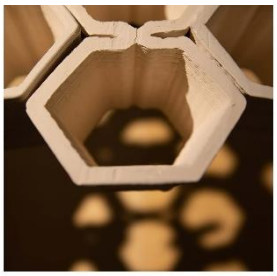





Mat. Syntax class 2018:

[Elaine Tat, Symon Tiansay, Joanne Yau]

[Elly Cho, Meghan Taylor, Jim Shi]

[Naeimeh Hosseininam, Rui Wang, Dishita Shah]

[Alexander Gontarz, Rui Hu, Victor Tulceanu],

[Justin Jones, Madeleine Slaney, Cynthia Tang],

[Erica Burgsma,Ed Chung, Dhroov Patel]

MATERIAL SYNTAX

UNIVERSITY OF WATERLOO | SCHOOL OF ARCHITECTURE
Arch 684_001 | Winter 2023

David Correa <david.correa@uwaterloo.ca>
Office: 3017 | (by appointment)

Lecture Times, Building and Room Number: Wednesday 6:00 PM - 9:00 PM (ARC 2026)

> *"Through most of history, matter has been a concern of metaphysics more than physics, and materials of neither. Classical physics at its best turned matter into mass, while chemistry discovered the atom and lost interest in properties . . . [In both metaphysical speculation and scientific research] sensitivity to the wonderful diversity of real materials was lost, at first because philosophical thought despised the senses, later because. . . the new science could only deal with one thing at a time. It was atomistic, or at least, simplistic, in its very essence."*
>
> Cyril Stanley Smith. Matter Versus Materials: A Historical View. In A Search for Structure. (MIT Press, 1992). p. 115

Course Description:

This course will explore design at multiple scales. Building from the micro-structure of material, the process of materialization to the functioning form, this course will challenge students to design an experimental façade building component at full scale. Conceived of as a hands-on concise design project of a façade element (3DP masonry component), the course will look at Making as an emergent and non-linear design process through direct engagement with additive material processes.

Operating as a small experimental micro-studio, the course will consist of introductory/foundational lectures followed by weekly design crits and hands-on experimentation with digital clay 3D printing. This course has been developed as part of a research collaboration with MasonryWorx into innovative masonry components.

Interest in materials to inspire curiosity and a strong interest in challenging design boundaries are assets for this course.

"In biology material is expensive but shape is cheap.

As of today, the opposite was true in the case of technology."

Julian Vincent

Learning Objectives:

By the end of the course, students will be able to/have:

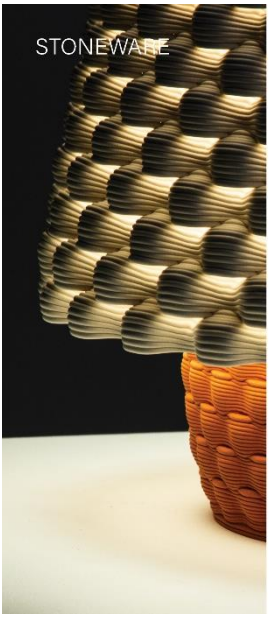
1. Investigated the role of fabrication and material research as an integral part of the creative process of design.
2. Developed a critical approach to making
3. Design and build a design at a 1:1 scale.
4. Gained expertise in the use of tools used to manufacture and prototype products and architecture components
5. Apply design rules for material selection, design for manufacturability, design for assembly
6. Recognize issues of product safety, risk, and reliability

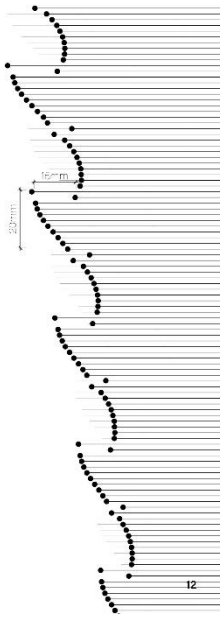
Class Structure:

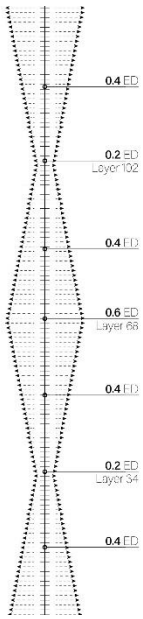
Classes will consist of Lectures, student presentation or desk reviews – project progress & class discussion

