Arch 1202.03
"Science of the Built Environment 2"

Course Duration	**Winter Term. Jan. 8th., 2023, to April.10th., 2024**
Location	**Ralph Medjuck Bldg. B102** (formerly HA18)
Lecture Times:	**Wednesday's at 2:30 until 5:30 PM**
Lecturer	**Douglas Pitcairn B.Sc.**
Office: School of Architecture.	**Room HA-31 (Architecture Building)**
Office Hours	**Not Applicable.**
Phone:	**Cell Phone will be given out on an "as needed " basis.**
E-mail (preferred)	**douglas.pitcairn@dal.ca or thepitcairns@ns.sympatico.ca**
Brightspace	**Partially utilized (for quizzes and handouts)**

Calendar Description.

ARCH 1202.03 Science of the Built Environment 2

CREDIT HOURS: 3

This course introduces a broad range of scientific principles that influence the relation between modern buildings and their exterior environment. Topics include heating, cooling, storms, water, and foundations. It uses a "common-sense" approach involving graphic images, practical understanding, and problem-solving. A background in mathematics or science is not required.

FORMAT: Lecture

Additional Course Description.

Architecture has always been a technologically supported endeavour. Our ability to construct comfortable living spaces that reflect our status and culture continues this trend, as increasingly sophisticated technologies are finding their way into all buildings. Modern houses now include many complex innovations once reserved for only the most advanced buildings. Yet for much of the world, the crushing need for basic shelter continues to be paramount. We will see that technology has the potential for both comfort and simplicity, and perhaps make a case that both are desirable.

This course will introduce and explain the various forces and challenges which effect and shape the built environment. Why buildings work, and why they don't. The intention is to instil in students a targeted yet broad science knowledge base, to introduce and explain most of the relevant topics, and encourage further thinking about potential solutions for

shelter. Particular attention will be directed towards a building's interaction with the external environment, both above and below ground.

The Class will attempt to use a common sense approach involving graphics, practical understanding and (hopefully) some actual scientific thinking. This course is lecture based, with outline notes and a list of web sites provided. There may be suggested readings, but no official textbook. There is, however, a complete set of study notes covering the entire course. These will make up the material for your review for the tests. Lectures are available online (via a Google Link, which I will email to you.) and should be downloadable for long term study.

A background in science or mathematics is not necessary, indeed, the class assumes you have very little if any science background. Class discussions will be encouraged. A sense of humor is useful as always.

Grading will consist of 3 minor assignments together worth %50, and two tests worth 50%. Access to reliable email is essential in this class. You must have an active e-mail account. I will use your Banner email address, so be sure to monitor it regularly. All assignments are handled through email. Dates of assignments and assignment grades with comments are all done via direct email between the instructor and the student. I would ask that you use a consistent subject line with the course, your name and the reason for the email... like this:

" **Subject:** Arch 1202 Harry Potter a question "

The Quizzes will be held online in the BrightSpace system. I will also use BrightSpace to distribute the study guides for the course. They will be available in a module called "handouts". There is no formal class schedule, the below list of topics is followed closely on a linear basis. Time on each subject can vary with students interest.

Note: There is an overlap of a few classes between this course and the previous Arch 1201.03. This is intentional, as there is no prerequisite, I will have students who did not take Arch 1201.03, and we need to cover that material.

Topics Covered.

Class Intro "A building as an insertion"
(A quick overview of the course's study)

Avenues for Interaction.

Energy/Space/Light/Heat/Radiation/Sound/Air/Water/Flora/Fauna.

Sciences' place in the modern world.

Science's necessity given the population.

The global rise in standard of living attributable to scientific knowledge?

Covid 19, The lesson we're all living in.
Technology History
Energy Consumption / Pollution
Food Production / Standard of Living
Human Life Expectancy*

Art and science in Architecture, a synergetic antithesis.

Dependent yet exclusive.

"Shelter most basic" class discussion / exercise

The Scientific Principle, A Path to Knowledge.

A process to determine the truth.

Systematic, repeatable, logical, peer reviewed

Math vs English, Communication of ideas...

A Little Physics goes a long way.

Atomic structure Tiny bits on which it all depends...

