DELIVERING ZERO CARBON IN PRACTICE
ECOBUILD 2015
PRP DESIGN TEAM

PETER LANCARIC
Associate Director
PRP Architects
ARCHITECT

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Associate Director
PRP Environmental
SUSTAINABILITY CONSULTANT
OUTLINE PLANNING PERMISSION GRANTED SEPTEMBER 2012

CONSENT SUBJECT TO OVER 300 CONDITIONS

S106 AGREEMENT

PARAMETER PLANS

DESIGN CODES

PLANNING DELIVERY ZONES
PLANNING STAGES

2012
COMPETITIVE BID

2013
ZONAL MASTERPLAN CONSENTED

JAN 2014
PHASE 1 RESERVED MATTERS CONSENTED

NOVEMBER 2014
PHASE 2 RESERVED MATTERS CONSENTED

2015
FIRST OCCUPATION
MASTERPLAN IN CONTEXT
MASTERPLAN VISION

3 Steps for a More Sustainable Masterplan

1. More Green Open Space
   Maximised Neighbourhood amenity space.

2. Building a Community
   Open spaces that “belong” to all the residents.

3. More Family Homes
   A sustainable community designed for families.
MASTERPLAN VISION

3 PHASES

75% 3-BED PLUS

VARIETY OF TRADITIONAL AND INNOVATIVE TYPOLOGIES

COMPLEMENTARY NON-RESI USES

WIDER DESIGN TEAM

COLLABORATIVE WORKING
BUILDING TYPOLOGIES

HOUSE WITH ON-PLOT PARKING SPACE

Ground floor  First floor  Second floor  Third floor  Section
BUILDING TYPOLOGIES

MEWS HOUSE

Ground floor

First floor

Section
BUILDING TYPOLOGIES

MULTI-GENERATIONAL HOME

Second floor

Third floor

Ground floor

First floor

Section
BUILDING TYPOLOGIES

VELOBLOCKS

Penthouse

Duplex

Duplex
BUILDING TYPOLOGIES

CORNER BLOCKS
ON THE GREEN
PRPe Sustainability Expertise

Zero carbon design and delivery

Energy and sustainability strategies

BREEAM and Code for Sustainable Homes

Daylight and sunlight design

Climate change adaptation and mitigation strategies

Building simulation and environmental modelling

Health and well-being

Post-occupancy evaluation and monitoring
Integrated Environmental Approach

Sustainability Strategies
Energy Strategies
Climate Change Adaptation and Mitigation Strategies
Sunlight & Daylight Design
Open Space Overshadowing Analysis
Microclimate Studies
BREEAM Certification and Assessment
Code for Sustainable Homes Certification and Assessment
Smart Metering Behaviour Monitoring and POE
Fabric Energy Efficiency
Thermal Modelling Overheating and Thermal Comfort
Zero Carbon Design and Delivery
Waste Management
Materials Embodied Energy and Thermal Performance
Water Management

Delivering Zero Carbon in Practice

Chobham Manor
Application to the Legacy Communities Scheme

LLDC secured the outline masterplan consent for the Legacy Communities Scheme, which included safeguarding challenging and unusual requirements through condition at zonal masterplan and reserved matters stages. Those particularly relevant to zero carbon objectives include:

1. Achievement of full FEES for LCS dwellings
2. Design for thermal comfort against future weather data in the 2030s
3. 20% reduction in CO2 emissions via renewable energy
4. Contribution from developers towards carbon offsetting to zero for residential development (regulated emissions only) from 2016.
5. Achievement of zero carbon non residential development from 2019
6. Provision of integrated smart metering within the home, with smart meters capable of exporting data for aggregated analysis at a later date

LLDC is joint applicant on all planning applications submitted by Chobham LLP under the Legacy Communities Scheme
Results to date: Chobham

To date, Chobham Manor is achieving, across the scheme, a 60% reduction in carbon emissions against Part L 2010

25 zero carbon exemplar units (CSH5)

We are working on our environmental engagement strategy

We are testing our approach to local carbon offset projects in advance of national Allowable Solutions policy
Energy and CO2

