



[AM]

to

[ARC]

**FROM
ADDITIVE MANUFACTURING
TO
ARCHITECTURE**

**MASTER ENTWURF / PROJECT
TU MUNICH / TU BRAUNSCHWEIG**

FROM ADDITIVE MANUFACTURING TO ARCHITECTURE

MASTER ENTWURF / PROJECT
Summer 2022

Cooperative Project TU Munich & TU Braunschweig

Teaching Team

Professorship for Digital Fabrication, TU Munich
Prof. Dr. Kathrin Dörfler
Dipl.Ing. Julia Fleckenstein

Chair for Architectural Design and Construction, TU Munich
Prof. Florian Nagler
Dipl.Ing. Anne Niemann

ITE / Institute for Structural Design, TU Braunschweig
Prof. Dr. Norman Hack
Philipp Rennen, M.Sc.

IKON / Institute for Building Construction, TU Braunschweig
Prof. Helga Blocksdorf
Dipl.Ing. Moritz Scheible

In association with the Collaborative Research Center,
Additive Manufacturing in Construction, TRR277.

INTRODUCTION

Additive Manufacturing (AM) offers a variety of technological perspectives that will influence all aspects of building construction in the future: materiality, structure, detailing, thermal envelope, building climate. Based on the AM technologies currently being developed, three currently relevant topics are to be addressed in the architectural design project: the creation of living space, urban densification, and sustainable building. At the beginning of this project work, the different methods of AM will be studied, and then structural principles and parameters will be derived. An inner-city residential building will be designed with this “toolbox” of AM methods. The focus is on the development of an intelligent construction configuration and a robust apartment typology. Structures should be developed that find a balance between durability, material justice, resource conservation, and flexible, spatial playability, and that take up the need for sustainability in various facets.

Following the project in the summer semester, specialization will be offered in the winter semester 2022/23, in which sections of the design can be additively manufactured on a scale of 1:1 in the Additive Manufacturing in Construction Laboratory of the TU Munich or the Digital Fabrication Lab, TU Braunschweig. Due to the amount of work involved, the design is worked on in groups of two students.

The cooperation between the Technical University of Munich and the TU Braunschweig requires mutual attendance of face-to-face events. For this purpose, excursions with overnight stay to Braunschweig and Munich are planned. The final presentation will take place at Bayrische Landwirtschaft Herrsching, Ammersee.

SEMESTER STRUCTURE

27.04.-03.05. Analysis

Analyzing various projects from the fields of Additive-Manufacturing-Research and Architecture gives all participants first knowledge of the core themes of the design course. Each group picks one topic and summarizes the essential information. Results will be presented in a 5 minute lecture and delivered in a PDF booklet of max. 10 pages DIN A3, landscape.

03.05. - 10.05. Hackathon

At the Hackathon the process of additive manufacturing will be experienced. All students receive a Rhinoceros 3D script to work with. The script allows the digital design of a 3D printable object. After a short design phase, groups of 4 students implement the scripted object in the AM fabrication process. Finally the clay printed object should be evaluated and presented to all participants, including a documentation of the process of design and production.

10.05.-24.05. Site & First Idea

In the first phase of the project design, three key topics should be addressed:

- interpretation of program / organization concept*
- building concept / urban form*
- construction concept / AM Method*

24.05.-21.06. Construction & Design Concept

In the second phase the typology and construction concept are developed simultaneously. The focus is on the combination of the spatial program with an intelligent construction system, based on the methods of Additive Manufacturing. Depending on the fabrication method an execution concept (on site or off site) needs to be invented.

21.06. - 26.07. Completion Phase

The project design will be completed.

The project objectives need to be checked:

- Typology and program*
- AM Method and execution concept*
- Architectural and urban concept*

