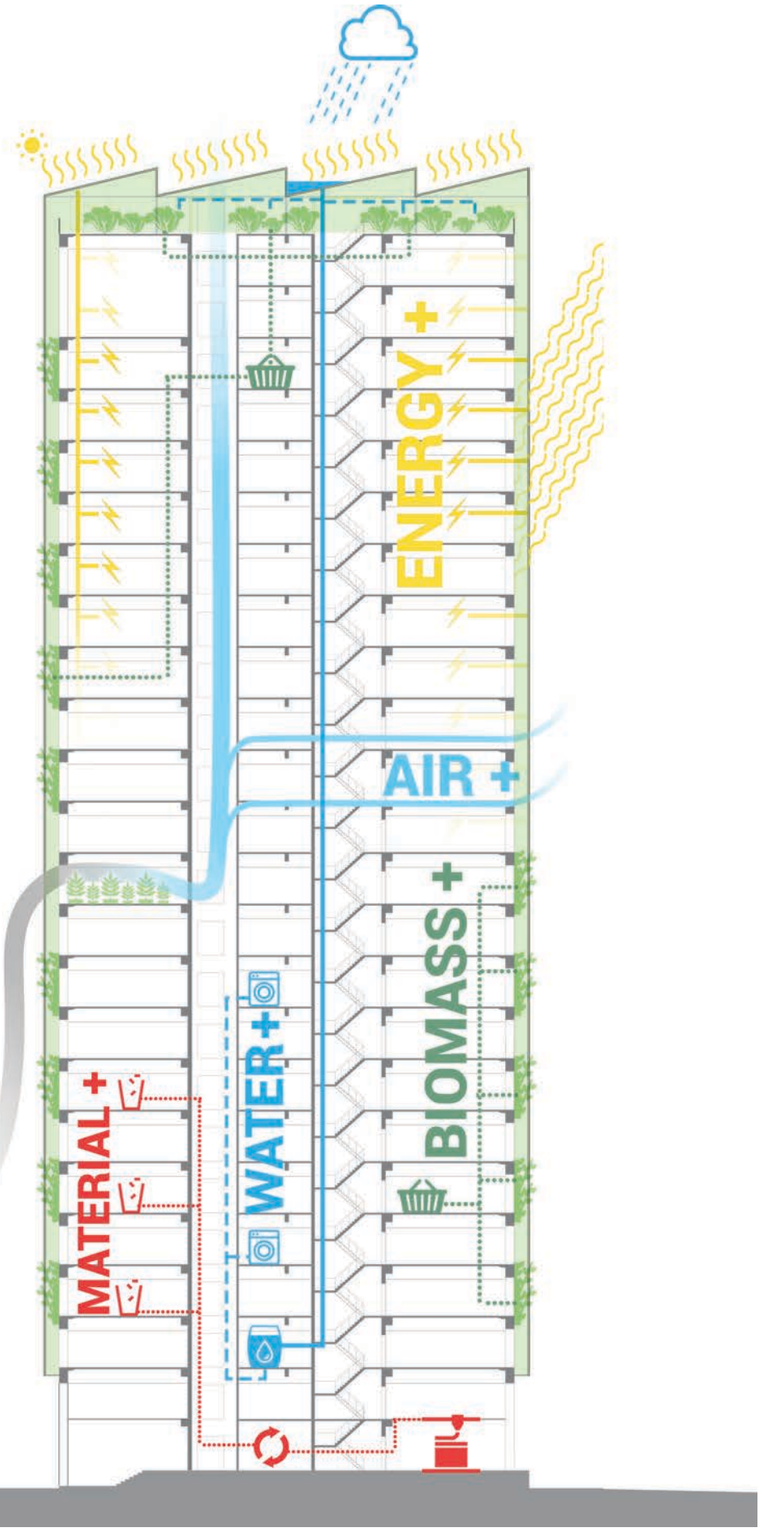
HOUSE DESCRIPTION

To propose a design which could be easily replicated on existing office buildings, we identified a typology that is common among the building stock from the 70s all over the world. A high rise with 22 levels located in Rotterdam serves as a case study to the address the complexities of the net positive renovation. These living systems will be integrated together, creating cohesive living and working environments.

