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Arch 172:
Building Construction 1

Fall 2023
Course Home Page

course outline

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Territorial Acknowledgement

We acknowledge that the School of Architecture is located on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. The University is situated on the Haldimand Tract, the land promised to the Six Nations that includes 10 kilometres on each side of the Grand River. (see references here: <https://uwaterloo.ca/engineering/about/territorial-acknowledgement>)

Course Description:

This is an introduction to building construction dealing with the systems surrounding the making of buildings, building science, soils, foundations, wood frame systems and masonry systems. The course begins with an historical introduction of the primary materials of stone, steel and reinforced concrete to discover the impact of their development on Architectural design through the past 300 years.

Students will

- keep a detailed sketchbook of examples and details addressed in class
- prepare a sketch per week of an aspect of construction/materiality/the city
- complete the Empathy Project
- complete an end of term technical drawing assignment

There will be an emphasis on developing communication skills through sketching - including both observed situations as well as detailed sketches of building construction assemblies.

Teaching Assistants:

- [Gwen del Rosario](#)

- [Angeline Reyes](#)

General Course Requirements:

This course is being delivered in person format. If the need arises we will switch to online. In that case the lectures will be held in our Teams channel. PDFs of the lecture presentations will be posted within a day following the lecture. Do not expect these to be available to use to improve your class notes. I have another class on Wednesday afternoon and then commute back to Toronto.

The most important thing that you can do is to attend the weekly lectures. To this end the major course requirement will be to take annotated (meaning sketches and words) notes from the lectures. ALL notes are to be *taken by hand in your required sketchbook*. No typed notes permitted unless you have authorization from the disabilities office. Sketchbooks will be scanned/photographed for submission and graded on their completeness as well as neatness. To ensure that you keep up with the work, you will be required to make PDFs of your notes pages EACH WEEK submit these to LEARN. Cellphone shots are fine as long as they are legible and in jpg format (iPhone users no HEIC format). The TAs will evaluate and provide feedback on a week by week basis. The notes are due to be submitted by 11pm on the Wednesday, same day as the lecture occurs to prevent you from spending time improving them.

Additionally there will be a sketch assignment each week. This is a full page sketch in the medium of your choice, to be made in the same sketchbook, of an assigned aspect of building construction, topic noted in the course outline below. This is due prior to the next class to give you time to enjoy the exercise.

As time permits, I will do some live detail sketches in class, and these should also be included in your sketchbook as part of the annotated notes. The final term project will require you to make a technical drawing and this information will be critical for your work.

Class Times:

The class runs from 9:30am to 12:30pm on Wednesdays in the e-classroom.

Office Hours:

I will be available after class for extra questions. If you wish to contact me personally, you can email, anytime tboake@uwaterloo.ca

Learning Outcomes:

There are some clear things that you should be able to do or know by the end of this course. You only have two courses in Building Construction in this degree. They both happen in first year. You will be expected to understand fairly detailed concepts and details of construction by the end of both courses.

1. The first 3 lectures are more historically based and trace the impact that invention in the area of structural materials had on the development of modern architectural design. You should be able to select a structural material and understand its design implications - benefits and limitations - when you start any design project. Design works best if you have materiality in mind when looking at the blank page.
2. Understand the critical role of technology as it informs architectural design. From Building Science, to laws, rules, etc - show that you can include these in your design process and thinking. Drawings are comprised of lines, but those lines infer materials.
3. We will look at low rise building systems this term. So be able to detail a residential shallow foundation. Be able to understand the framing of a light wood frame building and draw it both as a wall section and as a 3D axonometric. Understand the role of masonry and differentiate the detailing of load bearing versus veneer systems.
4. When you design and detail a building you don't do this from memory. You surround yourself with information and guides. You should know where to go to look for information on technical building requirements.

Course Materials:

This web page will be updated each week as required, so please check it.

