ETH zürich

Master of Advanced Studies ETH in Architecture and Digital Fabrication

MAS ETH DFAB

Nationaler Forschungsschwerpunkt Digitale Fabrikation

dbt

GRAMAZIO KOHLER RESEARCH

Master of Advanced Studies ETH in Architecture and Digital Fabrication

MAS ETH DFAB

1_ Our purpose

We are radical thinkers, deeply rooted in practice, forging the way towards a more intelligent and sustainable means of designing and making of architecture. Join our program, and gain the technological literacy needed to make a real impact. Become part of our vibrant and multidisciplinary community of experts: architects, engineers, designers, researchers.

Concrete Choreography

2019 MAS ETH DFAB Project
/Trimester 2

In our Robotics Fabrication Lab (RFL)

Over 11 weeks, students tackled the challenges of designing parametrized ornamentation for robotic concrete printing, while also grappling with the novel material challenges posed by concrete extrusion.

Photo: Axel Crettenand, Digital Building Technologies

Welcome from our faculty

Prof. Benjamin Dillenburger

Prof. Benjamin Dillenburger is Chair of Digital Building Technologies (DBT), at the Institute of Technology in Architecture, Department of Architecture, ETH Zürich.

"The MAS ETH DFAB is a flagship program, known for the innovative outcomes generated by our students each year. This program attracts individuals willing to stretch the boundaries of their creativity, students who are prepared to challenge the established norms, questioning the very foundations of architectural design and fabrication, exploring diverse materials, and considering the environmental impact of their work. We actively embrace radical thinkers."

Benjamin Dillenburger

Prof. Fabio Gramazio

Prof. Fabio Gramazio and Prof. Matthias Kohler are co-Chairs of Architecture and Digital Fabrication (GKR), at the Institute of Technology in Architecture, Department of Architecture, ETH Zürich. Together with Prof. Benjamin Dillenburger, they are the leading facutly of the MAS ETH DFAB program.

"We demystify technology and fully harness its potential. This program focuses on building a strong foundation in skills essential for leveraging technology within the field of architecture. Our students learn digital skills, needed to proficiently engage in informed discussions across a wide array of disciplines involved in the construction of architecture. We invite students with a passion for technology, eager to embrace new digital tools."

Fabio Gramazio

Prof. Matthias Kohler

"Digital fabrication is set to revolutionize architecture. The seamless integration of digital design technologies and physical construction processes is paving the way for the realisation of new design paradigms. Since 2015, ETH Zürich educates a new generation of collaborating architects, engineers and designers eager to define the future of architecture. We welcome the next generations of collaborators, who will shape the future of our profession."

Matthias Kohler

#7

ETH Zürich ranked #7 for study in Engineering & Technology worldwide

QS Ranking 2023

#3

ETH Zürich ranked #3 for study in Architecture & Built Environment worldwide

QS Ranking 2023

#7

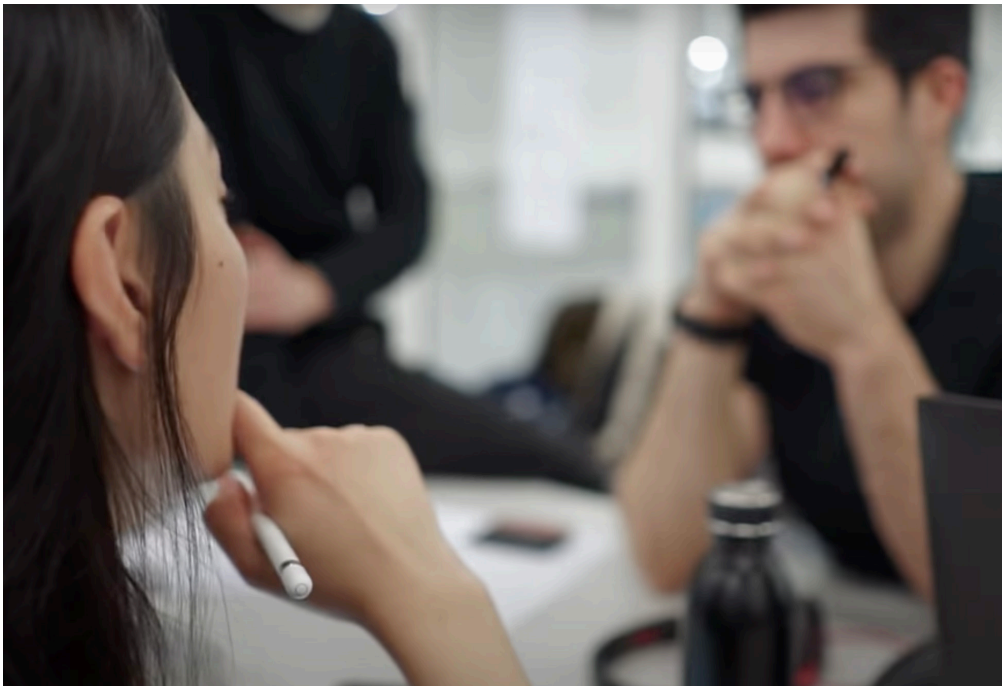
ETH Zürich ranked #7 overall university worldwide