To start off, our team analyzed the performance of the existing office building. The proposal will then reduce its energy, water, ventilation, biomass and materials demand to a minimum. What remains will be supplied by passive measures; only where such measures do not suffice, active systems will be used. In the meanwhile we generate electricity, clean the water and the air, and recycle biomass and materials to make the structure net positive. By such, MOR will not be less bad, but good for the people and the environment.
To ensure that the totality of the existing structure is addressed during the renovation, the building was split into three major constituents; the core, the floor space, and the facade. All three elements were evaluated for their ability to meet the demands of the new housing function and the accompanying program.

The core of the building currently contains all the vertical communication and building services. Considering the fact that the building was designed to meet the function of an office building which has more intensive circulation, after conversion to a residential one, the total number of elevators can be reduced, and the leftover space can be allocated to new functions such as additional ventilation, producing food which could thrive in such conditions (e.g. white asparagus, sprouts, oyster mushrooms). Additionally, the core space will be used to accommodate certain communal functions such as laundry rooms or storage spaces.

The adaptability of the concept includes the ability to restore the office function or to allow additional functions in the future as well.



5 NET+ ELEMENTS

Energy: Photo-voltaic (PV) panels and electricity generator

The facade will not only act as our passive skin to regulate the climate inside, but it will also become the main energy generator of our structure by usage of building integrated PV panels. In total, this allows our entire complex to become an energy supplier to the neighbourhood rather than only for the user.

Water: Greywater treatment, biogas from blackwater and rainwater harvesting

A net water positive system minimizes the use of freshwater and treats used water for reuse in the building and neighbourhood. The system is designed to reduce water demand, and collect and reuse water. Greywater is treated in a constructed wetland, offering a local supply of water for urban parks and farms. Blackwater is treated to produce biogas and plant fertilizer, hence returning nutrients to the Earth. Rainwater is used in the rooftop greenhouses and for flushing the toilets.

Air: Passive ventilation and air quality

Vegetation integrated in the building mainly includes air-purifying plants, apart from the food production system. This purified air is brought in through the second skin to pre-heat in winter. A central solar chimney then extracts the air through the central core where energy is recovered. In summer, cross-ventilation is introduced through the indoor gardens and the open floor plan with shading by the second skin ensuring a comfortable climate.

Biomass: Toilets and greenhouse

The integration of biomass in the built environment can be broadly addressed in two forms: food production in buildings to reduce food miles, and use of organic matter to restore soil fertility. This renovation proposal aims to be a food production unit integrated into Rotterdam's existing urban farm network, contributing to the larger goal of closing the food loop locally. With regard to organic matter, the proposal aims to treat human faecal matter and kitchen waste for biogas production and use the resulting sludge as fertilizer.

Materials: Upcycle, material passport and end-of-life plans for materials

Our strategy in the use of materials is to keep biological and technical materials in their respective flows, rather than use composites that are less easy to disassemble and recycle. Components designed to be dismantled allow individual materials to have a second life instead of being discarded in landfills or incinerated. Sources and end-of-life protocols of materials are determined during the design process to ensure material positivity.

MODULAR DESIGN

Our design is modular in the sense that the added structure is built-up out of different prefab modules. All connected they form the whole of a functional building that performs net positive within the framework of the 5 elements.

