Daylight Design
from the Architect's Perspective

Joint meeting CIBSE Daylight Group
CIBSE Building Simulation Group

1st December 2010
Structure

1. Daylighting – design vs verification
2. The design process
3. Tools available
4. Educate or prescribe?
“Architecture is the masterly, correct, and magnificent play of volumes brought together in light.

“The history of architecture is the history of the struggle for light.”

Le Corbusier
Design vs Verification

Daylight verification
- Quantifying a building's daylighting performance
  - Poor performance is usually impossible to correct

Daylight design
- Ensuring good daylighting, low energy consumption
  - Integrated Design Process
Many engineering tasks within the building design process can wait until a relatively late stage (elec, HVAC, fire, lighting).

Daylighting must be considered from the very onset.

One hour of your time right at the beginning can make all the difference between good and bad daylighting.

Fixing poor daylighting at a late stage is not possible.
“... architectural modeling, particularly at the early stages of design, represents one of the most difficult challenges for the interactive graphics software industry. Currently, available architectural design software is difficult to use at the preliminary design phase. ... What is needed is a ‘back-of-the-envelope’ environment, with the ability to sketch, doodle, and erase, to proceed in an iterative, non-linear fashion, and to perform these operations in a full three-dimensional domain.”

Integrated, iterative design process requires appropriate software tools

Yes, there are formats such as gbXML, but in reality:

Computer Aided Design

One way
Simon Fraser University, Burnaby, Canada: Sketch-Based Architectural Design System

“... our proposed framework distinguishes itself from existing systems with its simplicity and close conformation to the design habits of architects.”

Yu and Zhang, 2007
MIT Daylighting Lab:

“The Lightsolve project seeks to develop new approaches in daylight simulation and fill some critical gaps found in the tools available nowadays to architects. Specifically aimed at the early stages of a building design, it will help develop a form based on both aesthetical and technical indications of the desired performance.”
“Calculations are not an end in themselves. Their purpose is to help the designer to choose between alternatives or to check whether a particular solution meets a criterion. They are a small part of the whole design process – and aid to creativity in lighting, not substitute.”

Tregenza & Loe: *The design of lighting*, 1998
All compliance criteria are also design tools:

- Vertical Sky Component, VSC
- Average DF
- Sunpath diagrams
- Sunlight Availability
- Room depth
- No-sky line
Early design stage: How much natural light is available at the window?

Traditionally: Diagram

Rule of thumb: 25°-rule

Computer:
- 10,000 lx overcast sky
- External vertical illuminance
- Obstructions and ground are black
Average DF

- Level of daylight in a room
- Traditionally: BRE formula
- Computer: full-blown simulation

\[ ADF = \frac{A_g \theta T}{A \left(1 - R^2\right)} \]
Sunpath Diagrams

- Simple solar geometry
- Quick assessment of shading requirements
- Traditionally: Diagrams
- Computer: Rendering with overlay
Probable Sunlight Hours

- Climate-based metric, based on historic weather data
- Assess sunlight as an amenity
- Traditionally: Diagram with dot-overlay
- Computer: Render fisheye view, count dots
Glazing Area

- Different rules of thumb:
  - Glazing-to-wall ratio
  - Glazing-to-facade ratio
  - Glazing-to-floor ratio
- e.g. GPG245:
  - 1/25\textsuperscript{th} of total room area
- Dead-easy for a computer to sum up
• Daylight from windows only possible in the perimeter zone of the building
• BRE room depth criterion:
  \[ \frac{L}{W} + \frac{L}{H} \leq \frac{2}{(1 - R_b)} \]
• Rule of thumb:
• Who needs a computer for this?
Design Tool Requirements

- Simple, intuitive interface
- Two modes:
  - Calculation
    - Rules of thumb, simple calcs
    - Instant feedback: Traffic lights, gauges
  - Simulation
    - More accurate results
    - Graphs, numbers
- Export model to CAD, full simulation packages
We need simple tools that help with the interactive **design** of good buildings for 95% of cases

Current software tools are designed to sit at the very end of the design process, only allowing for **verification** of the design

The gap between architectural design and engineering solutions needs to be narrowed, not widened.
Educational vs Prescriptive Approach

Daylighting

- **Educate**
  - Raise awareness
  - Encourage good daylighting
  - Show how it's done
  - Provide the tools

- **Prescribe**
  - Enforce through building regs
  - Tick-box approach to compliance
  - Must-do, like paying taxes
William Willett vs Der Kaiser
Summer Time

- **William Willett**
  - 1907 pamphlet “The Waste of Daylight”
  - Parliamentary select committee in 1909: Daylight Savings Bill
  - Much lobbying, educating
  - Bill passed in 1916: Summer Time Act

- **Kaiser Wilhelm II**
  - 1916: “What, we'll save how many tonnes of CO2 with this? Jolly good idea. I hereby decree…” *

* Probably not his actual words.
Prost, Herr Willett!
Part L (now)
Part L (soon?)
Compliance Chasing

5%

Predominantly daylit appearance

Room appears strongly daylit

2%

Room looks gloomy

BREEAM
Education, Education, Education
“We suspect that architects had forgotten about daylight design. The windows are decorations; there was no connection made between daylight performance and the elevation design. ... Having worked with a variety of different architects, this focus on natural light has strengthened our belief that it is an art becoming lost to architects. In fact, it seems that many architecture courses don't teach daylight as an element of their curriculum anymore, so it's no surprise that the skill is slowly disappearing.”

Stammers and Lupton in *Lighting*, Dec 2010
Teach daylighting on every course of architecture and building-related engineering.

Architect do not have to become daylighting specialists, but need to be aware of the critical importance of daylight.

Contemplations on daylighting should become integral part of the creative design process, right after (or during) the scribble-on-a-napkin stage.
Encouraging Example

Bartlett Sky Simulator Dome
Time to ditch the 4x4?

Buyers shun large cars for something smaller

20 February 2009

The economic downturn means that downsizing cars - trading larger models for smaller, more fuel-efficient motors - has become all the rage, says Which? Car.

A previously healthy market for 4x4s has virtually collapsed and some people have finally realised that an off-roader isn’t the perfect car for the school run.

Expensive, 'gas-guzzling' cars such as 4x4s are becoming socially unacceptable - unless you’re a farmer. Buyers have also been turned off by high road tax and some models’ disappointing reliability.
Have you achieved 5%?

Архитектор достигли 5%?
Thank You