

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?

Le Corbusier

“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

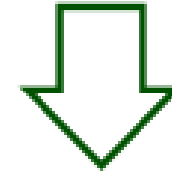


Quantifying a building's
daylighting performance

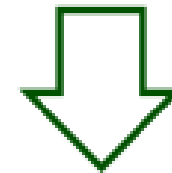


Poor performance
is usually
impossible to correct

Daylight design



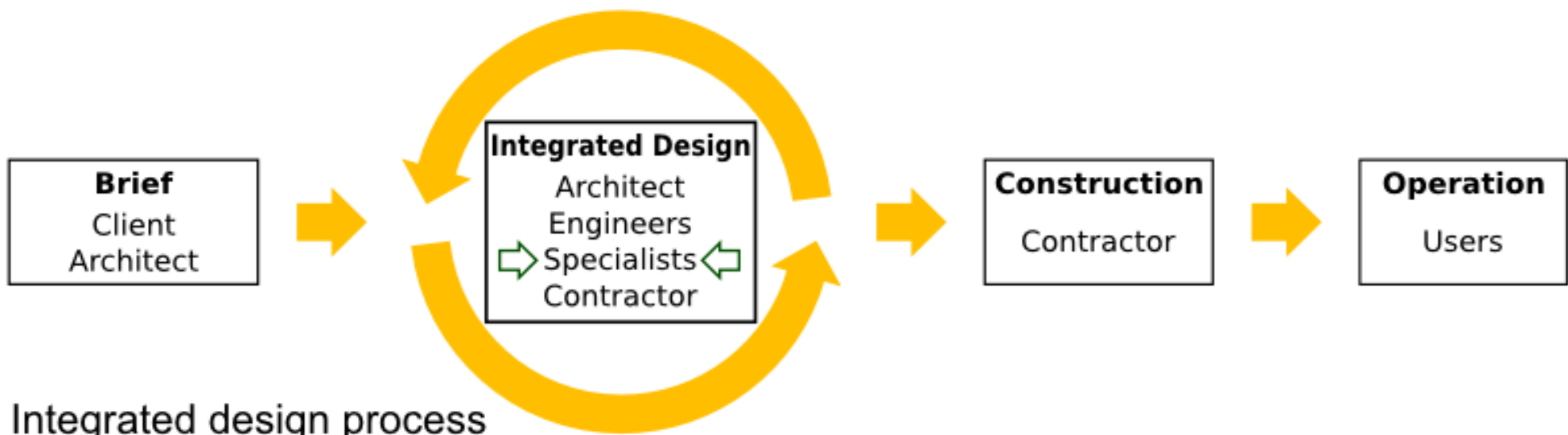
Ensuring good daylighting,
low energy consumption



Integrated
Design
Process

Building Design

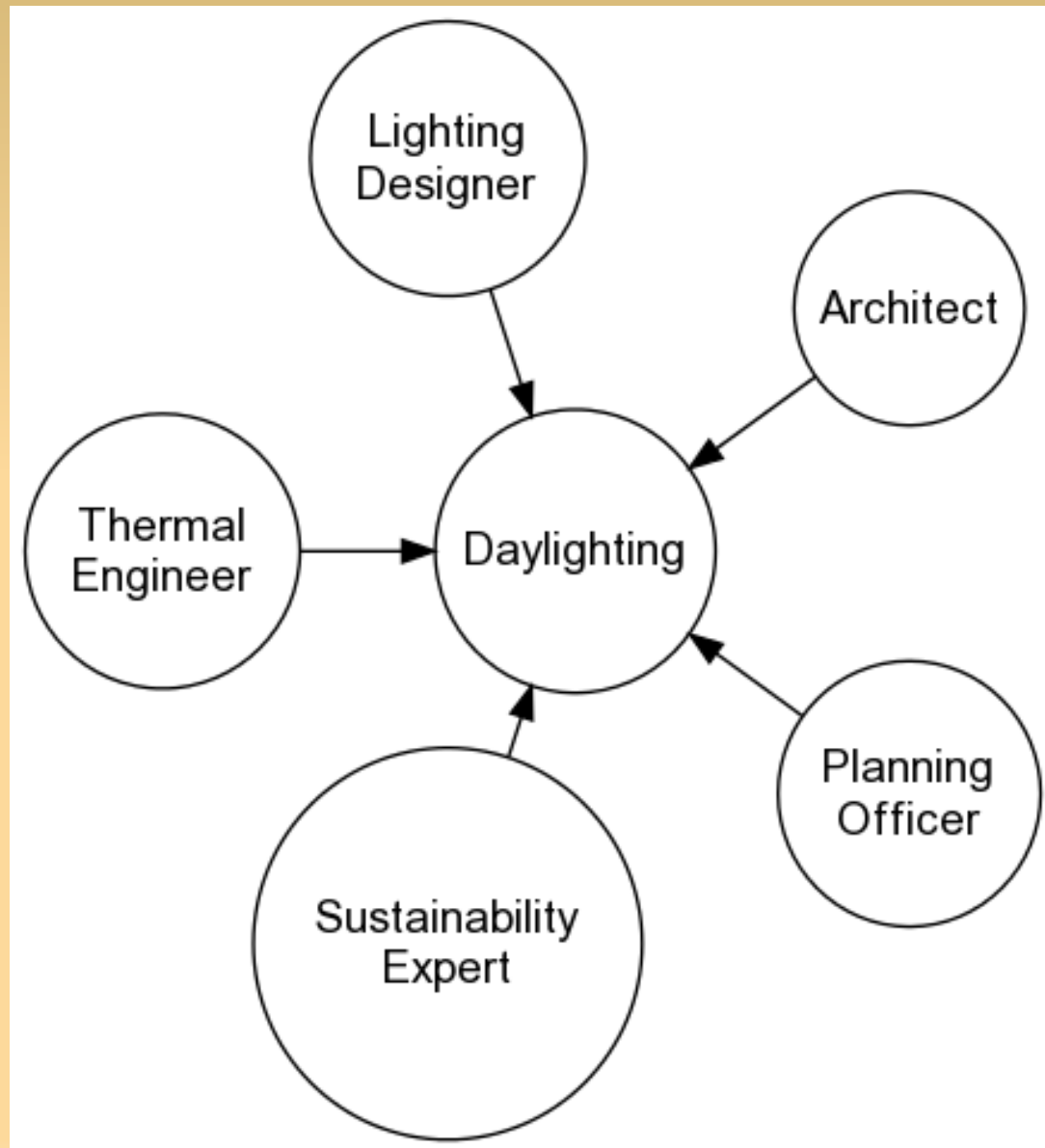
Traditional linear design



Design Challenge

- 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.

