

CE 507: BUILDING SCIENCE AND TECHNOLOGY

This course is directed at fourth-year undergraduate and M.Eng graduate civil engineering students who intend to make a career in the building industry. Architecture, mechanical engineering and other graduate students with the appropriate background and intentions may also take the course for credit or audit.

The major goal of the course is to impart some knowledge of the basic physics (especially regarding heat, air, and moisture) that governs the performance of the building enclosure. However, to provide the necessary background and context for this goal, we also:

- Develop an appreciation of the importance of buildings to society and sustainability and the context in which professions operate in the building industry
- provide some coverage of some aspects of buildings not covered in other civil engineering courses, e.g. economics, building methods, materials.
- explore some of the factors that influence the design of the buildings and their enclosure elements, especially durability, risk, reliability, insurance, etc.
- explain and thereby help avoid common building design and construction errors that result in poor performance, litigation, expensive repairs, etc.

The focus is on the needs of the civil engineer, i.e., the design, rehabilitation, construction and operational aspects of building enclosures i.e., walls, windows, roofs, etc.

Lectures: **Tuesday** RCH306 8:30-10:30 a.m. (usually lectures)
 Friday RCH306 8:30 to 10:30 a.m. (lectures, tutorials as needed)

Prerequisites: Some structures background or Instructors consent

Credits: Two Quizzes: 2@10%
 Assignments 30 % 4 Group assignments
 Exam #2 (final): 50 %

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Text: Straube, J.F., and Burnett, E.F.P., *Building Science for Building Enclosures*, Building Science Press, 2005. ISBN: 0-9755127-4-9 (to be sold in class at discount) www.buildingsciencepress.com

Supplemental notes will be provided on line.

Please check www.civil.uwaterloo.ca/beg and follow the Building Science Student links for updates, electronic copies of course handouts, and a range of technical resource files.

Topic	Textbook Chapter
INTRODUCTION:	
What is Building Science, Why is it important?	1
The Building and its Functions	1
The Building Enclosure and its Functions	2
ASSIGNMENT #1 –6%	
PHYSICS OF ENERGY, MATTER, AIR AND WATER	
States of Matter	4
Heat and Energy – definitions and units	
Radiation and Stefan-Boltzman's Equation	
Gas Laws and the Atmosphere	
Psychrometrics and Water vapor	
BUILDING ENCLOSURES: THERMAL CONSIDERATIONS	
Fourier's Law and Heat Flow	5
Predicting/Calculating Heat Flow and Temperature Gradients	
Thermal Bridging and Dynamics of Building Enclosures	
QUIZ #1 - 10%	
ASSIGNMENT #2 -6%	
BUILDING ENCLOSURES: WATER VAPOUR CONSIDERATIONS	
Fick's Law and Water Vapour Flow	6
Water Vapour Flow Through Building Enclosures	
Diffusion Wetting and Drying Analysis	
Air Leakage Condensation – Calculation	
Control of Interstitial Condensation	10
ASSIGNMENT #3 - 6%	
BUILDING ENCLOSURES: AIR MOVEMENT CONTROL	
Bernoulli/Darcy's Law and Air Flow	7
Wind and Buoyancy (Stack) Effects on Buildings	
Air Leakage Control: Air Barriers, Pressure Control	
QUIZ #2 - 10%	
DESIGN: THE VARIABLES AND THE CONSTRAINTS	
The Outdoor Environment: Climate and Weather	3
The Indoor Environment and Human Comfort	
The Limit States: Durability and Performance	
BUILDING ENCLOSURES: FROM PRINCIPLES TO PRACTISES	
Moisture Engineering: General Principles	9
Driving Rain and Rain Penetration Control Strategies	12
Example Walls Systems: Masonry, EIFS, Curtainwall, Precast	
PROJECT - 12%	
GIVEN TIME ...	
Moisture and Materials	8
Low-Rise Residential Housing	
Building Movements and Joints	
Roofs Systems: Pitched and Flat	
Below-grade Walls and Floors	
Windows and Curtainwalls	
Energy Consumption and Human Comfort	