Building Regulations Part L

IBCI Conference    April 2014

Contents

• Part L Overview  
• DEAP & BER  
• Case Study  
• Future

Conor Taaffe
Managing Director, HomeBond
Part L Overview
Part L - Conservation Of Fuel & Energy

TGD L Dwellings 2011
• New Dwellings
  ➢ EPC, CPC
  ➢ Renewable Energy
  ➢ U Values (backstop)
    ✓ BBA Research U Values
  ➢ Thermal Bridging
  ➢ Acceptable Construction Details
  ➢ Air Tightness (ventilation)
• DEAP & BER
• Existing Dwellings
TGD L Buildings 2008
  ➢ U Values (backstop)
  ➢ Thermal Bridging
  ➢ Services, controls
  ➢ Solar Overheating

Acknowledgements:
DECLG, DCENR, SEAI, CIT, NSAI, BBA, BRE & NHBC Foundation.
Part L Overview

60% improvement on 2005 Part L

NEW DWELLINGS

Renewal energy
10 kWh/m²/yr thermal
or 4 kWh/m²/yr electrical
or combination

Air Tightness
$q_{50} = 7 \text{ m}^3/(\text{hr.m}^2)$

TGD L 2008 MPEPC 0.6, MPCPC 0.69

MPEPC = 0.4
MPCPC = 0.46

MPEPC = 1.0
MPCPC = 1.0

Work commenced by 30 November 2011
Substantial completion by 30 November 2013

Artificial Lighting
CIBSE “Code for Lighting”

Solar Overheating
Daily load $\leq 25 \text{ W/m}^2$

Work commenced by 30 June 2008
Substantial completion by 30 June 2010
Essential References

- Other Codes / Standards / Software

References in TGD L:
Available on www.environ.ie, www.seai.ie or purchase from NSAI or BSI
Regulation L1

A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO₂) emissions associated with this energy use insofar as is reasonably practicable.

Design & Construct the building

LIMIT

1. Amount of Energy Required (EPC)
2. Amount of CO₂ emissions (CPC)

for the operation of the dwelling
Regulation L2

L1 A building shall be designed and constructed so as to ensure that the energy performance of the building is such as to limit the amount of energy required for the operation of the building and the amount of carbon dioxide (CO₂) emissions associated with this energy use insofar as is reasonably practicable.

L2 For existing dwellings, the requirements of L1 shall be met by:

(a) limiting heat loss and, where appropriate, maximising heat gain through the fabric of the building;

(b) controlling, as appropriate, the output of the space heating and hot water systems;

(c) limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air;

(d) providing that all oil and gas fired boilers installed as replacements in existing dwellings shall meet a minimum seasonal efficiency of 90% where practicable.
Regulation L2

Guidance relates to fabric heat loss by way of

- Material Alteration
- Extension
- Material Change of Use from building to dwelling

3 main issues

- Fabric Insulation
- Thermal Bridging – for Extensions adopt ACDs
- Limitation of Air Permeability – for Extensions adopt ACDs or equivalent alternative approach
SR 54 Code of Practice for the energy efficient retrofit of dwellings

Contents

(Published 7 March 2014 – 281 no. pages)

• Building Science
• Planning a retrofit
• Roofs
• Walls
• Opening
• Floors
• Ventilation
• Heating & hot water systems
• Residential Lighting
• Annexes A - H

Appendices
Annex A – U Values & Tables - Roofs
Annex B – U Values & Tables - Walls
Annex C – U Values & Tables - Floors
Annex D – Driven Rain Index
Annex E – Boiler Interlock
Annex F – Project Management
Annex G – Thermal Bridging
Annex H – Thermal Bridging Details
Regulation L3: New Dwellings

For new dwellings, the requirements of L1 shall be met by:

(a) providing that the energy performance of the dwelling is such as to limit the calculated primary energy consumption and related carbon dioxide (CO₂) emissions insofar as is reasonably practicable, when both energy consumption and carbon dioxide (CO₂) emissions are calculated using the Dwelling Energy Assessment Procedure (DEAP) published by Sustainable Energy Authority of Ireland;

(b) providing that, for new dwellings, a reasonable proportion of the energy consumption to meet the energy performance of a dwelling is provided by renewable energy sources;

(c) limiting heat loss and, where appropriate, availing of heat gain through the fabric of the building;

(d) providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;

(e) providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90%;

(f) providing to the dwelling owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and energy than is reasonable.
General Guidance

TGD L 2011 @ Page 6

Minimum performance levels for each of the following:

- Use of renewable energy
- Fabric insulation
- Air tightness
- Boiler efficiency
- Building services control

Primary Energy & CO2

Ins. of pipes, ducts & vessels
Mech. Ventilation systems
Performance of completed dwelling
User information
L4 For buildings other than dwellings, the requirements of L1 shall be met by:

(a) providing that the energy performance of the new building is such as to limit the calculated primary energy consumption and related CO₂ emissions insofar as is reasonably practicable, when both energy consumption and CO₂ emissions are calculated using the Non-domestic Energy Assessment Procedure (NEAP) published by Sustainable Energy Ireland;

(b) limiting the heat loss and, where appropriate, maximising the heat gains through the fabric of the building;

(c) providing energy efficient space and water heating services including adequate control of these services;

(d) ensuring that the building is appropriately designed to limit need for cooling and, where air-conditioning or mechanical ventilation is installed, that installed systems are energy efficient, appropriately sized and adequately controlled;

(e) limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air;

(f) limiting the heat gains by chilled water and refrigerant vessels, and by pipes and ducts that serve air conditioning systems;

(g) providing energy efficient artificial lighting systems (other than emergency lighting, display lighting or specialist process lighting) and adequate control of these systems.
TGD L Buildings other than Dwellings 2008