Molecules, Atoms, Protons to Quarks,
Atomic structure
Four Forces of Nature (The 4 fundamental forces which explain everything.)

Electromagnetism
The Nuclear Brothers
Newton & Motion & Gravity
Einstein

Electromagnetic Theory+

Nature of Light
Waves vs Particles
Light and Colour
White light & why
Absorption/emission?

The Other Bands+

Infrared
Ultra Violet
Radio
X Rays
Gamma

Danger/Temp/Energy/ Wavelength
Blackbody radiation in general.

Blackbody radiation in Architecture:
Spectral Lines
Emission and Absorption

Radiation in the Environment
Types of Radioactivity
Radioactivity in the Natural Environment
Radiation Damage
Half lives, Dosages and Effects
Medical Uses
Nuclear Reactor Accidents
Radioactive Dating
Radiation in buildings.

A little Astronomy (I couldn't resist!)
Where we are.
The long distance view, Threats to the species.
Motions and effects.
Calendar
Seasons
Solar angles and uses and implications

Keeping your Cool.... keeping your heat...

Temperature... Keeping Warm in a frozen Universe.
Absolutes and scales.
Thermodynamics
Warm interior?
Envelope loss and Infiltration.
Heat in motion
Conduction
Thermal Conductivity
Coefficient of expansion
Convection
Weather
Stack Effect
Chimneys
Radiation
The thermos bottle
Evaporation and Phase changes

Heat Transfer in the Built environment.
Insulation from A-Z,
Heat Load.
Surface area/Volume Ratios
Shapes and efficiencies

- Heat Island and micro climates.

Thermal Performance of Windows
- Transmittance
- Reflectance
- Absorption
- Emittance
- 4 EM classes
- Low E, Argon,Krypton and jargon

Domestic Heating/cooling systems
- Hot Air
- Hot Water
- Radiant Heating/Cooling
  - Concept
  - Task (spot)
  - Electric
  - Hot Water (in floor)
- Heat Pumps
  - Air, Water & Earth.
- Thermal Mass Storage Domestic Units
- Auxiliary Options
- Thermostats.
- Zones.

Commercial heating and cooling.
- Cooling in January?
- Cost now, cost later
- Some concepts
  - Passive / Dynamic Thermal effects
  - Thermal mass Generally
  - Phase Change Materials
  - Stack effect
  - Pressure equalization
  - Exhausts and why
  - Fresh Air and Consequences
  - Moisture
- A quick look at System design

Human Comfort
- Air Temperature
- Surface (Radiant Temperature)
- Humidity
- Air Velocity (2 air Ch/Hr.)(20 cfm/person)
- Activity Effects Watts per person.
- Clothing.

Energy For Buildings

- History of Primary Energy Sources
  - Muscle (Human/Animal)
  - Wind
  - Water
  - Wood
  - Steam engine
  - Coal
  - Oil
  - Hydro
  - Nuclear Fission
  - Fusion vs Fission
  - Waste Storage issues.

- Alternate Energy Sources, Pros and Cons*
  - Solar Energy
    - Thermal Passive
    - Thermal Active
    - Photovoltaic.
  - GeoThermal Energy
  - Tidal Power
  - Wind Energy
  - Biomass
  - Biogas
  - The Atmosphere
  - Focus for the Future

Air

- The "Ocean we Live in" The Earth's atmosphere
  - Atmosphere/Meteorology
    - History of the atmosphere.
    - Gas behavior temp, pressure, humidity
    - Global Circulation
    - Coriolis Force
    - Lows, Highs and Fronts

- Storms and Furies
    - Two sources, Front and System
    - Tornadoes
    - Hurricanes
    - Implications for Building design.

  - Amateur Meteorology

- Crossed winds
- Mackerel Sky
- Watery Sun
- Sunrise/sunset
- Barometer trends
- Farmer's Almanac

A World Out of Whack

- Climatic vs weather
- Climate records.
- Climate Change
  - The Carbon Cycle
  - The Greenhouse Effect,
  - Climate Gauges
    - Glaciers
    - Sediments
  - Ozone and Holes therein.