Log-in to LEARN: [here](#)

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| | Schedule of Classes Wednesdays 9:30 to 12:30 e-classroom |
| Date | Topic and Assignments |
| | For a BONUS mark of 1% please log into LEARN and provide a profile picture. Has to be done before September 30! |

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| 1 | <p>OVERALL INTRODUCTION TO THE MECHANICS OF THE COURSE</p> |
| Sept 6 | <p>INTRODUCTION: FROM TECHNIQUE TO TECHNOLOGY Stone Construction: General Principles and Stereometry <i>Architects of note: Brunelleschi, Palladio, Soufflot</i> <i>Material nature of stone: compressive</i></p> <p>READ: Course Notes: Stone Construction link Intrinsically Linked through Materiality link Internet: The Mystery of the Pyramids link (what do YOU think?) More on Vitruvius link</p> <p><i>50 Architects You Should Know: Brunelleschi, Bramante, Alberti, Michelangelo, Bernini, Palladio, Wren, Gaudi, Jefferson, Schinkel</i></p> <p>SKETCHING ASSIGNMENT: A STONE DETAIL/BUILDING SKETCHES FOR THIS CLASS CANNOT BE SUBMITTED FOR ANOTHER CLASS. SKETCHES ARE TO BE DRAWN FROM LIFE, NOT PHOTOS.</p> <p>What is a Sketch? It is not a frame quality drawing that takes many hours to complete. Generally it should show reasonable perspective, use varied line weights for emphasis and avoid excessive shading. Have a look at my Pinterest Board for some examples. https://www.pinterest.ca/terriboake/architecture-sketches/ To this end your sketches are not permitted to use shading, focus on linework and simplicity. They should take 30 minutes maximum to complete. They need to be neat, legible and compelling, but not look like renders. Lines have to be done well enough so that they can photograph for submission. You have a week to complete the weekly sketch - but that is by no means inferring that it is a week of work.</p> <p>The jpg or PDF of the sketch is due to the LEARN Dropbox by midnight the day before your next class.</p> <p>The Empathy Project Assigned the actual project participation will begin in two weeks.</p> |
| 2 | <p>STONE: THE IMPACT OF MATHEMATICS Continuation of discussion of stone looking at the Renaissance, Enlightenment to the Modern condition</p> <p><i>50 Architects You Should Know: Brunelleschi, Bramante, Alberti, Michelangelo, Bernini, Palladio, Wren, Gaudi, Jefferson, Schinkel</i></p> <p>SKETCHING ASSIGNMENT: A STONE DETAIL/BUILDING</p> |
| 3 | <p>IRON AND STEEL: THE CREATION OF THE STRUCTURAL SKELETON AND THE EVOLUTION OF MODERNISM An historical investigation of the invention of iron and steel framing systems and the ramifications on modern architectural conceptual design theories and implementation. <i>Architects of note: Behrens, Gropius, Mies, any High Tech architects like Foster, Rogers, Piano</i> <i>Material nature of steel: tensile</i></p> <p>READ: Allen: Chapter 11: Steel Frame Construction Course Notes: Steel images/course_pdf/172-ch5.pdf</p> <p><i>50 Architects You Should Know: Ledoux, Sullivan, Burnham, Horta, Gropius, Mies, Neutra, Pei, Rogers, Meier, Foster, Herzog&deMeuron, Gehry, Koolhaas, Nouvel</i></p> <p>SKETCHING ASSIGNMENT: SKETCH SOME EXPOSED STEEL DETAILS. Steel to steel connections can be pretty interesting. I do an entire course in this for 3B students!</p> |
| 4 | <p>Terri away at CISC Conference - no class</p> |
| 5 | <p>THE EVOLUTION OF REINFORCED CONCRETE AND ITS CONTRIBUTION TO MODERNISM An historical investigation of the invention of reinforced concrete and the ramifications of the monolithic structure on</p> |

