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Digital Intersections

+

Integrated Technology

Introduction

BIM @ USC past

BIM @ USC present

BIM @ USC future

Questions

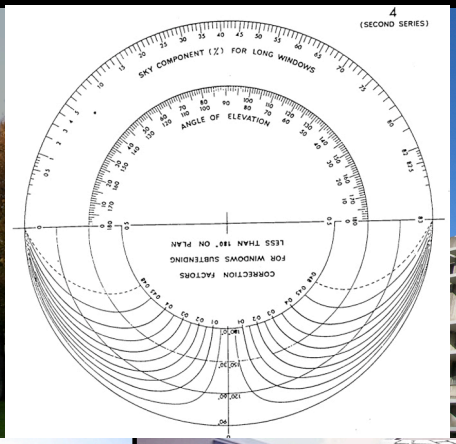
“Save often.”

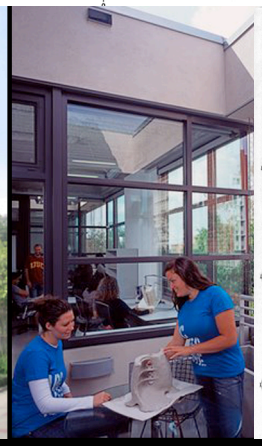
- Karen M. Kensek

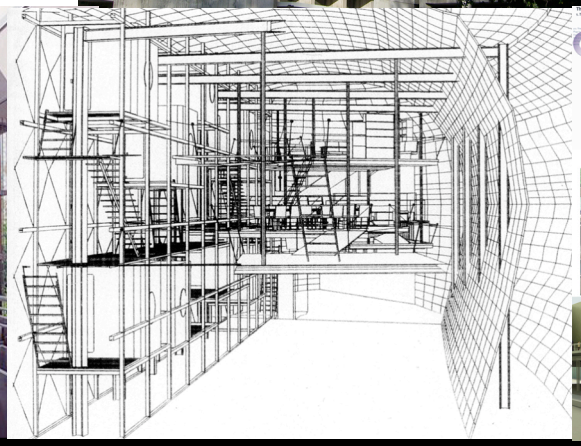
Introduction

Places
Transformations

Background


4
(SECOND SERIES)
SKY COMPONENT (%) FOR LONG WINDOWS
ANGLE OF ELEVATION
CORRECTION FACTORS
FOR WINDOWS SUBTENDING
LESS THAN 180° ON PLAN






Autodesk Revit

"The only way forward, if we are going to improve the quality of the environment, is to get everybody involved."

