



Digital fabrication is set to revolutionise 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 Zurich educates a new generation of collaborating architects, engineers and designers eager to define the future of architecture.

MAS ETH in Architecture and Digital Fabrication

Our Master of Advanced Studies ETH Zurich in Architecture and Digital Fabrication is a **one-year full time educational programme positioned within a vibrant multidisciplinary research environment.**

It is jointly organized by the chairs Digital Building Technologies and Gramazio Kohler Research at the Institute of Technology in Architecture (ITA) and the Department of Architecture (D-ARCH) at ETH Zurich. Furthermore, the MAS ETH DFAB is the educational program of the National Center of Competence in Research in Digital Fabrication (NCCR), benefiting from the leading interdisciplinary research center for digital fabrication and robotics in architecture.



NCCR DFAB team in the Robotics Fabrication Lab

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Become Leaders in the Field of Digital Architecture

Since 2015, students from around the world come together to learn from leaders in the field of digital architecture and fabrication. The MAS ETH DFAB is proud to have **eight generations of alumni** who are now working in leading academic and architectural institutions.

On a daily basis, our students **gain a foothold in the field of digital fabrication and insight into the day-to-day operations of research.** Placed in the research context of the NCCR DFAB, our students work in close contact with projects and research that deal with topics in the fields of materials, fabrication, and applications of robotics within the field of architecture. Our programme provides a regular interaction with leaders in academia, industry, and practice. Thus, students access to a network that prepares them for both practice and further study.

Join our Culture of Academic Excellence

Ranked among the world's leading universities, the **ETH Zurich gives our students access to academic excellence.** We benefit from exceptional infrastructures and technologies at the forefront of digital design to fabrication for architecture and construction. Within the curriculum, lectures and events are tailored to weave in other disciplines at ETH Zurich as well as from our larger global academic community. With individual curiosity, interest and motivation, this much **broader world of excellence is at our students' reach.**

At the Forefront of Digital Design and Fabrication

The MAS ETH DFAB provides expertise in the application of the latest digital technologies for design, simulation and fabrication of architecture and construction; offering training on advanced and wide-ranging theoretical and practical topics. With a focus on computational design, robotic fabrication and 3D printing, projects and assignments **enable students to develop strong design concepts and realize large-scale prototypes using the unique robotic and 3D printing facilities at ETH Zurich**. The courses are designed to not only provide a comprehensive understanding of computation and digital fabrication in architecture, but also to foster students' understanding of how new technologies, materials, and processes **contribute to an advanced and sustainable building culture**.



MAS ETH DFAB 2020 - Trimester 2 project - Intuitive Robotic Spraying

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Lead by the Chairs of Gramazio Kohler Research and Digital Building Technologies

The MAS ETH DFAB is jointly organised by the chairs of Gramazio Kohler Research and Digital Building Technologies. This dual teaching from established leaders is a proven formula for success. Professors, researchers, doctoral students, post-docs and senior scientists of both chairs contribute and teach throughout the year.

The small number of students (18-22) and the open space configuration of the ITA, enables the students to **interact each day with state-of-the-art researchers and professors**. To have such high level of technology and fabrication capacities next to the teaching teams makes for an **extraordinary potential of exchange and learning each day**.

ETH Zurich, ITA, NCCR DFAB Community

Our MAS ETH DFAB students are supported throughout their studies by the broader community of ETH Zurich, ITA and NCCR DFAB. When complementary topics or interests are identified, doctoral students can take on a mentoring role for our students and their projects. They help our MAS ETH DFAB students **develop their skills and give them the opportunity to experience a research environment and academic standards that will prepare them for their future careers**.

