The Role of Thermal Modelling
In the Design Process

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Introduction

The Importance of Modelling:

• Relative Measurement - Design Options and Features
• Assumptions - INCLUDING THE WEATHER!
• New Build & Refurbishment
• Technical / Client Requirements
• Carbon Critical Design
• Evolving Design Process
Concept Design

- Crude Load Analysis
- Options
  - Form, Layout, Orientation & Servicing Strategies
- Metrics:
  - Peak Plant Load, Daylighting & Energy Consumption
  - Capital and Whole Life Cost
  - Carbon
  - Impact of Structure (Thermal Mass)
  - Façade Design and Shading
- Specific Requirements
- Developing an Energy Strategy, e.g. to Include Renewables
Case Study 1 - Bahrain Residential Concept
Scheme Design

- Plant Loads for Central Plant and Main Service Sizing
  - Dynamic Analysis
  - Steady State Analysis
- Analysis of Façade and Shading
  - Thermal
  - Daylighting
- Compliance / Design Requirements Checks
Case Study 2 – Office Block N. Africa, Scheme Design

Typical Mid-Level Office Plan

Core

Lettable Office Space
Case Study 2 – Office Block N. Africa, Scheme Design

- Standard Glazing
- Improved Glazing
- Added Walkway
- Added Shading
Case Study 2 – Office Block N.
Africa, Scheme Design

![Bar chart showing solar gain totals for different options.]

- Option 1: 350 MWh
- Option 2: 250 MWh
- Option 3: 200 MWh
- Option 4: 150 MWh
Detailed Design

• Detailed Load Analysis
  • Complex Studies e.g. Atria
• Natural Ventilation Analyses
  • Air Flow Rates, IAQ, Overheating
• Plant, Unit and Service Sizing
• Daylighting Factors
• Compliance Calculations
  • Part L Criteria 1 & 3
  • BB101
  • EPC’s
  • Required for Part L 2010
For Refurbishment
Case Study 3 - Dining Hall

• Performance Studies
• Evaluation of Design Options
Technical Compliance
Case Study 4 - Historic Records Centre

• One Model, Specific Requirements at Concept Stage
  • Dynamic Load Analysis
  • Plant Loads
  • Thermal Retention / BS5454 Compliant
  • Carbon Critical / Part L Benchmark
  • Daylighting Assessment
Technical Compliance
Case Study 4 - Historic Records Centre

• Thermal Retention, 17°C Set point, Turned Plant “Off” for 5 Days
• 18°C After 2 Days
• Peak Temperature:
  • 18.35°C DRT
  • 18.38°C Air

Date: Sun 01/Jul to Tue 31/Jul
Carbon Critical Design

Using Carbon as a Design Factor, Equivalent to Time, Cost, CDM and H&S
Carbon Critical Design Case Study 1 - Bahrain Residential

- DSM Can be Used as a Tool to Evaluate in Operational Carbon Terms:
  - Architecture – Form, Material & Glazing Strategy
  - Structure – Optimise Thermal Mass
  - Building Services – Strategy and Renewables
- Zero Pavilions, Four Towers, 16 Duplex Apartments
Carbon Critical Design
Case Study 1 - Bahrain Residential
Carbon Critical Design
Case Study 1 - Bahrain Residential
An Evolving Design Process - BIM

Centralised Building Model

- Building Services Design
- Thermal, Energy & Daylighting
- Financial Modelling
- Documentation
- Visualisation
- Virtual Building
- Structural Analysis
- Structural Design
- Architecture
- Other Disciplines
Questions