

Defining a Fabric Energy Efficiency Standard for zero carbon homes

Appendix A Work Group 1 Form and Fabric

The views and recommendations within this report are those of the Task Group
and do not necessarily reflect the views of Government



Form and Fabric

Introduction

This appendix should be read in conjunction with the main report entitled 'Defining a Fabric Energy Efficiency Standard for zero carbon homes'.

As the Form and Fabric Work Group provided the core technical evidence for the Task Group discussions a series of investigations were commissioned in addition to those detailed in the main report.

This section provides a summary of this additional background work.

Contents

Introduction.....2

Scope of Work Group discussions4

Dwelling types4

 General4

 Core dwelling types.....4

 Dwelling types for sensitivity analysis.....4

Energy performance modelling package.....12

Construction specifications.....12

 Core specifications.....12

 Additional core specifications.....12

 Summary of core construction specifications13

 Additional details of cSAP inputs (core specs)14

 PHPP modelling results: Spec D construction specifications15

 Sensitivity analysis.....16

Construction elements and frame types analysed17

 General17

 Construction elements: Illustrative summary18

 Construction elements: Detailed summary21

Structural analysis45

Results of energy modelling50

 Initial analysis.....50

 The effect of ventilation heat recovery.....52

 Further analysis53

 Initial sensitivity modelling.....56

 Further sensitivity modelling57

 Modified SAP2005 modelling for 70% Carbon Compliance60

 Comparisons of Specs to Part L 2010 (consultation version) compliance63

Scope of Work Group discussions

The Work Group's outputs mainly consisted of:

- Defining the core dwelling types to model
- Defining additional dwelling types to provide sensitivity analysis on the core dwelling type model outputs
- Defining the core construction specifications to be modelled
- Defining the construction specification sensitivities to be modelled
- Developing example build specifications that would achieve the core construction specifications.

This included discussions on structural stability of wider wall cavities, suitability of different build types to high exposure zones,

- In conjunction with the other Work Groups, aiding Task Group discussions on the scope of the Energy Efficiency Standard

Dwelling types

General

A selection of dwelling types were chosen based upon the recorded mix registered with the NHBC during 2007 to ensure a representative range 'as built' by mainstream builders. Housing Developer members of the Task Group and Work Groups then kindly provided a selection of plans and elevations for dwellings of these types.

Core dwelling types

The following core dwelling types were agreed:

- Small apartment (43m²)
- Large apartment (66m²)
- Mid terrace house (76m²)
- Semi detached/ end terrace house (76m²)
- Detached house (118m²)

Details are provided overleaf.

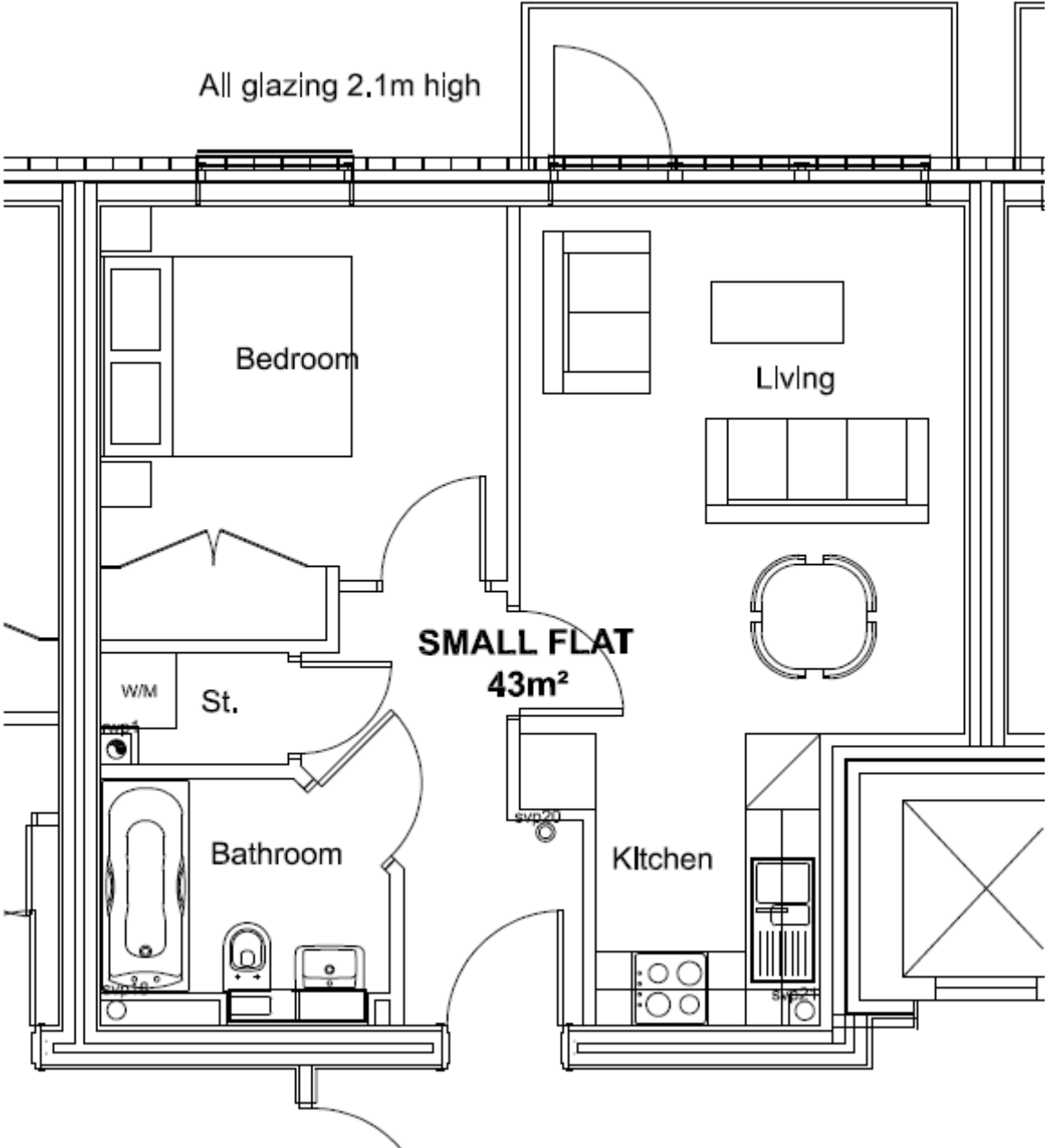
The apartments were modelled as both 4-storey and 8-storey blocks, with 4 small apartments and 4 large apartments per floor.

Dwelling types for sensitivity analysis

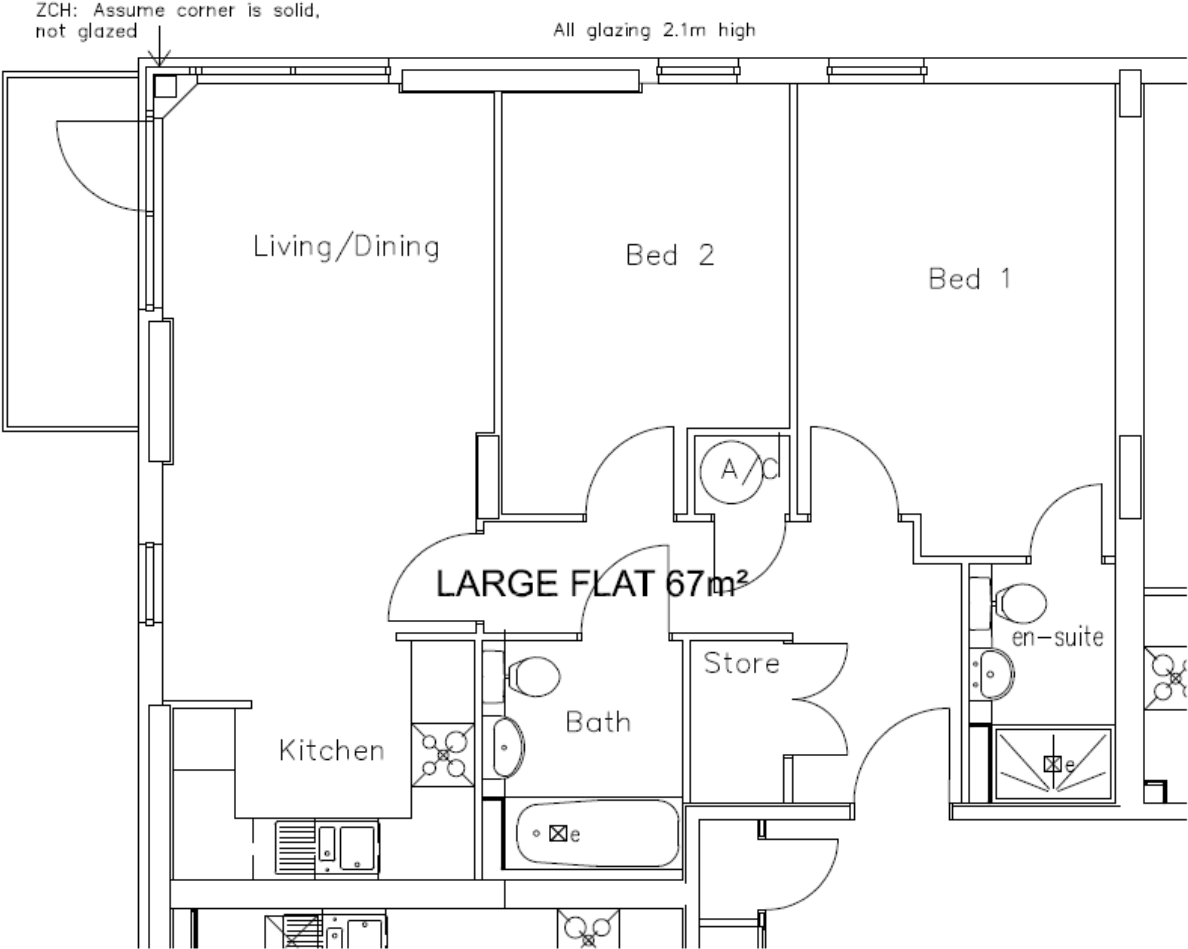
The following dwelling types were agreed for the sensitivity analysis:

- Small mid terrace house (62m²)
- Life time homes compliant mid terrace house (86m²)
- 3-storey mid terrace house with integral garage (107m²)
- 2.5-storey mid terrace house (room-in-roof) (123m²)
- Large detached house (212m²)
- Bungalow (73m²)