Collaborative Curriculum

Gramazio Kohler Research - Chair of Architecture and Digital Fabrication

Fabio Gramazio and Matthias Kohler developed the first architectural Robotic Fabrication Lab at ETH Zurich. The resulting research has been highly influential in the field of digital architecture, setting a precedent and initiating a new field of research focused on the integration of industrial robots in architectural design and construction. Within their decennial practice, they have realized numerous award-winning designs and have been presented within prestigious exhibitions and institutions around the world, including the Venice Architecture Biennale, FRAAC, Vitra Design Museum, and the Guggenheim Museum Bilbao. Their work has been widely published and extensively documented. They are architects with multidisciplinary interests ranging from computer design to robotic control and fabrication to material innovation. Their work includes international exhibitions, private and public buildings, and large-scale urban interventions.

Benjamin Dillenburger - Chair of Digital Building Technologies

digital fabrication methods in order to broaden the design freedom for architecture and develop performative and sustainable building solutions. His research focuses on 3D printing and related additive manufacturing strategies in architecture that have the potential to challenge traditional paradigms of building. Benjamin Dillenburger's work has been presented at international exhibitions like the Venice Architecture Biennale, London Design Week, and Art Basel Miami. Important projects include the design of two full-scale 3D printed rooms for the FRAC Centre Orleans and the permanent collection of Centre Pompidou Paris and the development of a material-optimized concrete slab, as part of the award-winning DFAB HOUSE project. Benjamin Dillenburger holds a Ph.D. and a Master of Advanced Studies degree from the ETH Zurich and is a Professor at the Institute of Technology in Architecture in the Department of Architecture at ETH Zurich, where he leads the research group Digital Building Technologies..



Semiramis, Tech Cluster Zug, Gramazio Kohler Research

© Gramazio Kohler Research



White Tower Mulegns, Benjamin Dillenburger

© Digital Building Technologies

Study environment and laboratories

ETH Zurich's infrastructure is among the best in the world in terms of technical equipment and research facilities, offering our students access to an exceptional and unique range of study and fabrication resources.



MAS ETH DFAB 20219 - Trimester 2 project - Concrete Choreography printing in the RFL

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MAS ETH DFAB Cluster

Our students have their permanent workstations in the MAS ETH DFAB Cluster. The cluster is equipped with UR5 industrial robot arms that are used for teaching and project development. It is also equipped with several Fused Deposition Modeling (FDM) 3D printers that are used in class for printing designs and tools. Tools and equipment are shared among students to streamline their work on physical models and prototypes.

Robotic Fabrication Lab

During integrated project weeks, students will be able to access the large-scale robotic facility Robotic Fabrication Lab (RFL). The RFL houses a unique robotic setup with four ABB industrial arms mounted on a hall-sized gantry system. There are additional robotic arms as well as a concrete lab.

Print Lab and Other Facilities

Within a separate space next to the RFL, our students can find a series of 3D printers (Stereolithography SLA, Digital Light Processing DLP, Fused Deposition Modelling FDM), which they can use all year round upon availability and sign ups. Other labs such as the Rap Lab D-ARCH, Ceramic Lab and many others are available on a project need basis.

New Satellite Laboratories

To achieve our long-term research goals, ETH Zurich steadily invests in new satellite laboratories. Recently, three new laboratories were built by ITA chairs. Guided tours and lectures ensure that **our students learn about these state-of-the-art laboratories: their technologies, their teams and projects**. They will be used for special projects of the MAS ETH DFAB curriculum.



Immersive Design Lab

© Gramazio Kohler Research

Design ++

The Design++ Center for Augmented Computational Design in Architecture, Engineering and Construction (AEC) aims to develop digitally augmented design tools and computational processes. An ETH+ initiative, its objective is to develop greater capacity at the intersections between disciplines and create new professorships in future-oriented domains at ETH. It therefore bridges domain expertise from Architecture, Civil Engineering and Computer Science, among others. Design++ will **develop digitally augmented design tools and computational processes primarily for the design phase to simultaneously increase construction productivity, improve the quality of the built environment and substantially reduce the ecological impact** within the Architecture, Engineering and Construction (AEC) sector.