26.07.2022 Final Presentation

SITE - ÄGIDIENMARKT BRAUNSCHWEIG



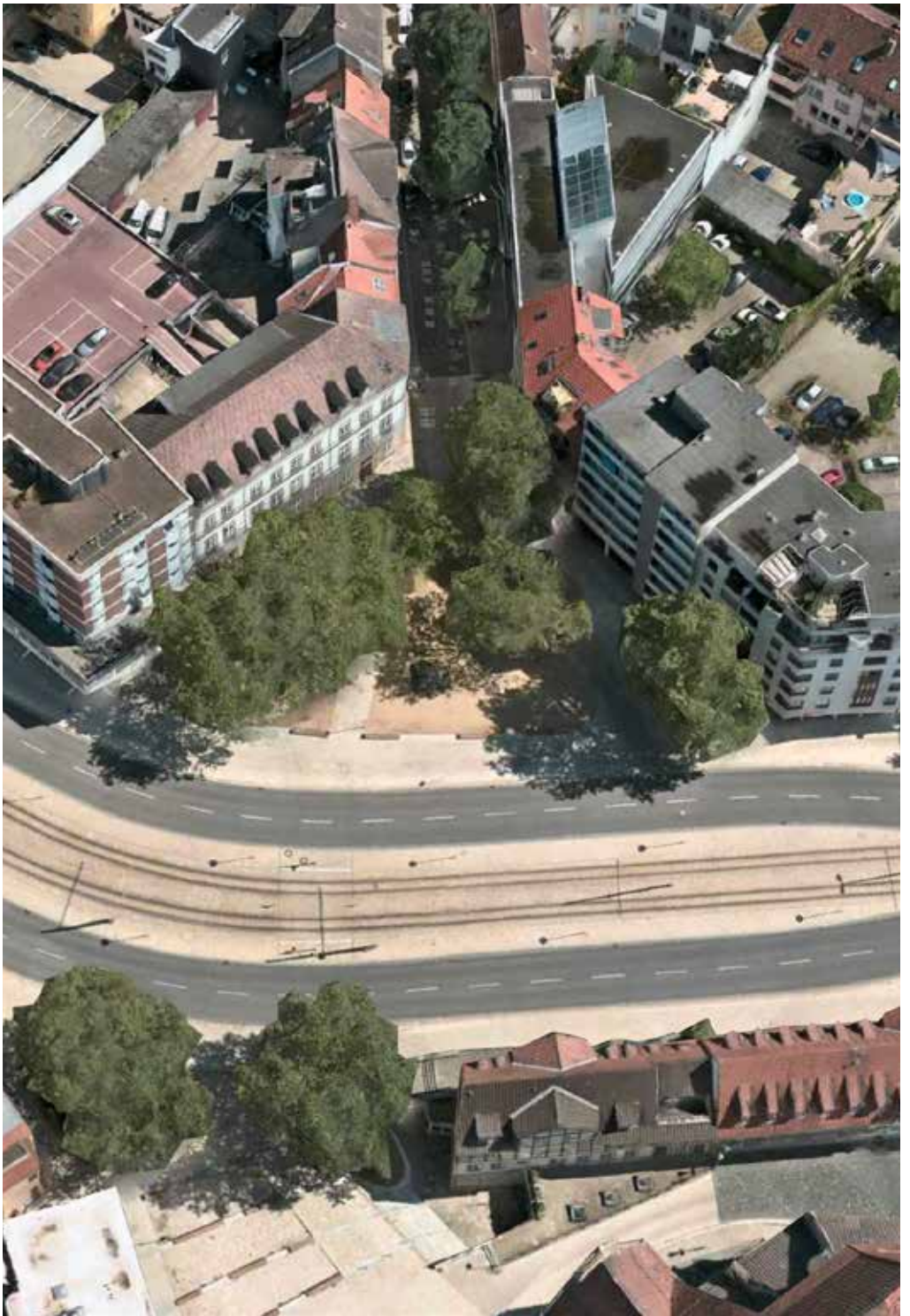
SITE - ÄGIDIENMARKT BRAUNSCHWEIG

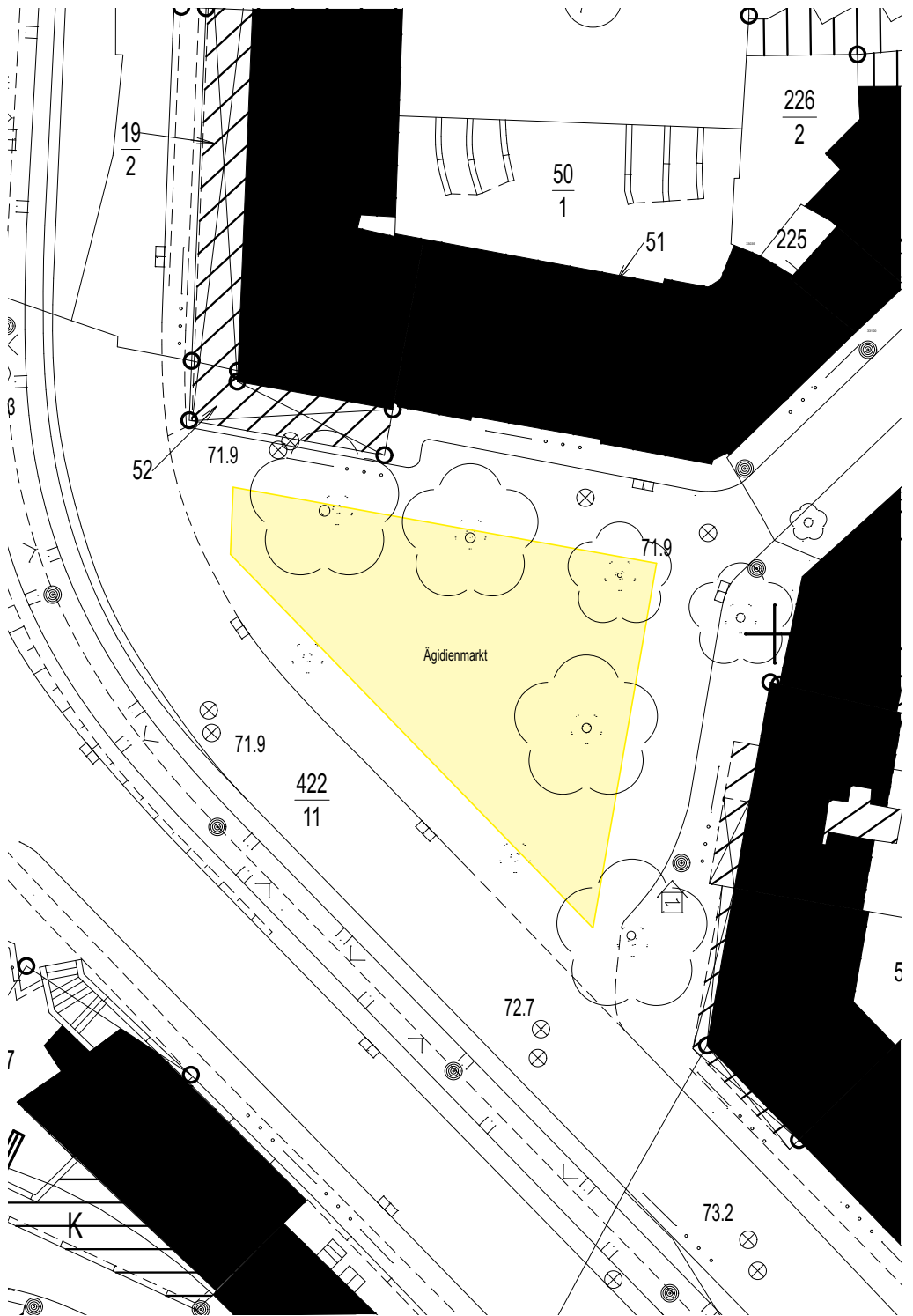
The Ägidiemarkt is one of the medieval marketplaces in downtown Braunschweig. In the Middle Ages it was the social and economic center of the Altewiek area, today it lies between the Magniviertel and the Aegidienviertel and is part of the city ring road. It was named after the Aegidienkirche and the associated Aegidienkloster. The pottery market was one of the most important markets on the Ägidiemarkt.

Today we experience Ägidiemarkt as a blank spot in a heterogenic, yet historically emerged downtown structure. The expansion of street infrastructure after World War II led to the impenetation of the so called City Ring, which nowadays crosses the former market place and only leaves relicts of what was formerly a subcentre of the city. By establishing a new buliding structure that contributes to the necessity of residential use, the underestimated place could be reactivated and newly interpreted as a part of the city structure.

