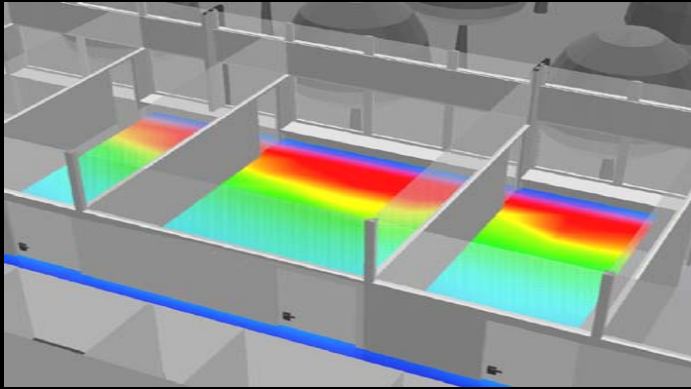
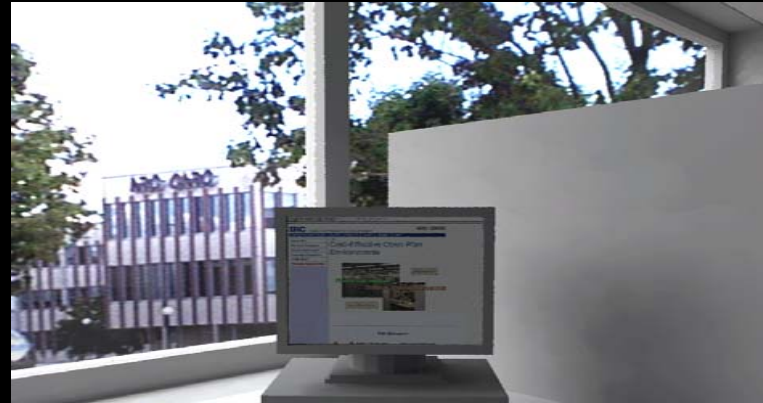


Natural Light in Design

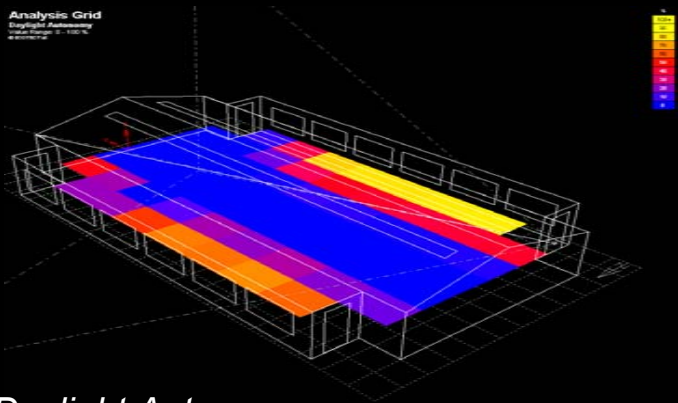
Using simulation tools to explore realistic daylight-responsive solutions



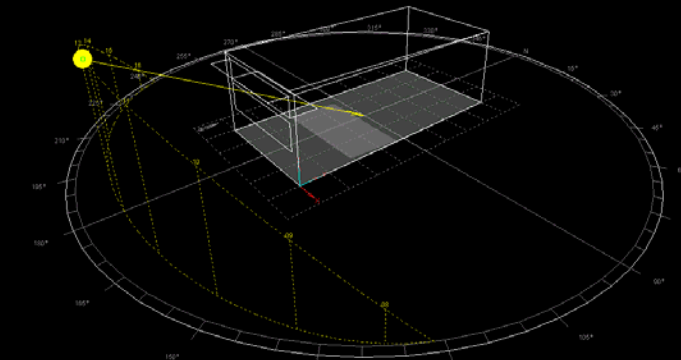
Daylight Factor



Visual Comfort



Daylight Autonomy



Avoidance of Direct Sunlight

Introduction to Simulation

Christoph Reinhart, Ph.D.

