More light, fewer emissions:
Daylight and Carbon Savings, from room to masterplan
Reinier Zeldenrust
Radiance Conference, 3rd September 2014

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Environmental Design Consultants + Lighting Designers
London | Glasgow | New York | New Haven | San Francisco | Abu Dhabi
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International Building Services and Environmental Engineers

We are an international team of building services engineers, environmental designers and lighting designers focused on delivering sustainability in the built environment.

We have been designing “green” buildings for 20 years and have evolved a team with the broad range of complementary skills that are essential to the design of high performance buildings of the future.

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The building design process

**Brief**
- Massing (depth, height)
- Floor-to-ceiling height
- Geometry (shape)

**Concept**
- Window size
- Internal walls
- Shading

**Scheme**
- VLT
- Fritting
- Interior layout

**Detail**

**Building**

Great! But how to get here?
Better
Sometimes poor starting point

What are the obstacles to working on the conceptual level?
Obstacles

• Getting a seat at the table as a daylight expert
• Ignorance in rest of design team
• Energy performance primary (DL only one credit)
• Cost / space planning / compliance more important
• No 3D model available – only sketches
• Too many parameters

Educating architects and engineers

Communicating visually
(sketches + renders)

Using experience and rules of thumbs

What if there are no rules of thumb or you don’t have much experience?
Factory Design in South Asia

Cotton → Humidity → Services → Lighting → Fluff → Factory → north facing roof lights

- 150-200 lux
- Primarily 700 lux
- Important
- 24 hour operation

- No easy rule of thumb for different lighting levels
- No design / 3D model from architect
- Many different parameters

150-200 lux
- Carding: 150 lux
  RH: To human comfort
- Speed Frame: 200 lux
  50-55% RH
- Ringframe: 200 lux
  55-60% RH
- Link Coners: 200 lux
  55-60% RH
- Winding: 150 lux
  68-72%
- Drawing in: 700 lux
  85-90% RH
- Weaving: 700 lux
  700 lux
  In room: 700 lux
  66-67% RH
- Inspection & Folding: 700 lux
  RH: To human comfort

Primarily 700 lux
- Cotton Store: 150 lux
  Ambient humidity
- Winding: 200 lux
  68-72% RH
- Sizing: 200 lux
  RH: To human comfort
- Godown: 150 lux
  RH: To human comfort
Building simple parametric model to estimate order of magnitude
Figure 4: Daylight levels throughout the year for a representative point in the middle of the factory floor. Window height: 1,200mm, Spacing: 5m. Useful Daylight Index: 84%
Deriving some rough rules of thumb

- Independent of window height – approx 30% of floor area needed to achieve ~8 hours per day at 900 lux
Testing range of options automatically

- Rhino
- Grasshopper
- Ladybug + Honeybee for Radiance
- Anemone to loop through series of options
Useful Daylight Index as function of truss spacing
Primary School in the UK

- BREEAM
- UK (Cloudy)
- No direct sunlight
- DF as initial metric
Use of Galapagos as evolutionary solver
Optimisation process sped up
Masterplan in the UK

Competition
Many architects
Cost & space very important for bid
Residential
Energy performance and benchmarking targets very high
Many parameters still open

Let designers make their own trade-offs!
A whole zoo of workflow used

- Rhino
- Grasshopper
- Ladybug + Honeybee for Radiance
- Diva VIPER for EnergyPlus
- Anemone to loop through series of options
- Custom FEE component
- D3 for visualisation
Obstacles & solutions

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Educating architects and engineers
  Communicating with images
  Using experience and rules of thumbs
  Range testing
  Evolutionary algorithm
  Creating a database to set the boundaries / give freedom
Thank you!

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