Taubman College of Architecture and Urban Planning
The University of Michigan – Ann Arbor
Master of Science in Architecture: Digital and Material Technologies HANDBOOK
Academic Year 2023-2024

The Master of Science in Architecture Research and Design: Digital and Material Technologies is a Rackham Graduate School program of study. Therefore, Rackham Graduate School Academic Policies and Regulations are followed. The content below is specific to current and incoming MS-DMT students.

CURRICULUM

Selecting electives

The intent for electives is to take advantage of the diversity of topics taught across the faculty in the college of architecture as well as the university more broadly, in order to expand learning beyond the core topics of the DMT curriculum. It's encouraged to take courses from faculty not teaching in the DMT program, or that are of a topic sufficiently different from those who are teaching in the program. Electives must be of a 500-level or higher. Within the college of architecture, many Arch509 elective courses are offered with topics that can be adjacent to or sufficiently different from the DMT curriculum.

It can be highly competitive to register for the Arch509 elective courses. To help alleviate such a situation, students must notify the Director of the DMT program no later than two weeks in advance of registration to indicate interest in a particular elective course. A communication will be sent to the instructor of the elective course to reserve the necessary number of seats for only DMT students to register.

Capstone and related courses

Typically, the Director of the DMT program will teach the Capstone course. To maintain continuity in the development of research topics to be explored in the Capstone course, the same faculty member will also teach an Engagement seminar and the ProPractice seminar. The ProPractice seminar will serve, in part, as an avenue to develop research writing and preparation for the Rackham Research Grant submission to help fund the Capstone work.

It is encouraged to work in groups of two students for the Capstone course. Those wanting to do individual research will be supported, but will need to show what level of production can be achieved in order to satisfy the expectations of the course. Similarly, for groups of three, a greater amount and scale of production is expected. Generally, each student must define their specific and unique contribution to the work. For instance, one student may concentrate in parametric modeling

and computational workflow, while the partnering student will focus on material experimentation and mastery of the fabrication process and tools.

For the Capstone semester, it is suggested to be strategic in the selection of an elective course. This is the chance to fold in expertise from an additional faculty member, to go alongside the knowledge and agenda introduced by the professor teaching the Capstone course. Faculty involved in the DMT program and others working in digital fabrication have indicated support in tailoring expectations in their electives so that it may align with the DMT Capstone. *This, of course, must be discussed with all faculty members involved in advance of the final Fall semester in which the Capstone takes place.* Note that this involves a re-shuffling of when electives courses are taken, in comparison to the course schedule outlined for the program, shown here.

2023-24 Research Theme: TRANSFORMABILITY

For each cohort, we would like to establish an open-ended theme that can be explored throughout the wide range of courses that will be taken, culminating in the final projects produced in the Capstone course. For AY23-24, the theme to consider will be *Transformability*. It is expected that the definition and shaping of this theme will evolve collectively and individually throughout the duration of the program. Some initial thoughts to begin with are:

> *Definition:* Transformability is the multivalent capacity of a material system to change properties, such as shape, behavior and function, in response to tangible factors such as the conditions of a specific environment, as well as in response to perceptual learning in the exploration of the sensorial nature of the material system.
>
> *Related Topics:*
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> - **Material elasticity**: Working with material systems, such as silicon, flexible casting, inflatables and pneumatic actuators, that have a capacity to be shaped under external forces, whether driven by human interaction (such as an physical "interface"), dynamic structural loading, or atmospheric properties.
> - **System modularity**: Exploring design process as a series of "events" that can produce different configurations of a material system.
> - **Gross multifunctionality**: Expanding the capacity of a material system to accomplish combinations of functionality, from rudimentary – such as lighting and shading, to more exotic functions such a multisensory interactivity.

For your Capstone project, you will also be asked to assess if and how your proposed research investigates issues related to inequalities in the field of computational design in architecture. Utilize the time in the program (and, specifically, in assessing the research seen at the ACADIA conference) to discern issues such as cultural bias, gender inequity, access to technology, and applicability to underserved populations. Through the theme of *transformability*, such learnings should be reflected in part or wholly in the research proposed for the Capstone project.

FABLab EXPECTATIONS

Much of the time in the DMT program is spent in the FABLab. It is therefore pivotal to build a strong and respectful relationship with staff of the FABLab and treat the machinery and tools with great care in order to ensure success in the program. The protocols established by the FABLab are to be followed at all times. Specific circumstances can be discussed with the FABLab team *only in advance* and not during the usage of a particular machine and/or space. At a minimum, the FABLab should be consulted no less than two weeks in advance of wanting to discuss a particular manner in which the machines, material and/or spaces may be used.