Refer also to

TGD M 2010
Lighting requirements

TGD B 2006
Lighting of Escape Routes

<table>
<thead>
<tr>
<th>Light source</th>
<th>Types and rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>High pressure Sodium</td>
<td>All types and ratings</td>
</tr>
<tr>
<td>Metal halide</td>
<td>All types and ratings</td>
</tr>
<tr>
<td>Induction lighting</td>
<td>All types and ratings</td>
</tr>
<tr>
<td>Tubular fluorescent</td>
<td>26 mm diameter (T8) lamps, and 16 mm diameter (T5) lamps rated above 11W, provided with high efficiency control gear, 38 mm diameter (T12) linear fluorescent lamps 2400 mm in length</td>
</tr>
<tr>
<td>Compact fluorescent</td>
<td>All ratings above 11W</td>
</tr>
<tr>
<td>Other</td>
<td>Any type and rating with an efficacy greater than 50 lumens per circuit Watt.</td>
</tr>
</tbody>
</table>
TGD L Buildings other than Dwellings 2008

Understanding overheating – where to start:
An introduction for house builders and designers

Overheating in new homes
A review of the evidence

Available from the NHBC Foundation Website.
www.nhbcfoundation.org

NF44 & NF 46

NHBC Foundation = NHBC + BRE Trust
Each dwelling should have a minimum level of energy provision from renewable energy technologies equivalent to

- 10 kWh/m²/annum of thermal energy, or
- 4 kWh/m²/annum of electrical energy, or
- A combination of these which would have equivalent effect
Heat Pumps

Operational considerations

- Technology proven
- High front end cost
- Operational and maintenance costs
- Lower water content & lower water operating temperature systems are most efficient

<table>
<thead>
<tr>
<th>Type</th>
<th>F2026-6</th>
<th>F2026-8</th>
<th>F2026-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound power level, according to EN12102 at 7.45</td>
<td>57</td>
<td>57/62</td>
<td>57/62</td>
</tr>
<tr>
<td>Fan speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>54</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>High</td>
<td>54</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Max sound pressure level at 2 m*</td>
<td>33.5</td>
<td>33.5</td>
<td>33.5</td>
</tr>
<tr>
<td>Max sound pressure level at 5 m*</td>
<td>38.5</td>
<td>38.5</td>
<td>38.5</td>
</tr>
<tr>
<td>Max sound pressure level at 10 m*</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
</tbody>
</table>

**NOTE**

It is important to the heat pump function that condensation water is led away and that the drain for the condensation water run off is not positioned so that it may cause damage to the house.
Solar Panels - Space Heating

- Needs large surface area of solar collectors
- Large buffer storage required
- Under-floor heating or low temperature radiators ideally
- Must have alternative heating system as back-up

SR 50 Code of Practice for Building Services - Part 2 – Solar Panels
Photovoltaic (PV)

Direct conversion of sunlight to electricity
RENEWABLE TECHNOLOGIES

Further Reading
Available form
NHBC Foundation,
SEAI

Advice on
Heat Pumps
PV systems
Solar thermal systems
Micro wind turbines
## Appendix A - U Values

### Table 1: Maximum elemental U-value (W/m²K)\(^1,2\)

<table>
<thead>
<tr>
<th>Column 1 Fabric Elements</th>
<th>Column 2 Area-weighted Average Elemental U-Value (Um)</th>
<th>Column 3 Average Elemental U-value - individual element or section of element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roofs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitched roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Insulation at ceiling</td>
<td>0.16</td>
<td>0.3</td>
</tr>
<tr>
<td>- Insulation on slope</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>Flat roof</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground floors(^3)</td>
<td>0.21</td>
<td>0.6</td>
</tr>
<tr>
<td>Other exposed floors</td>
<td>0.21</td>
<td>0.6</td>
</tr>
<tr>
<td>External doors, windows and rooflights</td>
<td>1.6(^4)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

### Table 2: Permitted variation in combined areas (\(A_{oee}\)) and average U-values (\(U_{oee}\)) of external doors, windows and rooflights

<table>
<thead>
<tr>
<th>Average U-value of windows, doors and rooflights ((U_{oee})) (W/m²K)</th>
<th>Maximum combined area of external doors, windows and rooflights ((A_{oee})), expressed as % of floor area ((A_{f}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>58.9</td>
</tr>
<tr>
<td>1.0</td>
<td>44.8</td>
</tr>
<tr>
<td>1.2</td>
<td>35.1</td>
</tr>
<tr>
<td>1.3</td>
<td>31.9</td>
</tr>
<tr>
<td>1.4</td>
<td>29.2</td>
</tr>
<tr>
<td>1.5</td>
<td>26.9</td>
</tr>
<tr>
<td><strong>1.6</strong></td>
<td><strong>25.0</strong></td>
</tr>
<tr>
<td>1.7</td>
<td>23.3</td>
</tr>
<tr>
<td>1.8</td>
<td>21.9</td>
</tr>
<tr>
<td>1.9</td>
<td>20.6</td>
</tr>
<tr>
<td>2.0</td>
<td>19.4</td>
</tr>
<tr>
<td>2.2</td>
<td>17.5</td>
</tr>
<tr>
<td>2.4</td>
<td>15.9</td>
</tr>
<tr>
<td>2.6</td>
<td>14.5</td>
</tr>
</tbody>
</table>

Notes:
1. The U-value includes the effect of unheated void spaces.
2. For alternative method of showing compliance see paragraph 1.3.2.3.
3. For insulation of ground floors and exposed floors incorporating underfloor heating, see paragraph 1.3.2.3.
4. Windows, doors and rooflights should have a maximum U-value of 1.6 W/m²K when their combined area is 25% of floor area. However areas and U-values may be varied as set out in Table 2.
# Fabric Insulation

Phenolic foam in partial fill cavity wall, Lambda value 0.020 W/mK

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>60mm</td>
<td>0.28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>80mm</td>
<td>0.22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mm</td>
<td>0.18</td>
</tr>
</tbody>
</table>

+ 

Phenolic foam insulated plasterboard fixed directly to inside

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5mm</td>
<td>0.191</td>
</tr>
<tr>
<td>52.5mm</td>
<td>0.167</td>
</tr>
<tr>
<td>62.5mm</td>
<td>0.152</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5mm</td>
<td>0.161</td>
</tr>
<tr>
<td>52.5mm</td>
<td>0.143</td>
</tr>
<tr>
<td>62.5mm</td>
<td>0.132</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5mm</td>
<td>0.137</td>
</tr>
<tr>
<td>52.5mm</td>
<td>0.125</td>
</tr>
<tr>
<td>62.5mm</td>
<td>0.116</td>
</tr>
</tbody>
</table>
Appendix B – Fabric Insulation

Additional guidance for common constructions TGD L 2011 - Page 43

General

B1. Guidance is not exhaustive & you are referred to BR 262:2001 Thermal Insulation: Avoiding Risks along with other relevant sources of guidance.

