

BUILD SOLUTIONS

LIVING DESIGN Intensive Programme REPORT

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1 – FOREWORD

Building Urban Intelligent Living Design Solutions

Cities currently host more than half of the world population, which is projected to increase up to 70% by 2050 (UN, 2014). Already, cities account for 70% of global CO₂ emissions (C40). With the expected population growth, cities would hence be the source of an estimated 85% of global GHG emissions.

There is a growing recognition and awareness that nature can help to provide viable solutions by using and deploying the properties of natural ecosystems and the services that they provide in a smart and 'engineered' way (EC). These living solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for various objectives. Working with nature, rather than against it, can further pave the way towards a more resource efficient, competitive and greener economy. It can also help to create new jobs and economic growth, through the manufacture and delivery of new products and services, which enhance the natural capital rather than deplete it (EC).

With that in mind, the big question is, why are nature-based solutions not used more to address the global urban challenges?

The main answer would be that there's a distinct skill and financing gap in the biotechnology sector. While we currently have great researchers in biotechnology, too often the commercialization and hence the implementation of their discoveries stumble due to a lack of personal experience in entrepreneurship and cooperation with industry leaders (Fritsch, 2010).

And even when most of those skills are present in a team attempting to commercialize a technology, another obstacle rears its head: the lack of short-term funding available to biotech start-ups and spinoffs (Swamidass, 2008). Recently, the High-Level Group for the European Innovation Council published their first recommendations which state that funding for disruptive, market-creating start-ups with deep-tech solutions (like biotech) is severely fragmented and doesn't meet the needs of the start-ups for developing the technology (http://ec.europa.eu/research/eic/pdf/eic_recommendations_set-1_2017.pdf). The lack of funding can be attributed to multiple factors, chief amongst them being the perceived risk and the huge capital expenditures necessary to develop sound biotechnology solutions.

Building Urban Intelligent Living Design Solutions (BUILD Solutions) project aims to set up transdisciplinary cooperation among universities and business, engaging students, teachers and researchers and providing them with the necessary entrepreneurial skills and connections to bring intelligent living solutions

to the market, by investigating biological systems, creating smart design prototypes, business plans, plans for start-ups and working with accelerators.

The project's objective is to develop an experimental transdisciplinary educational system linking biology, intelligent design and business through several kinds of activities, such as courses for students and trainers, symposiums, development of educational resources, the set-up of an accelerator programme, launching an international call for ideas and creating new networks.

The project is co-funded by the Erasmus+ Programme of the European Union.



Living design solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for several urban challenges.

2 – LIVING DESIGN Intensive Programme Course, IAAC

2.1 Introduction

The Institute for Advanced Architecture of Catalonia (IAAC) conducted the third Intensive Course on Living Design titled “Environmental Design” on 26 to 30 July 2021, in the framework of its 2021 Global Summer School Program (GSS).

Due to the current pandemic situation, the event was held online.



**ENVIRONMENTAL DESIGN
INTENSIVE PROGRAMME COURSE**

INSTITUTE FOR ADVANCED ARCHITECTURE OF CATALUNYA
26 - 30th July 2021

BUILD'S is conducting the third Intensive Course led by the Institute for Advanced Architecture of Catalonia (IAAC) in the framework of its 2021 **Global Summer School Program**. The Environmental Design Intensive Course Workshop will take place from the **26th of July until the 30th of July 2021**.

During this week-long course, students from around the world will participate in online classes about **computational design and environmental analysis** through the use of **genetic optimizations and simulation tools** at the early stages of architectural and urban design. It will combine lectures, discussions, mentoring, and review sessions.

In order to ensure a solid interdisciplinary experience for students that takes into account **biology and entrepreneurship** aspects into this architectural design course, the following two Lectures will be given:

How early design business decisions can affect the final marketable product at building or urban scale? by the University of Vienna.
Green Roof as Nature-Based Solution to tackle urban environmental issues, by the University of Lorraine.

These sessions will be paired with continuous mentoring and feedback sessions and informal desk crits provided by BUILD'S business partners' experts from Plant-e, CityFacilitators, GreenTech Challenge, Ersilia, and Econick.

