MIT Department of Architecture
4.022 Design Techniques and Technologies: Thinking through Making, Fall 2022, MW 2:00-5:00
Instructor: J. Jih
Teaching Assistant: Leanah Sloan Aulgur

Class Overview:

This class introduces students to the creative design process through acts of making & breaking. The studio environment provides a dynamic laboratory to explore ideas related to form, space, materials, systems, and structures through physical, project-based activities. This class emphasizes the translation of concepts into constructs--thinking through making, and making through thinking. This course is specifically created to play off of students' non-design education by introducing a domain of investigation whereby students can learn to design through the lens of cross-disciplinary experimentation. Three primary exercises will help develop student's techniques of drawing, fabricating and building.

Part I: Draw [Drift Drawing, 3 weeks, pairs] Sept 7 – Oct 03

The first project explores processes of drawing by looking at systems, rules and generative principles.

- We will begin with an introductory lecture on a range of drawing histories, mediums, techniques, and disciplinary types, ranging from descriptive geometry as a drawn form of calculation and integral to the foundation of the discipline of engineering itself, to architectural and scientific histories of orthographic drawing and perspectival representation, to historically pivotal moments in development of the diagram and visualization of information, and ending with the rule or process based drawings of the mid to late 20th century from practitioners such as Sol LeWitt, Josef Albers, and Julio LeParc.
- These drawing types will be discussed in terms of their impact on how meaning is conveyed, the principles and processes behind their construction, and the rich interdisciplinary histories and movements between fields they often trace.

Following this historical and analytic sampling of the ways in which drawing can be understood as a *rigorous pursuit*, we will embark on a drawing exercise whose aim is to produce a controlled arena for understanding how the tools and media of design have their own *agencies* –interior principles, orientations, and properties—both in how the drawings are conceived and constructed, and in the media and matter in which they are executed. We will focus on serial and process based drawings as the form of drawing which is mostly purely about drawing itself rather than the representation of other disciplinary interests and information.

- Through desk crits and an initial research assignment, students will select a point of entry – a drawing type, effect, process, or interest, and develop that set of interests through a drawing series.
- Projects will be generated in Rhino and Grasshopper, and executed on pen plotters in a variety of media. Drawings must feature an iterative process producing repetition, seriality, offset, displacement and/or slip and consider how lines interact within the script as well as how they are executed by the pen plotter.
- Variables within the script may determine how lines trim, offset, occlude, reinforce, repeat, obfuscate, hatch, or multiply.
- Variables within the execution of the drawings by pen plotter may include speed, draw order, blunting over time, or force.
- Effects explored by the drawings may include moire, impasto, cross hatching, bleeding, etching, embossing, or layering. How are you acting to divide the sheet of drawing paper? How are various lines, marks, imprints and/or incisions interacting with one another? How do various parts affect a larger whole? How do successive lines interact with each other? This drawing, as any other in architectural design, is a tool of exploration.

FINAL REVIEW: October 03

Part II: Make [Physics Fabricator, 6 weeks, pairs] Oct 05 – Nov 14

This project explores processes of making, breaking or recursive production through a physical, three dimensional system. The notion of systems, rules and generative principles as formative design processes explored in the first exercise is expanded from drawing to object.

- We will begin with an introductory lecture on fabrication processes, looking at precedents from four categories of Art, Products, Architecture, and Science, ranging from the artwork of Olafur Eliasson, the architectural work of Thomas Heatherwick, the photography and videos of Linden Gledhill, the machines and artifacts of Roxy Paine, to familiar fabrication processes such as lathing, slump forming, or cotton candy machines.

Students will begin with research into material processes and identify a process, technique, or precedent of interest to build from. These may include extrusion, weaving, coiling, stacking, braiding, felting, jamming, slip casting, lathing, spin forming, roto-molding, or others. From this starting point, students will devise process

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or construct that uses relatively simple analogue processes or movements to translate deceptively simple relationships into complex form. The aim is not to simply produce 2.5D laminations of two dimensional processes, but to produce a system that is fully three dimensional in both input and output.

Investigations may focus on particular material properties and behaviors, emergent principles or patterns such as decay or resonance, or geometric transformations. The objects should not be standardized or standalone, but a series that can reveal variable outputs, forms, and conditions in response to calibrated inputs. Generative processes are able to change and develop through time, expressing a myriad of possible results and forms.

Part III: Build [Habitat, 5 weeks, group work] Nov 16 – Dec 16

The final project asks you to synthesize the conceptual, design and fabrication skills developed in the first two projects and apply them at a new, larger scale. Students will build for, extrapolate/abstract from, or imitate a habitat or structure for a specific animal.

- Students will identify an animal and habitat type of interest. These habitats are often proto-architectural, and can range from woven nests to bird bowers, termite cathedral mounds, beaver lodges, spider webs, cat play structures, cocoons, communal silk nests, beehives, or more.
- Behaviors and properties these habitats may enable or exhibit may include patterns of branching spaces, spatial intersection types, surface enclosure types, thermal or ventilation properties and more.
- Techniques of construction that may be abstracted and developed from these animal precedents may include weaving, stacking, deposition, coiling, and more.

The final project may be intended to function as a habitat for the animal, or it may be a model or sculpture deriving its construction from or illustrating the principles of that habitat. In either case, the invisible metrics and patterns of occupation – generally prescribed by the implicit size of the animal's body and its movements – will be key to each project. As an example, the beehive is driven by dimensional units of "bee space" which are generally 3/8" – correlating to the dimension of a bee's body.

