More light, fewer emissions:

Daylight and Carbon Savings, from room to masterplan

Reinier Zeldenrust

Radiance Conference,
3rd September 2014

atelier ten

Environmental Design Consultants + Lighting Designers

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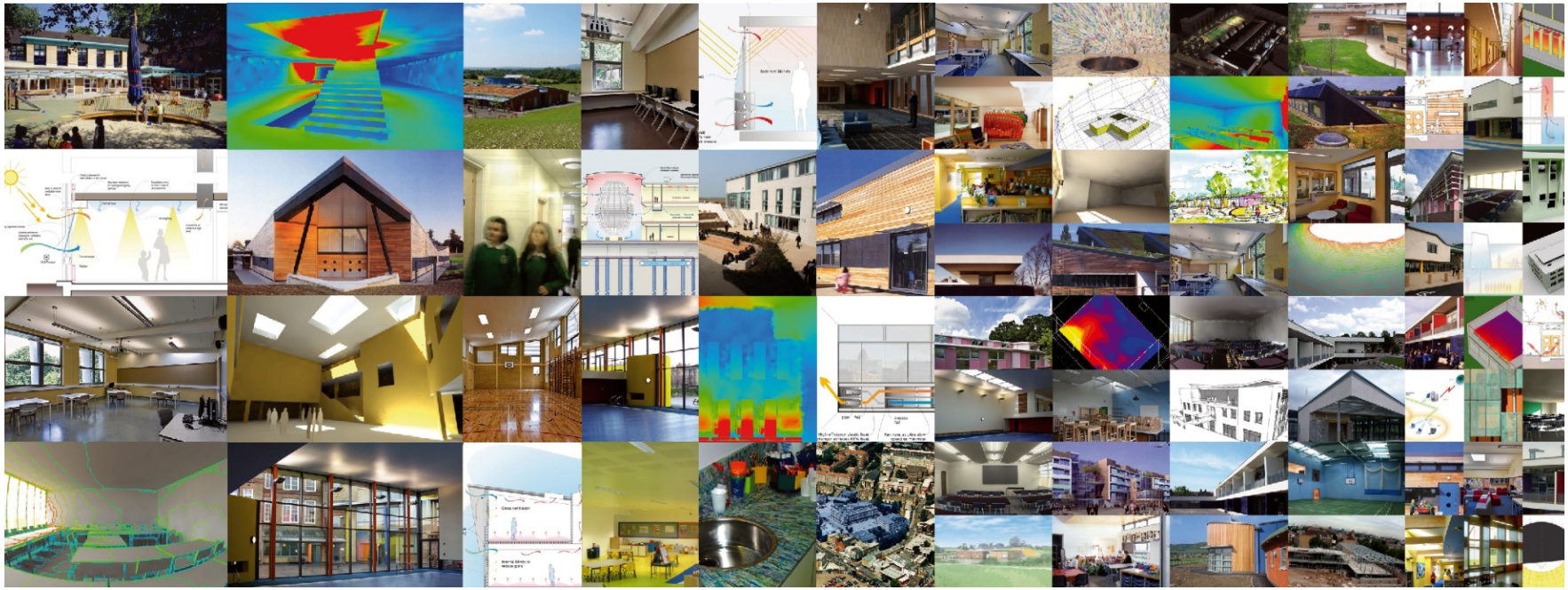

International Building Services and Environmental Engineers

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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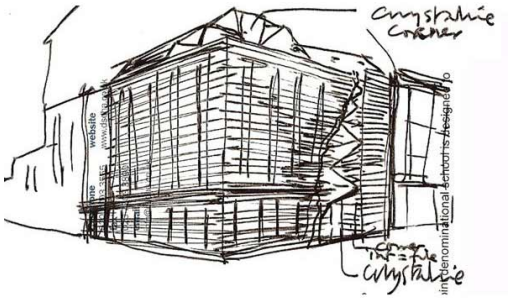
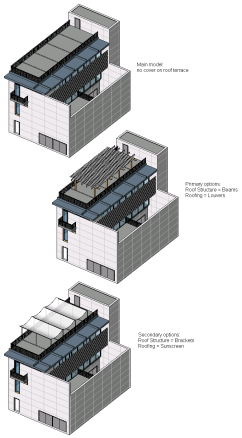
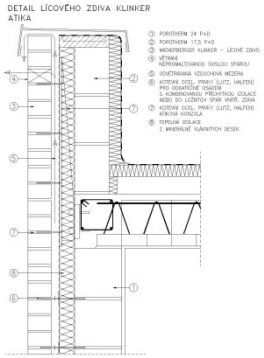
The building design process







Daylit + sustainable

Brief ····· Concept ····· Scheme ····· Detail ····→ Building

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

Great! But how to get here?