Immersive Design Lab

The Immersive Design Lab (IDL), initiated by Design++, is the interdisciplinary lab at ETH Zurich for future design, architecture and engineering. The IDL creates an unprecedented platform for collaborative research and teaching in the rapidly evolving field of interactive extended reality and machine learning in architecture and construction. It is a state-of-the-art acoustic lab. It **enables the in-real-time, synesthetic human-machine interaction with virtual design and engineering models, and provides design and fabrication interfaces using state-of-the-art technologies**.

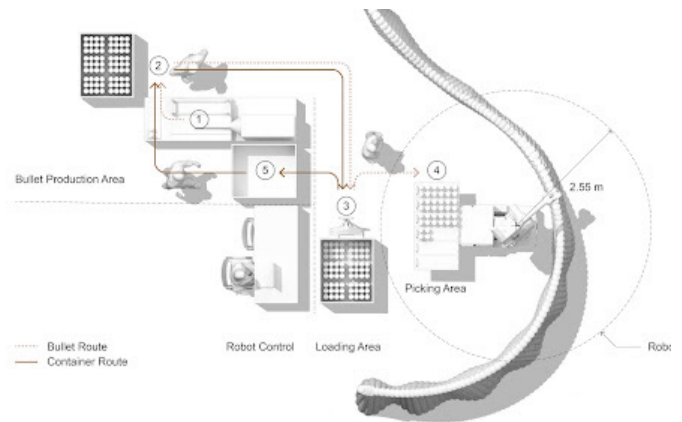
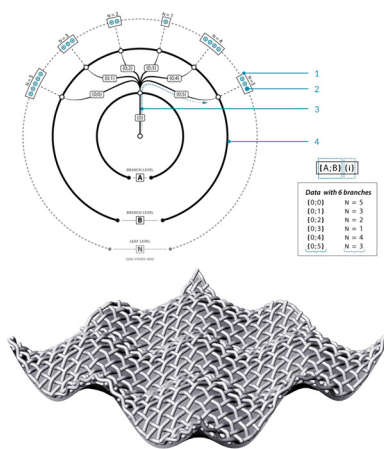
Zero Carbon Building Systems

This unique, state-of-the-art infrastructure was initiated by the Chair of Architecture and Building Systems at ETH Zurich and provides a collaborative environment for external researchers and industry partners. The laboratory facilitates innovative research and teaching in a wide range of building technology research and testing as well as user acceptance and interaction studies. In particular, the facility is used for **research on building systems and components, from early concept validation to system demonstration**. It is a place of development and a showcase for real-scale **research results on active facades, mechanical and passive building systems, and building-user interaction**.

Acquired Skills & Competences

Computational Design and Programming Skills

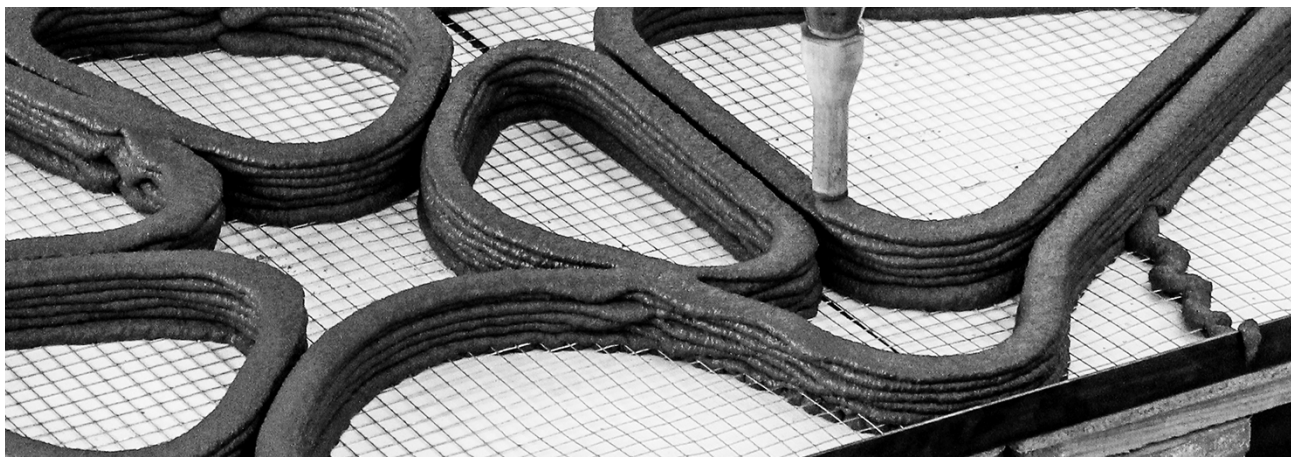
Teaching programming skills is one the main foci of the MAS ETH DFAB. Object oriented programming is necessary for computational design and digital fabrications as well as for establish effective and fast production pipelines. Students will gradually acquire skills from basic concepts to programming skills, from procedural to object orientated programming. Computational design refers to specific methods and techniques employed in design and architecture in which algorithms play a key role in the creative process. Parametric modeling has become commonly used as a method that enables a flexible, adaptable, and dynamic design approach in response to varying design inputs. The way such models are structured has a significant impact on their usability and ability to adapt to design changes. The concepts of geometric topology, hierarchy, and non-hierarchy of parametric modeling will enable students to develop robust approaches to parametric modeling. Main focus on Python, COMPAS framework, RhinoCommon and Grasshopper as well as robotic control based on UR script, RAPID and ROS.



