Solar heating in high performance buildings **EVDS 683.47 H(3.0)**

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Wednesdays 9:30-10:50, Classroom PF 3177

Introduction

The National Building Code of Canada will now include regulations beyond life-safety issues to include the Model National Energy Code, water conservation, radon protection, etc. This is a significant departure from all previous building codes, recognizing that buildings consume enormous resources in its construction and operation, and that the building industry has a significant role towards a healthier and sustainable future.

This course will examine how buildings consume materials resources and energy. It will discuss energy conservation strategies and techniques, from basic thermal insulation to air-tightness. Efficient mechanical systems for heating, cooling, and ventilation will also be discussed along with components designed for recycling heat, air, humidity, etc. Building configuration and building enclosures are examined to determine how fenestrations affect heat loss and solar heat gain.

An important component of any high performance building beyond energy conservation is to incorporate solar heating, wind power, ground source heat pumps, etc. From simple passive solar heating to active systems for year-round seasonal storage will also be illustrated in this class.

Objectives

1. To explore the design of sustainable built environments, and to develop strategies to reduce resource consumption and pollution.
2. To develop skills to integrate architectural & design ideas about space, form and structure and its response to environmental forces.
3. To learn how materials and technology such as mechanical systems can be applied to reduce energy consumption in the operations of buildings.
4. To acquire an understanding of passive and active environmental strategies, which harness the potential of natural phenomena: daylight, solar energy, natural ventilation and thermal cycles.
5. To acquire an understanding of the life span of a building and its components, to achieve overall energy efficiency, healthy occupants and environmental performance.

Teaching Approach

This is a lecture and seminar type course with class discussions and readings from Desire2Learn. A research paper and a case study critique of an existing project will demonstrate an understanding of the concept, its synthesis and applications.

Content: Topic Areas & Detailed Class Schedule

The course examines buildings and their design strategies to achieve high performance including energy conservation and use of renewable energies. Case studies of the design, construction and performance of local energy conserving and solar heated buildings from passive to active systems will be explored.

DATE	TOPIC
Sept 10	Introduction to state of the world, depletion of resources and pollution affecting human health. Assign team project. Defining high performance buildings and solar heating.
Sept 17	Energy efficiency in buildings, heat, cool, ventilation and power.
Sept 24	Solar energy
Oct 1	Solar collectors, concentrating and flat plate collectors.
Oct 8	Principles of solar energy and heating.
Oct 15	Sunspaces and greenhouses
Oct 22	Solar walls, solar roofs, earth tubes, etc. **Due:** Individual assignment
Oct 29	Tools for building energy analysis and solar system design, HOT2000, F-chart, TRNSYS.
Nov 5	Photovoltaic, wind electric, geothermal, ground source heat pump and earth tubes. Heat recovery, and emerging energy technologies.
Nov 8-11	Reading week
Nov 12	District heating, power generation, heat pump, Sterling cycle engine, etc. Alternative and waste as a resources.
Nov 19	Sustainable planning and urban design
Nov 26	Class presentations
Dec 3	Class presentations **DUE:** @ Midnight both team paper and PowerPoint

Means of Evaluation

The course evaluation will be based on the assignments completed during the term, which includes written assignments, presentation of work and facilitating discussions. There will be no final examination.

Individual Assignment: Investigate a sustainable technology and how it can be incorporated into a project.
Report (30%), Presentation (10%)

Team Project. **Analysis of a renewable energy project (40%).**
With one partner from the class, choose either a proposed or built project that you would upgrade or convert into a high performance building. Describe the proposed technologies, strategies or modifications and how you would retrofit into the project without significantly affect the original design. Provide precedents and expected performance outcome and cost effectiveness.

Class Presentation Prepare and present your team project **(20%).** Approximately 30 slides are typically sufficient.

Total: 100%

Submit paper, and presentation to the instructor ***lee@ucalgary.ca*** via e-mail or deposit into Desire2Learn. No hard copies are necessary.

Policy for Late Assignments

Assignments submitted after the deadline may be penalized with the loss of a grade (e.g.: A- to B+) for each day late.

Grading Scale

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

Grade	Grade Point Value	4-Point Range	Percent	Description
A+	4.00	4.00	92.5-100	Outstanding - evaluated by instructor
A	4.00	3.85-4.00	85-92.49	Excellent - superior performance showing comprehensive understanding of the subject matter
A-	3.70	3.50-3.84	80-84.99	Very good performance
B+	3.30	3.15-3.49	76-79.99	Good performance
B	3.00	2.85-3.14	73-75.99	Satisfactory performance
B-	2.70	2.50-2.84	70-72.99	Minimum pass for students in the Faculty of Graduate Studies
C+	2.30	2.15-2.49	66-69.99	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	63-65.99	
C-	1.70	1.50-1.84	60-62.99	
D+	1.30	1.15-1.49	56-59.99	
D	1.00	0.50-1.14	50-55.99	
F	0.00	0-0.49	0-49.99	

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.

Recommended Readings

- Boyle, Godfrey. *Renewable Energy: Power for a Sustainable Future*
- Kellert, Heerwagen and Mador (Ed.). Biophilic Design, John Wiley & Sons, Inc.
- Lopez Barnett, D. and Browning, W. *A Primer on Sustainable Building.* Rocky Mountain Institute. Snowmass, Colorado.
- Publications from Canada Mortgage and Housing Corporation (CMHC).
- Straube, John. High Performance Enclosures. Building Science Press. *www.buildingscience .com*

Internet resources:

Environmental Building News EBN: http://www.buildinggreen.com/
Good hotlinks from: http://www.yourhomeplanet.com
LEED 2.0 - http://www.usgbc.org
GBCTool - http://www.greenbuilding.ca

Textbook:

1. Design on the Edge – The Making of a High Performance Building
2. Adapting Cities and Building for Climate Change
3. High Performance Building Guidelines – New York City

(All books are on Blackboard)

Special Budgetary Requirements: Nil

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. It is the student's responsibility to request academic accommodations. If you are a student with a documented disability who may require academic accommodation and have not registered with the Student Accessibility Services, please contact their office at 220-8237. (http://www.ucalgary.ca/access) Students who have not registered with the Student Accessibility Services are not eligible for formal academic accommodation. You are also required to discuss your needs with your instructor no later than fourteen (14) days after the start of this course.

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. Information regarding the Freedom of Information and Protection of Privacy Act (http://www.ucalgary.ca/secretariat/privacy) and how this impacts the receipt and delivery of course material

5. Emergency Evacuation/Assembly Points (http://www.ucalgary.ca/emergencyplan/assemblypoints)

6. Safewalk information (http://www.ucalgary.ca/security/safewalk)

7. Contact Info for: Student Union (http://www.su.ucalgary.ca/page/affordability-accessibility/contact); Graduate Student representative(http://www.ucalgary.ca/gsa/) and Student Ombudsman's Office (http://www.su.ucalgary.ca/page/quality-education/academic-services/student-rights).