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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
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
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

199 Bishopsgate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>new ground and mezzanine facade wall</td>
<td>0.24</td>
<td>W/m²K</td>
</tr>
<tr>
<td>new ground and mezzanine facade glazing</td>
<td>1.31</td>
<td>W/m²K</td>
</tr>
<tr>
<td>existing windows to remain (estimated)</td>
<td>2.91</td>
<td>W/m²K</td>
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<tr>
<td>Provision of key performance parameters required to meet the target performance</td>
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</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>supply air specific fan power</td>
<td>1.3 (max.)</td>
<td>W/s⁻¹</td>
</tr>
<tr>
<td>extract air specific fan power</td>
<td>0.5</td>
<td>W/s⁻¹</td>
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<td>central AHU flow rate</td>
<td>1.6</td>
<td>1/s⁻¹/m²</td>
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<td>central AHU control</td>
<td>CO₂ sensing</td>
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<td>ASU heat recovery</td>
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<td>fan coil type</td>
<td>EC motor VAV</td>
<td>—</td>
</tr>
<tr>
<td>fan coil specific fan power</td>
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<td>W/s⁻¹</td>
</tr>
<tr>
<td>fan coil air changes</td>
<td>8 (max.)</td>
<td>air changes/h</td>
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<td>duct airtightness</td>
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<td>chiller efficiency</td>
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<td>COP ~ SEER</td>
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<td>boiler (gas) efficiency</td>
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<td>efficiency target</td>
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<td>W/m² per 100 lux</td>
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<td>presence detection</td>
<td>On then dimmed</td>
<td>—</td>
</tr>
<tr>
<td>daylight linking</td>
<td>Automatic dimming</td>
<td>—</td>
</tr>
</tbody>
</table>
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
One Airport Square, Ghana
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
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
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
Problem:
**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.
Problem:
**Intense Solar Radiation Year-Round**

Will impact the development a low energy strategy

Irradiation Mapping Comes Long Way In Demonstrating This.
Problem:
Intense Solar Radiation Year-Round

Solution:
Simple and Effective Solar Shading on Critical Elevations

Initial Sketch Demonstrating Shading Principle
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
Problem:
Lack Of Sufficient Daylight In Central Atrium At Lower Floors

Solution:
Explore Transparency and Glass Typology for Atrium Roof
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.
Guardian glass  
69% light transmittance

%DF
25.0+ Level +8
22.5 Level +7
20.0 Level +6
17.5 Level +5
15.0 Level +4
12.5 Level +3
10.0 Level +2
7.5 Level +1
5.0 Level M
2.5 Level G
0.0 Level G

80% with fins  
min value 4.81% DF
60% with fins  
min value 3.99% DF
40% with fins  
min value 2.40% DF

Parametrics
Varying Transparent /Opaque ratios

Section Through the Atrium
Summary of Process

Visualise The Problem

Via Selective Irradiation Mapping
Visualise The Problem

Via Selective Irradiation Mapping

Optimise External Shading

Via Thermal Modelling

Optimise Internal Atrium

Via Daylight Modelling

Summary of Process
Summary of Process

Visualise The Problem
- Via Selective Irradiation Mapping

Optimise External Shading
- Via Thermal Modelling

Optimise Internal Atrium
- Via Daylight Modelling

Optimise Ventilation & Cooling Strategy
- Via Detailed Thermal Modelling
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