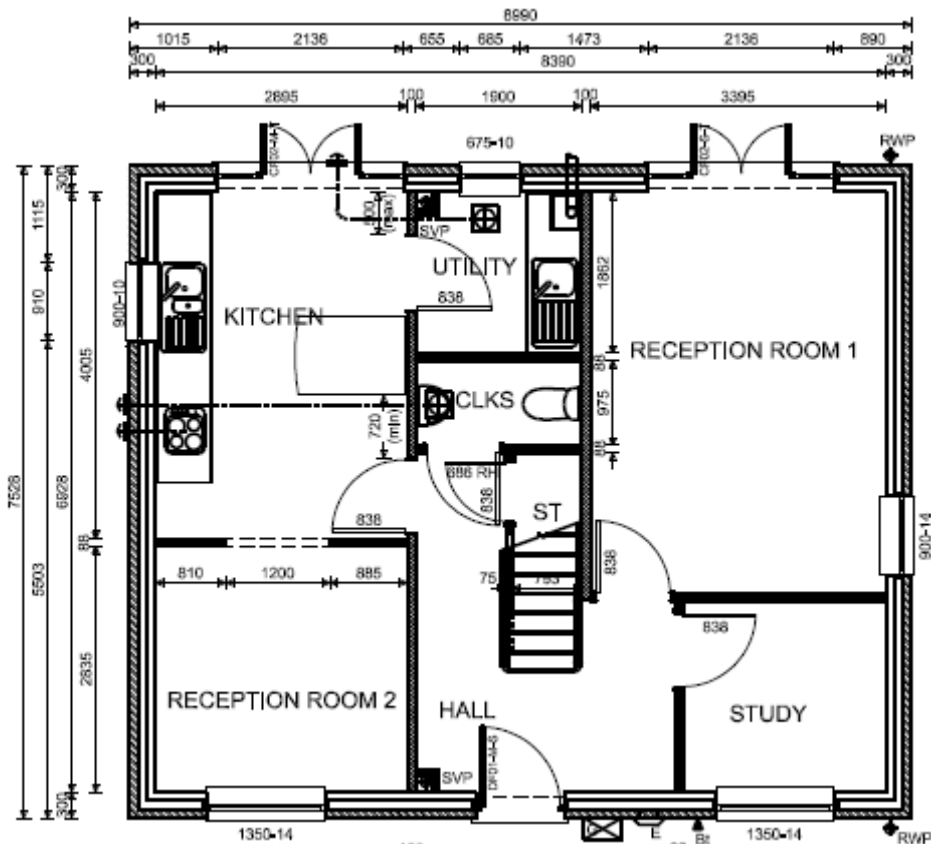
Small apartment



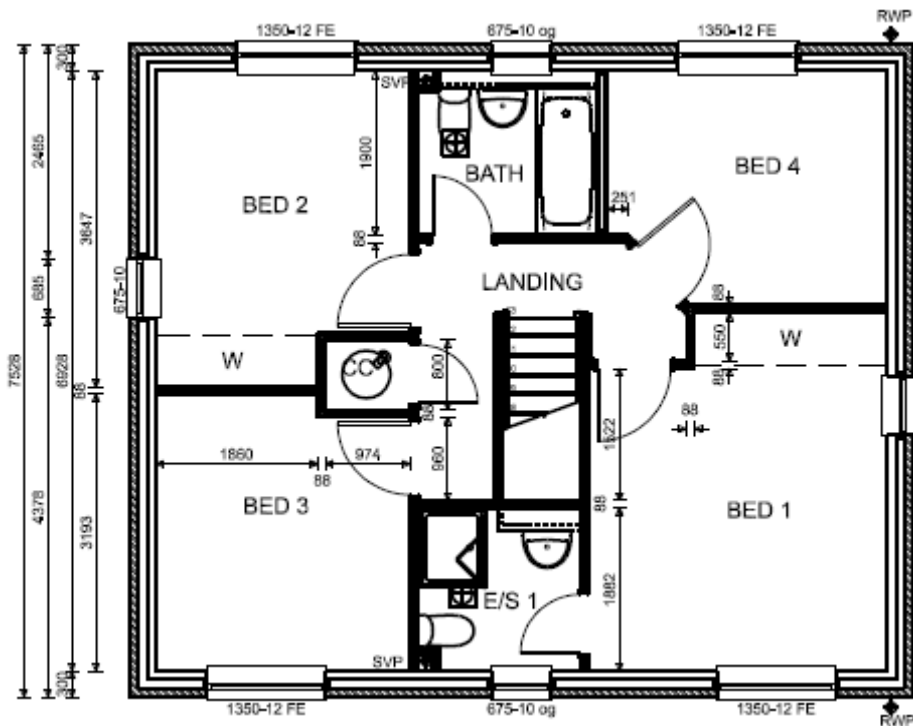
Large Apartment



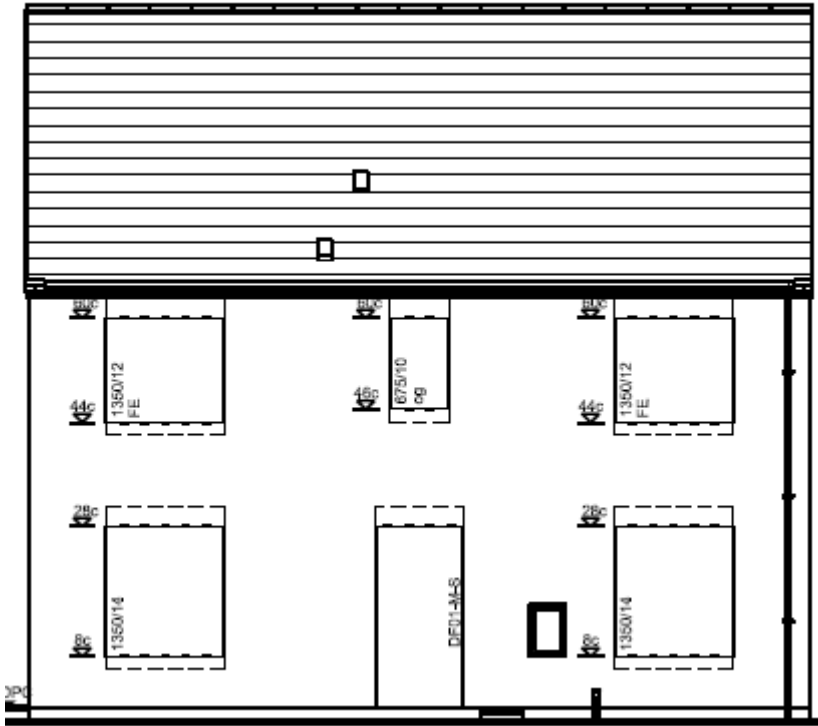
Detached house



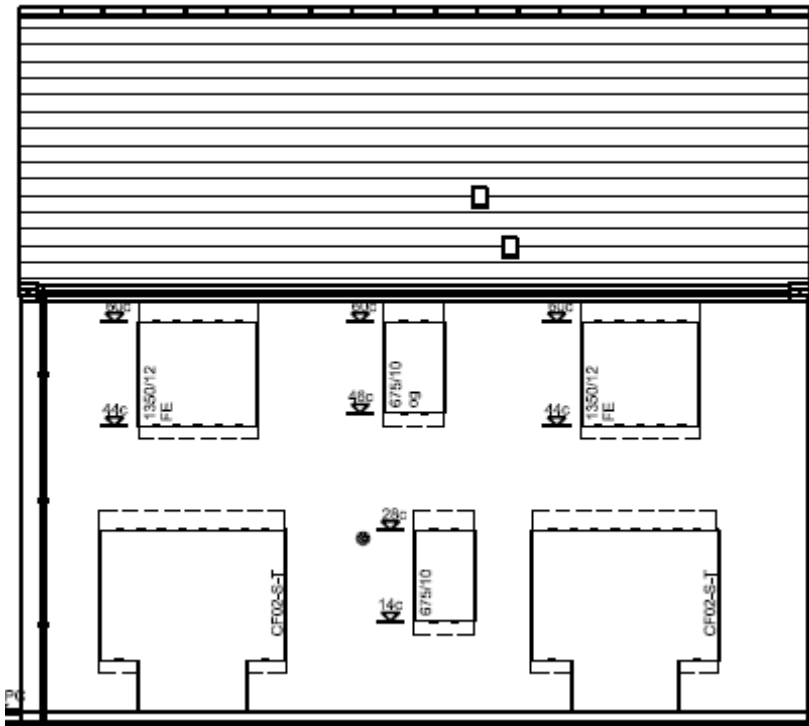
GROUND FLOOR



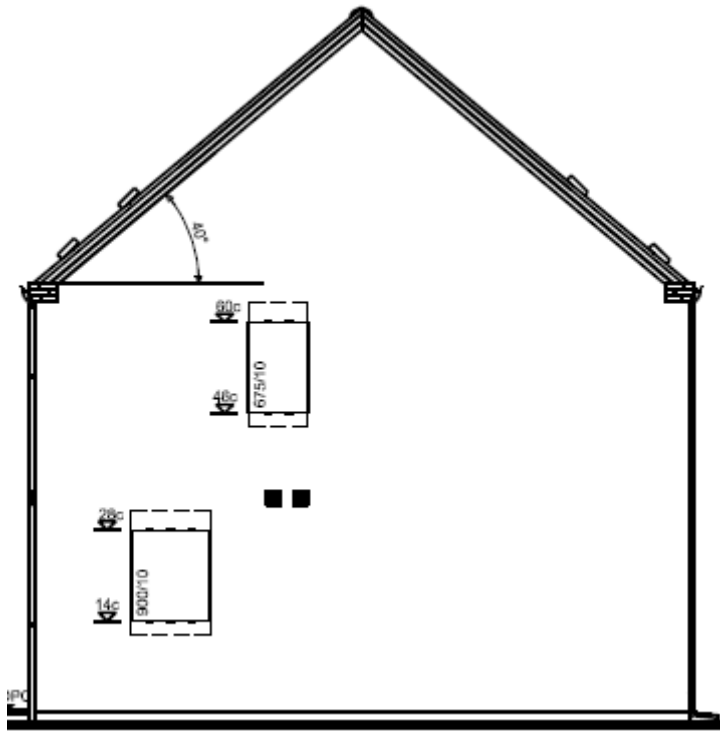
FIRST FLOOR



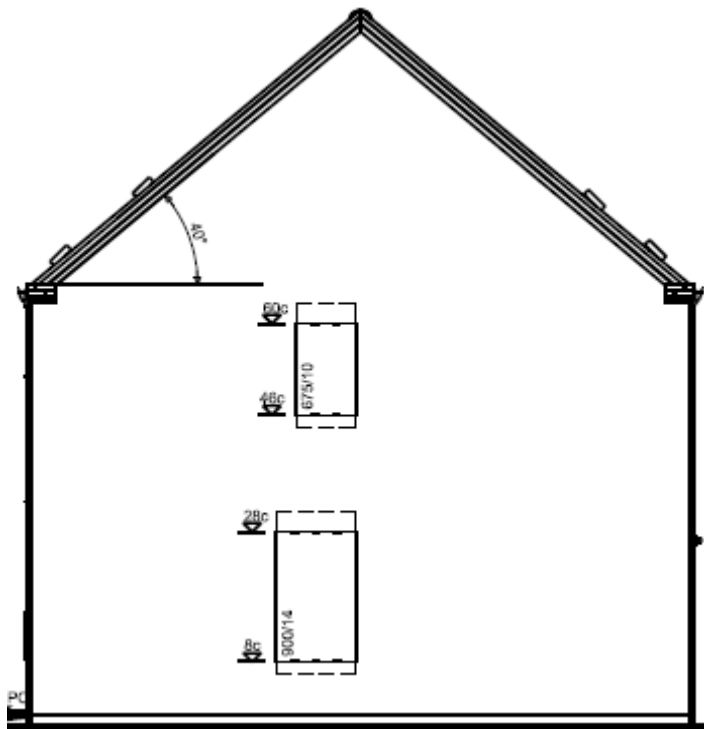
FRONT ELEVATION



REAR ELEVATION



SIDE ELEVATION (L)



SIDE ELEVATION (R)

Energy performance modelling package

The Group agreed that the latest consultation version of SAP2009 should be used for the energy performance modelling of the dwellings. Therefore all comparative modelling of the specifications was undertaken in cSAP (allowing for adjustment for known bugs in the software at time of modelling).

As this was only a consultation version of the software it was recognised by the Group that once the final version of SAP2009 was published, the final decisions of the Task Group regarding the level at which the Fabric Energy Efficiency Standard was set at would likely require re-basing.

Construction specifications

Core specifications

The Work Group's deliberations regarding specifications led initially to the development of five core specifications:

- Baseline (current practice)
- Spec A (slightly modified AECB Silver Standard)
- Spec B
- Spec C (EST APEE^a Standard)
- Spec D (PassivHaus)

The Group were keen to show progression in all the elements as one progressed up the specs, which is why some existing standards were altered slightly to match with this aim.

The baseline was set at an agreed approximate 'current practice' specification that the major house builders on the group were currently building to. It should be noted that this baseline is therefore slightly above what would be required for Part L 2006 compliance (but generally by less than 5%).

^a Energy Saving Trust Advanced Practice Energy Efficiency

EST BPEE^b Standard falls somewhere between Spec A and Spec B, but did not fit well into the progression the Group were looking for and so was not explicitly modelled.

Spec D is true PassivHaus in that the core dwelling types were modelled in PHPP^c until they showed compliance with the PassivHaus Standard^d and then the elemental specifications were used within the cSAP model so as to produce results that were able to be compared to the other specifications. The results of the PHPP modelling are included on page 15.

When initially modelled, Baseline and Spec A included natural ventilation strategy whereas Spec B, C and D included mechanical ventilation with heat recovery (MVHR).

All dwelling types (core and sensitivity) were modelled to the core construction specifications.

Additional core specifications

Following the first round of modelling work, the Task Group were keen to explore the differences in space heating demand depending on whether ventilation heat recovery was present. Therefore Spec B and C were additionally modelled with natural ventilation (with an air permeability of 3).

The Task Group were also keen to explore a specification which was "slightly back from Spec C" and so Spec C- was introduced which was Spec C but with double rather than triple glazed windows and an air permeability of 3.

A table detailing all the specifications modelled can be found overleaf.

^b Energy Saving Trust Best Practice Energy Efficiency

^c PassivHaus Planning Package

^d Space heating demand of less than or equal to 15kWh/m²/yr or a heat load of less than or equal to 10W

Summary of core construction specifications

| | | Baseline | Spec A (NV) | Spec B (NV) | Spec B (MVHR) | Spec C- (NV) | Spec C- (MVHR) | Spec C (NV) | Spec C (MVHR) | Spec D (MVHR) |
|------------------------------|---|------------------------|------------------------|------------------------|---------------|------------------------|----------------|------------------------|---------------|--------------------|
| U-Value (W/m ² K) | Wall | 0.28 | 0.25 | 0.18 | 0.18 | 0.15 | 0.15 | 0.15 | 0.15 | 0.1 - 0.15 |
| | Party Wall | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Floor | 0.2 | 0.2 | 0.18 | 0.18 | 0.15 | 0.15 | 0.15 | 0.15 | 0.1 - 0.15 |
| | Roof | 0.16 | 0.15 | 0.13 | 0.13 | 0.11 | 0.11 | 0.11 | 0.11 | 0.1 |
| | Windows | 1.8 (double) | 1.5 (double) | 1.4 (double) | 1.4 (double) | 1.2 (double) | 1.2 (double) | 0.8 (triple) | 0.8 (triple) | 0.8 - 1.0 (triple) |
| | Doors | 1.6 | 1.4 | 1.2 | 1.2 | 1 | 1 | 1 | 1 | 0.8 |
| | Air permeability (m ³ /hr/m ²) | 7 | 5 | 3 | 3 | 3 | 3 | 3 | 1 | 0.41 - 0.5 |
| | Thermal bridging (W/m ² K) | 0.08 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | Ventilation | Natural (extract fans) | Natural (extract fans) | Natural (extract fans) | MVHR | Natural (extract fans) | MVHR | Natural (extract fans) | MVHR | MVHR |

Current practice

Modified AECB Silver Standard

EST BPEE Standard = between Spec A & Spec B

EST APEE Standard

PassivHaus Equivalent

The Work Group agreed that all specifications would be modelled with a gas boiler providing the hot water and space heating. Because the Task Group decided early on that the metric for the Energy Efficiency Standard would not be carbon dioxide, it was not necessary to model

more than one energy delivery scenario, however energy consumption was required for the whole life cost analysis and therefore had to be generated.

Additional details on modelling assumptions are listed in the table below:

Additional details of cSAP inputs (core specs)

| | Apartments (Baseline) | Apartments (All other Specs) | Houses (Baseline) | Houses (All other Specs) |
|-------------------------------|--|--|--|--|
| Low energy lighting | 30% | 100% | 30% | 100% |
| MVHR spec (where used) | n/a | SFP = 1 W/l/s HR Eff. 85% | n/a | SFP = 1 W/l/s HR Eff. 85% |
| Orientation (max glazed area) | East | East | East | East |
| Thermal mass | Medium (TMP = 250) | Medium (TMP = 250) | Medium (TMP = 250) | Medium (TMP = 250) |
| Gas boiler type | 90% efficient condensing combi, auto ignition, modulating, balanced flue, fan assisted | 90% efficient condensing combi, auto ignition, modulating, balanced flue, fan assisted | 90% efficient condensing, auto ignition, modulating, balanced flue, fan assisted | 90% efficient condensing, auto ignition, modulating, balanced flue, fan assisted |
| Boiler controls | Boiler interlock | Boiler interlock, delayed start thermostat, weather compensation | Boiler interlock | Boiler interlock, delayed start thermostat, weather compensation |
| Space heating device | Radiators | Radiators | Radiators | Radiators |
| Space heating controls | Programmer, room thermostat & TRVs | Time & temp zone control | Programmer, room thermostat & TRVs | Time & temp zone control |
| Secondary heating | None | None | None | None |
| Potable water use | <125l/p/d | <125l/p/d | <125l/p/d | <125l/p/d |
| DHW storage | None | None | 150 litres (mid & end terrace) 200 litres (detached) | 150 litres (mid & end terrace) 200 litres (detached) |
| DHW storage losses | None | None | 1.14 kWh/day (150 litres) 1.44 kWh/day (200 litres) | 1.14 kWh/day (150 litres) 1.44 kWh/day (200 litres) |

Work Group 2 (Services) informed these choices.

PHPP modelling results: Spec D construction specifications

| | | Small apartment | Large apartment | Mid terrace house | End terrace / semi detached house | detached house |
|------------------------------|---|-----------------|-----------------|-------------------|-----------------------------------|----------------|
| U-Value (W/m ² K) | Wall | 0.15 | 0.10 | 0.10 | 0.10 | 0.09 |
| | Floor | 0.15 | 0.10 | 0.10 | 0.10 | 0.08 |
| | Roof | 0.10 | 0.10 | 0.10 | 0.10 | 0.06 |
| | Glazing (mid pane) | 1.0 | 0.8 | 0.8 | 0.6 | 0.6 |
| | Window frame | 1.2 | 1.2 | 1.2 | 0.7 | 0.7 |
| | Doors | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| | Air permeability (m ³ /hr/m ²) | 0.41 | 0.5 | 0.54 | 0.54 | 1.26 |

It should be noted that the Work Group and Task Group acknowledged that trying to achieve PassivHaus performance using typical current designs does not take advantage of the role passive solar gains and optimised orientation can play. The resulting low range of U-values may be an indication of this limitation. However the Task Group felt it important to understand the potential challenges without assuming that both planners and consumers will accept such fundamental design requirements for zero carbon homes.

Sensitivity analysis

Initial analysis

The following initial sensitivity analysis was carried out:

| | | Core house types | | | | | | | | |
|-------------------------------------|---|----------------------------------|----------------------------------|---|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| | | Small flat (around) | Small flat (mid) | Small flat (top) | Large flat (around) | Large flat (mid) | Large flat (top) | Mid terrace house | End terrace house | Detached house |
| Base specs | Baseline Spec | y | y | y | y | y | y | y | y | y |
| | Spec A | y | y | y | y | y | y | y | y | y |
| | Spec B | y | y | y | y | y | y | y | y | y |
| | Spec C | y | y | y | y | y | y | y | y | y |
| | Spec D | y | y | y | y | y | y | y | y | y |
| First round of sensitivity analysis | Ventilation type | MEV (SFP=0.6w/l/s) | | | | MEV (SFP=0.6w/l/s) | | | MEV (SFP=0.6w/l/s) | MEV (SFP=0.6w/l/s) |
| | Ventilation type | | | | | | | Passive Stack | Passive Stack | Passive Stack |
| | Ventilation type | MEV (SFP=0.6W/l/s) | | | | | | MEV (SFP=0.6w/l/s) | MEV (SFP=0.6w/l/s) | MEV (SFP=0.6w/l/s) |
| | Ventilation type | | | | | | | Passive Stack | Passive Stack | Passive Stack |
| | Ventilation type | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) | Appendix Q MVHR (ltho HRU ECO 4) |
| | Party wall u-values | | | | | | | 0.2 | 0.2 | |
| | Orientation (max glazing) | | S (i.e. E becomes S) | | | | | S (i.e. E becomes S, etc) | | S (i.e. E becomes S, etc) |
| | Orientation (max glazing) | | N (i.e. E becomes N) | | | | | N (i.e. E becomes N, | | N (i.e. E becomes N, etc) |
| | Thermal mass | HIGH (TMP=450) | | | | HIGH (TMP=450) | | HIGH (TMP=450) | | HIGH (TMP=450) |
| | Thermal mass | LOW (TMP=100) | | | | LOW (TMP=100) | | LOW (TMP=100) | | LOW (TMP=100) |
| | thermal bridging | | | | | | | | 0.03 | 0.03 |
| | thermal bridging floor-to-ceiling heights | | | HIGHER (2.8m; ext wall = 19.32m ² ; party wall = 29.96m ² ; semi exp wall = 29.96m ²) | | | | | 0.08 | 0.08 |

Further analysis

Further sensitivity analysis was carried out on the following:

- Thermal mass: for all house types
- Orientation: for all house types
- Air permeability: for all house types
- Gains from DHW system: for all house types

Results are presented later in this Appendix.

Construction elements and frame types analysed

General

The Work Group worked in conjunction with architects in order to provide the Task Group with an understanding of the buildability and design implications of the construction specifications proposed. A series of wall, floor, roof, window and door solutions were designed based upon the following principles:

- Walls for houses and the 4 storey apartments would be designed in both cavity masonry and timber frame
- Walls for the 8 storey apartments would be designed in concrete frame with block infill

These reflect the mainstream construction types and provide a reliable basis for financial modelling

It is recognised that other construction systems such as Insulated Concrete Formwork (ICF), Structural Insulated Panels (SIPs) and single skin block with External Wall Insulation (EWI) and many other systems also have the ability to achieve these specifications. Innovative build systems such as these may well provide additional solutions but the Task Group felt it unwise to presume this within the core assessments. Ultimately the market will gravitate to the most appropriate solutions. If these are lower cost than traditional solutions modelled this represents an additional benefit.

The following information that was produced for the Task Group is provided below:

- Construction elements: Illustrative summary

Showing typical build-up of elements to reach the required U-values of the construction specifications analysed.

It is important to note that these construction cross sections only illustrate a small proportion of the products available to industry. The thermal conductivities used for the

various materials are deliberately typical of mainstream products.

This is a conscious decision to avoid developing a standard with an inherent assumption that materials currently at prototype stage will become mass market by 2016. The Task Group took the view that should these materials proceed into mainstream use then this represents an additional benefit.

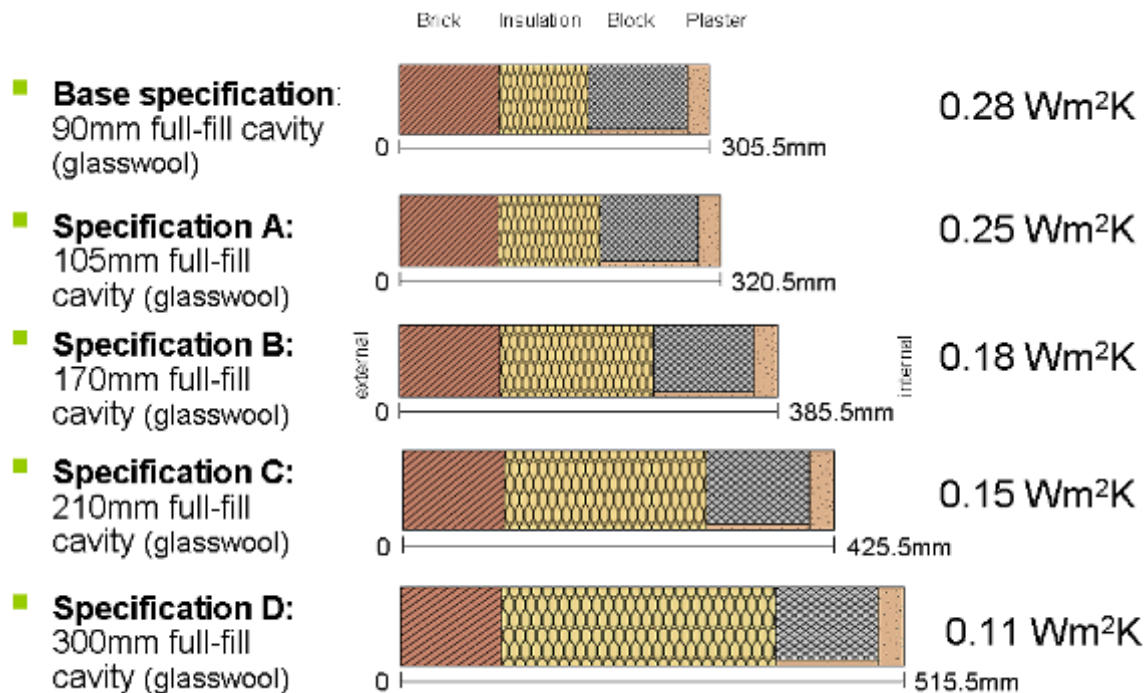
- Construction elements: Detailed summary

Detail on the final options for costing the construction elements for each core house type and Spec.