- Students should consider questions such as: How do parts assemble within your habitat? What is the part-to-whole relationship? What is the basic dimensional unit undergirding each habitat? What is its final form and how does it reach it? How does your system create, define, or occupy space? How does it meet the ground? How does it engage the body? Does it partition, reorient, encircle, or occlude?
- Students will begin by building maquettes, models, and small-scale prototypes before constructing a final, full-scale structure.

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4.022 Schedule (tentative and subject to change with covid or other events)

PART I – DRAW | Drift (3 Weeks)

Week 1

9/07	Introduction to the course
	Registration
	Self-Introductions
	Skills and backgrounds survey
	Launch Part 01: Draw (Drift Drawing)
	In-class work session

Week 2

9/12	Skills tutorial: Rhino and Grasshopper
	Desk Crits: Review possible design project agendas
	In-class work session
9/14	In-class work session and introduction to pen plotters

Week 3

9/19	desk crits
9/21	pin-up of student work

Week 4

9/26	desk crits
9/28	In-class work session

Week 5

10/03	DRAW FINAL REVIEW

PART II – DRAW | Physics Fabricator (6 Weeks)

10/05	Launch Part II: MAKE (Physics Fabricator)
	3D Software Tutorials
	Assignment: Gather research interests
10/07	Add Date: last day to add full-term subjects to registration

Week 6

10/10	*Indigenouse Peoples' Day – No Class*
10/11	*Student Holiday – No Class*
10/12	Pin-up: presentations of research interests
	Assignment: Identify single research topic supported by a collection of precedents, histories, processes, and principles

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Week 7

10/17	In-class work session and desk crits
	Assignment: identify materials needed for prototyping. Class trip to Blick and Artist and Craftsmen Supply
10/19	Desk crits
	Assignment: 3 prototypes

Week 8

10/24	Pin-up
10/26	Desk crits
	Assignment: 3 well developed prototypes

Week 9

10/31	In-class work session
11/02	Physics Fabricator Midreview
	Assignment: 3 prototypes

Week 10

11/07	Pin-up of student work
11/09	In-class work session
	Assignment: 3 prototypes per student
11/11	*Veterans Day – No Class*

Week 11

11/14	Physics Fabricator Final Review

Part III – BUILD | Habitat (5 Weeks)

11/16	Launch Part III: BUILD (Habitat)
	Introductory Lecture
	Group Assignments
	In-Class Work Session
	Assignment: Identify habitats, species, and materials of interest

Week 12

11/21	Pin-up: group presentations
11/23	In-Class work session, desk crits
11/24	*Thanksgiving – No Class*
11/25	*Institute Holiday*

Week 13

11/28	In-class work session, desk crits
11/30	In-class work session, desk crits

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Week 14

12/05	Project 03 Midreview
12/07	In-class work session, desk crits

Week 15

12/12	In-class work session, desk crits
12/14	In-class work session, desk crits
	LAST DAY OF CLASS

FINAL REVIEW WEEK

12/16 – 12/22

Learning Objectives:

The course consists of three projects exploring various topics through drawing, physical fabrication and large-scale building. Students should be able to engage with an increasing level of design research through iterative studies and move fluidly between different modes and scales of operation. Conventions of design representation and communication through drawing and modeling will be explored. Students will need to demonstrate basic application of design skills, understanding of conventions, and an ability to sustain an increasing level of research in the projects over the semester.

Completion Requirements:

Completion of each of the exercises, rigor in process and clarity in representation, as well as the overall progress of the semester (including attendance) will be fundamental to completing the course.

Evaluation Criteria and Grading:

The following criteria will be used for the evaluation of student's work, both in terms of helping their progress and in final grading. (01) Thesis: How clearly is the student articulating the conceptual intentions? (02) Translation of Thesis: How well is the student using their thesis to develop a design response to given problems? (03) Representation Appropriateness: How well matched is their choice of representational means to their intentions? (04) Representation Quality: How accomplished are they with drawing, modeling, digital representation, etc? To what degree does their representations convey what they ought to? (05) Oral Presentation Skills: How clearly are they presenting their ideas orally, whether at their desk, in class discussions, or to a more formal jury? (06) Participation in Discussions: How actively and how constructively are they involved in class discussions, both formally and

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informally? (07) Response to Criticism: How do they effectively take advantage of criticism from instructors, classmates and outside jurors? (08) Auto-Critical Skills: To what extent are they able to critique their own work regularly and effectively? (09) Attendance – see below.

A: Excellent - Project surpasses expectations in terms of inventiveness, appropriateness, verbal and visual ability, conceptual rigor, craft, and personal development. Student pursues concepts and techniques above and beyond what is discussed in class.
B: Above Average - Project is thorough, well researched, diligently pursued, and successfully completed. Student pursues ideas and suggestions presented in class and puts in effort to resolve required projects. Project is complete on all levels and demonstrates potential for excellence.
C: Average - Project meets the minimum requirements. Suggestions made in class are not pursued with dedication or rigor. Project is incomplete in one or more areas.
D: Poor - Project is incomplete. Basic skills including graphic skills, model-making skills, verbal clarity or logic of presentation are not level-appropriate. Student does not demonstrate the required design skill and knowledge base.
F: Failure - Project is unresolved. Minimum objectives are not met. Performance is not acceptable. This grade will be assigned when you have excessive unexcused absences.

Attendance: Attendance for the full duration of each class is mandatory. The studio is an exceptional learning environment that requires your virtual presence as well as your intellectual presence. You are allowed three excused absences for the semester. An excused absence is defined as one that was discussed with and approved by the professor at least 24 hours prior to the date of absence, or a family or medical emergency that is confirmed by your physician or a dean in Student Support Services. Absences beyond the three allotted will result in a decrease in your final grade. If you miss six or more studio classes, you will be asked to drop the subject or receive a failing grade.