Proper methods of coordination

- The FABLab has noticed many positive interactions with the students who often start with their faculty showing them how to work in the Lab as a part of their coursework, and then insisting throughout the semester that the students follow the Lab Protocols. In Practicum with Mark and Catie, the course has made a positive impact on the students' interactions with the Lab. They insist the students use the calendars to sign out machines in their class, they follow up with their students on keeping Lab spaces clean, and they schedule time with Lab staff far in advance for demos and machine schedules. This results in seeing some, but not all, students continue these behaviors after Practicum is finished. This is in contrast to other architecture students who don't go through this course, and frequently have little understanding of how to operate in Lab spaces.
- Success with the students happens when:
    - Students work with Lab Staff to set up specific training sessions in advance, then follow through with any prep work they are asked to do.
    - Meet several times, in advance, with Lab Staff to discuss their needs (training, space usage, scheduling, material, or otherwise).
    - Students lean up after themselves.
    - All Lab tools are returned.

Problematic activities

- Conduct outside of supervised lab hours
    - The Lab is generally misused when no staff is present or over the **weekends**. Lab Staff regularly come in on Monday morning to find anything from broken or damaged tools with no communication of what happened, to missing parts, hand tools, or materials, to massive messes in Lab spaces. *Lab Staff must be notified if something was damaged during use*, so it can be fixed or replaced. The more specificity provided in what occurred means the Lab Staff can more quickly determine the issue and get the machines back up and running.
    - Running machines alone **late at night**. There are often instances of students starting their files and leaving machines unattended. *Leaving any machine unattended while running is entirely against Lab policy.*
- Machine misuse

    - There was a former student who was struggling with a Mastercam File and getting their parts cut. Wanting to make sure that their parts were cut all the way through the first time, the student chose to set their Mastercam file to cut an inch past their material depth, and ended up cutting through their material, through the spoilboard and almost entirely through the machine table. This is an example of someone prioritizing the completion of their project irrespective of protocols in the FabLab.
- Respecting materials
    - Sometimes students walk around the lab looking for items for their projects or 'shopping'. This is always problematic as almost everything in the Lab is there for a specific purpose. It's always better if the student reaches out to Lab Staff asking to see what is available. Lab Staff, of course, is also a valuable resource for where to source all kinds of different materials, and also to coordinate deliveries from vendors that may make frequent deliveries for the FABLab. Additionally, below is a list of suppliers that are most often used by the FABLab and DMT students.

MATERIALS AND SUPPLIERS

Materials are largely covered by the DMT program through funds allotted to each course. The instructor manages the responsibility to purchase materials. We would like to avoid having students purchase materials to then be reimbursed as this is a heavily administrative process, which can also mean that receiving reimbursement will take some time.

Capstone materials

For the Capstone course, it is expected that the funds received through the Rackham Research Grant will cover all material costs. Needs for additional funding will be dealt with on a case by case basis only in advance and in unexpected circumstances. The budgeting for the DMT program prioritizes distributing funds for material support across all other courses except the Capstone course. This is based upon the continued success in receiving the funding provided through the Rackham Research Grant and the freedom in which the funds can be spent by the students themselves.

Suppliers

Local

Alro Metals Outlet

2466 S Industrial Hwy, Ann Arbor, MI 48104

Note: Metals, plastics (sheets and extrusions). Delivery is available. They can also cut materials to custom sizes, upon request.

Harbor Freight Tools

2399 Ellsworth Rd, Ypsilanti, MI 48197

Note: Inexpensive tools and supplies

Carpenter Brothers Hardware (walkable from North Campus)

2753 Plymouth Rd, Ann Arbor, MI 48105

Note: Good source for small scale metals (music wire), hardware, and paints.

Stadium Hardware

2177 West Stadium Blvd

734-663-8704

Note: The best hardware store in the area. If they don't have it no one will. The only place in town to get West System Epoxy supplies.

B&B Heartwoods

5444 Whitmore Lake Rd
734-332-9525
https://www.bandbheartwoods.com/
Note: Rough sawn hardwoods and softwoods. Some locally sourced and salvaged.

Armstrong Millworks, Inc.

3039 W Highland Rd
Highland, MI 48357
248-887-1037
https://www.armstrongmillworks.com/woodtypes.aspx
Note: Large selection of domestic and tropical hardwood. They are happy to plane, joint and crosscut materials on site.

LL Johnson

563 N Cochran Ave, Charlotte, MI 48813
517-543-1660
www.theworkbench.com
Note: Hardwoods, softwoods, marine and cabinet grade plywood. Will deliver to area Mondays and Wednesdays.

Lowe's

3900 Carpenter Rd, Ypsilanti, MI 48197
Note: Selection of standard lumber, sheet materials, EPS foam, concrete supplies, paint, hardware, etc…

All American Plywood

18840 John R St, Detroit, MI 48203
313-891-6880
Note: Plywood supplier for FabLab. Check with the lab, you may need to place an order through them or add to an existing order.