QS Ranking 2024

Researcher Group

Our program and its facilities encourage frequent meetings, exchange of ideas, and build a collaborative culture.

Photo: Digital Building Technologies



Our approach to all that we do

Radical thinking

We need bold visionaries, who are skilled in navigating risk, solving complex problems, and harnessing technology's immense potential to address contemporary societal and environmental challenges.

The collaborative efforts of our faculty (DBT & GKR) epitomize this spirit: directing research to unlock technology's full capacity, revolutionizing architecture through radical ideas yet achieving practical solutions.

Our pioneering methods have not only reshaped conventional architectural processes but have also redefined the very essence of our profession.

As radical thinkers, we thrive in this 'high risk - high value' environment, positioning us at the forefront within our field.

Technological literacy

Technological literacy is the key to developing more intelligent and sustainable approaches to architectural design and construction.

Our program provides expertise in utilizing the latest digital technologies for architecture, covering design, simulation, and fabrication. Focused on computational design, robotic fabrication, and 3D printing, our projects and assignments enable students to foster robust design concepts and create large-scale prototypes using our exceptional robotic and 3D printing facilities.

Our curriculum not only educates students about computation and digital fabrication but also fosters an understanding of how emerging technologies, materials, and processes contribute to an advanced, next-generation way of building.

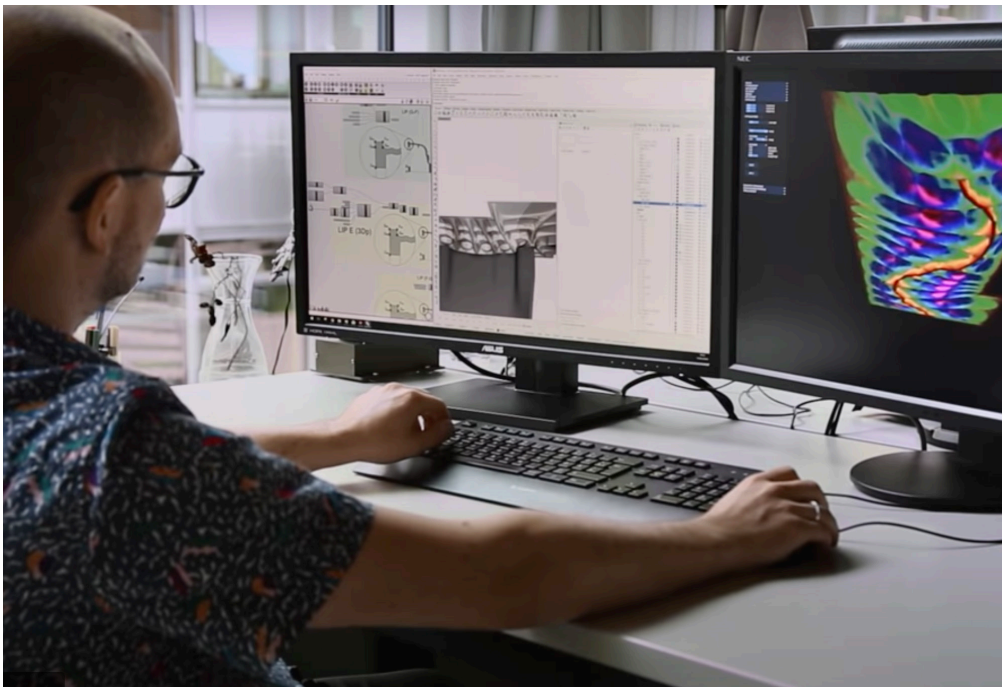
Future of architecture

The future of architecture hinges on architects' influence. With advancements in various fields, especially through new technologies, architects need to oversee a broader range of expert disciplines. Adapting working methods is crucial.