Modularity

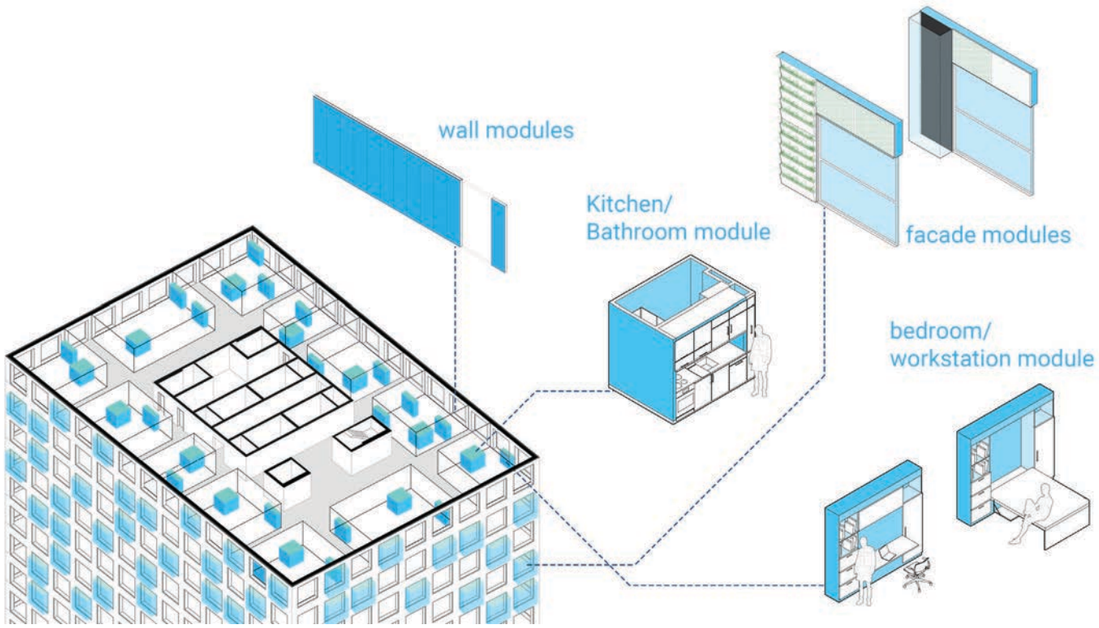
The concept of modularity aids the circular dimension of the project. Use of de- and re- mountable materials to build up the modules promotes extraction, reusing and recycling. We plan to facilitate this by making use of the concept: 'Buildings as material banks.' Where suppliers of materials remain the owner of the product and lease it to the building users. All the applied materials will be compiled in a material passport which will be monitored in a database. This will encourage suppliers to invest in sustainable building components and make money by leasing it out while remaining the owner of it.