Examples of Trimester 1 teaching topics and skills - from programming to robotic set-ups

3D Printing

The MAS ETH DFAB program explores new applications of 3D printing in building construction. Additive fabrication promises non-standardized constructions and almost unlimited complexity at no extra cost. Based on the tectonic logic of 3D printing, new building systems can be developed for integrative building components. The focus is not only on the design of the external form, but also on the internal structures of such components to generate functionally graded elements in high resolution. These explorations are linked to the study of traditional prefabricated building components. Students work with custom algorithmic design tools and materialize designs either as prototypes or as full-scale 3D prints.



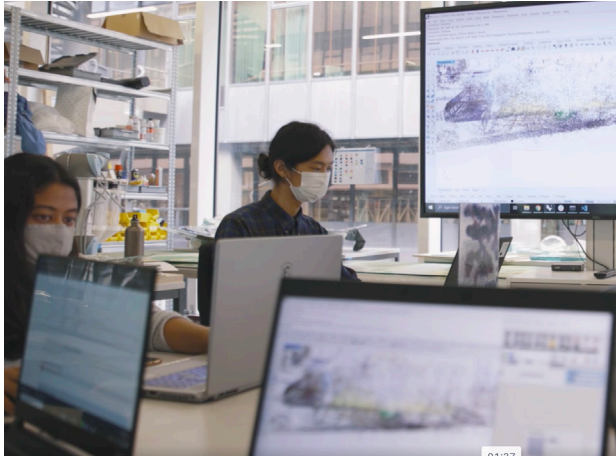
MAS ETH DFAB 2020 - Trimester 1 - Exercise on concrete printing

© Digital Building Technologies

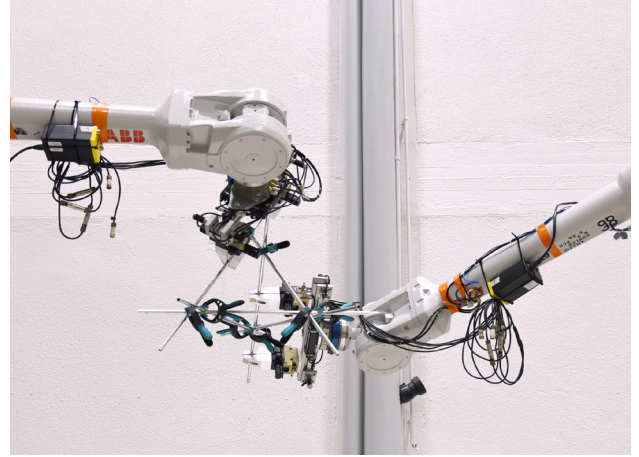
Acquired Skills & Competences

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.