Design processes now stress collaboration, often explicitly formulated and occasionally scripted in code. Architects' pivotal new tasks involve defining interfaces, managing data transfer, and orchestrating operational collaborations, granting them deeper involvement in architectural creation and sparking new and meaningful design possibilities that have the potential to solve today's challenges.

Collaboration stands as the future of architecture - this is at the core of our approach.

Student at work



At work inside ITA.
Here, a design optimation software has been designed to insure that concrete usage, structural needs and aesthetics are interwoven as parameters into a final design.

Photo: Digital Building Technologies

Intuitive Robotic Spraying

2020 MAS ETH DFAB Project
/Trimester 2

in situ Rumlang, Switzerland

Over 11 weeks, students tested ongoing research projects on Robotic Plaster Spraying and Human-Machine Collaboration to propose new design and fabrication methodologies

Photo: Gramazio Kohler Research

2_
Our Program

In just one year, become industry ready. Our streamlined curriculum hones in on the essential skills necessary for launching the next step of your career. Structured into three distinct trimesters, our program employs tailored teaching methods that lead to clear learning outcomes. Your journey is enriched through your immersion into our academic excellence, digital culture, and commitment to practice: you will visit innovative companies, attend guest lectures on emergent topics, and receive feedback on your work from practitioners in the field.

Key development areas: 1,2,3

1_Programming

Teaching programming, with a focus on object-oriented programming, is a core aspect of MAS ETH DFAB.

Students progress from fundamentals to advanced skills, covering both procedural and object-oriented techniques. Computational design, integral to the creative process in architecture, relies on algorithm-driven methods. Parametric modeling, known for its adaptability and dynamic design, is emphasized, with a focus on structuring models for usability. Geometric topology, hierarchy, and non-hierarchy concepts in parametric modeling are explored to develop robust approaches.

The curriculum highlights Python, COMPAS framework, RhinoCommon, Grasshopper, and robotic control via UR script, RAPID, and ROS.

2_3D Printing

The MAS ETH DFAB program explores 3D printing in construction, promising complex, non-standardized structures at no extra cost.

It leverages 3D printing's tectonic logic to create integrative building systems, emphasizing both external design and internal structures for high-resolution functionally graded elements. These studies are connected to traditional prefab components.

Students use custom algorithmic design tools and produce designs as prototypes or full-scale 3D prints.

3_Robotic Control

The program teaches the basics of robotic control and tool design, including mechanical and electronic requirements for specific fabrication tasks.

Industrial robotic arms can be considered one of the universal tools of the digital age, having been instrumental in shaping the notion of digital materiality. Their ability to very precisely position building material in the desired location and in a given orientation has enabled the construction of large scale, complex spatial structures with unprecedented accuracy and speed.

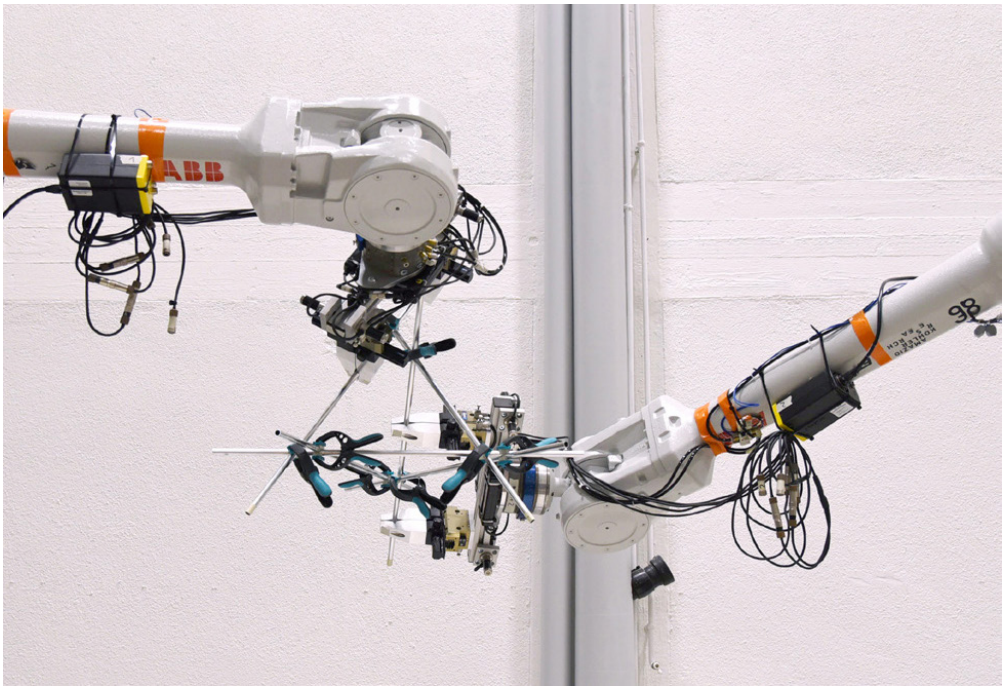
Students make creative use of acquired skills in modeling, scripting, and fabrication exercises, and will develop their own robotic coordination, path planning, and kinematic simulation.