- Richard Rogers

Past Explorations

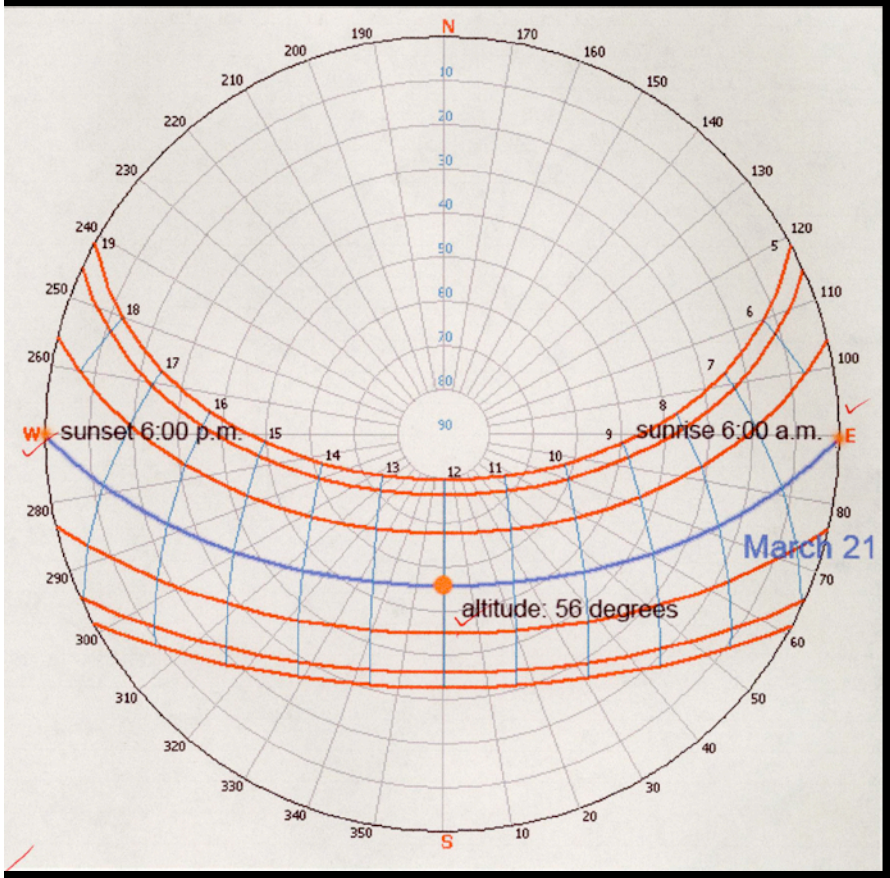
BIM

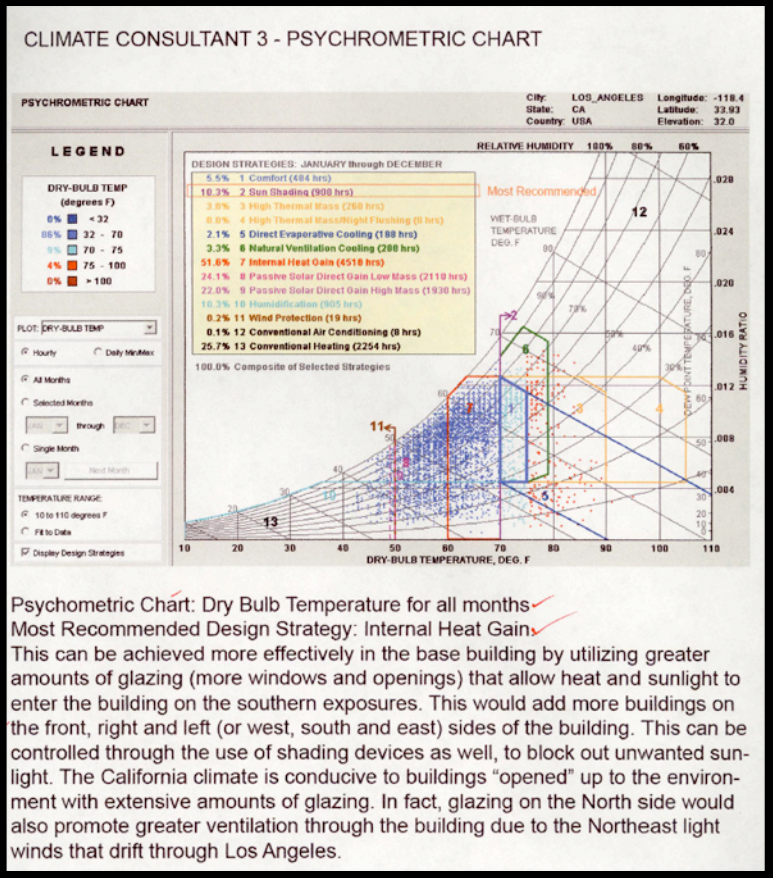
Sustainability
Integrated Technology

Intro BIM: elective courses as testing grounds

2d/3d integration, parametric modeling, interoperability

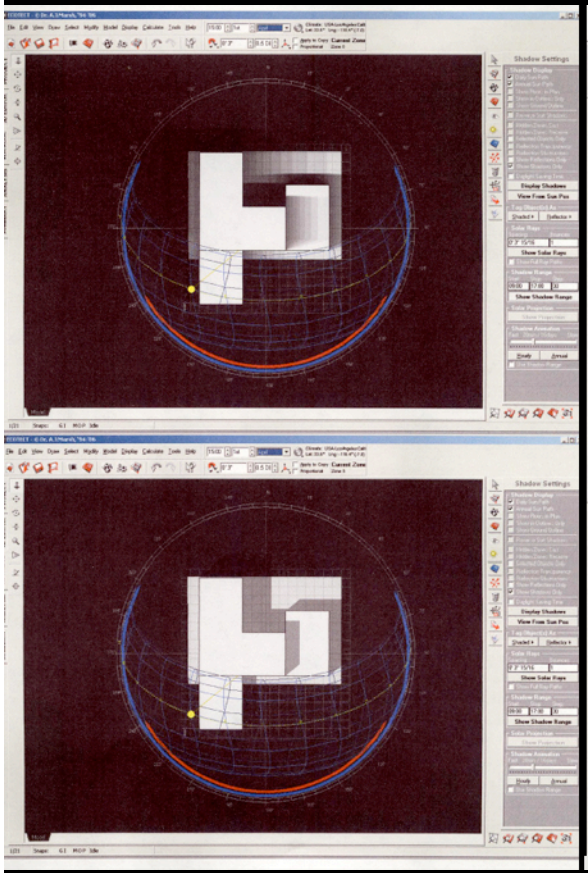
Connection to sustainable design

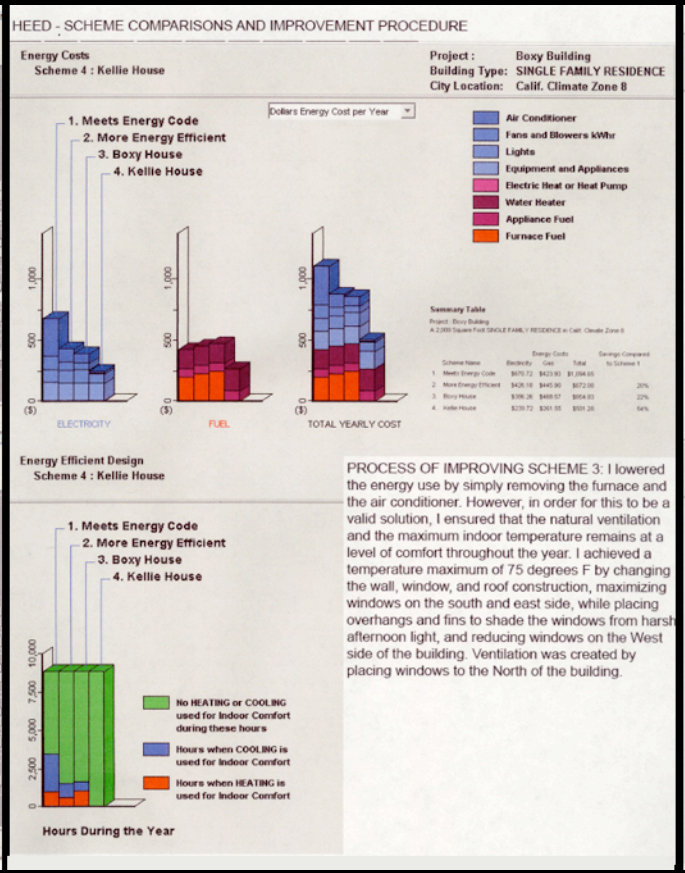


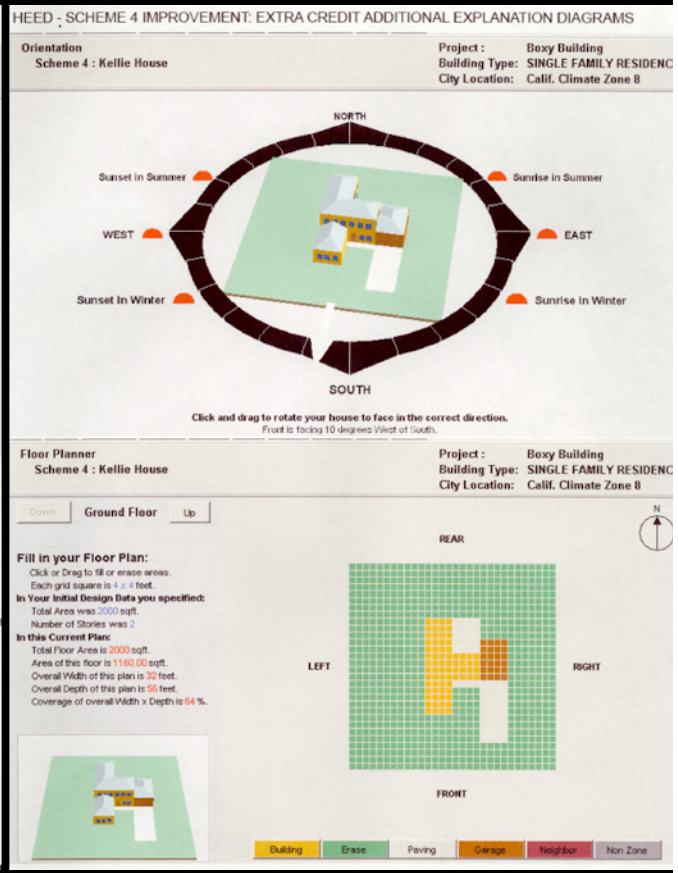


Psychometric Chart: Dry Bulb Temperature for all months
Most Recommended Design Strategy: Internal Heat Gain
This can be achieved more effectively in the base building by utilizing greater amounts of glazing (more windows and openings) that allow heat and sunlight to enter the building on the southern exposures. This would add more buildings on the front, right and left (or west, south and east) sides of the building. This can be controlled through the use of shading devices as well, to block out unwanted sunlight. The California climate is conducive to buildings "opened" up to the environment with extensive amounts of glazing. In fact, glazing on the North side would also promote greater ventilation through the building due to the Northeast light winds that drift through Los Angeles.

Ectotect and HEED, IES







Autodesk Sustainability Curriculum +/-

Unit 2 Modeling the Sustainable Building Site Exercise: Permeable/Non-permeable

Permeable / Non-permeable Surface Analysis with Areas and Color Fills

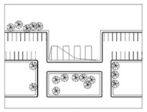
Analysis type:	Software required:	Starting Point Dataset:
Visual Analysis	Revit® Architecture 2008	***Unit 2_i_Start.rvt***

Permeable surfaces act to passively harvest rain water and enable it to percolate into the soil, where it can be used by onsite landscaping or to recharge the ground water system. Projects containing higher percentages of permeable surfaces also reduce the amount of pollutants (e.g. surface oils and litter) that are washed off site into the environment's water system.

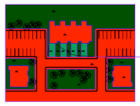
The exercise for this unit outlines how to create a visual analysis that compares permeable and non-permeable surfaces in a site plan. To contrast the site's permeable surfaces with the non-permeable ones, use Revit Architecture software's Area object to delineate areas with different permeability characteristics. When you finish, apply a color scheme so you can visually analyze the site.
You can use the Area tool to provide customized plan visualizations (with color fill schemes) or calculations. If you generate calculations, make sure that you also generate an area schedule after you are done. In this exercise, color schemes provide a visual representation of the permeable parameter you add to the areas. See Unit 18 in the Revit Educational Curriculum workbook for more information on schedules and color fill schemes.

This exercise consists of the following tasks:
- Creating a new area scheme.
- Creating a new area plan and adjust the view settings to make the site elements visible.
- Creating boundaries and areas.
- Adding and applying a Permeable Project Parameter.
- Adding color fill.
- Creating a color fill scheme.

Use dataset *Unit 2_i_Start.rvt* as a starting point for this exercise. You may also use your own dataset. Even if you have only a drawing or image of your site, you can import these and draw the area lines directly on top of the image or drawing file. See Revit Educational Curricula, Unit 12, Exercise A for information on how to link an AutoCAD® drawing into a Revit project. Linking an image is a very similar process.



Before: Initial site plan from sample



After: A color-filled area plan that shows permeable and non-permeable site areas

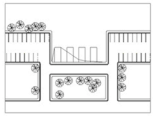
Unit 3) Modeling Building Placement, Size, and Layout for Sustainability Exercise: Plant Shade Cover of Hardscape

Plant Shade Cover of Hardscape Various Methods

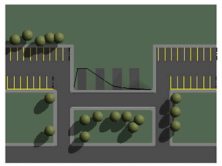
Analysis type:	Software required:	Starting Point Dataset:
Visual Analysis	Revit® Architecture 2008	***Unit 3_i_Start.rvt***

Site hardscape (concrete, paving, etc...) acts as a heat sink, storing solar energy and contributing to the heat island phenomena found in most cities. Shading the hardscape can help minimize this effect.

This exercise provides three methods for analyzing how shade from nearby trees falls on the hardscape:
- Rendering a 3D view from above to show shadow on the site.
- Editing a plant family to show an approximation of the area shaded by the plant.
- Editing a plant family to add a solid element that casts a shadow with Revit Architecture software's Advanced Model Graphics shadow function.

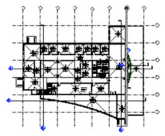


Before: Sample dataset site plan

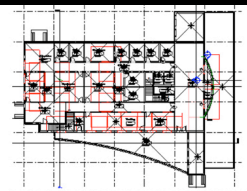


After: A color-filled area plan that shows how nearby trees cast shadows on the hardscape

1 ***Render A 3D View***
Revit Architecture Tree families are model lines that do not cast shadows in a plan view. However, when you use the internal Accurender function to

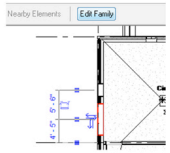


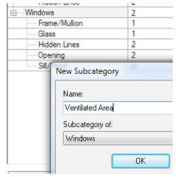
Before: Sample dataset ***Unit 4_i_start.rvt***



After: A single modified window that illustrates the rough guide of the natural ventilation areas

1 ***Edit One of the Window Families from the Sample Project***





To open the family for editing, click one of the windows. Then, on the Options bar, click Edit Family. To add the new window subcategory, click Settings menu > Object Styles. Click the New button and enter "Ventilated Area" as the new subcategory name.

Unit 5) Modeling the Design of the Building Envelope for Sustainability: Envelope Daylighting Exercise

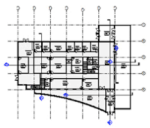
Envelope Daylighting

Analysis type:	Software required:	Starting Point Dataset:
External Analysis	Revit® MEP 2008, IES <VE> toolkits for Revit MEP	***Unit 5_i_Start.rvt*** (adapted from *Convention Center Extensions.rvt*)

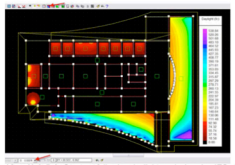
Daylighting is intricately related to heat gain in a building. To minimize heat gain, you can reduce the window area, but that also reduces the amount of natural daylight. It also forces you to replace the natural daylighting with electric lights, which are inefficient and, in turn, produce heat.

This exercise illustrates how to perform a daylighting analysis using the FLUCS component of IES <VE>.

This exercise consists of the following tasks:
- Exporting the building model to IES <VE> using Revit MEP.
- Running the calculations using FLUCS, the artificial/natural lighting design and analysis tool in IES <VE>.



Before: ***Unit 5_i_ Start.rvt***



After: ***Unit 5_i_ Start.rvt*** following daylight analysis using IES <VE>

1 ***Export the Building Model to IES <VE> Using Revit MEP***
Revit MEP now has a direct, built-in link to IES <VE> that enables you to easily import data from the building information model to IES <VE>. This

Unit 6) Modeling the Design of Mechanical, Electrical, and Plumbing Systems for Sustainability Exercise: Energy Analysis Packages

This unit has 3 standalone exercises. Each of the exercises outlines how to perform a distinct type of energy analysis on a building. As stated in the introduction, there are more than 350 different energy analysis software packages. This workbook unit demonstrates how to use three of those packages that work directly with the building information model produced by Revit® MEP software. In Exercise 6A, you use the Heating and Cooling Loads tool built into Revit MEP. In Exercise 6B, you use IES <VE> toolkits to analyze building energy usage. Finally, in Exercise 6B, you learn how to create a gbXML file, and also how to perform an analysis using Green Building Studio tools.

The Analytical Model

One concept common to all three packages is the analytical model. The analytical model is a simplified version of the building information model created by the analysis software specifically for its calculations. In Revit MEP, you use walls, doors, floors, and roofs to create a model of the building. The analytical model is much more limited in scope. It contains only those surfaces and objects that hold parameters directly relevant to the energy loading analysis. This process is not unlike the radiosity rendering process, which creates a separate internal model to process light bouncing from surface to surface within the building. Rather than attempting to understand all of the different software object classes from different software packages (for example, a Revit wall is not the same as an AutoCAD® Architecture wall), you simply create a model specifically for the analysis software. For IES <VE>, the process of creating the analytical model is built into the analysis tools. For Green Building Studio, you export the Revit model as a gbXML file, or green building xml file. In most cases, the analysis package produces more accurate results if you optimize the Revit model to make conversion to the analytical model easier for the translating software. What might make sense to an architect (room stops at ceiling) might not make sense for energy analysis (room stops at underside of floor above because an acoustical ceiling does not necessarily provide any real barrier to the air flow through a room.

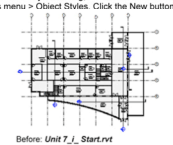
If you are working at a conceptual level or early schematic design level, when the fenestration changes frequently, or you are studying the effects of a particular solar light shelf, you may only be concerned with *differences* in design options rather than with the final heating and cooling load numbers. When you are more concerned with a percentage change rather than an end total, the validity of rooms may be a non-issue. However, if you wish to get more accuracy, you will need to verify a few things about the rooms prior to running the heating and cooling load calculations.

building_performance_analysis_using_revit.pdf

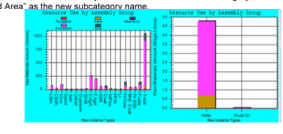
The compressed file for this unit also contains the PDF file *building_performance_analysis_using_revit.pdf*. This document outlines the differences between the Revit model and the analytical model, and gives some advice on how to optimize the Revit model for the most accurate analysis results.

Exercise 6A, B and C Prerequisite: Modifying the Revit Model for Analysis Tools

Analysis type:	Software required:	Starting Point Dataset:
N/A	Revit® Architecture 2008 or Revit® MEP 2008	There are no datasets for this prerequisite exercise, However there is the document referenced ***building_performance_analysis_using_revit.pdf*** in the zip file for Unit 6.