Overview – Building Simulation

Tuesday, Jan 24th 2006

| time slot | Content | instructor |
|-----------|---|-------------|
| Mon 9.30 | Welcome, class introduction, design project (teams formed next morning) | MA, all |
| Mon 10.00 | - General Introduction to daylighting (benefits, history, some case studies) | MA |
| Mon 10.30 | - Introduction to Building Simulation (why simulations for architects, tools used in this course) | CR |
| Mon 11.00 | coffee break | |
| Mon 11.15 | <ul style="list-style-type: none"> - Photometry (definition, measurement, typical values, DF definition) (MA) - Static Daylighting Metrics (context of LEED, selected results from NRC survey, DF & Solar Shading) (CR) - Daylight factor calculations: protractor method, LEED spreadsheet method, sky models CIE and Perez (MA) - Daylight factor simulation: design sky, split flux method in Ecotect (CR) <ul style="list-style-type: none"> ▪ Hands-on exercise: DF calculation in Ecotect (split flux) (CR) ▪ Hands-on exercise: solar shading module in Ecotect (CR) - Intro to Radiance (CR) <ul style="list-style-type: none"> ▪ Hands-on exercise: Radiance visualizations (CR) ▪ Hands-on exercise: DF calculation in Ecotect (Radiance) (CR) | MA, CR, all |
| Mon 13.00 | lunch (on your own) | |
| Mon 14.00 | <ul style="list-style-type: none"> - Climate Data (kind of data and measurement, weather files, E+ weather data directory) (MA) <ul style="list-style-type: none"> ▪ Hands-on exercise: weather tool in Ecotect (CR) - Overview on visual comfort (glare, contrast, requirements, health) (MA) - Dynamic Metrics & related tools (CR) | MA, CR, all |
| Mon 15.45 | coffee break | |
| Mon 16.00 | <ul style="list-style-type: none"> ▪ Hands-on exercise: Daysim exercise from tutorial interrupted by discussions on: <ul style="list-style-type: none"> - Short time steps dynamics - Daylight Coefficients - User Behavior Model - Daylight Autonomy Results | all |
| Mon 17.00 | <ul style="list-style-type: none"> ▪ Hands-on exercise: students to repeat at DF, Solar Shading & DA analysis on their own | all |
| Mon 17.30 | end of first day | |

Objective for this module

Convince you that:

- **Building simulation is fun and can add value to the design process.**
- **To understand your simulation results, you need to understand the underlying models.**

Overview - Building Simulation

provide shelter

adequate indoor
environment

Building Simulation

sustainability



Canadian Centre for Housing Technology

cultural identification

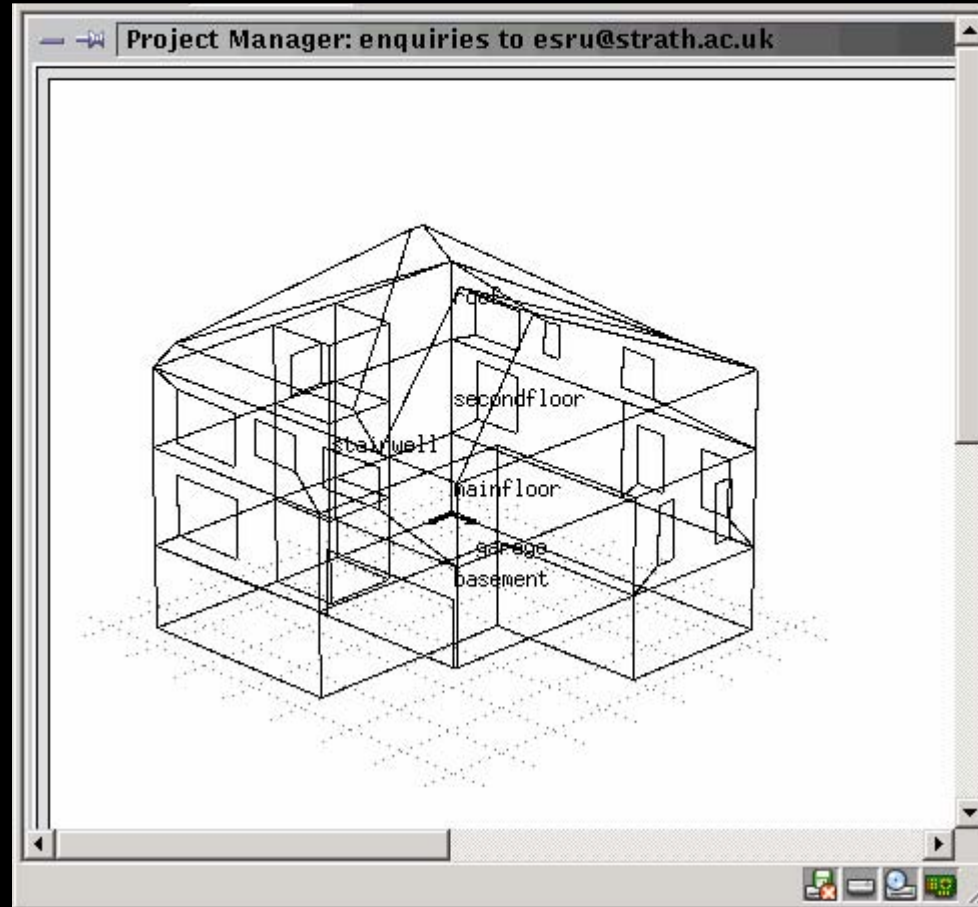
social representation

esthetics

Energy Simulation

The Building as a Thermodynamic Object

transient conduction
surface convection
shading and isolation
moisture



longwave radiation
shortwave radiation
fluid flow
casual gains
plants

energy and mass balance
radiosity
raytracing
sky models
time series analysis

Why building simulation?