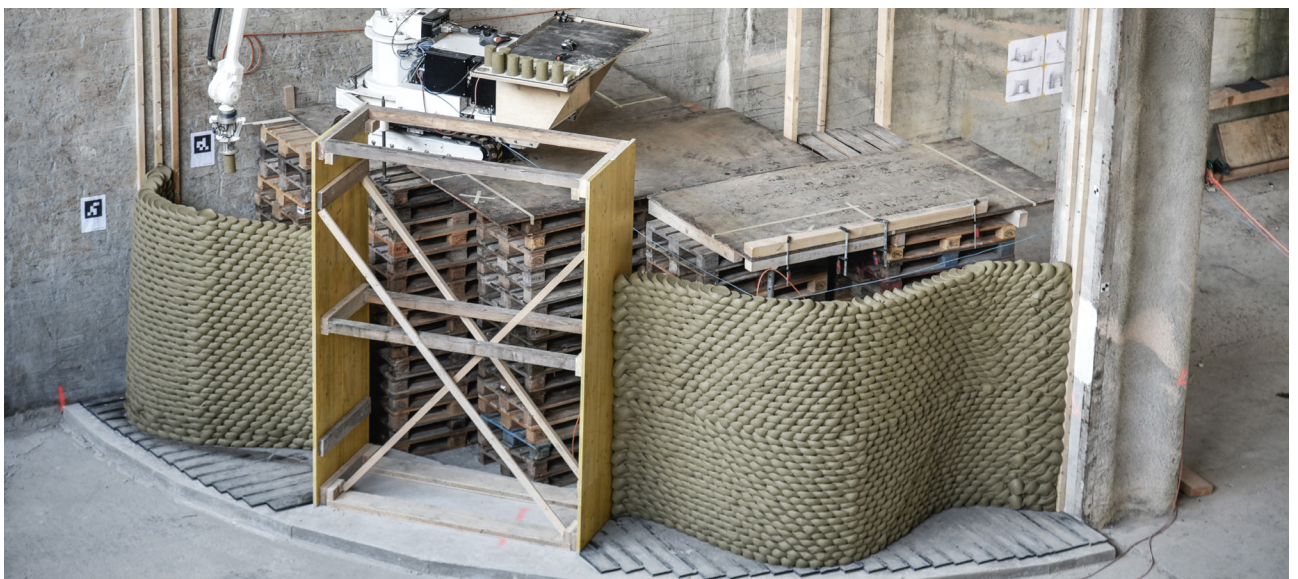
MAS DFAB students working in the cluster



Robotic Interaction

Full-Scale Demonstrators

ETH Zurich's exceptional infrastructure gives students the opportunity to build large-scale and 1-to-1 demonstrators. Projects are often a way to test at architectural scale. These large projects put students through an intense design and manufacturing workflow. Alongside tutors, students iterate on design, test full-scale techniques, resolve problems and finally build. The projects are often linked to industry partners and built at exceptional locations. **These projects immerse the team in a digital design loop, where ideals are confronted with the realities of materiality, schedule, budget, and time constraints.**



MAS ETH DFAB 2020 - Trimester 2 project - Rapid Clay Formations

© Gramazio Kohler Research

Curriculum - Trimester 1 & 2

T1 - Skill Building

September to December - 20 Credits

The first trimester is dedicated to training and teaching. Lectures, tutorials and workshops are conducted daily by both chairs. The courses are designed so that students with different backgrounds can quickly follow and develop their coding and fabrication skills. Small group design projects allow students to apply their newly acquired knowledge and control. The goal of this trimester is to achieve a common foundation so that each student can develop individually over the course of the academic year.