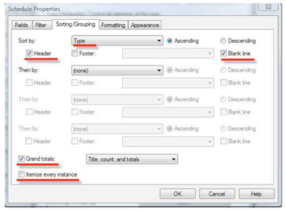


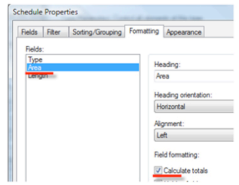
Before: ***Unit 7_i_ Start.rvt***



After: Analysis reports in Athena EIE

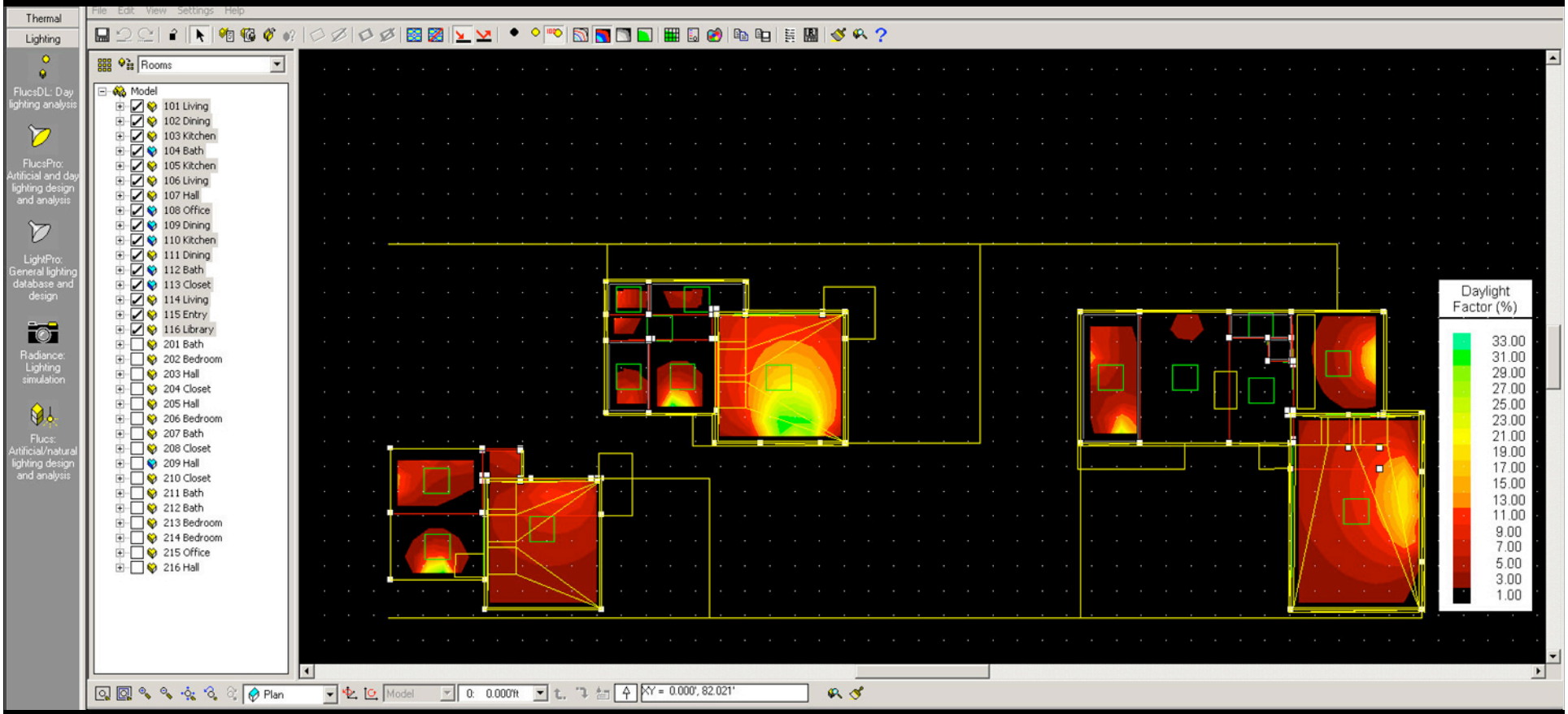
Generate Revit Schedules to Find Total square Footages of the roof, exterior Walls, Interior Walls, and Floor Systems
To generate the schedules, use the filter.



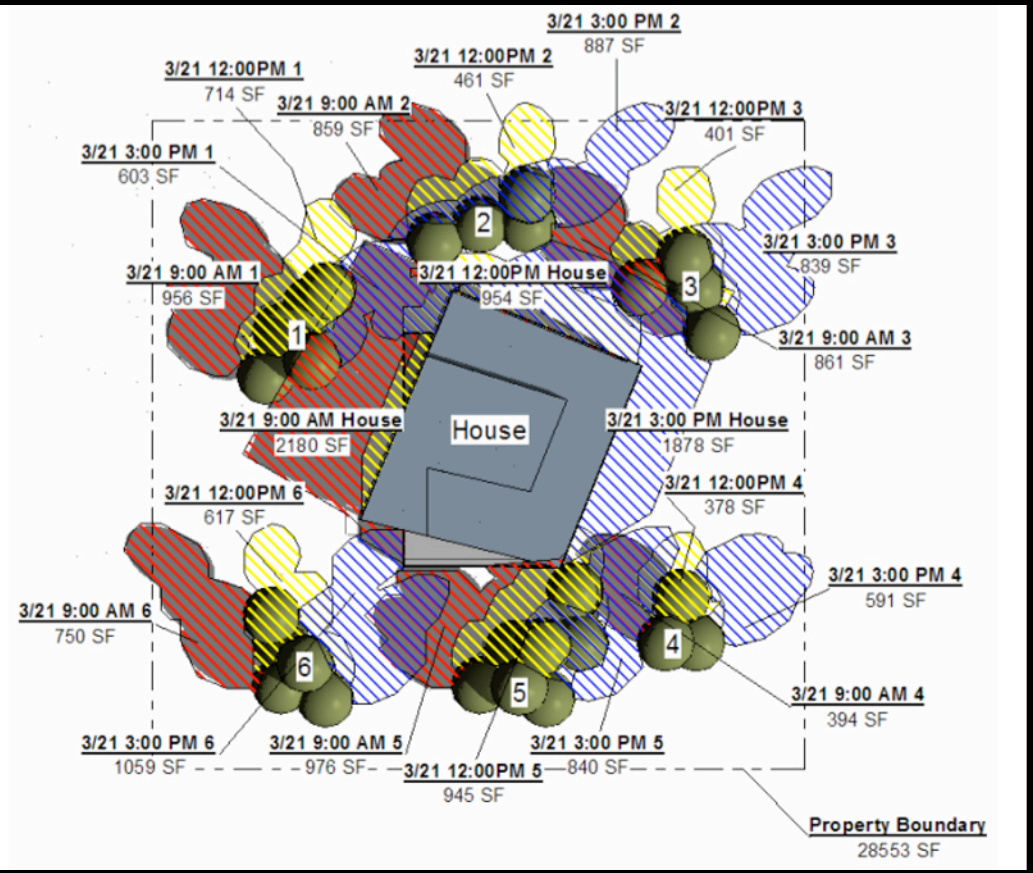


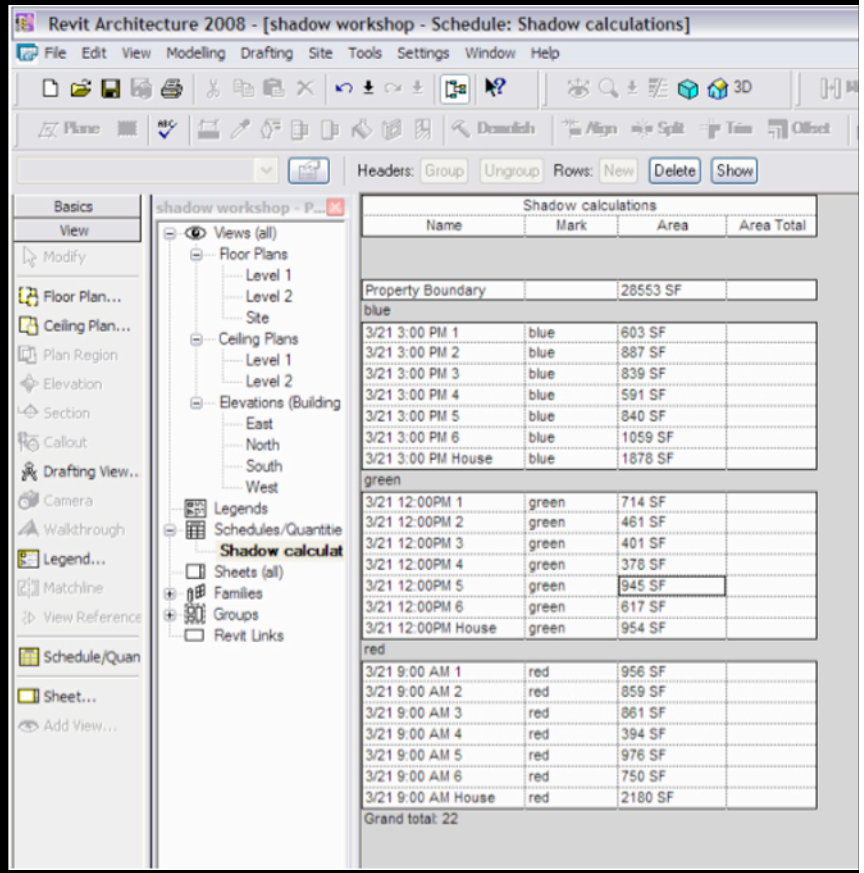
To generate a new wall schedule, on the Views design bar, click Schedule/Quantity. Add fields Type, Area, and Length. On the tabs listed below, follow the bulleted suggestions:
- Filter: Filter By = None.
- Sorting/Grouping: As shown in the screen capture above.
- Formatting: Click Calculate totals for both Area and Length.