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| Oct 4 | <p>modern design theories and construction practices. <i>Architects of note: LeCorbusier, Pier Luigi Nervi, Eero Saarinen</i> <i>Material nature of concrete: compressive</i></p> <p>READ: Allen: Chapter 13: Concrete Construction Course notes: Reinforced Concrete images/course_pdf/172-ch6.pdf</p> <p><i>50 Architects You Should Know: Wright, Perret, Le Corbusier, Kahn, Niemeyer, Saarinen, Ando, Hadid, Ito, Tange</i></p> <p>Info on Brutalism</p> <p>Futurist Manifesto of Antonio Sant'elia</p> <p>SKETCHING ASSIGNMENT: SKETCH SOMETHING CONSTRUCTED IN REINFORCED CONCRETE THAT HAS SOME TEXTURE. The challenge here is to show the concrete nature of the structure using simple lines. How do we know it is not steel or wood?</p> |
| 6 Oct 11 | <p>Reading Week - no class</p> |
| 7 Oct 18 | <p><i>Terri at CTBUH Conference in Singapore - please reference recorded lecture - notes and sketches due at the normal times.</i></p> <p>MAKING BUILDINGS/DESIGNING BUILDINGS <i>The Process; Zoning; Codes; Drawings</i></p> <p>THE RESIDENTIAL PROJECT: Building and fire code issues as they apply to housing.</p> <p>BARRIER FREE DESIGN: It is a legal requirement that we design for barrier free in all public buildings, no matter how large or small. This includes interior and exterior requirements.</p> <p>https://www.constructioncanada.net/a-practical-guide-to-barrier-free-washrooms/</p> <p>City of Toronto Guide for Barrier Free Design</p> <p>READ: Fundamentals of Building Construction: Chapter 1: Making Buildings Course Notes: Regulatory Determinants link Canadian Wood Frame House Construction: p. 2-18 <i>Internet:</i> Have a look at the Official Plan for the City of Toronto link</p> <p><i>50 Architects You Should Know: Aalto, Johnson, Pei, Rossi, SOM, Libeskind</i></p> <p>SKETCHING ASSIGNMENT: SKETCH SOMETHING THAT LOOKS ILLEGAL IN TERMS OF THE WAY THE BUILDING IS SITUATED ON A SITE OR CONSTRUCTED. This one is a challenge but look around Cambridge for anything that seems constructed in a dodgy way, decrepit, falling down, unsafe.</p> |
| 8 Oct 25 | <p>SUSTAINABILITY WEEK 1</p> <p>THE EVOLUTION TOWARDS CONTEMPORARY CLIMATE RESPONSIVE DESIGN: An Introduction to the Science of Buildings Buildings must not only work from a cultural and functional perspective, but they need to address fundamental issues of site, climate and sustainability. There is much to be learned from indigenous and vernacular architecture - that worked before the advent of modern AC and heating systems. The location and siting of the building must acknowledge solar orientation, the availability of wind for natural cooling, microclimate. Many buildings are designed to meet Green Building ratings.</p> <p>READ: Primitive Architecture and Climate: James Marston Fitch and Daniel P. Branch</p> |