Robotic Cooperation

In our Robotics Fabrication Lab (RFL)

Research on collaboration potential between two 6-axis industrial robotic arms. The precision of movement, positioning and gripping building elements in space offers new non regular fabrication.

Photo: Gramazio Kohler Reasearch



Key development areas: 4

4_ Full-scale Demonstrators

Our outstanding infrastructure provides students with the opportunity to create large-scale, 1:1 demonstrators. These projects serve as a platform for testing architectural concepts at full scale. Students engage in rigorous design and manufacturing processes, guided by tutors, allowing them to iterate on designs, experiment with full-scale techniques, troubleshoot issues, and ultimately bring their designs to life.

These projects often involve collaborations with industry partners and are executed in exceptional locations. They immerse students in a digital design cycle, where conceptual ideals meet the practical realities of materials, schedules, budgets, and time constraints.

Demonstrator

above:
2020 MAS ETH DFAB Demonstrator
Rapid Clay Formations

Photo: Gramazio Kohler Research

left:
2020 MAS ETH DFAB Demonstrator
Digital Bamboo , ZAZ Museum

Photo: Andrei Jipa Digital Building Technologies

Structured into three trimesters

Trimester 1 (T1)

FOCUS_

T1 is designed as an "introduction" into the program, and provides an intensive skills-building bootcamp format featuring full-time lectures and tutorials supported by a team of researchers. The curriculum is strategically designed to prioritize the rapid acquisition of digital skills, with primariy focus on Python programming and robotic control.

METHOD_

In T1, the teaching method revolves around small design projects that encourage active and iterative skill application. This "learning-by-doing" approach facilitates a swift immersion into the digital mindset, language, and design philosophy that are integral to our school's culture.

OUTCOMES_

By the end of T1, you will:

- develop skills in coding, robotic control, and 3D printing;
- learn to apply digital tools and processes for digital design and fabrication;
- be able to work in teams of 3 to 4 on computational design projects;
- become familiarized with the digital culture of the program;
- define your personal learning journey and skills development focus for the year.

Trimester 2 (T2)

In T2, we advance: students are tasked with applying their T1 skillset to a larger and more intricate architectural project, which is executed to a 1:1 scale. The primary objective here is to gain a comprehensive understanding of the cross disciplinary technological aspects embedded in these new architectural projects.

In T2, the central teaching approach is a collaborative project in which students work together throughout the entire digital design-to-fabrication process. This project concludes with the creation of "demonstrators" designed to test the project in architectural scale. Often exhibited for a larger audience.

By the end of T2, you will :

- have advanced in your computational skills (individual and group);
- understand the challenges of full scale prototyping;
- develop cross-disciplinary project management and coordination skills;
- develop skills in group presentation and documentation of a complex digital project;
- further refine your personal learning and development plan for the remainder of the program.

Trimester 3 (T3)

The final T3 focuses on tackling precise research questions proposed by PhD or Postdoc researchers. The process encompasses different stages, from formulating a research brief to conducting experiments, measuring and documenting scientif results and ultimately developing physical demonstrators.

Students undertake focused research projects, working individually or in pairs under the guidance of assigned researchers. Projects adhere to rigorous scientific research methods and culminate in the creation of a large-scale demonstrator. Research findings are presented to expert jury.