Simple daylighting; LEED compliance

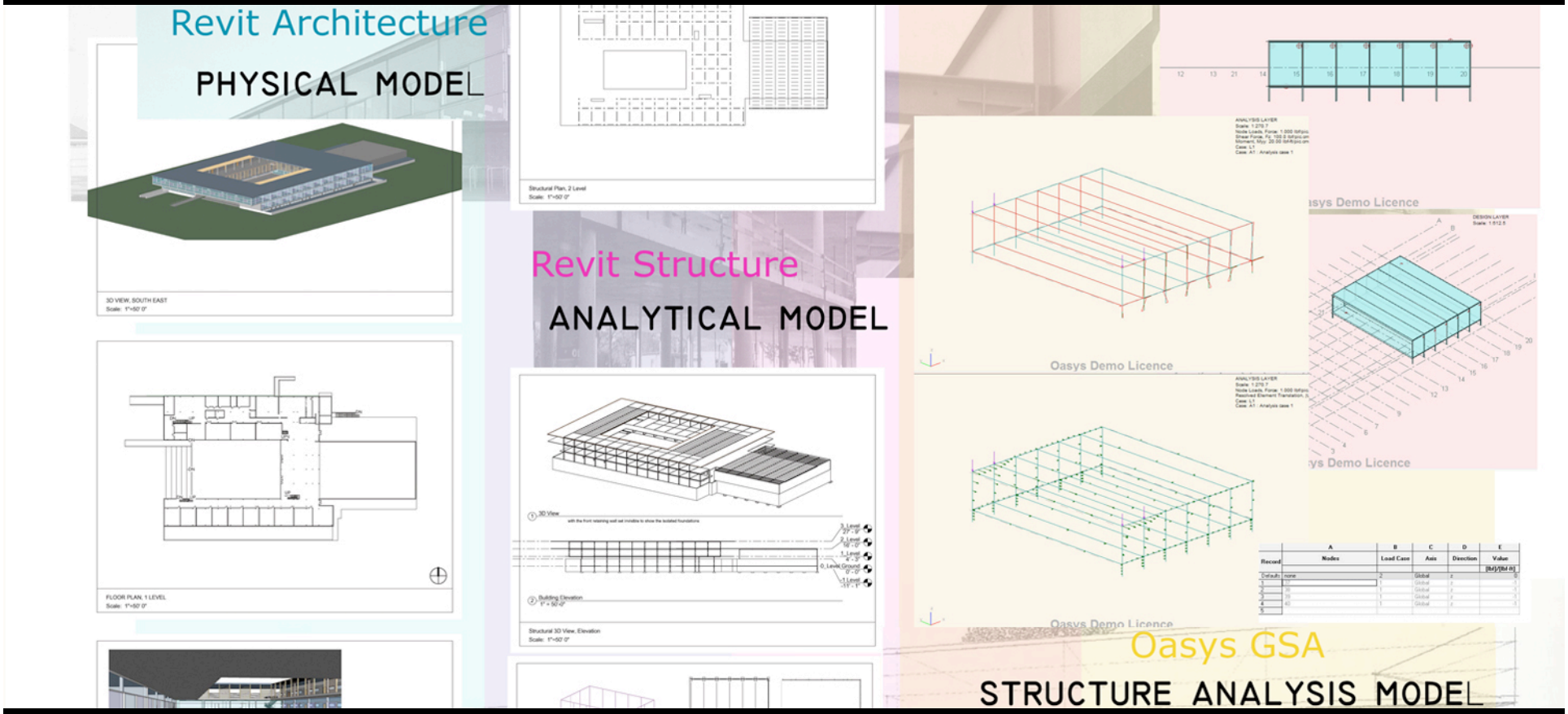


Landscaping and shadows





Structural analysis



Rendering

Final Project: Interoperability

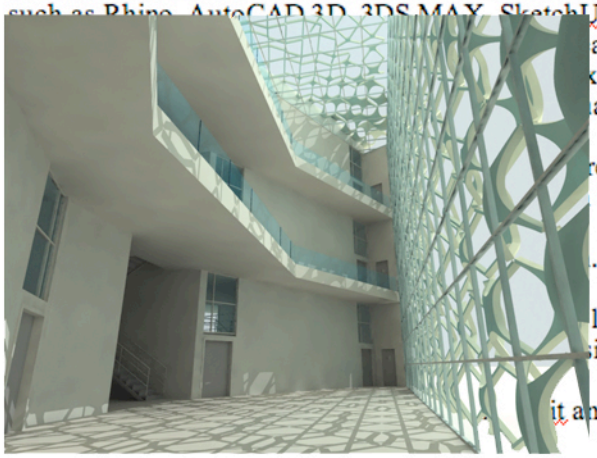
Description: exporting Revit model into 3DSMAX and render with VRAY renderer.

Steps: 1) Model building in Revit, 2) Create lights and cameras in Revit and render, 3) Export File to .Dwg. and open in 3DSMAX, 4) Delete lights and cameras of Revit file and create new lights and cameras in 3DSMAX, 5) Assign VRAY renderer and render views

Additional Software: 3DS MAX, VRAY renderer

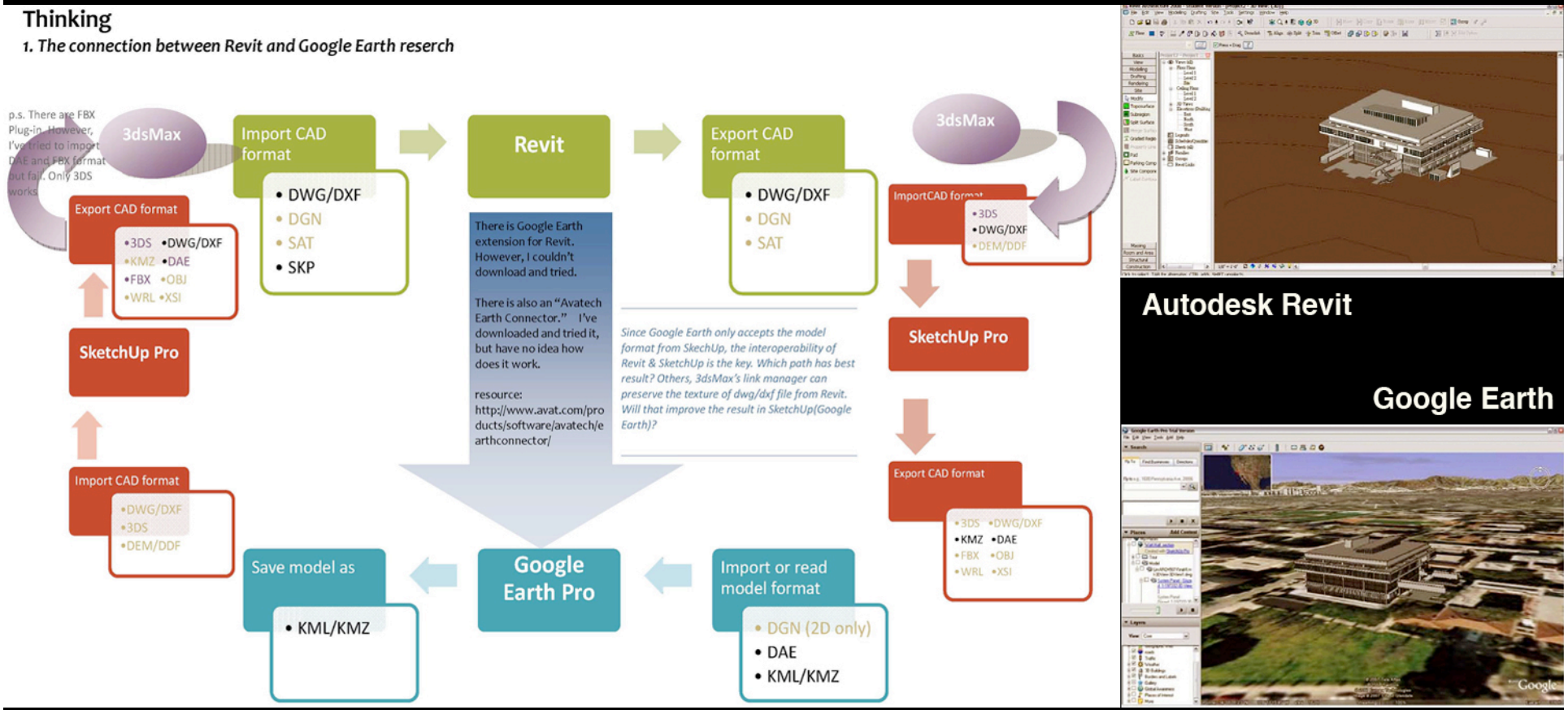
Comments: My objective was to figure out the most quick, precise and beautiful way to create 3D renderings for student projects.

Although Revit is more well known as a BIM software, its modeling function is great for creating simple orthogonal projects. Compared to other software

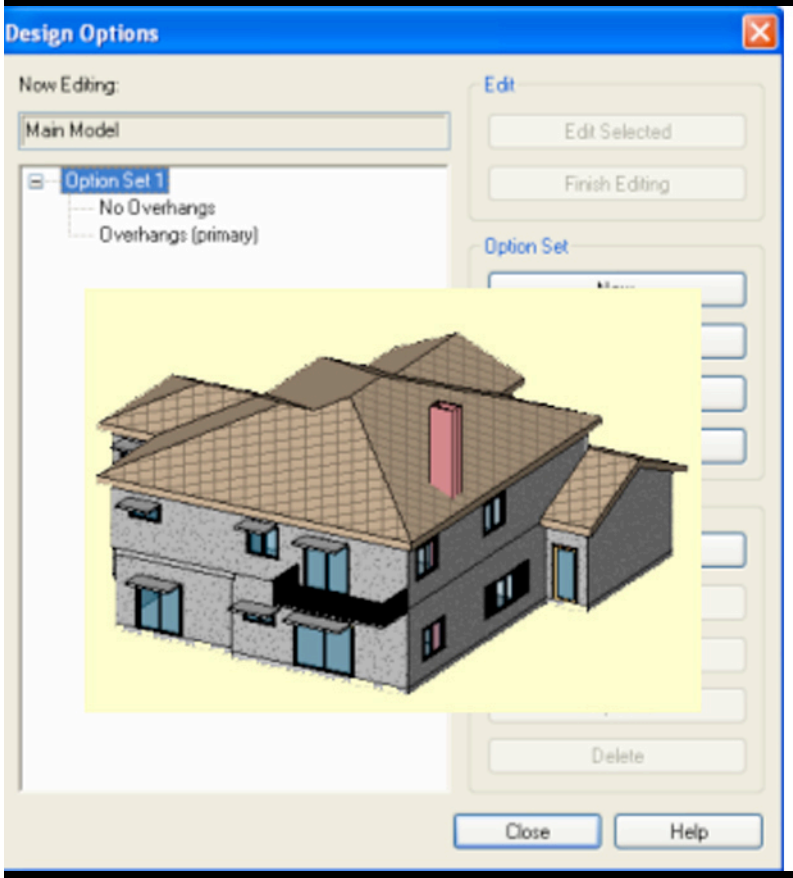


Rendering

Google Earth



Evidence based design



Analysis

Using steps 1 through 8 above it is now possible to look at the impact of alternative design options on the total solar gain. The goal is to maximize solar gain during the winter and minimize solar gain during the summer. The following design options should be evaluated in this exercise.

1. Site orientations – 0, 45, 90, 135, 180, 225, 270, 315
2. Glazing – Double glazing, low-e double glazing
3. External shading – no shading, 3' shading overhangs on south facing windows

Results

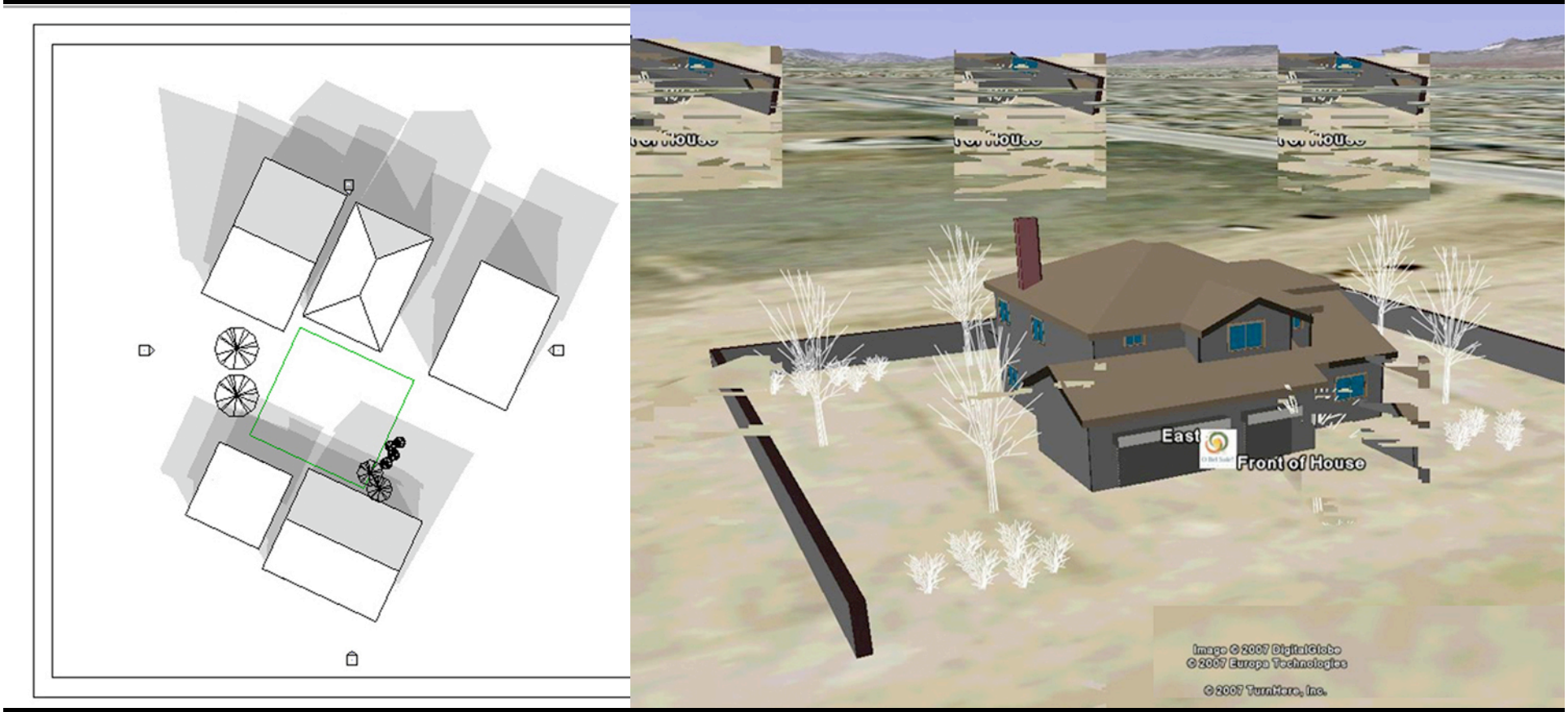
Using the steps outlines in the exercise above the following results were calculated for monthly solar gain.

