

Environmental DESIGN

architecture + landscape architecture + planning

Building Science and Technology 1
T/TH 9:10 – 10:40 AM, PF 2151

EVDA 511 / ARST 449 H (3-0)

Winter 2019

Instructor: Guy Gardner

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PF 2151, hours by appointment

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PF 2151, hours by appointment

Introduction

“The importance of contemporary building science is often fully appreciated only after the occurrence of building performance problems, or worse, after failures, rather than at the planning and design stage of building projects” (Kesik, 2016).

Building Science and Technology 1 looks at how the principles of building science and the properties of building materials can inform the design of buildings. It examines the elements that make up the building enclosure and the conditions affecting their performance. Through case study analysis and explorations of wall sections and building details the course will explore design principles for enhancing occupant comfort, lighting, acoustics, indoor environmental quality and energy performance.

Objectives

1. Introduction to principles of building science and the properties of building materials
2. To acquire a basic understanding of the design of building envelope systems
3. To understand the impact of environmental conditions and occupant behaviour on building materials and assemblies
4. To learn to evaluate the condition of building components and identify opportunities to improve their performance.
5. To develop an ability to interpret and describe building assemblies through wall sections and details
6. To gain an understanding of the relationship between building science and technology and building regulations.

Content: Topic Areas & Detailed Class Schedule

Date	Topic	Readings
Tues, Jan 8	Introduction to building science, course format and objectives , overview of syllabus and d2l, reading materials	Olin’s 1.3 Codes. p.16-23 *114 - Safety in Buildings. 135 - Consideration of the Physically

	<p>Accessibility, safety and building regulations</p> <p>Divide students into weekly detail presentation groups – 15 to 20 topics ASSIGN: Acoustics Assignment.</p>	<p>Disabled. 200 - Building Technology and Its Use. 237 - The Regulation of Building Construction.</p>
<p>Thurs Jan 10</p>	<p>2: Principles of Building Science Understanding the functions and durability of the building enclosure as it relates to Indoor Environmental Quality, Human Factors, Ergonomics, Climate, Performance, Acoustics, Light, Thermal Considerations, Air Quality, Privacy + Safety</p>	<p>*48 - Requirements for Exterior Walls. *30 - Water and Building Materials. *56 - Thermal and Moisture Deform'n Bldg. *115 - Performance of Building Materials. *120 - Design and Service Life.</p>
<p>Tues Jan 15</p> <p>Thurs Jan 17</p>	<p>3: Acoustic Principles Design Considerations for Attenuation + Enhancement</p> <p>Sound intensity, transmission loss, absorption, insulation, reflection, reverberation, vibration, and ambient noise.</p> <p><i>Ian Bonsma Acoustic Engineer</i></p>	<p>Olin's 12 Sound Control. p.842-874-(889) Olin's 9.7 Acoustical Treatm't. p.717-730 Olin's 7.2.11 Sound Control. p.1024-1025 10 - Noise Transmission in Buildings. 41 - Sound and People 51 - Sound Insulation in Office Buildings. *92 - Room Acoustics - for Listening. 139 - Acoustical Design of Open-Planned Office 173 - Floor Vibrations. *232 - Vibrations in Buildings *236 - Introduction to Building Acoustics. 239 - Factors Affecting Sound Transm'n 240 - Sound Transmission - Windows.</p>
<p>Tues Jan 22</p>	<p>4: -Environmental Conditions Weather, Temperature, solar radiation, sol-air effects, wind, precipitation, snow loads, drifting, humidity, atmospheric, fire, toxins, pollutants. RADON, Ozone, CO, CO₂</p>	<p>Olin's 16 HVAC. p.956-995 *14 - Weather and Building. 28 - Wind on Buildings. 37 - Snow Loads on Roofs. *47 - Extreme Temp. Outer Surfaces of Bldgs. 121 - Irradiation Effects on Organic Mtls. 122 - Radiation and other Weather Factors. 126 - Influence of Orientation on Ext. Cladding. 146 - Control of Snow Drifting about Bldgs. *155 - Joint Movement and Sealant Selection. 170 - Atmospheric Corrosion of Metals. *247 - Control of Radon in Houses</p>
<p>Thurs Jan 24</p>	<p>-Impact of Water Intrusion water intrusion, water vapor, – staining, occupant health implications, remediation strategies</p>	<p>Olin's 7.1 Moisture Ctrl. p.427-443 *1 - Humidity in Canadian Buildings. *42 - Humidified Buildings. *72 - Control of Air Leakage is Important. 83 - Indoor Swimming Pools.</p>