- Window size
- Internal walls
- Shading

Better

- VLT
- Fritting
- Interior layout

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

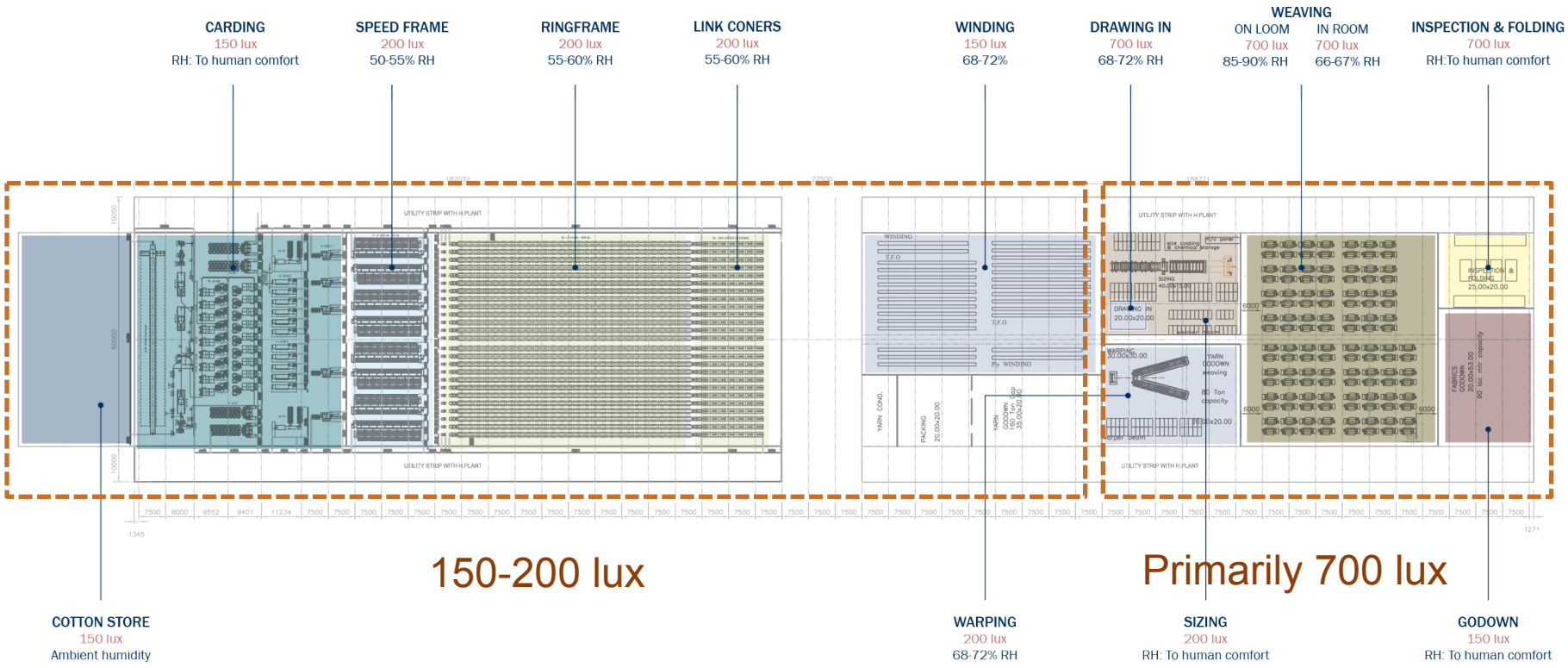
What if there are no rules of thumb or you don't have much experience?

Factory Design in South Asia

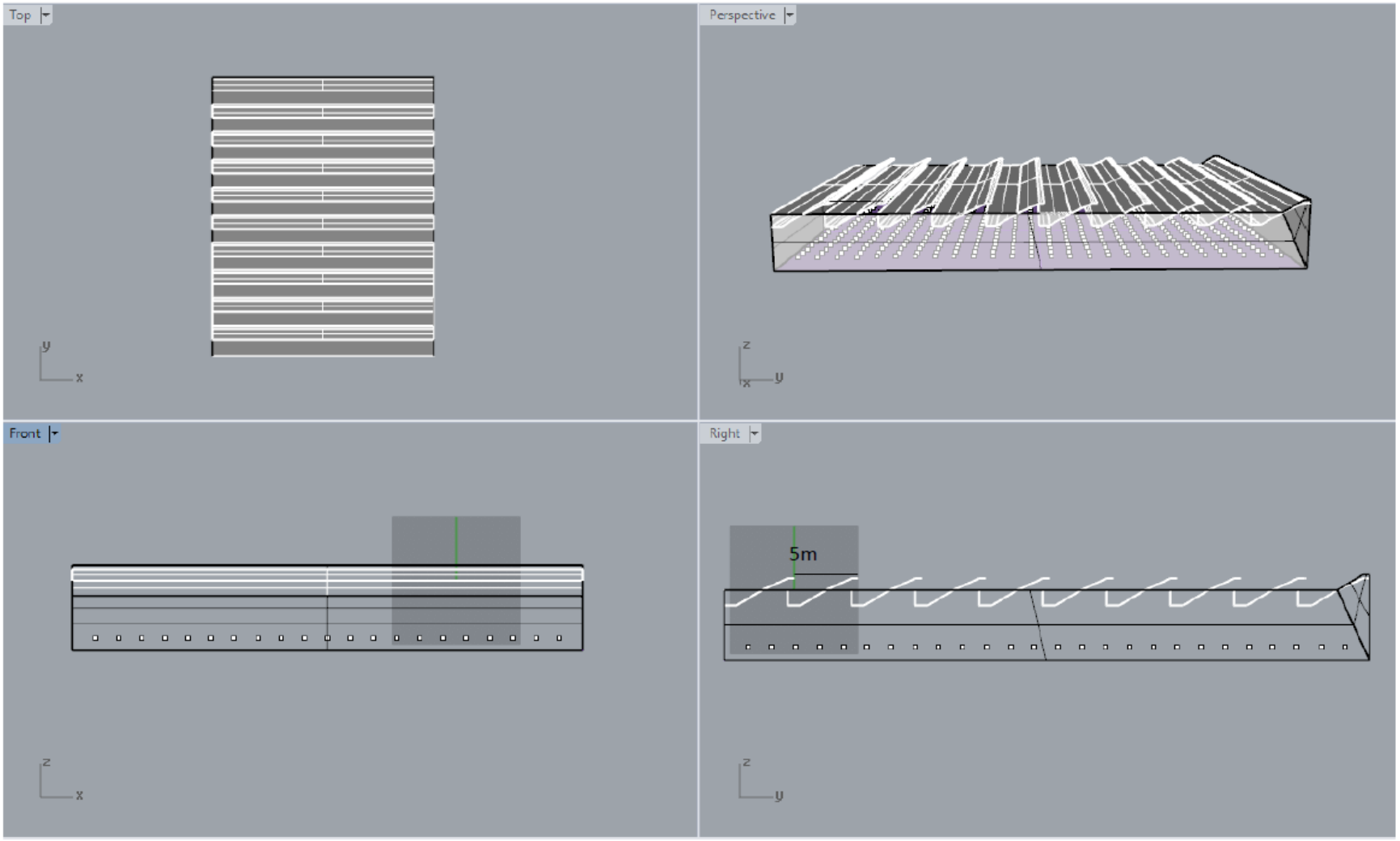
Cotton → Humidity, Services, Lighting, Fluff