Also refers to Limiting Thermal Bridging and Air filtration – Acceptable Construction Details.

B2. U value will vary depending on conductivity i.e. Higher performing insulating materials can achieve any given U value with a lower thickness of insulating material.
B3. Use I.S EN ISO 13788 to assess the risk of
  • Surface condensation & Mould Growth
  • Interstitial Condensation

I.S. EN 15026 can also be used to assess the risk of
  • Surface Condensation & Mould Growth
Appendix B – Fabric Insulation

Additional guidance for common constructions TGD L 2011 - Page 43

B4. VCL reduces the water vapour transfer through any building component.

• Place on warm side of insulation.
• Seal to adjoining elements e.g. Glazing, Masonry upstands and any VCL in those elements.
• Seal around all service penetrations.
• 50mm minimum laps, sealed and have solid backing.
• Polythene sheeting where used should be protected from heat & sunlight to reduce risk of degradation.
• Foil back plasterboard joints should be sealed & allow for thermal movement
B5. Roof Constructions

- Provision of adequate roofspace ventilation
- Minimise transfer of water vapour from occupied dwelling air to cold attic space
- Minimise the extent of cold bridging – ACDs
- Protect water tanks & pipework against risk of freezing
- Overheating of electric cables or fittings
- Access to tanks, services & fittings in roofspace

- Types R1 – R5
Appendix B – Fabric Insulation

Additional guidance for common constructions TGD L 2011 - Page 48

B6. Wall Constructions

• Condensation
• Thermal bridging - ACDs
• Junctions with solid party walls & partitions
• Junctions with intermediate floors
• Stairs, cupboards & other fittings supported on or abutting the external wall – continuity of insulation
• Ducts against external walls – continuity of insulation, ingress of cold external air

❖ Types W1 – W4
Appendix B – Fabric Insulation

Additional guidance for common constructions TGD L 2011 - Page 52

B7. Floor Constructions

• Ground conductivity should be taken as 2.0 W/mK
• Insulation may be placed above or below DPM (should perform well under prolonged damp conditions)
• Taping of joints between insulation boards
• Fractional area of timber joists 11%
• Minimise air circulation in suspended timber floors
• Thermal bridging at wall/floor junctions - ACDs

❖ Types F1 – F5
Appendix B – Fabric Insulation

Additional guidance for common constructions TGD L 2011 - Page 56

B8. Windows & Doors

- Table B1 – indicative U-values (W/m²K)
- Annex F  I.S. EN ISO 10077-1
- Window Energy Performance Certification Scheme (WEP) or equivalent.
- DEAP Manual

WEP Certificates available on www.nsai.ie
Cavity Fill Insulation

Rendered Walls – Everywhere
- 12m height 90mm Cavity

Brickwork – Only Normal Exposure
- 2 storeys 90mm Cavity
- 3 storeys 140mm Cavity

Un rendered blockwork – Never
Timber Frame - Never

Cavity Fill insulation must be appropriately certified in relation to its intended use and conditions of use.

See guidance in independent certificate in relation to topography & influence on wind driven rain and other conditions.
Table C1 – notional reference dwelling

- Total external window, rooflight and door area is taken to be 25% of the dwelling floor area
- Primary heating system for space & water heating is gas
- Secondary heating system is open fire – contributes 10% to space heating
- Walls: $U = 0.27 \text{ W/m}^2\text{K}$, Roof: $U = 0.16 \text{ W/m}^2\text{K}$
- Floor: $U = 0.25 \text{ W/m}^2\text{K}$, Windows/doors: $U = 2.2 \text{ W/m}^2\text{K}$
- Hot water cylinder: 120L, 35mm factory applied foam
- Programmer + room thermostat + TRVs, boiler interlock
Appendix D – Thermal bridging

Thermal bridging at junctions and around openings TGD L 2011 - Page 61

NSAI Thermal Modellers Scheme

- Table D1 Cavity wall
- Table D2 Ext insulation
- Table D3 Internal
- Table D4 Timber frame
- Table D5 Steel frame
- Table D6 Hollow block

1.3.3.2 (ii) TGD L 2011

Use certified details which have been assessed in accordance, and comply, with Appendix D for all key junctions.
Thermal Bridges

• Repeating Thermal bridges
  – Roof Rafters / Ceiling Joists
  – Wall Ties
• These are accounted for in U-Value calculations (Thermally Bridged Calculations)

• Non-repeating / Linear
  – Junctions
  – Lintels
  – Reveals
  – Floor/wall
  – Wall/Ceiling
• These are not accounted for in U-Value calculations
Acceptable Construction Details

- Developed by DEHLG, HomeBond and SEAI.
  - in consultation with an Industry Working Group made up of representatives from different Sectors of the Construction Industry.

- Section 1
  - General theory of insulation continuity & air tightness in construction.

- Section 2 - seven separate parts
  - Indicative detail drawings of thermal insulation
  - Air tightness provisions for specific construction interfaces.