By the end of T3, you will:

- be able to develop individual computational strategies;
- have in-depth understanding of computational tools;
- understand fabrication technologies as well as material processes;
- perfect your project management for digital fabrication skills;
- perfect your documentation and presentation skills;
- develop skills on scientific writing;
- gain in-depth understanding of a specific digital fabrication topic.

8+

Professorships contribute to the Institute of Technology in Architecture, that will be your home during your studies

80+

Researchers engage with you during your program, through direct 1-2-1 or group teaching

100+

Companies partner with our program and contribute through teaching, guest lectures or offer company visits

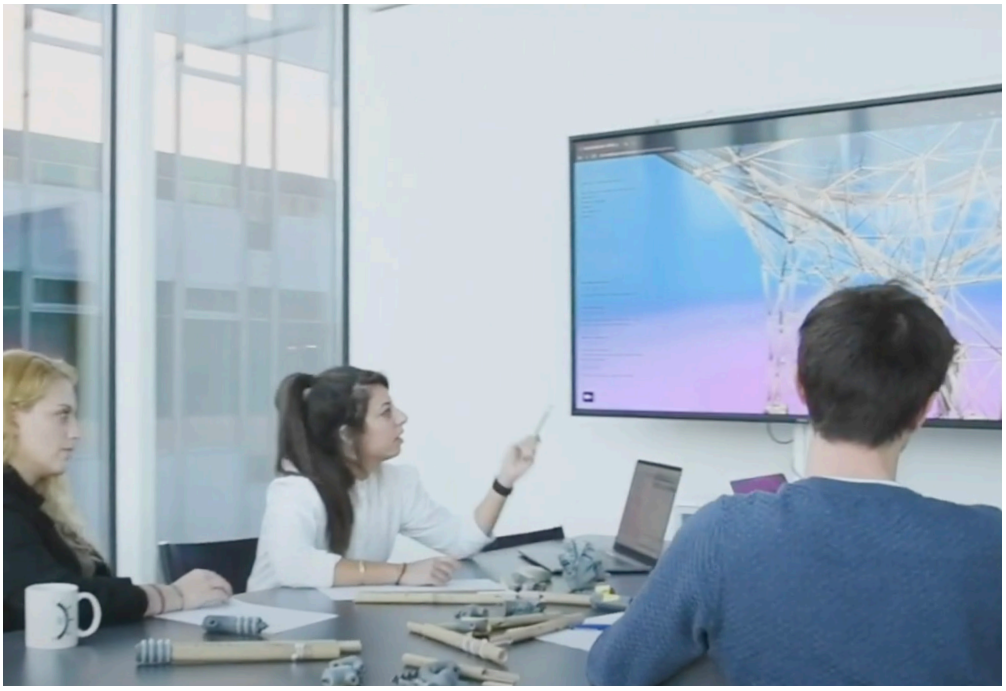
Design in Progress

Group project meeting inside ITA.

2020 MAS ETH DFAB

Customized computation allow for agile design and analysis. Here, structural challenges of this light weight structure are being reviewed with the design team and integrated into the design workflow.

Photo: Digital Building Technologies



The ETH program experience

Academic excellence

ETH Zürich's environment of academic excellence is driven by a combination of renowned faculty, research prowess, a multidisciplinary approach, exceptional facilities, and a dedication to nurturing top talent. The institution's commitment to rigorous standards and innovation places it among the world's leading academic and research institutions, making it an inspiring place for intellectual growth and achievement.

Our program's advanced methods and technologies are at the forefront of digital technologies for our industry.

As a student of our program, you will experience this excellence on daily basis.

Digital culture

Our culture is inherently digital, embracing technology's transformative potential, fostering innovation, and promoting interdisciplinary collaboration.

This culture places significant emphasis on digital fabrication, prototyping, continuous iteration, simulation, and experimentation, reflecting the very essence of research itself.

Importantly, this digital ethos shapes a mindset that extends the boundaries of aesthetics, challenging conventional design paradigms, and, in essence, defining the future of architecture with technology at its core.