More info at <https://www.build-solutions.org/environmental-design-intensive-course/>

Organized by:

Co-funding by:
Erasmus+ Programme
of the European Union

With the collaboration of:

IAAC
UNIVERSITÉ DE LORRAINE
WU
fundació Ersilia
econick
Plant-e
CITY FACILITATORS
GREENTECH CHALLENGE

During this week-long course, students from around the world have participated in online classes about computational design and environmental analysis through the use of genetic optimizations and simulation tools at the early stages of architectural and urban design. It combined lectures, discussions, mentoring, and review sessions.

The learning objectives of the Environmental Design Intensive Course were:

- Learn key concepts of environmental analysis using parametric tools
- Understand concepts of multi-objective optimization
- Understand how to define sustainability goals as measurable design parameters
- Learn to setup a generative optimization process
- Be capable to perform multi objective optimization on a parametric model
- Be able to set out an optimization strategy on a given problem.

The main goal was to take the students through the workflow of evidence-based environmental design along with generative optimization. They had the opportunity to choose a site, formulate the design problem, develop an optimization hypothesis, parametrically explore solutions and propose an optimal solution.

In order to ensure a solid interdisciplinary experience for students that takes into account biology and entrepreneurship aspects into this architectural design course, the following two Lectures were given:

- How early design business decisions can affect the final marketable product at building or urban scale? by the University of Vienna.
- Green Roof as Nature-Based Solution to tackle urban environmental issues, by the University of Lorraine.

These sessions were be paired with continuous mentoring and feedback sessions and informal desk crits provided by BUILDs business partners' experts from CityFacilitators, GreenTech Challenge, Ersilia, and Econick.

2.2 About the Organisers

IAAC Intensive Course Program was organized in the frame of the Global Summer School Workshop titled "Environmental Design Online Course" by IAAC team.

The Programme was conducted by instructor Oana Taut from IAAC (together with Stefana Zupac as faculty assistant) with the support of BUILDs trainers from WU (Hannah Frost), UL (Geoffroy Séré) and business partners of City Facilitators (Martin Petersen), GreenTech Challenge (Frederik van Deurs), Econick (Gabrielle Michaudel), and Ersilia (Marité Guevara).

All the GSS Course details can be found [here](#).

2.3 Main Topics addressed

Throughout the IAAC Environmental Design Intensive Course, the focus was on how environmental analysis can aid design through parametric design and generative optimization tools. The topics covered included:

- How to set up Ladybug Analysis (Grasshopper Plugin) to extract data such as wind, sunlight hours, solar shading, radiation levels, etc.
- Setting up a parametric model.
- How to set up generative optimization based on parameters that involve data.
- How to apply these tools to a real-life problem or design.

In order to address these issues holistically, BUILDs partners brought insights from a biology and business perspective and created discussions by inserting the following topics:

- How can we design a system to create higher yields of produce per square meter using vertical farming methods?
- Agrofarming and how plants can bring benefits to architectural solutions;
- Legal implications in relation to meeting legal regulations;
- Consideration for the internal structure of building in order to achieve multiple uses or to allow them to adapt in the future.

BUILDs partners UL and WU conducted two theoretical lectures:

“Green Roof as a Nature-Based Solution to tackle urban environmental issues”, by Geoffrey Sere, University of Lorraine. This included topics such as:

- The impact of urban sprawl and the consequences of creating impervious surface areas
- The importance of soil science and understanding the wide impact soil has on many processes like
 - Providing food
 - Water management
 - Creating a home for biodiversity
- Nature-based solutions versus ecosystem services in relation to technology
 - High tech nature-based solutions often provide less ecosystem services than low tech nature-based solutions
- Demonstrating that green roofs are a mid-tech solution providing many ecosystem services

“How early design business decisions can affect the final marketable product at building or urban scale”, by Hannah Frost, University of Vienna. Topics raised during the presentation included:

- 7 out of 10 products fail when they reach the market and why
- Knowing your user is key, especially understanding their pains and gains
- Understanding the fundamental problem your client is facing
- Talking to each target group in the right way
 - Speaking to their emotions and using the right vocabulary

2.4 Methodology

The IAAC Intensive Course, Environmental Design, brought 49 students from across the world together to learn about environmental design through the software Rhinoceros and Grasshopper. These students signed up to take part in the program and received a certificate upon the completion on the course. The course was open to all applicants with a bachelor degree related to the fields of Architecture, Design and Engineering, and took place fully online.