Available on DECLG website [www.environ.ie](http://www.environ.ie)
Acceptable Construction Details
Section 2

• Drawings for each construction type.
• 21-25 Drawings for each construction type

– Type 1 - Cavity wall insulation
– Type 2 - External insulation
– Type 3 - Internal insulation
– Type 4 - Timber Frame
– Type 5 - Steel Frame
– Type 6 - Hollow Block Internal Insulation
– Type G - General Details (common to all constructions)
Thermal Bridging Calculations

DEAP Manual  Appendix K  & TGD L 2011:

additional heat loss due to thermal bridging is expressed as a multiplier \((y)\) applied to the total exposed surface area.

“\(y\)” can also be derived by calculating each thermal bridge separately in the calculation.

– “\(y\)” = 0.08 where details comply with the Acceptable Construction Details.

– In all other cases “\(y\)” = 0.15 may be used.

Note: for “\(y\)” other than 0.08 or 0.15, the details used should be fully specified and their performance certified.
**GENERAL NOTES**

Thermal performance of junction can be improved significantly by using blockwork with a thermal conductivity of ≤ 0.20 W/mK in direction of heat flow in external wall at attic floor level or alternatively by running insulation of R-value 1.5 m²K/W vertically up internal face of gable wall to a height of 450 mm above ceiling level.

Keep cavities clean of mortar snots and other debris during construction.

Use of over joist insulation is considered best practice, as it eliminates the cold bridge caused by the joist.

Cavity must be closed along the verge.

Read this detail in conjunction with details 1-09: Eaves - Ventilated Attic, or 1-10: Eaves - Unventilated Attic, as appropriate.

Where different block materials are being used consideration should be given to avoid cracking in plaster at the junction between the block materials.

**THERMAL PERFORMANCE**

- Continue wall insulation a minimum of 250 mm over top of attic insulation.
- Ensure full depth of insulation between and over joists extends to inner edge of wall.
- Pack compressible insulation between last truss or joist, and gable wall.
- Ensure partial fill insulation is secured firmly against inner leaf of cavity wall.

**AIR BARRIER - OPTIONS**

- Masonry inner leaf with wet-finish plaster, or
- Masonry inner leaf with scratch coat, and finished with plasterboard, or
- Inner leaf with plasterboard on dabs, with continuous ribbon of adhesive tape around all openings, along top and bottom of wall, and at internal and external corners, or
- Airtightness membrane and tapes.

**Complying with checklist qualifies builder to claim R value in Table 3 of AP 106 and Table K1 of DEAP 2006**

**Complying with checklist will help achieve design air permeability**

**Vented Roof - Attic Floor Level**
Eaves - Insulation between and under rafters - Ventilated Rafter Void - Pitched ceiling

**THERMAL PERFORMANCE CHECKLIST (TICK ALL)**

1. Ensure continuity of insulation throughout junction
2. Ensure insulation is installed tightly between rafters and in contact with under-rafter insulation
3. Ensure full depth of insulation between and under rafters abuts eaves insulation
4. Ensure gap between wall plate and proprietary eaves vent is completely filled with insulation having a min. R-value across the insulation thickness of 1.2 m² K/W
5. Ensure insulated dry-lining tightly abuts underside of ceiling

Complying with checklist qualifies builder to claim U value in Table 3 of IP 1/06 and Table K1 of DEAP 2006

**AIR BARRIER - CONTINUITY CHECKLIST (TICK ALL)**

1. Bed wall plate on continuous mortar bed
2. Fix ceiling first, and seal all gaps between ceiling and masonry wall with either adhesive or flexible sealant
3. Seal all penetrations through air barrier using a flexible sealant

Complying with checklist will help achieve design air permeability

**GENERAL NOTES**
Thermal performance of junction can be improved by incorporating an eaves wind barrier (plywood, OSB, softboard or other suitable material) around insulation to be sealed to connect with the ventilator strip thereby mitigating wind chill from the vent inlet in the eaves.
Use a proprietary eaves ventilator to ensure ventilation in accordance with BS5250. Installation of the eaves ventilator must not prevent free water drainage below the tiling battens.
If required by BS5250, use vapour control plasterboard or separate vapour control layer behind plasterboard.
Use of over joist and under rafter insulation is considered best practice, as it eliminates the cold bridge caused by the joist/rafter.
Read this detail in conjunction with detail 3-16, Gable - Ventilated Rafter Void

**OPTION (TICK ONE)**

1. Masonry inner leaf, with scratch coat applied to internal face of inner leaf, with insulated dry-lining on dabs or mechanically fixed pre-treated timber battens, or

2. Insulated dry-lining on dabs or battens, with continuous ribbon of adhesive tape around all openings, along top and bottom of wall, and at internal and external corners, or

3. Airtightness membrane and tapes

**ACCEPTABLE CONSTRUCTION DETAIL**
Eaves - Insulation between and under rafters - Ventilated Rafter Void - Pitched ceiling
Recommendation to further reduce Thermal Bridging

60mm @ $\lambda = 0.04 \text{ W/mK}$

**GENERAL NOTES**

Thermal performance of junction can be improved significantly by using blockwork with a thermal conductivity of ≤20 W/mK in direction of heat flow in external wall at attic floor level or alternatively by running insulation of R-value 1.5 m$^2$K/W vertically up internal face of gable wall to a height of 450 mm above ceiling level.

