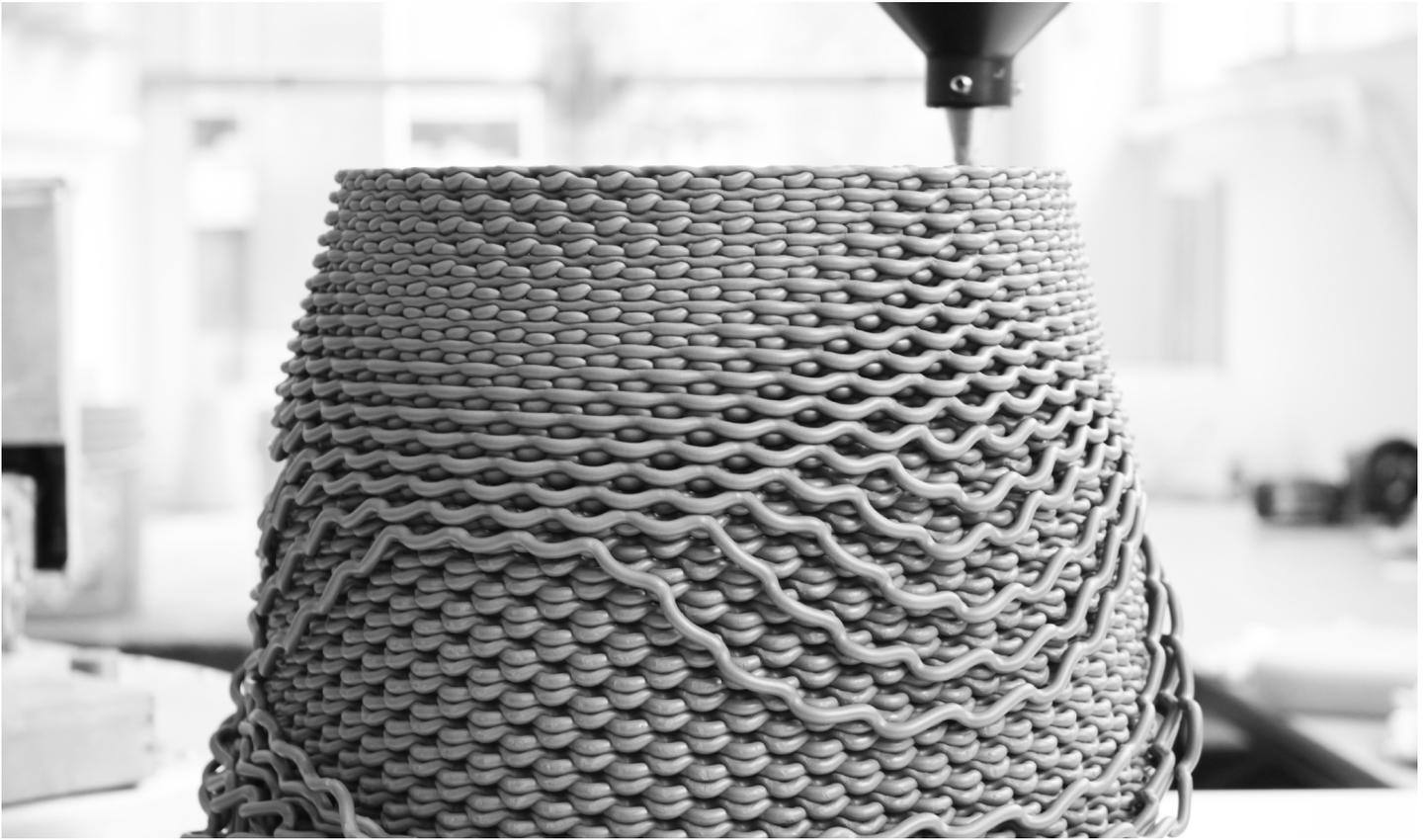


New Ceramic Skins | Material Computation in LDM Printing



Terracotta light screen, print in progress by OCH Works, 2021.