To **compare different design options** during design development.

To **reduce risk** through reduced planning uncertainty.

To demonstrate **code compliance** (absolute values).

LEED Green Rating System

Categories for New commercial construction and major renovation projects

- Sustainable Sites (14)
- Water Efficiency (5)
- Energy & Atmosphere (17)
- Materials & Resources (14)
- Indoor Environmental Quality (15)
- Innovation & Design Process (5)

Why building simulation for architects?

Better interfaces. Faster computers.

To **interactively improve** your design at the schematic design stage.

To be able to **engage in a dialogue** with the HVAC engineer.

Competitive edge: high demand for simulationists

Opportunity to work on more interesting projects.

Caveat: You have to understand the underlying assumptions.

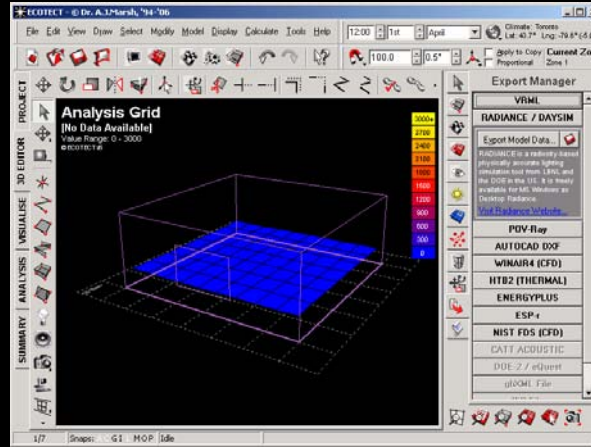
Mailing Lists

Mailing List : Radiance Online <http://www.radiance-online.org/>

Mailing List: Building Simulation <http://www.gard.com/ml/bldg-sim.htm>
(technical information and job postings)

Simulation Tools used in this Course - Tuesday

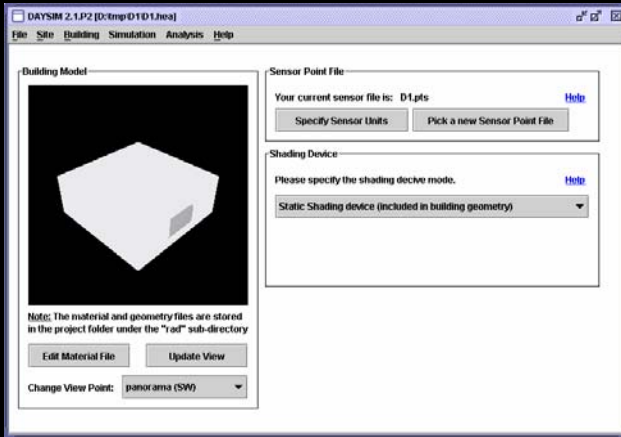
Ecotect



Daylight Autonomy

Daylight Factor, Illuminances...