Solar gain (MMBtu) — South Window Overhangs

Glazing Type	DG-D	DG-D	DG-D	DG-D	DG-D	DG-D	DG-D	DG-D	LE-D	LE-D
Site Rotation (Degrees)	0	45	90	135	180	225	270	315	180	180
Jan 01-31	2.961	3.236	4.206	4.945	5.241	4.435	3.792	3.088	4.416	3.771
Feb 01-28	3.555	3.846	4.875	5.487	5.74	5.007	4.417	3.585	4.835	4.071
Mar 01-31	4.387	4.729	5.578	5.985	6.081	5.723	5.149	4.418	5.125	4.245
Apr 01-30	5.233	5.921	6.123	6.365	6.096	6.408	5.619	5.301	5.141	4.387
May 01-31	5.762	6.439	6.143	6.203	5.939	6.599	5.887	5.922	5.011	4.644
Jun 01-30	6.054	6.573	6.091	5.955	5.778	6.403	5.989	6.11	4.88	4.646
Jul 01-31	5.88	6.41	6.019	6.036	5.869	6.563	6.012	6.072	4.953	4.66
Aug 01-31	5.309	5.992	6.011	6.232	5.957	6.461	5.64	5.466	5.025	4.43
Sep 01-30	4.526	5.004	5.704	6.078	6.072	5.961	5.309	4.613	5.116	4.149
Oct 01-31	4.098	4.413	5.572	6.151	6.383	5.632	5.013	4.128	5.377	4.479
Nov 01-30	3.234	3.513	4.5	5.206	5.477	4.662	4.023	3.295	4.615	3.925
Dec 01-30	2.854	3.159	4.113	4.949	5.241	4.419	3.693	3.006	4.416	3.793
Summed total	53.872	59.237	64.935	69.591	69.874	68.273	60.542	55.004	58.91	51.2
Winter (kWh)	3,700	4,031	5,186	6,034	6,360	5,429	4,667	3,802	5,358	4,560
Winter gain relative to 0 degrees		9%	40%	63%	72%	47%	26%	3%	45%	23%
Summer (kWh)	6,742	7,448	7,111	7,159	6,900	7,628	6,896	6,908	5,823	5,387
Summer gain relative to 0 degrees		10%	5%	6%	2%	13%	2%	2%	-14%	-20%

DG-D = Double Glazing Domestic
LE-D = Low-e Double Glazing Domestic

Less successful



External glazing

Process Steps

1. Compare heating & cooling load of a building with different exterior glazing type

a. Open the file in Revit MEP.

b. From Design Bar>Mechanical call out Heating and Cooling Load window.

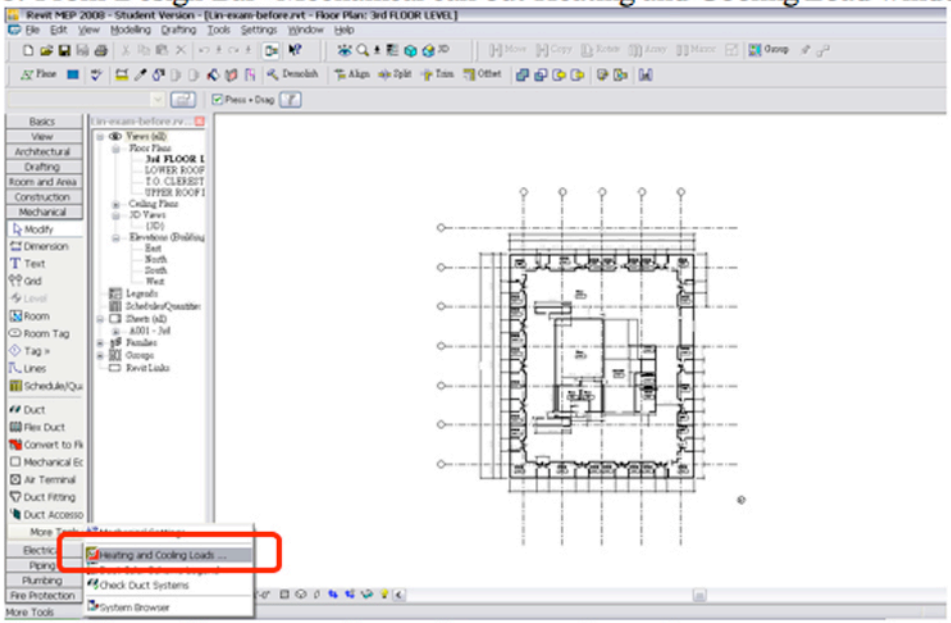


FIGURE 4 SELECT HEATING AND COOLING LOAD FROM DESIGN BAR

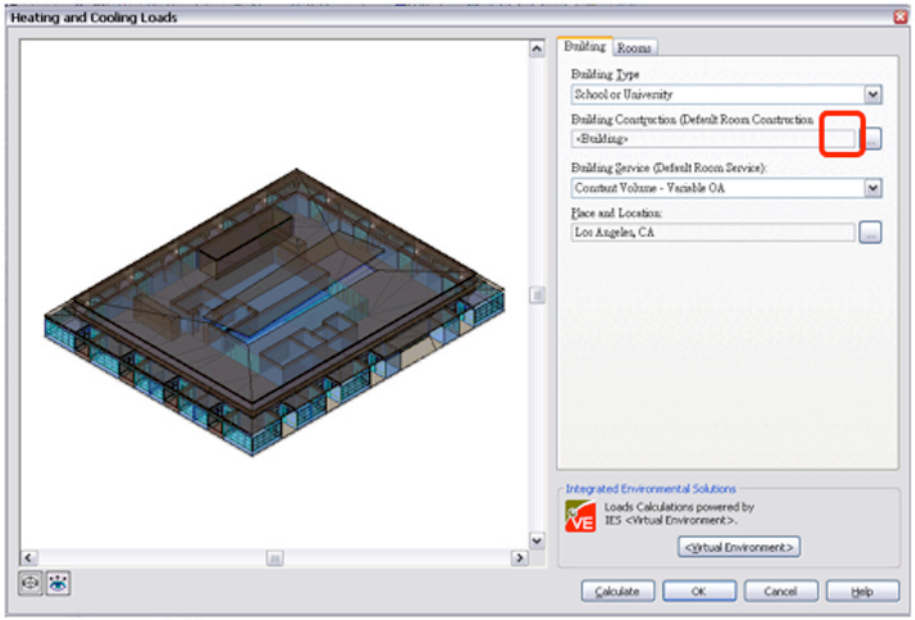


FIGURE 5 CHANGE EXTERIOR GLAZING FROM BUILDING CONSTRUCTION SETTING

Studies building on other research

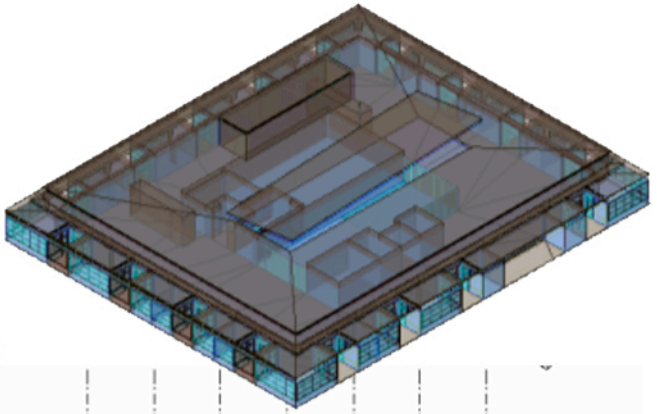
FIGURE 14 USE LIGHTING ANALYSIS TO UNDERSTAND THE IMPACT OF DIFFERENT EXTERNAL GLAZING

h. Copy & paste the results to Excel to compare the results of different external glazing

Room 0004A85F (312 OFFICE)		Reflectance	7%			
		Transmittance	70%			
Analysis calculation for room 0004A85F (312 OFFICE)						
Summary results for working planes and floor						
Surface	Quantity	Values			Uniformity (Min./Ave.)	Diversity (Min./Max.)
		Min.	Ave.	Max.		
Working plane 1 Reflectance=20% Transmittance=100% Grid size=0.61 m Area=28.726m2 Margin=0.00 m	Daylight factor	0.60%	15.40%	35.00%	0.04	0.02
	Daylight illuminance	66.23 lux	1614.39 lux	3685.66 lux	0.04	0.02

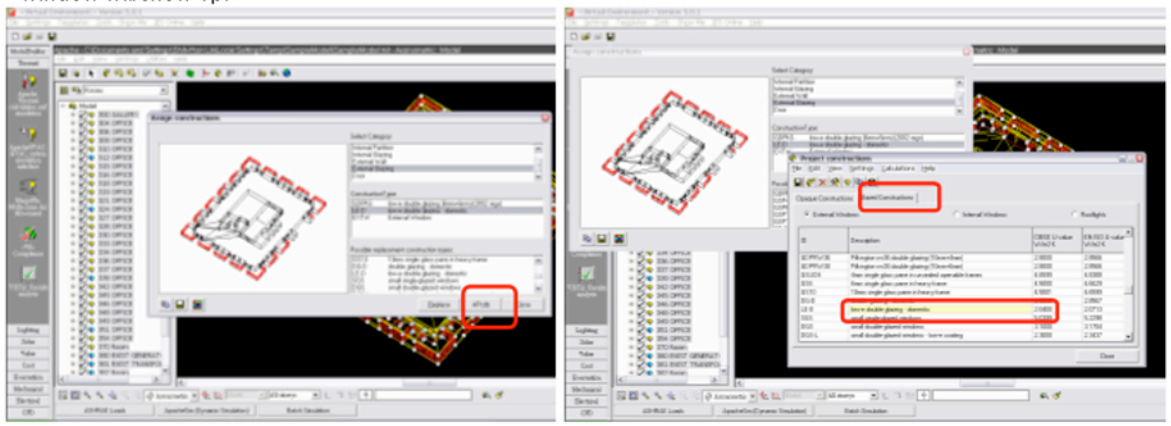
Room 0004A85F (312 OFFICE)		Reflectance	30%			
		Transmittance	8%			
Analysis calculation for room 0004A85F (312 OFFICE)						
Summary results for working planes and floor						
Surface	Quantity	Values			Uniformity (Min./Ave.)	Diversity (Min./Max.)
		Min.	Ave.	Max.		
Working plane 1 Reflectance=20% Transmittance=100% Grid size=0.61 m Area=28.726m2 Margin=0.00 m	Daylight fa	0.10%	1.80%	4.00%	0.04	0.02
	Daylight il	7.57 lux	184.50 lux	420.99 lux	0.04	0.02