Design Team



Non-linear Requirements...

“... 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.”

But Linear Solutions

- Integrated, iterative design process requires appropriate software tools
- Yes, there are formats such as gbXML, but in reality:

Computer

Aided

~~Design~~

Drawing

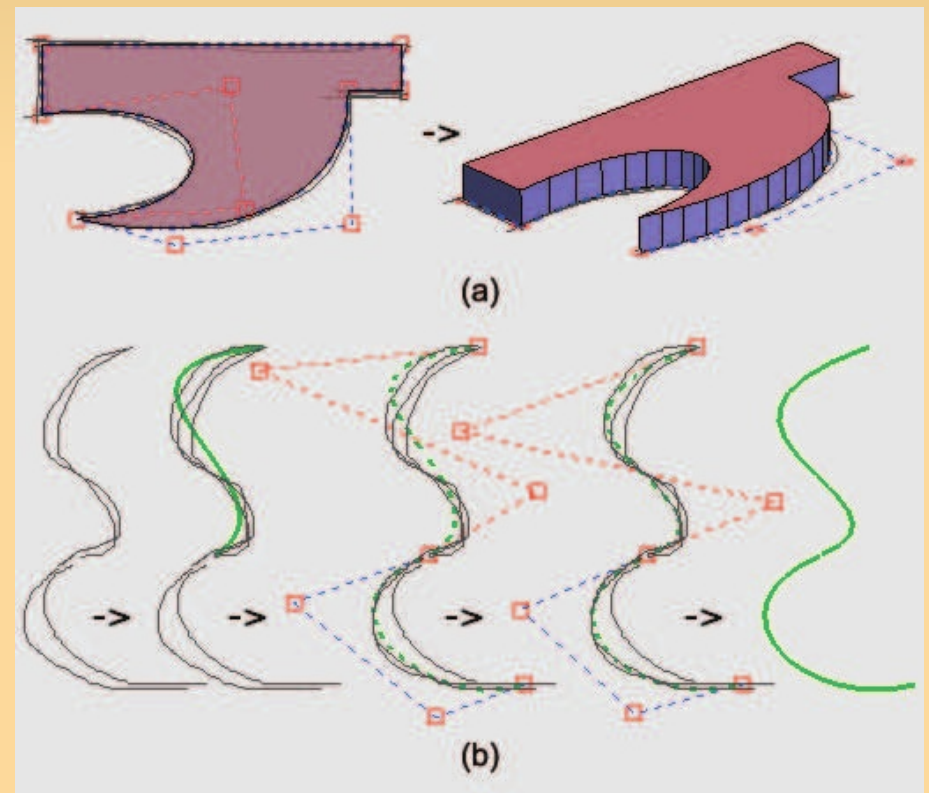


Research

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.”

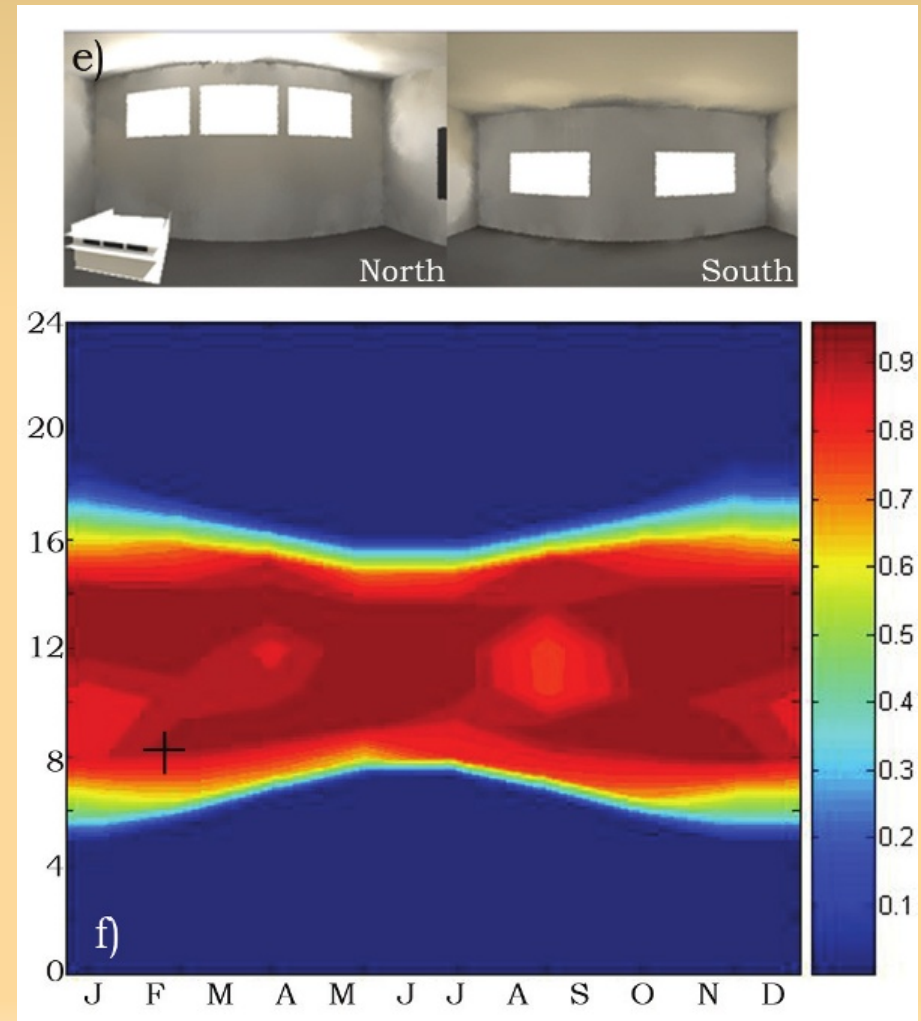
Yu and Zhang, 2007



More Research

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.”