Factory → €$£ important, 24 hour operation → north facing roof lights

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



Building simple parametric model to estimate order of magnitude



Daylight levels throughout the year

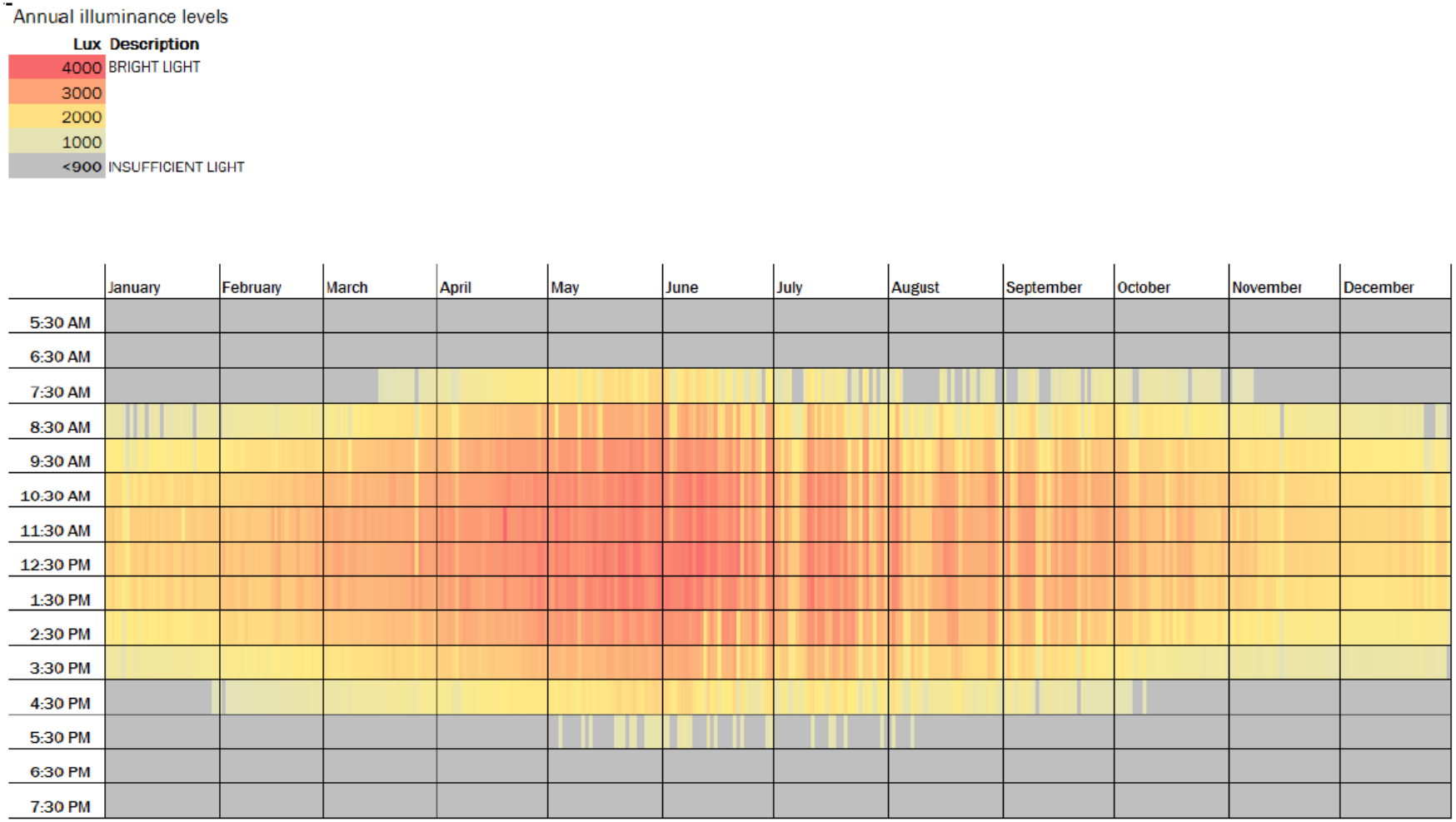
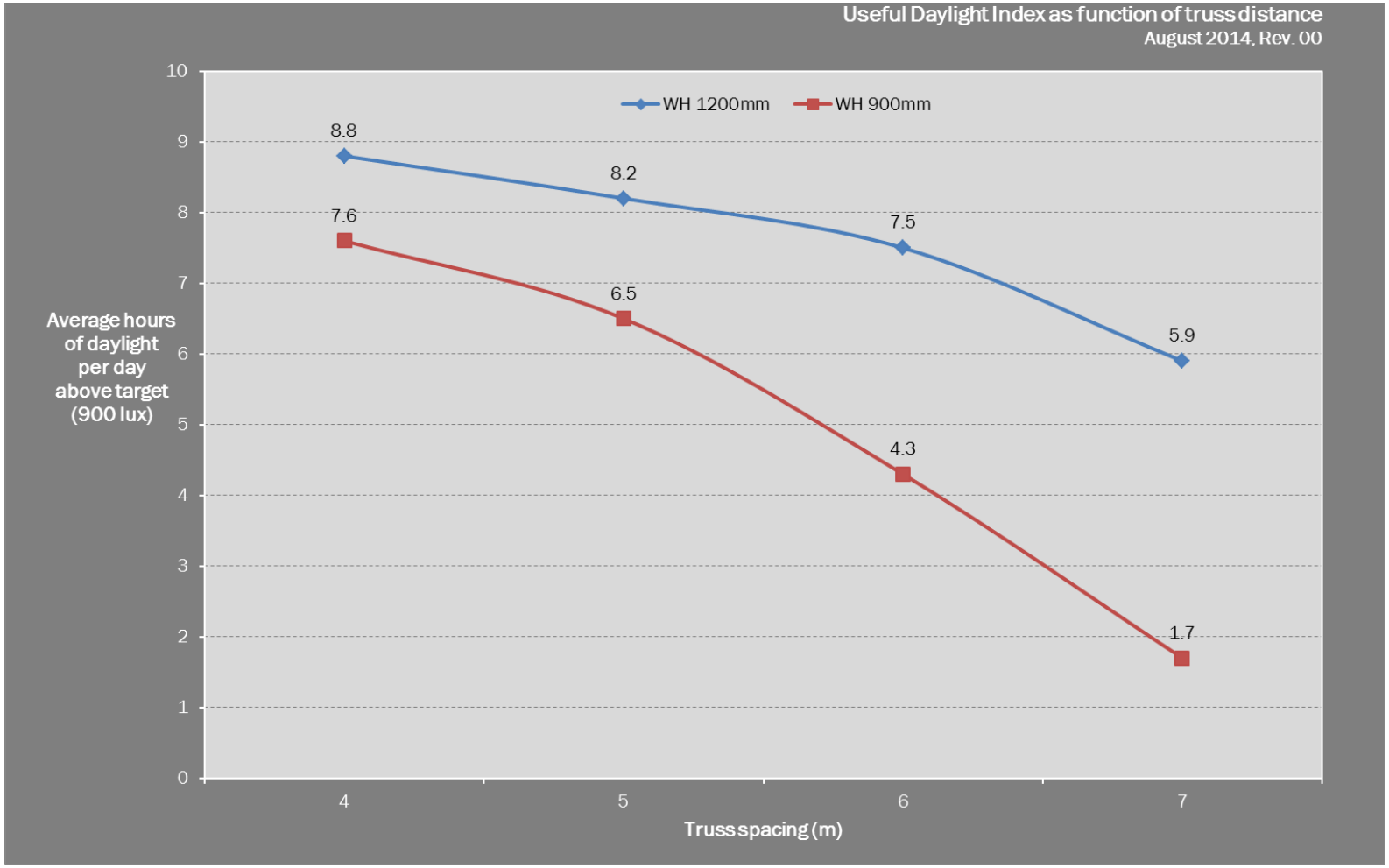