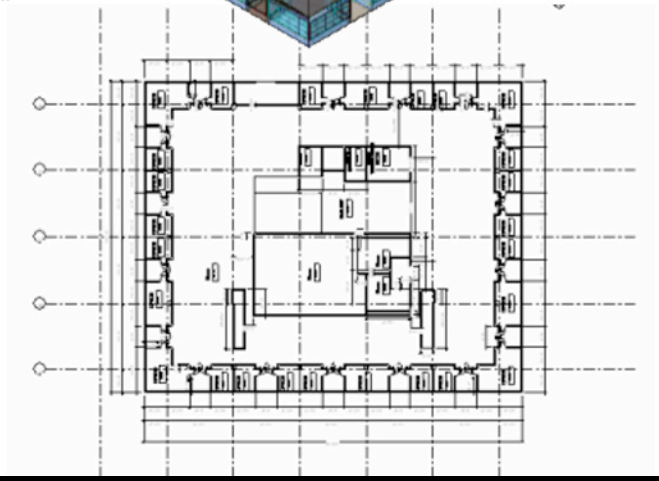
FIGURE 15 COPY AND PASTE THE RESULTS OF DIFFERENT EXTERNAL GLAZING TYPE TO EXCEL TO COMPARE THE DAYLIGHT IMPACT OF DIFFERENT GLAZING TYPE



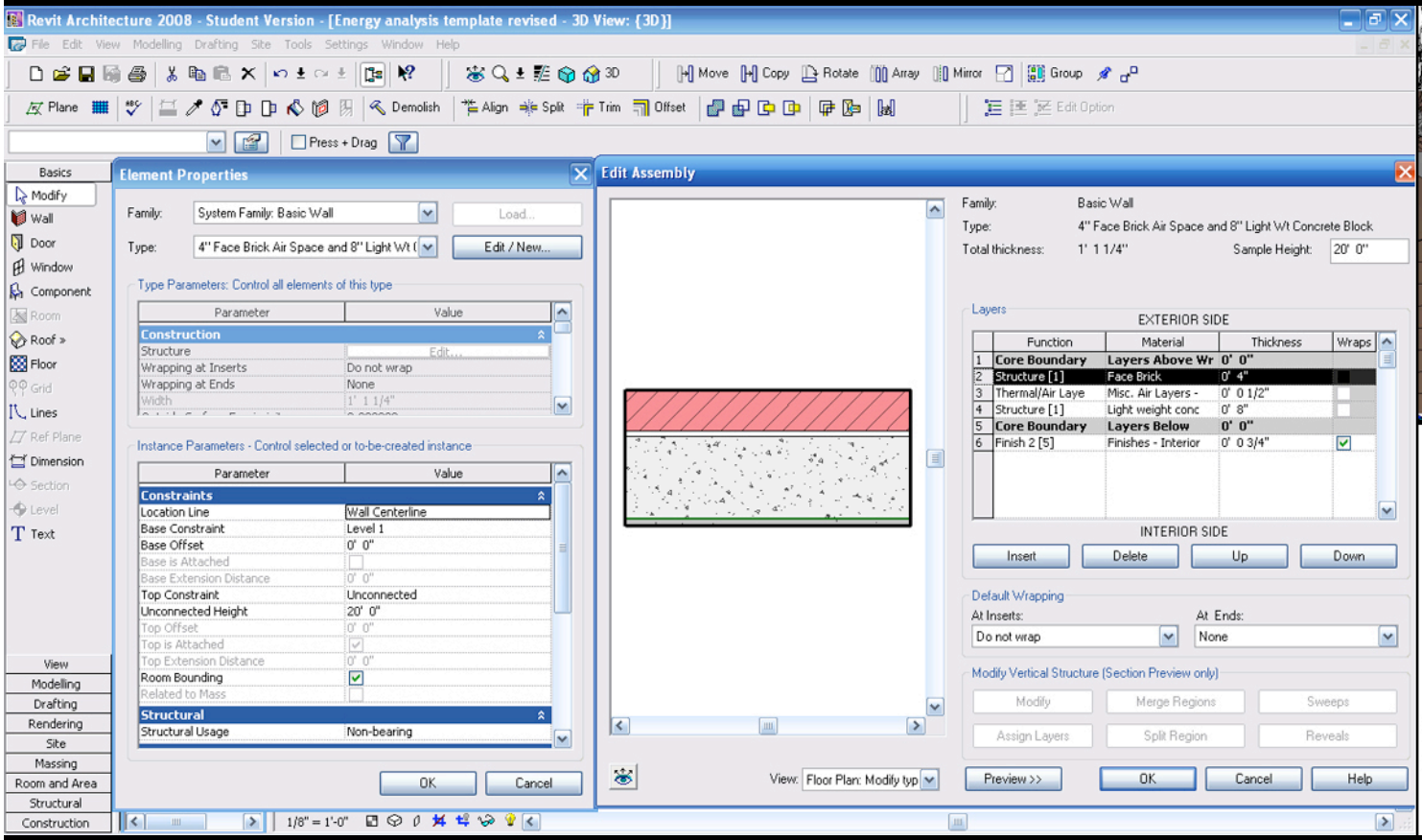
3. Understand the external glazing detail in Revit Model

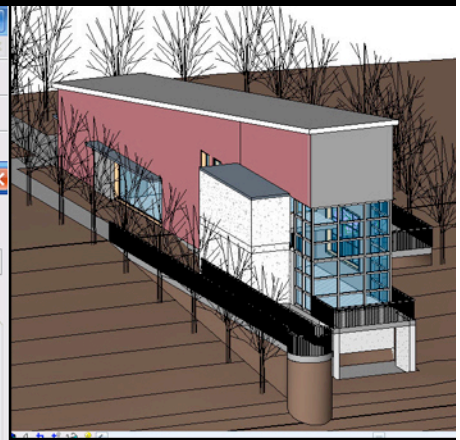
a. Repeat 2.b to 2.d. In "Assign Constructions" window, under "Construction Type" select the type which you defined in Revit model, the model on the right side will high light your external glazing. Then, click "APcdb", the "Project constructions" window will show up.

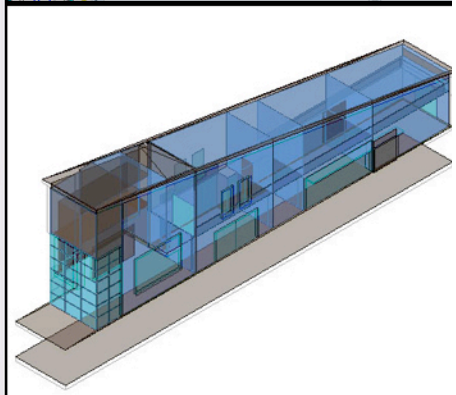




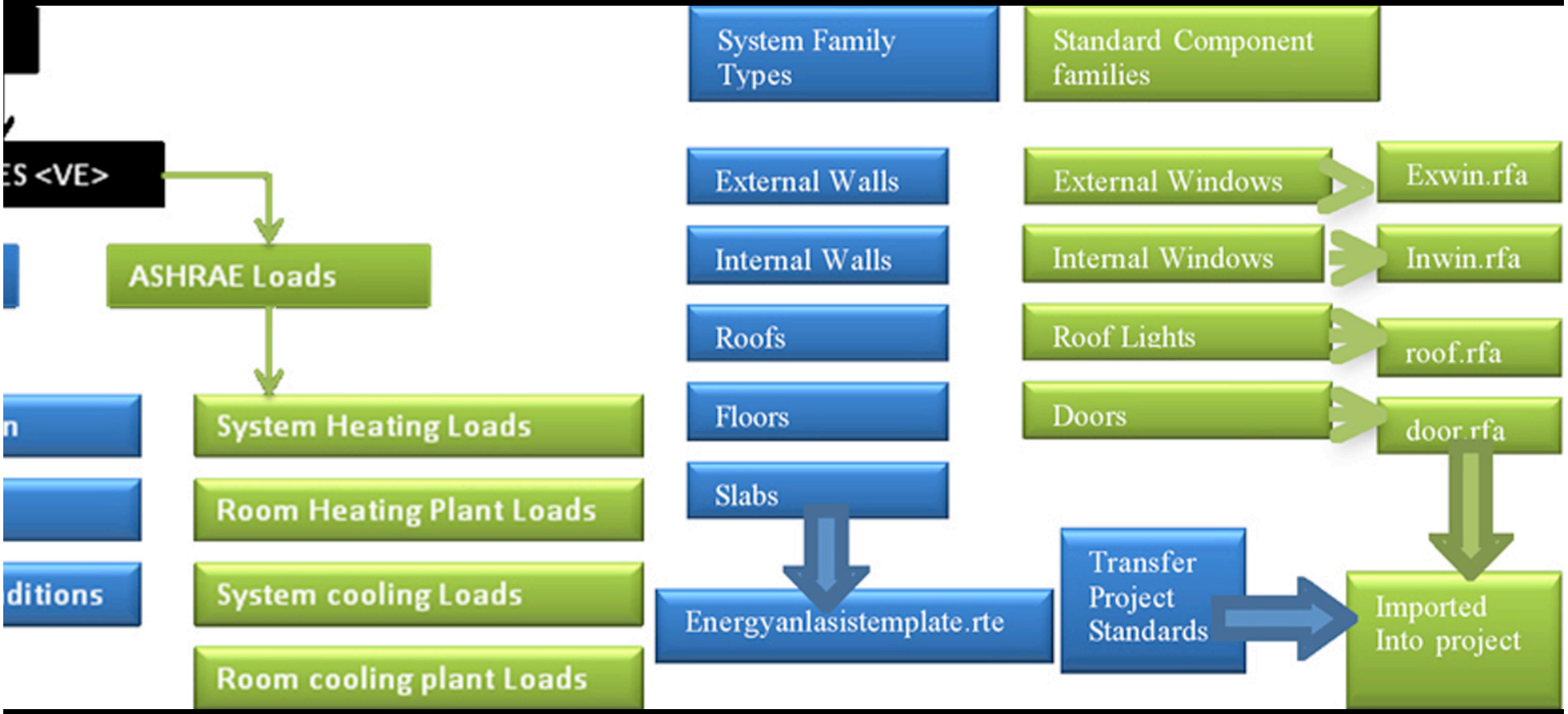
BIM + IES


Revit Architecture 2008 - Student Version - [Energy analysis template revised - 3D View: {3D}]
Element Properties
Edit Assembly