Energy Conservation & CO2 Abatement

- Designed to deliver very low energy demand homes with smart meter displays and collection of performance data

Fabric Energy Efficiency

- All units to achieve ZCH full FEES definition (original definition with absolute targets – ZCH FEES report Nov09)
- Thermal bridging analysis (detailed analysis of all major junctions with bespoke detailing where required)

Connection to Low Carbon Heat

- All units & non-domestic buildings connected to the Queen Elizabeth Olympic Park District Heat Network
- Low carbon heat – biomass, gas CHP, gas

On-site Renewables

- PVs on blocks with commercial spaces
- Biomass (lead energy plant at energy centre)
Fabric Energy Efficiency Standard

Space heating and cooling demand related to:
- Building fabric U-values
- Thermal bridging
- Air permeability
- Thermal mass
- Solar shading
- Gains from metabolic, lighting, solar & household appliances (TV, computer etc)

Covered elsewhere in the definition of zero carbon:
- Efficiency of heating / cooling equipment (boilers, air conditioners etc)
- Mechanical ventilation
- Hot water
- Active controls
- Fixed lighting
- All LZC technologies
Achieving Full Fabric Energy Efficiency Standard

**Different forms of construction**

- Traditional cavity masonry; Reinforced Concrete Frame (Metsec with Brick/rainscreen)

**Achieving Full FEES**

- Very onerous for this form of dense urban development
- Requires very high specification (U-values + airtight)
- Attention to thermal bridging junctions
- Triple glazing in most blocks/house typologies
- Can conflict with other requirements (daylight; mitigating over-heating)

**Building Services**

- System 2 ventilation (MEV); HIUs with heat meters, timer and TRVs

<table>
<thead>
<tr>
<th>Element</th>
<th>Performance spec</th>
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</thead>
<tbody>
<tr>
<td>Ext Walls – flats</td>
<td>0.13W/m2K</td>
</tr>
<tr>
<td>Ext Walls – houses</td>
<td>0.13W/m2K</td>
</tr>
<tr>
<td>Party walls (flat to unheated space)</td>
<td>0.18W/m2K</td>
</tr>
<tr>
<td>Party walls (flat to flat)</td>
<td>0.0W/m2K</td>
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<tr>
<td>Ext doors</td>
<td>1.3W/m2K</td>
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<tr>
<td>Windows – DG</td>
<td>1.4W/m2K</td>
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<td>0.7 G-value</td>
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<tr>
<td></td>
<td>0.8 Frame Factor</td>
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<tr>
<td>Windows - TG</td>
<td>0.83W/m2K</td>
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<tr>
<td></td>
<td>0.5 G-value</td>
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<tr>
<td></td>
<td>0.8 Frame Factor</td>
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<tr>
<td>Ground Floors – flats</td>
<td>0.10W/m2K</td>
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<tr>
<td>Ground floors – houses</td>
<td>0.11W/m2K</td>
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<tr>
<td>Intermediate floors (flat to unheated space)</td>
<td>0.20W/m2K</td>
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<tr>
<td>Terrace – flats</td>
<td>0.13W/m2K</td>
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<tr>
<td>Roof – flats</td>
<td>0.13W/m2K</td>
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<tr>
<td>Roof – houses</td>
<td>0.12W/m2K</td>
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<tr>
<td>Exposed soffit</td>
<td>0.15W/m2K</td>
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</table>
FEES Relationship Diagram

- PSI values
- Thermal Mass
- U-values
- Building Form Efficiency
- Air tightness
- Gains

- Parapet roofs
- Deep reveals
- Cantilever balconies
- TraX/XTerT
- RC frame & MetSec
- Sheltered Walls
- Terraces
- Ceiling heights
- Glazing

- Do not directly influence FEES
- Heating
- Hot Water
- Ventilation
- Trickle vents
FEES analysis (pre-planning)

- Very high pass rate
- Steps & Staggers accounted for in calculations where relevant (sliding scale between 39 & 46 kWh/m²)
- Only 8 mews houses fail to achieve full FEES due to high surface area to volume ratio (‘Z’ shaped houses with internal courtyards)
- Strong emphasis on buildability and sequencing
- Use of BIM where relevant; coordinated design team with PRP architects leading to RIBA stage 4