The Intensive Course was ran as follows.

The course began with an introduction to the programme and the software the participants would be using throughout the week. Once the students had a basic understanding, they were asked to select an existing unused site or a site that required rehabilitation. Students were then asked to formulate the design problem based on the chosen site. Throughout the week they worked individually to develop an optimization hypothesis, explore parametric solutions and finally produce an optimized design solution based on data. The week was split into teaching sessions and mentoring sessions where students could discuss their proposals and receive any advice or help. Designated exercises also facilitated the progression of the project proposals. The week culminated in desk crit sessions where BUILDs business partners (experts from CityFacilitators, GreenTech Challenge, Ersilia, and Econick) were able to contribute to the discussion and give feedback from the different disciplines – biology, business and design.

The Summer lecture was also integrated as part of the Intensive course to foster interdisciplinary discussions. Chiara Farinea (IAAC) gave an introduction about the BUILDs Project and introduced the session. The lecture was conducted by partners of UL and WU to give insight into how biology and business can contribute to the environmental design process. Both partners provided interesting presentations related to environmental design, and the session finished with a short question and answer session where students could ask questions and engage in interdisciplinary discussions.

3 – OUTPUTS

3.1 Programme

Taking into consideration the world's various time zones, the IAAC Intensive Course was organized in two calendars. Firstly, the Synchronous Calendar for those able to attend the Barcelona time zone. The structure is displayed below.

DAY 1 (26 July 2021)	
10.00 - 14.00	2 hours of live teaching integrated with 2 hours of live mentoring and exercise review
DAY 2 (27 July 2021)	
10.00 - 14.00	2 hours of live teaching integrated with 2 hours of live mentoring and exercise review
DAY 3 (28 July 2021)	
10.00 - 14.00	2 hours of live teaching integrated with 2 hours of live mentoring and exercise review
15.00 - 16.00	IAAC Summer Lecture presented by BUILDs Partners WU and UL <ul style="list-style-type: none"> How early design business decisions can affect the final marketable product at building or urban scale? by the University of Vienna. Green Roof as Nature-Based Solution to tackle urban environmental issues, by the University of Lorraine.
DAY 4 (29 July 2021)	
10.00 – 12.00	2 hours of live teaching
12.00 – 14.00	Desk Crit session with the BUILDs Business Partners (CityFacilitators, GreenTech Challenge, Ersilia, and Econick)

The second option, the Asynchronous Calendar for those looking for a more flexible schedule. The structure is displayed below.

DAY 1 (26 July 2021)	
11.00 - 13.00	Live teaching activities- mentoring and exercise reviews

2hours	Recorded teaching to be viewed when suits the participant
DAY 2 (27 July 2021)	
11.00 - 13.00	Live teaching activities- mentoring and exercise reviews
2hours	Recorded teaching to be viewed when suits the participant
DAY 3 (28 July 2021)	
11.00 - 13.00	Live teaching activities- mentoring and exercise reviews
2hours	Recorded teaching to be viewed when suits the participant
15.00 - 16.00	IAAC Summer Lecture presented by BUILDs Partners WU and UL <ul style="list-style-type: none"> • How early design business decisions can affect the final marketable product at building or urban scale? by the University of Vienna. • Green Roof as Nature-Based Solution to tackle urban environmental issues, by the University of Lorraine.
DAY 4 (29 July 2021)	
2hours	Recorded teaching to be viewed when suits the participant
DAY 5 (30 July 2021)	
17.00 - 19.00	Desk crit session and certificate ceremony

3.2. Main results

In such a short course with so many complex ideas and tools to learn, the students produced some very interesting work. Many of them had never worked with the software before and some joined the course without much of a design background, but were passionate about the topic. The course managed to give students the tools to create a script in Grasshopper, where they combined data and generative optimization to produce a design. Working with the computer software also gave the students the opportunity to critically evaluate their designs and compare the computer-generated results with the expected results.