Course Schedule:

			Lecture	**Class Discussion**
EXPLORE: MAT.CAPACITY				
W1	**01.11**	Intro Lecture Clay Workshop - P1 issued	Intro- Material Capacities	Aim State of the Art Scope & Context
W2	**01.18**	P1 workshop – Michael Syms		
W3	**01.25**	Lecture P 2 – issued - D. Proposal	Informed Materials & Additive Manufacturing	Context Methods
W4	**02.01**	Guest Lecture – Isabel Ochoa and James Clark-Hicks	Material Informed - Smart Building Components	
W5	**02.08**	Lecture Desk Crits	Smart and Designed Materials	Outlook
DEVELOP: SYSTEM DESIGN				
W6	**02.15**	**P2 A – Review deadline** – Proof of Concept Prototype		
W7	**02.22**	NO CLASS – Reading Week		
W8	**03.01**	Lecture Desk Crits	Presenting Research / Research Narrative	Documentation
W9	**03.08**	Desk Crits / fabrication time		
PRODUCE AND OPTIMIZE				
W10	**03.15**	Desk Crits / fabrication time		
W11	**03.16**	**P2 B - Review**		
W12	**03.22**	Desk Crits / fabrication time		
W13	**03.29**	Desk Crits / fabrication time		
W14	**04.05**	**P2 - Final Project full submission deadline** - Exhibition		
	04.10	End of Lectures / Classes		







Ochoa, I. Grading Light: Utilizing plastic deformation to functionally grade ceramic light screens. UWSpace.

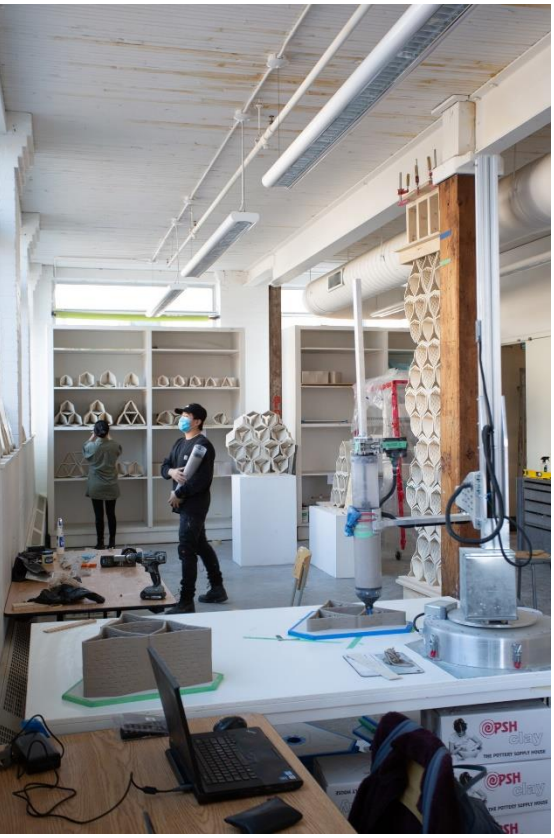
Clarke-Hicks, J. Grading Light: Utilizing plastic deformation to functionally grade ceramic light screens.

Supporting Literature:

There is no required text for this course but the following publications can support any student in their own quest for further insights. For instance, if you want to learn more about grasshopper and how to manipulate toolpaths [1], work with the plastic properties of the material[2,3], affect the quality of the print by using a custom nozzle[4], create amazing 3DP clay lights (UW thesis[5,6] or dedicated publication[7,8]), or learn about the state of the art research on 3DP with clay [9]. Alternatively, I am listing here some references that might provide insight into the theories behind the tools and processes of computational design[10–12] and their implications to craft[13]. I hope some of these tiles peak your interest.