Means to an End

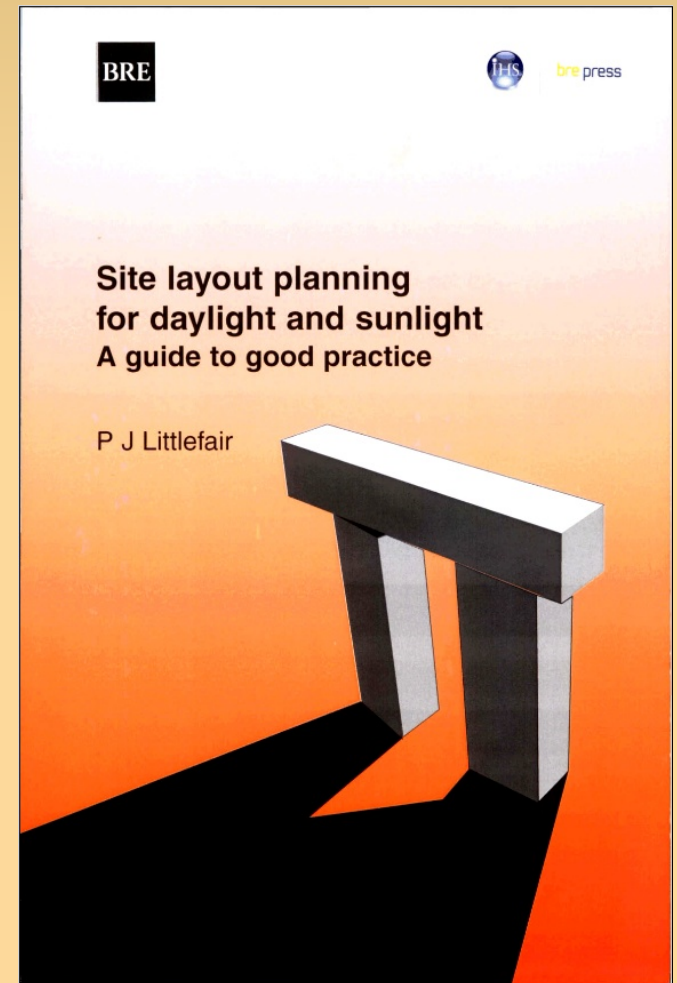
“Calculations are not an end in themselves. Their purpose is to help the designer to choose between alternatives or to check whether a particular solution meets a criterion. They are a small part of the whole design process – and aid to creativity in lighting, not substitute.”

Tregenza & Loe: *The design of lighting*, 1998

Design Tools

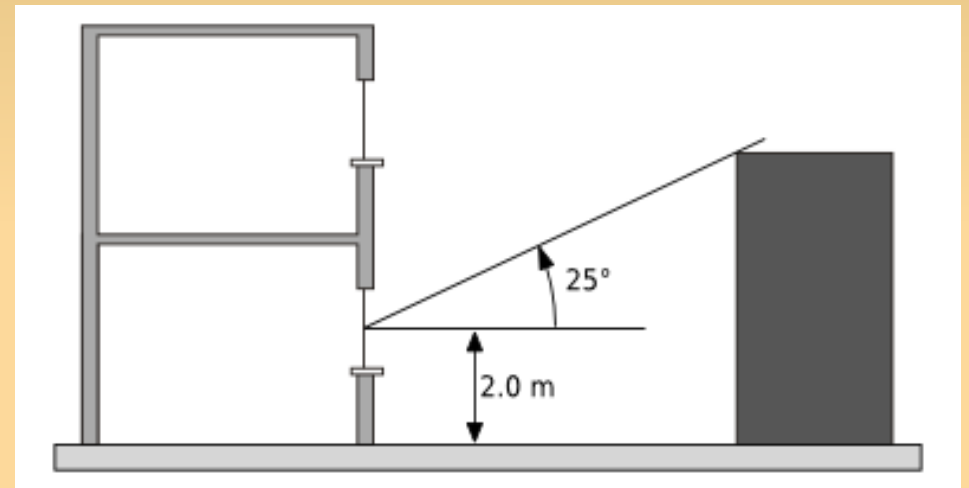
All compliance criteria are also design tools:

- Vertical Sky Component, VSC
- Average DF
- Sunpath diagrams
- Sunlight Availability
- Room depth
- No-sky line



Vertical Sky Component

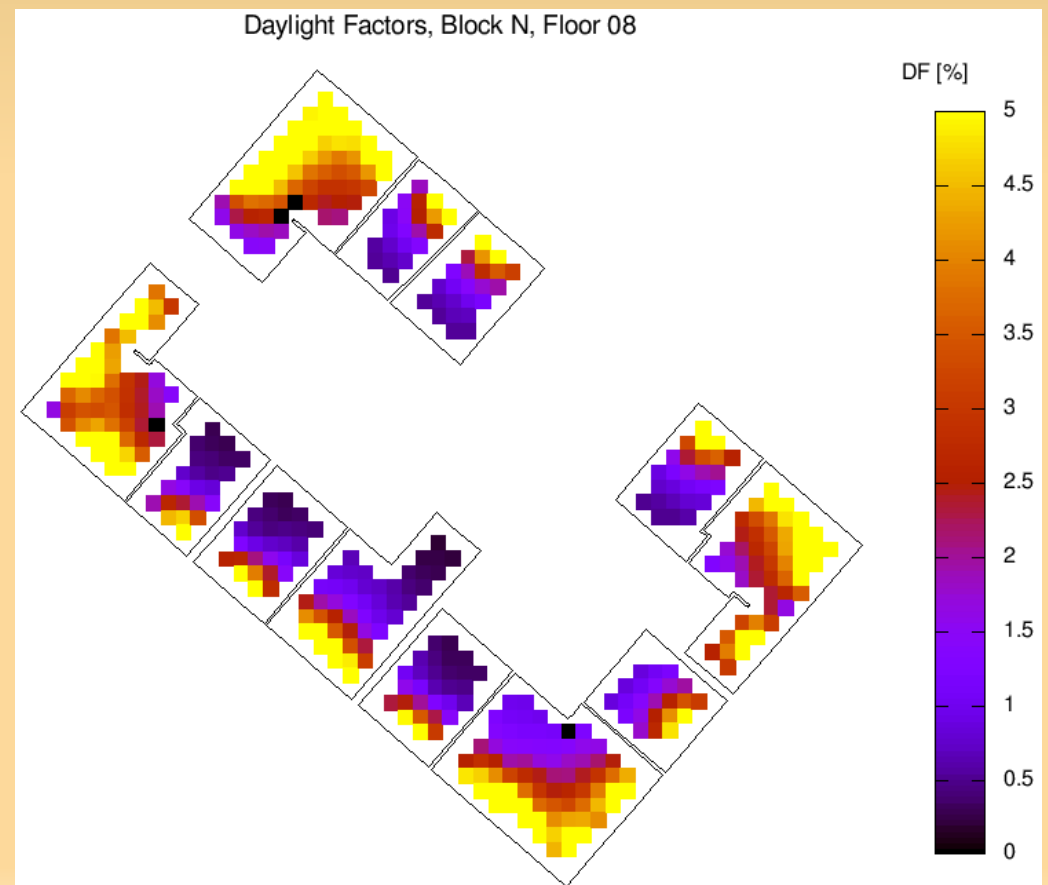
- Early design stage: How much natural light is available at the window?
- Traditionally: Diagram
- Rule of thumb: 25°-rule
- Computer:
 - 10,000 lx overcast sky
 - External vertical illuminance
 - Obstructions and ground are black