Tues Jan 29	-Water Vapor, condensation and freezing -relative humidity, dewpoint, diffusion, vapor retardants, air barriers, psychrometry, sublimation	*57 - Vapour Diffusion and Condensation. 175 - Vapour Barriers: What are they? effective? *231 - Moisture Problems in Houses.
Thurs Jan 31	Comfort + human factors IAQ, Psychrometrics, Condition of thermal neutrality, temperature, air flow, radiation, humidity; comfort zones, variability with age and sex; adaptation, light, colour and noise, work and metabolism; conduction, convection evaporation and perspiration.	*102 - Thermal Environment and Human Comfort. *199 - Air Ions and Human Comfort. *110 - Ventilation and Air Quality. *222 - Airtight Houses and CO Poisoning.
Tues Feb 5	Heat flow + Thermal considerations Modes of heat transfer, heating load, ground temperatures, thermal bridges, resistance, thermal gradient, heat loss calculations; insulation materials. Case study: London apt fire from foam insulation	Olin's 7.3 Insulation. p.443-457 *16 - Thermal Insulation in Dwellings. *149 - Thermal Resistance of Building Insulation. 178 - Fire and Plastic Foam Insulation Materials 218 - Effects of Insulation on Fire Safety.
THURS Feb 7	Air flow + stack effect Wind pressure, wind tunnel effect, stack effect	34 - Wind Pressures on Buildings. *104 - Stack Effects in Buildings. *107 - Stack Effects in Building Design. *174 - Ground Level Winds Around Tall Bldgs. 245 - Mechanical Ventilation and Air Pressure.
TUES Feb 12	Acoustics assignment review and work periods - Guest Lecture TBD	
THURS Feb 14	Acoustics assignment review and work periods - Guest Lecture TBD	
	Feb 19-23 Reading Break	
THURS Feb 26	Envelope failures - Building forensics pertaining to building envelopes, mechanisms for failure and remediation. Design strategies for durability and optimal performance. Fire and the building envelope. Fireproofing ASSIGN: Team Projects (Building failures).	
	Material Properties	
THURS Feb	Wood	Olin's 6.0 Wood. p.316-413 *30 - Water and Building Materials.

<p>28</p>	<p>Dimensional changes, durability, strength seasoning, types of wood, decay, preservatives, fire protection, log enclosures, PWF, CLT, wood frame, Engineered floor and roof systems, SIP and panelized wall systems, FSC + SFI certification –</p> <p>Metal</p>	<p>*85 - Some Basic Characteristics of Wood. *86 - Some Implications Properties of Wood. *111 - Decay of Wood. *115 - Performance of Building Materials. 117 - Weathering of Organic Materials. 124 - Biological Attack on Organic Materials. 130 - Wetting and Drying of Porous Materials. *224 - Deterioration of Indoor Parking Garages. Olin's 5.0 Metals. p.248-312</p>
<p>TUES MAR 5</p>	<p>Concrete</p> <p>Cements, mixtures, admixtures, joints, curing, precast, reinforcing, and corrosion.</p> <p>Glass Composites</p>	<p>Olin's 3.0 Concrete. p.68-147 *15 - Concrete. *103 - Admixtures in Portland Cement Concrete. *116 - Durability of Concrete Under Winter Condition. 136 - Concrete in Sulphate Environments. 223 - Fibre reinforced Concrete.</p>
<p>THURS MAR 7</p>	<p>Masonry</p> <p>Efflorescence, weep holes, flashings</p>	<p>Olin's 4.0 Masonry. p.152-243 *2 - Efflorescence. 6 - Rain Penetration of Walls of Unit Masonry. 123 - Cold Weather Masonry Construction. 131 - Coatings For Masonry Surfaces. 138 - On Using Old Bricks in New Bldgs. 169 - Bricks. *194 - Cleaning of Brickwork.</p>
<p>March 12+14Block Week</p>		
<p>TUES MAR1 2</p>	<p>Wall Design</p> <p>Openings, kinetic energy, pressures, ventilation of cavities, rain screen principles, Cladding types, drainage, joints, capillary action, Stucco+ EIFS</p>	<p>Olin's 7.7 Siding. p.502-521 Olin's 7.9.2 Wall Flashing. p.537-540 *6 - Rain Penetration of Walls of Masonry Units *21 - Cavity Walls. 97 - Look at Joint Performance. 125 - Cladding Problems Due to Frame... *20 - Corrosion in Buildings. 98 - Coatings for Exterior Metals.</p> <p>Olin's 7.6 Steep-Slope Roofing. p.458-502 Olin's 7.8 Membrane Roofing Sys. p.521-5 roof membranes. 537</p>