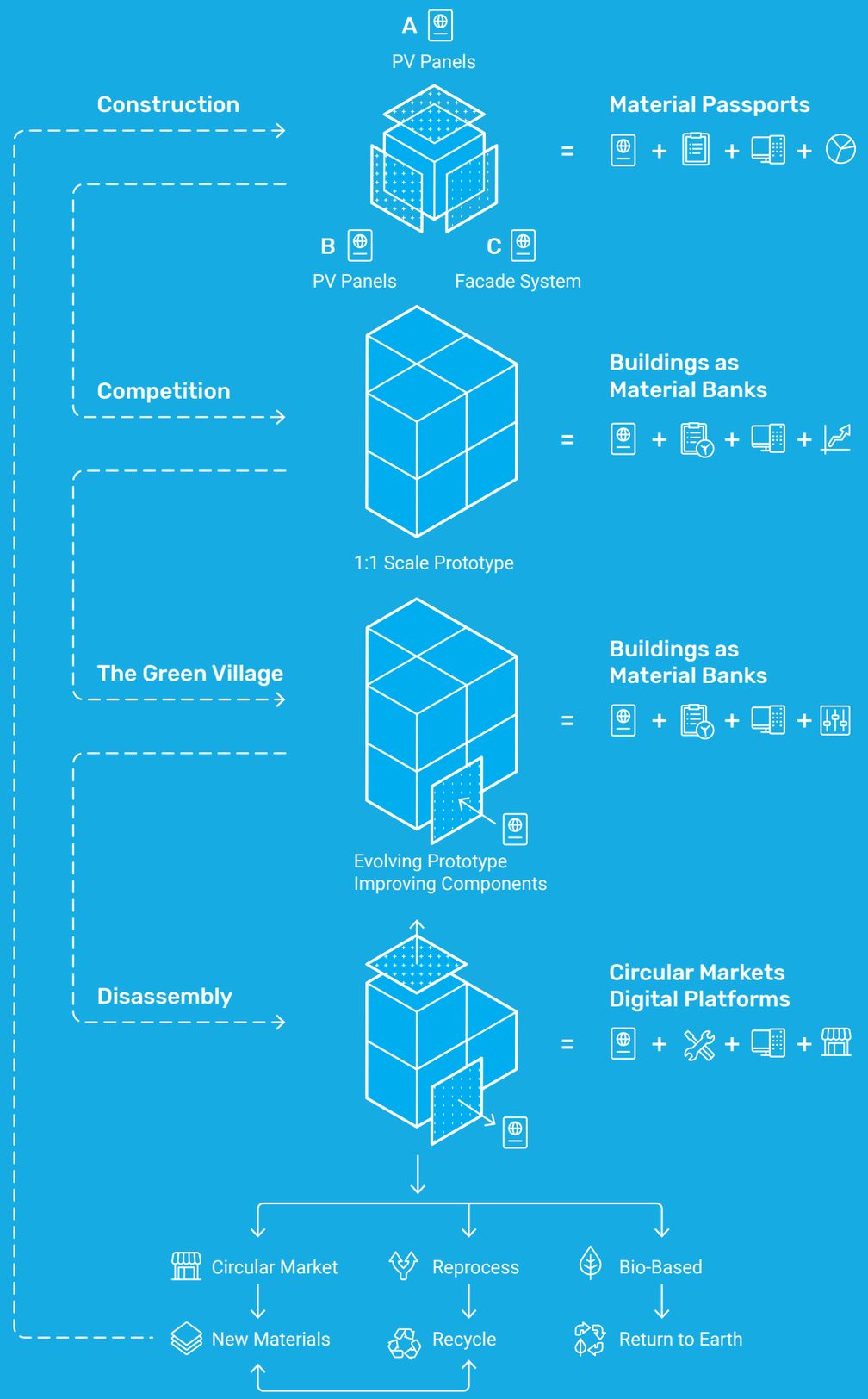
Circularity

Catering to the growing issues of waste in the construction industry, the MOR team aims to exert the material circularity with this project. All the materials and systems are intricately designed keeping in mind the reuse of the materials post the project life cycle. This will help demonstrate the opportunities and advantages of using these concepts from the initial design stage of the project adding value to the project rather than it being a design constraint. Every component in this project is not only assessed in terms of its performance but also its reusability at the end of the project cycle, thus carefully crafting it to cater to future needs as well.

BIM

To achieve a high level of prefabrication and low amount of waste material, an extensive 3D model of the added structure is required. We make use of a Building Information Model in which all different modules are designed and materials are defined. All materials consist of a material passport that is monitored in a database. The performance of the applied materials will be measured during their lifespan and the acquired information will be shared with the material owners. By experimenting with this strategy the material suppliers can gain information about the actual performance of their products and can get insight in the return of investment of their products.



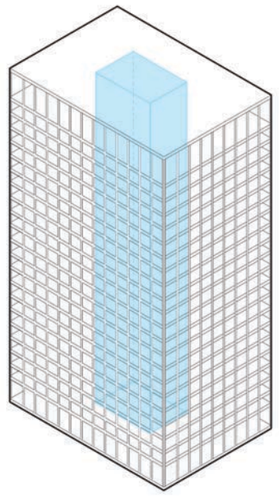


ADAPTABILITY

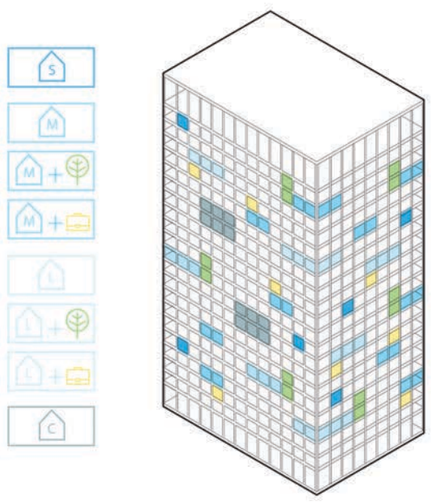
The social context we live in is always changing due to all kinds of societal and technical developments. The current building stock needs to be able to adapt to these developments in order to retain its active function. Within the context of societal developments there can be considered the changing concept of working and living, economic fluctuations but also changing legislations for health, safety or energy performance in buildings. Within the scope of technical developments there can be considered the exponential improvement of smart building installations combined with integrated design solutions. We envision a flexible building that is able to adapt to these changing market conditions and allows for technical improvements which are aligned with the users' needs. Our solution is based on applying modular and demountable units which will provide the building to change it's function on each floor, with a minimal effort and investment.