References

1. Cuevas, D. G. & Pugliese, G. *Advanced 3D Printing with Grasshopper, Clay and FDM* (Independently published, 2020).
2. Shi, J., Cho, Y., Taylor, M. & Correa, D. Guiding Instability A craft-based approach for modular 3D clay printed masonry screen units. In *Blucher Design Proceedings* (Editora Blucher, São Paulo, Tuesday, September 10, 2019 - Thursday, September 12, 2019), pp. 477–484.
3. Rael, R. & San Fratello, V. *Printing architecture. Materials and methods for 3D printing* (Princeton Architectural Press, Hudson New York, 2018).
4. Wu, Y. M., Kenny, A., Kim, I. & Correa, D. Embedding ornament: Custom nozzle design in 3-D clay printing. In *Structures and Architecture A Viable Urban Perspective?,* edited by P. J.S. Cruz & M. F. Hvejsel. 1st ed. (CRC Press, London, 2022), pp. 1077–1086.
5. Ochoa, I. Grading Light: Utilizing plastic deformation to functionally grade ceramic light screens. UWSpace.
6. Clarke-Hicks, J. Grading Light: Utilizing plastic deformation to functionally grade ceramic light screens. UWSpace.
7. Clarke-Hicks, J., Ochoa, I. & Correa, D. 3D Printed Ceramic Screens:. Leveraging Tool Path Design in Functionally Graded Additive Manufacturing. In *BE-AM Built Environment Additive Manufacturing 2022,* edited by P. Rosendahl & J. Muth (Frankfurt, Wednesday, November 16, 2022), pp. 68–75.
8. Clarke-Hicks, J., Ochoa, I. & Correa, D. Harnessing plastic deformation in porous 3D printed ceramic light screens. *Archit. Struct. Constr.* **8,** 483; 10.1007/s44150-022-00079-0 (2022).
9. Wolf, A., Rosendahl, P. L. & Knaack, U. Additive manufacturing of clay and ceramic building components. *Automation in Construction* **133,** 103956; 10.1016/j.autcon.2021.103956 (2022).
10. Menges, A. Fusing the Computational and the Physical. Towards a Novel Material Culture. *Archit. Design* **85,** 8–15; 10.1002/ad.1947 (2015).
11. Menges, A. & Ahlquist, S. *Computational design thinking* (Wiley, Chichester, 2011).
12. Kolarevic, B. *Architecture in the digital age. Design and manufacturing* (Taylor & Francis, New York, 2005).
13. Sennett, R. *The craftsman* (Yale University Press, New Haven, 2008).



HIVE: Meghan Taylor, Elly Cho, Jim Shi, David Correa, James Clarke-Hicks and Isabel Ochoa.

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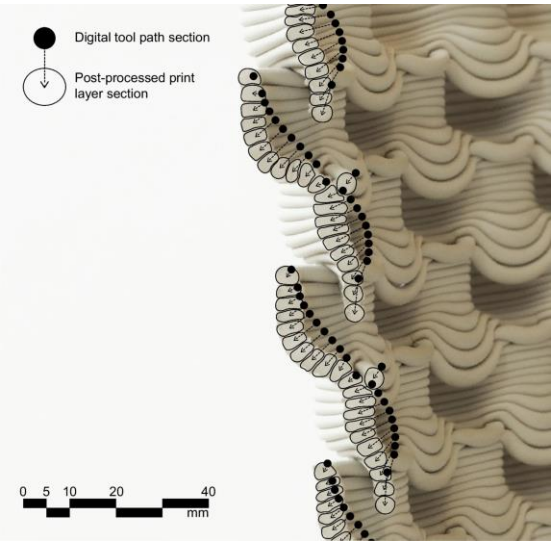

Clarke-Hicks, J., Ochoa, I. & Correa, D. Harnessing plastic deformation in porous 3D printed ceramic light screens. Archit. Struct. Constr. 8, 483; 10.1007/s44150-022-00079-0 (2022)

Attendance:

Attendance to all Lectures and Tutorials is required. Students are expected to arrive shortly before 9:30 am.

Course Time Zone

All dates and times communicated in the document are expressed in Eastern Time (EDT Local time in Waterloo Ontario, Canada).

COVID-19 Special Statement

Given the on-going situation around COVID-19, students are to refer to the University of Waterloo's developing information resource page (https://uwaterloo.ca/coronavirus/) for up-to-date information on academic updates, health services, important dates, co-op, accommodation rules and other university level responses to COVID-19.

Fair Contingencies for Emergency Remote Teaching

To provide contingency for unforeseen circumstances, the instructor reserves the right to modify course topics and/or assessments and/or weight and/or deadlines with due and fair notice to students. In the event of such challenges, the instructor will work with the Department/Faculty to find reasonable and fair solutions that respect rights and workloads of students, staff, and faculty.