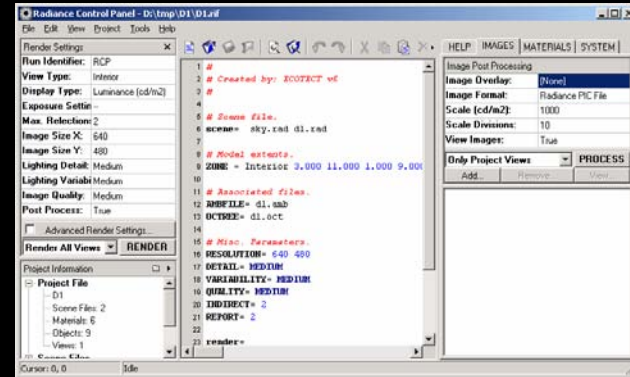
Daysim



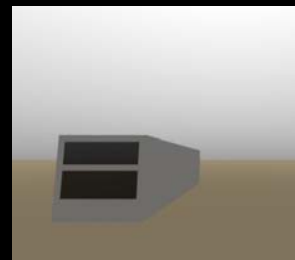
Lighting Energy



Radiance Control Panel

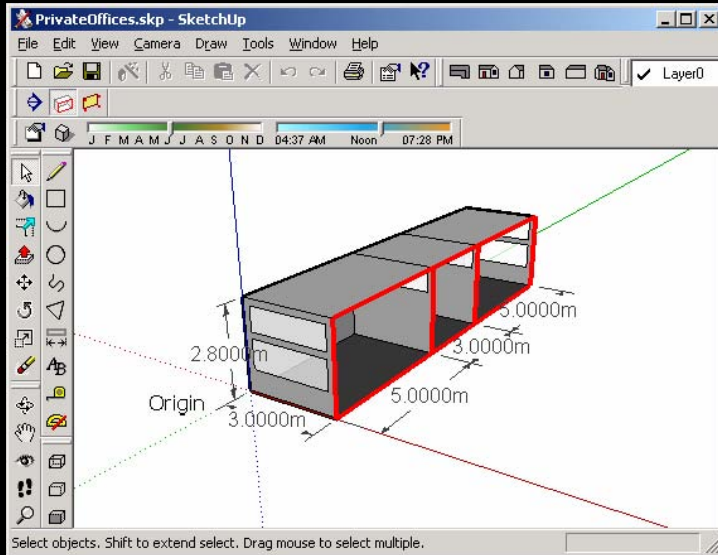


Visualization



Simulation Tools used in this Course (Wednesday)

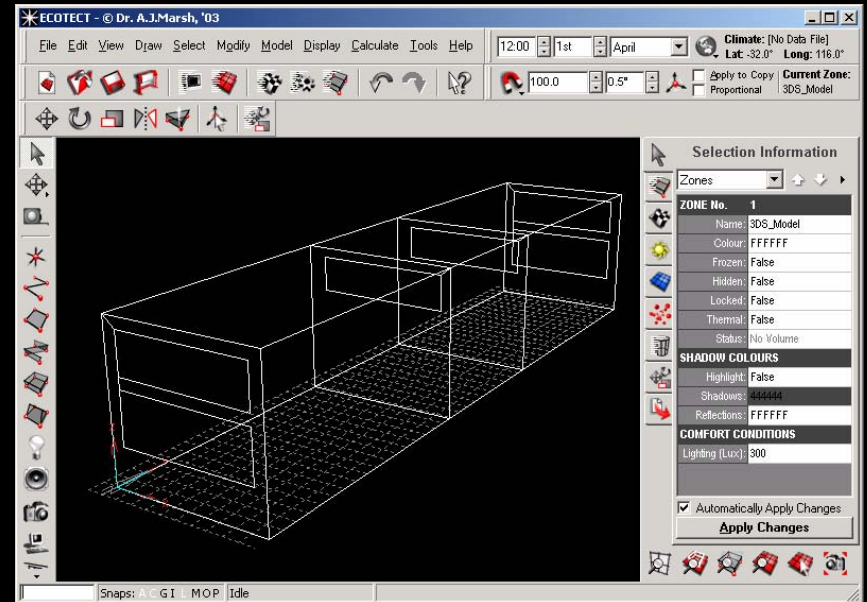
Sketch Up, FromZ,...



3ds file



Ecotect



Building Energy Software Tools Directory

The screenshot shows a Microsoft Internet Explorer browser window displaying the Building Energy Software Tools Directory. The address bar shows the URL: http://www.eere.energy.gov/buildings/tools_directory/. The page header includes the U.S. Department of Energy logo and the text "Energy Efficiency and Renewable Energy" with the tagline "Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable". The main navigation menu includes "About the Program", "Program Areas", "Information Resources", "Financial Opportunities", "Technologies", "Deployment", and "Home". The main content area features a search bar and a "Search" button. Below the search bar, there are sections for "EERE Information Center", "UPDATES", and "EVENTS". The "UPDATES" section lists "EnergyPlus - Version 1.2.1" released on October 1, 2004. The "EVENTS" section lists "IBPSA-USA Winter Meeting" in Orlando, Florida, USA on February 5, 2005, and "IBPSA Building Simulation 2005 International Conference". The "FEATURED SOFTWARE" section highlights "Tetti FV", a program for the simulation, design, and calculation of grid connected photovoltaic systems. The left sidebar contains a table of contents for the directory.

| About the Directory | |
|------------------------------------|--|
| Tools by Subject | This directory provides information on 295 building software tools for evaluation energy efficiency, renewable energy, and |
| Tools Listed Alphabetically | |
| Tools by Platform | |
| Tools by Country | |
| Related Links | |

http://www.eere.energy.gov/buildings/tools_directory/