A new business model can be thought of regarding the principal investment for the refurbishment of buildings. Instead of buying the modular units they can be leased directly from the manufacturers. This way the modules can be seen as services rather than goods. When the modules will reach their technical end-of-life, or the building requires a change of function; the manufacturers will take back its modules in order to find a new application for it or recycle/ reuse the materials (principle of circular economy). Within this business model the principal investment for the refurbishment will be less for the building owner since they would share the costs directly with the manufacturers of the modules. Therefore a cost-effective and energy-efficient renovation will be more feasible in our common goal to make the building industry independent from finite resources.

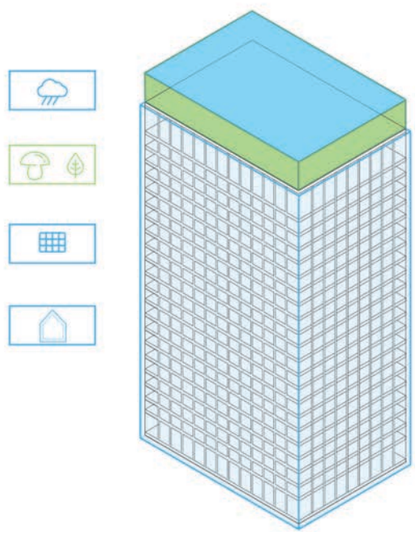
Reuse of the sructure

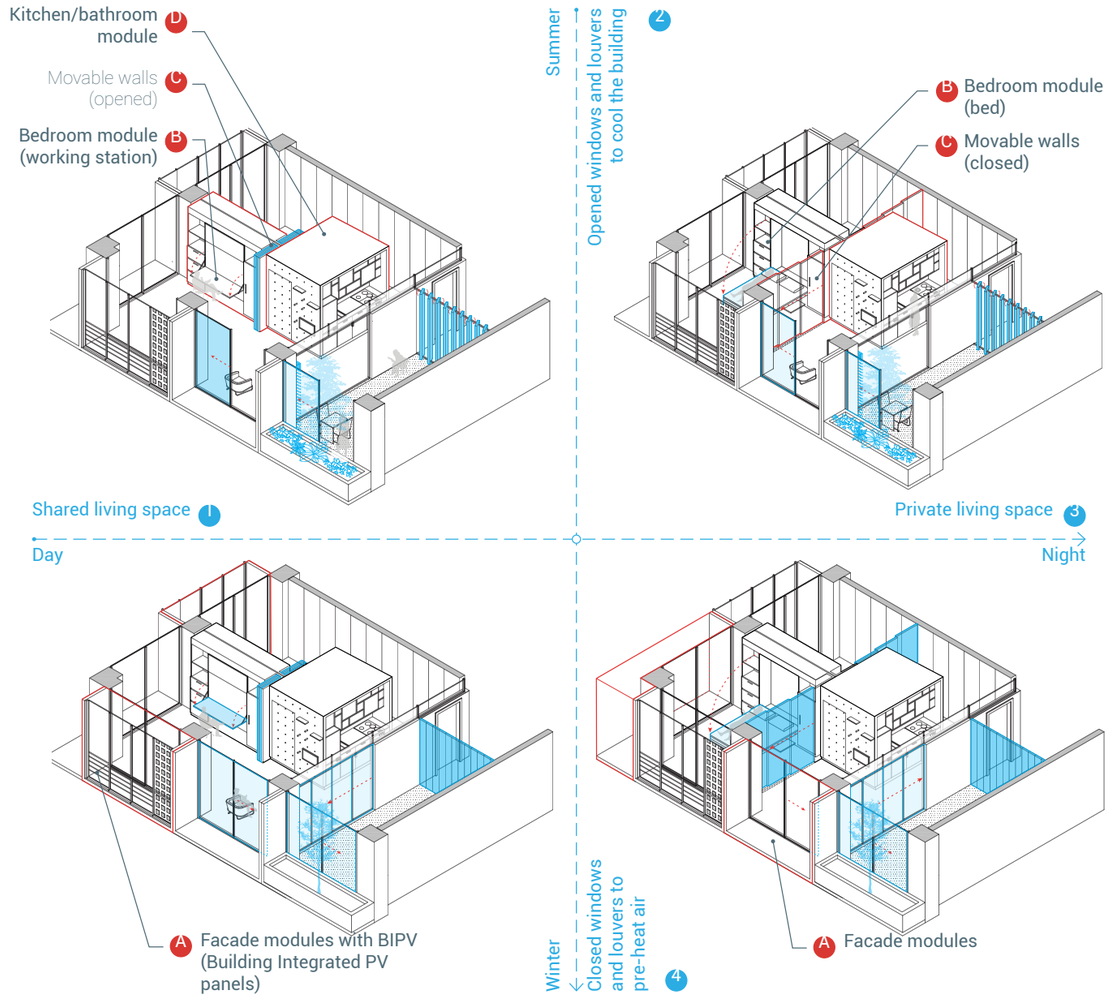


Implementation of new housing typology



Net positivity





Daily and seasonal adaptation

With the conversion of the building we are aiming to achieve net positivity for 5 goals of sustainability. Active and passive systems will be implemented on the apartment scale. On a daily basis, walls can slide in and out to create a shared (1) or private (3) space. The flexible façade modules will allow the users to open both the vertical louvers and exterior windows (2) to increase the ventilation rate which is a passive measure to cool down the building in summer. During the colder months, this air circulation inlet and outlet will be closed (4), to pre-heat the incoming air.