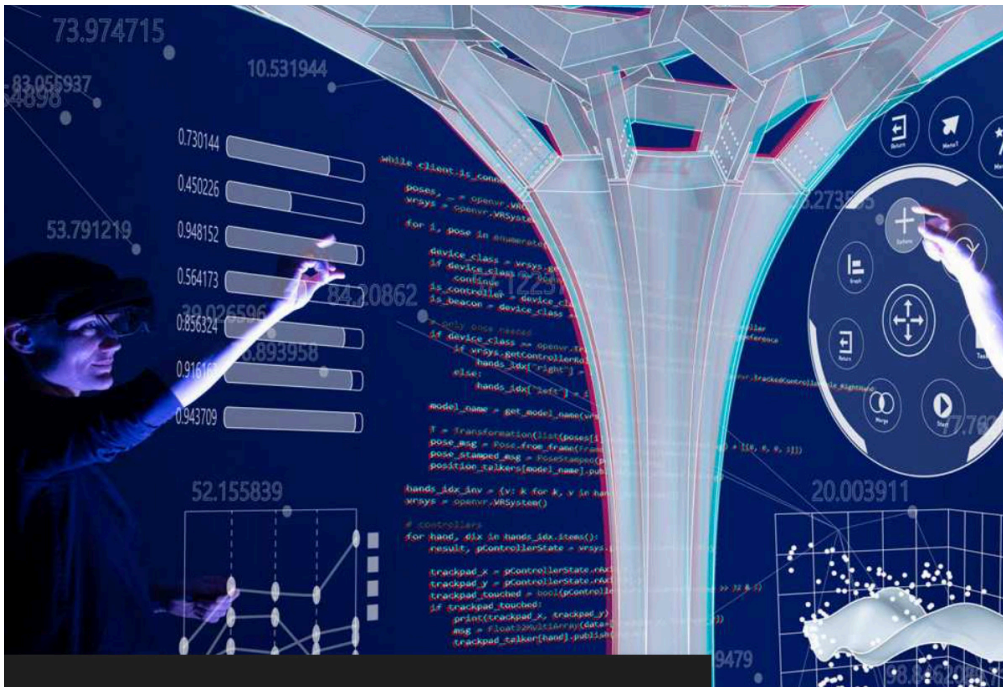
Acquiring this mindset is fundamental to the experience of our program.

Commitment to practice

We are commited to empowering our students with the practical skills and knowledge essential for success in real-world architectural practice and the broader construction industry.

This commitment is palpable in our curriculum, which integrates hands-on exercises, iterative prototyping, and the realisation of 1:1 demonstrators, emphasizing the transformation of design concepts into tangible , buildable solutions.

To enrich the learning experience, we engage industry partners in our curriculum, whether through guest lecturers, expert jurors, or organized company visits.



The IDL

Inside the Immersive Design Lab (IDL), part of the ETH Zürich Design++, Center for Augmented Computational Design in Architecture, Engineering and Construction.

Photo: ETH Zürich Design++

Spatial Timber Assemblies

In our Robotics Fabrication Lab (RFL)

The focus is on the development and implementation of an innovative robot-based fabrication process of timber frame module.
a joint collaboration of Gramazio Kohler Research, ETH Zürich and ERNE AG Holzbau.

Photo: Gramazio Kohler Research

3_ Our Context

ETH Zürich is a leading university in science and technology, situated in Zürich, one of Europe's most important technology hubs. We offer an exceptional learning environment, supported by substantial funding and access to cutting-edge facilities. With commitment to high quality education, we maintain small class sizes, ensuring a close teacher-student interaction. Each graduating class contributes to an ever-expanding network of experts, making strides in both practice and academia.

Meet our class / program statistics

Small and personal

Our small classes mean that we get to know each and every one of our students well. The close teacher-student interaction is what maintains a high quality of education.

Diverse and inclusive

We are happy to welcome talent from around the globe, with different professional and cultural backgrounds - this is what makes our program so uniquely vibrant.

18
class size
8-year average
cohorts 16/17 to 23/24

35
nationalities
7-year count
cohorts 16/17 to 22/23

29
average age
7-year count
cohorts 16/17 to 22/23

42%
from Europe
7-year average
cohorts 16/17 to 22/23

38%
women
7-year average
cohorts 16/17 to 22/23

Researchers

Researchers working in the Robotics Frabication Lab (RFL)

Photo: MAS ETH DFAB

Meet our alumni / program statistics

Graduates

Each graduating class contributes to our ever-expanding network of experts, making strides in both practice and academia. In 2023, we now proudly count 129 graduates of our program, which first opened in 2016.