<table>
<thead>
<tr>
<th>Block</th>
<th>Construction type</th>
<th>Description</th>
<th>FEES target</th>
<th>No.s</th>
<th>Pass</th>
<th>Fail</th>
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<tr>
<td>1B-A</td>
<td>RCF</td>
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<td>Trad</td>
<td>Terrace</td>
<td>39/46</td>
<td>12</td>
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<td>1B-F</td>
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<tr>
<td>1C-A</td>
<td>Trad</td>
<td>Terrace</td>
<td>39/46</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1C-C</td>
<td>Trad</td>
<td>Terrace</td>
<td>39/46</td>
<td>10</td>
<td>10</td>
<td></td>
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<tr>
<td>1C-D</td>
<td>RCF</td>
<td>Apartments</td>
<td>39</td>
<td>84</td>
<td>84</td>
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<tr>
<td>1C-B</td>
<td>Trad</td>
<td>Mews</td>
<td>39/46</td>
<td>4</td>
<td>0</td>
<td>4</td>
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<tr>
<td>1D-A</td>
<td>Trad</td>
<td>Terrace</td>
<td>39/46</td>
<td>5</td>
<td>5</td>
<td></td>
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<tr>
<td>1D-B</td>
<td>Trad</td>
<td>Apartments</td>
<td>46</td>
<td>8</td>
<td>8</td>
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<tr>
<td>1D-C</td>
<td>Trad</td>
<td>Maisonettes</td>
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<td>16</td>
<td>16</td>
<td></td>
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<tr>
<td>1D-D</td>
<td>RCF</td>
<td>Apartments</td>
<td>39</td>
<td>18</td>
<td>18</td>
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<tr>
<td>1D-E</td>
<td>Trad</td>
<td>Terrace</td>
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<td>10</td>
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<td></td>
<td></td>
<td>261</td>
<td>253</td>
<td>8</td>
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</table>

Pass rate 96.9%
Terrace Parapet Detail

Thermal bridging modelling

- Default Psi = 0.56 W/mK
- ACD = 0.28 W/mK
- Bespoke = 0.18 W/mK
# Treatment of Balconies

<table>
<thead>
<tr>
<th>Balcony types</th>
<th>Psi-value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete cantilevered balcony</td>
<td>1 W/mK</td>
<td>Limit the number of cantilevered balconies in blocks wherever possible.</td>
</tr>
<tr>
<td>Heavyweight Thermally broken (Schoek)</td>
<td>0.2 – 0.5 W/mK</td>
<td>Aim to achieve average Y-value (summation of psi-values) for balconies of 0.05 W/mK.</td>
</tr>
<tr>
<td>Lightweight thermally broken</td>
<td>0.1 W/mK</td>
<td>If using RCF construction, use pillars at corners (where lengths of bridge is limited).</td>
</tr>
<tr>
<td>Separate structure</td>
<td>0.02 – 0.00 W/mK</td>
<td>Addition of roof terraces, complex shapes and changes in wall thickness mitigate achievement of target FEES</td>
</tr>
</tbody>
</table>
Impact on FEES targets (balconies)
CHOBHAM MANOR       DELIVERING ZERO CARBON IN PRACTICE
Detailed analysis for each form of construction