Figure 4: Daylight levels throughout the year for a representative point in the middle of the factory floor. Window height: 1,200mm, Spacing: 5m. Useful Daylight Index: 84%

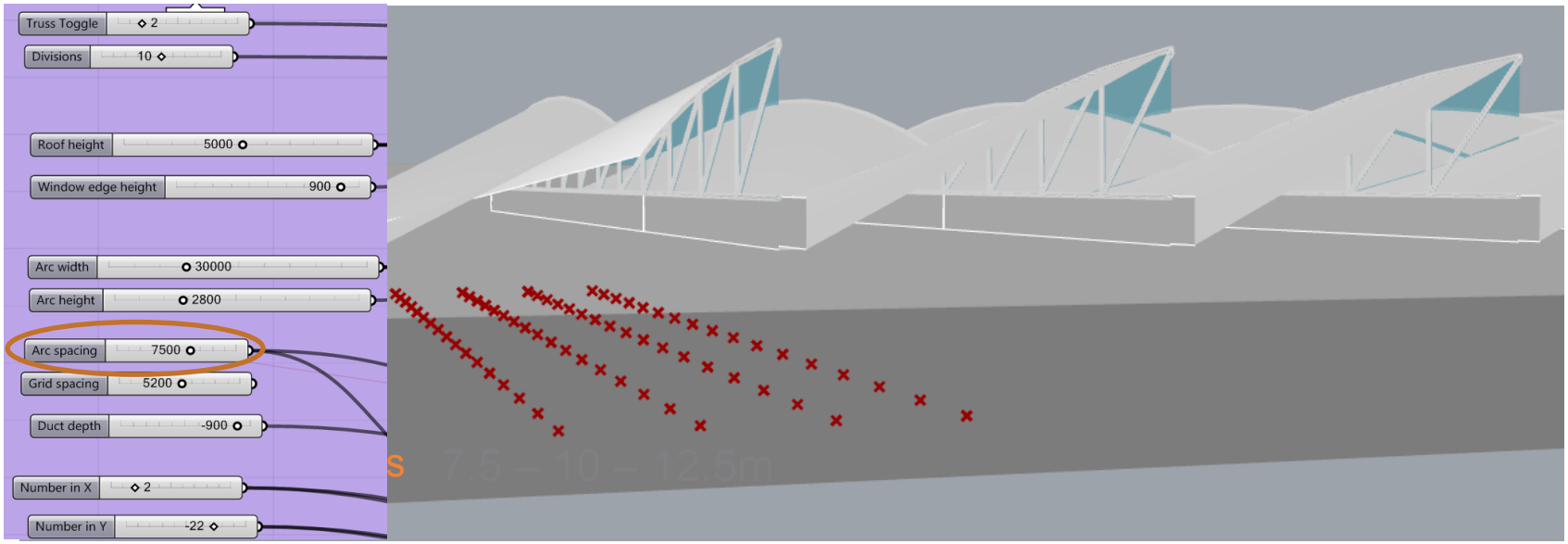
Deriving some rough rules of thumb

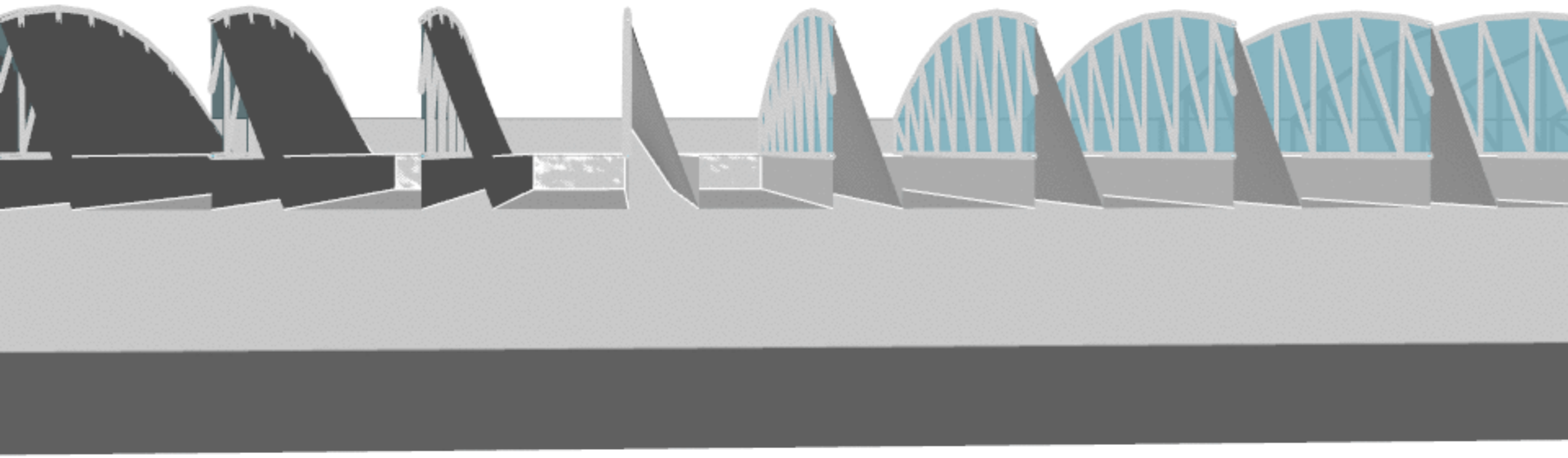