Average DF

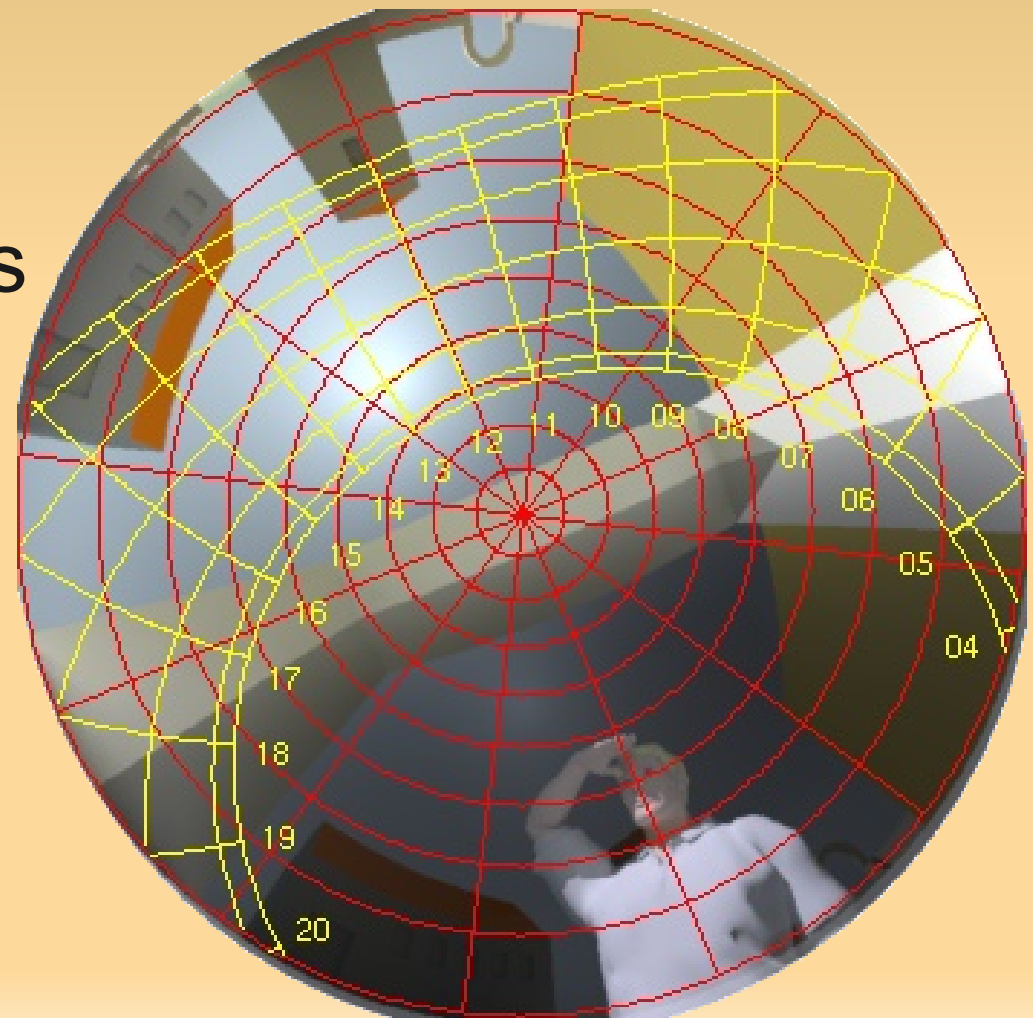
- Level of daylight in a room
- Traditionally:
BRE formula
- Computer:
full-blown simulation