Projects developed included:

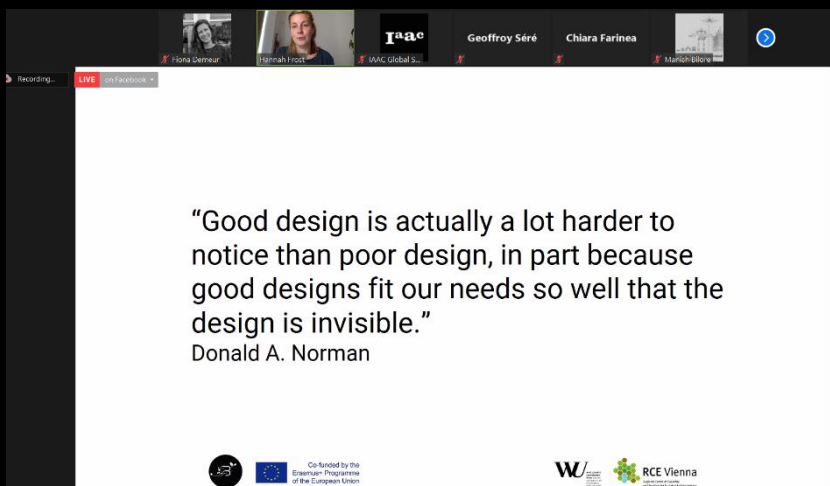
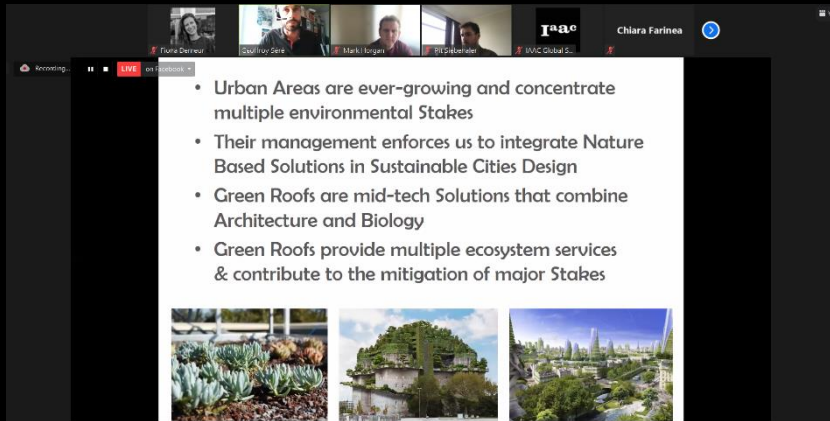
- Optimized high rise building for Dublin based on direct and diffused sunlight
- Greenhouse structures to make land more productive in North America, considering area and solar analysis

- Apartment complex design for Shanghai where the form was optimized on solar and wind analysis
- Terraced apartment blocks
- Creating courtyard spaces based on radiation levels
- Minimizing surface area of the structure

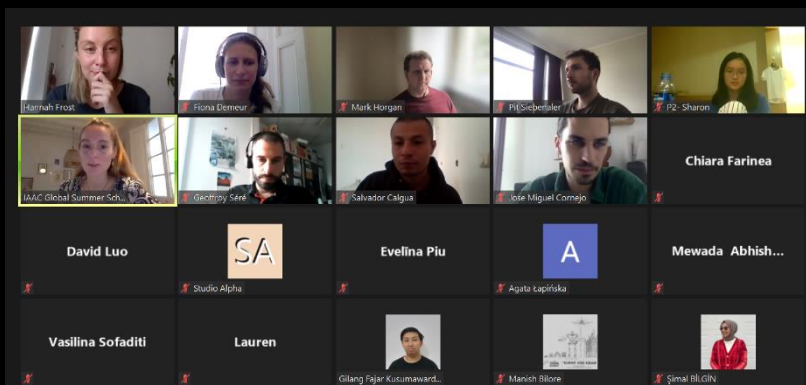
One of the greatest results of the course was the interdisciplinary discussions that took place between the students and the BUILDs partners, both after the lectures and during the desk crit sessions. The partners were able to give new and alternative perspectives related to environmental design that really got the students thinking. In particular, the business perspective, one which is often left out in design and architectural education, sparked many conversations about how to address clients and sell your ideas. These discussions also highlighted the importance of integrating various disciplines into the design process to really address the issues designers are trying to solve.