Siteplan Ägidiemarkt 1889 - Ludwig Winter







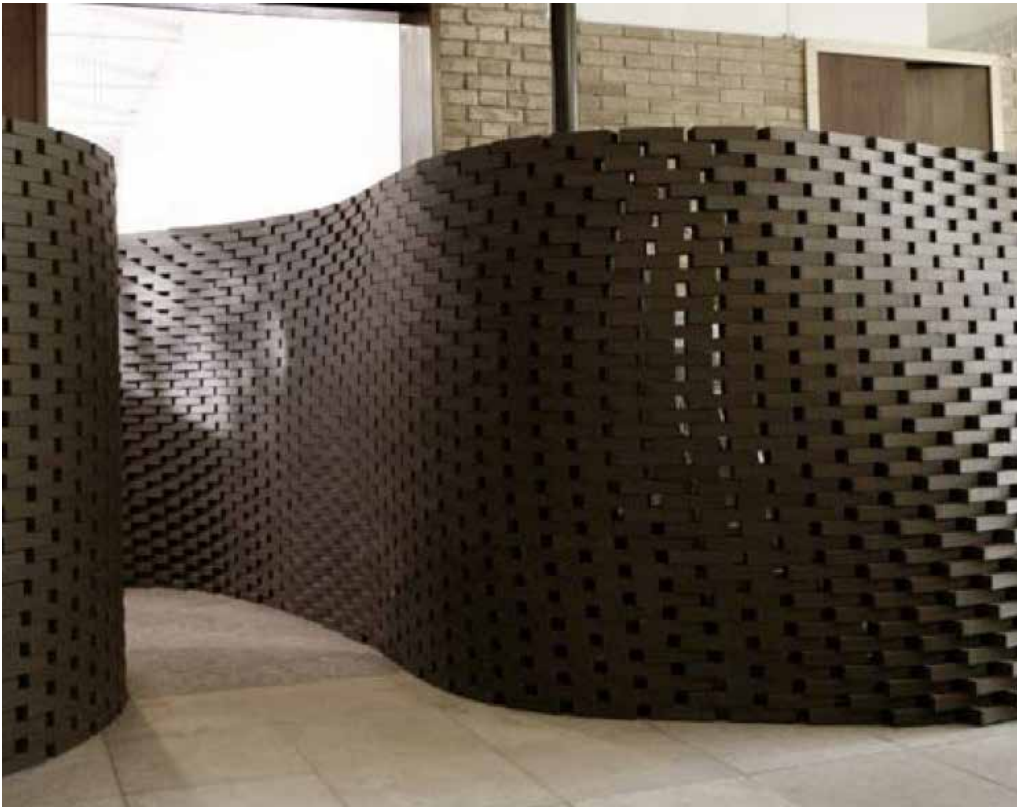
DESIGN TASK

„Are you are seeking flexibility? Keep on building your walls of stone.“
Luigi Snozzi, Parole Nr. 12

With the project „From Additive Manufacturing to Architecture“ two main topics shall be adressed. Firstly: an architectural form and structure for the application of Additive Manufacturing Methods. Secondly: typologies of mixed and residential use that can change over coming decades and that are intelligently interacting with the construction structure.

Luigi Snozzi is arguing flexibility with a massive, unflexible material. The intention is to emphasize on robust grids and structures to host a variety of functions throughout their lifecycle. The goal of sustainability results from a wide range of factors. The intention with this design project is to take a closer look on long lasting structures, effciently built with methods of Additive Manufacturing.

Gramazio Kohler - Digital Materiality



DESIGN TASK



Duplex Architekten - Mehr als Wohnen

The spatial program contains a market hall for the ground floor and therefore generates a reminiscence to the former function of the site.

While organizing the program on site, at least one of the existing trees needs to be conserved and integrated in the position and design of the building volume.

The upper floors should provide space for residential typologies and community areas. Residential concepts can reach from multigenerational living over shared appartement typologies to micro appartements.

However, the design concept should be developed in a constant dialogue between AM construction concept and flexible typologies. It is important to follow the idea of explorative design: understanding and incorporating the technical consequences of additive manufacturing fabrication methods on the one hand and examination of sustainable architectural structures for flexible long-term use on the other.

Joris Jan Burger - Eggshell



DESIGN PROGRAM

SITE

Footprint 550-650 m²

GROUND FLOOR

Market Hall 400 m²

including Storage/Sanitary Rooms

Room Height 5m

UPPER FLOORS

Appartements 1.200 m²

Community Space 400 m²

SUBMISSION

Master Plan M 1:1000

Site Plan M 1:500

Plans M 1:200

Sections M 1:200

Elevations M 1:200

Facade Section M 1:20

AM Details M 1:5-1:50

Schemes/Diagram Construction Process

Sketches/Schemes Design Concept

Urban Model M 1:500

Building Model M 1:200

Model of Constution Concept M 1:20/50

Visualization Exterior

Visualization Interior



RESEARCH

Scientific Publications

1. *Aejmelaeus-Lindström et al. - 2020 - Rock print Pavilion*
2. *Anton et al. - 2021 - A 3D concrete printing prefabrication platform for bespoke columns*
3. *Architecture of Continuity - 2019 – IAAC Blog*
4. *Dörfler et al. - 2019 - Mobile robotic fabrication beyond factory conditions case study Mesh Mould wall of the DFAB HOUSE*
5. *Gramazio, Kohler - 2012 - Digital materiality in architecture*
6. *Jan, Falcon - 2020 - Eggshell Ultra-Thin Three-Dimensional Printed Formwork for Concrete Structures*
7. *Minibuilders - 2014 - web_robots_iaac_net*
8. *Einfach Bauen - Ein Leitfaden, Hrsg. Florian Nagler*