Course Number

ARCH 698

Classroom

CBDL Building, Room TBD

Schedule

2024/02/12 - 2024/02/16, 9:00AM - 6:00PM MT

Instructor

Isabel Ochoa (she/her) – iochoa@uwaterloo.ca

Course Description

For millennia, ceramicists have mitigated structural collapse and plastic deformation by using moulds or formwork to control the unstable behaviour of wet clay. Unlike conventional forms of 3D printing, Liquid Deposition Modelling (LDM) with clay does not employ quick-curing mediums or support structures. How does LDM then fit into this continuum of ceramic craft? How can digital fabrication leverage the behaviour of clay in ways that are not possible using traditional methods of making?

The plastic deformation of clay, when harnessed by LDM, presents an opportunity to generate materially responsive sculptural relief in ceramic surfaces. Integrating digital fabrication in ceramic craft allows us to create highly contoured surfaces and complex forms. Novel form languages emerge when shaping this highly fluid medium with a tool designed for accuracy and high fidelity between digital inputs and physical outputs; robotically fabricated ceramic surfaces droop, sag, and squish- with robotic precision. These surfaces, often resembling non-woven textiles, are made possible by the unique capacity of wet clay to shift during deposition. Inherent to the LDM process is the 'tool mark,' the distinctive trace of the extruder as it manipulates a highly elastic material. How the designer addresses the tool mark and the material's tendency to deform during production is pivotal in shaping the topology of clay 3D-printed components.

If plastic deformation and the expression of the tool mark are essential drivers in the process of clay printing, how can the surface of 3D-printed clay emerge as a tectonic form in its own right? How can ceramic surfaces transcend being byproducts of form definition and express ornament in a way that speaks to the material's properties and the process by which it was shaped?

This seminar will introduce students to material and computational strategies for crafting 3D-printed ceramic components. Students will be guided through design exercises in custom tool path manipulation to prototype clay surface topologies.

Prototyping will involve an interplay between digital and analogue methods of craft. Prototypes will steer away from global form-making and, instead, examine how micro deformations in clay surfaces can be developed in response to the printer's tool path. The course will engage students in exploring the relationship between conceptualization and production in ceramic 3D printing.

Graduate Academic Calendar Description

ARCH 698 examines the role of computation and making in architecture. Explores these topics through a guided process of fabrication using contemporary design techniques. Outputs may include prototypes of various scales, drawings, digital workflows, installations and exhibits.

Course hours: 3 units. Not included in GPA.

Course Goals and Learning Outcomes

- Gain familiarity with the stages of wet-processing ceramics including material preparation, drying, glazing, and firing.
- Develop a practical understanding of how to operate ceramic 3D printing equipment.
- Acquire hands-on experience in applying basic glaze techniques and their relevance to 3D printed surfaces.
- Develop an introductory grasp of the material characteristics of common clays (e.g. stoneware and earthenware) and their impact on the 3D printing process.
- Understand the role of tool path expressions and functions in ceramic 3D printing.
- Gain exposure to computational techniques for manipulating digital ceramic surface topologies.

Structure

Class time will be split between three sections:

Lectures (~0.5-1hr) – Will focus on examining ceramic 3DP context, state of the art, tools, and methods.

Tutorials (~1-2hrs) – Will focus on digital and/or physical skill acquisition. These tutorials will explain the fundamental tools required to complete the course work.

Labs (~4hrs) – Will support the completion of course deliverables by providing groups with one-on-one contact hours with the instructor and supervised machine time. Labs will also provide instruction on analogue skill acquisition and machine operation. These sessions will be scheduled with the instructor on a daily basis for the duration of the week. Groups must come prepared with completed print files to their scheduled lab time.

Field Trips

As part of the block week seminar, the class will be conducting a glaze workshop at the North Mount Pleasant Art Centre. This will allow students to acquire hands-on experience in basic glaze application techniques and their relevance to 3D printed surfaces. Attendance at the workshop is mandatory.