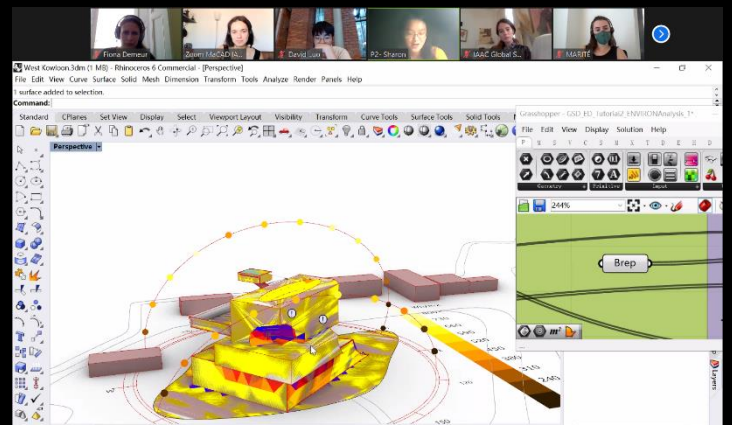
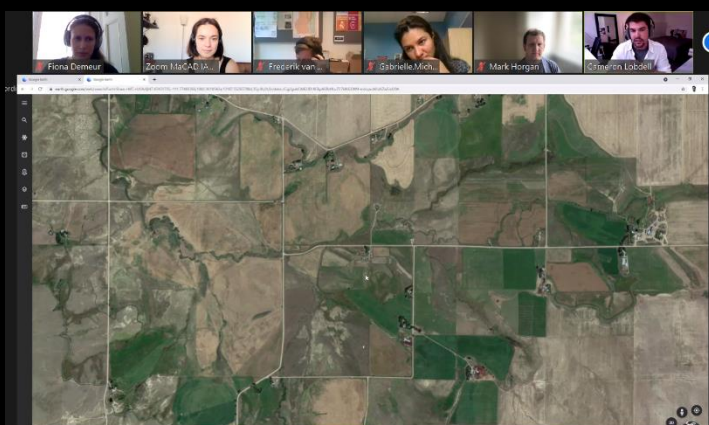
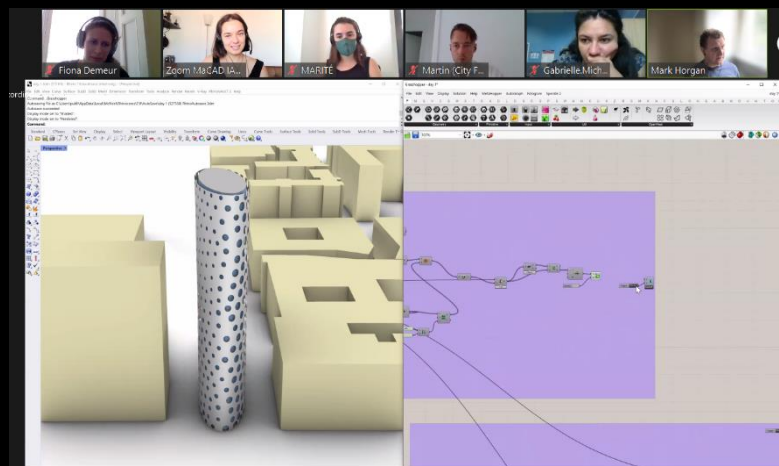
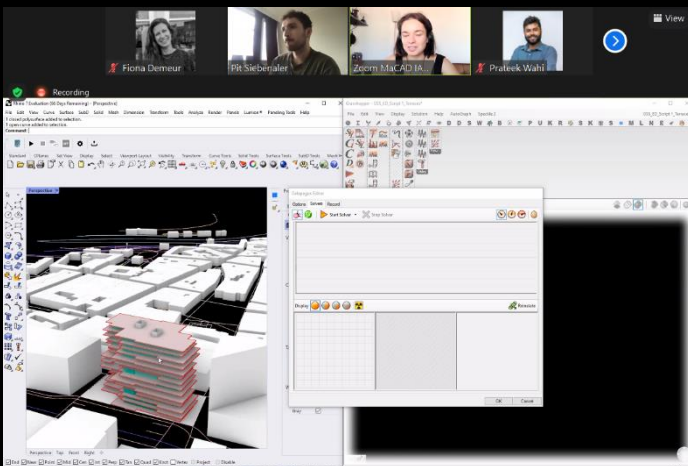
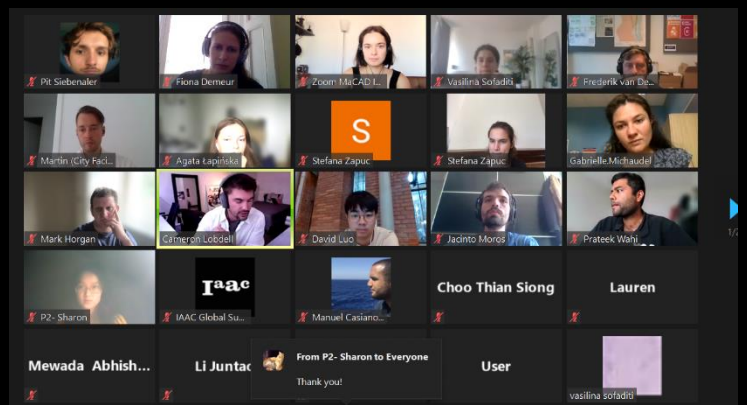
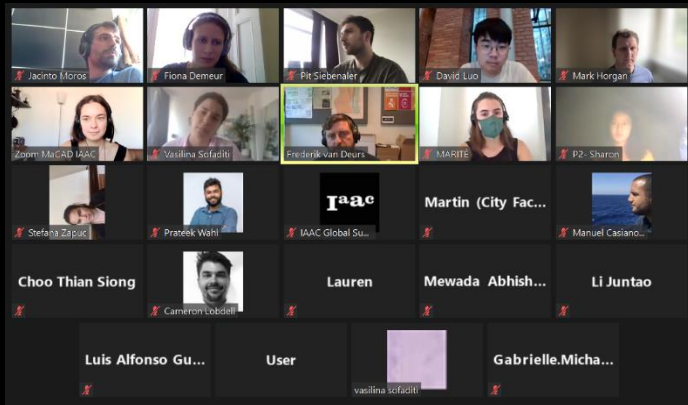
Furthermore, the partners provided great references of existing projects for the students that were related to the projects they were developing. This added another layer to the dissemination of information between disciplines. Students were able to go back later and look into the links provided.