Architectural Projects

9. *Marcel Breuer, IBM Research Center, 1960*
10. *Toyo Ito, Sendai Mediatheque, 2001*
11. *Duplex Architekten, Mehr als Wohnen, 2005*
12. *FAR frohn&rojas, Wohnregal, 2019*
13. *Summecumfemmer/Juliane Greb, Wohnhaus San Riemo, 2021*
14. *Ten Studio, 500 Year Tower, Unbuilt*



SEMESTER SCHEDULE

26.04.2022 Train to Munich

14:59 – 19:41

27.04.2022 Kick-Off Event Munich

Arcisstrasse 21 | Room 0730

Bestelmeyer Nord, 80333 Munich

<https://www.arc.ed.tum.de/df/contact/>

09:15 - 10:15 *Welcome and Introduction at the Vorhölzer Forum together with the students joining from TU Braunschweig*

10:15 - 10:45 *Getting started - Research and Reader Handout*

11:00 - 12:00 *Visit AMC Lab at Kreativquartier with guest talk: B05 Gido Dielemans, A06 Johannes Diller*

12:00 - 13:00 *Lunch Break*

14:00 - 15:30 *Visit AMC Lab in Achering with guest talks: TUM: A02 Alexander Straßer, A03 Carla Matthäus, A08 Birger Buschmann*

15:30 - 16:30 *Return to TUM*

17:17 - 21:59 *Train to Braunschweig*

02.05.2022 Train to Braunschweig

15:18 – 19:59

03.05.2022 Site Visit Braunschweig

Technische Universität Braunschweig

DBFL / Leichtweiß-Institut für Wasserbau

Beethovenstraße 51A, 38106 Braunschweig

<https://www.tu-braunschweig.de/ite/forschung/dbfl>

09:15 - 9:30 *Welcome and Introduction at the DBFL together with the students joining from TU München*

09:30 - 11:00 *Presentation Research*

11:00 - 13:00 *Visit DBFL Lab at Nordcampus with guest talk: A01 Inka Mai, A04 Robin Dörrie, A05 Stefan Gantner, A07 Johanna Müller*

13:00 - 14:00 *Lunch Break*

14:00 - 15:00 *Presentation Project Site and Project Programm at IKON, Schleinitzstr. 21b*

15:00 - 16:30 *Visit Project Site*

16:59 - 21:41 *Train to Munich*

SEMESTER SCHEDULE

10.05.2022 Hackathon / Online Presentation

23.05.2022 Train to Munich
14:59 – 19:41

24.05.2022 Midterm Review 1 / Munich
9:30 - 16:30 *Project Presentations*
17:17 - 21:59 *Train to Braunschweig*

02.05.2022 Train to Braunschweig
15:18 – 19:59

21.06.2022 Midterm Review 2 / Braunschweig
09:15 - 16:15 *Project Presentations*
16:59 - 21:41 *Train to Munich*

25.06.2022 Train to Ammersee
13:10 - 19:30

26.07.2022 Final Presentation / Ammersee
Haus der bayerischen Landwirtschaft Herrsching
Rieder Str. 70, 82211 Herrsching am Ammersee
<http://www.hdbl-herrsching.de/>

27.06.2022 Train to Braunschweig
09:45 - 16:48



TEACHING COOPERATION

TT Professorship Digital Fabrication

*Prof. Dr. sc. ETH Kathrin Dörfler
Department of Architecture
Technical University of Munich
Arcisstrasse 21
80333 München*

Lehrstuhl für Entwerfen und Konstruieren

*Prof. Florian Nagler
TUM School of Engineering and Design
Technical University of Munich
Arcisstrasse 21
80333 München*

ITE / Institut für Tragwerksentwurf

*Univ.-Prof. Dr. sc. ETH Norman Hack
Technische Universität Braunschweig
Pockelsstrasse 4
38106 Braunschweig*

IKON / Institut für Baukonstruktion / Institute for Construction

*Univ.-Prof. Dipl.-Ing. Helga Blocksdorf
Technische Universität Braunschweig
Schleinitzstraße 21b
38106 Braunschweig*

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