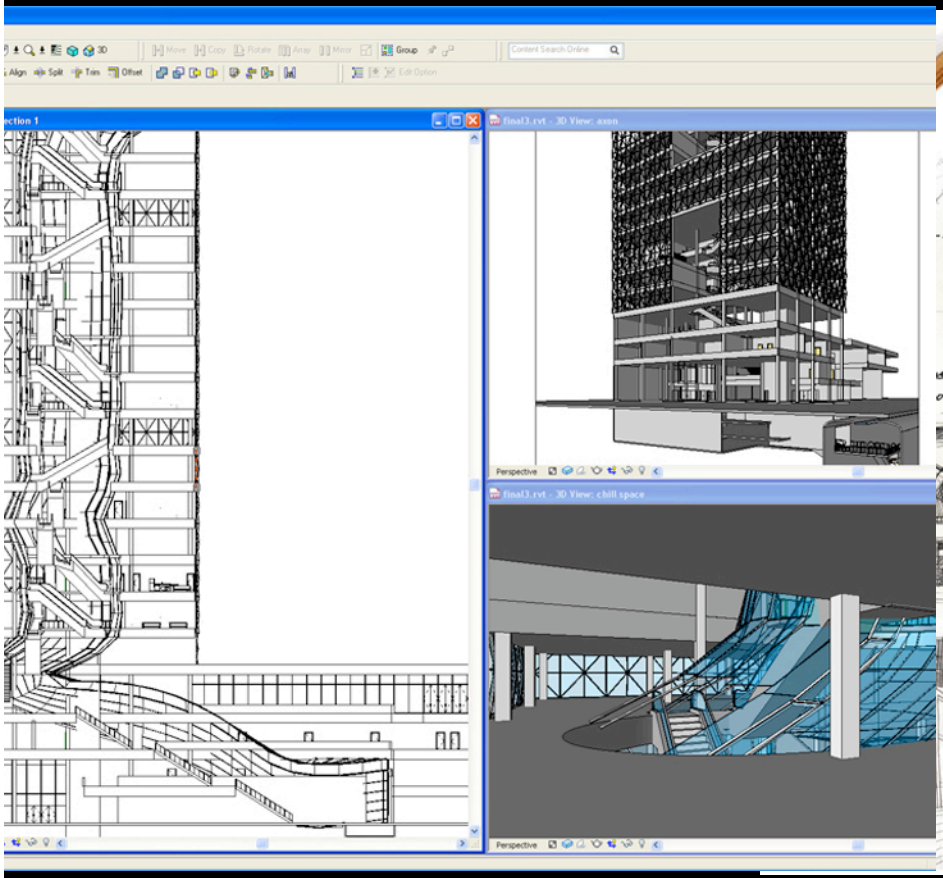


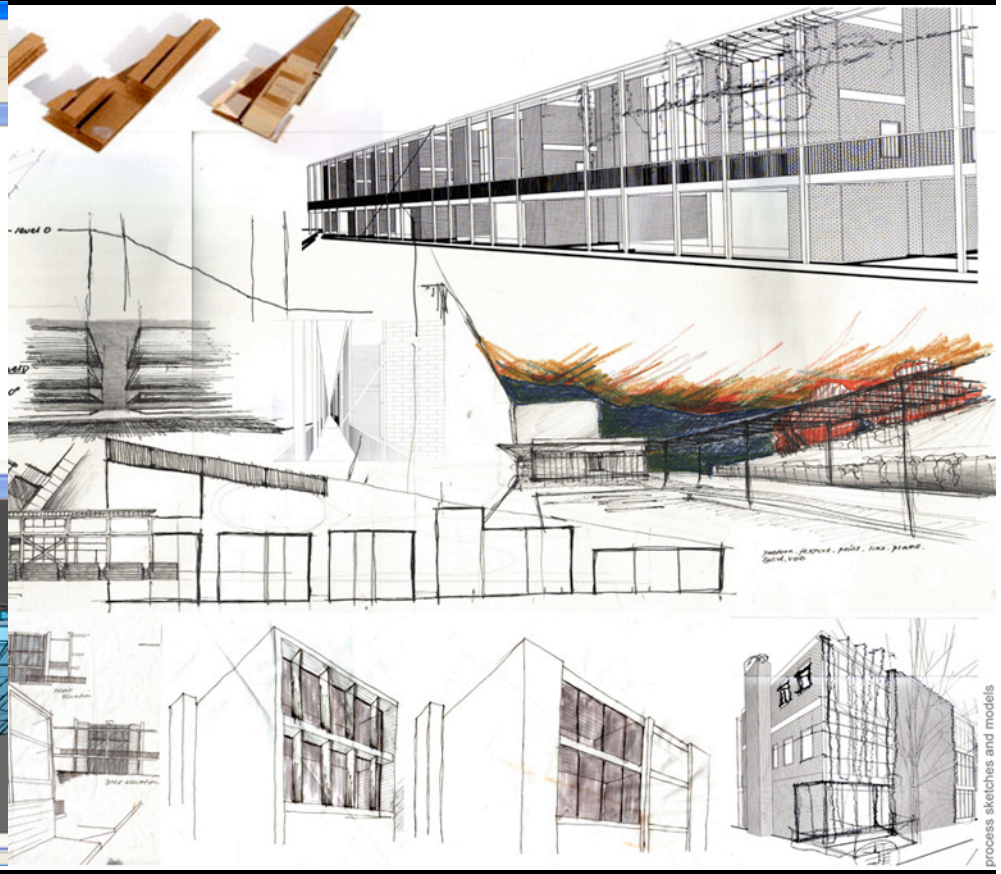
Seed for master's thesis; new PhD program



Studio work

Studio work: not yet another “CAD” battle!

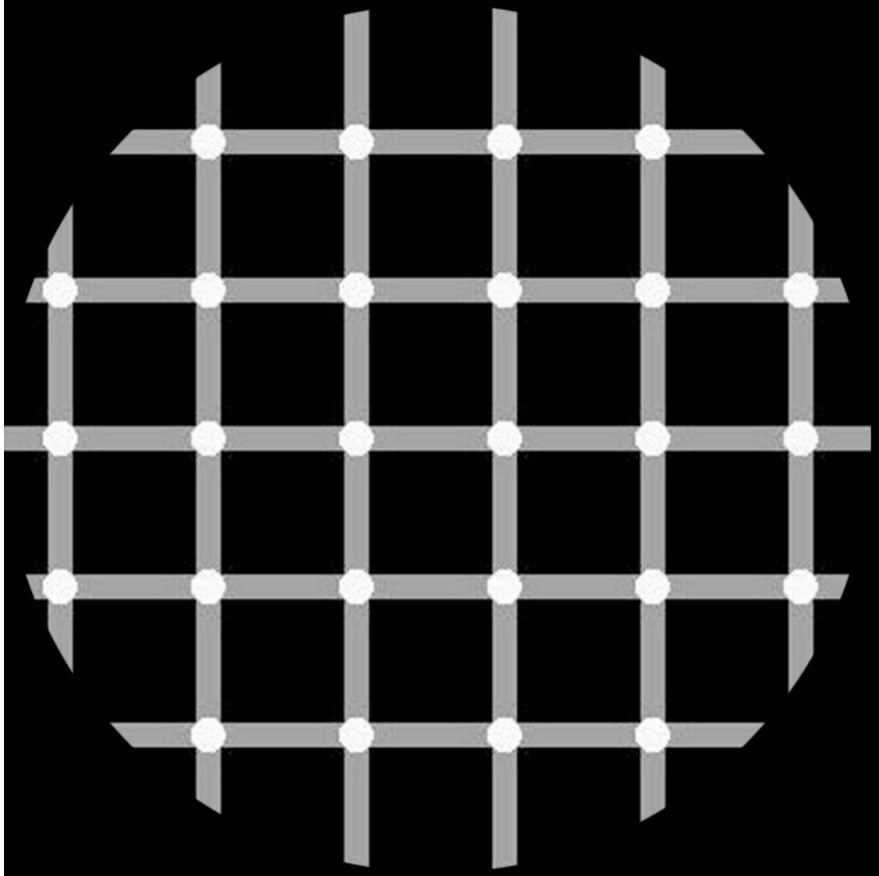




Conferences and connections to profession

Conferences: academy, software firms, AEC professionals

"If it's there and you can see it — it's real.
If it's not there and you can see it — it's virtual.
If it's there and you can't see it — it's transparent.
If it's not there and you can't see it — you erased it !"