THURS MAR 14	Roof Design Principles Insulation and waterproofing, Drainage, ice dams, roof cladding types, inverted roof membranes	Olin's 7.10 Metal Roofing. p.540-545 65 - Mineral Aggregate Roof Surfacing. 67 - Fundamentals of Roof Design. *73 - Moisture Considerations in Roof Design. *89 - Ice on Roofs. *99 - Application of Roof Design Principles. 112 - Designing Wd Roofs Prevent Decay. *150 - Protected-Membrane Roofs. *151 - Drainage from Roofs. 176 - Venting of Flat Roofs. 228 - Sliding Snow on Sloping Roofs. 235 - Single-ply Roofing Membranes.
TUES MAR 19	Window + Door Design Code requirements, materials, energy transmissions, absorption, types, condensation, thermal breaks, and hardware	Olin's 8.5 Glazed Curtain Wall p.583-615 Olin's 8.10 Glazing. p.615-633 *4 - Condensation on Inside Window *5 - Condensation Panes of Dble 39 - Solar Heat Gain through Glass Walls. 46 - Factory-Sealed Double-Glazing Units. 55 - Glazing Design. 58 - Thermal Characteristics of Dble Windows. *60 - Characteristic of Window Glass. *101 - Reflective Glazing Units. 240 - Sound Transmission - Windows.
THURS MAR 21	Prefabricated construction techniques Modular and Flat-pack off-site construction methods, Code requirements, transportation and on-site assembly considerations	
TUES MAR 26	Energy Performance Optimization Passive and Active Solar Design, high performance building components and assemblies, Passive and active solar design, PV, BIPV and Solar thermal.	Olin's 7.12 Fireproofing. p.545-548 *36 – Temp. Gradient thro Bldg. Envelopes 209 - Energy Conservation Exist'g Bldg. *142 - Space Heating and Energy Conservation.
APR 2, 4 + 9	STUDENT PRESENTATIONS (10 minutes + 2min q+a) APRIL 11 EXAM REVIEW (last day of class) APRIL 17 – EXAM	

Means of Evaluation

The EVDS standard grading scale will be used in all evaluations for this course.

- 1) Acoustics Assignment 25%
- 2) Team Project: Building Failures 30%

Class presentation 10%

3) Final Exam (Registrar-scheduled final exam) 35%

Total 100%

Final grades will be reported as letter grades, with the final grade calculated according to the 4-point range. All assignments will be evaluated by their letter grade equivalents as shown.

Registrar-scheduled Final Examination: Yes.

Policy for Late Assignments

Assignments submitted after the deadline will be penalized with the loss of a grade (e.g.: A- to B+). For late submission after one week but not more than 2 weeks late, the loss will be two grades, e.g.: A- to B. Assignments will not be accepted after 3 weeks.

Grading Scale

Faculty shall use the following methods for reporting grades and for determining final grades. Final grades shall be reported as letter grades, with the grade point value as per column 2. Final grades shall be calculated according to the 4-point range in column 3.

Should faculty members evaluate any individual exams or assignments by percentage grades, the equivalents shown in column 4 shall be used.

Students must be informed of the method of calculation, and should be able to, from the grades provided by the instructor, determine their standing.

The following note shall be included in all course outlines:

"Final grades will be reported as letter grades, with the final grade calculated according to the 4-point range."