- Independent of window height – approx 30% of floor area needed to achieve ~8 hours per day at 900 lux

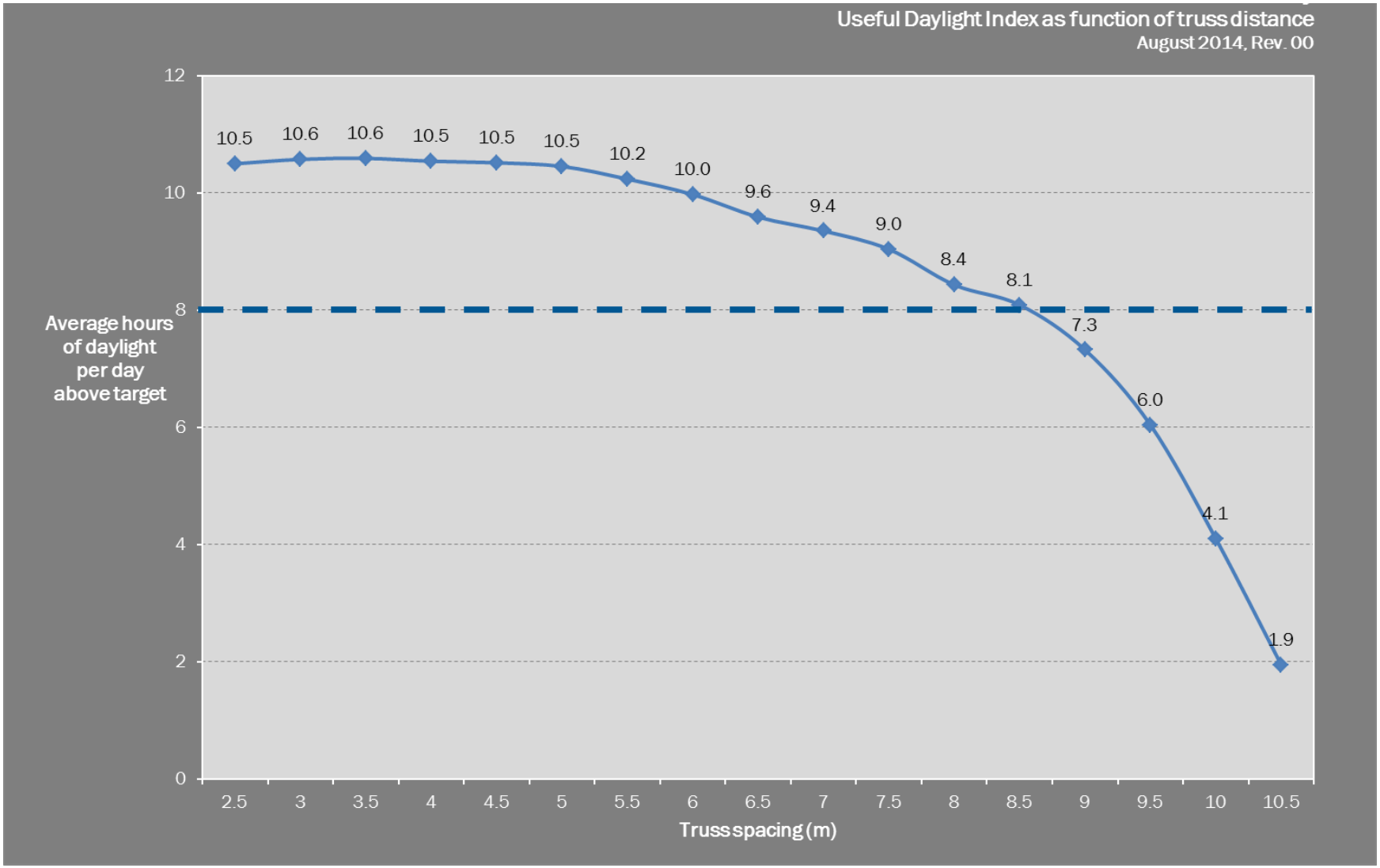
Testing range of options automatically

- Rhino
- Grasshopper
- Ladybug + Honeybee for Radiance
- Anemone to loop through series of options

