North West Cambridge Development: Zero Carbon Housing

- 5000 New Dwellings
- 40,000 m² Commercial floor space
- 60,000 m² Academic floor space
- Over 5000 m² Retail floor space
- Community facilities
- Largest CfSH level 5 Development

*Images of various developments within the North West Cambridge Development, including Parkland - Storey's Field, Jodrell Laboratory, Royal Botanic Gardens, Kew, and University housing.*

*Design Brief - Part 1 | July 2012*
North West Cambridge Development: Zero Carbon Housing

Lot 1: Wilkinson Eyre and Mole Architects
Lot 2: Stanton Williams Architects
Lot 3: Mecanoo
Lot 4: Cottrell Vermeulen Architects
Sarah Wigglesworth Architects
The AOC
Lot 5: RH Partnership
Lot 6: Marks Barfield Architects
Lot 7: MUMA
Lot 8: Maccreanor Lavington + Witherford Watson Mann
Lot 9: Alison Brooks Architects
Lot A: Aecom Landscape
Lot B: Townsend Landscape Architects
INITIAL FABRIC VALUES:
- Walls: 0.13 W/m²K
- Roof: 0.13 W/m²K
- Floor: 0.12 W/m²K
- Windows: 1.3 W/m²K
- Doors: 1.0 W/m²K
- Air Tightness: 5 m³/m²h
- Y Value: 0.06 W/m²K
North West Cambridge Development: Zero Carbon Housing

**Sample Flat: Part L TER**

CO2 emissions (Tonnes CO2/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>CO2 Emissions (Tonnes CO2/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>740</td>
</tr>
<tr>
<td>Domestic Hot water</td>
<td>623</td>
</tr>
<tr>
<td>Lighting</td>
<td>157</td>
</tr>
<tr>
<td>Auxiliary Energy</td>
<td>174</td>
</tr>
</tbody>
</table>

Total: 1594

**Reduction due to Energy Efficiency**

CO2 emissions (Tonnes CO2/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>CO2 Emissions (Tonnes CO2/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>286</td>
</tr>
<tr>
<td>Domestic Hot water</td>
<td>491</td>
</tr>
<tr>
<td>Lighting</td>
<td>119</td>
</tr>
<tr>
<td>Auxiliary Energy</td>
<td>18</td>
</tr>
</tbody>
</table>

Total: 914

**Reduction due to District Heating CHP**

CO2 emissions (Tonnes CO2/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>CO2 Emissions (Tonnes CO2/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Heating</td>
<td>88</td>
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<tr>
<td>Domestic Hot water</td>
<td>151</td>
</tr>
<tr>
<td>Lighting</td>
<td>119</td>
</tr>
<tr>
<td>Auxiliary Energy</td>
<td>21</td>
</tr>
</tbody>
</table>

Total: 383

**Photovoltaic offset**

CO2 emissions (Tonnes CO2/year)

<table>
<thead>
<tr>
<th>Category</th>
<th>CO2 Emissions (Tonnes CO2/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>-383</td>
</tr>
</tbody>
</table>

Total: 0

*Photovoltaic offset: 383 Tonnes CO2/year*
Lot 1 at Heart of development
Mixed use scheme;
- Foodstore
- District Heating Energy Centre
- Health Centre
- Police Office
- 117 Residential Units
North West Cambridge Development: Zero Carbon Housing

Lot 1 Proposed Uses and Active Frontages

Lot 1 Building Block Typologies

Lot 1 Design Development

Key
- Residential
- Health Care Centre
- Police Office
- Energy Centre
- Retail
- Foodstore

Entrances
- Residential Entrance
- Health / Police Entrance
- Energy Centre Access
- Retail Entrance
- Fire Escape
- Vehicle Route

Key
- Foodstore / Energy Centre
- Single Level Residential Typology to Busgate Street accent
- Duplex Residential Typology to wrap large volume uses
- Single level Residential Typology to accent corner
- Access Core
- Accent Area

