

UNIVERSITY OF NOTRE DAME
Department of Aerospace and Mechanical Engineering
AME 47431: Designing Energy-Efficient Buildings
4th Year Design Studio Space, Bond Hall
Monday, Wednesday, Friday, 2:00 p.m. – 2:50 p.m.

Instructor:

Prof. David B. Go
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Co-Instructor:

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Office Hours: By appointment.

Email Contact:

Dr. Go will respond to any email sent during the week within 24 hours. Dr. Go cannot guarantee email availability on weekends, but will respond as soon as possible.

Course Website: We will use the Box utility to share documents, submit assignments, and communicate course requirements.

Course Text: There is no formal course text, but students are encouraged to download manuals for SketchUp and Sefaira.

- <http://help.sketchup.com/en/article/36213>
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Final Exam: None

Course Content:

This project-oriented course introduces students to engineering practice by creating an interdisciplinary, collaborative environment with students from the School of Architecture. The intent is to expose the students to collaborative design and analysis by completing design projects in teams that utilize the architectural design skills of the architecture students and thermal analysis skills of the engineering students. Engineering students will be exposed to building thermal and energy analysis software, building computer-aided design software, and architectural concepts and topics.

Learning Goals: At the conclusion of the course, the student should be able to:

1. Construct a 3D dwelling or building using the SketchUp software.
2. Analyze the thermal performance of model building using Sefaira software.
3. Make design choices informed by analysis to enhance a building's energy performance and recommend energy-efficient design changes for a building design concept.

Grade and Assignments: Final grades will be based primarily on project technical memos, project presentations, and overall engagement in the course and its objectives. Exact values of relative course assignments have not been determined and will be communicated throughout the semester. However, based on the multiple projects and task throughout the semester, the Instructors anticipate the following breakdown:

Task/Project	Deliverable	Percentage of Grade
Project 1a	Presentation/Technical Memo	10%
Project 1b	Presentation/Technical Memo	10%
Project 2a Site Analysis	Presentation	10%
Project 2b Comprehensive Building and Site Design & Analysis	Mid Review Iteration Technical Memos Final Review	10% 10% 10%
Project 2c Final Report	Technical Report	20%
Overall Engagement		20%

Studio Component:

Unlike most engineering courses, this course does not have a major lecture component. Instead the majority of the course will take place during the typical studio time for the sister course ARCH 41121. During these studio times, the students will be given time to work on specific projects (see projects outlined below), work with their Architecture student collaborators, give presentations, and receive feedback from the Instructors. However, because of the nature of the two different courses, the meeting times do not overlap completely:

ARCH 41121 Monday, Wednesday, Friday, 1:00 p.m. – 5:00 p.m.

AME 47431 Monday, Wednesday, Friday, 2:00 p.m. – 2:50 p.m.

Attendance during the course meeting time is mandatory for every class; failure to attend class without proper notification will adversely affect the engagement portion of the course grade. In many instances, the students will find that being at the studio and working with their Architecture peers outside the specified course time is very beneficial, and the Instructors encourage the students to use the studio time to be as productive as possible (both during and outside of class time).

On a few instances, the Instructors will be required to extend the class time to accommodate the activities of the day – in particular a trip to Chicago and major reviews that last the duration from 1:00 – 5:00 p.m. the Instructors will provide notification of these dates well in advance and will help facilitate overcoming any conflicts with other classes with reasonable scheduling. The Instructors do not anticipate this being a major issue, but if it is, please bring it their attention as soon as possible.

Note that any absence must be accompanied by an **approved absence from the Office of Residence Life**. Students should note that there are only seven approved absences under the policies outlined in *du Lac* (Section 3.1): 1) participation in a University-authorized activity, 2) death or major illness in the family, 3) participation in off-campus legal proceedings or administrative procedures, 4) religious holy day, 5) illness, 6) required military duties, and 7) *post-graduate interviews with at least one week notification in advance*.

General Course Philosophy:

As a project-based course, there is a significant amount of “self-learning” that is expected of the students, as they will encounter (and tackle) challenges that neither the Instructors or their peers have encountered before. Liberal use of all available resources is encouraged, including the internet, message boards, print resources, and discussion among classmates. However, while collaboration and interaction

is encouraged, submitted and graded projects must ultimately be the work of the individual student or pre-identified student teams.