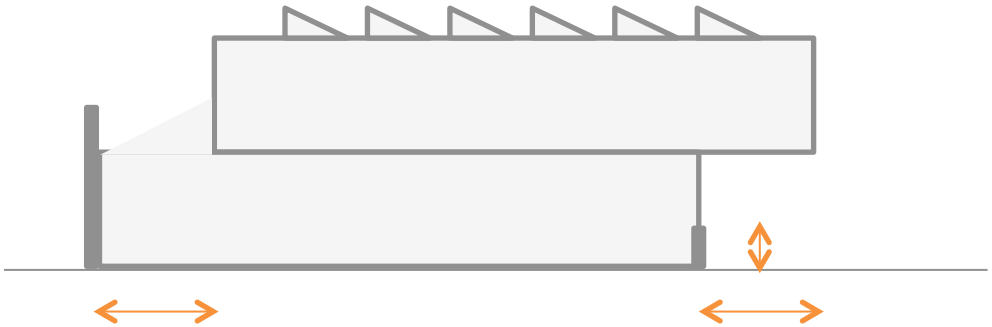




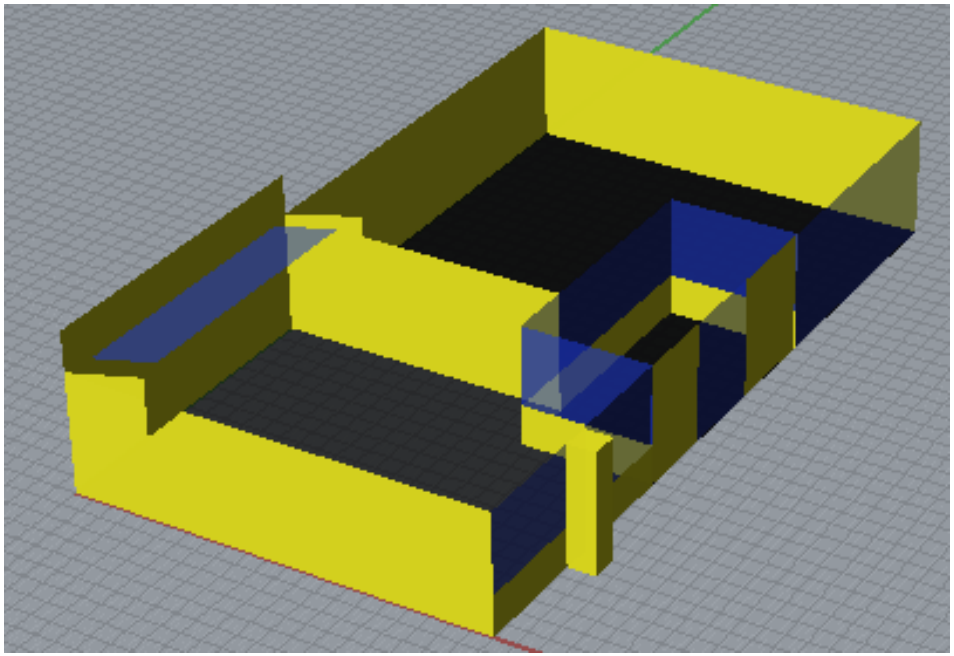
Useful Daylight Index as function of truss spacing



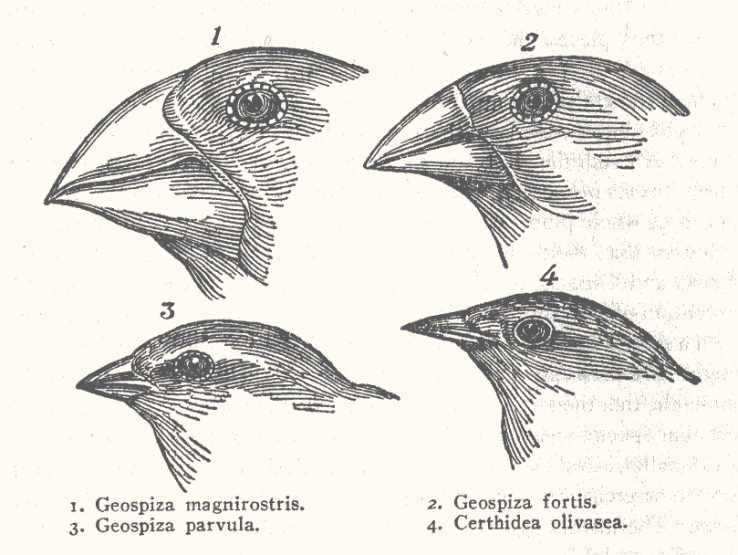
Primary School in the UK

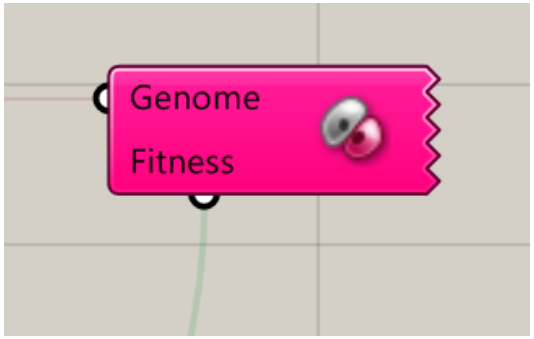


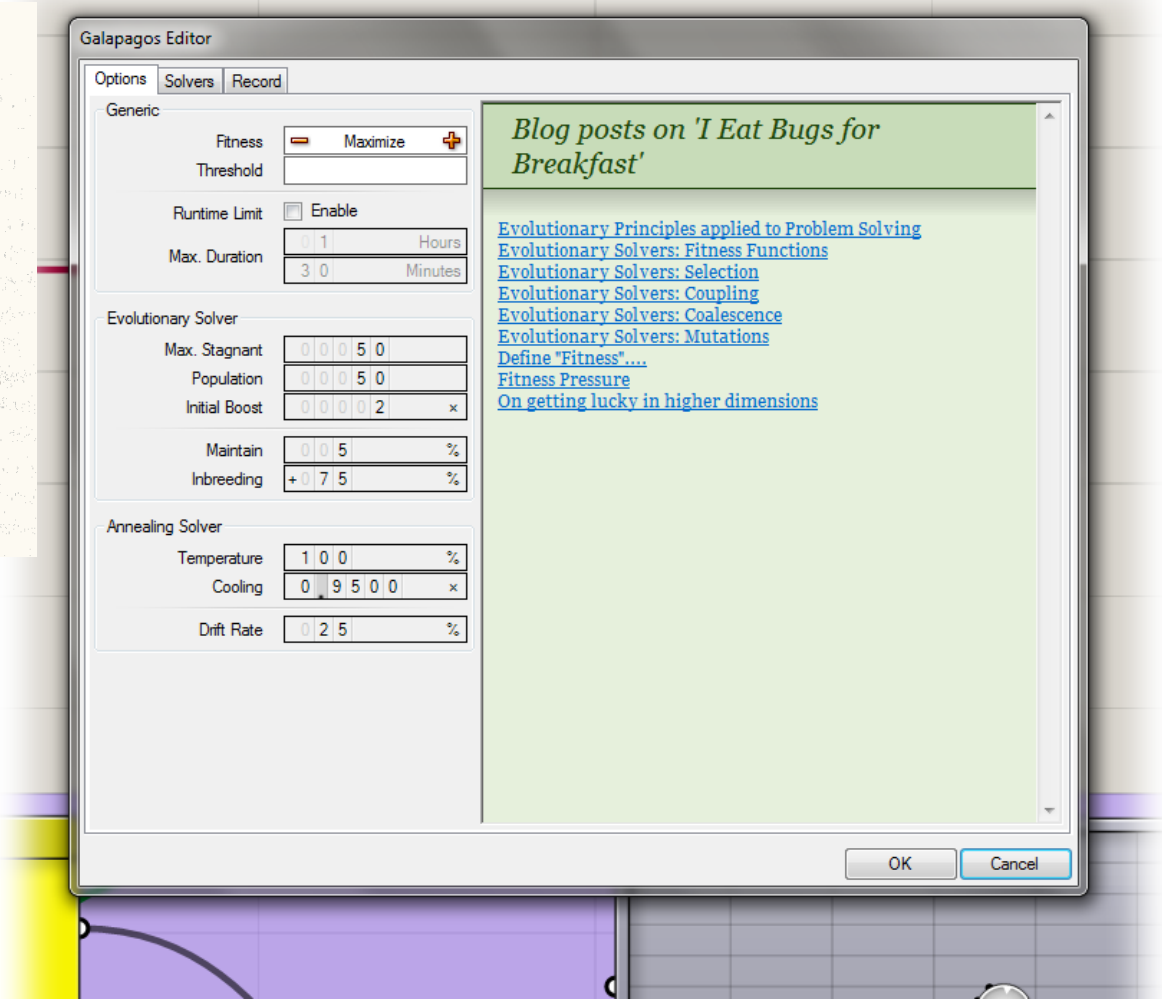
- BREEAM
- UK (Cloudy)
- No direct sunlight
- DF as initial metric