Flexible modules

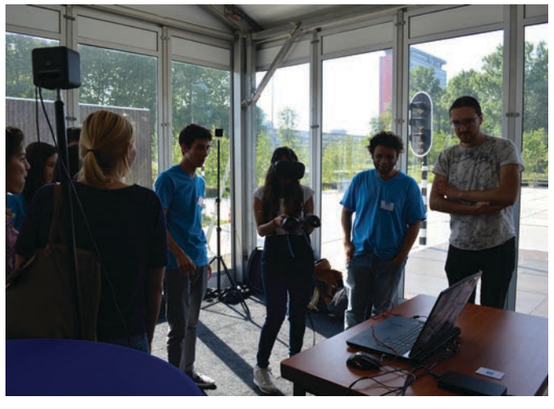
The introduction of pre-fabricated and demountable modules to create the different functions in the building is a key element of the concept. Firstly, the different façade modules (A) produce energy and will take care for a high performance of thermal comfort. The bedroom module (B) gives the opportunity for the users to use their personal space as a working station, bedroom or common space. The moveable walls (C) can create rooms, or even extend the apartment. The kitchen/bathroom module (D) takes care of the basic domestic needs within the apartment units.

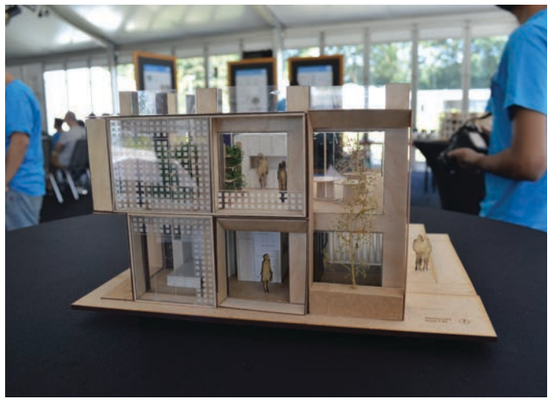
Demountable modules

The heavy renovation works in the building will be limited to the first year of the renovation, with the installation of central systems and of the façade modules. During the following years, it will be possible for the users to demount and move the modules by using the existing elevators, and to assemble them with light tools. Designed as an assembly of demountable elements, it will be possible for the users to assemble the interior modules from a kit of components. This concept will allow for the replacement of critical parts, that will be repaired or recycled.