Along those lines, the Instructors are not experienced nor experts with the two primary software packages that will be used for this course (SketchUp and Sefaira). The students will be expected to teach themselves these software tools in order to address the problems defined by the Instructors. Some guidance will be given in the form of tutorials, but the students are encouraged (and expected) to seek other resources and tutorials on their own to improve and enhance their skill with these software packages.

Honesty:

All students are expected to follow the Academic Honor Code of the University, which states “**As a member of the Notre Dame community, I will not participate in or tolerate academic dishonesty.**” Copying (in part or whole) another's design, computer program or written work, and cheating on projects or presentations are considered dishonest and absolutely will not be tolerated. It is dishonest to use the work of another student/team even with his or her consent if you are being graded on an individual/team basis. **ALL aspects of every report/memo (text, figures, tables) MUST be the original work of the authors.** If you have questions about the University’s honesty policy – do not assume, ask!

Disclosure:

The Instructors retain the right to modify the contents/requirements/deliverables for this course throughout the semester. The students retain the right for adequate notice of any changes via email or in-class announcements.

Course Overview

In this course, engineering students will use a combination of computer-aided design (CAD) software, thermal analysis software, and hand calculations to conduct energy analysis on buildings designed by their architecture collaborators. In addition to these analyses, students will also investigate different energy systems for buildings and learn about energy efficient building design requirements and policy. The course is broken up into a series of tasks and projects as outlined below, with more detail provided throughout the semester:

1. Assignment 1 – Basic Parametric Analysis (**Deliverable:** Technical Memo)
 - a. The objective of this assignment is to introduce the student to the software packages SketchUp, OpenStudio, and EnergyPlus by analyzing a model office building. Parametric studies will be conducted to exercise the student’s skills, expand their capability with the software tools, and enhance their understanding of how buildings perform (from an energy perspective)
2. Assignment 2 – Advanced Parametric Analysis (**Deliverable:** Presentation)
 - a. The objective of this assignment is to advance the students capabilities with SketchUp and EnergyPlus by requiring an advanced structural design accompanied by a series of parametric studies.
3. Assignment 3 – Types of Energy Systems and Integration into EnergyPlus (**Deliverable:** Presentation and Technical Memo)
 - a. The objective of this assignment is for the student to investigate and analyze different types of energy systems, including HVAC systems and renewable energy systems, and how to integrate them into EnergyPlus analyses.
4. Assignment – Energy Efficient Design Policy (**Deliverable:** Presentation)
 - a. The objective of this assignment is to research basic aspects of energy efficient building design from a standards and policy perspective. The point is to understand what are the expectations for comfort and energy use from organizations such as the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) and how this influences building design.
5. Assignment – Archetype Analysis (**Deliverable:** Presentation and Technical Memo)
 - a. The objective of this assignment is for the student to conduct an energy analysis of a traditional architectural prototype (archetype) that has some inherent energy efficiency features. The students will attempt a combination of hand calculations and using EnergyPlus to analyze these structures.
6. Project 2c – Comprehensive Building Design/Analysis (**Deliverable:** Reviews (mid & final), Presentation, Technical Memo)
 - a. The objective of this task to conduct iterative studies with their architecture collaborators on the design of a building. The student will conduct energy analysis using EnergyPlus to evaluate the energy performance of the building and work closely with the architecture student to make design decisions that balance form and function with energy performance.

Deliverables

There are multiple types of deliverables for this class depending on the class or project.

Technical Memos

Technical memos will follow the format used in AME20213 Measurements and Data Analysis. They will be double spaced and limited to 5 pages (excluding references and appendices). They will be delivered as both hard and soft (electronic) copies.

Presentations

Presentations using Powerpoint or a similar software program will be given during class. Because of the number of students, class may be extended on these days and the option of shortening studio time on other days will be offered – note that the presentations are only scheduled for Fridays. Guidelines on the number of slides and presentation length will be given for each assignment. In addition to giving the presentation, copies of the slides must also be delivered as both hard and soft (electronic) copies.

Reviews

The engineering students are expected to partake in the mid- and final reviews that their architecture students give to a jury of experts and clients with vested interest in the project. They will provide tables/charts/diagrams as necessary and partake in the review process, both explaining aspects of their analysis and how it impacted design as well as answering questions.