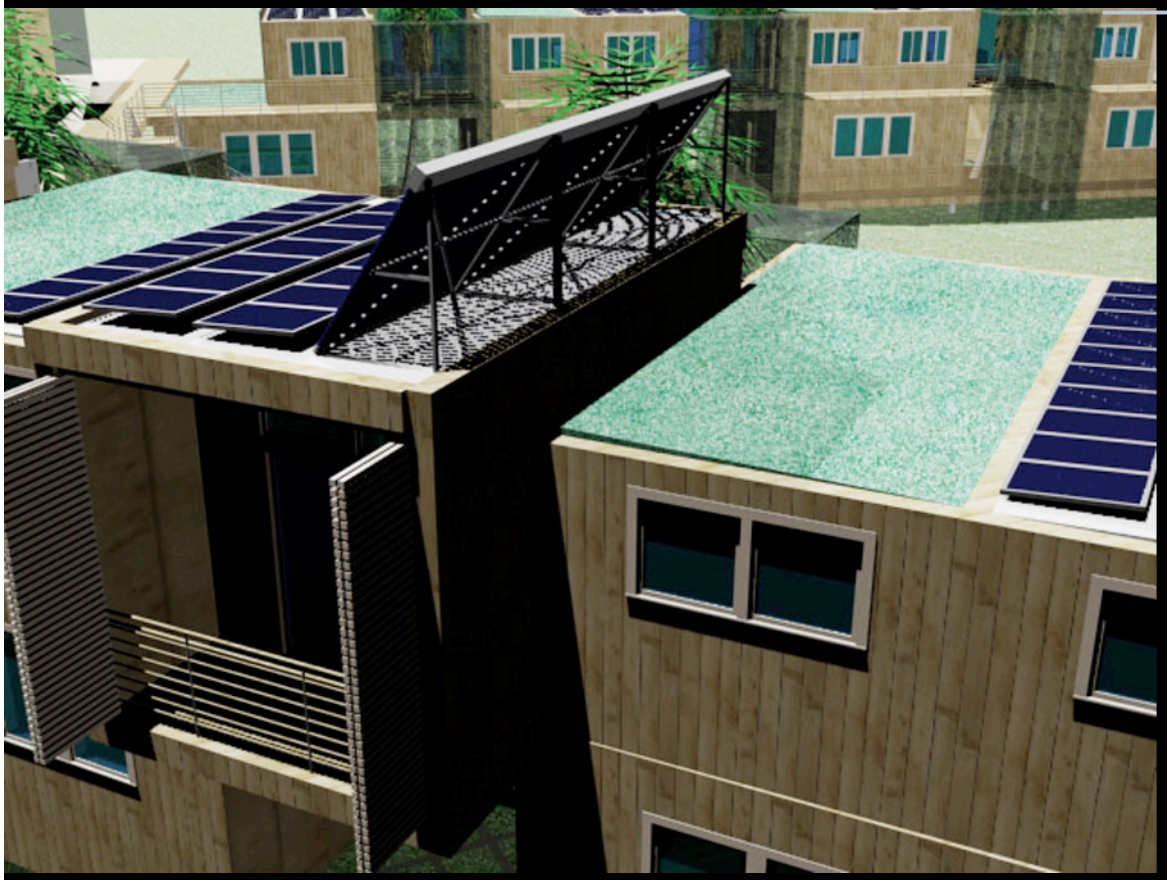


Current Musings

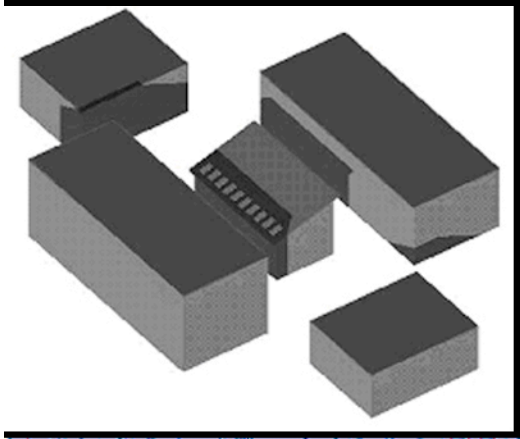
Connections

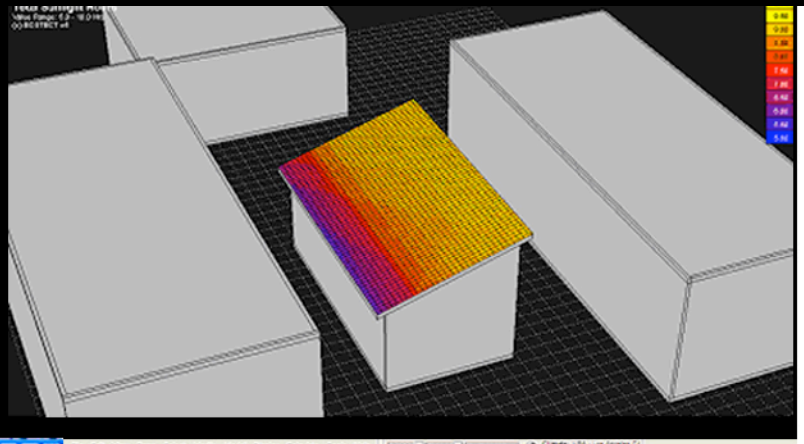
Interdisciplinary

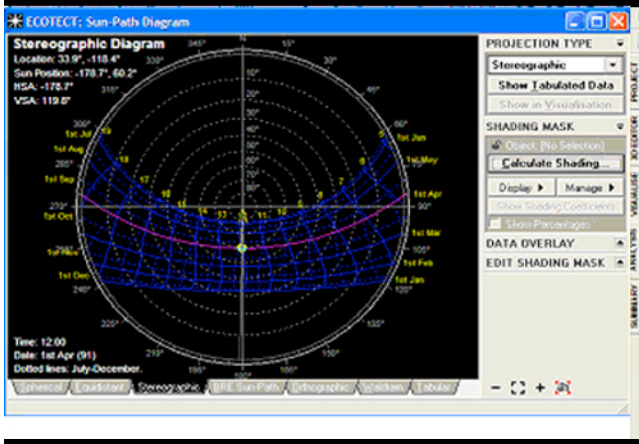
Renderings <> Simulation

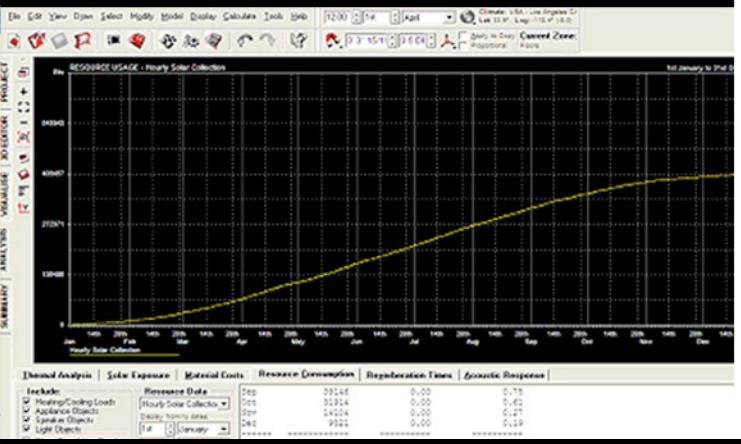


Insolation









Sustainable Design Issue: Photovoltaic Energy
Determining the Best Location for Solar Panels on a Roof

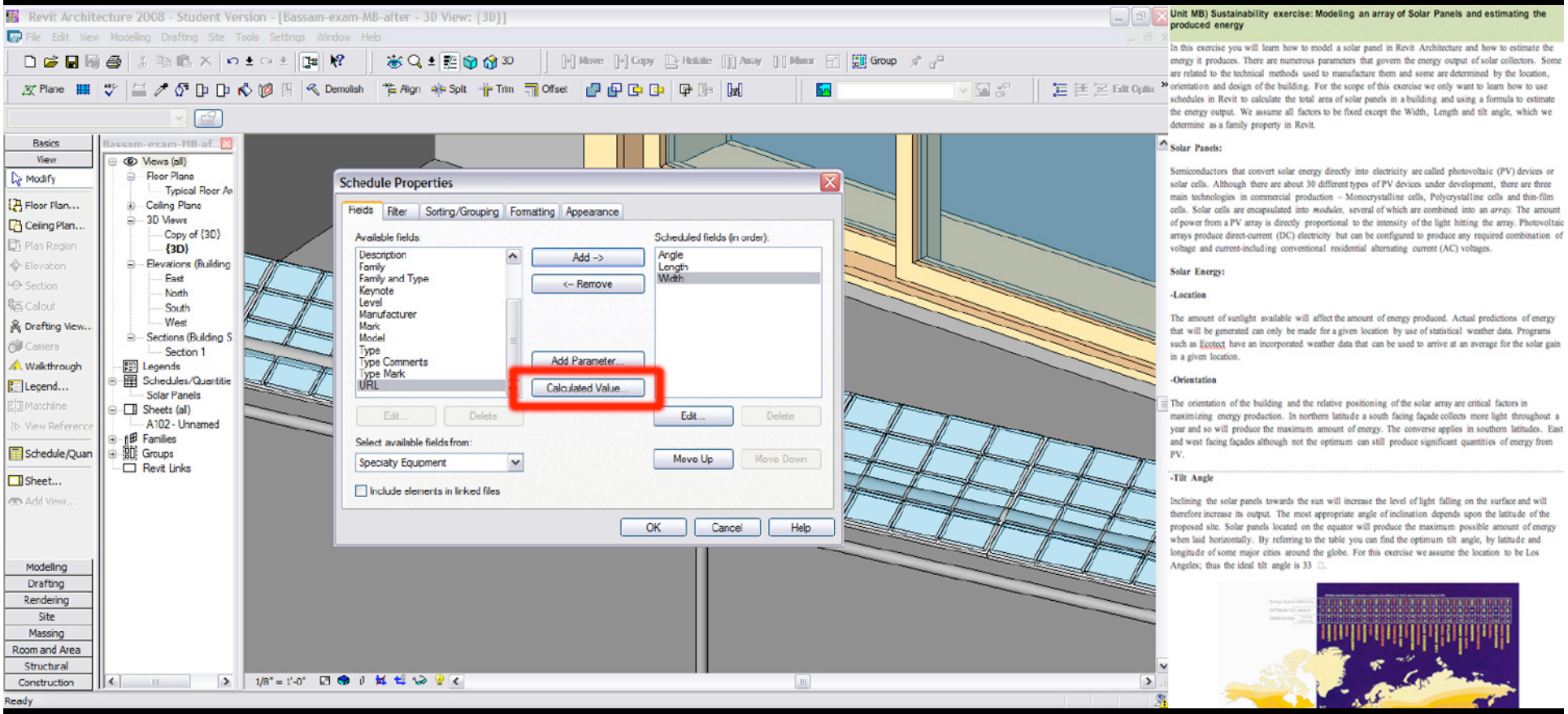
Software Required: Revit Architecture 2008 & Ecotect
Starting Point Dataset: loghmani-exam-before.rvt

When incorporating solar panels into a design, it is important to analyze the solar access of a particular building or site. Once you know which surfaces of your building provide the most annual sun exposure, then you can efficiently integrate a photovoltaic system into your building.

This exercise consists of the following tasks:

- Analyzing the roof with a solar access study to determine which areas have the most annual sun exposure.
- Applying a solar collector material to the solar panels in its initial location to determine how much annual electricity it will produce.
- Relocating the solar panels according to the solar access study.
- Calculating the amount of electricity produced from the relocated solar panels on the roof.
- Comparing the before and after results from the solar collectors.

Photovoltaics



Professional Practice Undergraduate Course

one topic of many

Building information modeling

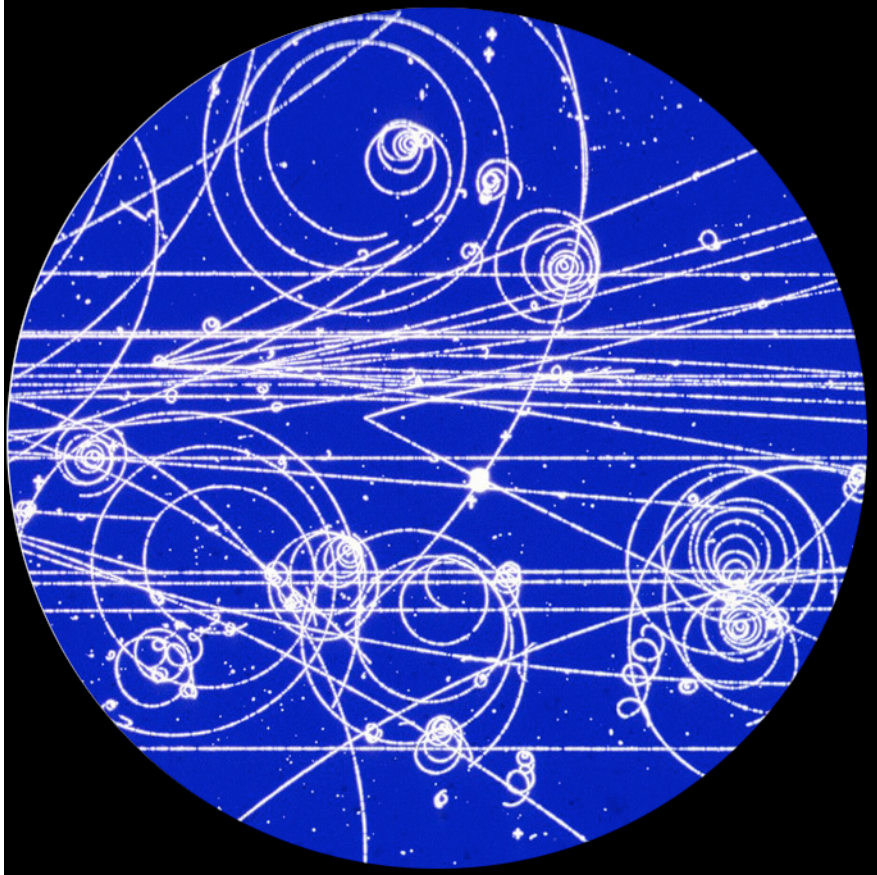
Detailing

Coordination

Collaboration

"The areas of consensus shift unbelievably fast: the bubbles of certainty are constantly exploding."

- Rem Koolhaas



Future

Paradigm shift or
Call to battle or promised integration

Collaborations!

University of Southern California

USC

Sonny Astani

Department of Civil and Environmental Engineering

USC Viterbi School of Engineering

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Becerik-Gerber, Burcin

Burcin Becerik-Gerber, Assistant Professor of Civil Engineering

Research Interests

- Building Information and Construction Management
- Information Management and Technology
- Infrastructure and Urbanization
- Sustainable Practices
- Integrated Practice Management

For information about a Ph.D. in Civil Engineering with a focus on Construction Management, please CLICK HERE

Biographical Information

- DDes – 2006 – Information Systems and Project Management – Harvard University
- M.S. – 2002 – Civil & Environmental Engineering – University of California, Berkeley
- M.S. – 2001 – Architecture – Istanbul Technical University
  B.S. – 1999 – Architecture – Istanbul Technical University

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FM – Cinematic Arts Building

http://www.aia.org/aiarchitect/thisweek06/1103/1103d_pwlucas.cfm

http://la.curbed.com/uploads/2008_01_usc-cinema2.jpg

BIM

BIM SYM

BIM BOP

BIM FAB

BIM CON

… kill bim?

Integrated practice, integrated teaching

Design intelligence, evidence based design

Research

The different meanings of BIM from Google Images - a subset.