- Keep cavities clean of mortar snots and other debris during construction.
- Use of over joist insulation is considered best practice, as it eliminates the cold bridge caused by the joist.
- Cavity must be closed along the verge.
Appendix E – EPC, CPC

### Table E1: Example Dwellings

<table>
<thead>
<tr>
<th>Element or system</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling size and shape</td>
<td>Semi-detached house, two-storey. Overall internal dimensions: 7 m wide x 9 m deep x 5.1 m high. Total floor area 126 m². Rectangular shape with no irregularities.</td>
</tr>
<tr>
<td>Opening areas (windows and doors)</td>
<td>25% of total floor area. The above includes one opaque door of area 1.85 m², any other doors are fully glazed.</td>
</tr>
<tr>
<td>Walls</td>
<td>U = 0.13 W/m²K. Example: 150 mm cavity wall with 100 mm cavity insulation of thermal conductivity 0.022 W/m²K and 60 mm internal insulation of conductivity 0.022 W/m²K.</td>
</tr>
<tr>
<td>Roof</td>
<td>U = 0.11 W/m²K. Example: 360 mm insulation of conductivity 0.04 W/m²K between and over ceiling joists.</td>
</tr>
<tr>
<td>Floor</td>
<td>U = 0.14 W/m²K. Example: Slab-on-ground floor with 120 mm insulation of conductivity 0.023 W/m²K.</td>
</tr>
<tr>
<td>Opaque door</td>
<td>U = 1.5W/m²K. Example: Double glazed, low E (En = 0.05, soft coat) 20 mm gap, argon filled, PVC frames. (U = 1.3 W/m²K, solar transmittance = 0.63)</td>
</tr>
<tr>
<td>Windows and glazed doors</td>
<td>Double glazed, low E (En = 0.05, soft coat) 20 mm gap, argon filled, PVC frames. (U = 1.3 W/m²K, solar transmittance = 0.63)</td>
</tr>
<tr>
<td>Living area fraction</td>
<td>25% of total floor area.</td>
</tr>
<tr>
<td>Shading and orientation</td>
<td>All glazing oriented E/W; average overshading.</td>
</tr>
<tr>
<td>Number of sheltered sides</td>
<td>2.</td>
</tr>
<tr>
<td>Allowance for thermal bridging at element junctions</td>
<td>0.05 x total exposed surface area (W/m²K).</td>
</tr>
<tr>
<td>Internal heat capacity category</td>
<td>Medium.</td>
</tr>
<tr>
<td>Ventilation system</td>
<td>Natural ventilation with intermittent extract fans.</td>
</tr>
<tr>
<td>Air permeability</td>
<td>Infiltration due to structure = 0.25 ac/h (5m³/(hr.m²)) at 50pa.</td>
</tr>
<tr>
<td>Chimneys</td>
<td>None.</td>
</tr>
<tr>
<td>Open flues</td>
<td>None.</td>
</tr>
<tr>
<td>Extract fans</td>
<td>3.</td>
</tr>
<tr>
<td>Draught lobby</td>
<td>One.</td>
</tr>
<tr>
<td>Primary heating fuel (space and water)</td>
<td>Mains gas.</td>
</tr>
<tr>
<td>Heating system</td>
<td>Boiler and radiators with energy efficient water pump in heated space.</td>
</tr>
<tr>
<td>Boiler</td>
<td>Mains gas condensing boiler, seasonal efficiency 91.3%, room-sealed, fanned flue.</td>
</tr>
<tr>
<td>Heating System Controls</td>
<td>Time and Temperature Zone Control.</td>
</tr>
<tr>
<td>Hot water system</td>
<td>Solar water heating system with evacuated tube collector of aperture area = 5.0 m², r¹ = 0.6, a¹ = 3.0 W/m²K, facing SE-SW at 30 degrees and unshaded, twin coil cylinder 330 litre with 100 mm insulation. Remainder of demand met by space heating boiler, separate time control for space and water heating, cylinder temperature controlled by thermostat.</td>
</tr>
<tr>
<td>Primary water heating losses</td>
<td>Insulated primary pipework between boiler and cylinder.</td>
</tr>
<tr>
<td>Secondary space heating</td>
<td>Gas fire, closed front, fan assisted, balanced flue – efficiency 80%.</td>
</tr>
<tr>
<td>Low energy light fittings</td>
<td>100%.</td>
</tr>
</tbody>
</table>

Wall – 0.13 W/m²K  
Roof – 0.11 W/m²K  
Floor – 0.14 W/m²K  
Windows – 1.3 W/m²K

Y value – 0.05 W/m²K  
Air Tightness – 0.25 ac/h
Building Envelope Air Permeability

Air Tightness Pressure Tests

$q_{50} = \frac{m^3}{(hr.m^2)} \text{ @ } 50\text{Pa} \quad \text{(per Dwelling Type)}$

Upper limit air permeability of 7 $m^3/(hr.m^2)$

Best practice: $q_{50} < 3m^3/(hr.m^2)$

Passive House: 0.6 ach

<table>
<thead>
<tr>
<th>Number of units</th>
<th>Number of tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 or less</td>
<td>1 test</td>
</tr>
<tr>
<td>Greater than 4 but equal or less than 40</td>
<td>2 tests</td>
</tr>
<tr>
<td>Greater than 40 but equal or less than 100</td>
<td>At least 5% of the dwelling type</td>
</tr>
<tr>
<td>More than 100</td>
<td></td>
</tr>
<tr>
<td>(a) where the first five tests achieved the design air permeability</td>
<td>At least 2% (for dwellings in excess of the first 100 units)</td>
</tr>
<tr>
<td>(b) where one or more of the first five test do not achieve the design air permeability</td>
<td>At least 5% of units, until 5 successful consecutive tests are achieved, 2% thereafter</td>
</tr>
</tbody>
</table>
Common Air Leakage Paths

HomeBond House Building Manual @ Page 509
Airtightness...How?

1. Design for airtightness
2. Build to achieve airtightness
3. Test for airtightness

Communication & Coordination
NHBC Foundation - UK Data

TGD L Dwellings 2011

Air permeability (m³/hr/m²)
Control & Responsiveness

Control

e.g. Programmer & Thermostat V’s On/off Switch

Responsiveness

e.g. Radiators V’s Storage Heating

The greater the controls & responsiveness of the systems, the greater benefits allowed in the DEAP calculation software.
Contents

- Cold Water supply systems
- Hot water supply systems
- Above ground sanitation systems
- Space heating systems – System design
- System selection
- Central Heating distribution system
- System control
- Interlocking
- Commissioning, Handover & Maintenance
Mechanical Ventilation Systems

TGD L 2011 @ 1.4.5.2 Page 22

• Heat recovery ventilation recommended < 5 m³/(hr.m²)
  – Design & Installation GPG 268, SAP Appendix Q
  – Certified systems
  – Continuous Operation
  – Airtight House
  – Maintenance
    • Cleaning Filters
    • Changing Filters
    • Servicing

Table 3

<table>
<thead>
<tr>
<th>System type</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Fan Power (SFP) for continuous supply only and continuous extract only</td>
<td>0.8 W/litre/sec</td>
</tr>
<tr>
<td>SFP for balanced systems</td>
<td>1.5 W/litre/sec</td>
</tr>
<tr>
<td>Heat recovery efficiency</td>
<td>66%</td>
</tr>
</tbody>
</table>
MVHR - How it works

- Used in airtight houses to provide a continuous controlled supply of fresh air. Moist warm air is extracted from the kitchen, bathroom and utility rooms. The heat in this air is transferred to the cool fresh air drawn in from outside. This warm fresh air is supplied to the living room and bedroom.