Our program graduates also become part of the bigger ETH Zürich alumni community, of which there are some 80,000, with alumni hubs around the globe. Being an ETH alum comes with many benefits, see more information on our ETH alumni webpage:

https://www.alumni.ethz.ch/en/

Geography

Although 58% of our students come from outside of Europe, upon graduation 78% find post-program employment in Europe (including Switzerland).

78%
jobs in Europe

6-year average
cohorts 16/17 to 21/22

49%
jobs in Switzerland

6-year average
cohorts 16/17 to 21/22

Careers

Our graduates build careers both in practice and academia - as such our program offers the flexibility for our graduates to purposefully choose their career path.

60%
jobs in practice

6-year average
cohorts 16/17 to 21/22

40%
jobs in academia

6-year average
cohorts 16/17 to 21/22

Our people

NCCR DFAB team in the Robotics Fabrication Lab (RFL)

Photo: NCCR DFAB

Our funding, labs, and institute

NCCR DFAB

The MAS ETH DFAB program is the educational program of the National Center of Competence and Research in Digital Fabrication (NCCR DFAB), supported by the Swiss National Science Foundation (SNSF).

Founded in 2014, the center strives to revolutionize architecture by seamlessly merging digital technology and physical construction.

With 130+ researchers spanning six academic disciplines, including architects, engineers, scientists, and computer programmers, interdisciplinary collaboration drives large-scale projects and spawns new research domains.

The DFAB supports groundbreaking technologies and processes for the future construction, and reinforces the position of Switzerland as the global leader in digital fabrication.

RFL and satellite labs

During the integrated project weeks, students gain direct access to the ITA's impressive robotic facility, the Robotic Fabrication Lab known as the RFL.

The RFL provides an exceptional set up for research and industry. Its four ABB industrial arms on a hall-sized gantry system, enabling full-scale architecture fabrication.

Students also have the opportunity to explore a network of interconnected labs: 3D Printing Lab, Concrete Materials Lab, and Adaptive Building Systems Lab, along with the Immersive Design Lab (AI and VR).

Our state-of-the-art lab network facilitates comprehensive full-scale testing of building components and systems across various domains.

ITA

The MAS ETH DFAB program is housed within the Institute of Technology in Architecture (ITA), which brings together 8 professorships and 100+ researchers.

ITA's doctoral researchers bring a wide range of expertise and interdisciplinary knowledge to the program. When complimentary topics or interests are identified, doctoral researchers may take on a mentoring role for one of our MAS students or projects.

Doctoral researchers support the skills development of our MAS ETH DFAB students while also providing exposure to our research environment and academic standards, preparing MAS students for a potential career in academia.

ITA

The interior office floor of the Institute of Technology in Architecture (ITA).

Photo: Roman Keller

Our university, in Zürich Switzerland

ETH Zürich

ETH Zürich, founded in 1855, embodies Swiss values of freedom, responsibility, entrepreneurship, and open-mindedness. It provides an environment for independent thinking, fostering top-tier research and global collaboration from its central European location.

With 530 professors and 20,500 students from 120+ countries, ETH covers diverse disciplines. Their research yields innovations for Switzerland's high-tech sectors, from computer science, robotics, to medicine, with an impressive record of 90 patents and 200 inventions annually.

Since 1996, 380 commercial spin-offs have emerged. With 21 Nobel laureates, ETH consistently ranks among the world's top universities in international tables.

Zürich

Zürich is an excellent city for students, home to renowned, high-ranked universities offering high-quality education and cutting-edge facilities. The city hosts approximately 70,000 students annually. Zürich's strong economy and low unemployment rates, coupled with diverse industries like finance, technology, and pharmaceuticals, provide numerous job opportunities.

Zürich is a thriving hub of entrepreneurship, especially in technology and robotics. It is home to companies like ABB, a global leader in industrial automation. The city greatly benefits from ETH's research in robotics and AI. Zürich's commitment to innovation has fostered a growing ecosystem of tech and robotics companies, making it a magnet for entrepreneurs in these fields.

Switzerland

Switzerland consistently ranks high for its quality of life, boasting a robust healthcare system, excellent public transport, low crime rates, and a strong commitment to environmental sustainability.

Known for its emphasis on research and innovation, Switzerland fosters an environment conducive to forward-thinking and entrepreneurship.

Its stunning landscapes, including the Swiss Alps and serene lakes, offer a unique living experience, with ample opportunities for outdoor activities.

Switzerland is an ideal destination for students, both local and international, and residents alike.