$$ADF = \frac{A_g}{A} \frac{\theta T}{1 - R^2}$$



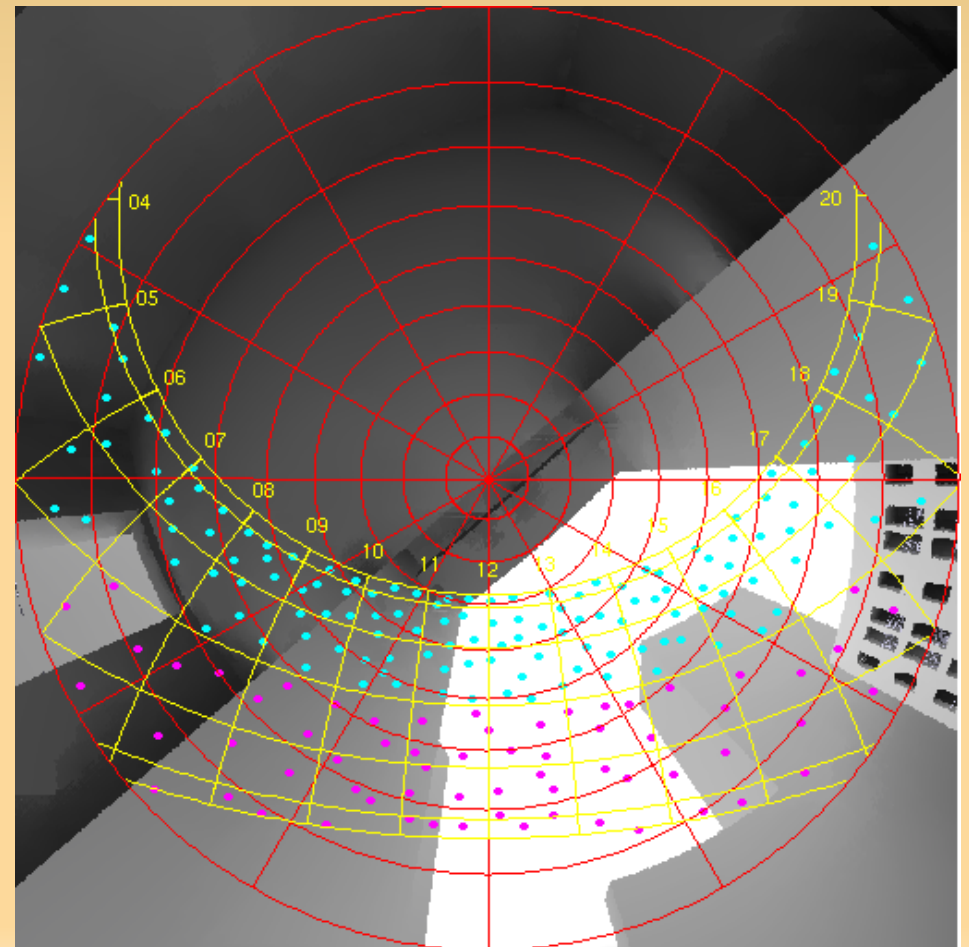
Sunpath Diagrams

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



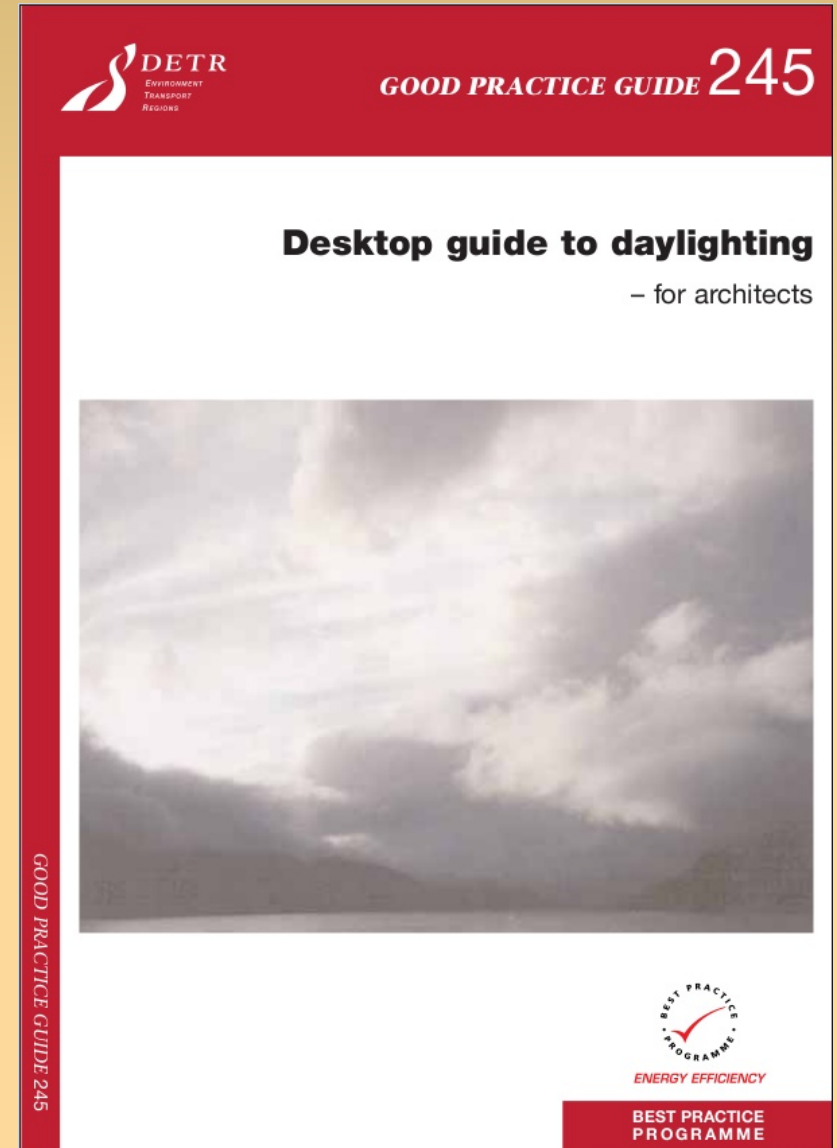
Probable Sunlight Hours

- 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:
 - $1/25^{\text{th}}$ of total room area
- Dead-easy for a computer to sum up