- The extracted air and supply air do not mix. Instead they pass either side of a heat exchange plates that allow the transfer of heat energy. The fresh air is filtered as it enters the house for pollen and dust. This provides better air quality that simply opening a window. The MHRV should be located to allow easy changing of filters.

- During cold weather a post heating element is used to raise the temperature of the incoming air to ensure a constant comfortable temperature of 20 degrees is maintained in the home at all times. During warm weather a summer bypass is used to prevent over heating.

- A sound attenuator is used to ensure that noise does not transfer from one space to another. This is particularly important for bedrooms.
The design of the system must be balanced for the entire dwelling to ensure that a minimum air change rate of 0.3 changes per hour is achieved.
Passivhaus

Box 3: A summary of Passivhaus requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating demand</td>
<td>\leq 15 kWh/m^2yr</td>
</tr>
<tr>
<td>Space cooling demand</td>
<td>\leq 15 kWh/m^2yr</td>
</tr>
<tr>
<td>Airtightness</td>
<td>\leq 0.6 ach @ 50 Pa</td>
</tr>
</tbody>
</table>

Passivhaus software

Air Permeability = Air Leakage / Envelope Area

Air Changes per hour = Air Leakage / Volume
DEAP Software

BER Assessor

- NEAP is used for Buildings other than Dwellings
DEAP Output

### Property Details

<table>
<thead>
<tr>
<th>Dwelling Type</th>
<th>Detached house</th>
<th>Type Of BER Rating</th>
<th>New Dwelling - Provisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address line 1</td>
<td>Home Type 1</td>
<td>Year of Construction</td>
<td>2014</td>
</tr>
<tr>
<td>Address line 2</td>
<td>Option C</td>
<td>Date of Assessment</td>
<td>24/01/2014</td>
</tr>
<tr>
<td>Address line 3</td>
<td>Air / Water Heat Pump</td>
<td>Date of Plans</td>
<td>24/01/2014</td>
</tr>
<tr>
<td>County</td>
<td>Co. Dublin</td>
<td>Planning Reference</td>
<td></td>
</tr>
<tr>
<td>Post Code</td>
<td></td>
<td>Building Regulations</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a rating been previously submitted?</td>
<td>No</td>
<td>Is MPRN shared with another dwelling?</td>
<td>No</td>
</tr>
<tr>
<td>BER Number</td>
<td></td>
<td>MPRN No.</td>
<td></td>
</tr>
<tr>
<td>Purpose of rating</td>
<td>Sale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>HomeBond Technical Services Ltd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Client Name</td>
<td></td>
<td>Client Phone</td>
<td></td>
</tr>
<tr>
<td>Address line 1</td>
<td>Construction House</td>
<td>Client Email</td>
<td></td>
</tr>
<tr>
<td>Address line 2</td>
<td>Canal Road</td>
<td>Assessor Name</td>
<td>Conor Havannah</td>
</tr>
<tr>
<td>Address line 3</td>
<td></td>
<td>Assessor Reg No.</td>
<td>100000</td>
</tr>
<tr>
<td>County</td>
<td>Dublin 6</td>
<td>Developer Name</td>
<td></td>
</tr>
</tbody>
</table>

### Dimension Details

<table>
<thead>
<tr>
<th>Area [m²]</th>
<th>Height [m]</th>
<th>Volume [m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Floor</td>
<td>75.00</td>
<td>2.70</td>
</tr>
<tr>
<td>First Floor</td>
<td>210.00</td>
<td></td>
</tr>
<tr>
<td>Second Floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third and other floors</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Room in roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Floor Area</td>
<td>155.00</td>
<td></td>
</tr>
<tr>
<td>Living Area [m²]</td>
<td>30.00</td>
<td></td>
</tr>
<tr>
<td>No of Storeys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### VENTILATION DETAILS

- Chimneys: Yes
- Open Flues: Yes
- Para & Vents: Yes
- Number of business combustion room: 0
- Percentage windows/doors draughtstriped: 0%
- Is there a draught lobby on main entrance? No
- Number of sides sheltered: 2
- Ventilation method: Natural ventilation
- Specific fan power [W/per m³]: Not Applicable
- Heat exchanger efficiency [%]: Not Applicable
- Mechanical Ventilation Manufacturer: Not Applicable
- Mechanical Ventilation Model Name: Not Applicable
- How many vents (incl. kitchen)? Not applicable

### BUILDING ELEMENTS - Floor Details

- Type: Concrete slab on insulation
- U-Value [W/m²K]: 0.150
- Area [m²]: 70.00
- Underfloor heating: No

### BUILDING ELEMENTS - Roof Details

- Type: Insulated on ceiling
- U-Value [W/m²K]: 0.130
- Area [m²]: 70.00

### BUILDING ELEMENTS - Wall Details

- Type: Brickwork
- U-Value [W/m²K]: 0.200
- Area [m²]: 174.300

### BUILDING ELEMENTS - Door Details

- Type: Glazed
- U-Value [W/m²K]: 1.400
- Area [m²]: 1.200

### BUILDING ELEMENTS - Window Details

- Type: Triple-glazed, argon filled (low-e, u=0.85, soft coat)
- U-Value [W/m²K]: 1.100
- Area [m²]: 10.900
- Type: Triple-glazed, argon filled (low-e, u=0.85, soft coat)
- U-Value [W/m²K]: 1.100
- Area [m²]: 13.300
- Type: Triple-glazed, argon filled (low-e, u=0.85, soft coat)
- U-Value [W/m²K]: 1.100
- Area [m²]: 6.900