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| | <p>SKETCHING ASSIGNMENT: Design your own north arrow, graphic scale, and human scale figure. These should be present in all of your drawings. You cannot speak about solar orientation or convince anyone it was important to your design if you don't show where north is.</p> |
| <p>9</p> <p>Nov 1</p> | <p>SUSTAINABILITY WEEK 2</p> <p>CLIMATE RESPONSIVE DESIGN - THE BASIS OF SUSTAINABLE DESIGN IN ARCHITECTURE An introduction to passive site design - issues of climate, orientation, solar geometry, shading, natural ventilation, site materials</p> <p>SKETCHING ASSIGNMENT: Sketch an interesting device that can be used on a facade to shade the windows.</p> |
| <p>10</p> <p>Nov 8</p> | <p>SOILS, EXCAVATIONS AND SURVEYING <i>The implications of site conditions on design, Introduction to the principles of surveying and how to read a survey</i></p> <p>FOUNDATIONS <i>An investigation of foundation types as linked to building design strategy and choices</i></p> <p>READ: Fundamentals of Building Construction: Chapter 2: Foundations (excluding portion on deep foundations) Canadian Wood Frame House Construction: Location and Excavation p. 29-36 Canadian Wood Frame House Construction: Concrete Work p.37-42 Footings, Foundations and Slabs p.43-72</p> <p>SKETCHING ASSIGNMENT: An interesting exterior building detail, your choice.</p> |
| <p>11</p> <p>Nov 15</p> | <p>AN INTRODUCTION TO WOOD CONSTRUCTION <i>The materiality of wood and the structural implications and potentials of wood systems; sawn framing (traditional) versus engineered wood (more recent)</i></p> <p>READ: Fundamentals of Building Construction: Chapter 3: Wood Chapter 4: Heavy Timber Frame Construction Canadian Wood Frame Construction: Protection and Care of Materials on Site p.73-76 Lumber and Other Wood Products p.77-82 Framing the House p.83-88</p> <p>SKETCHING ASSIGNMENT: Residential foundation (a real one or you can draw the detailed technical section from last week's class by hand) Make sure it is fully labeled.</p> |
| <p>12</p> <p>Nov 22</p> | <p>WOOD FRAME CONSTRUCTION <i>An in depth investigation of the making and detailing of the wood frame building</i></p> <p>READ: Fundamentals of Building Construction: Chapters 5, 6 and 7: Wood Light Frame Construction, Exterior and Interior Finishes. Canadian Wood Frame Construction: Floor Framing, Wall Framing, Ceiling and Roof Framing, Roof Sheathing and Coverings, Wall Sheathing and Exterior Finishes, Exterior Trim and Millwork p.89-190 Wood Resources link</p> <p>Interesting video of framing in Japan link</p> <p>SKETCHING ASSIGNMENT: SKETCH SOMETHING THAT SHOWS THE SKELETAL WOOD FRAME, PREFERABLY SOMETHING UNDER CONSTRUCTION OR EXPOSED TIMBERS. DO NOT ENTER A CONSTRUCTION SITE TO DO THIS.</p> |

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| 13 Nov 29 | AN INTRODUCTION TO MASONRY CONSTRUCTION <i>Introduction to the fundamentals of masonry construction, including brick and concrete block, modular sizing, terminology, building practices</i> READ: Fundamentals of Building Construction: Chapter 8: Brick Masonry Chapter 9: Stone and Concrete Masonry Links: Brick Institute of America http://www.bia.org/ Hanson Brick (coursing charts and good general diagrams) http://www.hansonbrick.com/english/products/sizes_coursing_us.php No sketch. |
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| Dec. 19 | Hand in for Final Term Project - 4pm Front Office The Drawing Handbook |

Evaluation:**SKETCHBOOK:** 44%

You are required to keep a sketchbook/notebook for the course. 8 ½" by 11" format is recommended with BLANK pages. Grades are allocated based upon notes and technical sketches taken from the lecture.

11 LECTURES: @ 4% EACH (2 marks for completeness, 2 marks for neatness/clarity)**SKETCHES:** 10 @ 3% EACH**EMPATHY PROJECT:** 6%**FINAL DESIGN:** 20% Winter Oasis (Groups of 4 students)**Late Penalties:**

The weekly sketch and copies of your class notes are due as noted above. After 24 hours a grade of zero will be assigned.

For the Final Project late penalties of 5% per day will be applied, following the 24 hour grace period. After 5 days of lateness a grade of zero will be applied.

Reference Texts and other Materials:

The following texts will be used for BOTH Arch 172 and Arch 173 (Winter term).

CMHC. Canadian Wood Frame House Construction. Available as a downloadable PDF. [here](#)

Allen, Edward. Fundamentals of Building Construction: Materials and Methods.

Seventh Edition preferred. If you are using an older edition, please refer to the chapter titles (rather than chapter numbers) and read the appropriate sections. Honestly, whatever you can get your hands on will do. This is an expensive text but it is also used for Arch 173: Building Construction 2 and will serve as a reference for the balance of your student career.