### RC CONSTRUCTION

<table>
<thead>
<tr>
<th>Junction Reference</th>
<th>Type (Primary/Secondary)</th>
<th>Psi Value (Primary)</th>
<th>Psi Value (Secondary)</th>
<th>Default Psi Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1-steel lintel/perf base</td>
<td>PRP / ACD</td>
<td>0.05*</td>
<td>0.30</td>
<td>1.00</td>
</tr>
<tr>
<td>E2-other lintels</td>
<td>PRP / ACD</td>
<td>0.04</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>E3-ground flr</td>
<td>SCOT / PRP</td>
<td>0.058</td>
<td>0.058</td>
<td>0.32</td>
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<tr>
<td>E4-interm. flr. Within</td>
<td>PRP</td>
<td>7</td>
<td>7</td>
<td>0.14</td>
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<tr>
<td>E5-interm. flr. Btwn</td>
<td>PRP</td>
<td>7</td>
<td>7</td>
<td>0.14</td>
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<tr>
<td>E6-eaves (ceiling)</td>
<td>SCOT / ACD</td>
<td>0.21</td>
<td>0.21</td>
<td>0.04</td>
</tr>
<tr>
<td>E7-eaves (rafter)</td>
<td>SCOT / XT</td>
<td>0.0402</td>
<td>0.0402</td>
<td>0.08</td>
</tr>
<tr>
<td>E8-gable (ceiling)</td>
<td>XT</td>
<td>0.04</td>
<td>0.04</td>
<td>0.12</td>
</tr>
<tr>
<td>E9-gable (rafter)</td>
<td>ACD</td>
<td>0.05</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>E10-flat roof</td>
<td>ACD</td>
<td>0.04</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>E11-flat r.f parapet</td>
<td>SCOT / PRP</td>
<td>0.02</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>E12-corner (normal)</td>
<td>ACD / PRP</td>
<td>0.09</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>E13-corner (neutral)</td>
<td>ACD / XT</td>
<td>0.06</td>
<td>0.0719</td>
<td>0.12</td>
</tr>
<tr>
<td>E14-party wall corner</td>
<td>ACD / XT</td>
<td>0.06</td>
<td>0.0719</td>
<td>0.12</td>
</tr>
</tbody>
</table>

### TRADITIONAL CONSTRUCTION

<table>
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<tr>
<th>Junction Reference</th>
<th>Type (Primary/Secondary)</th>
<th>Psi Value (Primary)</th>
<th>Psi Value (Secondary)</th>
<th>Default Psi Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1-steel lintel/perf base</td>
<td>XT</td>
<td>0.01</td>
<td>0.01</td>
<td>1.00</td>
</tr>
<tr>
<td>E2-other lintels</td>
<td>XT</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
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<tr>
<td>E3-ground flr</td>
<td>XT</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>E4-interm. flr. Within</td>
<td>XT</td>
<td>0.054</td>
<td>0.054</td>
<td>0.14</td>
</tr>
<tr>
<td>E5-interm. flr. Btwn</td>
<td>XT</td>
<td>0.07</td>
<td>0.07</td>
<td>0.14</td>
</tr>
<tr>
<td>E6-eaves (ceiling)</td>
<td>XT</td>
<td>0.05</td>
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<td>E7-eaves (rafter)</td>
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<td>0.04</td>
<td>0.04</td>
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<tr>
<td>E8-gable (ceiling)</td>
<td>XT</td>
<td>0.0402</td>
<td>0.0402</td>
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</tr>
<tr>
<td>E9-gable (rafter)</td>
<td>SCOT</td>
<td>0.04</td>
<td>0.04</td>
<td>0.08</td>
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<tr>
<td>E10-flat roof</td>
<td>SCOT</td>
<td>0.1817</td>
<td>0.1817</td>
<td>0.56</td>
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<td>E11-flat r.f parapet</td>
<td>XT</td>
<td>0.04</td>
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<td>0.08</td>
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<tr>
<td>E12-corner (normal)</td>
<td>XT / SCOT</td>
<td>0.06</td>
<td>0.0619</td>
<td>0.12</td>
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<tr>
<td>E13-corner (neutral)</td>
<td>XT / SCOT</td>
<td>0.06</td>
<td>0.0619</td>
<td>0.12</td>
</tr>
<tr>
<td>E14-party wall corner</td>
<td>SCOT / ACD</td>
<td>0.0024</td>
<td>0.0024</td>
<td>0.12</td>
</tr>
</tbody>
</table>

### KEY

| PRP | Accredited Construction Details |
| ACD | Scottish Accredited Construction Details |
| SCOT | PRP Calculated |

**Detailed analysis for each form of construction**

**Psi-Value Choice Selection Table**

**U-values - RC Construction**

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
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<tbody>
<tr>
<td>Wall</td>
<td>0.13</td>
</tr>
<tr>
<td>Floor</td>
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</tr>
<tr>
<td>Roof</td>
<td>0.13</td>
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</table>