By the end of T1 students should be able to:

- Understand the range of digital tools needed for digital fabrication at ITA
- Develop your own programming skills set
- Rate your skills and achievements on a scale
- Define your own learning curve and goals
- Execute Robotic control, 3D printing, geometry coding
- Work in groups of 3 or 4 on computational design projects
- Improve your presentation skills on computational design projects
- Learn about ITA, D-ARCH and current topics in digital fabrication at ETH Zurich

T2 – Design & Fabrication Build Up

January to June - 20 Credits

The second trimester is devoted to 1:1 scale group design and fabrication. It is divided into two parts, each of which is complementary: one focuses on 3D printing technologies, the other on robotic fabrication. This allows students to apply the knowledge gained in the first trimester on a large-scale project while deepening and broadening their skills. Students work collaboratively on all aspects, from design to digital and robotic fabrication. Numerous T2 projects have been displayed in relevant Swiss and international venues and museums, such as the Venice Biennale, the V&A in Aberdeen, Swiss Consulate in Rome, or The Vitra Design Museum.

By the end of T2 students should be able to:

- Coordinate a design and digital fabrication project at a fast pace in a group of +20 people
- Gain additional skills in technologies such as AI, AR or data structure management
- Further develop your knowledge on computational tools, fabrication technologies, and materials based on the two T2 topics
- Learn how to document and present your work and design strategies
- Gain solid computational skills



MAS ETH DFAB 2018 - Trimester 2 - Digital Metal - Deep Facade - ITA

© Digital Building Technologies

Curriculum - Trimester 3 - Individual Master Thesis



MAS ETH DFAB 2022 - Trimester 2 - Ice Concrete - Final Presentation

© Gabriele Mattei for Digital Building Technologies

T3 - Individual Master Thesis

June to September - 20 Credits

In the third trimester, students focus on developing their research thesis, working individually or in groups of two. Students select a proposed research topic in the fields of robotic manufacturing processes and 3D printing technologies. Under the close supervision of researchers from the chairs of Gramazio Kohler Research and Digital Building Technologies, students work on their thesis while building prototypes and a final demonstrator that illustrates their findings. Through a series of experiments, students gradually refine their arguments and findings, familiarizing themselves with the rigor of academic research.

At the end of the T3, students present their work in front of a panel of international experts and condense their results into a written thesis.

By the end of T3 students be able to:

- Develop individual computational strategies and applications
- Acquire in-depth knowledge on computational tools, fabrication technologies and material related to your thesis
- Acquire skills in managing digital fabrication projects from concept to production
- Experience a complete digital design to fabrication process in a restricted team
- Define a autonomous work flow and production calendar
- Professionally document and present your work and strategy
- Document thoroughly a computational design project
- Gain practice in academic and scientific writing

Other Activities



Lecture Series

© NCCR Digital Fabrication

Lectures

Conferences featuring leading speakers from practice, industry, and academia provide an important external input and a forum for discussion, not just for the MAS ETH DFAB, but also for the broader ITA research community. The conferences are intended to bring together experts from all over the world to discuss and exchange views on topics relevant to digital fabrication in architecture, and to provide a platform for discussing the broader cultural, technological, and practical implications of digitalization in architecture. Guest speakers in past years have included Neri Oxman, Xavier de Kestelier, Nader Tehrani, Philip Yuan, Geoffrey West, Mario Carpo, and Roland Snooks.

ITA, D-ARCH, ETHZ and beyond

ETH Zurich, with its affiliated departments and institutes, provides its community a vast range of events and conferences that you can attend individually. As an ETH student, you can attend lectures not just in the field of architecture, but also in the field of robotics, materials science, and other related disciplines that are of individual interest.

Excursions and events

Excursions are organized each year to visit architectural sites, leading companies. These events will be a key part of the curriculum and are designed to broaden the students' experience, inform their coursework, and provide opportunities for networking and future collaboration.



MAS ETH DFAB 2022 - Trimester 2 - Egg Shell Concrete - Visit to cement factory

© Digital Building Technologies



MAS ETH DFAB 2022 - Trimester 2 - Egg Shell Pavilion - Vitra Foundation, Basel

© Gramazio Kohler Research

Requirements & Tuition Fees

Target group

The MAS ETH DFAB programme is designed for university graduates from Switzerland and abroad. The MAS 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.