Timber Assembly

2018 MAS ETH DFAB project
/ Trimester 2

Exibited in V&A Dundee Museum

Photo: Michael McGurk

Application, program fees, and scholarships

Application

Our program is designed for university graduates from Switzerland and abroad and will accept qualified applicants who are specifically interested in improving their skills and gaining experience in the areas of advanced digital design methods, digital fabrication, and the application of robotics and 3D printing within construction and architecture.

Applicants must also evidence their creative design skills and technological capabilities.

For further explanation of the minimum qualifications required, full list of all application documents to be submitted, and application timeline, see here:

https://www.masdfab.arch.ethz.ch/application

Fees / ECTS / Certificates

The program tuition fee is CHF 20,000. In addition, administrative fee of CHF 1,460 for the three trimesters is applied. The total program fee is CHF 21,460.

Upon successful completion of the program, 60 credit points (ECTS) will be awarded, and students will receive their Master of Advanced Studies ETH in Architecture and Digital Fabrication (MAS ETH DFAB).

A diploma supplement is issued together with the MAS certificate according to the guidelines laid out by the Rector Conference of Swiss Universities.

See full academic regulations here:

https://sce.ethz.ch/en/programmes-and-courses.html

Scholarships

Scholarships from the ETH Zürich, School of Continuing Education, or directly from the MAS ETH DFAB program, are offered on application and are awarded on case-by-case basis.

Scholarships are provided as supplementary financial support - they do not cover full fees.

The number of scholarships offered is limited.

For full list of scholarships offered, and how to apply for a scholarship, please refer to our website.

Read about all our scholarships, and application details here:

https://www.masdfab.arch.ethz.ch/application/fees-scholarships

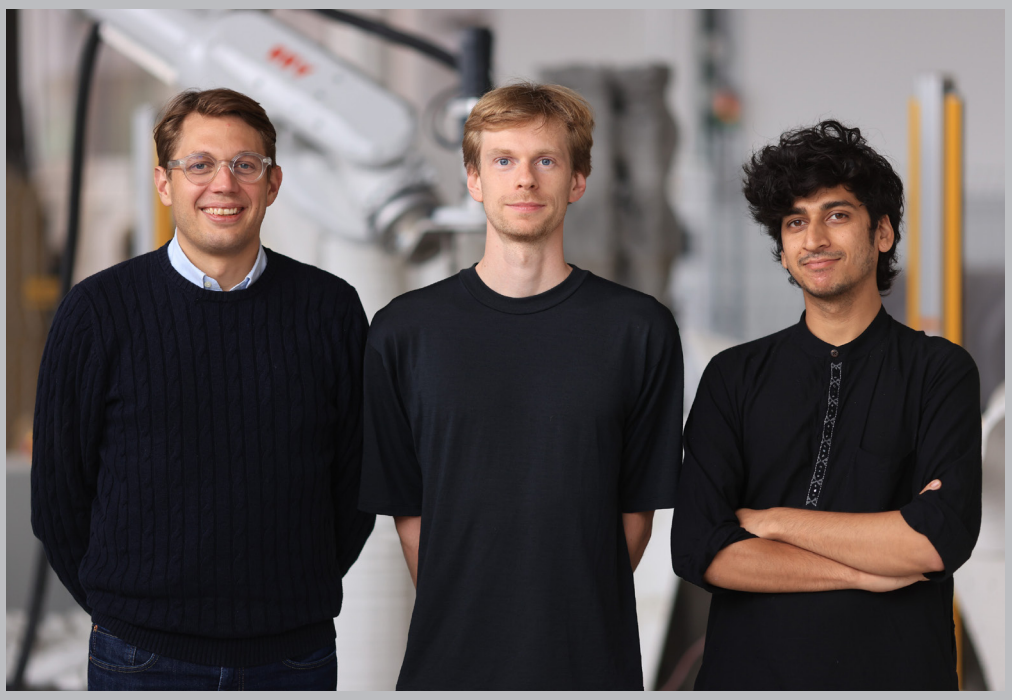
Get in touch!

We understand making a decision to invest in your career takes some thinking and planning. We are here to consult you.

Get in touch with us, we will be happy to speak with you, or to connect you with a student or alum of our program.

Petrus Aejmelaeus-Lindström (left)
Simon Griffeon(middle)
Ananya Kango (right)

contact :
https://www.masdfab.arch.ethz.ch/contact



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