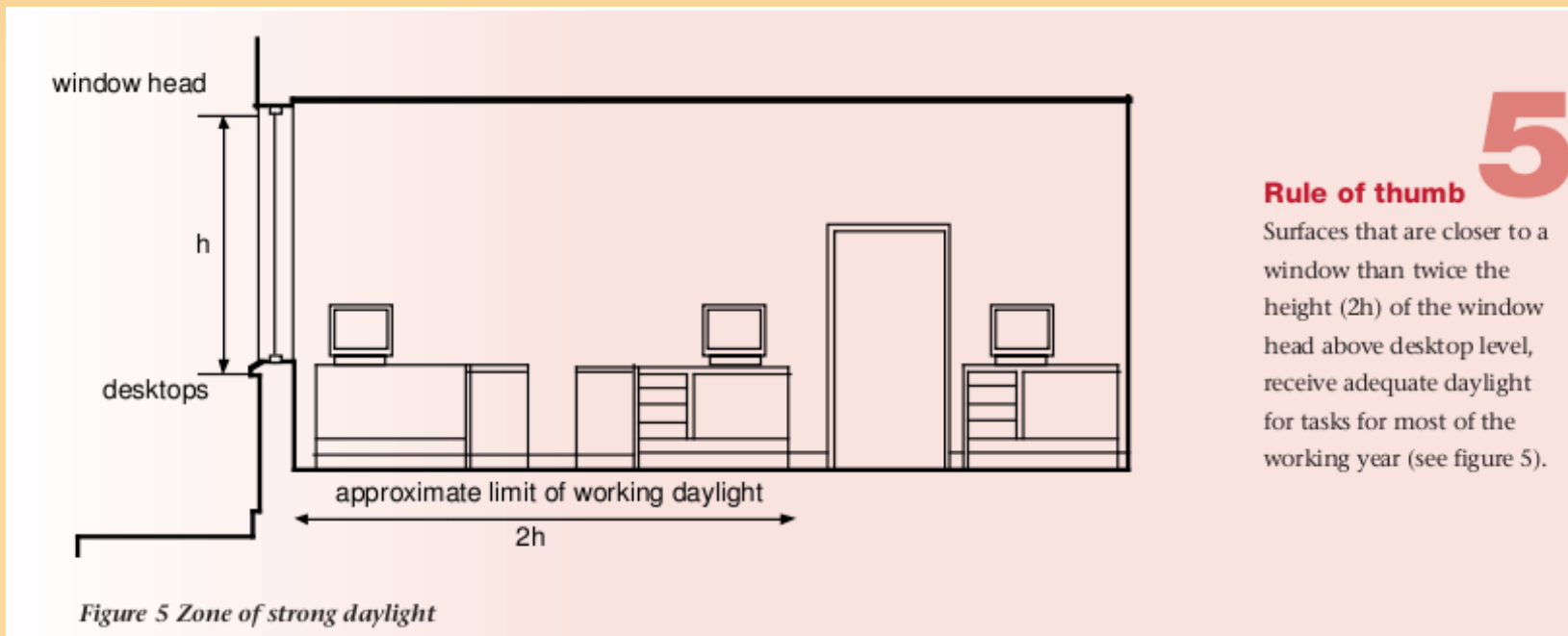
Room Depth

- 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

95%-Solutions

- 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



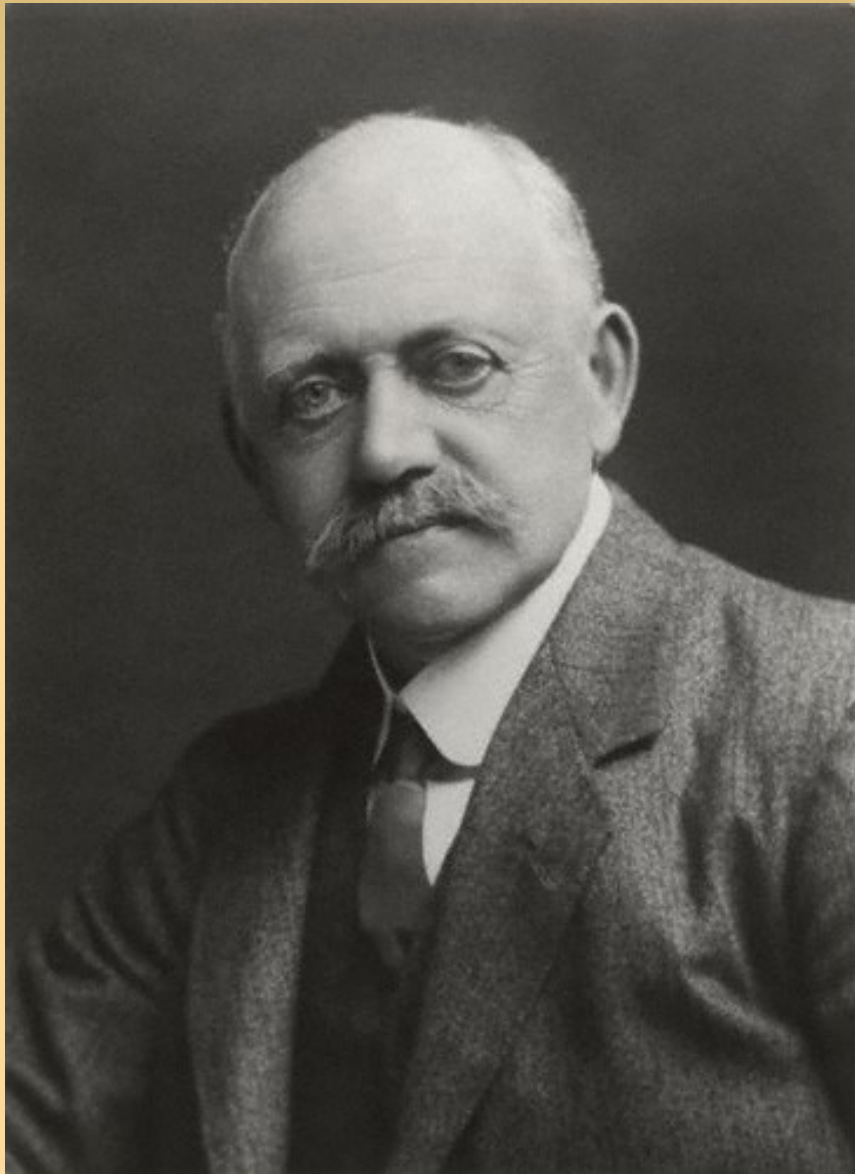
■ Educate

- 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

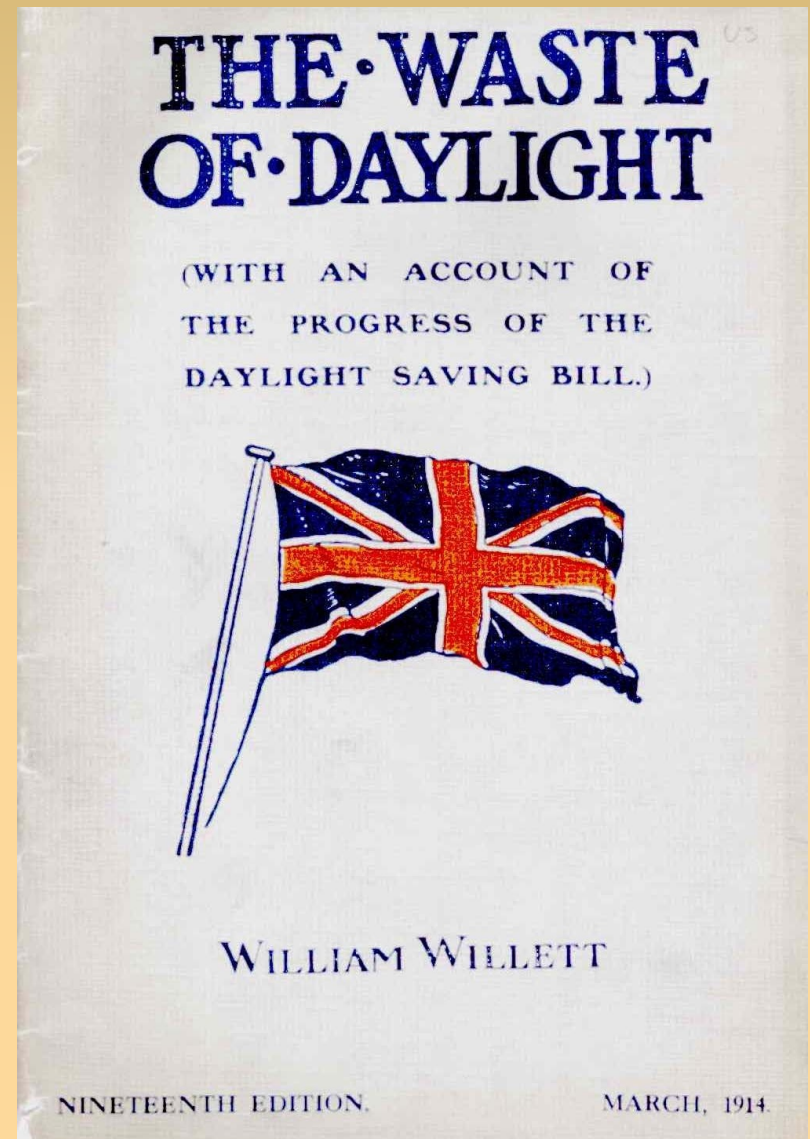
William Willett vs Der Kaiser



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.