**Psi-Value Choice Selection Table**

**U-values - Traditional Construction**

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
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<td>Wall</td>
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<td>Floor</td>
<td>0.11</td>
</tr>
<tr>
<td>Roof</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**XTRATHERM NOTE**

Use of Xtratherm details subject to floor/roof insulation having the same thermal properties as those of Xtratherm products. Confirmed via Email from Mark Magennis of Xtratherm 2013-12-10.
Relevance of using ACDs
FEES Performance Compared Across Different Projects
Achieving Carbon Compliance

- Allowable Solutions
  - On site low/zero carbon heat and power
  - Fabric Energy Efficiency

Carbon Compliance

Zero Carbon
Connection to Low Carbon Heat Source

- All buildings and dwellings connected to Queen Elizabeth Olympic Park District Heat Network
  - Challenging; limiting (choice of solution); but also enabling in terms of CO2 abatement
- Energy plant – gas CHP, Biomass, Gas (redundancy & resilience)
- ESCO required to progressively reduce CO2 content of heat during contract term (40yrs)
- Gas CHP H:P ratio = 1 : 1; DHN losses assumed = 18.8% (primary) and 15% (secondary)

<table>
<thead>
<tr>
<th>Proportion of heat met</th>
<th>Gas CHP</th>
<th>Biomass</th>
<th>Gas</th>
<th>CO2 intensity of heat delivered</th>
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<tbody>
<tr>
<td>Phase 1</td>
<td>79%</td>
<td>11%</td>
<td>10%</td>
<td>0.034KgCO2/kWh</td>
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<tr>
<td>Phase 2</td>
<td>42%</td>
<td>32%</td>
<td>25%</td>
<td>0.174KgCO2/kWh</td>
</tr>
<tr>
<td>Phase 3</td>
<td>58%</td>
<td>24%</td>
<td>18%</td>
<td>0.103KgCO2/kWh</td>
</tr>
</tbody>
</table>
Allowable Solutions

On-site low/zero carbon heat and power

Fabric Energy Efficiency

Carbon Compliance

Zero Carbon
LLDC Zero Carbon Approach

The LLDC approach to Zero Carbon is set out in its sustainability policy, available here

http://queenelizabetholympicpark.co.uk/our-story/transforming-east-london/sustainability

It builds on the Energy Hierarchy:

• Adopts full FEES for all homes
• Requires connection to Queen Elizabeth Olympic Park District Energy Network
• Additional renewable energy considered on site
• Carbon offset of residual emissions to zero within the surrounding community
Offset Solutions

LLDC is seeking to adopt a policy on carbon offset within its Local Plan (at EIP now)

LLDC will trial its approach to local carbon offset by offsetting the Carbon associated with phases 1, 2 and 3 of Chobham Manor.

Approaches under consideration include:

• Considering embodied carbon savings achieved through use of low impact materials
• Considering measurable carbon savings achieved through behaviour change interventions
• Installation of renewable energy systems
• Retrofitting for energy efficiency

Key challenges to date include:
1. Proving ‘additionality’
2. Consistently assessing the potential carbon savings to be achieved across projects
3. Verification of carbon savings achieved, especially for embodied carbon and behaviour change

Carbon offset projects to commence in 2015
Allowable Solutions vs PV costs (chobham)

- Average of PV costs
- Average of £120
- Average of £90
- Average of £60
- Average of £30

- Average of £/TCO2 PV
- Average of AS - £30/TCO2
- Average of AS - £60/TCO2
- Average of AS - £90/TCO2
- Average of AS - £120/TCO2
Allowable Solutions vs PV costs (industry)
Conflicts Tree

**FEES**
- Heating demands outweigh cooling demands
- Active cooling increases CO2 emissions
- Building vs design vs efficiency vs durability vs maintainability

**Future Climate**
- Future climate change
- Future energy demands
- Future climate resilience

**Daylight**
- Daylighting vs overheating
- Location of living rooms
- Location for access to daylight
- Mitigating overheating risks

**Code**
- Code compliance
- Code credits
- Code requirements
- Code vs energy efficiency

**BREEAM**
- BREEAM vs energy efficiency
- BREEAM vs code
- BREEAM vs future climate
- BREEAM vs day lighting

**Future Climate**
- Future climate change
- Future energy demands
- Future climate resilience

**BREEAM**
- BREEAM vs energy efficiency
- BREEAM vs code
- BREEAM vs future climate
- BREEAM vs day lighting

---

Balconies and roof terraces increase heat loss through thermal bridges but can provide shading to mitigate overheating.

Highly insulated & air tight envelope increases risk of overheating.

Balconies and roof terraces increase heat loss through thermal bridges but can provide shading to mitigate overheating.

Internal kitchens in single aspect apartments achieve poor daylight factors but optimise floorplans.

Location of living rooms can compete with best location for access to daylight.

Solar Photovoltaics abate increasing lower emissions as grid decarbonises.

Window choice conflicts: useful gains vs overheating vs losses vs daylighting.

Achieving FEES can limit choice of construction and higher materials credits.

Ventilation choice conflicts: balanced vs expel only vs trickle ventilation vs ψ values vs acoustic mitigation.

Design vs Efficiency conflicts: high surface area to volume ratio vs more interesting shapes/floorplans.

Heavyweight (thermal mass) vs lightweight construction (rapid heating response).

Flat roofs vs parapets vs roofspace for PV vs green roof requirements.

Internal kitchens in single aspect apartments achieve poor daylight factors but optimise floorplans.

Location of living rooms can compete with best location for access to daylight.

Solar Photovoltaics abate increasing lower emissions as grid decarbonises.

Window choice conflicts: useful gains vs overheating vs losses vs daylighting.

Achieving FEES can limit choice of construction and higher materials credits.

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Climate Change Analysis

- Site is assessed against future projections for climate (2030 medium scenario using TM49 – projected London climate data)

- Testing resilience to current and future overheating risk

- Dynamic relationship between OH and achieving FEES
  - Lightweight Structure tends to favour achievement of FEES, compared to heavyweight construction which tends to favour mitigation of overheating risk
Overheating

- Recommendations for meeting CIBSE 2013 criteria up to 2030
- Early stage climate proofing concepts (form, orientation, natural ventilation, thermal mass)
- Dynamic thermal simulation for fine tuning (glazing specification, ventilation strategy and facade detailing)
- Mitigation measures: highly insulated envelope; thermal mass; openable windows; low G-value; shading from Balconies & roof terraces
Daylight, Sunlight and Microclimate

**Daylight & Sunlight**

- Daylight and sunlight analysis carried out to maximise potential for daylight and sunlight access

**Overshadowing**

- All outdoor open spaces analysed to maximise solar access and amenity value

**Microclimate (Wind)**

- CFD analysis used to analyse local wind conditions and pedestrian comfort
Daylight, Sunlight and Microclimate

- Iterative design process with all Chobham architectural teams
- Sunlight and daylight design advice
- NB achieving good access to daylight can increase risk of overheating
- Triple glazing (low G-values) + attention to thermal bridges allows larger window areas relative to exposed surface area
Summary Findings
Applied Wisdom

Achieving FEES

- Building form efficiency – keep it simple!
- Thermal mass – lightweight supports FEES/heavyweight to mitigate overheating
- U-values – high specification
- Ψ-values – address thermal bridges
- Air tightness & Ventilation – lower DAPs have little impact on FEES (cf. thermal bridging), but thermal integrity of windows can be compromised by trickle vents
- Gains – FEES is sensitive to window U-values, frame factors and G-values. Balance between performance and aesthetics
- Windows – triple glazing may be required in marginal cases and supports the balanced approach to performance and comfort.
Code 5 (exemplar)

- Orientation of roofs – PV is required for exemplar homes. Shading is an issue in dense development.
- Space for PV – need to finalise CO2 content of low carbon heat before finalising PV quantities.
- Space for RWH/GWH – space for RWH or GWH to allow water consumption to be reduced to ≤80lpd.

Managing Conflicts

- Helps to have a consultant that can provide all the necessary services and even better run them in the same Virtual Environmental model!
- Aim to combine modelling of FEES/Overheating/DSO/Code/BREEAM where possible to manage potential conflicts.
- Run design surgeries with design team – test as you go!