

# ARCH 4150/5550 • Whole Building Analysis

## *Envisioning the Sustainable Campus*

*towards zero: integrating carbon, energy, water and ecological impacts*

### **Exercise 1: Creating a Shoebox Model and establishing a Baseline Case**

#### **Exercise 1 Part A Due Date**

Tues. Sept. 20, 2011, 12:30 PM

Upload to Exercise 1 assignment drop box on course Moodle site

*Phase Grade weighting: 5% total grade (50 points); individual grade*

#### **OBJECTIVES**

- To learn to create a pre-design phase rudimentary building energy model
- To establish a baseline performance model for your project including loads and energy use.
- To identify the performance metrics, tools and related performance goals for your project.
- To begin to establish an holistic approach to integrated whole building analysis
- To identify energy conservation measures (ECMs) for evaluation prior to beginning design

#### **Introduction**

This exercise will guide you through the process of creating a “shoebox” model based on the requirements of your project. A "Shoebox" energy model is a preliminary energy model of the building in the form of a shoebox, using the actual floor area, climate, building type, operating schedule, and utility rates for the project. The shoebox energy model is often created during the pre-design or early schematic design phase before the building form has been determined, and can be used to inform early design decisions to optimize energy performance. In this exercise several key building performance metrics (e.g., energy use, average monthly heating and cooling loads, utility costs, energy use intensity (KBtu/sf, etc.) will be measured and a performance baseline that corresponds to ASHRAE 90.1 2004 will be established. This Baseline will be used for comparison to evaluate the relative effectiveness of a variety of design strategies and energy conservation measures (ECMs). The results of this series of studies will be used to establish specific performance goals for the key performance metrics under consideration. Students will work in teams of 2 or 3 and will divide up the responsibilities for evaluating the various ECM's under consideration, but will combine the results to reach a consensus on the findings and conclusion. Each individual will be responsible for turning in their own **shoebox model** for Exercise 1A.

As you perform the following steps, note that:

- ☞ This symbol is your prompt to take an action in Google Sketchup.
- ☐ This symbol is your prompt to take an action in IES <VE>.

**REMEMBER TO SAVE OFTEN!**

Exercise One Part A: Follow the following steps:

STEP 1: Determine the total square footage and number of floors of your project based on the assignment for your team, i.e., 4<sup>th</sup> St. Residence Hall, Tate Lab or Rapson Hall. Determine the total window area for your model (See pg.\_\_\_\_) and then calculate the Window : Floor Area Ratio (WFAR) for your project.

STEP 2: ☞ Start a New Project in Google Sketchup

Choose from one of the following:

- A. Open The Shoebox.skp file and using the Shoebox Plugin create a building or...
- B. Draw the floor plate for you building, create exterior walls and windows and replicate the no. of floors you want in your model.
- C. Open a pre-prepared shoebox model for your building and revise it to the configuration you wish to simulate.

STEP 3: ☞ Set the necessary IES Parameters in Google Sketchup

- A. Set Location: Set your location as Minneapolis, Minnesota or locate your site using Google Earth.
- B. Set Building Use: Set your Building Type, e.g., Dormitory or University Building
- C. HVAC System: Use default for building type
- D. Set Building Construction for walls, floors, windows and skylights (if you have them)

STEP 4: ☞ Create any desired shading and set group settings to: “Shading”

STEP 5: ☞ Identify Rooms. Click on the IES Rooms Identification tool (Red Square).

Note: Check you list of rooms and your model to make sure all of the rooms correctly identified. If not you may have to revise your geometry to correctly enclose each individual room.

Next: Revise or set room occupancy types if necessary.

STEP 6: ☞ Export your model to IES VE Ware (first IES tool button)

☐ Run the 2030 Challenge and see if your building meets the requirements. Copy the report and export to an excel spreadsheet for later reference.

STEP 7: Upload your initial shoebox model sketchup file to the appropriate dropbox on the course Moodle Site.

In Exercise 1B we will create our Baseline performance case.