### OTHER DETAILS

- Thermal bridging factor [W/m²K]: 0.000
- Internal mass of dwelling: Medium-high
- Low Energy Lighting [%]: 100

### HEATING SYSTEM - Solar Water Heating

- Solar Water Heating Present?: Yes
- Aperture area of solar collector [m²]: n/a
- Collector heat loss coefficient, a₁ [W/K]: n/a
DEAP Output

### SUMMARY FOR PART L CONFORMANCE

<table>
<thead>
<tr>
<th>BER Number</th>
<th>Building Regulations</th>
<th>2011 TGD L</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3</td>
<td>Energy Value [kWh/yr]</td>
<td>55.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C02 emissions [kg/m²/yr]</td>
<td>Total compliance with Part L in DEAP</td>
<td>Pass</td>
</tr>
<tr>
<td>0.358</td>
<td>EPC Pass/Fail</td>
<td>Pass</td>
</tr>
<tr>
<td>0.383</td>
<td>CPC Pass/Fail</td>
<td>Pass</td>
</tr>
</tbody>
</table>

#### PART L CONFORMANCE - Fabric

- Conformity with Maximum U-value requirements: U-value [W/m²K]
- Pass/Fail

<table>
<thead>
<tr>
<th>Conformity</th>
<th>U-value [W/m²K]</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitched roof insulated on ceiling</td>
<td>0.12</td>
<td>Pass</td>
</tr>
<tr>
<td>Pitched roof insulated on slope</td>
<td>0.09</td>
<td>Pass</td>
</tr>
<tr>
<td>Flat roof</td>
<td>0.11</td>
<td>Pass</td>
</tr>
<tr>
<td>Walls</td>
<td>0.22</td>
<td>Pass</td>
</tr>
<tr>
<td>External doors / windows / rooflights</td>
<td>1.40</td>
<td>Pass</td>
</tr>
<tr>
<td>Average U-value of openings</td>
<td>1.12</td>
<td>Pass</td>
</tr>
</tbody>
</table>

### HEATING SYSTEM - Hot Water System

- Distribution Losses: Central heating pumps
- Supplementary electric water heating: Hot water storage manufacturer and model name
- Hot water storage manufacturer and model name: NSAI Agreement (Sample)
- Temperature factor unadjusted: 0.60
- Primary Circuit loss type: Boiler with insulated primary pipework and with cylinder thermostat

### HEATING SYSTEM - Dist. system losses and gains (Table 4 in DEAP)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central heating pumps</td>
<td>1 Oil Boiler Pump</td>
</tr>
<tr>
<td>Gas boiler</td>
<td>No</td>
</tr>
</tbody>
</table>

### HEATING SYSTEM - Energy Requirements (individual heating system)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main space heating system efficiency [%]</td>
<td>39.00</td>
</tr>
<tr>
<td>Main water heating system efficiency [%]</td>
<td>39.00</td>
</tr>
<tr>
<td>Secondary heating system efficiency [%]</td>
<td>None</td>
</tr>
<tr>
<td>Fraction of heating from secondary heating system</td>
<td>None</td>
</tr>
<tr>
<td>Electrical efficiency of CHP</td>
<td>1.0000</td>
</tr>
<tr>
<td>Heat efficiency of CHP</td>
<td>1.0000</td>
</tr>
<tr>
<td>CHP Fuel type</td>
<td>None</td>
</tr>
<tr>
<td>Total thermal equivalent</td>
<td>3267.59</td>
</tr>
<tr>
<td>Total thermal</td>
<td>14.54</td>
</tr>
<tr>
<td>Total electrical</td>
<td>6.39</td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
</tr>
<tr>
<td>Does total thermal equivalent meet Part L requirement?</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Provisional BER Certificate

- valid 2 years
BER Certificate

- Calculated using DEAP software.
- No minimum standard applies.
- BER is valid for 10 years unless changes are made to the building.
- The BER is independent of how the occupants manage the building heating.
- Advisory Report
- BER Assessor
### Indicative CO₂ emissions and running costs for different rating bands:

<table>
<thead>
<tr>
<th>Rating</th>
<th>2 Bed Apartment (75m²)</th>
<th>3 Bed Semi-D (100m²)</th>
<th>4 Bed Detached (200m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tonnes CO₂</td>
<td>Cost</td>
<td>Tonnes CO₂</td>
</tr>
<tr>
<td>A2</td>
<td>0.8</td>
<td>€ 230</td>
<td>1.1</td>
</tr>
<tr>
<td>B1</td>
<td>1.2</td>
<td>€ 340</td>
<td>1.6</td>
</tr>
<tr>
<td>C1</td>
<td>2.3</td>
<td>€ 600</td>
<td>3.1</td>
</tr>
<tr>
<td>D1</td>
<td>3.7</td>
<td>€ 1,000</td>
<td>4.9</td>
</tr>
<tr>
<td>E1*</td>
<td>5</td>
<td>€ 1,400</td>
<td>6.7</td>
</tr>
<tr>
<td>F*</td>
<td>6.8</td>
<td>€ 1,900</td>
<td>9</td>
</tr>
<tr>
<td>G*</td>
<td>8.5</td>
<td>€ 2,400</td>
<td>11.3</td>
</tr>
</tbody>
</table>

* Running costs are estimated on the basis of typical occupancy and heating the entire dwelling to a comfortable level throughout the year.