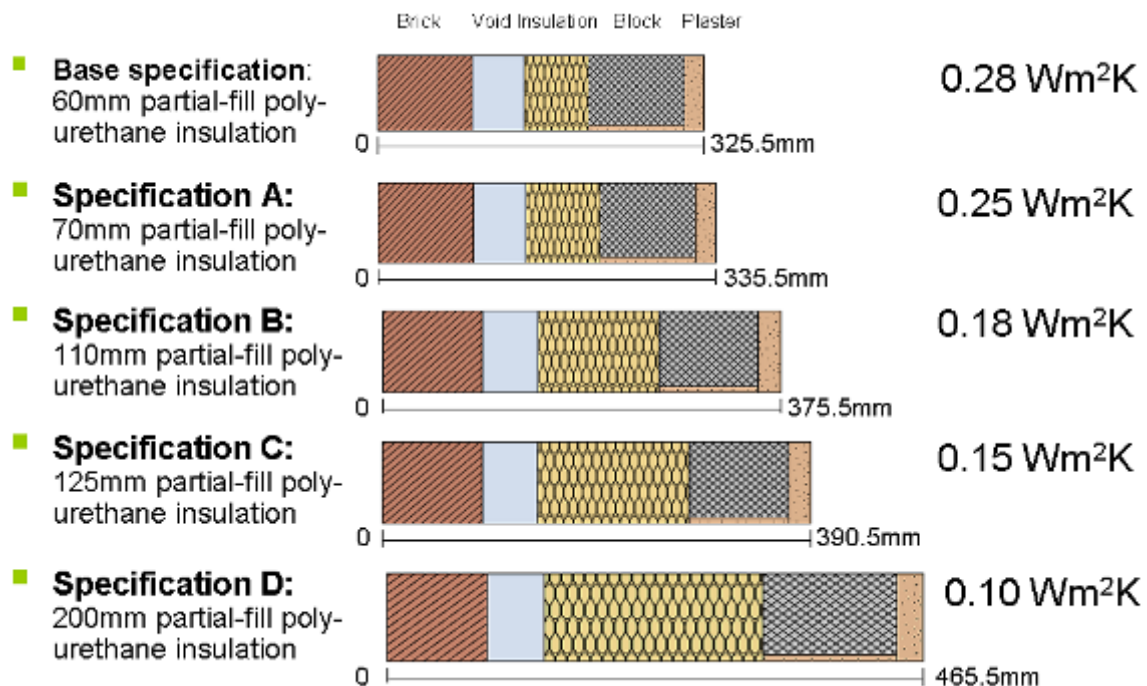
- Construction elements: All considered
Full details of the construction elements analysis work

Construction elements: Illustrative summary

Masonry Walls (Full-fill glass wool insulation)

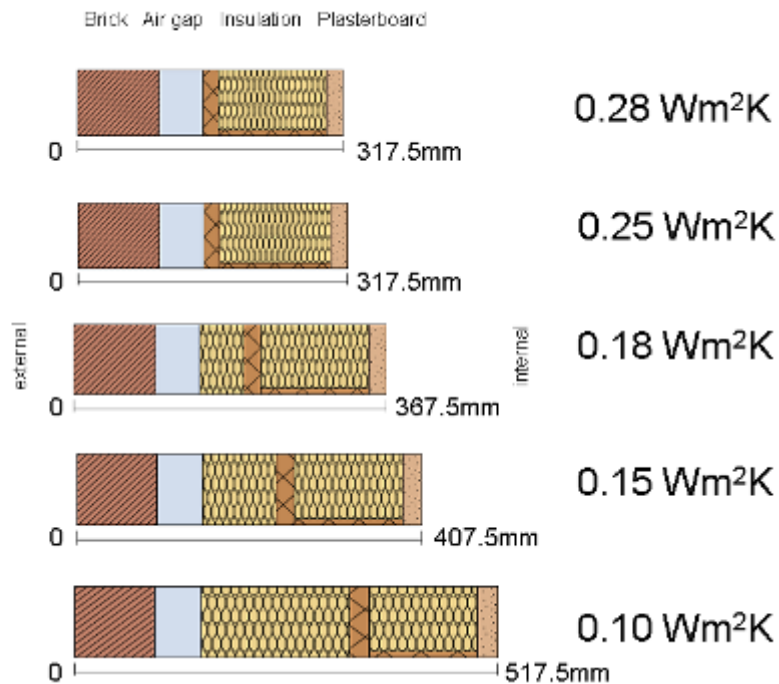


Masonry Walls (Partial fill PU foam insulation)



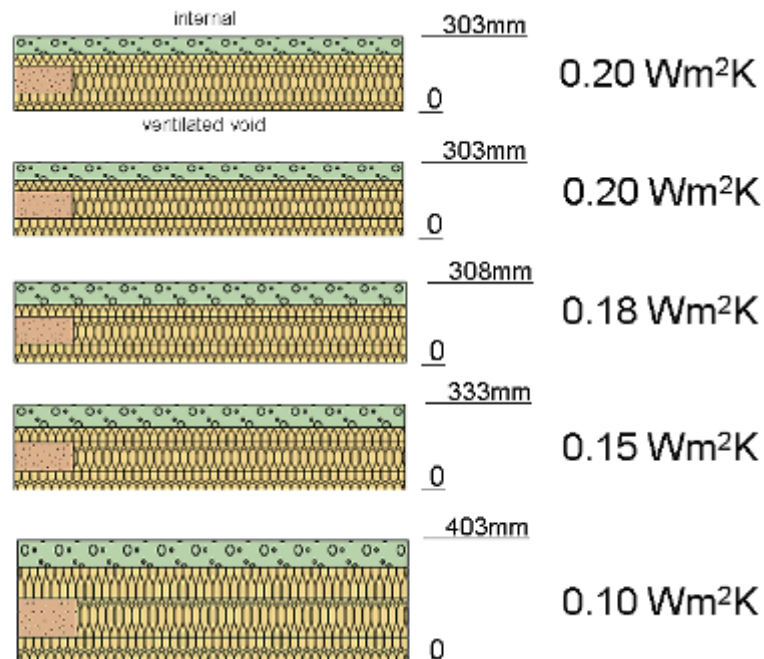
Timber Frame Walls

- **Base specification:**
140mm insulation between studs (mineral wool)
- **Specification A:**
140mm insulation between studs (glass wool)
- **Specification B:**
140mm insulation (glasswool) between + 50mm outside of frame
- **Specification C:**
140mm insulation (glasswool) between plus 90mm outside of frame
- **Specification D :**
140mm insulation (glasswool) between plus 200mm outside of frame



Floors – Beam and block suspended floor with internal screed

- **Base specification:**
218mm insulated concrete beam system + 10mm rigid insulation, screed
- **Specification A:**
218mm insulated concrete beam system + 10mm rigid insulation, screed
- **Specification B:**
218mm insulated concrete beam system + 15mm rigid insulation, screed
- **Specification C:**
218mm insulated concrete beam system + 40mm rigid insulation, screed
- **Specification D :**
218mm insulated concrete beam system + 110mm rigid insulation, screed



Roofing – Insulation between and above joists in ceiling void

| | | | |
|--|--|--------------------|-----------------------------|
| <p>■ Base specification: 125mm mineral wool insulation between joists + 150mm above</p> | | <p>288mm 0</p> | <p>0.16 Wm²K</p> |
| <p>■ Specification A: 125mm mineral wool insulation between joists + 175mm above</p> | | <p>313mm 0</p> | <p>0.15 Wm²K</p> |
| <p>■ Specification B: 125mm mineral wool insulation between joists + 210mm above</p> | | <p>348mm 0</p> | <p>0.13 Wm²K</p> |
| <p>■ Specification C: 125mm mineral wool insulation between joists + 290mm above</p> | | <p>428mm 0</p> | <p>0.11 Wm²K</p> |
| <p>■ Specification D : 125mm mineral wool insulation between joists + 320mm above</p> | | <p>458mm 0</p> | <p>0.10 Wm²K</p> |

Richards Partington Architects

First Floor | Fergusson House | 124-128 City Road | London EC1V 2NJ
 T 020 7490 5490 | F 020 7490 5494 | E post@rparchitects.co.uk | www.rparchitects.co.uk

reference : 2183_File Note 010A_Final Specifications.doc

issued by : RPA

date : 03.11.09

Zero Carbon Hub : EESTG Costed Specification Summary

| Base Specification: | | |
|---|-------------------------------------|---|
| Houses | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 100mm - 305.5mm wall | 0.28 | Internal finish: 13mm plaster. Inner leaf: 100mm 4N/mm ² AAC blockwork (0.16Wmk) Cavity: Full-fill (90mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.50 | Leaf 1: 100mm 4N/mm ² AAC blockwork, 13mm plaster finish. Cavity: Open cavity (no insulation) Leaf 2: 100mm 4N/mm ² AAC blockwork, 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - Based on a worst case perimeter:area ratio of 0.55 - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 287.5mm roof | 0.16 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 150mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Base Specification: | | |
|--|-------------------------------------|--|
| Flats (up to and including 4 storeys) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 100mm - 400.5mm wall. | 0.28 | Internal finish: 13mm plaster Inner leaf: 215mm 10N/mm ² AAC blockwork (0.19Wmk, 100mm block on its side) Cavity: Full-fill (70mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall. | 0.50 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Open cavity (no insulation) Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |

| | | |
|---|------|--|
| Semi-Exposed Walls: - Cavity wall construction - 85mm cavity width - 311mm wall | 0.25 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk), 13mm plaster finish. Cavity: Full-fill (85mm) glass wool insulation (0.032Wmk) Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk), 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 287.5mm roof | 0.16 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 150mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Base Specification: | | |
|---|---------------------------------|--|
| Flats (5 storeys and above) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Insulated concrete frame with blockwork in-fill - Approx. 218mm wall | 0.28 | Internal finish: 13mm plaster External wall: 140mm 3.5N/mm ² AAC blockwork (0.11Wmk) Insulation: 55mm rigid polyurethane insulation mechanically fixed to blockwork and sealed at joints (0.023Wmk) External finish: Reinforced synthetic render. |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.50 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork with 13mm plaster finish. Cavity: Open cavity (no insulation) Leaf 2: 100mm 3.5N/mm ² AAC blockwork with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 60mm cavity width - 286mm wall | 0.25 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (60mm) glass wool insulation (0.032Wmk) Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Flat roof construction - 647.5mm roof (incl. service void) | 0.16 | External finish: Mastic asphalt onto 100mm screed to falls Insulation: 210mm EPS insulation (lambda value 0.033Wmk) Structure: 150mm in-situ concrete slab Internal finish: 12.5mm MF plasterboard ceiling with 150mm service void above |

| Base Specification: All Dwelling Types | | |
|---|------|---|
| Windows (W/m ² K) | 1.8 | Double glazed Upvc windows with Low-E coating (hard). |
| Doors (W/m ² K) | 1.6 | Insulated steel faced doors with partial glazing. |
| Airtightness (m ³ /hr/m ²) | 7 | Standard practice assumed. No special measures. |
| Thermal Bridging (W/m ² K) | 0.08 | CLG accredited details assumed. No special measures. |

| Specification A: | | |
|---|-------------------------------------|--|
| Houses | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 150mm - 320.5mm wall | 0.25 | Internal finish: 13mm plaster Inner leaf: 100mm 4N/mm ² AAC blockwork (0.16Wmk) Cavity: Full-fill (105mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 4N/mm ² AAC blockwork (0.16Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 4N/mm ² AAC blockwork (0.16Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - Based on a worst case perimeter:area ratio of 0.55 - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 312.5mm roof | 0.15 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 175mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification A: | | |
|---|-------------------------------------|--|
| Flats (up to and including 4 storeys) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 150mm - 415.5mm wall | 0.25 | Inner leaf: 215mm 10N/mm ² AAC blockwork (0.19Wmk, 100mm block on its side), 13mm plaster finish Cavity: Full-fill (85mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm dense plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 80mm cavity width - 306mm wall | 0.23 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (80mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² , cross section of 30mm ² |

| | | |
|---|------|---|
| Ground Floor - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023WmK). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 312.5mm roof | 0.15 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042WmK) laid between and 175mm above the ceiling joists Internal finish: 50mm plasterboard ceiling. |

Specification A:

Flats (5 storeys and above)

| Element | U-Value W/m ² K | Specification |
|---|-------------------------------|--|
| External Walls: - Insulated concrete frame with blockwork in-fill - Approx. 228mm wall | 0.25 | Internal finish: 13mm plaster External wall: 140mm 3.5N/mm ² AAC blockwork (0.11WmK) Insulation: 65mm rigid polyurethane insulation mechanically fixed to blockwork and sealed at joints (0.023WmK) External finish: Reinforced synthetic render. |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11WmK) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032WmK) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11WmK) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 70mm cavity width - 296mm wall | 0.23 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11WmK) with 13mm plaster finish. Cavity: Full-fill (70mm) glass wool insulation (0.032WmK) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11WmK) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 303mm floor | 0.20 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 10mm rigid polyurethane insulation (lambda value 0.023WmK). Finish: 75mm screed |
| Roof - Flat roof construction - 657.5mm roof (incl. service void) | 0.15 | External finish: Mastic asphalt onto 100mm screed to falls. Insulation: 220mm EPS insulation (lambda value 0.033WmK) Structure: 150mm in-situ concrete slab Internal finish: 12.5mm MF plasterboard ceiling with 150mm service void above |

| Specification A: All Dwelling Types | | |
|---|------|--|
| Windows (W/m ² K) | 1.5 | Double glazed Upvc windows with Low-E coating (soft). |
| Doors (W/m ² K) | 1.4 | Insulated steel faced doors with limited glazing. |
| Airtightness (m ³ /hr/m ²) | 5 | Best practice assumed. Workmanship measures required on-site. |
| Thermal Bridging (W/m ² K) | 0.06 | Best practice assumed. Calculations required to show lower value than the standard 0.08. |

| Specification B: | | |
|---|-------------------------------------|--|
| Houses | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 200mm - 385.5mm wall | 0.18 | Internal finish: 13mm plaster Inner leaf: 100mm 4N/mm ² AAC blockwork (0.16Wmk) Cavity: Full-fill (170mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 4N/mm ² AAC blockwork (0.16Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 4N/mm ² AAC blockwork (0.16Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - Based on a worst case perimeter:area ratio of 0.55 - 308mm floor | 0.18 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 15mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed. |
| Roof - Pitched roof construction - Insulation at ceiling level - 347.5mm roof | 0.13 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 210mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification B: | | |
|---|-------------------------------------|--|
| Flats (up to and including 4 storeys) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 200mm - 470.5mm wall | 0.18 | Internal finish: 13mm plaster. Inner leaf: 215mm 10N/mm ² AAC blockwork (0.19Wmk, 100mm block on its side) Cavity: Full-fill (140mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |

| | | |
|--|------|---|
| Semi-Exposed Walls: - Cavity wall construction - 150mm cavity width - 376mm wall | 0.17 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (150mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 308mm floor | 0.18 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 15mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 347.5mm roof | 0.13 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 210mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification B: | | |
|---|---------------------------------|--|
| Flats (5 storeys and above) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Insulated concrete frame with blockwork in-fill - Approx. 273mm wall | 0.18 | Internal finish: 13mm plaster. External wall: 140mm 3.5N/mm ² AAC blockwork (0.11Wmk) Insulation: 110mm rigid polyurethane insulation mechanically fixed to blockwork and sealed at joints (0.023Wmk) External finish: Reinforced synthetic render. |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm dense plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 125mm cavity width - 351mm wall | 0.17 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (125mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Stainless steel and 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 308mm floor | 0.18 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 15mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |

| | | |
|--|------|--|
| Roof - Flat roof construction - 687.5mm roof (incl. service void) | 0.13 | External finish: Mastic asphalt onto 100mm screed to falls. Insulation: 250mm EPS insulation (lambda value 0.033WmK) Structure: 150mm in-situ concrete slab Internal finish: 12.5mm MF plasterboard ceiling with 150mm service void above |
|--|------|--|

| | | |
|---|------|--|
| Specification B: All Dwelling Types | | |
| Windows (W/m ² K) | 1.4 | Double glazed Upvc windows with Low-E coating (soft). |
| Doors (W/m ² K) | 1.2 | Insulated steel faced doors with no glazing. |
| Airtightness (m ³ /hr/m ²) | 3 | Best practice assumed. Workmanship measures required on-site combined with continual assessment of every dwelling. |
| Thermal Bridging (W/m ² K) | 0.05 | Best practice assumed. Calculations required to show lower value than the standard 0.08. |

| Specification C: Houses | | |
|---|-------------------------------------|---|
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 250mm - 405.5mm wall | 0.15 | Internal finish: 13mm plaster. Inner leaf: 100mm 4N/mm ² AAC blockwork (0.16WmK) Cavity: Full-fill (190mm) glass wool insulation (0.032WmK) External leaf: 102.5mm brickwork. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 4N/mm ² AAC blockwork (0.16WmK). With 13mm plaster finish Cavity: Full-fill (75mm) glass wool insulation (0.032WmK) sealed at the top and bottom of the cavity. Leaf 2: 100mm 4N/mm ² AAC blockwork (0.16WmK) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - Based on a worst case perimeter:area ratio of 0.55 - 333mm floor | 0.14 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 40mm rigid polyurethane insulation (lambda value 0.023WmK). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 427.5mm roof | 0.11 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042WmK) laid between and 290mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification C: Flats (up to and including 4 storeys) | | |
|---|-------------------------------------|---|
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 250mm - 505.5mm wall | 0.15 | Internal finish: 13mm plaster. Inner leaf: 215mm 10N/mm ² AAC blockwork (0.19WmK, 100mm block on its side) Cavity: Full-fill (175mm) glass wool insulation (0.032WmK) External leaf: 102.5mm brickwork. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19WmK) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032WmK) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19WmK) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |

| | | |
|--|------|--|
| Semi-Exposed Walls: - Cavity wall construction - 185mm cavity width - 411mm wall | 0.14 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (185mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 333mm floor | 0.15 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 40mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 427.5mm roof | 0.11 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 290mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification C: Flats (5 storeys and above) | | |
|---|-------------------------------|--|
| Element | U-Value W/m ² K | Specification |
| External Walls: - Insulated concrete frame with blockwork in-fill - Approx. 313mm wall | 0.15 | Internal finish: 13mm plaster. External wall: 140mm 3.5N/mm ² AAC blockwork (0.11Wmk). Insulation: 150mm rigid polyurethane insulation mechanically fixed to blockwork and sealed at joints (0.023Wmk) External finish: Reinforced synthetic render. |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 175mm cavity width - 401mm wall | 0.14 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (175mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 333mm floor | 0.15 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 40mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |

| | | |
|--|------|--|
| Roof - Flat roof construction - 737.5mm roof (incl. service void) | 0.11 | External finish: Mastic asphalt onto 100mm screed to falls. Insulation: 300mm EPS insulation (lambda value 0.033WmK) Structure: 150mm in-situ concrete slab Internal finish: 12.5mm MF plasterboard ceiling with 150mm service void above |
|--|------|--|

| Specification C: All Dwelling Types | | |
|---|------|---|
| Windows (W/m ² K) | 0.8 | Triple glazed Upvc windows with Low-E coating (soft). |
| Doors (W/m ² K) | 1.0 | Insulated steel faced doors with no glazing, thermally broken frame. |
| Airtightness (m ³ /hr/m ²) | 1 | Beyond best practice assumed. Bespoke detail design measures required in combination with workmanship measures on-site and testing of every dwelling. |
| Thermal Bridging (W/m ² K) | 0.04 | EST Enhanced Construction Details required. |

| Specification D: | | |
|---|-------------------------------------|---|
| Houses | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 300mm - 515.5mm wall | 0.11 | Internal finish: 13mm plaster. Inner leaf: 100mm 4N/mm ² AAC blockwork (0.16Wmk) Cavity: Full-fill (300mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 4N/mm ² AAC blockwork (0.16Wmk). With 13mm plaster finish Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 4N/mm ² AAC blockwork (0.16Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - Based on a worst case perimeter:area ratio of 0.55 - 403mm floor | 0.10 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 110mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 457.5mm wall | 0.10 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 320mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification D: | | |
|---|-------------------------------------|---|
| Flats (up to and including 4 storeys) | | |
| Element | U-Value W/m²K | Specification |
| External Walls: - Cavity wall construction - Limiting cavity width 300mm - 620.5mm wall | 0.10 | Internal finish: 13mm plaster. Inner leaf: 215mm 10N/mm ² AAC blockwork (0.19Wmk, 100mm block on its side) Cavity: Full-fill (290mm) glass wool insulation (0.032Wmk) External leaf: 102.5mm brickwork. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |

| | | |
|--|------|--|
| Semi-Exposed Walls: - Cavity wall construction - 285mm cavity width - 511mm wall | 0.10 | Leaf 1: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Cavity: Full-fill (285mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 7N/mm ² AAC blockwork (0.19Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 403mm floor | 0.10 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 110mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |
| Roof - Pitched roof construction - Insulation at ceiling level - 457.5mm roof | 0.10 | Structure: Timber trussed cold roof with 125mm ceiling joists Insulation: 125mm mineral wool insulation quilt (lambda value 0.042Wmk) laid between and 320mm above the ceiling joists Internal finish: 12.5mm plasterboard ceiling. |

| Specification D: Flats (5 storeys and above) | | |
|---|-------------------------------|--|
| Element | U-Value W/m ² K | Specification |
| External Walls: - Insulated concrete frame with blockwork in-fill - Approx. 423mm wall | 0.10 | Internal finish: 13mm plaster. External wall: 140mm 3.5N/mm ² AAC blockwork (0.11Wmk). Insulation: 260mm rigid polyurethane insulation mechanically fixed to blockwork and sealed at joints (0.023Wmk) External finish: Reinforced synthetic render. |
| Party Walls: - Cavity wall construction - 75mm cavity width - 301mm wall | 0.00 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (75mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Semi-Exposed Walls: - Cavity wall construction - 260mm cavity width - 486mm wall | 0.10 | Leaf 1: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Cavity: Full-fill (260mm) glass wool insulation (0.032Wmk) sealed at the top and bottom of the cavity. Leaf 2: 100mm 3.5N/mm ² AAC blockwork (0.11Wmk) with 13mm plaster finish. Wall ties: Low thermal conductivity ties. 2.5/m ² with a cross section of 30mm ² |
| Ground Floor - 403mm floor | 0.10 | Structure: Suspended insulated concrete beam floor (150mm beam assumed, total 218mm depth with insulation to underside of beams) Insulation: 110mm rigid polyurethane insulation (lambda value 0.023Wmk). Finish: 75mm screed |

| | | |
|--|------|--|
| Roof - Flat roof construction - 767.5mm roof (incl. service void) | 0.10 | External finish: Mastic asphalt onto 100mm screed to falls. Insulation: 330mm EPS insulation (lambda value 0.033WmK) Structure: 150mm in-situ concrete slab Internal finish: 12.5mm MF plasterboard ceiling with 150mm service void above |
|--|------|--|

| Specification D: All Dwelling Types | | |
|---|------|--|
| Windows (W/m ² K) | 0.8 | Triple glazed Upvc windows with Low-E coating (soft). |
| Doors (W/m ² K) | 1.0 | Insulated steel faced doors with no glazing, thermally broken frame. |
| Airtightness (m ³ /hr/m ²) | 1 | PassivHaus standards required. Bespoke detail design measures required in combination with workmanship measures on-site and testing of every dwelling. |
| Thermal Bridging (W/m ² K) | 0.02 | PassivHaus standards required. Calculations required to illustrate achieved value. |

distribution :