Requirements

A master's degree in architecture or engineering recognized by ETH Zurich, or an equivalent educational qualification (i.e. a bachelor's degree and a minimum of two years of professional experience in a directly related field) is required. Also required are proof of creative design skills and technological capabilities. Documents submitted with the application and a portfolio review will be used to assess a candidate's qualification. If your mother tongue is not English or German, you need C1 in either languages.

Language

All instruction will occur in English. All applicants are expected to be highly proficient in English (spoken, written and reading). Interviews may be requested to evaluate a candidate's language abilities. German speaking applicants are highly sought for.

Tuition fees

Tuition for the course is CHF 20,000. Fees and administrative costs are CHF 1,460 for three trimesters. The total for the programme is CHF 21,460.

Credits

The MAS in Architecture and Digital Fabrication provides 60 credit points according to the European Credit Transfer and Accumulation System (ECTS), a standard for comparing university studies within Europe. This corresponds to one academic year or 1,500–1,800 hours of study.

Accreditation

Students who successfully complete the programme 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.

Financing your education

We offer full or partial tuition scholarships. The ETH Zurich offers various other scholarships. For more information on potential opportunities for scholarships and financial aid, please contact the ETH Scholarship Office.



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Your Application Process

The School for Continuing Education (www.sce.ethz.ch/en/) is responsible for all applications for admission to all MAS programmes.

Application Process

The School for Continuing Education is responsible for all applications for admission to MAS programmes. The application process opens on **15th November 2022**. Please submit your application via the online eApply (www.lehrbetrieb.ethz.ch/eApply) and pay the application and handling fee using your credit card.

The programme accepts 18 - 22 students per year. In order to maintain its multi-cultural environment, the admissions committee is encouraged to keep a balanced ratio of a diverse multi-national intake of applicants every year.

Deadlines for submitting documents

The application **deadline for the MAS ETH DFAB is January 15th 2023**. Candidates will be informed of their acceptance by latest April of the next year.

New Scholarships Opportunities - Tuition scholarships

MAS DFAB Scholarship of Excellence: The program will offer **full or partial tuition or partial scholarships** for 2 to 3 students. Deadline for submitting your application and your scholarship applications will be 15th January. (

As well, the ETH Zurich offers various scholarships. For more information please contact the ETH Scholarship Office.

Portfolio requirements

The portfolio should feature three projects which you feel demonstrate your analytical, design capabilities as well as your technical knowledge. Layout quality will also be evaluated and should emphasize images and design diagrams.

Your motivation letter is a key part of the assessment. It should explain in specific terms, why you would like to participate in the programme as well as three letters of recommendation.

Late applications

Late applications may be considered if places are still available for a second application window that opens February 15th 2023 and closes at April 15th 2023.

Links

MAS Programme:

www.masdfab.com

www.dfab.ch/mas

Online Application:

www.ethz.ch/en/studies/continuing-education/

application-and-studies/application-MAS-MBA

Housing Office of University and ETH Zurich

www.ethz.ch/en/the-eth-zurich/working-teaching-and-research/working-environment/accommodation

Arriving in Switzerland for international students:

www.ethz.ch/en/the-eth-zurich/working-teaching-and-research/welcome-center/arriving-in-switzerland

Information on general living cost in Switzerland:

www.ethz.ch/en/the-eth-zurich/working-teaching-and-research/welcome-center/services-and-downloads/cost-of-living

The MAS DFAB administration reserves the right to change any content stated in this document without further notice.

Contact

For questions concerning the application, please contact:

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Digital Building Technologies, ETH Zurich

Prof. Benjamin Dillenburger

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Programme Coordinators

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Dr. Petrus Aejmelaes-Lindström - Gramazio Kohler Research

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Eggshell Pavilion - MAS ETH DFAB 2021 - Gramazio Kohler Research
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