Building Energy Analysis and Modeling:
An analysis of campus buildings to improve efficiency and sustainability.

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Green Design is a movement in the architectural and engineering disciplines to design and build structures in an environmentally friendly fashion. Over the years, engineers and architects have been trying to implement sustainable design concepts by constructing buildings that enhance occupancy comfort while actively considering reduction of energy consumption, water usage, carbon emissions and increasing the aesthetic. Building systems consume large amount of energy and most of the buildings at CSUN were not designed to today's standards of efficiency. For the last decade CSUN has actively pursued sustainable infrastructure and in many cases are considered a leader in energy conservation among universities across the United States. Out of 23 large buildings in CSUN campus, only two of the recently constructed buildings achieved LEED "Gold" certification. But, it is imperative to assess how all these buildings are performing regarding energy efficiency and sustainable design. A significant number of these energy inefficient buildings can be renovated or upgraded to provide higher level of efficiency.

Ojectives and Course Redesign

The objectives of this course redesign is to study how CSUN buildings are performing; evaluate how much ecological efficiency they can offer in their current conditions; identify possible avenues that can be implemented to increase the level of efficiency; and finally develop an optimized renovation scheme based on a 3-D simulation model to increase the level of efficiency. The proposed project will be carried out in several phases by senior level civil engineering students. The project will be incorporated as part of their course curriculum satisfying their degree requirements. At the end of each semester a Building Energy Analysis Report will be supplied to FPDC/PPM that will outline all feasible upgrades including cost, ROI, savings, etc.

Courses to be Redesigned

CE 438 – Reinforced Concrete Design (3)
Prerequisite: CE 335. Basic concepts in the design of reinforced concrete structures. Applications to beams, columns, slabs, shear walls, footing, and composite construction. (Design units: 3)

CE 439 – Structural Steel Design. (3)
Prerequisite: CE 335. Basic concepts in the design of steel structures. Design in steel of tension and compression members, beams, columns, welded and bolted connections; eccentrically loaded and moment resistant joints; plate girders. Introduction to computer aided design. (Design units: 3)

CE 698 – Thesis. (6)
Prerequisite: Advancement to candidacy for the MS degree and written approvals of faculty advisor and Department Graduate Coordinator or Department Chair.

Course Contributions

The senior students of the Civil Engineering Department will participate in this course redesign. The students will be divided into several groups that will perform a specific task concerning the project. They will work in several teams which will collaborate with personnel from the FPDC and PPM departments to gather information and discus the feasibility of the solutions. The project will be conducted in three phases:

In Phase I
Study the building's architectural, structural and MEP systems, assess the existing conditions and calculate total water and power usage and CO2 emission per unit time (day).

In Phase II
Identify the potential improvements such as, water efficiency (water recycling), material usage (window glazing) and addition of PV panels, which can be added to the existing system to improve the efficiency. Calculate the benefits of each potential improvement to maximum the efficiency of the building in each category independent of the influence of other categories.

In Phase III
Student teams will use AECOSim software to run the 3-D building energy simulation for each building. Based on the available improvements options the students will develop an interactive model which will optimize the energy consumption. The model, developed by the students, will serve as a guideline for future building renovations and improvements.

Course Offerings & Learning Outcomes

CE 438 – Reinforced Concrete Design
- Offered in both Fall & Spring

Attain and demonstrate the following program outcomes:
- an ability to apply knowledge of mathematics, science and engineering.
- an ability to design a system, component or process to meet desired needs.
- an ability to identify, formulate and solve engineering problems.
- an understanding of professional and ethical responsibilities.
- apply knowledge in a minimum of four (4) recognized major civil engineering areas.

CE 439 – Structural Steel Design
- Offered in both Fall & Spring

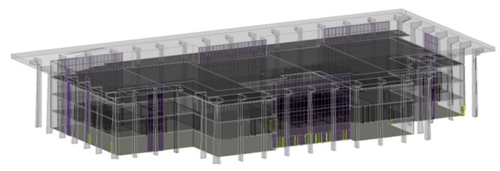
Attain and demonstrate the following program outcomes:
- an ability to apply knowledge of mathematics, science and engineering.
- an ability to design a system, component or process to meet desired needs.
- an ability to function on multidisciplinary teams.
- an ability to communicate effectively.
- a knowledge of contemporary issues.
- apply knowledge in a minimum of four (4) recognized major civil engineering areas.

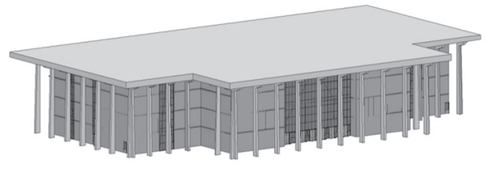
CE 698 – Thesis.
- Offered throughout the year
- Graduate Thesis with the intentions of building on applicable real life Sustainable building designs and retrofits.

Oviatt Modeling Pilot Project: 14/15

CSUN student's piloted a building efficiency and modeling project in 2014/15. This project was completed on both the Valley Performing Arts Center and the Oviatt Library. The students used AECOsim to model the energy usage of each building. Below are renderings of Oviatt Library the models they developed and analyzed.


Oviatt Library





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