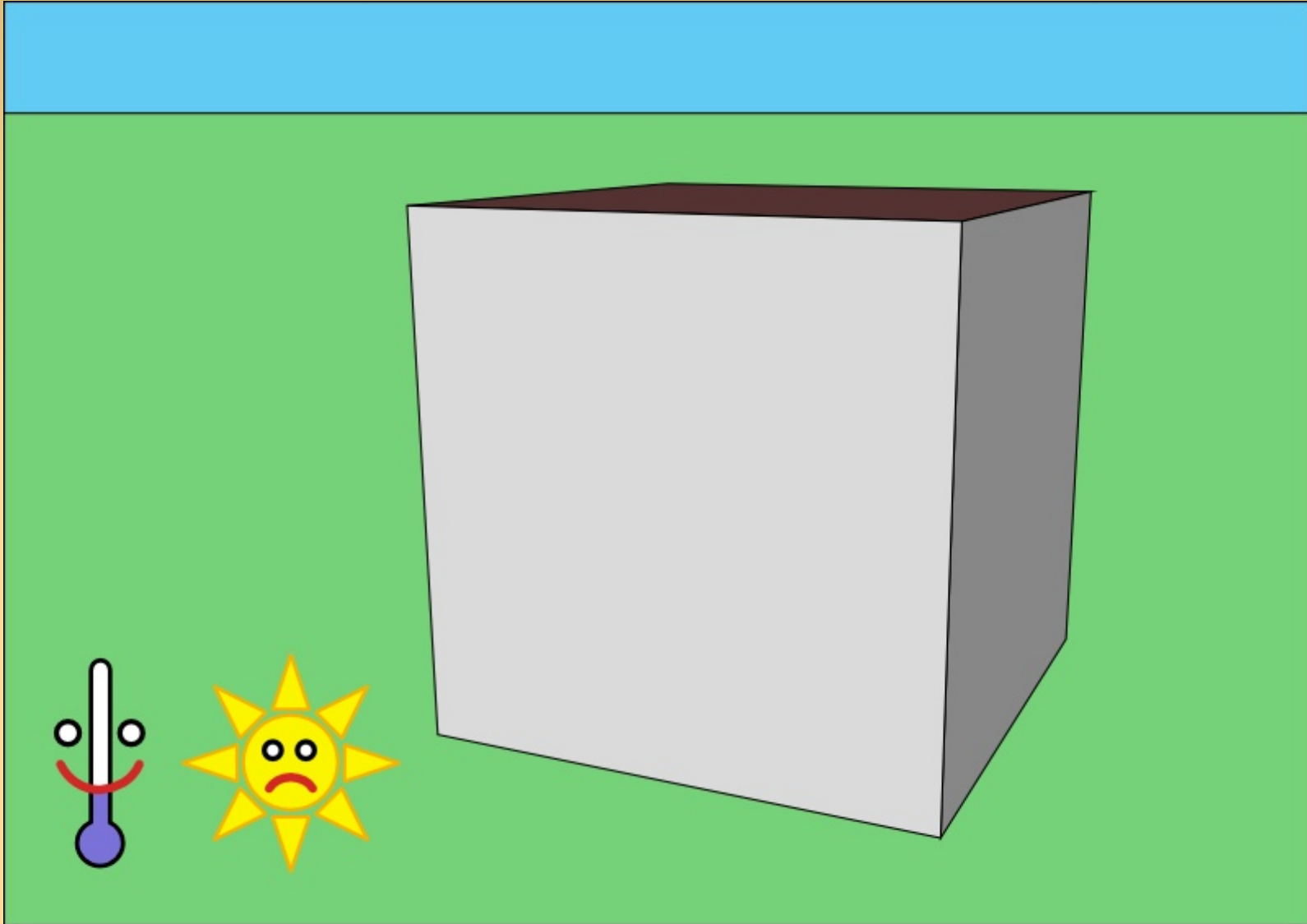


Prost, Herr Willett!