3.3. Pictures



*Images from the
live streamed
lecture provided
by BUILDs
partners UL and
WU.*





Pictures from the discussions between students and BUILD'S

4 - CONCLUSIONS AND RECOMMENDATIONS

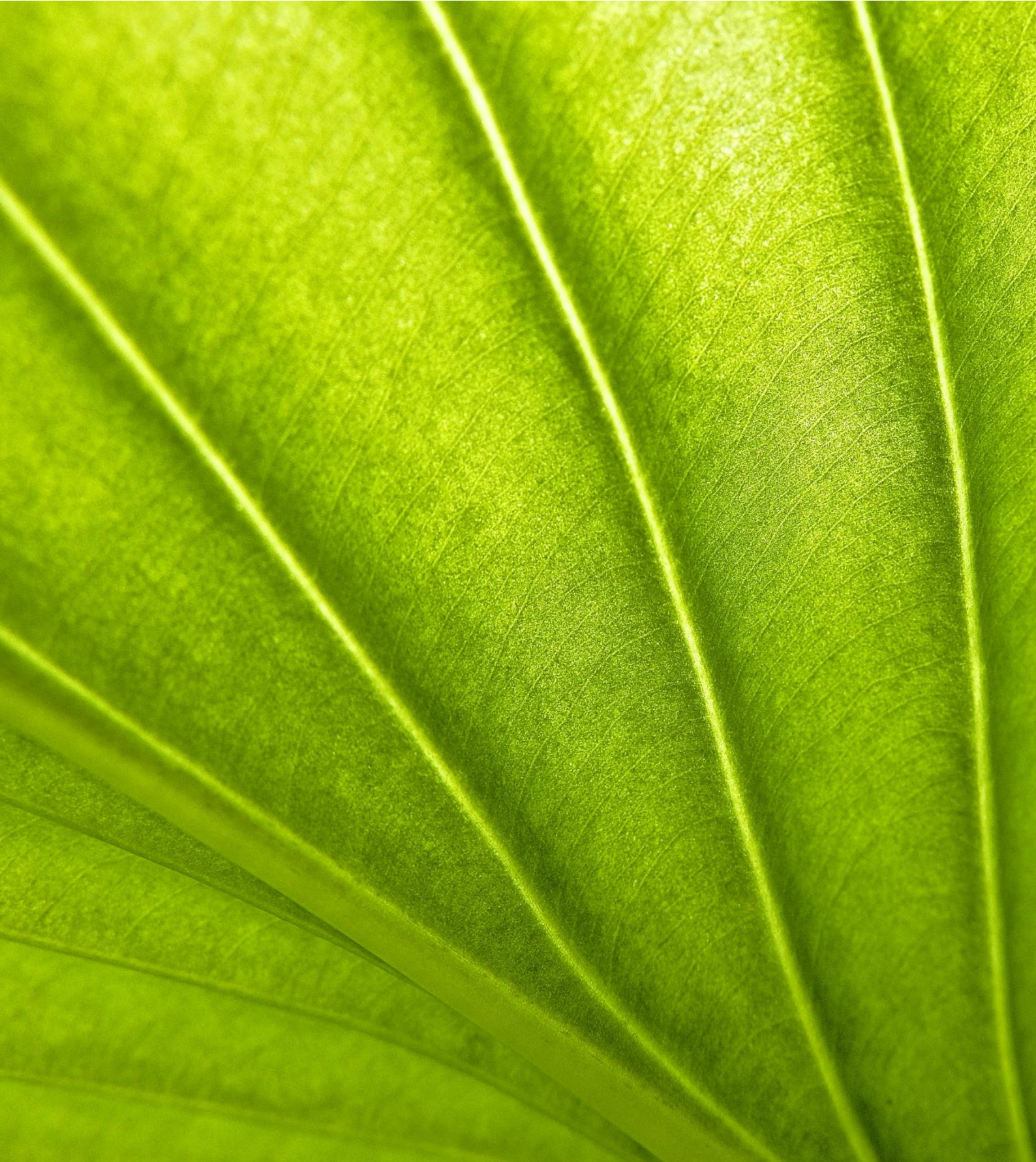
The IAAC Intensive Program Environmental Design was considered to be a huge success. The students thoroughly enjoyed the course and appreciated the interdisciplinary inputs they received from BUILDs partners throughout the week. Considering the amount of time, the students had to propose and develop a design solution, the proposals far exceeded expectations.

The BUILDs partners actively engaged with the design solutions providing their expert opinions and insight. This enriched the discussions and allowed the students to understand the importance of an interdisciplinary approach to design. The lectures provided by Geoffroy Sere (UL) and Hannah Frost (WU) also provided very interesting insights in regards to green roofs tackling urban issues and how design business decisions can affect the marketable product. These lectures demonstrated the importance of working together across different disciplines to achieve mutual benefits.

The IAAC faculty did a wonderful job packing in as much knowledge as possible about the complex software in such a short course. They very much enjoyed seeing the development of the student projects and appreciated the input from the BUILDs partners, whom brought other perspectives to the design process.



IAAC Valldaura Labs: taking nature as an inspiration for the design of responsive buildings and resilient urban spaces!



Building Urban Intelligent Living Design Solutions, 2018-2021