The North Mount Pleasant Art Centre is located 25 minutes from the SAPL City Building Design Lab via public transit. All students are required to facilitate their own transportation to the Art Centre. Workshop times for groups will be staggered due to capacity limits at the venue. Please allow yourself enough travel time to arrive punctually.

Learning and Technology Resources

A working computer with Rhino 7 and Adobe Photoshop CC installed is required to complete the course work. Students must bring their computers to class. Experience with Grasshopper is an asset but is not required.

Assessment Components

Attendance and Participation in Labs, Lectures, and Tutorials - 30%

- This is a workshop-based course in which learning will take place through in-person digital and physical skill acquisition. The course assessment is therefore largely participation-based.
- Labs, lectures, and tutorials will take place daily, attendance from all group members is mandatory.
- Failure to attend labs, lectures, and tutorials will result in a 10% grade deduction per missed course component.

Prototypes - 40%

- Will be completed daily in groups. Print files will be due at the beginning of each lab; prototypes will be completed during the lab with hands-on assistance from the instructor.
- Completion of all prototypes is required to receive a passing grade in the course.

Final Exhibition

- All work will be mounted and displayed on Friday, February 16th. Attendance from all students is required.

Final Document - 30% - Due date TBD

- Must document all design exercises and prototypes completed throughout the week. The final document will be submitted in groups.
- Completion of the final document is required to receive a passing grade in the course.

**Note: Additional handouts will be provided for each course component. Course content and deliverables are subject to change. See page 5 for Topics and Schedule.*

Late Assignments

Course deliverables that are handed in late will receive 0%.

ARCH 698 relies on digital tools to complete all course deliverables. Students are expected to work diligently to ensure all assignments are submitted on time. Digital fluency, including file and software maintenance, are critical to both your academic success as well as your professional development. Computer crashes, corrupt files or forgetting to save or back-up will not be acceptable excuses for incomplete work or late submissions.

Passing Criteria

Students must complete all prototypes and submit their final document to receive credit for this course. Assessment will be based on attendance, the completion of all prototyping exercises, and the submission of a final booklet documenting the prototyping process, and physical artifacts produced. Students should contact the instructor immediately if they are unable to complete these requirements.

Workshop Safety Training Requirement

If a course requires the use of the SAPL workshop, students must complete all online University of Calgary safety courses, the online Trajectory safety training course, as well as in-person workshop training and a grade of pass on the final evaluation project, to be granted access to the SAPL workshop. This training is offered once a year, around the start of the Fall term and has a completion deadline.

A Note on 'Wet Laboratory' Etiquette

Raw clay and glazes are difficult materials to manipulate. They have a range of states that we will be working with: from liquid, to plastic, to highly brittle. When wet clay is left to dry it hardens into a fragile medium. If this substance is crushed or broken into small particles, it turns into fine clay 'dust' that can be easily inhaled. For everyone's health and safety, and the quality and craft of the course work, it is of utmost importance that we strive to keep our 'wet lab' and tools clean using the appropriate protocols mandated by our workshop staff and the instructor. These protocols will be discussed and demonstrated at length during class.