Online

McMaster Carr

Note: Complete catalog of hardware as well as materials such as metals and plastics. Items are often delivered next-day. To ensure reliability of delivery, have orders shipped to:

Your Name
ATTN: Course Instructor's Name (optional)
University of Michigan - Architecture
2000 Bonisteel Boulevard
Ann Arbor, MI 48109

The following are online resources for 3D-printing filaments, all shipped from the United States:

MatterHackers PLA
3D-Fuel PLA
Hatchbox on Amazon

Smooth-On Silicone

Note: For inflatables, the DragonSkin 10 product (Durometer 10A) has been typically used. Conventional silicon tubing of Durometer 35A and higher can be found at McMaster-Carr.

The Thread Exchange

Note: For purchase of monofilaments and threads that can be used on the CNC knitting machine. Review exact specifications with Prof. Ahlquist before purchase, as some materials are not compatible with CNC knitting.

RACKHAM GRADUATE STUDENT RESEARCH GRANTS FOR CAPSTONE FUNDING

Read thoroughly the description and requirements for the research grant on the Rackham website: Rackham Research Grant.

The written grant proposals are developed through the Theory and ProPractice seminars. Topics and preliminary research will come from work developed in the core DMT Engagement seminars. Grant proposals are expected to be submitted within the first two weeks of the Capstone semester. The submission process takes place in 2 stages:

(1) Complete the written grant proposal including budget and initiate the online submission process through the Rackham portal. Indicate the Director of the DMT program (who will also be serving as the Capstone instructor) as the recommender. Once initiated, email the DMT director with (1) PDF of the proposal and (2) short answers to the following questions:

- **Current graduate record:** Provide a list of courses completed to date for the DMT program
- **Research topic:** In 2-3 sentences, describe the central focus of the research to be developed
- **Research progress to date:** In 2-3 sentences, describe the progress to which this research has been developed, through courses in the summer and/or fall semesters.
- **Originality:** In 2-3 sentences describe the uniqueness of the work in the context of the field of computational design

(2) Once the recommendation has been uploaded to Rackham, an email will be sent to the student. The student will now be responsible to complete the process and submit the grant request to Rackham

If the grant is awarded then the following must be done:

(1) Forward the official email received from Rackham to the Taubman College finance office: TaubmanCollegeFinance@umich.edu. In the email, make sure to include:

- Student name
- Student UMID
- The funding amount that was awarded

(2) Once the money has been received by the college, they will forward it to the student's account. Rackham sends the funds to the college without any description. It is therefore

critical to send the email to the finance office so that they may correlate the funds with each student.

NOTE: Alternative means need to be determined **for a student with federal financial support** to receive the Rackham Research Grant funding. If they receive the funding as a payment from the college, then this will be read as financial aid, and therefore be subtracted from whatever federal financial support the student is receiving.

DMT RESEARCH FELLOWSHIP

The DMT Research Fellowship provides the opportunity for students to receive additional scholarship while working with faculty on active research projects. Soon after the start of the program in the fall semester, information will be gathered among faculty to indicate projects and relevant skill-sets that would be appropriate for the DMT students to participate in. Subsequently, DMT students will be polled regarding their preferences towards these different research opportunities. Faculty involved in the research fellowship will be from within the DMT program, and also, sometimes, from the college at-large.

Once assignments have been made, the weekly schedule and overall duration of the fellowship will be negotiated between the student and supervising faculty member. At the end of each week, hours must be logged through a Google Form that will be provided. The status of hours completed can be provided upon request. Otherwise, it is up to the student and the supervising faculty member to keep track of the progress towards completion of the fellowship.

Fellowship hours can only be done during the Fall and Winter semesters, when DMT courses are taking place. If research work is done with a faculty member during the spring or summer months, then it is the responsibility of that faculty member to hire the student as a Temporary Hourly Employee and provide an appropriate hourly wage.

Assignments can be reorganized, if needed, at the end of each semester. This will be done upon specific request by the student or the supervising faculty member.

Monthly FABLab support

On the first Monday of each month (starting in the 2nd month of each semester), two students will be assigned to provide one hour of support for FABLab Staff in order to help clean and organize all of the FABLab workspaces. This is intended to give you some familiarity with the inner workings of the FABLAB as well as exposure to the myriad of ways in which it is used by the students and faculty across the college.

ACADIA

Attendance to the ACADIA conference is required whether in person or virtually for students in the DMT program.

Registration

- ACADIA registration is paid directly by the DMT program. Forms will be distributed to gather the necessary information to complete this registration process for each student.
- For those who choose not to travel to the conference, registration to attend virtually will be provided if the virtual option exists in the given year.

Travel

- The Taubman College travel fund will support up to $1,000 per student for travel and accommodation to attend the ACADIA conference
    - TCAUP will purchase flights directly for students. We will coordinate with Taubman-Arch-admin@umich.edu to gather the appropriate information to make flight reservations.
    - Students are expected to pay for all other expenses related to travel and accommodation.
    - After the completion of the ACADIA conference, students will each submit receipts to receive up to $1,000 in reimbursement, which includes the cost of the flight. For instance, if the flight is $400, then you can be reimbursed up to $600 for other hotel and travel expenses. Reimbursement is restricted to the cost of the hotel for the nights of the conference and for the cost of a taxi to and from the airport.

Other

- There will be no DMT courses held during the week of the ACADIA conference in order to accommodate attendance to the conference and also to workshops, for those who wish to participate.
- The DMT program nor the Taubman College travel funds can be used to reimburse for any part of the workshop, including registration fee and hotel stay during that period of time.
- Reimbursement will be processed by submitting receipts to Taubman-Arch-admin@umich.edu . The protocol for submitting receipts will be provided by the admin department.

Conference follow-up in Arch701

Attendance to the ACADIA conference and discussions around the experience and learnings is coordinated through the Arch701 Theories in Digital Technology seminar. All students are expected to share thoughts on the presentations and discussions during the seminar in the week following the conference.

COLLEGE and DMT CULTURE

Read the College Compact and "Our Shared Beliefs" to get a general understanding of the college's approach towards creating a supportive and productive educational environment.

Plagiarism

See the Taubman College Academic Policies. The Rackham Policies for Academic Integrity apply to all students and courses that are a part of the Rackham Graduate School, which includes the DMT

program. In terms of academic writing and guidelines for conference submissions, we utilize the information provided in the guidelines for ACADIA publication ethics.

TCAUP statement on diversity, equity and inclusion

Taubman College affirms the principles of diversity, equity, and inclusion and we organize resources and priorities that align with our values. We seek to have a diverse group of persons at all levels of the college – students, faculty, staff and administrators – including persons of different race and ethnicity, national origin, gender and gender expression, socioeconomic status, sexual orientation, religious commitment, age, and disability status. We strive to create a community of mutual respect and trust, a community in which all persons and their respective backgrounds, identities and views are allowed to be made visible and communicated without the threat of bias, harassment, intimidation, or discrimination.

DMT Citizenship Award

Each year one DMT student will be presented with the Citizenship Award. This recognizes a student who both masters the technical aspects of the DMT curriculum and also exhibits the following traits:

- being highly inquisitive towards their own work and that of others,
- eagerness to learn from the wide range of topics offered in the program and college,
- show great interest and support for their fellow students personally and academically
- respect towards their fellow students, faculty and staff, particularly the FABLab staff who are absolutely critical to success in the DMT program.

KEY DATES FOR AY2023-24

Monday, Dec 11 - Final Review for Practicum and Arch703 - Virtual Engagement

AY 2023-24 COURSE SCHEDULE

FALL 2023 15 credits	**WINTER 2024** 12-15 Credits	**FALL 2024** 6-9 Credits
Arch700 **Practicum** Catie Newell and Mark Meier 6 credits	**Arch702** **Robotic Engagement** Wes McGee 3 credits	**Arch739** **Capstone Studio** Sean Ahlquist 6 credits
Arch701 **Theories in Digital Technology** Matias del Campo 3 credits	**Arch707** **Material Engagement** Mania Aghaei Meibodi 3 credits	**Elective 2*** 3 credits
Arch703 **Virtual Engagement** Glenn Wilcox 3 credits	**Arch708** **Systems Engagement** Sean Ahlquist 3 credits	
Elective 1 3 credits	**Arch714** **Proseminar** Sean Ahlquist 3 credits	
	Elective 2* 3 credits	

36 credits in total are required for completion of the MS-DMT program.

* Elective 2 can be taken in the Winter or final Fall semester. In terms of coursework, consider taking Elective 2 in the Fall semester alongside the Capstone course. Done strategically, you can use the elective, in coordination with the instructor, to augment the type of work being developed for the Capstone project. As mentioned in the *Curriculum* section above, this must be discussed and approved by all faculty members involved in advance of course registration.

NOTES

Materials budget for DMT courses

For the first two semesters of the program, students will be provided with funds for purchasing materials, utilizing guidance from the course instructors. It will be the responsibility of the student to manage funds in order to purchase materials throughout the semester and meet the expectations and requirements outlined in the curriculum for each course. Materials will be required for the following courses: FALL: Arch700-Practicum, WINTER: Arch702-Robotics, Arch707-Materials, Arch708-Systems. Students will need to organize themselves in the cases where bulk purchases are required.