And, as required:

"Assignment(s) xxx will be evaluated by percentage grades, with their letter grade equivalents as shown."

Grade	Grade Point Value	4-Point Range	Percent	Description
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	

Notes:

- 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.

Readings

Canadian Building Digest, Institute for Research in Construction, National Research Council. Volumes 1-250. Free download from:

<http://nparc.cisti-icist.nrc-cnrc.gc.ca/eng/search/?m=1&q=Canadian+Building+Digest&fc=%2Bgn%3Ais&fc=%2Bhte%3ACanadian+Building+Digest>
 (Type in i.e., CBD48 in "Search for")

Recommended books:

Simmons, H.L., **Olin's Construction: Principles, materials, and methods**. 9th Ed. John Wiley & Sons, Inc. ~\$142.00 U/C bookstore or electronic copy. Might be cheaper to order from Amazon.com or the Used Bookstore.

Canadian Wood Frame House Construction. Canada Mortgage and Housing Corporation (CMHC). <http://chbanl.ca/wp-content/uploads/CMHC-Canadian-Wood-Frame-House-Construction.pdf>

Special Budgetary Requirements

Nil.

CACB Student Performance Criteria

The following CACB Student Performance Criteria will be covered in this course at a primary level (other criteria will be covered at a secondary level):

Primary:

- B8. Environmental Systems,
- B9. Building Envelopes,
- B11. Building Materials,

Secondary: A6. Human Behaviour; B3. Site Design; B4. Sustainable Design; B6. Life Safety Systems, etc.; C2. Building Systems Integration; C3. Technical Documentation

Notes:

1. Written work, term assignments and other course related work may only be submitted by e-mail if prior permission to do so has been obtained from the course instructor. Submissions must come from an official University of Calgary (ucalgary) email account.
2. Academic Accommodations. Students who require 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 or the designated contact person in EVDS, Jennifer Taillefer (jtaillef@ucalgary.ca). Students who require an accommodation unrelated to their coursework or the requirements for a graduate

degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Vice-Provost (Student Experience). For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/

3. Plagiarism - Plagiarism involves submitting or presenting work in a course as if it were the student's own work done expressly for that particular course when, in fact, it is not. Most commonly plagiarism exists when:(a) the work submitted or presented was done, in whole or in part, by an individual other than the one submitting or presenting the work (this includes having another impersonate the student or otherwise substituting the work of another for one's own in an examination or test),(b) parts of the work are taken from another source without reference to the original author,(c) the whole work (e.g., an essay) is copied from another source, and/or,(d) a student submits or presents work in one course which has also been submitted in another course(although it may be completely original with that student) without the knowledge of or prior agreement of the instructor involved. While it is recognized that scholarly work often involves reference to the ideas, data and conclusions of other scholars, intellectual honesty requires that such references be explicitly and clearly noted. Plagiarism is an extremely serious academic offence. It is recognized that clause (d) does not prevent a graduate student incorporating work previously done by him or her in a thesis. Any suspicion of plagiarism will be reported to the Dean, and dealt with as per the regulations in the University of Calgary Graduate Calendar.
4. Appeals: If a student has a concern about the course, academic matter, or a grade that they have been assigned, they must first communicate this concern with the instructor. If the concern cannot be resolved with the instructor, the student can proceed with an academic appeal, which normally begins with the Faculty:
<http://www.ucalgary.ca/provost/students/ombuds/appeals>
5. Information regarding the Freedom of Information and Protection of Privacy Act (<https://www.ucalgary.ca/legalservices/foip>)
6. Emergency Evacuation/Assembly Points (<http://www.ucalgary.ca/emergencyplan/assemblypoints>)
7. Safewalk information (<http://www.ucalgary.ca/security/safewalk>)
8. Contact Info for: Student Union (<https://www.su.ucalgary.ca/contact/>); Graduate Student representative <https://gsa.ucalgary.ca/about-the-gsa/gsa-executive-board/>) Student Union Wellness Centre: <https://www.ucalgary.ca/wellnesscentre/>; Library Resources: <http://library.ucalgary.ca/> and Student Ombudsman's Office (<http://www.ucalgary.ca/ombuds/>).