Topics and Schedule

<u>Monday, February 12</u>	9:00AM - 12:30PM	Introductory Lecture Tutorial 01
	12:30PM - 1:30PM	Lunch
	1:30PM - 3:00PM	Work session
	3:00PM - 6:00PM	Work session Lab 01 - Prototype 01 print files due.
<u>Tuesday, February 13</u>	9:00AM - 12:30PM	Group A - Glaze Workshop/Lab 02 (at North Mount Pleasant Art Centre) - Prototype 02 to be completed during lab. Group B - Lab 03 (at school) - Prototype 03 print files due.
	12:30PM - 1:30PM	Lunch
	1:30PM - 6:00PM	Group A - Lab 03 (at school) - Prototype 03 print files due. Group B - Glaze Workshop/Lab 02 (at North Mount Pleasant Art Centre) - Prototype 02 to be completed during lab.
<u>Wednesday, February 14</u>	9:00AM - 11:00AM	Tutorial 02
	11:00AM - 12:30PM	Work session
	12:30PM - 1:30PM	Lunch
	1:30PM - 6:00PM	Work session Lab 04 - Prototype 04 print files due.
<u>Thursday, February 15</u>	9:00AM - 10:00AM	Tutorial 03
	10:00AM - 12:30PM	Work session Lab 05 - Prototype 05 print files due.
	12:30PM - 1:30PM	Lunch
	10:00AM - 12:30PM	Work session Lab 05 - Prototype 05 print files due.
<u>Friday, February 16</u>	9:00AM - 12:30PM	Work session Lab 05 (continued) - Prototype 05 print files due.
	12:30PM - 1:30PM	Lunch
	1:30PM - 3:00PM	Final exhibition set-up.
	6:00PM	Final exhibition.
<u>TBD</u>	<u>TBD</u>	Final Booklet due.

**Note: Topics and schedule are subject to change.*

Grading Scale

<u>Grade</u>	<u>Point Value</u>	<u>4-Point Range</u>	<u>Percent</u>	<u>Description</u>
A+	4.00	4.00	95-100	Outstanding - evaluated by instructor.
A	4.00	3.85-4.00	90-94.99	Excellent - superior performance showing comprehensive understanding of the subject matter.
A-	3.70	3.50-3.84	85-89.99	Very good performance.
B+	3.30	3.15-3.49	80-84.99	Good performance.
B	3.00	2.85-3.14	75-79.99	Satisfactory performance.
B-	2.70	2.50-2.84	70-74.99	Minimum pass for students in the Faculty of Graduate Studies.
C+	2.30	2.15-2.49	65-69.99	All final grades below B- are indicative of failure at the graduate level and cannot be counted toward Faculty of Graduate Studies course requirements.
C	2.00	1.85-2.14	60-64.99	
C-	1.70	1.50-1.84	55-59.99	
D+	1.30	1.15-1.49	50-54.99	
D	1.00	0.50-1.14	45-49.99	
F	0.00	0-0.49	0-44.99	

A student who receives a "C+" or lower in any one course will be required to withdraw regardless of their grade point average (GPA) unless the program recommends otherwise. If the program permits the student to retake a failed course, the second grade will replace the initial grade in the calculation of the GPA, and both grades will appear on the transcript

The School of Architecture, Planning and Landscape will not permit the Flexible Grade Option (CG Grade) for any course offered by the School. <https://www.ucalgary.ca/pubs/calendar/current/f-1-3.html>

Academic Accommodation

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://www.ucalgary.ca/legal-services/university-policies-procedures/student-accommodation-policy>.

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for->

[Students-with-Disabilities-Procedure.pdf](#). Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to their instructor (contact information on first page above).

SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/.

Academic Misconduct

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar. For information on the Student Academic Misconduct Policy and Procedure please visit: <https://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy>. Additional information is available on the Academic Integrity Website at <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>.

Copyright Legislation

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy>) and requirements of the copyright act (<https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>) to ensure they are aware of the consequences of unauthorized sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy (<https://www.ucalgary.ca/pubs/calendar/current/k.html>).

Instructor Intellectual Property

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

Freedom of Information and Protection of Privacy

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary.

Sexual and Gender-Based Violence Policy

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports

University Student Appeals Office

If a student has a concern about a grade that they have received, they should refer to Section I of the Undergraduate Calendar (<https://www.ucalgary.ca/pubs/calendar/current/i-3.html>) which describes how to have a grade reappraised. In addition, the student should refer to the SAPL's Procedure for reappraisal of grades available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at <https://www.ucalgary.ca/legal-services/university-policies-procedures/sexual-and-gender-based-violence-policy>.

Other Important Information

Please visit the Registrar's website at: <https://www.ucalgary.ca/registrar/registration/course-outlines> for additional important information on the following:

- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk