CIBSE Application Manual AM11 ‘Building Performance Modelling’

Chapter 9: Case Studies

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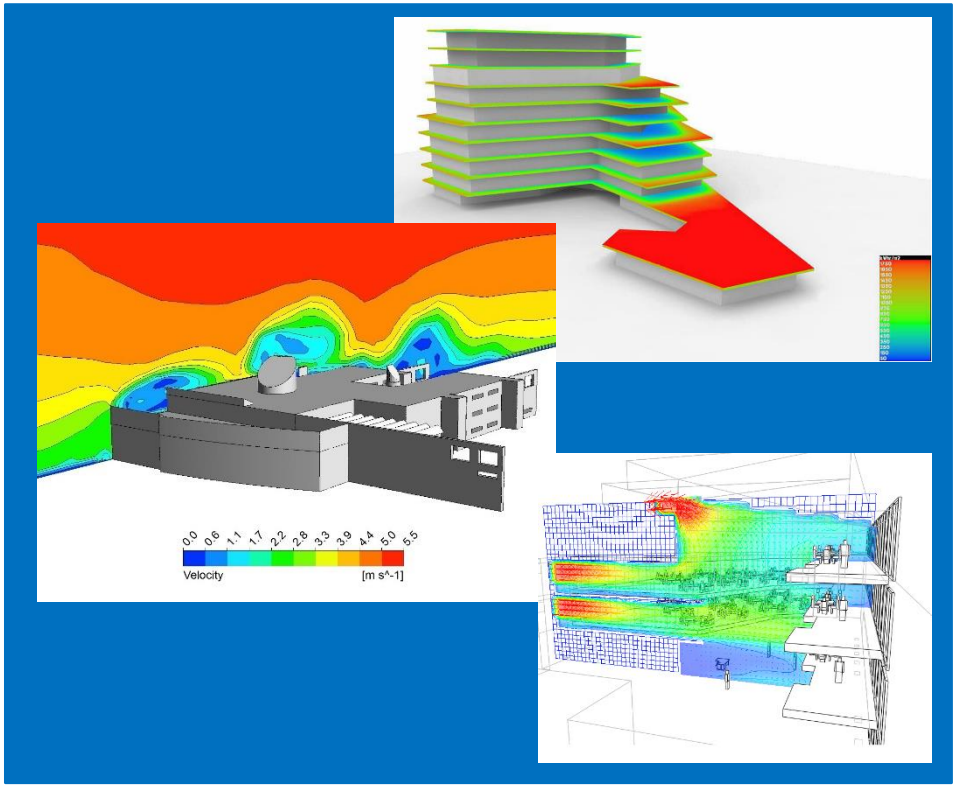

Darren Coppins, Built Physics Limited

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Chapter 9: Case Studies

Contributors (with current affiliations)

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Chapter 9: Case Studies

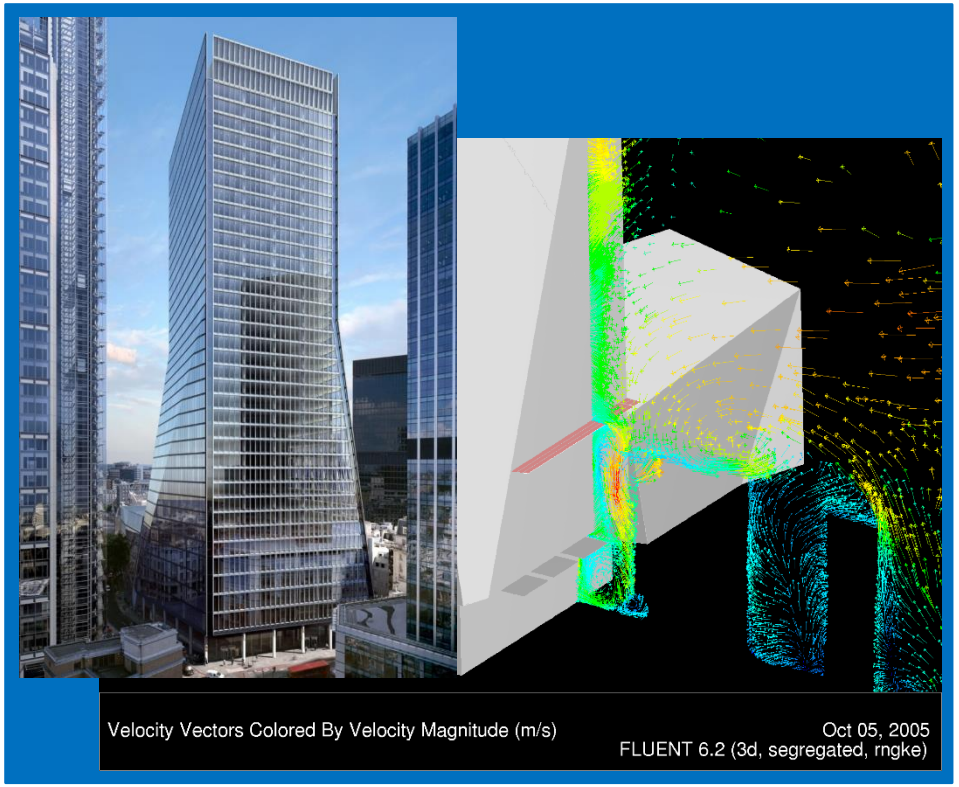
Selection

- Selection of case studies
  - Cross section of modelling techniques
  - Not intended as a simulation guide
  - To provide examples of the application of building performance modelling

Challenges in practice

Suitability of modelling

- 100 Bishopsgate
  - CFD used to evaluate potential external environment issues
  - Modelling permitted analysis of a number of potential solutions
  - Final solution refined using wind tunnel

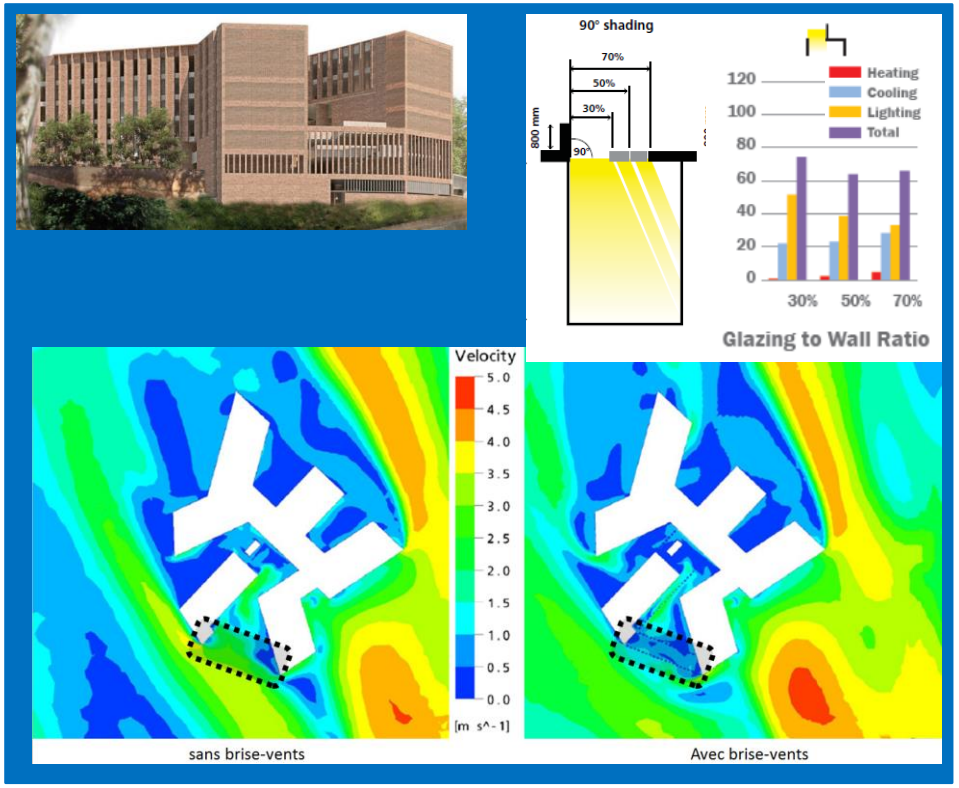


100 Bishopsgate

Challenges in practice

Client reporting

- Reporting the results is as important as the modelling itself
- Appropriate to intended audience
- Toulouse School of Economics
  - Presentation of results to non-technical audience using simple graphics and tables
  - Clear 'before and after' illustrations



Toulouse School of Economics

Challenges in practice

Technical reporting

- Consider important factors that need to be carried forward in the design
- Present in a clear manner for incorporation into the design
- 199 Bishopsgate – EPC Performance
  - Provision of key performance parameters required to meet the target performance

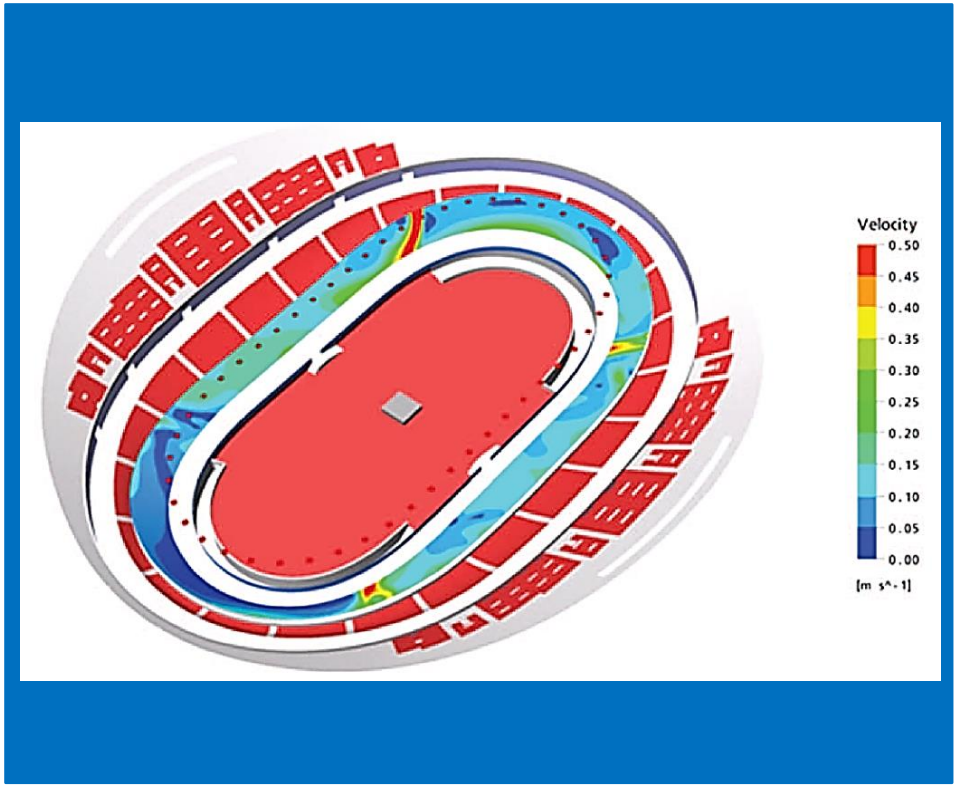
Variable	Value	Units
U-values:		
— new ground and mezzanine facade wall	0.24	W/m²·K
— new ground and mezzanine facade glazing	1.31	W/m²·K
— existing windows to remain (estimated)	2.91	W/m²·K
HVAC:		
— supply air specific fan power	1.3 (max.)	W/l·s⁻¹
— extract air specific fan power	0.5	W/l·s⁻¹
— central AHU flow rate	1.6	l·s⁻¹/m²
— central AHU control	CO_2 sensing	—
— AHU heat recovery	75%	—
— fan coil type	EC motor VAV	—
— fan coil specific fan power	0.3	W/l·s⁻¹
— fan coil air changes	8 (max.)	air changes/h
— duct airtightness	Class B	—
— chiller efficiency	4.0	COP – SEER
— boiler (gas) efficiency	91%	—
Lighting:		
— efficiency target	3.3	W/m² per 100 lux
— presence detection	On then dimmed	—
— daylight linking	Automatic dimming	—

199 Bishopsgate

Challenges in practice

Target performance criteria

- Performance targets are not always clear or documented
- Often the modelling practitioner needs to research and determine with client team
- Velodrome - Stratford
  - The team needed to engage stakeholders and visit other venues to develop the environmental performance targets & associated risks



Velodrome

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One Airport Square, Ghana

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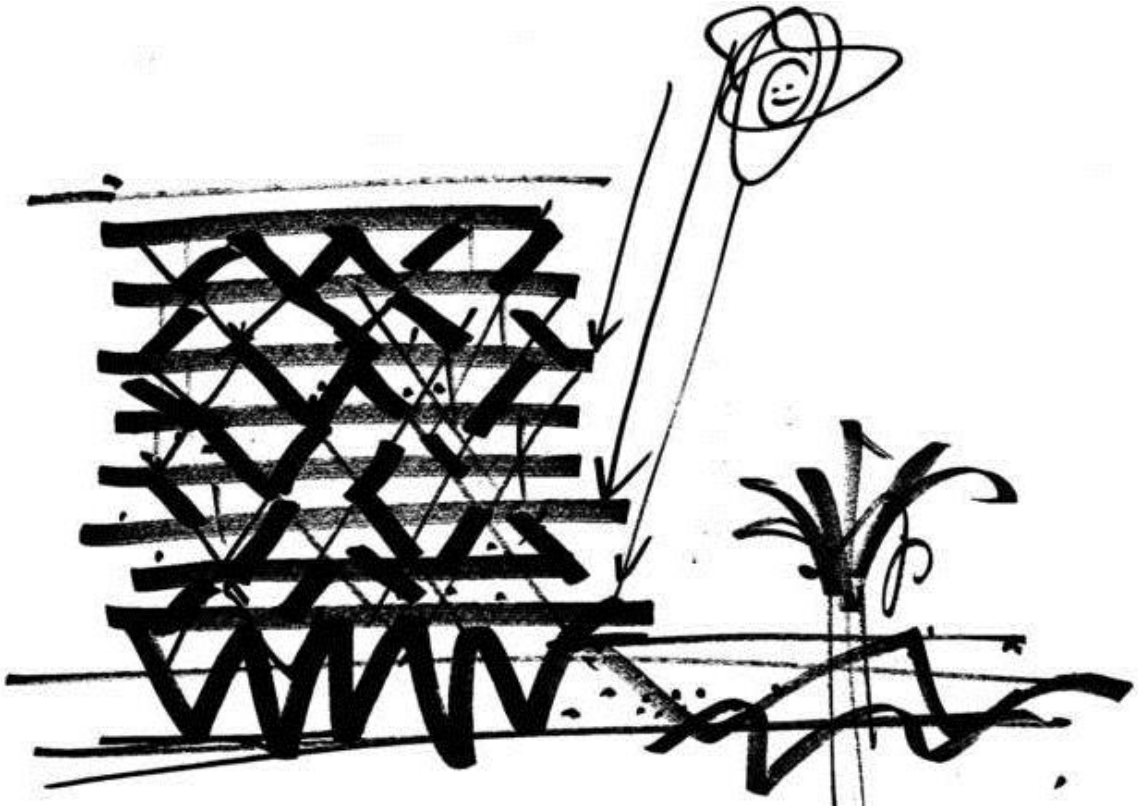

One Airport Square – Sketch By Mario Cucinella

Key Facts

- Located in Accra, Ghana
- First Environmentally Certified Building in West Africa
- Market Unfamiliar With Non-Standard Design

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One Airport Square – As Built

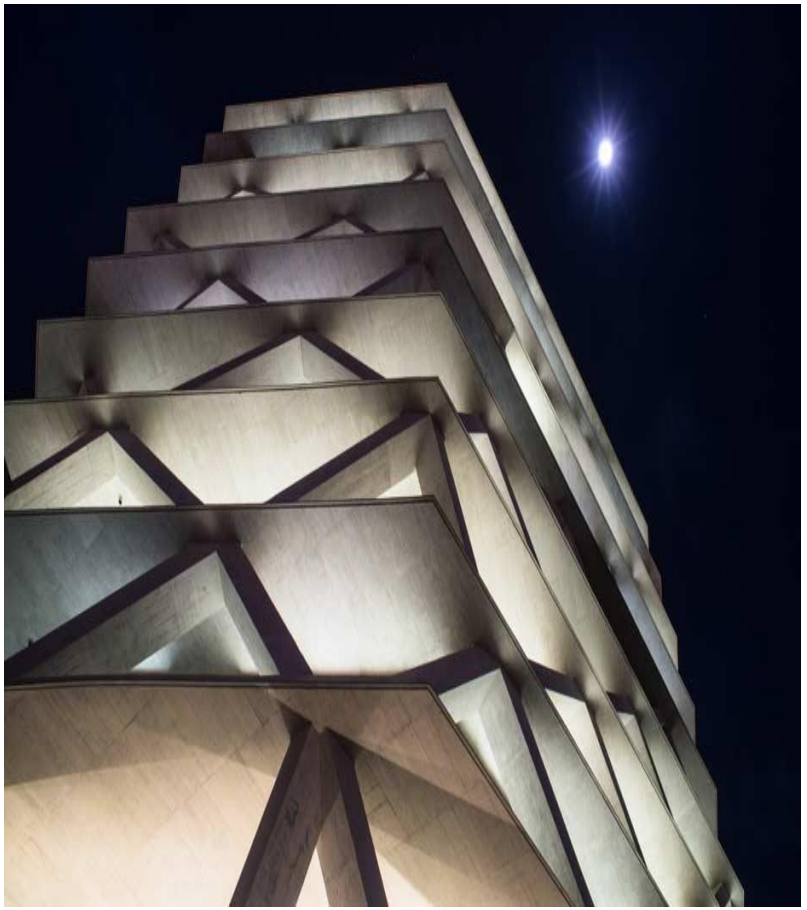
One Airport Square– As Built

Key Challenges:

- Full Height Glass Facade Required
- Lack of Local Design and Construction Expertise

Solutions Needed To Be:

- Simple
- Involve As Little Technology As Possible



One Airport Square – Overhangs

Methodologies Deployed:

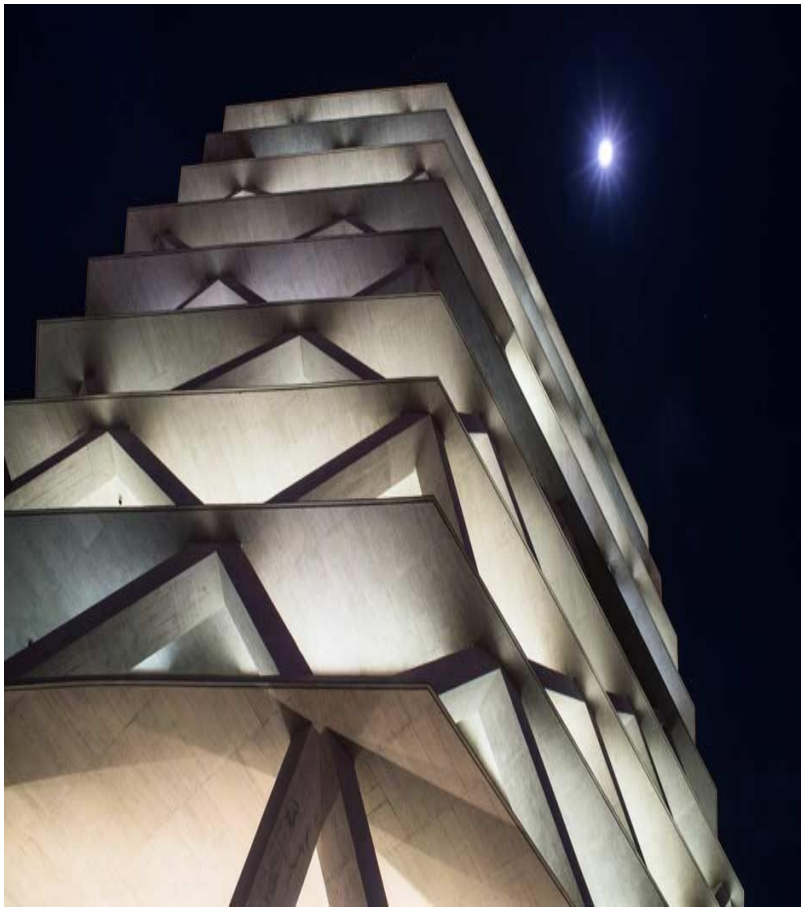
- Irradiation Modelling

  i.e. Visual Representation of How

  Local Climate Impacts the Building
- Daylight Modelling
- Thermal Modelling

Principles:

- Rapid Design Advise Response
- Information Design



One Airport Square – Overhangs

Problem:

Intense Solar Radiation Year-Round

Will impact the development a low energy strategy.

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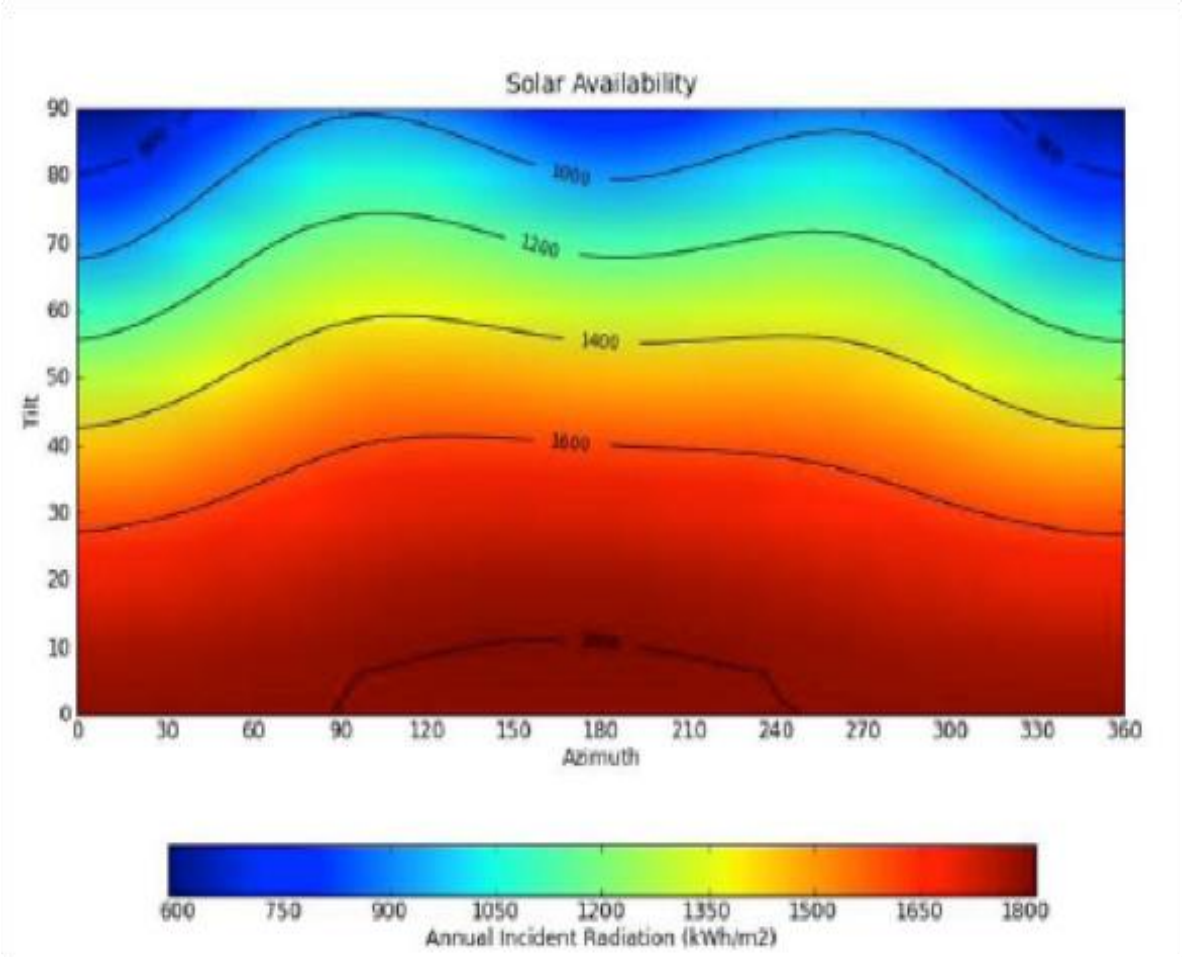
Intense Solar Radiation Year-Round

Will impact the development a low energy strategy.

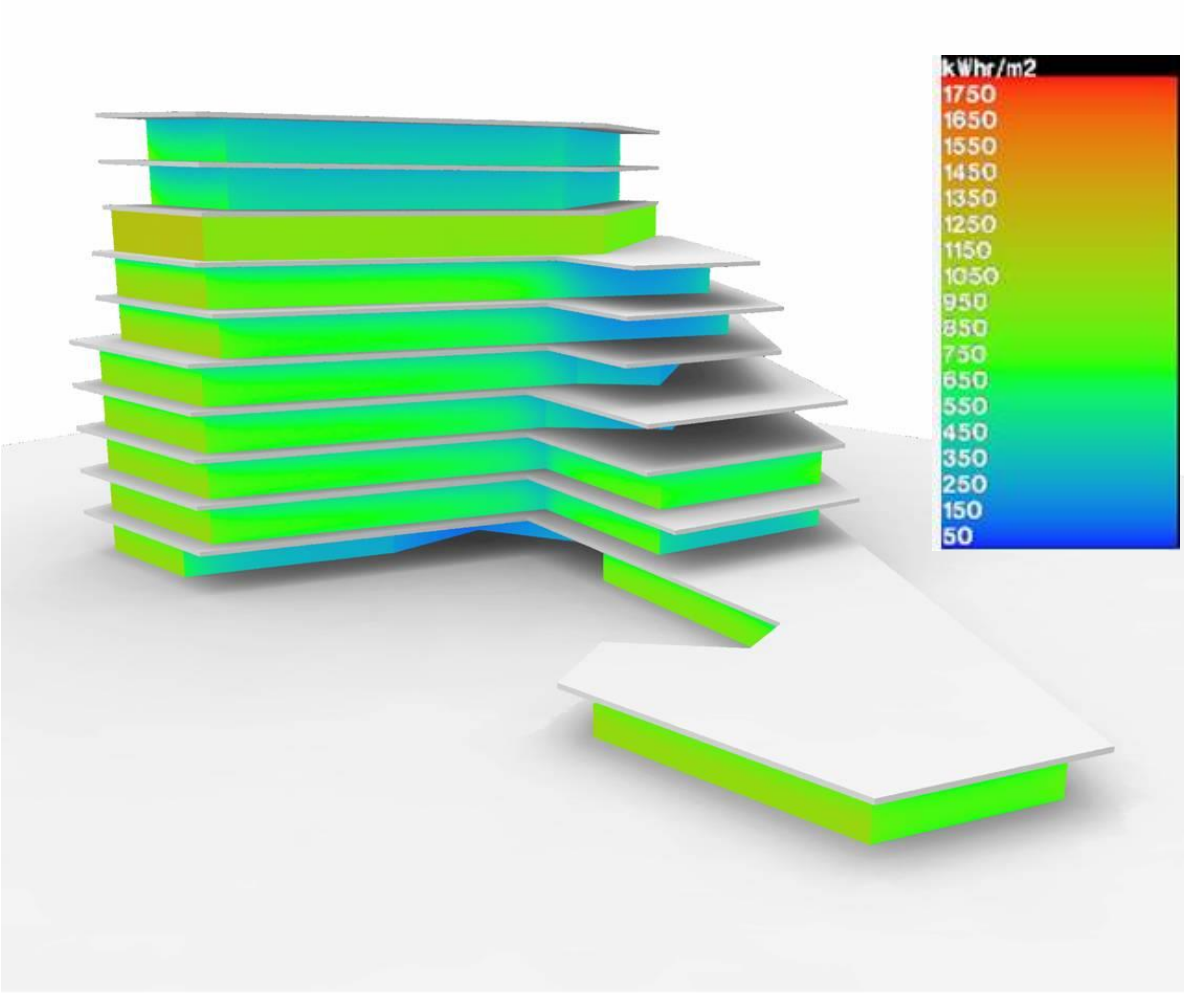


Problem:

Intense Solar Radiation Year-Round

Will impact the development a low energy strategy

Irradiation Mapping Comes Long Way In Demonstrating This.



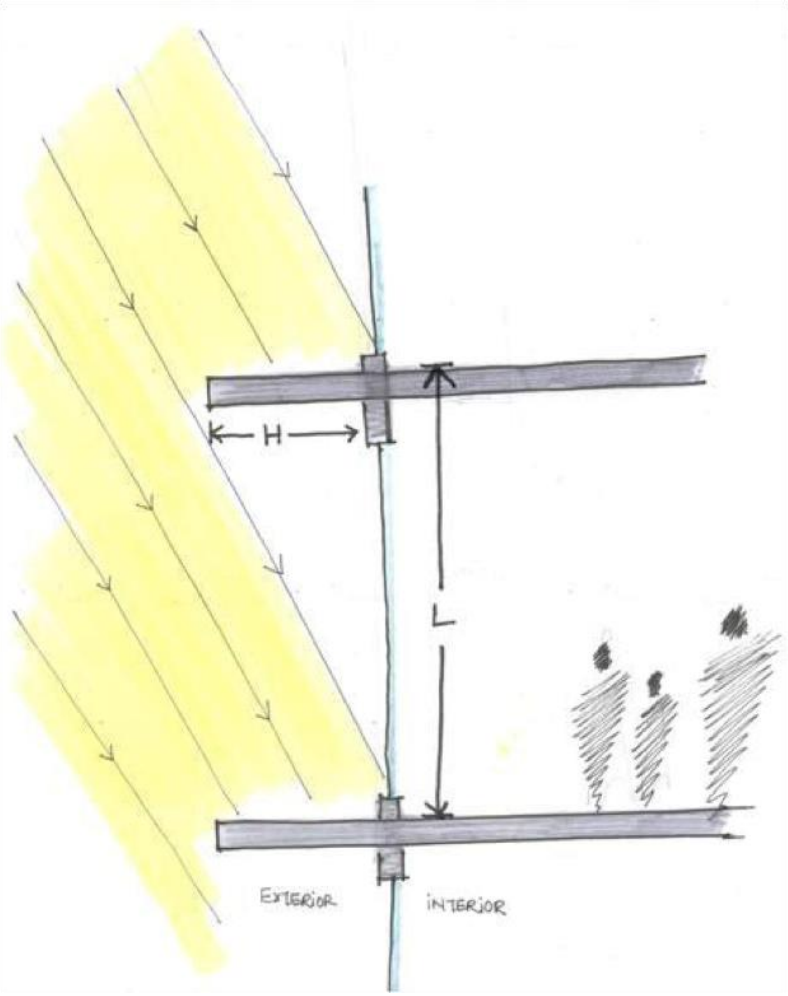
Selective Irradiation Mapping

Problem:

Intense Solar Radiation Year-Round

Solution:

Simple and Effective Solar Shading on Critical Elevations



Initial Sketch Demonstrating Shading Principle

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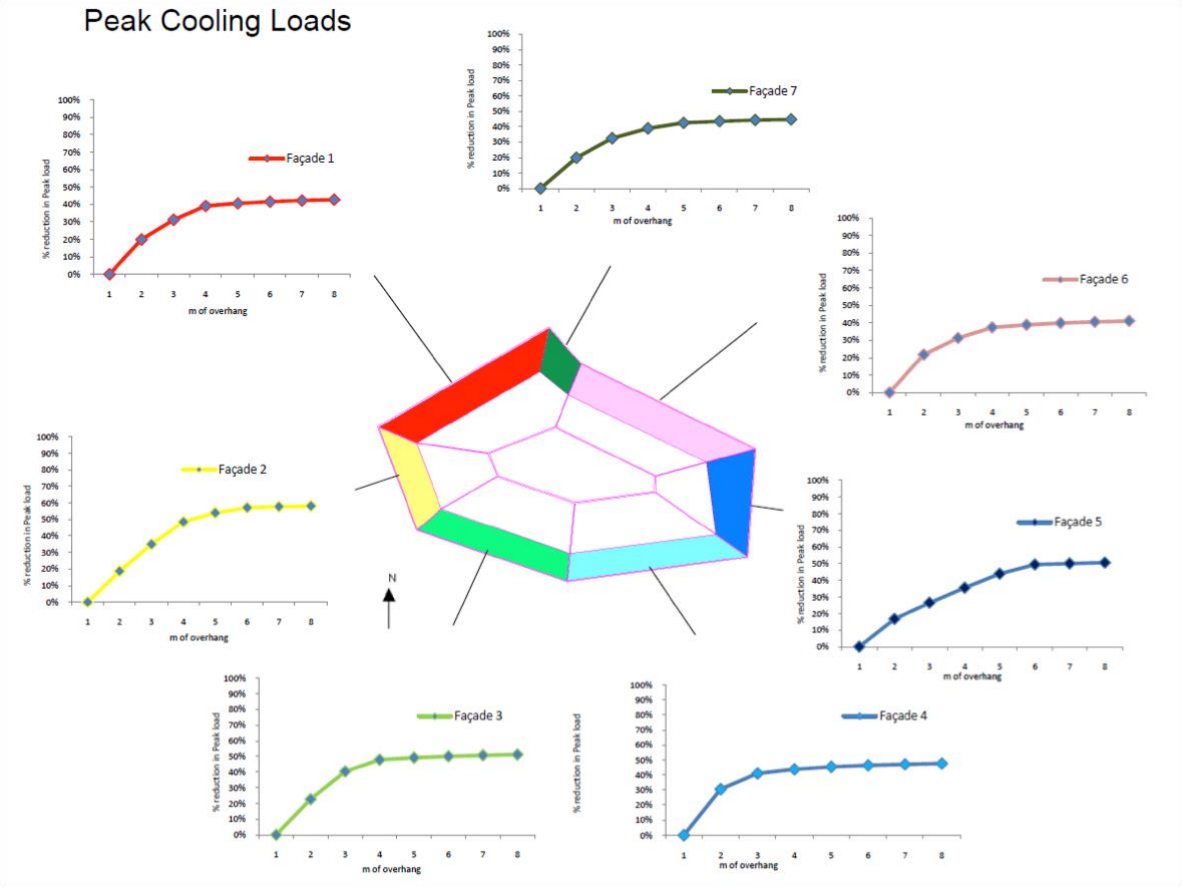
Problem:
Intense Solar Radiation Year-Round

Solution:
Simple and Effective Solar Shading on Critical Elevations

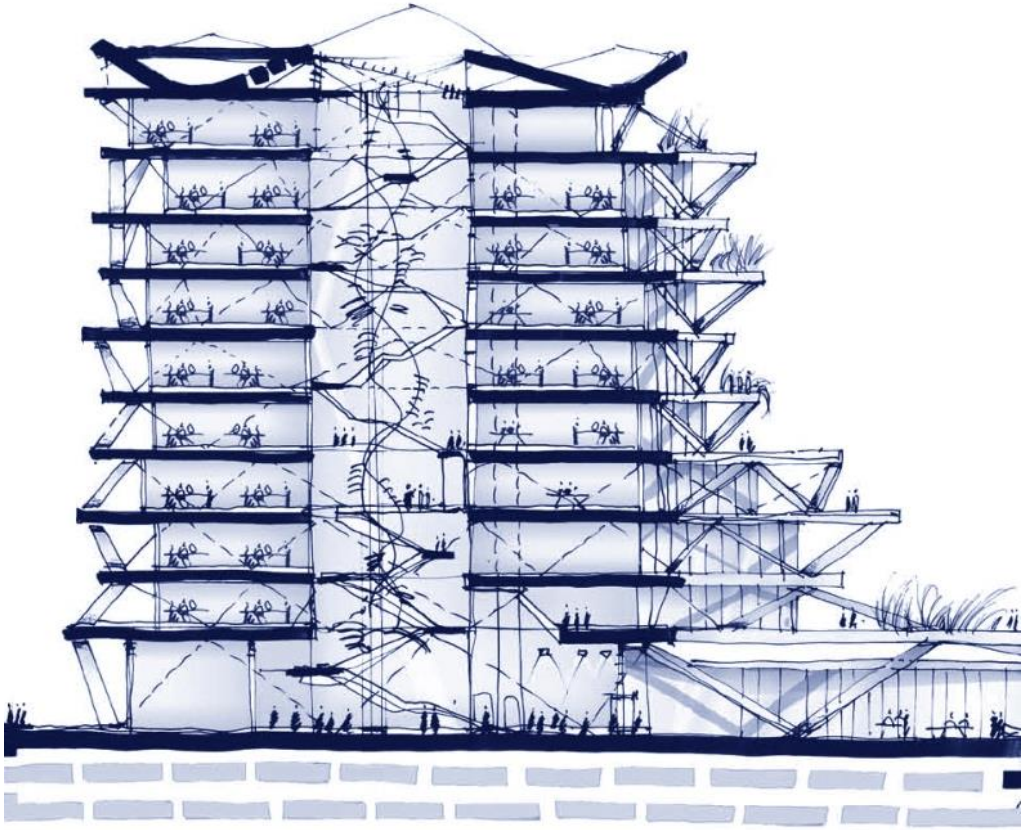
Approach:
Study Peak and Annual Cooling Loads For Various Overhang/Terrace Depths Per Orientation, Using Dynamic Thermal Modelling



Results from Thermal Modelling Studies

Problem:

Lack Of Sufficient Daylight In Central Atrium At Lower Floors



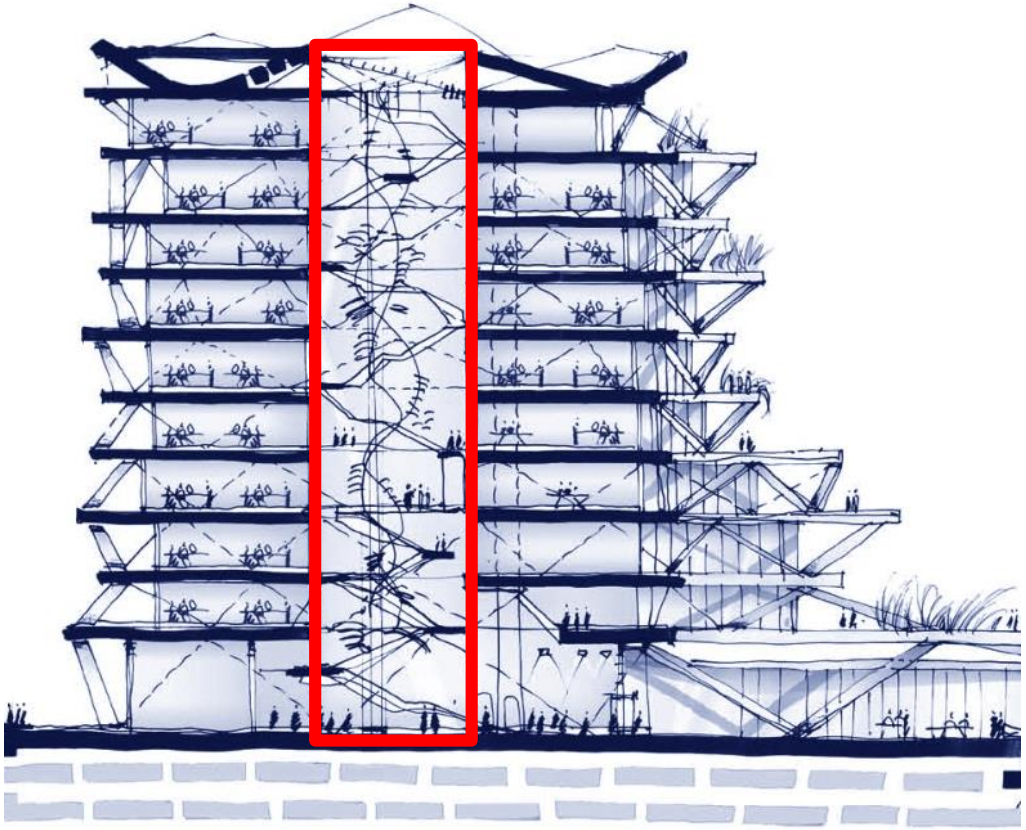
Section Through the Atrium

Problem:

Lack Of Sufficient Daylight In Central Atrium At Lower Floors

Solution:

Explore Transparency and Glass Typology for Atrium Roof



Daylight Assessment of Atrium

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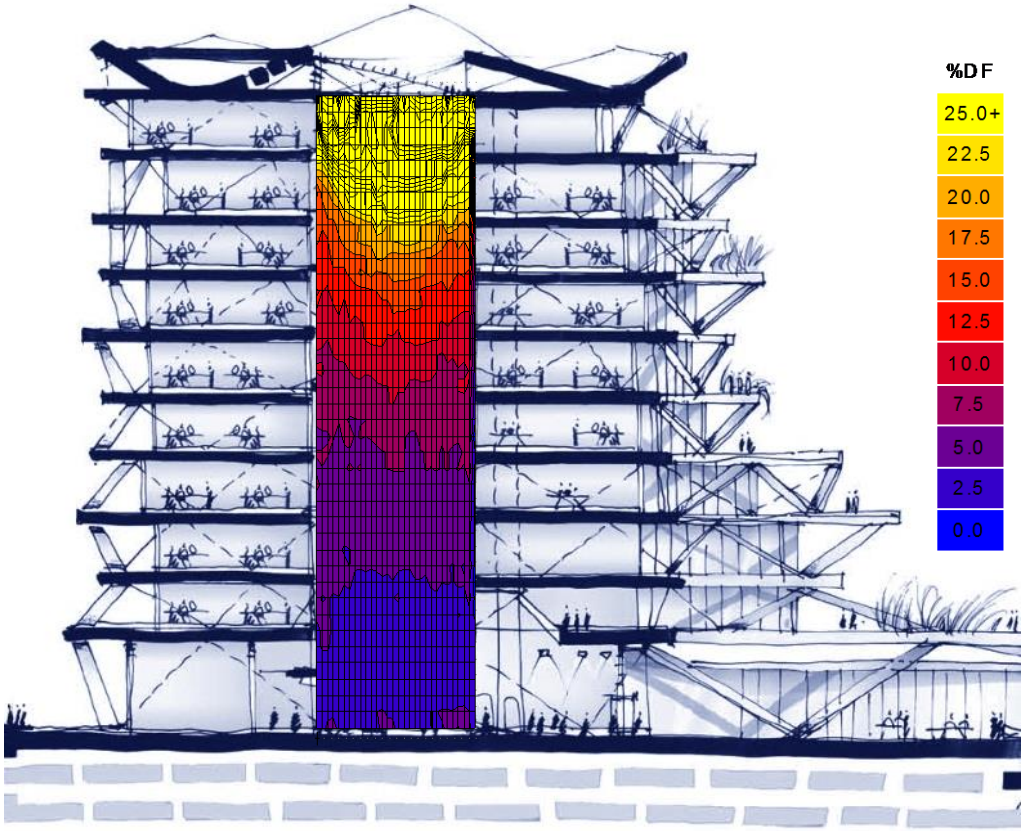
Problem:
Lack Of Sufficient Daylight In Central Atrium At Lower Floors

Solution:
Explore Transparency and Glass Typology for Atrium Roof

Approach:
Study Daylight Distribution (DF) For Various Glass/Opaque ratios and Glass Types.



Daylight Assessment of Atrium

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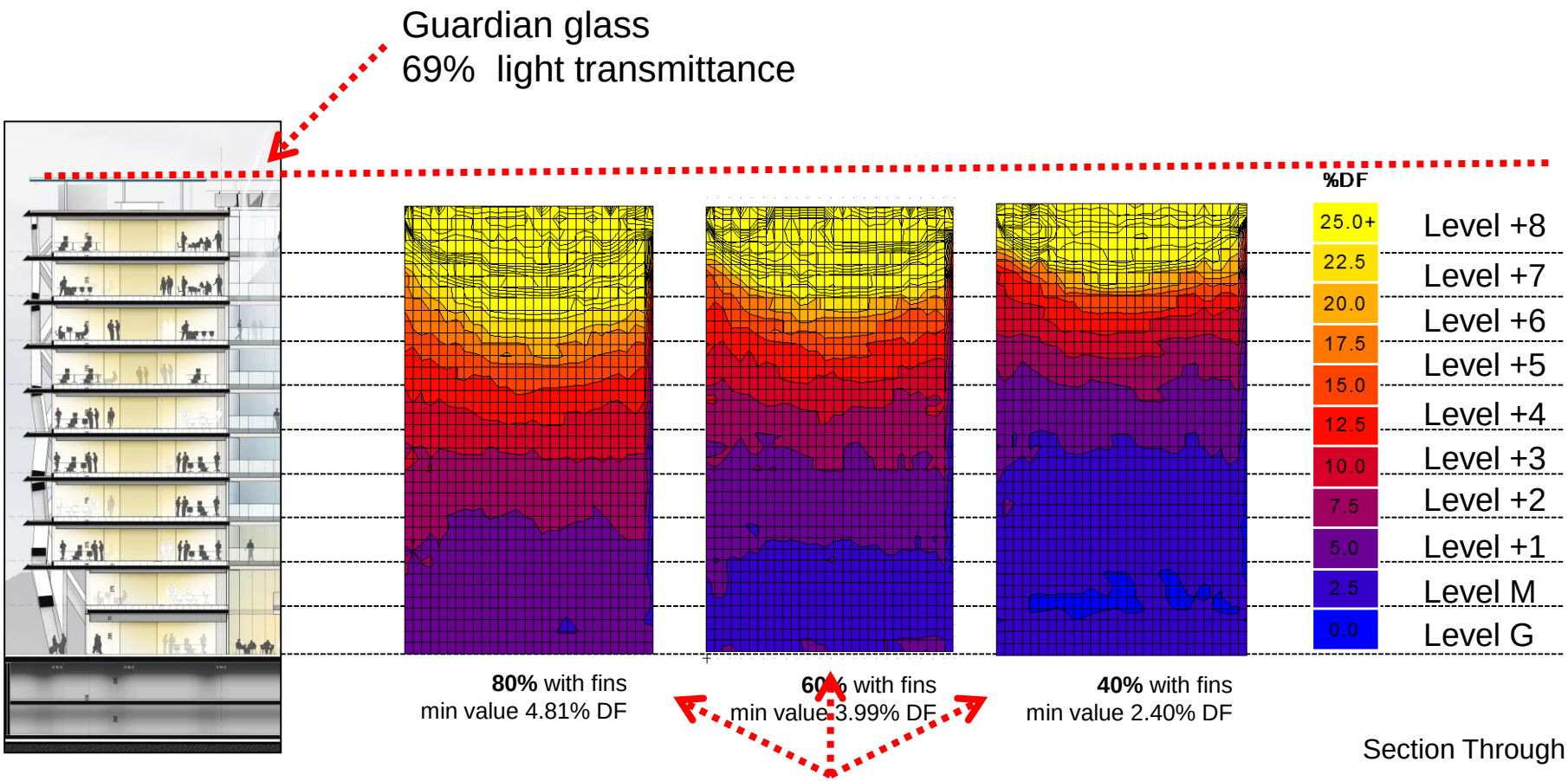

Section Through the Atrium

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Summary of Process

Visualise The Problem

Via Selective Irradiation Mapping

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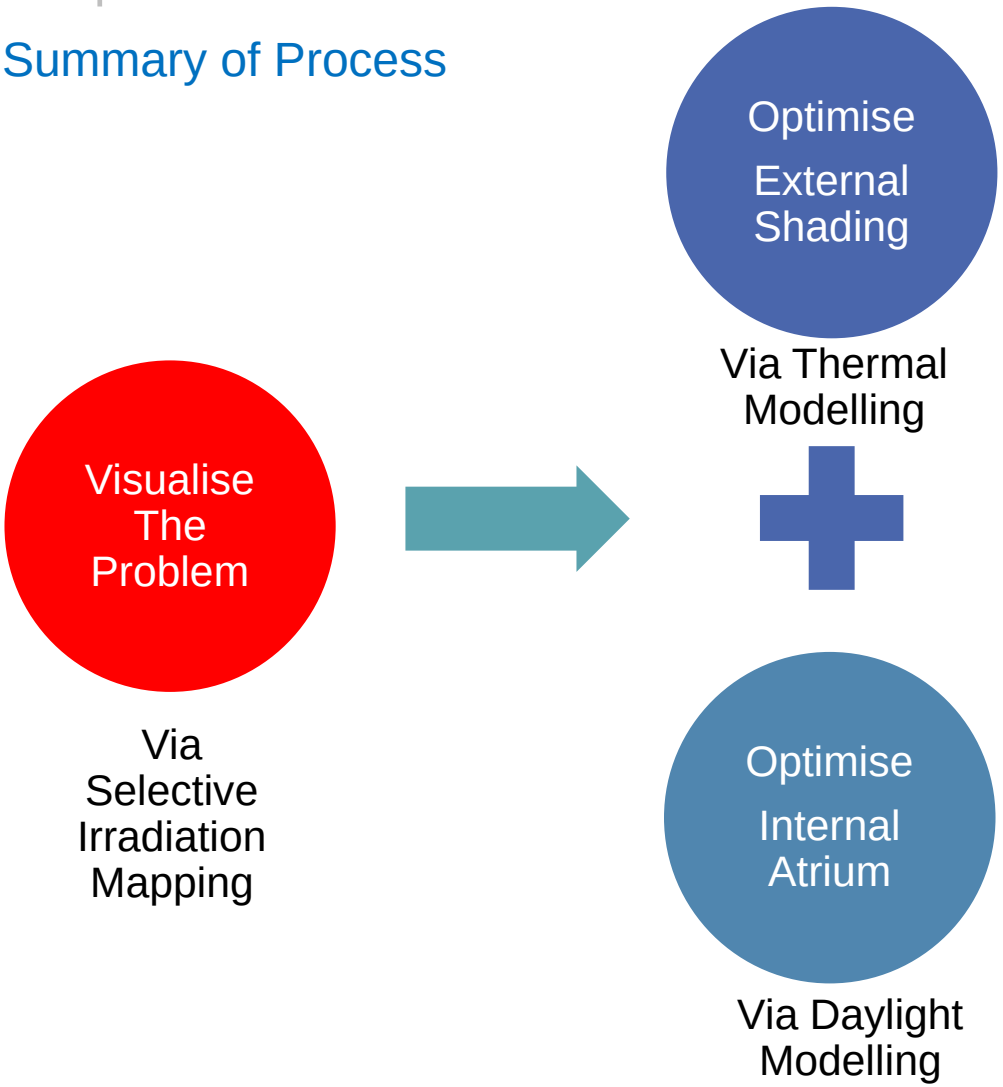
Summary of Process



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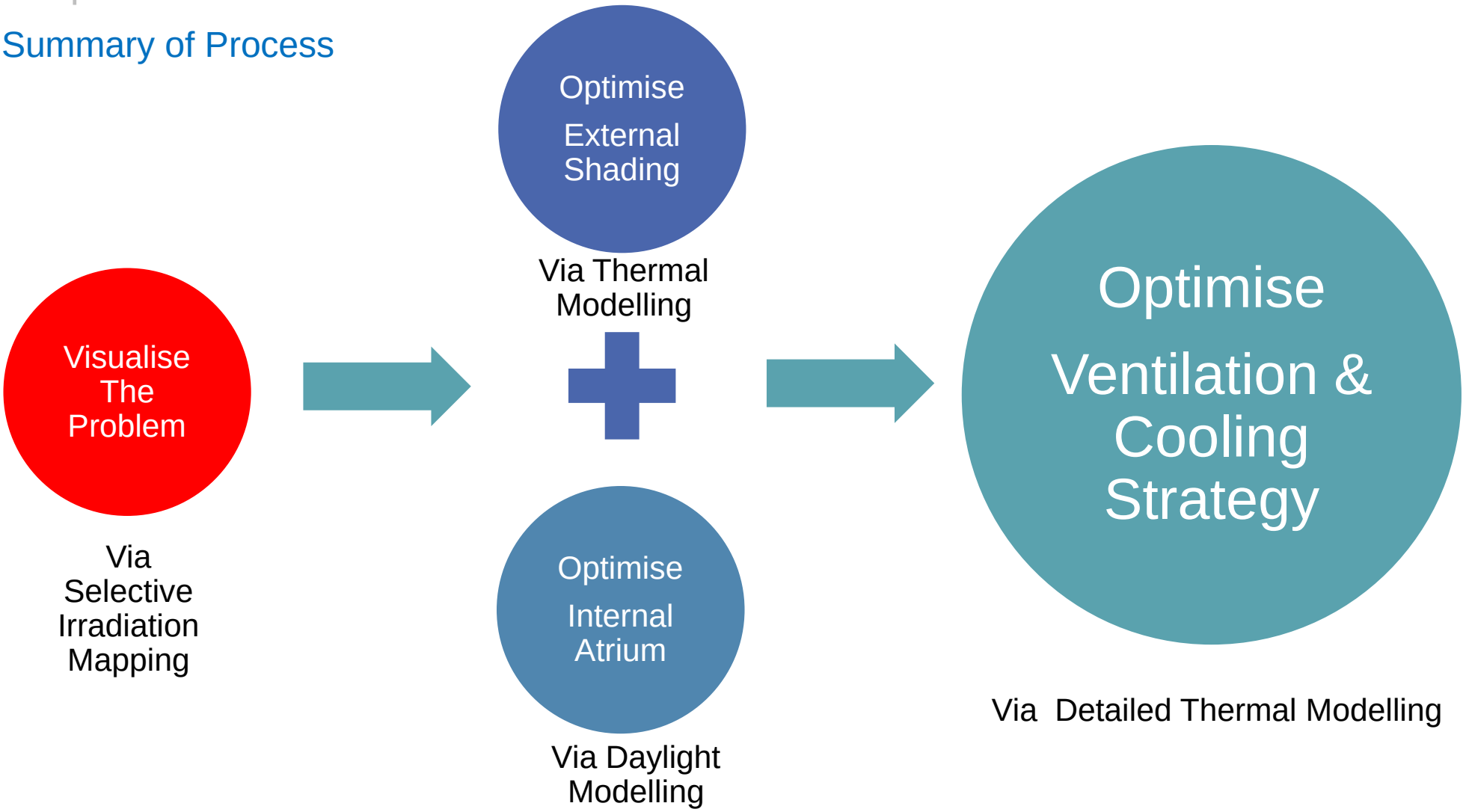
Summary of Process



Summary and conclusions

- Case studies form useful examples of building modelling and challenges that may arise
  - Modelling may need to be supported with other forms of analysis
  - Ability to communicate modelling results visually to clients and non-technical members of the construction team
  - Understanding of each disciplines requirements out of the model to set appropriate performance values
  - Target performance criteria not always well documented and needs to be determined by the practitioner.
- Case study by Ioannis Rizos

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