8 x 1 BEDS UNITS
4 x 2 BED UNITS

16 x 2 BED DUPLEX UNITS

28 x 2 BED DUPLEX UNITS

28 x 1 BEDS UNITS
10 x 2 BED DUPLEX UNITS

2 x 1 BEDS UNITS
10 x 2 BED DUPLEX UNITS

3 x 1 BEDS UNITS
2 x 2 BED DUPLEX UNITS

18 x 2 BED DUPLEX UNITS

2 x 1 BEDS UNITS
10 x 2 BED DUPLEX UNITS

2 x 2 BED DUPLEX UNITS

Residential Courtyard

SOUTH RESIDENTIAL COURTYARD

WESTERN DUPLEX

NORTH RESIDENTIAL COURTYARD

28 x 1 BEDS UNITS
26 x 2 BED UNITS

18 x 2 BED DUPLEX UNITS

Lot 1 Building Block Typologies
North West Cambridge Development: Zero Carbon Housing

**TYPOLOGY 1:**
Large volume blocks

**TYPOLOGY 2:**
Linear Perimeter block
- Large external wall surface area
- Predominantly Single Aspect
- Acoustic Issues

- Building Cantilevers / walkways
- Varied fenestration
- Retail uses below
- External areas below
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- Early design implications
- Overhangs omitted
- Balconies removed
- Core arrangement revised

LINEAR BLOCK DESIGN CONSIDERATIONS

- Daylight difficulties
- Ventilation difficulties
- Heated Cores introduced
- Window areas revised
- Planning implications

- Triple glazing introduced
- Cross ventilation provided
- Open plan through living spaces
- External cores and walkways
- Thermal line around risers

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Standard Reveal Window Type

Deep Reveal Window Type

Pop Out Window Type

Flush Window Type
- All Bespoke details
- Key details to be reviewed

- Iterative process required for more complex details
- Reliant on good products
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MORE THERMAL BRIDGING CALCULATIONS...

FINAL FABRIC VALUES:

<table>
<thead>
<tr>
<th>Surface</th>
<th>U-value (W/m²K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls</td>
<td>0.13 / 0.10 - 0.11</td>
</tr>
<tr>
<td>Roof</td>
<td>0.13 / 0.10 - 0.13</td>
</tr>
<tr>
<td>Floor</td>
<td>0.12 / 0.10 - 0.12</td>
</tr>
<tr>
<td>Windows</td>
<td>1.3 / 0.9</td>
</tr>
<tr>
<td>Doors</td>
<td>1.0 / 1.0</td>
</tr>
</tbody>
</table>

Air Tightness:

- 5 m³/m²h
- 3 m³/m²h

Y Value: 0.06 W/m²K

Average U-value: 0.1 W/m²K
Y values had to be calculated.

The most difficult parameter for achieving the FEE targets.

The default (0.15 W/m2K) Thermal bridging, y-value, is not an option!
<table>
<thead>
<tr>
<th>LOT NUMBER</th>
<th>NUMBER OF DWELLINGS</th>
<th>AVERAGE FEE VALUE (kWh/m2)</th>
<th>AVERAGE Y-VALUE (W/m2K)</th>
<th>AVERAGE PV Required (kWp/Dwelling)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOT 1</td>
<td>117</td>
<td>37.0</td>
<td>0.1</td>
<td>1.11</td>
</tr>
<tr>
<td>LOT 2</td>
<td>264</td>
<td>36.7</td>
<td>0.08</td>
<td>1.07</td>
</tr>
<tr>
<td>LOT 3</td>
<td>232</td>
<td>35.0</td>
<td>0.08</td>
<td>1.11</td>
</tr>
<tr>
<td>LOT 4</td>
<td>70</td>
<td>37-43.5</td>
<td>0.06-0.1</td>
<td>1.43</td>
</tr>
<tr>
<td>LOT 8</td>
<td>73</td>
<td>36.5</td>
<td>0.06-0.15</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Y Value calculated for over 750 Details for all lots
Checklist nature of code could sometimes lead to suboptimal design:

- Heating corridors to achieve FEE;
- Using high g-values to meet FEE as overheating has no credit in Code;
- Reducing master bedrooms glazing in favour of study as main bedroom is not counted in daylight credits;
- Fully filled party walls with little external faces. Acoustics conflict.
- Removing balconies to achieve daylight.
Code engages the design team on issues that are cross cutting.

It helps integrated design.

Daylight?

Acoustics?

Waste/Recycling?

Transport/Bikes?

Materials?
Either way we need a new way of working.

Achieving FEE and Zero Carbon, but also daylight, and comfort, aesthetic and cost constraints needs:

Integrated Design.

More analysis earlier.

More time and money for concept stage.

Client Brief must evolve during concept design:
Flexibility/limit of usage, green lease, cost, maintenance issues.

Planning process de-risked.