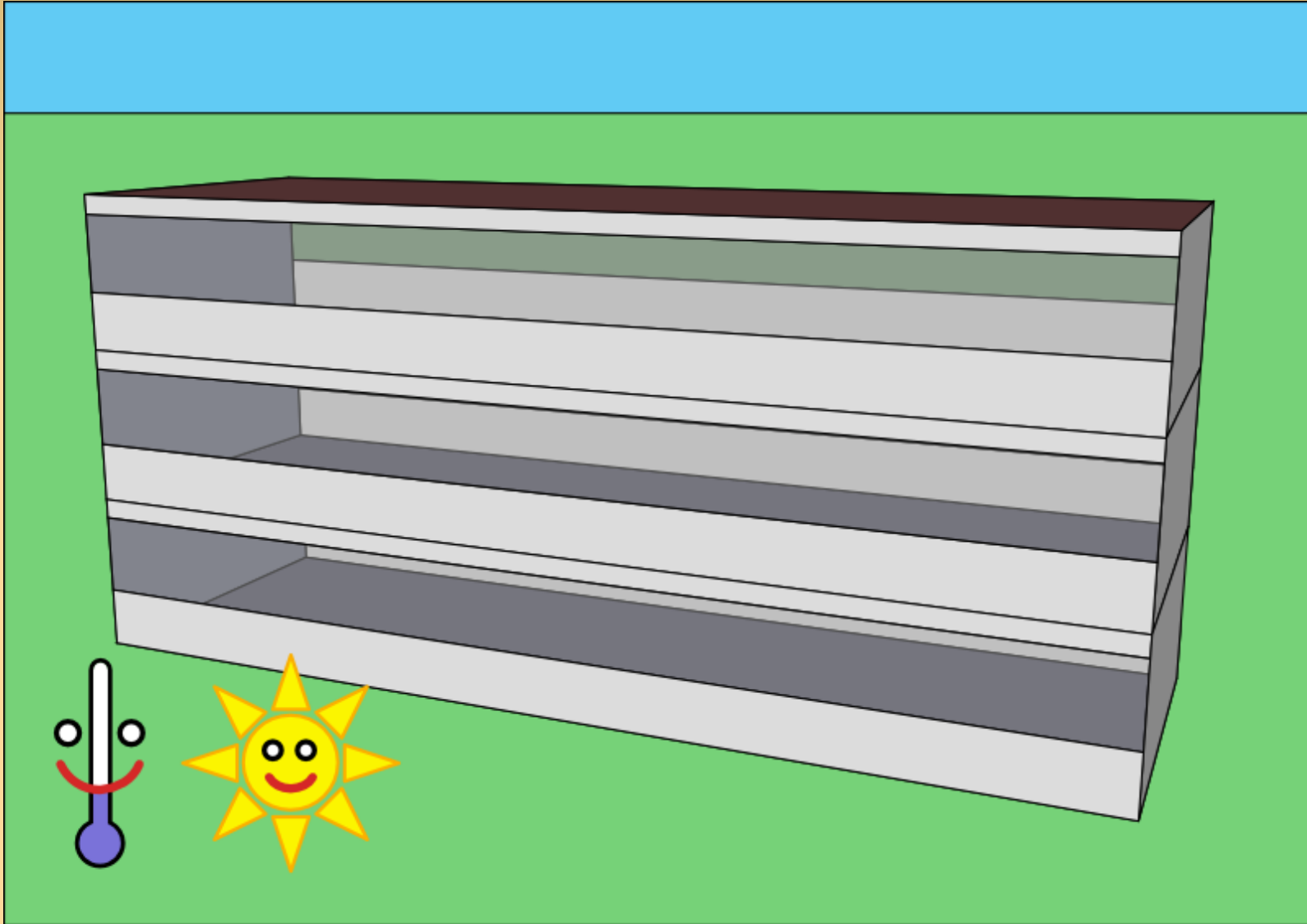


CC by-nc-nd
diamond geezer

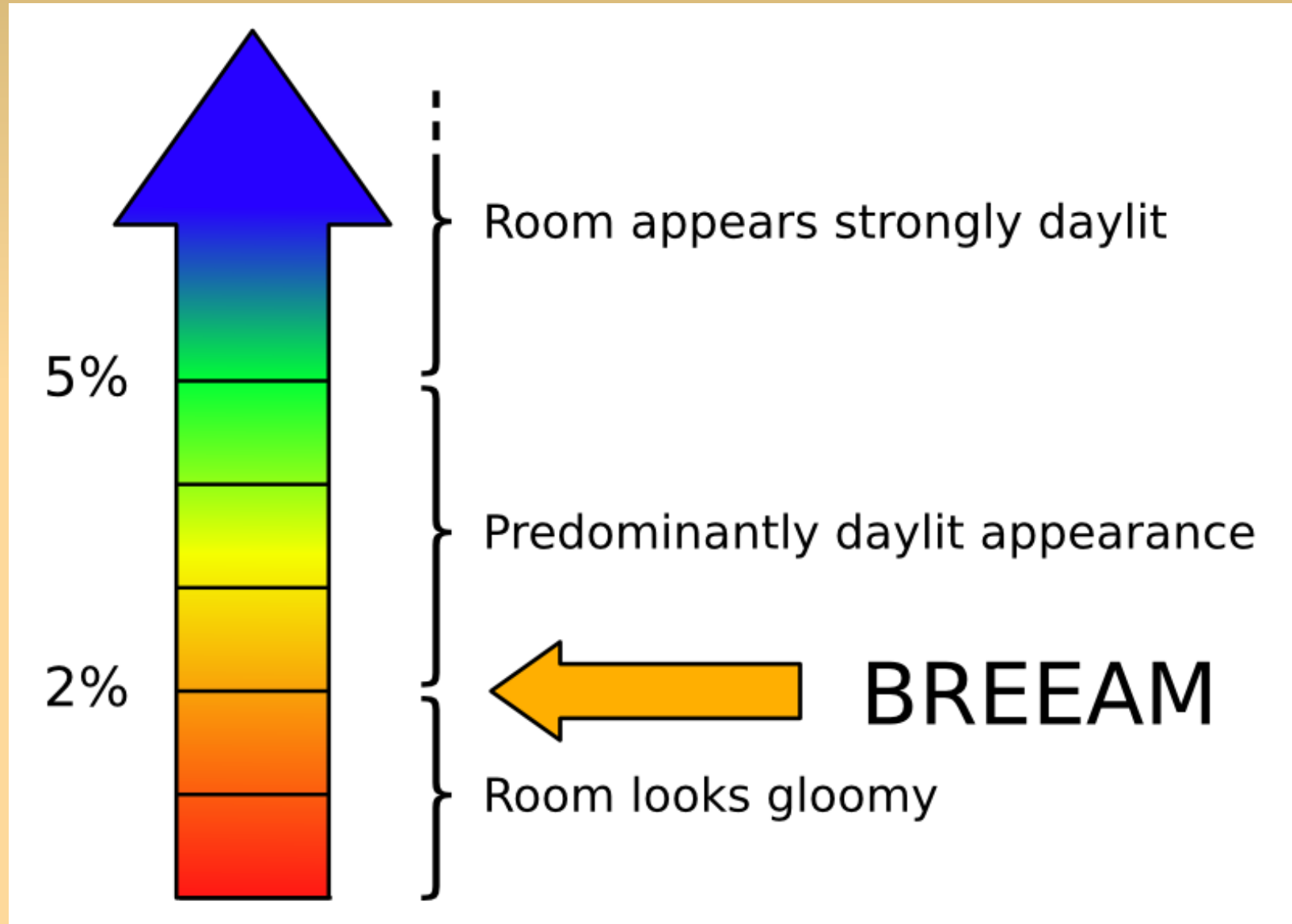
Part L (now)



Part L (soon?)



Compliance Chasing



Education, Education, Education



Lighting Designers

“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

Awareness, Awareness, Awareness

- 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

Other Incentives

You are here: [Which? home](#) > [News](#) > [2009](#) > [February](#) > Time to ditch the 4x4?

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](#).



4x4s are having a tough time as car buyers downsize

Have you achieved 5%?



Thank You