MEET THE MOR TEAM EVENT

On the 5th of June 2018, we proudly presented our first public event in the inspiring setting of The Green Village, located on the campus of the TU Delft. The first edition of Meet the MOR Team gave us the opportunity to bring together existing and potential partners alongside professors and fellow curious students. Being the only Dream Team working in the field of the built environment on the campus, our common goal was to inspire the people visiting the event, getting enthusiastic members on board and getting valuable feedback from external point of views.
Following a presentation from the previous TU Delft team for the SDE, we offered an overview of our concept, ideas and team structure. Then, the event became interactive with the MOR Expo, an open fair where every committee prepared visual tools to explain the topics they are working on for the competition. We could find posters about the solutions for the 5 net positivity aspects (water, biomass, air, materials and energy), including strategies for thermal and electrical energy.
At the center, models detailed accurately the different scales of the projects: urban context, building scale and prototype scale. Moreover, an interactive model offered the possibility to the visitors to experiment different uses for the floors of the empty tower. Another interactive stand asked the visitors to compose the function on a blank facade, information that could be used to reflect on our design. Finally, a VR experience allowed the visitors to view and interact with the indoor space, while seeing the living modules moving and changing functions! More than a great communication activity, this event brought the team together in creating the first tangible and concrete prototypes of the project. We are looking forward for the construction phase!





DISSEMINATION ACTIVITIES

InnovationQuarter

The MOR team went to the InnovationQuarter event on the 11th of June 2018 where we displayed our project as part of the innovation market. It was an inspiring day full of interesting presentations and introducing new people to our project. "The InnovationQuarter's mission is to strengthen the regional economy in West Holland by supporting and stimulating the innovation potential of this unique delta region." They work closely with the TU Delft and they support technological developments with a social impact, encourages entrepreneurship and invests in fast-growing companies.

Sustainable Thursday market at OWee

During the OWee (introduction week of new students at TU Delft) MOR had a stand during the Sustainable Thursday market where we showed our project to the new students. We explained our project through models and posters. It was a huge success and we ended up winning the first prize as the best new sustainable initiative, sponsored by Rabobank.

CURRENT IMPACT

Tenants festival together with Prêt-à-Loger

On the 29th of September 2018 MOR went to the tenants festival together with Prêt-à-Loger, the previous TU Delft team that competed in the Solar Decathlon Europe 2014. There were more than 600 people that learned about the importance of both projects. Hopefully, we inspired tenants to make their own houses more sustainable.

Presentations at different lectures

At the start of the academic year, MOR gave presentations in a couple of different lectures around the TU Delft. We spoke to students from the third year bachelor Architecture and the Built Environment as well as first-year Building Technology, Architecture and Urbanism master students. Also, a presentation was given to first-year master students of Sustainable Energy Technology. The two main purposes of those presentations were to educate students about our project and recruit new team members. This was very successful since 17 new students joined our team.

Dreamteam

The collaboration with the other dreamteams of the TU Delft kickstarted in September 2018. We are joining the meetings with all the other team managers and PR managers and a few team members joined the course Toptrack provide by D:Dream. MOR is becoming a part of this awesome community, that focuses on innovation.

D:DREAM

SPONSORS

COLLABORATING INSTITUTIONS & SPONSORING COMPANIES

To live up to our vision, which is to realise a built environment that gives back to its surroundings more than it takes away from it. We have developed a business strategy that focuses on realizing a consortium of supporting institutions and companies including the most important stakeholders from the built environment. This creates valuable input from all supporting partners for the development of our concept and at the same time brings all parties together that could actually introduce the concept into the market. In general, the following table shows the nature of the supporting partners.

Academic institutions	University of Technology Delft	Provides resources for the team in various areas.
Public organization	National government: • Ministry of internal affairs and kingdom relations • Ministry of economic affairs and climate	Funding for the further development of the concept
Design and building team	Main contractor: JP van Eesteren	Inkind sponsoring focussed on construction management and building
	Facade engineer: De Groot en Visser	Inkind sponsoring focussed on development of the facade system
	Interior modules: The New Makers	Inkind sponsoring focussed on development of the interior modules
	Circular materials supplier: Stiho	Inkind sponsoring focussed on supplying circular materials
	Technical building advisor: DGMR	Inkind sponsoring focussed on a wide range of technical aspects
	Management & consultancy: Brink	Inkind sponsoring focussed on the business-case
Other supporters	The Green Village	Facilitates the building plot

DE GROOT VISSER BUILDING HUMAN ENERGY
ramen | gevels | zonwering | solar

jp van eesteren | TBI

brink management / advies

THE NEW MAKERS

dGmR

Ministerie van Economische Zaken en Klimaat

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties

THE GREEN VILLAGE

stiho thuis in de bouw

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TU Delft

solar decathlon europe

energy endeavour FOUNDATION