Edward Mayes
Rob Pannell
Jobran Hammoud
Philip Scotney
Collaboration Zone
ESG

Anser
Zero Carbon Hub
Davis Langdon
Davis Langdon
ZCH
RPA

Baseline Specification: Limiting cavity width - 100mm / Values indicated are thickness of element in mm

| External wall: 0.28W/m2K | | | | | | | | Total | | | |
|--|------|-------------------------------|-----|--|-----|------------------------|------------------------------|---------------|--------|---------|-----|
| Houses: | 103 | External Brickwork leaf | 90 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 305.5 | | |
| Low flats: (Upto and incl. 4 storeys) | 103 | External Brickwork leaf | 70 | Fully-filled Glasswool | 215 | AAC Blockwork | 13 | Plaster | 400.5 | | |
| Flats : (5 storeys and above) | 10 | External Render | 55 | Externally fixed PU | 140 | AAC Blockwork | 13 | Plaster | 218 | | |
| Sheltered wall: 0.25W/m2K | | | | | | | | Total | | | |
| Low flats: (Upto and incl. 4 storeys) | 13 | Plaster | 100 | AAC Blockwork | 85 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 311 |
| Flats : (5 storeys and above) | 13 | Plaster | 100 | AAC Blockwork | 60 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 286 |
| Ground floor: 0.20W/m2K | | | | | | | | Total | | | |
| | 218 | Beam + EPS Block system | 10 | PU rigid floorboard | 75 | Screed | | | | 303 | |
| Roof: 0.16W/m2K | | | | | | | | Total | | | |
| Pitched roof: Insulation at ceiling level | 12.5 | Internal Plasterboard ceiling | 125 | Timber joists with mineral wool infill | | 150 | Mineral wool insulation over | | | 287.5 | |
| Flat roof | 150 | Concrete slab | 210 | EPS insulation board over slab | | 100 | Screed | 25 | Finish | 485 | |
| Windows: 1.80W/m2K | | | | | | | | | | | |
| uPVC double glazed, hard low-E coating | | | | | | | | | | | |
| Doors: 1.60W/m2K | | | | | | | | | | | |
| Insulated steel faced doors, partially double glazed | | | | | | | | | | | |

Specification A: Limiting cavity width - 150mm / Values indicated are thickness of element in mm

| External wall: 0.25W/m2K | | | | | | | | Total | | | |
|---|------|-------------------------------|-----|--|-----|------------------------|------------------------------|---------------|--------|---------|-----|
| Houses: | 103 | External Brickwork leaf | 105 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 320.5 | | |
| Low flats: (Upto and incl. 4 storeys) | 103 | External Brickwork leaf | 85 | Fully-filled Glasswool | 215 | AAC Blockwork | 13 | Plaster | 415.5 | | |
| Flats : (5 storeys and above) | 10 | External Render | 65 | Externally fixed PU | 140 | AAC Blockwork | 13 | Plaster | 228 | | |
| Sheltered wall: 0.23W/m2K | | | | | | | | Total | | | |
| Low flats: (Upto and incl. 4 storeys) | 13 | Plaster | 100 | AAC Blockwork | 95 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 321 |
| Flats : (5 storeys and above) | 13 | Plaster | 100 | AAC Blockwork | 70 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 296 |
| Ground floor: 0.20W/m2K | | | | | | | | Total | | | |
| | 218 | Beam + EPS Block system | 10 | PU rigid floorboard | 75 | Screed | | | | 303 | |
| Roof: 0.15W/m2K | | | | | | | | Total | | | |
| Pitched roof: Insulation at ceiling level | 12.5 | Internal Plasterboard ceiling | 125 | Timber joists with mineral wool infill | | 175 | Mineral wool insulation over | | | 312.5 | |
| Flat roof | 150 | Concrete slab | 220 | EPS insulation board over slab | | 100 | Screed | 25 | Finish | 495 | |
| Windows: 1.50W/m2K | | | | | | | | | | | |
| uPVC double glazed, soft low-E coating | | | | | | | | | | | |
| Doors: 1.40W/m2K | | | | | | | | | | | |
| Insulated steel faced doors, limited double glazing | | | | | | | | | | | |

Specification B: Limiting cavity width - 200mm / Values indicated are thickness of element in mm

| External wall: 0.18W/m2K | | | | | | | Total | | |
|--------------------------|-----|-------------------------|-----|------------------------|-----|---------------|-------|---------|-------|
| Houses: | 103 | External Brickwork leaf | 170 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 385.5 |

| | | | | | | | | | |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|
| Low flats: (Upto and incl. 4 storeys) | 103 | External Brickwork leaf | 140 | Fully-filled Glasswool | 215 | AAC Blockwork | 13 | Plaster | 470.5 |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|

| | | | | | | | | | |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 10 | External Render | 110 | Externally fixed PU | 140 | AAC Blockwork | 13 | Plaster | 273 |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|

| Sheltered wall: 0.17W/m2K | | | | | | | Total |
|---------------------------|--|--|--|--|--|--|-------|
|---------------------------|--|--|--|--|--|--|-------|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|---------------------|-----|---------------|----|---------|-----|
| Low flats: (Upto and incl. 4 storeys) | 13 | Plaster | 100 | AAC Blockwork | 150 | Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 376 |
|---|----|---------|-----|---------------|-----|---------------------|-----|---------------|----|---------|-----|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|---------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 13 | Plaster | 100 | AAC Blockwork | 125 | Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 351 |
|---|----|---------|-----|---------------|-----|---------------------|-----|---------------|----|---------|-----|

| Ground floor: 0.18W/m2K | | | | Total |
|-------------------------|--|--|--|-------|
|-------------------------|--|--|--|-------|

| | | | | | | |
|-----|-------------------------|----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 15 | PU rigid floorboard | 75 | Screed | 308 |
|-----|-------------------------|----|---------------------|----|--------|-----|

| Roof: 0.13W/m2K | | | | | | | Total |
|-----------------|--|--|--|--|--|--|-------|
|-----------------|--|--|--|--|--|--|-------|

| | | | | | | | |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|
| Pitched roof: Insulation at ceiling level | 12.5 | Internal Plasterboard finish | 125 | Timber joists with mineral wool infill | 210 | Mineral wool insulation over | 347.5 |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|

| | | | | | | | | | |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|
| Flat roof | 150 | Concrete slab | 250 | EPS insulation board over slab | 100 | Screed | 25 | Finish | 525 |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|

| Windows: 1.40W/m2K | |
|--------------------|--|
|--------------------|--|

| | |
|--|--|
| uPVC double glazed, soft low-E coating | |
|--|--|

| Doors: 1.20W/m2K | |
|------------------|--|
|------------------|--|

| | |
|---|--|
| Insulated steel faced doors, no glazing | |
|---|--|

Specification C: Limiting cavity width - 250mm / Values indicated are thickness of element in mm

| External wall: 0.15W/m2K | | | | | | | Total |
|--------------------------|--|--|--|--|--|--|-------|
|--------------------------|--|--|--|--|--|--|-------|

| | | | | | | | | | |
|---------|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|
| Houses: | 103 | External Brickwork leaf | 210 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 425.5 |
|---------|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|

| | | | | | | | | | |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|
| Low flats: (Upto and incl. 4 storeys) | 103 | External Brickwork leaf | 190 | Fully-filled Glasswool | 215 | AAC Blockwork | 13 | Plaster | 520.5 |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|

| | | | | | | | | | |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 10 | External Render | 150 | Externally fixed PU | 140 | AAC Blockwork | 13 | Plaster | 313 |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|

| Sheltered wall: 0.14W/m2K | | | | | | | Total |
|---------------------------|--|--|--|--|--|--|-------|
|---------------------------|--|--|--|--|--|--|-------|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|
| Low flats: (Upto and incl. 4 storeys) | 13 | Plaster | 100 | AAC Blockwork | 185 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 411 |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 13 | Plaster | 100 | AAC Blockwork | 175 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 401 |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|

| Ground floor: 0.15W/m2K | | | | Total |
|-------------------------|--|--|--|-------|
|-------------------------|--|--|--|-------|

| | | | | | | |
|-----|-------------------------|----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 40 | PU rigid floorboard | 75 | Screed | 333 |
|-----|-------------------------|----|---------------------|----|--------|-----|

| Roof: 0.11W/m2K | | | | | | | Total |
|-----------------|--|--|--|--|--|--|-------|
|-----------------|--|--|--|--|--|--|-------|

| | | | | | | | |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|
| Pitched roof: Insulation at ceiling level | 12.5 | Internal Plasterboard finish | 125 | Timber joists with mineral wool infill | 290 | Mineral wool insulation over | 427.5 |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|

| | | | | | | | | | |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|
| Flat roof | 150 | Concrete slab | 300 | EPS insulation board over slab | 100 | Screed | 25 | Finish | 575 |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|

| Windows: 0.80W/m2K | |
|--------------------|--|
|--------------------|--|

| | |
|--|--|
| uPVC triple glazed, soft low-E coating | |
|--|--|

| Doors: 1.00W/m2K | |
|------------------|--|
|------------------|--|

| | |
|--|--|
| Insulated steel faced doors, no glazing, thermally broken frame. | |
|--|--|

Specification D: Limiting cavity width - 300mm / Values indicated are thickness of element in mm

| External wall: 0.10W/m2K | | | | | | | | Total | | |
|--------------------------|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|--------------------|
| Houses: | 103 | External Brickwork leaf | 300 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 515.5 | 0.11W/m2K achieved |

| | | | | | | | | | |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|
| Low flats: (Upto and incl. 4 storeys) | 103 | External Brickwork leaf | 290 | Fully-filled Glasswool | 215 | AAC Blockwork | 13 | Plaster | 620.5 |
|---|-----|-------------------------|-----|------------------------|-----|---------------|----|---------|-------|

| | | | | | | | | | |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 10 | External Render | 260 | Externally fixed PU | 140 | AAC Blockwork | 13 | Plaster | 423 |
|---|----|-----------------|-----|---------------------|-----|---------------|----|---------|-----|

| Sheltered wall: 0.10W/m2K | | | | | | | | Total |
|---------------------------|--|--|--|--|--|--|--|-------|
|---------------------------|--|--|--|--|--|--|--|-------|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|
| Low flats: (Upto and incl. 4 storeys) | 13 | Plaster | 100 | AAC Blockwork | 285 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 511 |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|

| | | | | | | | | | | | |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|
| Flats : (5 storeys and above) | 13 | Plaster | 100 | AAC Blockwork | 260 | Fully-filled Glasswool | 100 | AAC Blockwork | 13 | Plaster | 486 |
|---|----|---------|-----|---------------|-----|------------------------|-----|---------------|----|---------|-----|

| Ground floor: 0.10W/m2K | | | | | Total |
|-------------------------|--|--|--|--|-------|
|-------------------------|--|--|--|--|-------|

| | | | | | | |
|-----|-------------------------|-----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 110 | PU rigid floorboard | 75 | Screed | 403 |
|-----|-------------------------|-----|---------------------|----|--------|-----|

| Roof: 0.10W/m2K | | | | | | | | Total |
|-----------------|--|--|--|--|--|--|--|-------|
|-----------------|--|--|--|--|--|--|--|-------|

| | | | | | | | |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|
| Pitched roof: Insulation at ceiling level | 12.5 | Internal Plasterboard finish | 125 | Timber joists with mineral wool infill | 320 | Mineral wool insulation over | 457.5 |
|---|------|------------------------------|-----|--|-----|------------------------------|-------|

| | | | | | | | | | |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|
| Flat roof | 150 | Concrete slab | 330 | EPS insulation board over slab | 100 | Screed | 25 | Finish | 605 |
|------------------|-----|---------------|-----|--------------------------------|-----|--------|----|--------|-----|

| Windows: 0.80W/m2K | |
|--------------------|--|
|--------------------|--|

| | |
|--|--|
| uPVC triple glazed, soft low-E coating | |
|--|--|

| Doors: 1.00W/m2K | |
|------------------|--|
|------------------|--|

| | |
|--|--|
| Insulated steel faced doors, no glazing, thermally broken frame. | |
|--|--|

Construction elements: All considered

Specification does not achieve U-value within cavity limitation
 Costed Specification **Key**

External Wall

Masonry Cavity Wall Construction

| | Outer Leaf | Insulation | Inner leaf | Internal finish | Total (mm) | Actual U-value achieved |
|--|------------|------------|------------|-----------------|------------|-------------------------|
|--|------------|------------|------------|-----------------|------------|-------------------------|

Baseline: 0.28W/m²K

Houses: Limiting cavity width - 100mm

| | | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|---------|-------|-------|
| Mineral wool (rock) | 103 | Brickwork | 100 Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 315.5 | 0.286 |
| EPS | | | 85 Fully-filled cavity | | | | | 300.5 | |
| Mineral wool (glass) | | | 90 Fully-filled cavity | | | | | 305.5 | |
| PU | | | 60 + 50mm air cavity | | | | | 325.5 | |

Low flats (Upto and including 4 storeys): Limiting cavity width - 100mm

| | | | | | | | | |
|----------------------|-----|-----------|------------------------|-----|---------------|----|---------|-------|
| Mineral wool (rock) | 103 | Brickwork | 85 Fully-filled cavity | 215 | AAC Blockwork | 13 | Plaster | 415.5 |
| EPS | | | 75 Fully-filled cavity | | | | | 405.5 |
| Mineral wool (glass) | | | 70 Fully-filled cavity | | | | | 400.5 |
| PU | | | 45 + 50mm air cavity | | | | | 425.5 |

Flats (5 to 8 storeys)

| | | | | | | | | |
|----------------------|----|--------|----------------------|-----|---------------|----|---------|-----|
| Mineral wool (rock) | 10 | Render | 100 Externally fixed | 140 | AAC Blockwork | 13 | Plaster | 263 |
| EPS | | | 90 Externally fixed | | | | | 253 |
| Mineral wool (glass) | | | 85 Externally fixed | | | | | 248 |
| PU | | | 55 Externally fixed | | | | | 218 |

Spec A: 0.25W/m²K

Houses: Limiting cavity width - 150mm

| | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|---------|-------|
| Mineral wool (rock) | 103 | Brickwork | 120 Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 335.5 |
| EPS | | | 110 Fully-filled cavity | | | | | 325.5 |
| Mineral wool (glass) | | | 105 Fully-filled cavity | | | | | 320.5 |
| PU | | | 70 + 50mm air cavity | | | | | 335.5 |

Low flats (Upto and including 4 storeys): Limiting cavity width - 150mm

| | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|---------|-------|
| Mineral wool (rock) | 103 | Brickwork | 100 Fully-filled cavity | 215 | AAC Blockwork | 13 | Plaster | 430.5 |
| EPS | | | 90 Fully-filled cavity | | | | | 420.5 |
| Mineral wool (glass) | | | 85 Fully-filled cavity | | | | | 415.5 |
| PU | | | 55 + 50mm air cavity | | | | | 435.5 |

Flats (5 to 8 storeys)

| | | | | | | | | |
|----------------------|----|--------|----------------------|-----|---------------|----|---------|-----|
| Mineral wool (rock) | 10 | Render | 120 Externally fixed | 140 | AAC Blockwork | 13 | Plaster | 283 |
| EPS | | | 105 Externally fixed | | | | | 268 |
| Mineral wool (glass) | | | 100 Externally fixed | | | | | 263 |
| PU | | | 65 Externally fixed | | | | | 228 |

Spec B: 0.18W/m²K

Houses: Limiting cavity width - 200mm; Stainless steel wall ties

| | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|---------|-------|
| Mineral wool (rock) | 103 | Brickwork | 190 Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 405.5 |
| EPS | | | 180 Fully-filled cavity | | | | | 395.5 |
| Mineral wool (glass) | | | 170 Fully-filled cavity | | | | | 385.5 |
| PU | | | 110 + 50mm air cavity | | | | | 375.5 |

Houses: Limiting cavity width - 150mm; Low thermal conductivity wall ties

| | | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|--------------|-------|-------|
| Mineral wool (rock) | 103 | Brickwork | 150 Fully-filled cavity | 100 | AAC Blockwork | 13 | Plasterboard | 365.5 | 0.185 |
| EPS | | | 150 Fully-filled cavity | | | | | 365.5 | |
| Mineral wool (glass) | | | 130 Fully-filled cavity | | | | | 345.5 | |
| PU | | | 100 + 50mm air cavity | | | | | 365.5 | |

Low flats (Upto and including 4 storeys): Limiting cavity width - 200mm; Stainless steel wall ties

| | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|---------|-------|
| Mineral wool (rock) | 103 | Brickwork | 170 Fully-filled cavity | 215 | AAC Blockwork | 13 | Plaster | 500.5 |
| EPS | | | 150 Fully-filled cavity | | | | | 480.5 |
| Mineral wool (glass) | | | 140 Fully-filled cavity | | | | | 470.5 |
| PU | | | 95 + 50mm air cavity | | | | | 475.5 |

Low flats (Upto and including 4 storeys): Limiting cavity width - 150mm; Low thermal conductivity wall ties

| | | | | | | | | | |
|----------------------|-----|-----------|-------------------------|-----|---------------|----|--------------|-------|-------|
| Mineral wool (rock) | 103 | Brickwork | 150 Fully-filled cavity | 215 | AAC Blockwork | 13 | Plasterboard | 480.5 | 0.188 |
| EPS | | | 140 Fully-filled cavity | | | | | 470.5 | |
| Mineral wool (glass) | | | 120 Fully-filled cavity | | | | | 450.5 | |
| PU | | | 90 + 50mm air cavity | | | | | 470.5 | |