DFL Ceramics and COVID Cleaning Procedures

Students are responsible for the cleaning of all tools, equipment, and surfaces following the DFL Ceramic Cleaning Procedures. There should be no clay residue left on any tool, equipment or surface before proceeding to sanitizing your work area. If floor needs to be mopped because of clay residue on the floor also do this before proceeding. See documents pertaining cleaning protocols on LEARN.

Course Evaluation

Project 1	5%
Project 2A	20%
Project 2B	60%
Participation	15%
Total	100%

Exhibition

Selected student projects will be invited to present at the "Robotic Clay: New Methods in Architectural Ceramics" at the **Canadian Clay and Glass Gallery** from May 27 to September 10, 2023. Installation at the gallery will take place between May 15 and May 26. Opening reception on June 4. This exhibition is contingent on the changing COVID 19 situation.

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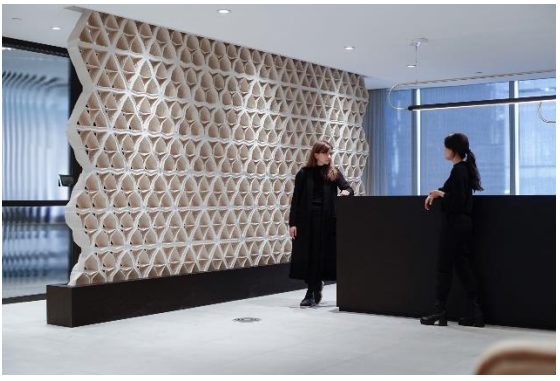


Collaborative Work

Professional practice in architecture, design or engineering takes place through close collaborations between teams of people. Identifying effective ways to communicate, assign responsibilities, identify milestone and achieve objectives are essential skills to succeed in professional practice. For this reason, the studio will require students to work in teams. This collaboration should allow for intensive work and iteration to take place in parallel. Generally, the more iterations are pursued the stronger the work.

Working in groups also means that you will be evaluated as a group – thus, pick your team wisely.

As it will be presented in the course, working online with teams distributed across various continents has been standard practice over the last few decades. However, as difficulties might emerge, faculty will work with students to work through problems and make accommodations in group formations to support the production of high-quality work as needed.

Evaluation:

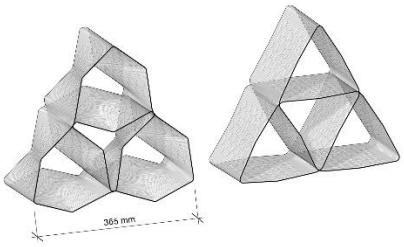
Each assignment throughout the term will be assessed on the following basis:

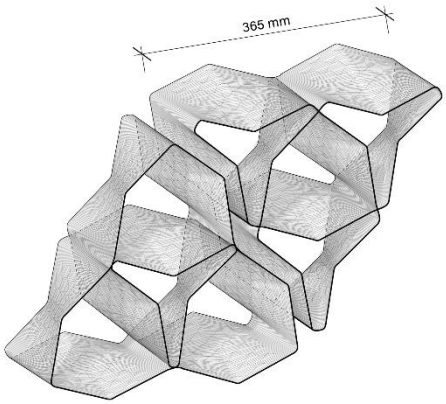
- Successful implementation of technical goals as well as meaningful design/architectural insight
- Ambition, clarity and appropriateness of the ideas addressed within the work
- Precision and craft of work developed
- The capacity of the submission to communicate the project's intention in the author's absence.

Deadlines and extension for ARCH 684_001 are only possible in cases of illness or incapacity. Requests for such extensions must be made before the project deadline, as soon as is possible, using the request for extension form available from the Undergraduate Student Services Coordinator, accompanied by a medical certificate when necessary, and submitted to the ARCH 684_001 instructor. All assigned parts of the work must be completed. Students must complete all assignments, and obtain a passing average in order to receive credit for this course.