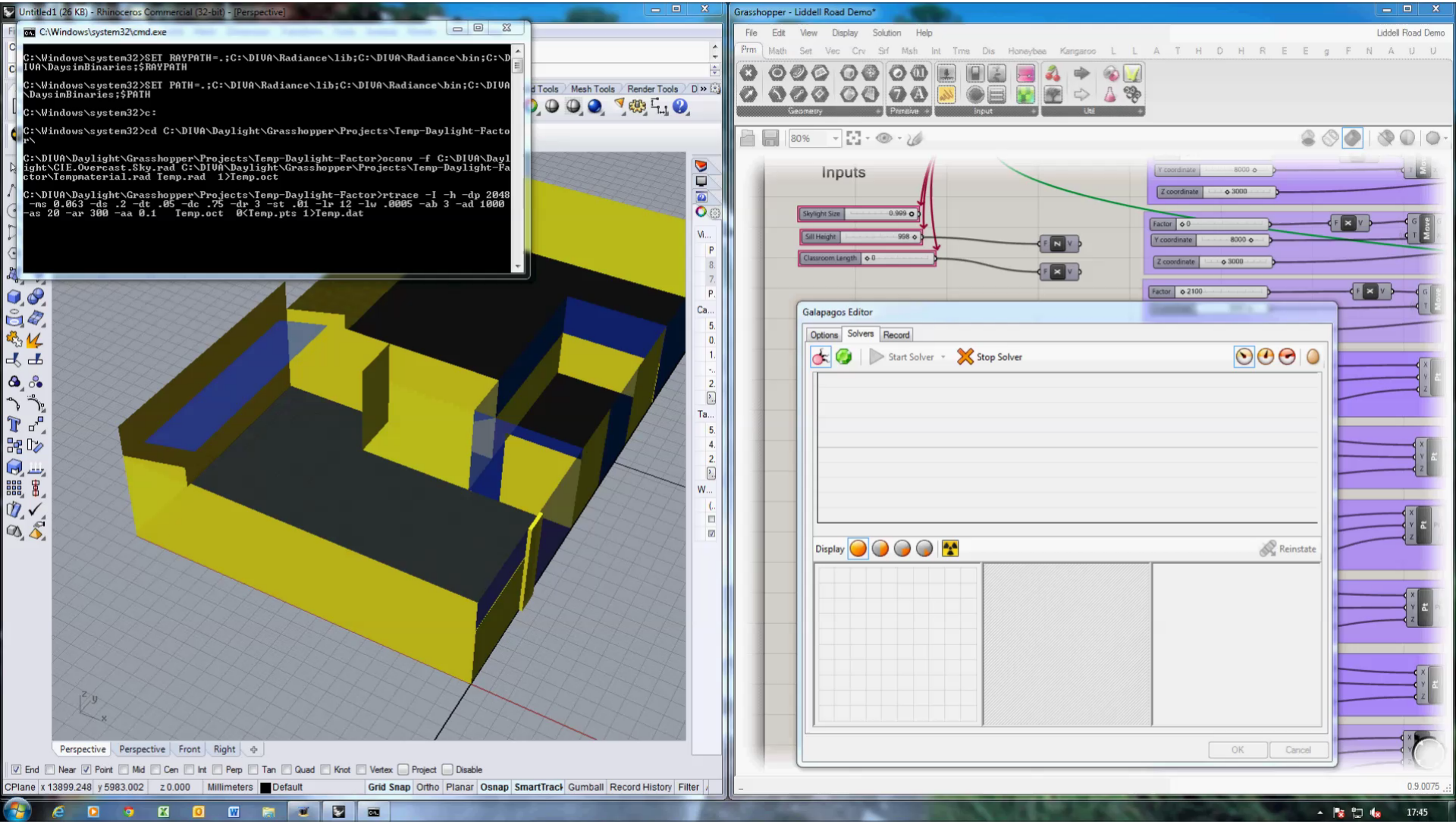
Use of Galapagos as evolutionary solver





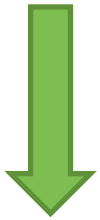


Optimisation process sped up



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

- 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 with images

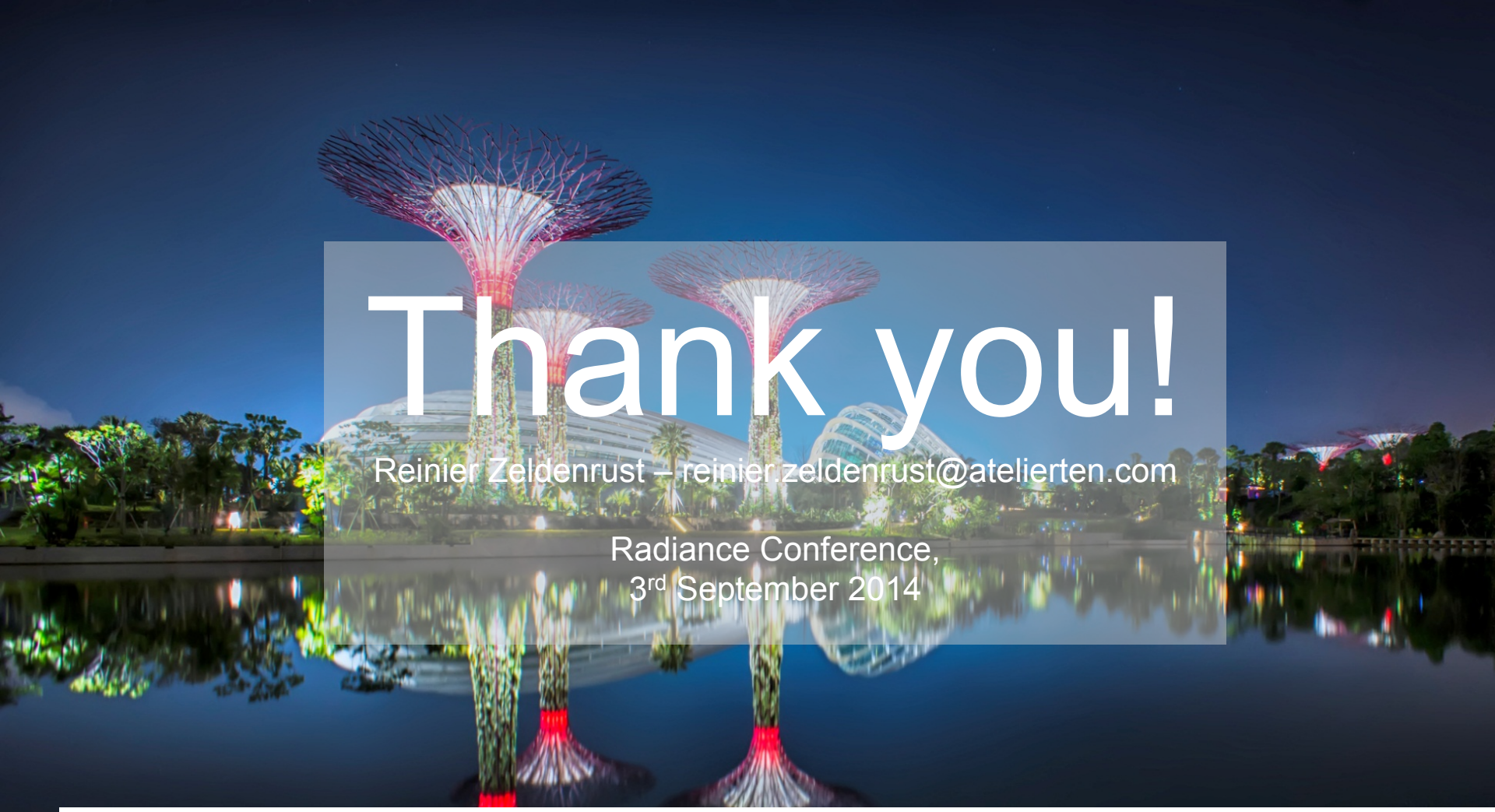
Using experience and rules of thumbs

+

Range testing

Evolutionary algorithm

Creating a database to set the boundaries / give freedom



Thank you!

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