Flats (5 to 8 storeys)

| | | | | | | | | |
|----------------------|----|--------|----------------------|-----|---------------|----|---------|-----|
| Mineral wool (rock) | 10 | Render | 190 Externally fixed | 140 | AAC Blockwork | 13 | Plaster | 353 |
| EPS | | | 170 Externally fixed | | | | | 333 |
| Mineral wool (glass) | | | 170 Externally fixed | | | | | 333 |
| PU | | | 110 Externally fixed | | | | | 273 |

Specification does not achieve U-value within cavity limitation Key
 Costed Specification

External Wall

| Spec C: 0.15W/m ² K | | | | | | | | | |
|--|-----|---------------|-----|---------------------|-----|---------------|----|------------------------|-------------------|
| Houses: Limiting cavity width - 250mm; Stainless steel wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 250 | Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 465.5 |
| EPS | | | 220 | | | | | | 435.5 |
| Mineral wool (glass) | | | 210 | | | | | | 425.5 |
| PU | | | 150 | | | | | | + 50mm air cavity |
| Houses: Limiting cavity width - 200mm; Low thermal conductivity wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 200 | Fully-filled cavity | 100 | AAC Blockwork | 13 | Plasterboard | 415.5 |
| EPS | | | 200 | | | | | | 415.5 |
| Mineral wool (glass) | | | 190 | | | | | | 405.5 |
| PU | | | 125 | | | | | | + 50mm air cavity |
| Houses: Limiting cavity width - 150mm; PU lined internal plasterboard | | | | | | | | | |
| Mineral wool (rock) | 103 | AAC Blockwork | 150 | Fully-filled cavity | 100 | AAC Blockwork | 40 | Insulated Plasterboard | 392.5 |
| EPS | | | 150 | | | | | | 382.5 |
| Mineral wool (glass) | | | 150 | | | | | | 382.5 |
| PU | | | 100 | | | | | | + 50mm air cavity |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 250mm; Stainless steel wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 220 | Fully-filled cavity | 215 | AAC Blockwork | 13 | Plaster | 550.5 |
| EPS | | | 200 | | | | | | 530.5 |
| Mineral wool (glass) | | | 190 | | | | | | 520.5 |
| PU | | | 130 | | | | | | + 50mm air cavity |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 200mm; Low thermal conductivity wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 200 | Fully-filled cavity | 215 | AAC Blockwork | 13 | Plasterboard | 530.5 |
| EPS | | | 180 | | | | | | 510.5 |
| Mineral wool (glass) | | | 175 | | | | | | 505.5 |
| PU | | | 115 | | | | | | + 50mm air cavity |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 150mm; PU lined internal plasterboard | | | | | | | | | |
| Mineral wool (rock) | 103 | AAC Blockwork | 150 | Fully-filled cavity | 100 | AAC Blockwork | 30 | Insulated Plasterboard | 382.5 |
| EPS | | | 150 | | | | | | 372.5 |
| Mineral wool (glass) | | | 150 | | | | | | 367.5 |
| PU | | | 100 | | | | | | + 50mm air cavity |
| Flats (5 to 8 storeys) | | | | | | | | | |
| Mineral wool (rock) | 10 | Render | 250 | Externally fixed | 140 | AAC Blockwork | 13 | Plaster | 413 |
| EPS | | | 230 | | | | | | 393 |
| Mineral wool (glass) | | | 220 | | | | | | 383 |
| PU | | | 150 | | | | | | Externally fixed |

0.163

| Spec D: 0.10W/m ² K | | | | | | | | | |
|--|-----|-----------|-----|---------------------|-----|---------------|----|---------|-------------------|
| Houses: Limiting cavity width - 300mm; Low thermal conductivity wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 300 | Fully-filled cavity | 100 | AAC Blockwork | 13 | Plaster | 515.5 |
| EPS | | | 300 | | | | | | 515.5 |
| Mineral wool (glass) | | | 300 | | | | | | 515.5 |
| PU | | | 200 | | | | | | + 50mm air cavity |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 300mm; Low thermal conductivity wall ties | | | | | | | | | |
| Mineral wool (rock) | 103 | Brickwork | 300 | Fully-filled cavity | 215 | AAC Blockwork | 13 | Plaster | 630.5 |
| EPS | | | 300 | | | | | | 630.5 |
| Mineral wool (glass) | | | 290 | | | | | | 620.5 |
| PU | | | 190 | | | | | | + 50mm air cavity |
| Flats (5 to 8 storeys) | | | | | | | | | |
| Mineral wool (rock) | 10 | Render | 440 | Fully-filled cavity | 140 | AAC Blockwork | 13 | Plaster | 603 |
| EPS | | | 410 | | | | | | 573 |
| Mineral wool (glass) | | | 390 | | | | | | 553 |
| PU | | | 260 | | | | | | Externally fixed |

0.121
0.108
0.105

Specification does not achieve U-value within cavity limitation
Costed Specification

Key



External Wall

| Timber frame construction - 140mm timber frame with fully filled insulation | | | | | | | | | |
|---|-----|-----------------|----|------------|-----|----------------|-----|--------------------|-------|
| Baseline: 0.28W/m²K | | | | | | | | | |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | rockwool (140) | 50 | Air cavity | 103 | External Brick | | | 317.5 |
| Spec A: 0.25W/m²K | | | | | | | | | |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | | | 317.5 |
| Spec B: 0.18W/m²K | | | | | | | | | |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 50 | External glasswool | 367.5 |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 40 | Internal PU board | 357.5 |
| Spec C: 0.15W/m²K | | | | | | | | | |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 90 | External glasswool | 407.5 |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 65 | Internal PU board | 382.5 |
| Spec D: 0.10W/m²K | | | | | | | | | |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 200 | External glasswool | 517.5 |
| Timber frame stud wall incl. 12mm sheathing + 13mm plasterboard | 165 | glasswool (140) | 50 | Air cavity | 103 | External Brick | 125 | Internal PU board | 442.5 |

PU = Rigid Poly Urethane Insulation Board
EPS = Expanded Polystyrene Insulation

Key

Sheltered Wall - Flats: Walls adjacent to circulation

Costed Specification

| Masonry Cavity Wall Construction | | | | | | | Total (mm) |
|---|------------|-------------------|-----------------------|---------------------|-------------------|------------|------------|
| Internal Finish | Outer Leaf | Insulation | Inner leaf | Internal finish | | | |
| Baseline: 0.25W/m²K | | | | | | | |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 100mm; PU lined internal plasterboard | | | | | | | |
| Mineral wool (rock) | 13 Plaster | 100 AAC Blockwork | 90 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 316 |
| EPS | | | 80 | | | | 306 |
| Mineral wool (glass) | | | 85 | | | | 311 |
| PU | | | 50 + 50mm air cavity | | | | 326 |
| Flats (5 to 8 storeys) | | | | | | | |
| Mineral wool (glass) | 13 Plaster | 100 AAC Blockwork | 60 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 286 |
| Spec A: 0.23W/m²K | | | | | | | |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 150mm; PU lined internal plasterboard | | | | | | | |
| Mineral wool (rock) | 13 Plaster | 100 AAC Blockwork | 105 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 331 |
| EPS | | | 90 | | | | 316 |
| Mineral wool (glass) | | | 95 | | | | 321 |
| PU | | | 55 + 50mm air cavity | | | | 331 |
| Flats (5 to 8 storeys) | | | | | | | |
| Mineral wool (glass) | 13 Plaster | 100 AAC Blockwork | 70 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 296 |
| Spec B: 0.17W/m²K | | | | | | | |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 200mm; PU lined internal plasterboard | | | | | | | |
| Mineral wool (rock) | 13 Plaster | 100 AAC Blockwork | 180 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 406 |
| EPS | | | 160 | | | | 386 |
| Mineral wool (glass) | | | 150 | | | | 376 |
| PU | | | 100 + 50mm air cavity | | | | 376 |
| Flats (5 to 8 storeys) | | | | | | | |
| Mineral wool (glass) | 13 Plaster | 100 AAC Blockwork | 125 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 351 |
| Spec C: 0.14W/m²K | | | | | | | |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 250mm; PU lined internal plasterboard; low thermal wall ties | | | | | | | |
| Mineral wool (rock) | 13 Plaster | 100 AAC Blockwork | 215 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 441 |
| EPS | | | 185 | | | | 411 |
| Mineral wool (glass) | | | 185 | | | | 411 |
| PU | | | 115 + 50mm air cavity | | | | 391 |
| Flats (5 to 8 storeys) | | | | | | | |
| Mineral wool (glass) | 13 Plaster | 100 AAC Blockwork | 175 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 401 |
| Spec D: 0.10W/m²K | | | | | | | |
| Low flats (Upto and including 4 storeys): Limiting cavity width - 300mm; PU lined internal plasterboard; low thermal wall ties | | | | | | | |
| Mineral wool (rock) | 13 Plaster | 100 AAC Blockwork | 330 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 556 |
| EPS | | | 290 | | | | 516 |
| Mineral wool (glass) | | | 285 | | | | 511 |
| PU | | | 180 + 40mm air cavity | | | | 446 |
| Flats (5 to 8 storeys) | | | | | | | |
| Mineral wool (glass) | 13 Plaster | 100 AAC Blockwork | 260 | Fully-filled cavity | 100 AAC Blockwork | 13 Plaster | 486 |

PU = Rigid Poly Urethane Insulation Board

EPS = Expanded Polystyrene Insulation

Ground floor

| Floor System | Insulation | Inner leaf | Total (mm) |
|--------------|------------|------------|------------|
|--------------|------------|------------|------------|

| Baseline & Spec A: 0.20W/m ² K | | | | | | |
|---|---------------------------------|----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 10 | PU rigid floorboard | 75 | Screed | 303 |
| 100 | Dense concrete beam and block | 90 | PU rigid floorboard | 75 | Screed | 265 |
| 100 | Dense concrete beam & AAC block | 80 | PU rigid floorboard | 75 | Screed | 255 |

| Spec B: 0.18W/m ² K | | | | | | |
|--------------------------------|---------------------------------|-----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 15 | PU rigid floorboard | 75 | Screed | 308 |
| 100 | Dense concrete beam and block | 100 | PU insulation | 75 | Screed | 275 |
| 100 | Dense concrete beam & AAC block | 90 | PU rigid floorboard | 75 | Screed | 265 |

| Spec C: 0.15W/m ² K | | | | | | |
|--------------------------------|---------------------------------|-----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 40 | PU rigid floorboard | 75 | Screed | 333 |
| 100 | Dense concrete beam and block | 125 | PU insulation | 75 | Screed | 300 |
| 100 | Dense concrete beam & AAC block | 115 | PU rigid floorboard | 75 | Screed | 290 |

| Spec D: 0.10W/m ² K | | | | | | |
|--------------------------------|---------------------------------|-----|---------------------|----|--------|-----|
| 218 | Beam + EPS Block system | 110 | PU rigid floorboard | 75 | Screed | 403 |
| 100 | Dense concrete beam and block | 200 | PU insulation | 75 | Screed | 375 |
| 100 | Dense concrete beam & AAC block | 190 | PU rigid floorboard | 75 | Screed | 365 |

Upper floor - above car port / recessed porch

| External Soffit | Insulation | Floor Structure | Floor Decking | Total (mm) |
|-----------------|------------|-----------------|---------------|------------|
|-----------------|------------|-----------------|---------------|------------|

| Baseline & Spec A: 0.2W/m ² K | | | | | | | | |
|--|------------------------|----|---------------|-----|---|----|-----------|-----|
| 13 | MR plasterboard soffit | 10 | PU insulation | 175 | Timber joist with Mineral wool batt insulation infill | 19 | Chipboard | 217 |

| Spec B: 0.18W/m ² K | | | | | | | | |
|--------------------------------|------------------------|----|---------------|-----|---|----|-----------|-----|
| 13 | MR Plasterboard soffit | 20 | PU insulation | 175 | Timber joist with Mineral wool batt insulation infill | 19 | Chipboard | 227 |

| Spec C: 0.15W/m ² K | | | | | | | | |
|--------------------------------|------------------------|----|---------------|-----|---|----|-----------|-----|
| 13 | MR Plasterboard soffit | 45 | PU insulation | 175 | Timber joist with Mineral wool batt insulation infill | 19 | Chipboard | 252 |

| Spec D: 0.10W/m ² K | | | | | | | | |
|--------------------------------|------------------------|-----|---------------|-----|---|----|-----------|-----|
| 13 | MR Plasterboard soffit | 120 | PU insulation | 175 | Timber joist with Mineral wool batt insulation infill | 19 | Chipboard | 327 |
| 13 | MR Plasterboard soffit | 75 | PU insulation | 176 | Timber joist with PU insulation infill | 19 | Chipboard | 283 |

Roof

| Ceiling | Structure | Insulation | Total (mm) |
|---|--|----------------------------------|------------|
| Baseline: 0.16W/m²K | | | |
| Pitched roof: | | | |
| Insulation between joists - flat ceiling | | | |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 150 Mineral wool insulation over | 287.5 |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 80 PU rigid insulation over | 217.5 |
| Insulation between rafters - Room-in-roof | | | |
| 12.5 Plasterboard | 150 Timber rafter with mineral wool infill | 70 PU rigid insulation over | 232.5 |
| Flat roof: not including service void and plasterboard ceiling | | | |
| 150 Concrete slab | 210 EPS insulation board over slab | 125 Screed + Finish | 485 |
| 150 Concrete slab | 120 PU insulation board over slab | 125 Screed + Finish | 395 |

| | | | |
|---|--|----------------------------------|-------|
| Spec A: 0.15W/m²K | | | |
| Pitched roof: | | | |
| Insulated ceiling | | | |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 175 Mineral wool insulation over | 312.5 |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 90 PU rigid insulation over | 227.5 |
| Insulation between rafters - Room-in-roof | | | |
| 12.5 Plasterboard | 150 Timber rafter with mineral wool infill | 80 PU rigid insulation over | 242.5 |
| Flat roof: not including service void and plasterboard ceiling | | | |
| 150 Concrete slab | 220 EPS insulation board over slab | 125 Screed + Finish | 495 |
| 150 Concrete slab | 150 PU insulation board over slab | 125 Screed + Finish | 425 |

| | | | |
|---|--|----------------------------------|-------|
| Spec B: 0.13W/m²K | | | |
| Pitched roof: | | | |
| Insulated ceiling | | | |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 210 Mineral wool insulation over | 347.5 |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 120 PU rigid insulation over | 257.5 |
| Insulation between rafters - Room-in-roof | | | |
| 12.5 Plasterboard | 150 Timber rafter with mineral wool infill | 110 PU rigid insulation over | 272.5 |
| 12.5 Plasterboard | 150 Timber rafter with PU infill | 70 PU rigid insulation over | 232.5 |
| Flat roof: not including service void and plasterboard ceiling | | | |
| 150 Concrete slab | 250 EPS insulation board over slab | 125 Screed + Finish | 525 |
| 150 Concrete slab | 170 PU insulation board over slab | 125 Screed + Finish | 445 |

| | | | |
|---|--|----------------------------------|-------|
| Spec C: 0.11W/m²K | | | |
| Pitched roof: | | | |
| Insulated ceiling | | | |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 290 Mineral wool insulation over | 427.5 |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 160 PU rigid insulation over | 297.5 |
| Insulation between rafters - Room-in-roof | | | |
| 12.5 Plasterboard | 150 Timber rafter with mineral wool infill | 140 PU rigid insulation over | 302.5 |
| 12.5 Plasterboard | 150 Timber rafter with PU infill | 100 PU rigid insulation over | 262.5 |
| Flat roof: not including service void and plasterboard ceiling | | | |
| 150 Concrete slab | 300 EPS insulation board over slab | 125 Screed + Finish | 575 |
| 150 Concrete slab | 200 PU insulation board over slab | 125 Screed + Finish | 475 |

| | | | |
|---|--|----------------------------------|-------|
| Spec D: 0.10W/m²K | | | |
| Pitched roof: | | | |
| Insulated ceiling | | | |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 320 Mineral wool insulation over | 457.5 |
| 12.5 Plasterboard | 125 Timber joists with mineral wool infill | 220 PU rigid insulation over | 357.5 |
| Insulation between rafters - Room-in-roof | | | |
| 13 Plasterboard | 150 Timber rafter with mineral wool infill | 170 PU rigid insulation over | 333 |
| 13 Plasterboard | 150 Timber rafter with PU infill | 130 PU rigid insulation over | 293 |
| Flat roof: not including service void and plasterboard ceiling | | | |
| 150 Concrete slab | 330 EPS insulation board over slab | 125 Screed + Finish | 605 |
| 150 Concrete slab | 220 PU insulation board over slab | 125 Screed + Finish | 495 |

PU = Rigid Poly Urethane Insulation Board
 EPS = Expanded Polystyrene Insulation

Structural analysis

The Work Group were concerned that some of the specifications with wider cavities might not be structurally stable, so a structural engineer was commissioned to provide expert opinion.

Reports were produced for both masonry and timber frame constructions, and are reproduced below.

Structural Implications for the various wall and building types to Inform Workgroup 1:

1. Houses - 2 storeys. Generally the 100mm AAC blockwork at 2.8 N/mm² is adequate. The blockwork will struggle however if there are large openings or small load bearing piers. Here, higher strength blocks should be used.

Note that AAC blocks have higher drying shrinkage values and are liable to cracking if suitable movement joints are not allowed for. For example a Tarmac AAC block has a drying shrinkage of 0.09% which is equivalent to 5.4mm over a 6m length or 3.6mm over 4m of wall.

For the wall ties (which comply with DD 140) any type 1 to 4 can be used as standard depending of course on the location in the UK (eg higher wind loads such as in NW Scotland only type 1 can be used). I have used Ancon ties: Type 1 = Ancon ST1, Type 2 = Staifix RT2, Type 4 = Staifix HRT4. Other tie types can be considered – particularly low thermal conductivity ties such as Magma Tech Teplo ties.

For large openings or long walls it might be necessary to introduce wind posts (particularly outside the south or east of England).

For the baseline spec and spec A there is no implication on wall ties.

For Spec B only Type 1 tie works as 2 and 4 are too short.

For Spec C and D with larger cavities of +160mm special ties are required. These can be Ancon two-part ties for cavities up to 300mm.

For these larger cavities there will be implications on lintel types. More traditional single lintels bridging the cavity wall won't work and single lintels for each skin will be required. There could be an implication on the width of the foundations as a wider cavity may require wider strip footings.

Only one main structural implication of the masonry design that is affected by the larger cavity is the effective width of the internal wall when assessing either the wind load resistance or vertical load capacity. For narrower cavities wider effective widths can be used which enhance the load capacity of the masonry.

One non-structural point worth noting is the extra footprint of a building with larger cavities.

2. Low level Flats - up to 4 storeys.

4 storeys is on the limit of load bearing masonry as more stringent tying of floors and walls are required to satisfy Disproportionate Collapse rules above this. If Load bearing masonry is used then obviously we'd need higher strength blocks. It might be that the AAC block doesn't work at the lower level - and a dense block required particularly if concrete floors are used as the loads are heavier, however, I notice that 215 wide blocks are specified which will have higher vertical load capacity. It may also be viable to use 140mm thick blocks.

As the building is higher than 10m type 4 wall ties cannot be used.

For the baseline spec and spec A use either type 1 or type 2 wall ties.