- Implications and uses for design.
  - Snow load
  - Storm drain sizing
  - Wind loading
  - Insulation cost effectiveness.
  - Foundations and Erosion

Air as a Force.

- Airflow around Buildings
  - Positive vs negative pressure zones
  - Asymmetry for ventilation
  - Problems from Tall Buildings
    - Solutions
    - Skirts
    - Pedestals
    - Aerodynamics

Snow

- Snow vs wind dilemma
- Snow loading
- Snow control

Air quality, Sick buildings.

- Indoor Air Pollution
  - Efficiency vs toxicity
  - Biological
  - Chemical

Radiation

Air Supply to Buildings,
- Passive Ventilation
  - Attics
  - Soffets
  - Ridge Vents
  - Venmars
  - Fans
  - Windows
  - Stack effect.
  - Passive circulation
- Active supply
  - Heat exchangers
  - Exhaust makeup air
  - Air structures
  - Systems and options

- Filters
  - Replaceable
  - Washable
  - Mechanical
  - ElectroStatic

Spring Break.?

The Earth beneath your Feet.

The Earth as a Planet. "A terrestrial world"
- Formation
- Overall structure / How we Know...
- Geological Time Scale
  - Impacts/Tectonism/Volcanism/Gradation

- Earthquakes
  - EarthQuake damage/earthquake proofing?
  - Tsunami
  - Mudslides

Surface structure
- Soils and Layers
- Thermal Gradient
- Heat Exchange
- Permafrost
- Implications for Buildings

Foundations for Buildings
- Basics / Normal Construction
- Cracks and Repairs
- Loads and Piles

Man's Environmental Impact

Soils for Crops. Feeding the Human Parasite.
- Bio/Geo Cycles
  - Carbon/Water/Nitrogen/Phosphorous
- Value of dirt (Soil Maintenance / management)
- Food production limits
  - Biological engineering
  - Genetic engineering
  - Climatic change
- Land sat and Land Use Planning

Architecture's Role
- Leeds, a softer impact. An environmental rating System
  - Sustainable Sites
  - Water efficiency
  - Energy and Atmosphere
  - Materials and Resources
  - Indoor Environmental Quality
  - Bonus for design and regional Priority

Sewage and Disease, Separating Waste and People....
- Domestic septic systems/Municipal Systems
- Treatment methods
  - Screening
  - Settling
  - Anaerobic / Aerobic
  - Chemical
  - Organic

Garbage, garbage everywhere....(Solid Wastes)*
- Disposal Methods
- Historical Patterns in Waste Disposal
- Sanitary Landfills Site Selection
- Pollution from Sanitary Landfills
- Incineration
- Source Reduction

Water Water everywhere....

Water, Unique matter for a complex chemistry.... the Liquid of Life

- Some Basic facts
  - Basic Chemistry
  - Waters origins
  - Heat issues
  - Solvent issues
- Hydrologic cycle
- Fresh vs salt

Water as a resource. Water as a weapon.

- Resource depletion
- Costs

Ground Water*

- The Water Table and Movement of Groundwater
- Porosity and Permeability
- Aquifers
- Changes in the Groundwater System
- Water Quality and Groundwater Contamination

Moisture in the Built environment.

- Humidity sources,
  - Cooking
  - Respiration
  - Bathing
  - Infiltration
- Standards for comfort.
  - Temperature vs Relative Humidity
  - Psychrometric Chart
- Seasonal Changes
- Destructive nature of humidity
- Passive methods of adding and removing interior moisture.
  - Condensation
  - Vapor barriers
  - Good old open Windows
- Active methods of adding and removing moisture.
  - Dehumidification.
  - Pressurization
  - Stack effect
  - Air/Heat exchangers
  - R2000 issues
- Exterior Water
  - Roof details and materials
  - Gutters and storm drains
  - Wall Claddings as “waterproofing”
  - Rain screen principles
    - Get types from references.
  - Flashing

Wind pressure

Accommodation

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic under the Nova Scotia Human Rights Act. Students who require academic accommodation for either classroom participation or the writing of tests and exams should make their request to the Advising and Access Services Centre (AASC) prior to or at the outset of the regular academic year. Please visit www.dal.ca/access for more information and to obtain the Request for Accommodation - Form A