50 Architects You Should Know. Prestel Press.

<http://www.amazon.ca/50-Architects-You-Should-Know/dp/3791340433>

Archived old version Course notes. Available online. As linked throughout the course outline, or find them all here: [crsnotes.html](#)

As there are no quizzes in the course you will be responsible for monitoring your reading of the accompanying texts. The Allen book is typically retained for the duration of this degree as it has a lot of helpful information. The CMHC Wood book will be

helpful for your final term project. 50 Architects will help you understand more about the architects I reference in the lectures and help to build your vocabulary of terms/people.

Wood Resources:

Below are links to pdf copies of some fantastic guides put together by Canada Mortgage and Housing Corporation on different construction practices in Canada. They are fairly hefty in size, so download with a good connection. Each has a series of details contained within the text. The one on "Wood Frame" would be applicable to most areas of Canada. Since BC is so wet, they have developed a special set of details for BC construction. You could also refer to these for your work -- they are just "better" from a building science perspective. The BC guide also includes some more developed information on different assemblies. Those of you detailing roofs without attics, need to look in the BC guide under roof assemblies for a sandwich type roof that is comprised of rigid polystyrene insulation rather than batt insulation. You need to vent batt insulation as it can retain moisture and freeze/leak. Rigid polystyrene (the blue stuff that comes in boards) is a closed cell system and does not get waterlogged. It is used on flat roofs and below grade around foundations.

CMHC Best Practice Guides: [Wood Frame Guide](#), [BC Wood Frame Guide](#), [Brick and Block](#) and [Brick and Steel Stud](#)

All of the CMHC Best Practice Guides are available in binder as well as CD form in Musagetes.

Just looking for neat ideas of how to build in wood? Look at the Wood Design & Building periodicals in Musagetes!

Powerpoint Presentations:

The files listed below will take you to some interactive powerpoint files. Upload the files then go to the slide show mode. Every time you click your mouse, the detail will "build itself". You will be able to see all the materials and the sequence of assembly. They are all for wood frame with stucco or wood veneer. You will have to extrapolate the sequence as it applies to masonry veneer situations.

Window Head [link](#)

Window Sill [link](#)

Door Sill [link](#)

Exterior Stair Landing [link](#)

"Saddle" (where a roof parapet from a lower roof meets a wall) [link](#)

Exhaust Vent [link](#)

Avoidance of Academic Offenses

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/>) and 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 [Becky Moore](#) or [Terri Boake](#), or director ([Maya Przybylski](#)). 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: To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

AI Policy: Permitted in this Course with Attribution: In this course, students are not permitted to use Generative AI Tools like ChatGPT and Midjourney to support their work. In order to maintain academic integrity, students must disclose any AI-generated material they use and properly attribute it. This disclosure should include AI generation whether in whole or part, including images, designs, in-text citations, quotations, and references.

The full extent of images and text passages should be cited. The following statement in assignments may be used to indicate general use of a Generative AI Tool: “The author(s) acknowledges the use of [Generative AI Tool Name], a model developed by [Generative AI Tool Provider], in the preparation of this assignment. The [Generative AI Tool Name] was used in the following way(s) in this assignment: [indicate, e.g. grammatical correction, gathering sources, generating specific images, etc.].”

Caution: When using AI tools, it is important to be aware that the user data supplied might be utilized for training AI models or other purposes. Consequently, there is no guarantee that the information you provide will remain confidential. Instructors and students should exercise caution and avoid sharing any sensitive or private information when using these tools. Examples of such information include personally identifiable information (PII), protected health information (PHI), financial data, intellectual property (IP), and any other data that might be legally protected.

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, <http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm>

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 - Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, <http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm>

Appeals: A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals, <http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm>

Note for students with disabilities: YOU MUST VERIFY YOUR DISABILITY AND ACCOMMODATIONS WITH THE OPD AT THE START OF THE TERM. FOR EACH AND EVERY NEED FOR ACCOMMODATION, THEY MUST CONTACT ME TO MAKE ARRANGEMENTS OR ELSE LATE PENALTIES WILL BE APPLIED. The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, 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 the OPD at the beginning of each academic term. Once registered with OPD, please meet with the professor, in confidence, during my office hours to discuss your needs.

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