Spec B needs ST1 ties.

Specs C & D require two-part ties.

If the structure is framed then lower strength blockwork can be used.

3. Flats - 5 to 8 storeys.

Load bearing masonry is not really a viable scheme because of the stringent rules to satisfy Disproportionate Collapse. I have therefore discounted load bearing masonry. I assume that the structure will be either concrete or steel framed.

I notice that there is no scheme using an outer brick skin which could of course be adopted. There is a limit of a maximum lift of 3 storeys for the external leaf so brickwork support angles would be required. There could be an issue with providing suitable insulation at the junction of the support angle and structure. Also adopting wider cavities means that these angles work harder structurally and may prove cost inefficient.

All blockwork masonry is non loadbearing so the lower strength blocks are suitable.

As the building will be greater than 15m high the ties required are Type 1 if cavity walls are considered. It is not particularly clear whether the part of the building under 10m (lower three stories) can have the lower grade ties and only the higher part the higher grade. In any case it is not advisable to have different type ties on site as they will invariably get mixed up.

As the building is higher it attracts higher wind loads and also given that the walls are not supporting vertical loads the lack of pre-compression reduces the ability to withstand lateral wind forces. Windposts will be required at regular intervals with only a single skin and are likely alongside large openings with a cavity wall. An alternative to windposts could be the use of bed joint reinforcement.

Structural Implications for the various wall and building types to Inform Workgroup 1:

Timber Frame and brick perimeter wall

Price and Myers have been asked to review the different types of external wall details for the brick outer skin and timber internal frame and comment only on the structural implications of the options. This form of construction is common for low rise houses and can be used for buildings up to a maximum of 4 storeys. Due to a limitation on the uninterrupted height of brickwork not exceeding 12m or 4 storeys timber frame and brick clad buildings higher than 4 storeys are impractical. This is because the timber frame is unsuitable to support the brickwork at the upper floors.

Below are structural comments for the different wall constructions based on the standard wall and wall specifications A to D:

1. External brick wall + 140mm stud with 50mm cavity

Standard wall tie details can be used in this detail, for example Staifix Frame ties by Ancon. These comply with Type 6 to DD140: part 2 and can be used for buildings up to 4 storeys high. Ties should be installed at a density of 4.4 ties per square metre in buildings where the basic wind speed does not exceed 44m/s (ie Southern England) or in town or cities where this does not exceed 52m/s (ie UK except Western Scotland). The density of ties should increase to 7 ties per square metre in more severe situations. It is assumed that the internal timber frame is strong enough to withstand the lateral wind loads so that windposts are not required.

2. External wall Spec A – brick + 140mm stud with 70mm cavity

Standard wall ties can be used in this detail as for 1 above. It is assumed that the 20mm mineral wool is dressed over the ties so that the ties are connected directly to the plywood layer. Density of ties applies as 1 above.

3. External wall Spec B – brick + 140mm stud with 130mm cavity

Assuming that the wall ties must be fixed to the plywood and not the 80mm thick mineral wool the cavity increases to 130mm overall. The standard Staifix Frame ties in 1&2 above are not suitable as they are only applicable for cavities of 50mm to 75mm. Instead a channel and slot in tie system would be suitable. Ancon 25/14 channels are screwed at around 450mm centres through the ply to the timber studs. Then Ancon SD25 wall ties slot into the channel and are spaced accordingly dependant upon wind zones.

4. External wall Spec C – brick + 140mm stud with 180mm cavity

The tie detail in 3 above suits cavities up to 150mm wide but this specification has a cavity of 180mm. As far as I am aware there is no standard wall detail that works for cavities of this width. For this detail a slot in Ancon SD25 would be required in conjunction with an Ancon 25/14 channel, however as the maximum standard SD25 length is 200mm, a tie special 225mm long will be required. Since a special tie is required the brick tie manufacturer should be consulted to confirm the density of ties. The tie manufacturer should also confirm whether tie specials could be manufactured to order.

5. External wall Spec D – brick + 140mm stud with 330mm cavity

The tie detail in 3 above suits cavities up to 150mm wide but this specification has a cavity of 330mm. As far as I am aware there is no standard wall detail that works for cavities of this width. It is unlikely that the tie detail in 4 above would be suitable at longer lengths, therefore it is vital to consult with brick tie manufacturers prior to adopting this detail.

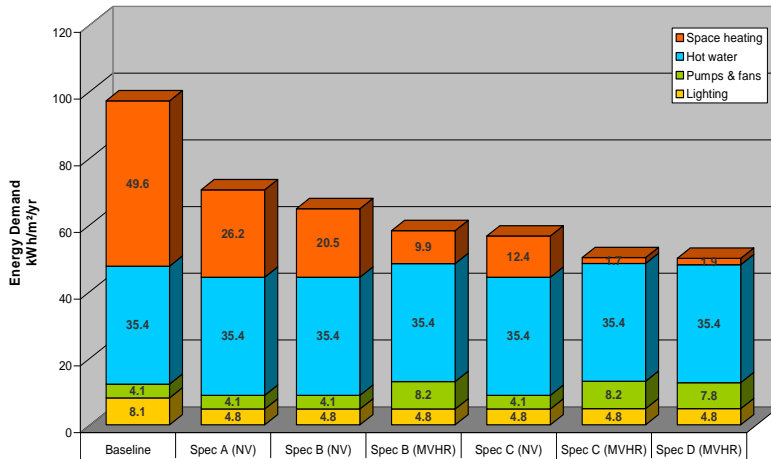
Results of energy modelling

Results of the energy modelling carried out for the Task Group's deliberations are shown below. Explanation is provided only where considered necessary.

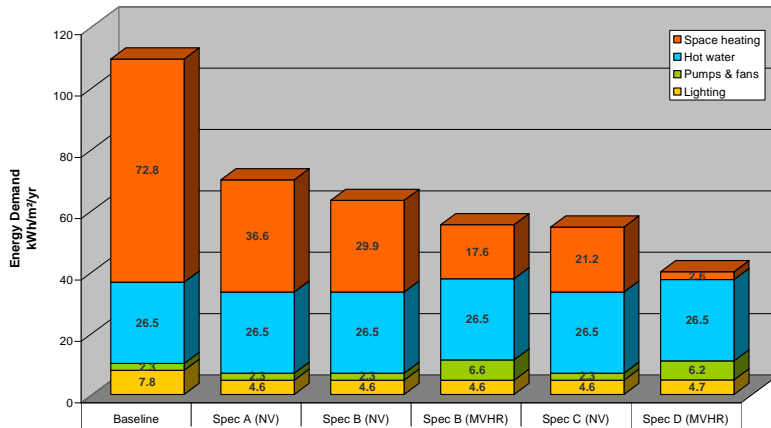
Initial analysis

Selection of initial results

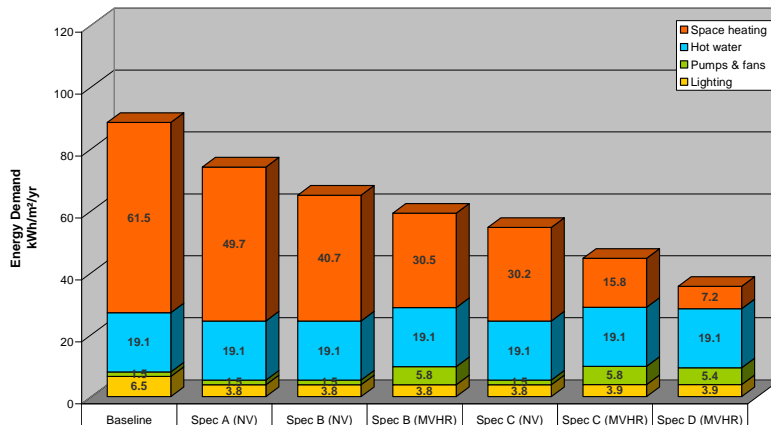
Yearly Energy Demand Comparison - Small Flat Mid



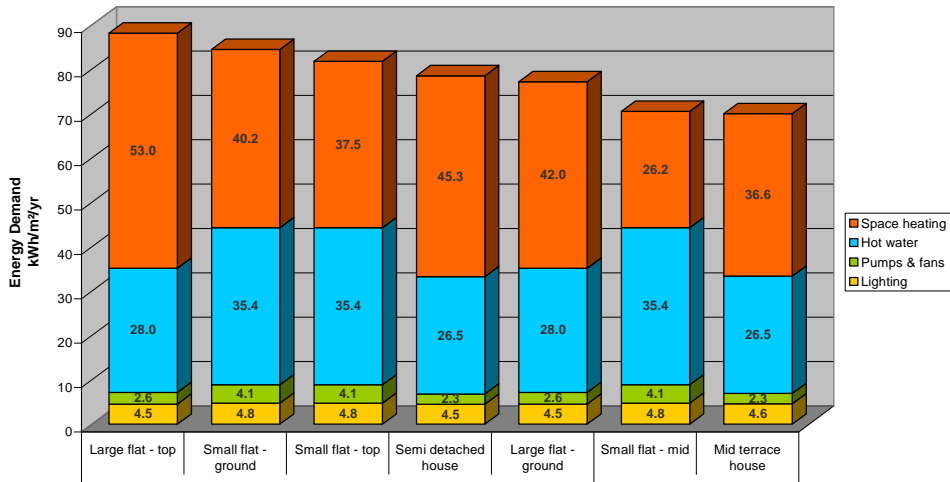
Yearly Energy Demand Comparison - Mid Terrace House



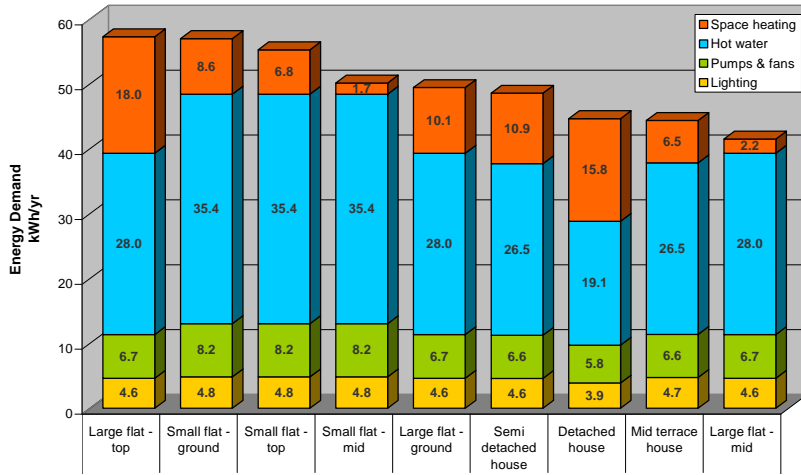
Yearly Energy Demand Comparison - Detached House



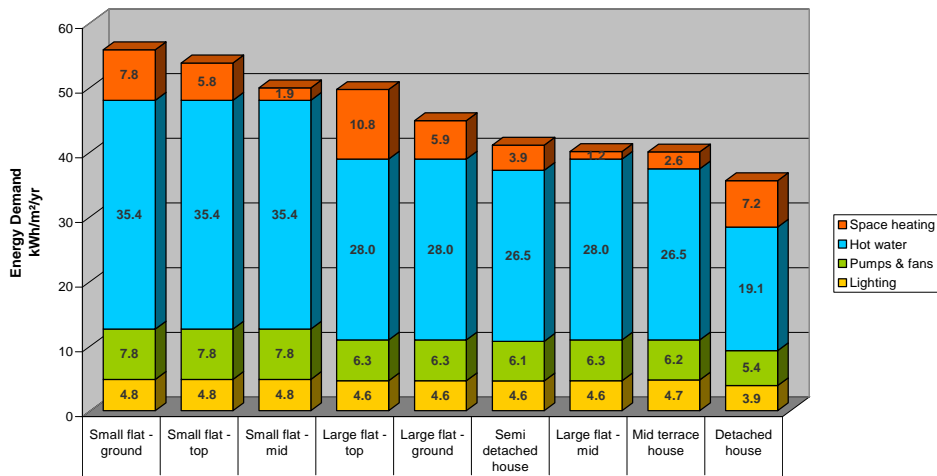
Yearly Energy Demand Comparison - Spec A



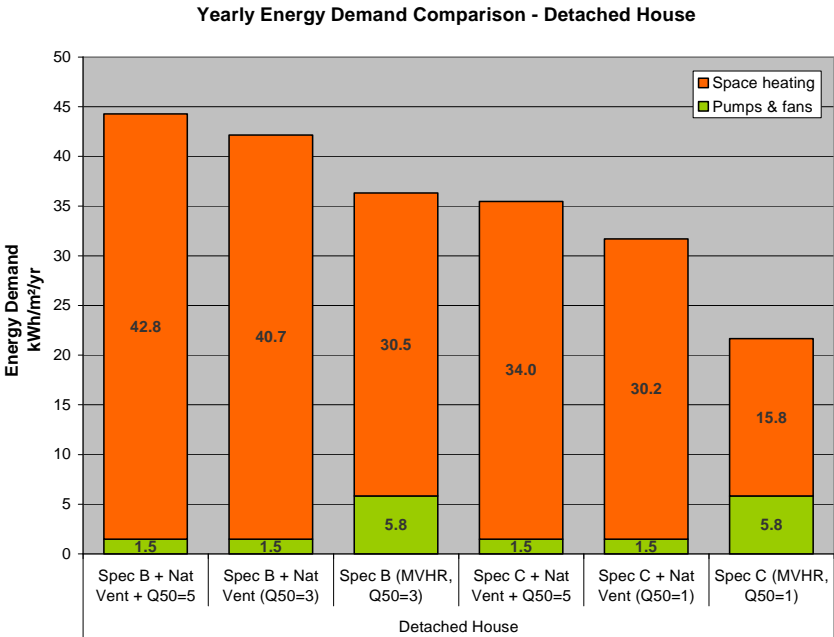
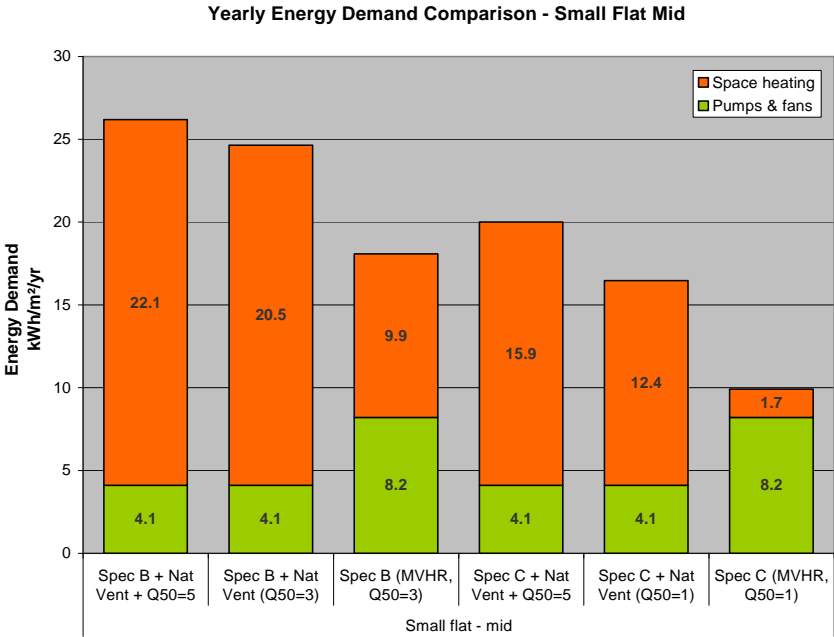
Yearly Energy Demand Comparison - Spec C (MVHR)



Yearly Energy Demand Comparison - Spec D (MVHR)

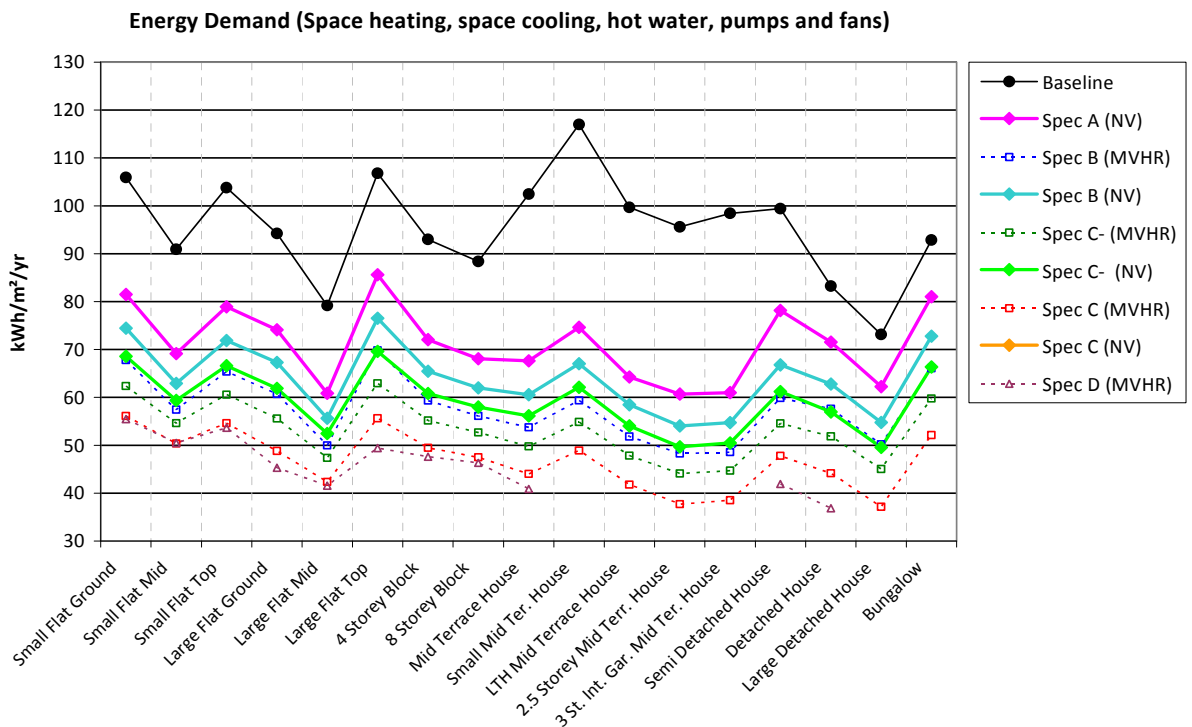
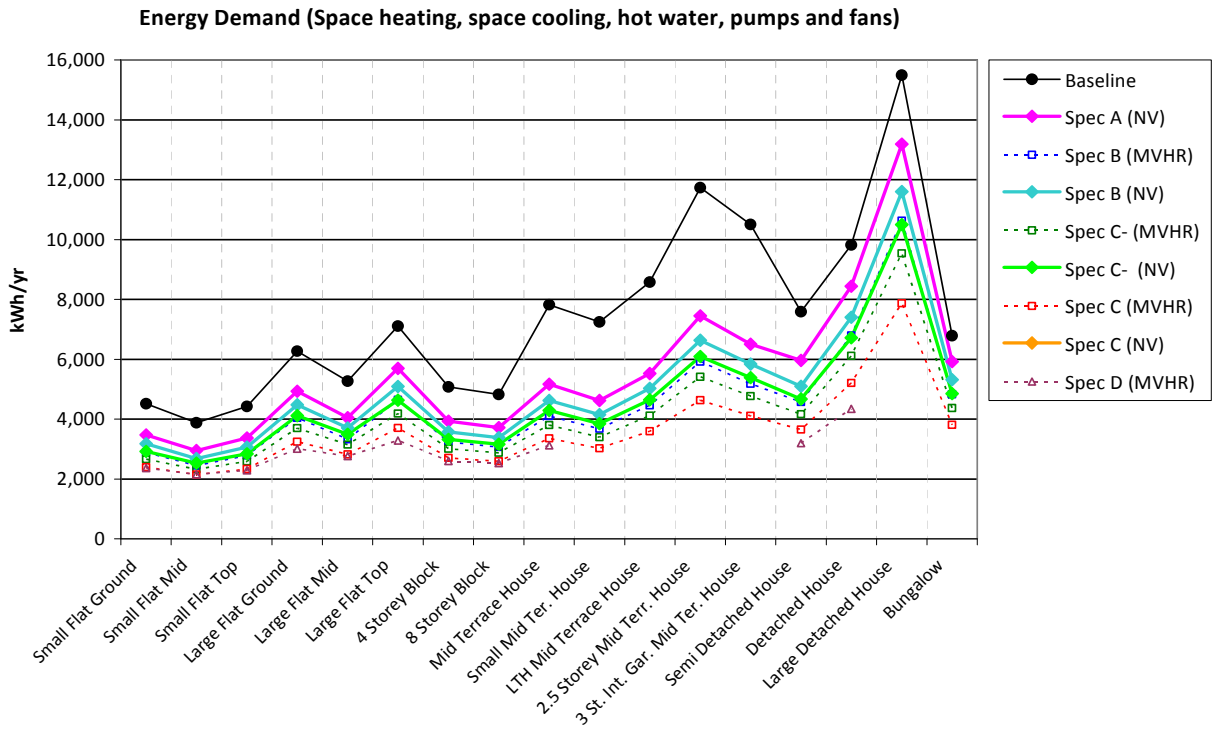