**kWh** Annual kilowatt hours of primary energy. (Natural gas and electricity are purchased in terms of “units” or kWh. 1 litre of kerosene has an energy content of just over 10 kWh)

**CO₂** Tonnes of CO₂ emitted per annum

**Cost** Annual running cost for principal energy usage, based on an average of domestic oil and gas prices as of July 2010.
# Regulation L1 & EPBD New Dwellings

<table>
<thead>
<tr>
<th>TGD L</th>
<th>BER</th>
<th>Kwh/m²/yr</th>
<th>EPC</th>
<th>CPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Avg Dwelling)</td>
<td>(Avg Dwelling)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002/05</td>
<td>C1/B3</td>
<td>150</td>
<td>1.0</td>
<td>0.69</td>
</tr>
<tr>
<td>2008</td>
<td>B1</td>
<td>90</td>
<td>0.6</td>
<td>0.46</td>
</tr>
<tr>
<td>2011</td>
<td>A3</td>
<td>60</td>
<td>0.4</td>
<td>0.46</td>
</tr>
<tr>
<td>2013/20</td>
<td>A2</td>
<td>45</td>
<td>0.3</td>
<td>0.345</td>
</tr>
</tbody>
</table>

2013/20 Based on note under Table 4 of the RIA 2010 (70% reduction)
**ICSH AWARDS:**

**Mixed Communities**

**Winner:** Tuath Housing Association - Honeypark, Dun Laoghaire, Co. Dublin

The Judging Panel highlighted the project as being "a most effective example of achieving the right balance of mixed community occupancy in harmony with the surrounding developments" and highlighted the "excellent holistic design for environmental sustainability including a strategy for post occupancy energy and waste management".
ROCHDALE, HONEYPARK

HONEYPARK DESIGN TEAM:

DEVELOPER: COSGRAVE DEVELOPMENTS
ARCHITECT: McCROSSAN O’ROURKE MANNING
STRUCTURAL ENGINEER: MOYLANS
M&E CONSULTANT: COAKLEY MACLEUGOTT
LANDSCAPE ARCHITECT: MITCHELL & ASSOCIATED
H&S CONSULTANT: OLM CONSULTANCY

COSGRAVE PROPERTY GROUP
Combined Heat Power (CHP)

Traditional Electricity Generation Efficiency: <35%

65% waste

10-20% lost in transmission

Industry Hotels Hospitals

Combined Heat and Power Efficiency: >80%

Electricity, heat and hot water. 80-90% efficiency

The heat is sent to your apartment substation unit and this is the source of instantaneous heat & hot water for your home.
Combined Heat Power (CHP)

NOW FOR THE TECHNICAL BIT: THE CONSUMER UNIT

There are six pipe work connections to the bottom of the consumer unit. Reading from the left hand side of the consumer unit the six pipes are as follows:

1. Two district heating (flow and return) connections from the basement boiler plant room.
2. A cold water inlet feed from the basement water storage tanks.
3. A hot water outlet (flow) – this heats the cold water inlet feed instantaneously via the plate heat exchanger in the consumer unit, providing hot water on demand to showers, baths and basins. The heat exchanger is shown on the left hand side of the consumer unit above, with four horizontal pipe work connections to it, inside the consumer unit.
4. Two apartment heating (flow and return) connections to your radiators.
District Heating Installation options: GSM or M-Bus
The App is designed to be user friendly, straightforward and easy to use. The increasing consumer use of Apps means users tend to navigate through the menus intuitively.

Home Screen - The prepay system uses a Home "Meter Screen" which updates the consumer balance. From this central page we offer 9 screens including the nearest place to buy a top-up and the consumers barcode which is given to the retailer during the top-up process. We use a colour coded system for top-up and supporting data.

Arrears tool While there will not be arrears in the prepay system, however arrears collection from the legacy billing system can be facilitated with three strategies capable of being offered; time based daily or a weekly charge; a top-up based or hybrid of the two.
The Future ??
Where are we going?

EPBD-2 2010

EU Regulations 2012
Reduction of Energy Consumption

• National Energy Efficiency Action Plan (NEEAP 2) to 2020
  • Launched 28th February 2013.
  • Endorses Europe’s energy strategy for 2020
  • 20% National Energy Savings target by 2020
  • Key Action Plan measures for all sectors of the economy
    – Residential
      • Implement EPBD 2
      • Target those in Energy Poverty
      • Encourage low or Zero Energy Housing on a voluntary basis from 2013

• NEEAP 2013 available on www.dcenr.gov.ie
Recast EPBD requires that energy efficient standards be set at Cost Optimal Levels for new buildings and buildings undergoing major renovation.

Cost Optimal Level means the energy performance level which leads to the lowest cost during the estimated Economic Lifecycle, taking into account energy related investment costs, maintenance, operating and disposal costs.

### Nearly Zero Energy Roadmap

#### Part L Dwellings

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part L</strong>&lt;sup&gt;1&lt;/sup&gt; % Improvement</td>
<td>Baseline</td>
<td>40% and renewables requirement</td>
<td>60%</td>
<td>Nearly Zero Energy Dwellings</td>
</tr>
<tr>
<td>Primary Energy&lt;sup&gt;1&lt;/sup&gt; (Avg Dwelling) kWh/m2/annum</td>
<td>150</td>
<td>90</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>CO2&lt;sup&gt;1&lt;/sup&gt; (Avg Dwelling) kg/m2/annum</td>
<td>30</td>
<td>18</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td><strong>EPBD</strong></td>
<td>BER (Avg Dwelling)</td>
<td>B3</td>
<td>B1</td>
<td>A3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A2</td>
</tr>
</tbody>
</table>

#### Part L Buildings other than Dwellings

<table>
<thead>
<tr>
<th>Timeline</th>
<th>2005</th>
<th>2013</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part L</strong>&lt;sup&gt;1&lt;/sup&gt; % Improvement</td>
<td>Baseline</td>
<td>40%</td>
<td>Nearly Zero Energy Building Standard</td>
</tr>
</tbody>
</table>
Designing homes for the 21st century
Lessons for low energy design

Available from the NHBC Foundation Website. [www.nhbcfoundation.org](http://www.nhbcfoundation.org)