Late Work

Assignments that are handed in late will receive an initial penalty of 20% on the first calendar day late and a 5% penalty per calendar day thereafter. After 5 calendar days, the assignment will receive a 0%. Only in the case of a justified medical or personal reason will these penalties be waived, and only if these have been officially submitted to the Graduate Student Services Co-Ordinator and accepted by the Graduate Office. Students seeking accommodations due to COVID-19, are to follow Covid-19-related accommodations as outlined by the university here: [https://uwaterloo.ca/coronavirus/academic-information#accommodations]





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Laptop and Software equipment:

Laptops should be ready for in class exercises. Students are required to have equipment and software tools ready (installed with appropriate license privileges) prior to class.

Costs

The Material Syntax course is a material-oriented investigation. The course requires intensive material explorations that have material costs. It is expected that participants can purchase required materials (as locally available) to support these explorations. Please budget $150 / student for the term

Note: ONLY #516 CONE 6 WHITE CLAY from Pottery Supply House can be used in the course. This is done in order to facilitate the recycling of

Technological Platforms

Since there will be no access to the computer lab at the school, students are expected to have Rhino on their computers. While associative modelling workflows for geometric modelling are encouraged, they are not required. Image capturing (camera) will be needed to appropriately document your work.

Remote Course Delivery Platforms & Communication

During remote learning, we will be using additional platforms to deliver, organize and share course content, learning and work. Here is a breakdown of tools we will use in this course:

MS TEAMS – Virtual Hub for the course. Used for organizing course documents, activities and discussions. Students will be added to the course team in the first week of class.

LEARN – Official communication, work submission, and grade recording and release.

(MIRO – group desk-crits, graphic feedback, discussion with classmates' work – if we are required to move into online teaching)

Digital Submissions:

Students must make and maintain regular backups of their digital files and documentation material. Lost or corrupt files will not be accepted as an excuse for late project submissions. Digital Submissions will be required for all assignments, as individual students or groups, throughout the term. All files must be submitted in readable pdf and mp4 formats to LEARN.

Credits:

Credit all sources for your work. Identify original authors of all visual documents. Footnote text sources. Include full captions for illustrations. Provide a detailed list of credits with each assignment.

Wu, Y. M., Kenny, A., Kim, I. & Correa, D. Embedding ornament: Custom nozzle design in 3-D clay printing. In Structures and Architecture A Viable Urban Perspective?, edited by P. J.S. Cruz & M. F. Hvejsel. 1st ed. (CRC Press, London, 2022), pp. 1077–1086.

Mental Health Support

All of us need a support system. We encourage you to seek out mental health supports when they are needed. Please reach out to:

Campus Wellness
[https://uwaterloo.ca/campus-wellness/]

Counselling Services
[https://uwaterloo.ca/campus-wellness/counselling-services]

We understand that these circumstances can be troubling, and you may need to speak with someone for emotional support. Good2Talk [https://good2talk.ca/] is a post-secondary student helpline based in Ontario, Canada that is available to all students.

Equity, Diversity and Inclusion Commitment

At the School of Architecture, we are committed to foster and support equity, diversity and inclusion. We recognize however, that discrimination does occur, sometimes through an isolated act, but also through practices and policies that must be changed. If you experience discrimination, micro-aggression, or other forms of racism, sexism, discrimination against LGBTQ2S+, or disability, there are different pathways to report them:

A) If you feel comfortable bringing this up directly with the faculty, staff or student who has said or done something offensive, we invite you, or a friend, to speak directly with this person. People make mistakes and dealing them directly in the present may be the most effective means of addressing the issue.

B) you can reach out to either the Undergraduate office, Graduate office, or Director (DirectorArchitecture@uwaterloo.ca). If you contact any of these people in confidence, they are bound to preserve your anonymity and follow up on your report.

C) You may also choose to report centrally to the Equity Office. The Equity Office can be reached by emailing equity@uwaterloo.ca. More information on the functions and services of the equity office can be found here: https://uwaterloo.ca/human-rights-equity-inclusion/about/equity-office.

Academic integrity, grievance, discipline, appeals and note for students with disabilities:

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check the Office of Academic Integrity for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for his/her actions. [Check the Office of Academic Integrity for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline. For typical penalties, check Guidelines for the Assessment of Penalties.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals.

Note for students with disabilities: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit the alternate assignment.

Land Acknowledgement

We acknowledge that we live and work on the traditional territory of the Attawandaron (Neutral), Anishinaabeg and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations that includes ten kilometers on each side of the Grand River.