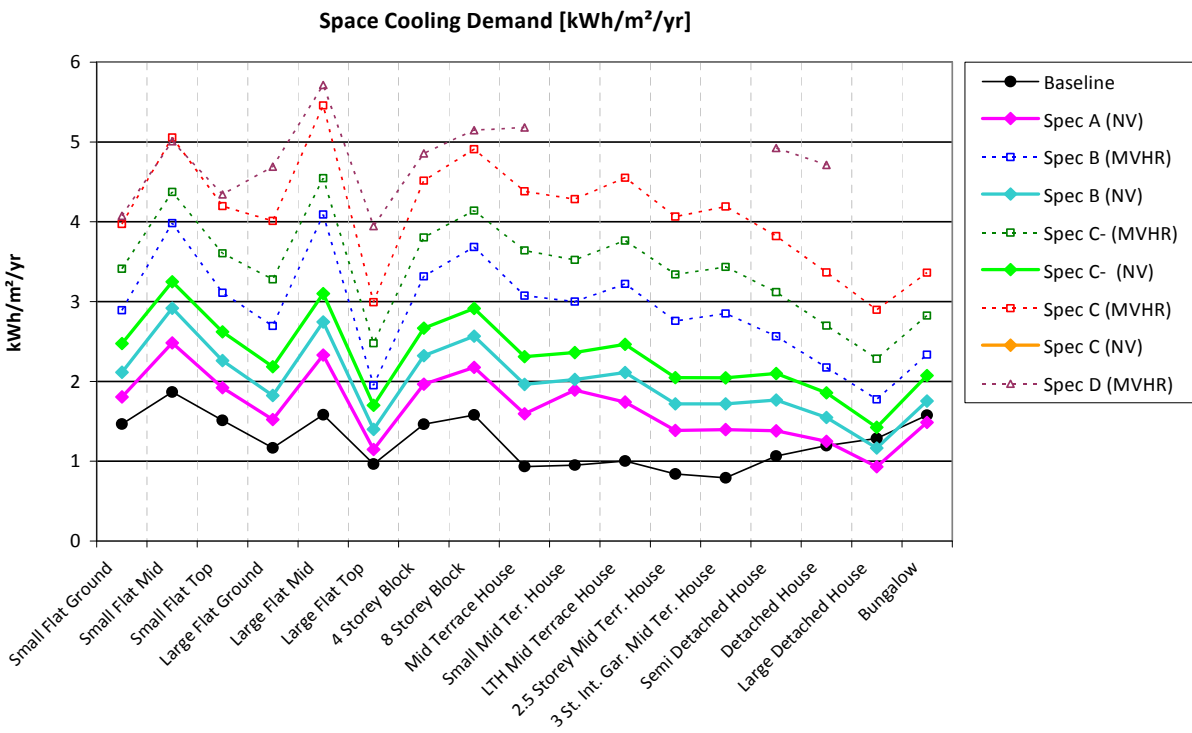
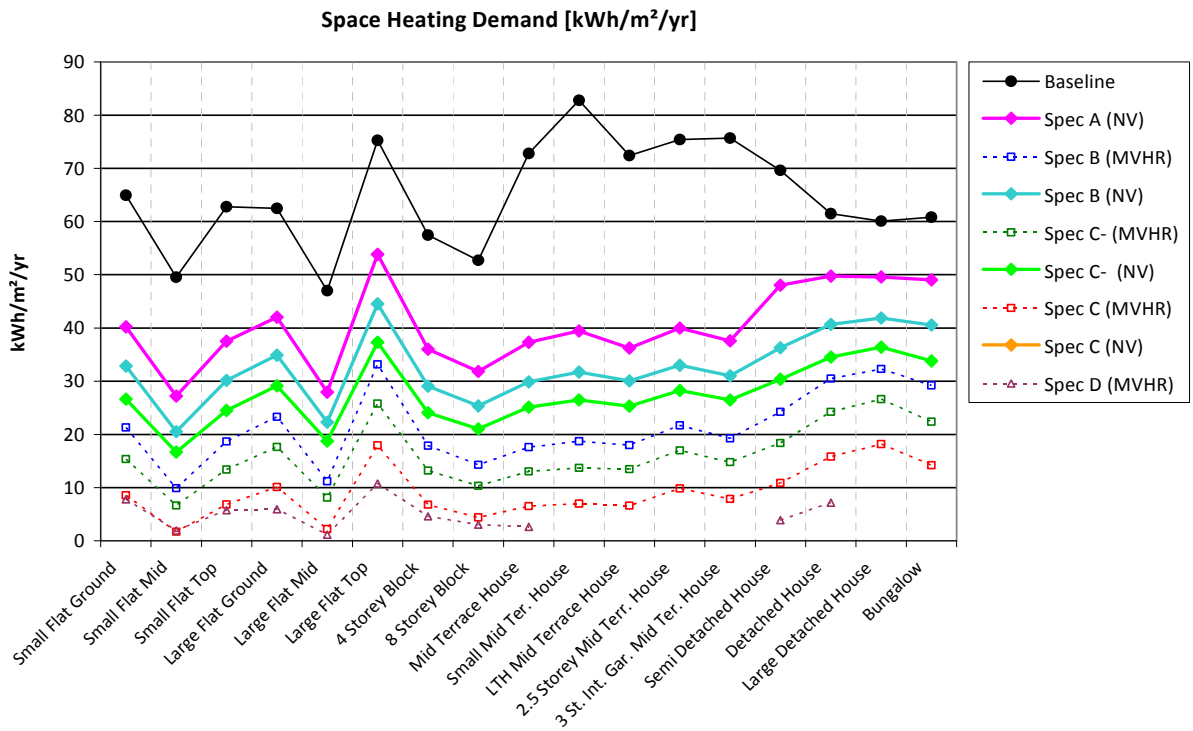
The effect of ventilation heat recovery

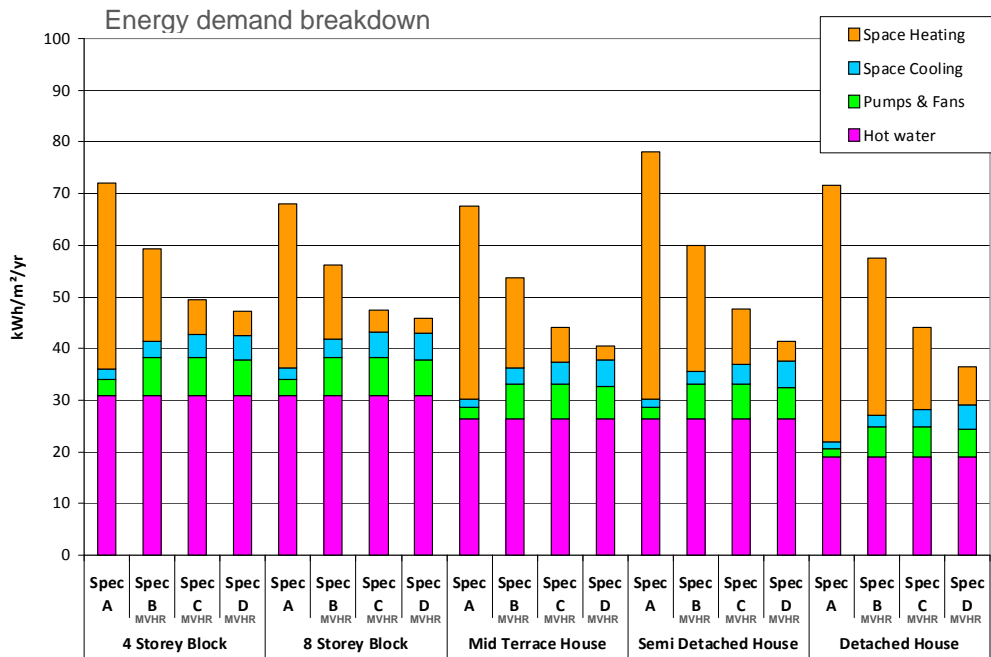
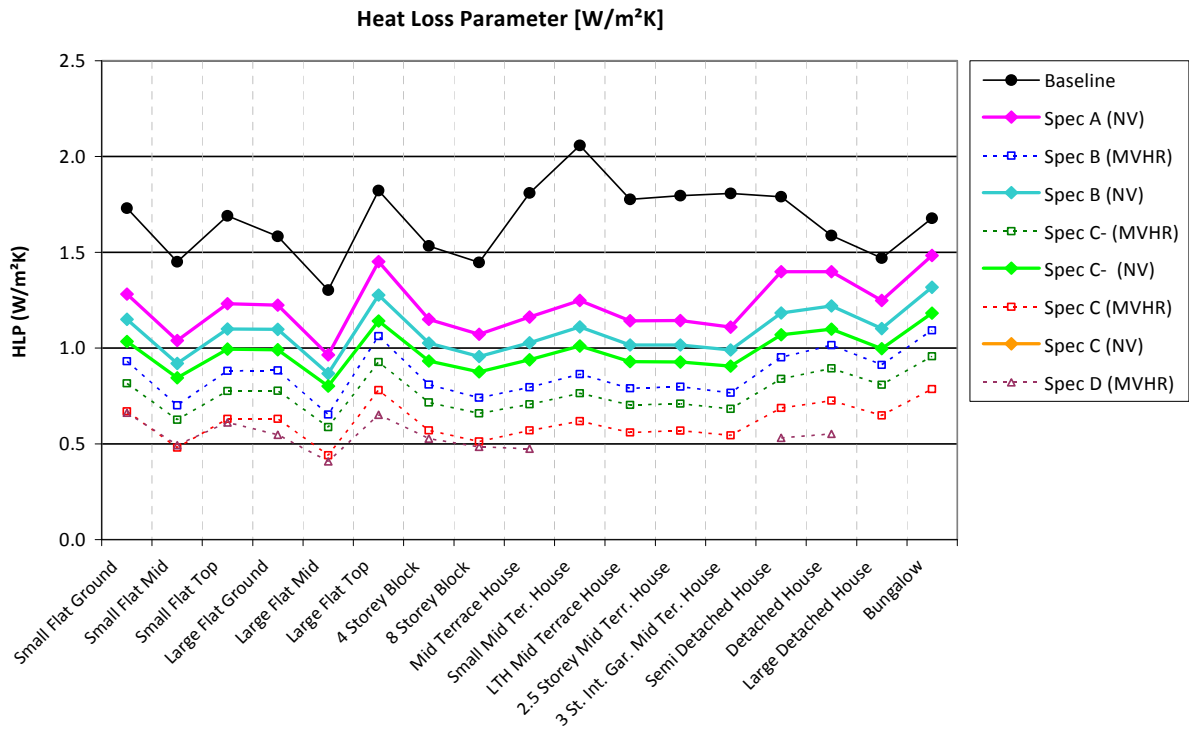


Ventilation heat recovery can significantly reduce space heating demand; but if MVHR is used it comes with a penalty of increased electricity demand for fans.

Further analysis

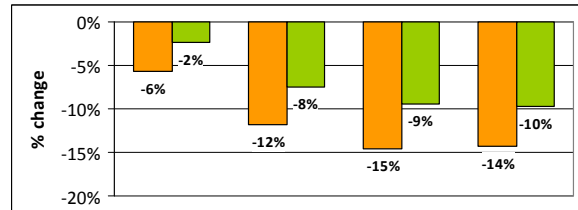
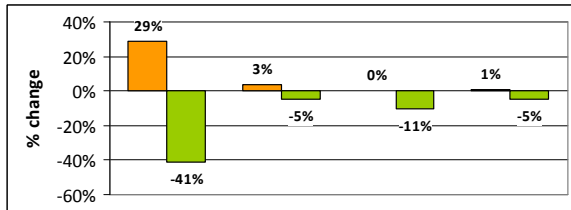
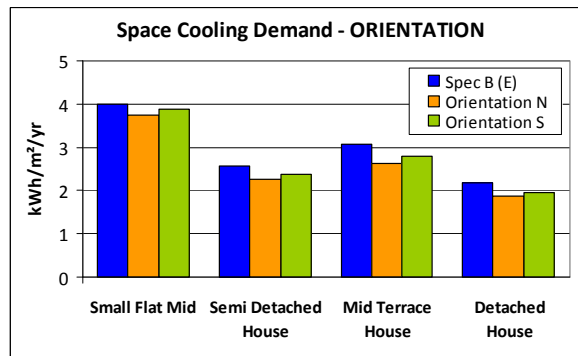
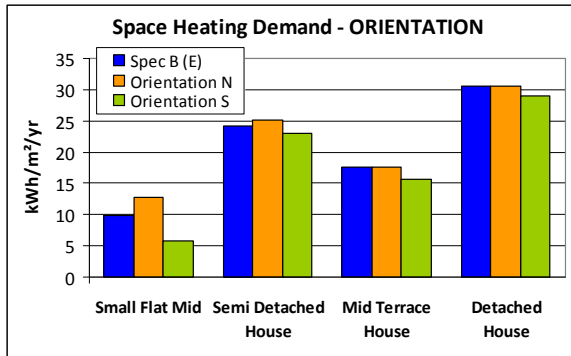




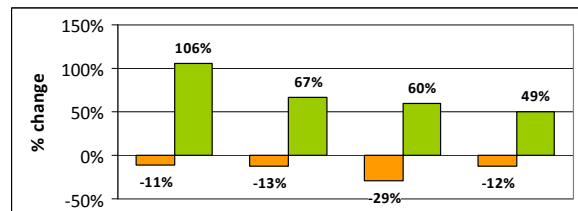
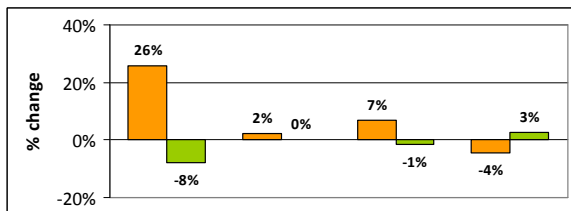
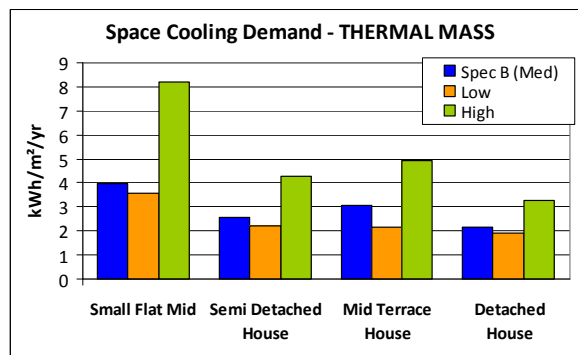
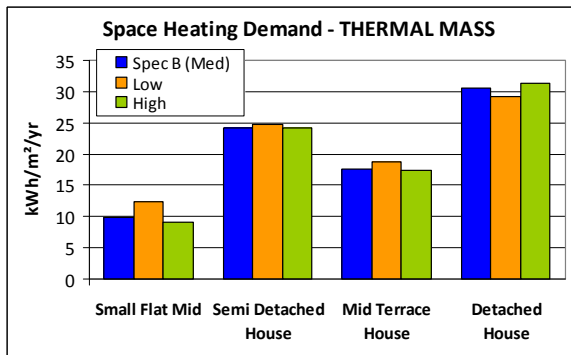


Initial sensitivity modelling

Orientation: Spec B (MVHR)

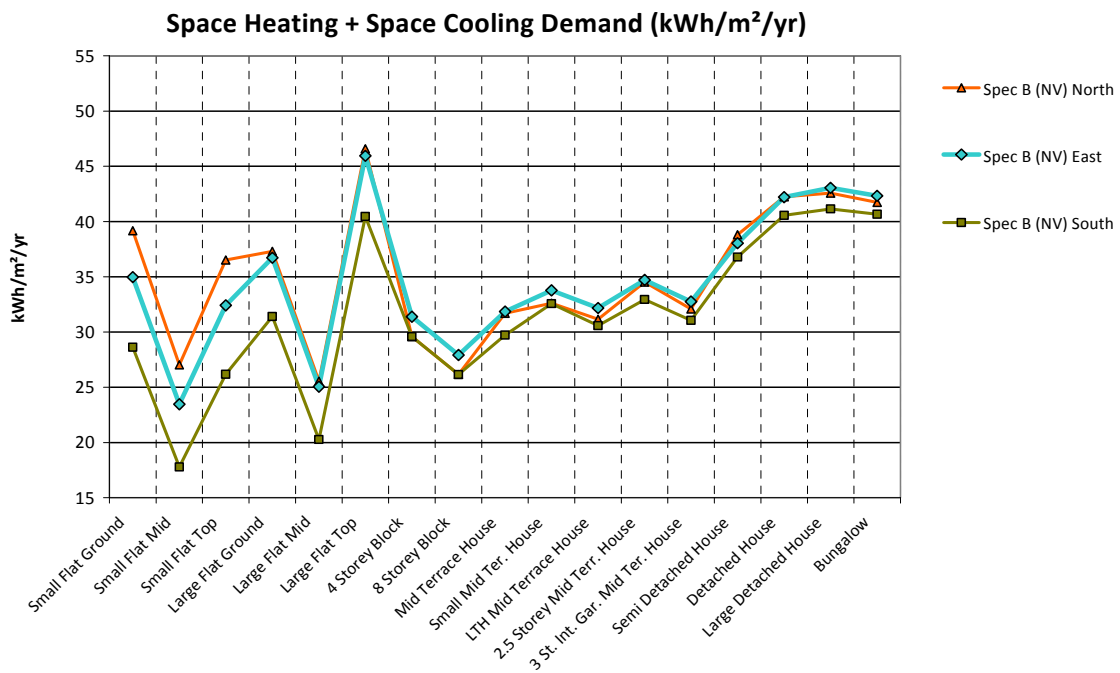


Thermal Mass: Spec B (MVHR)

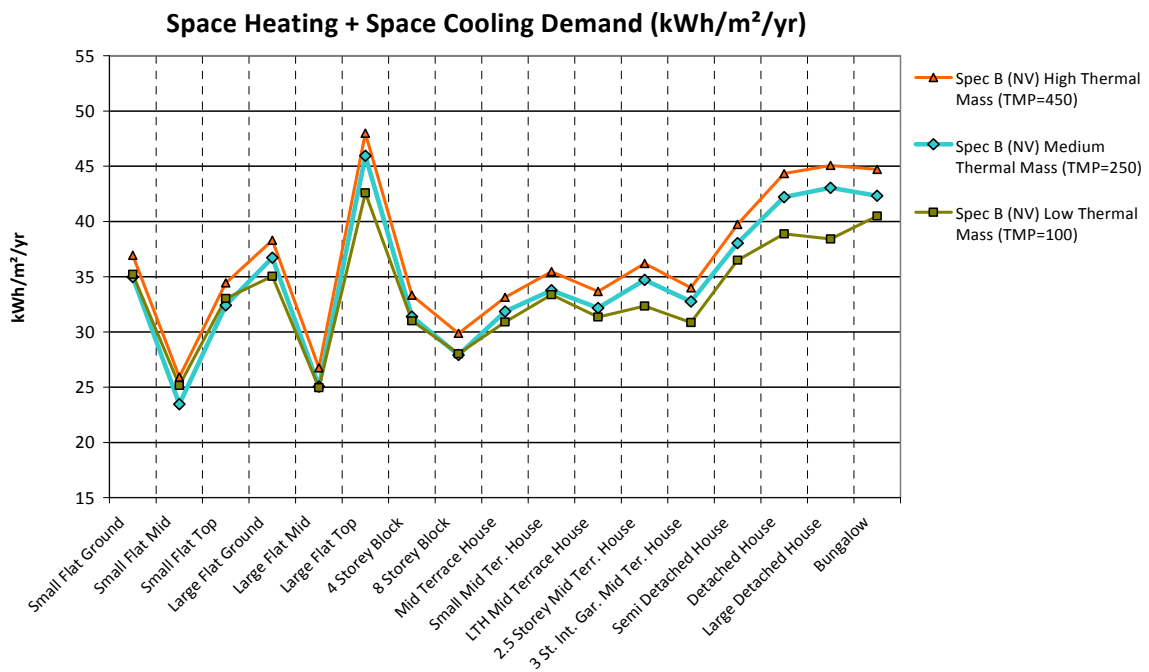


Further sensitivity modelling

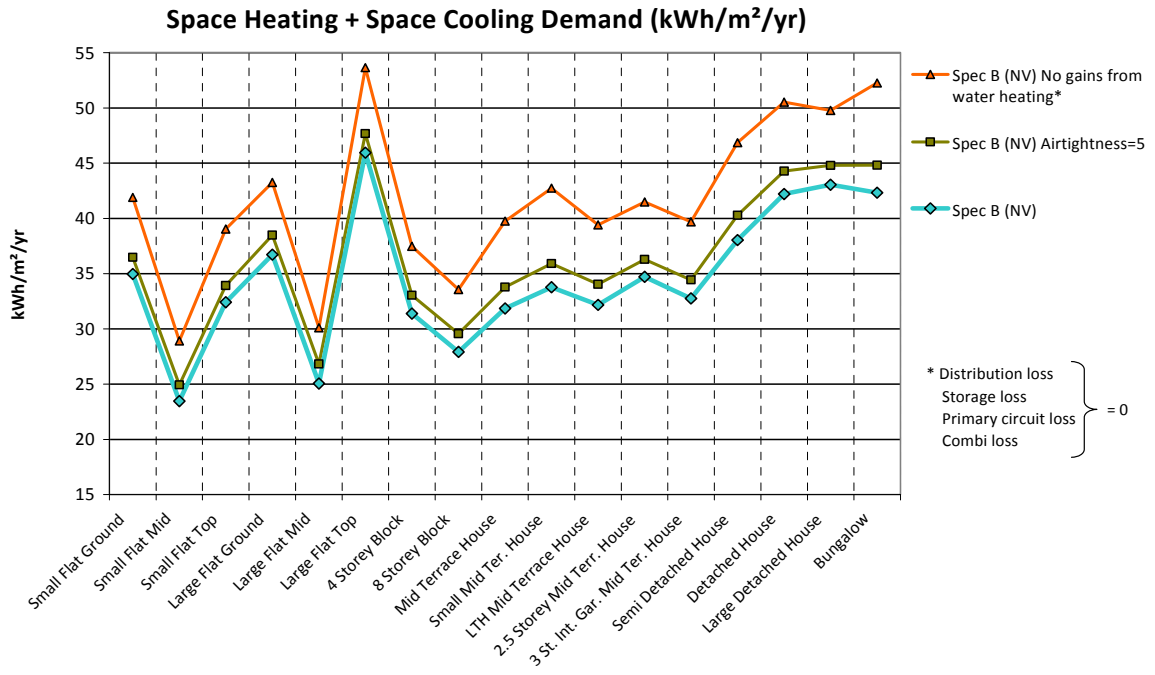
Orientation: Spec B (NV)



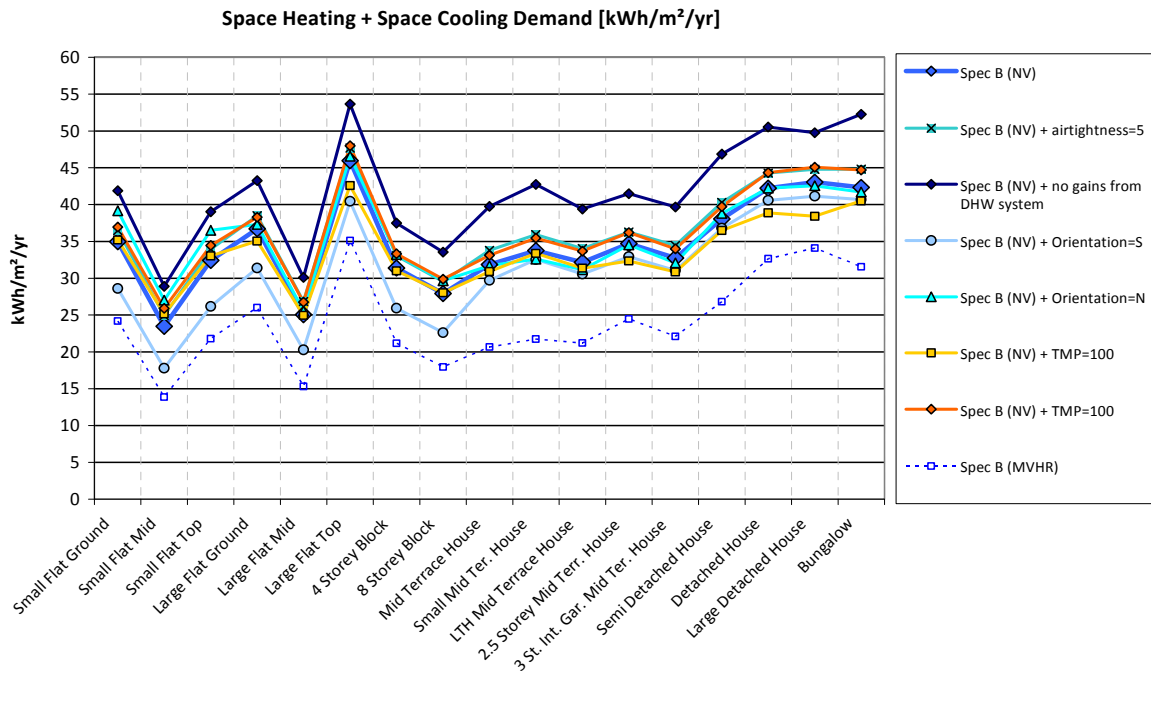
Thermal Mass: Spec B (NV)



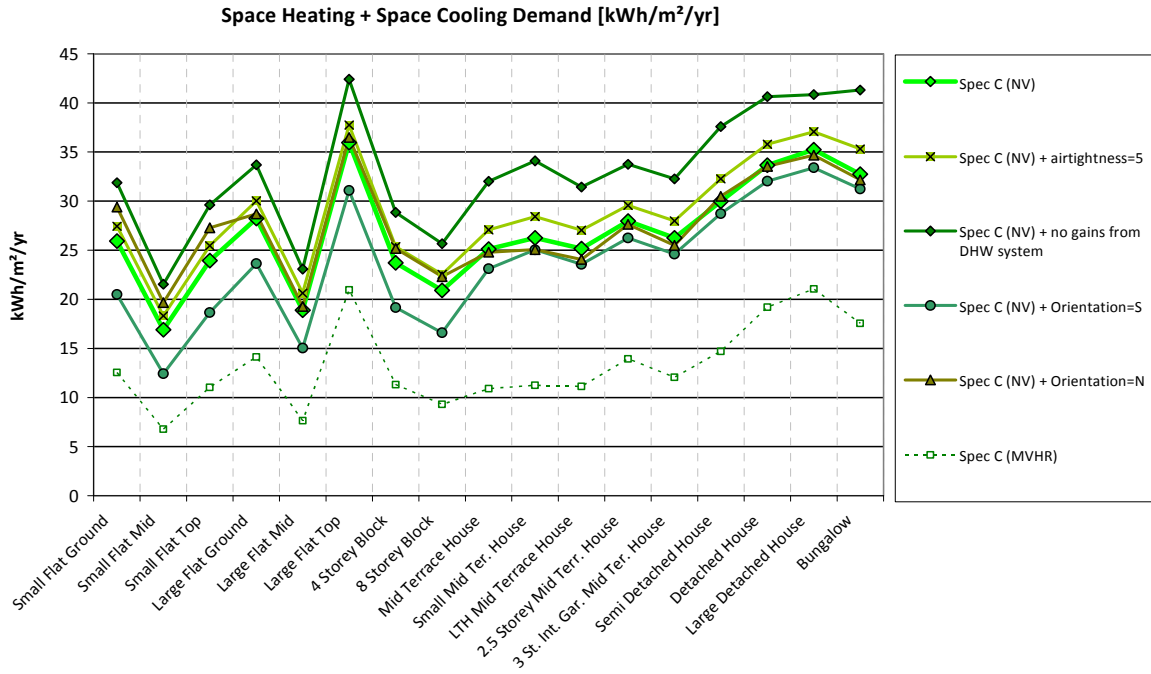
Gains from hot water system, airtightness:
Spec B (NV)



Spec B (NV)



Spec C (NV)



Modified SAP2005 modelling for 70% Carbon Compliance

Small apartment (Ground)

How far with Gas system?

| | SPEC | Baseline | Spec A (NV) | Spec B (MVHR) | Spec B (NV) | Spec C- (MVHR) | Spec C- (NV) | Spec C (MVHR) | Spec C (NV) | Spec D (MVHR) |
|--|---------------------------|----------|-------------|---------------|-------------|----------------|--------------|---------------|-------------|---------------|
| Yearly energy demands (kWh/yr) | Hot water | 2007.98 | 2007.98 | 2007.98 | 2007.98 | 2007.98 | 2007.98 | 2007.98 | 2007.98 | 2007.98 |
| | Space heating | 1715.00 | 1478.01 | 790.34 | 1232.78 | 611.56 | 1019.33 | 472.15 | 934.07 | 494.50 |
| | Pumps & fans | 175.00 | 175.00 | 309.15 | 175.00 | 309.15 | 175.00 | 336.24 | 175.00 | 344.24 |
| | Lighting* | 334.40 | 191.09 | 191.09 | 191.09 | 191.09 | 191.09 | 194.24 | 194.24 | 194.24 |
| Yearly energy consumption (kWh/yr) | Hot water | 2231.08 | 2231.08 | 2231.08 | 2231.08 | 2231.08 | 2231.08 | 2231.08 | 2231.08 | 2231.08 |
| | Space heating (main) | 1715.00 | 1478.01 | 790.34 | 1232.78 | 611.56 | 1019.33 | 472.15 | 934.07 | 494.50 |
| | Space heating (secondary) | 171.50 | 147.80 | 79.03 | 123.28 | 61.16 | 101.93 | 47.22 | 93.41 | 49.45 |
| | Pumps & fans | 175.00 | 175.00 | 309.15 | 175.00 | 309.15 | 175.00 | 336.24 | 175.00 | 344.24 |
| | Lighting* | 334.40 | 191.09 | 191.09 | 191.09 | 191.09 | 191.09 | 194.24 | 194.24 | 194.24 |
| | PV energy input | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2006 methodology | DER | 24.62 | 23.05 | 20.66 | 21.72 | 19.70 | 20.56 | 19.27 | 20.14 | 19.46 |
| | % improvement | 9% | 15% | 23% | 19% | 27% | 24% | 29% | 25% | 28% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 432.83 | 432.83 | 432.83 | 432.83 | 432.83 | 432.83 | 432.83 | 432.83 | 432.83 |
| | Space heating (main) | 332.71 | 286.73 | 153.33 | 239.16 | 118.64 | 197.75 | 91.60 | 181.21 | 95.93 |
| | Space heating (secondary) | 73.75 | 63.55 | 33.98 | 53.01 | 26.30 | 43.83 | 20.30 | 40.17 | 21.26 |
| | Pumps & fans | 75.25 | 75.25 | 132.93 | 75.25 | 132.93 | 75.25 | 144.58 | 75.25 | 148.02 |
| | Lighting* | 143.79 | 82.17 | 82.17 | 82.17 | 82.17 | 82.17 | 83.52 | 83.52 | 83.52 |
| | Saved by PV | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 |
| | Adjusted DER | 24.82 | 22.06 | 19.59 | 20.69 | 18.59 | 19.51 | 18.12 | 19.07 | 18.33 |
| | % improvement | 8% | 19% | 28% | 24% | 31% | 28% | 33% | 30% | 32% |
| PV System | kWp PV | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

* Without cap on low energy lighting

For 70% Carbon Compliance with Solar Thermal and PV

| | SPEC | ST & PV Baseline +70% | ST & PV Spec A (NV) +70% | ST & PV Spec B (MVHR) +70% | ST & PV Spec B (NV) +70% | ST & PV Spec C- (MVHR) +70% | ST & PV Spec C- (NV) +70% | ST & PV Spec C (MVHR) +70% | ST & PV Spec C (NV) +70% | ST & PV Spec D (MVHR) +70% |
|--|---------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------|--------------------------------|------------------------------|-------------------------------|-----------------------------|-------------------------------|
| Yearly energy demands (kWh/yr) | Hot water | 1491.37 | 1491.37 | 1491.37 | 1491.37 | 1491.37 | 1491.37 | 1491.37 | 1491.37 | 1491.37 |
| | Space heating | 1715.00 | 1478.01 | 790.34 | 1232.78 | 611.56 | 1019.33 | 472.15 | 934.07 | 494.50 |
| | Pumps & fans | 250.00 | 250.00 | 384.15 | 250.00 | 384.15 | 250.00 | 411.24 | 250.00 | 419.24 |
| | Lighting* | 334.40 | 191.09 | 191.09 | 191.09 | 191.09 | 191.09 | 194.24 | 194.24 | 194.24 |
| Yearly energy consumption (kWh/yr) | Hot water | 1657.08 | 1657.08 | 1657.08 | 1657.08 | 1657.08 | 1657.08 | 1657.08 | 1657.08 | 1657.08 |
| | Space heating (main) | 1715.00 | 1478.01 | 790.34 | 1232.78 | 611.56 | 1019.33 | 472.15 | 934.07 | 494.50 |
| | Space heating (secondary) | 171.50 | 147.80 | 79.03 | 123.28 | 61.16 | 101.93 | 47.22 | 93.41 | 49.45 |
| | Pumps & fans | 250.00 | 250.00 | 384.15 | 250.00 | 384.15 | 250.00 | 411.24 | 250.00 | 419.24 |
| | Lighting* | 334.40 | 191.09 | 191.09 | 191.09 | 191.09 | 191.09 | 194.24 | 194.24 | 194.24 |
| | PV energy input | 1458.80 | 1208.72 | 958.64 | 1067.01 | 850.27 | 933.63 | 816.93 | 900.29 | 833.60 |
| 2006 methodology | DER | 3.31 | 5.08 | 6.02 | 5.63 | 6.50 | 6.25 | 6.52 | 6.28 | 6.49 |
| | % improvement | 88% | 81% | 78% | 79% | 76% | 77% | 76% | 77% | 76% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 321.47 | 321.47 | 321.47 | 321.47 | 321.47 | 321.47 | 321.47 | 321.47 | 321.47 |
| | Space heating (main) | 332.71 | 286.73 | 153.33 | 239.16 | 118.64 | 197.75 | 91.60 | 181.21 | 95.93 |
| | Space heating (secondary) | 73.75 | 63.55 | 33.98 | 53.01 | 26.30 | 43.83 | 20.30 | 40.17 | 21.26 |
| | Pumps & fans | 107.50 | 107.50 | 165.18 | 107.50 | 165.18 | 107.50 | 176.83 | 107.50 | 180.27 |
| | Lighting* | 143.79 | 82.17 | 82.17 | 82.17 | 82.17 | 82.17 | 83.52 | 83.52 | 83.52 |
| | Saved by PV | 627.28 | 519.75 | 412.22 | 458.81 | 365.62 | 401.46 | 351.28 | 387.12 | 358.45 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 | 27.07 |
| | Adjusted DER | 8.25 | 8.01 | 8.07 | 8.08 | 8.16 | 8.24 | 8.03 | 8.13 | 8.07 |
| | % improvement | 70% | 70% | 70% | 70% | 70% | 70% | 70% | 70% | 70% |
| PV System | kWp PV | 1.75 | 1.45 | 1.15 | 1.28 | 1.02 | 1.12 | 0.98 | 1.08 | 1.00 |

* Without cap on low energy lighting

End terrace/ semi-detached house

How far with Gas system?

| SPEC | GAS | GAS | GAS | GAS | GAS | GAS | GAS | GAS | GAS |
|--|---------------------------|-------------|---------------|-------------|----------------|--------------|---------------|-------------|---------------|
| | Baseline | Spec A (NV) | Spec B (MVHR) | Spec B (NV) | Spec C- (MVHR) | Spec C- (NV) | Spec C (MVHR) | Spec C (NV) | Spec D (MVHR) |
| Yearly energy demands (kWh/yr) | Hot water | 2699.72 | 2699.72 | 2699.72 | 2699.72 | 2699.72 | 2699.72 | 2699.72 | 2699.72 |
| | Space heating | 3464.45 | 2778.10 | 1457.85 | 2307.71 | 1134.41 | 1935.05 | 850.96 | 1772.89 |
| | Pumps & fans | 175.00 | 175.00 | 415.16 | 175.00 | 415.16 | 175.00 | 476.66 | 175.00 |
| | Lighting* | 599.95 | 349.97 | 349.97 | 349.97 | 349.97 | 349.97 | 359.07 | 359.07 |
| Yearly energy consumption (kWh/yr) | Hot water | 2999.69 | 2999.69 | 2999.69 | 2999.69 | 2999.69 | 2999.69 | 2999.69 | 2999.69 |
| | Space heating (main) | 3464.45 | 2778.10 | 1457.85 | 2307.71 | 1134.41 | 1935.05 | 850.96 | 1772.89 |
| | Space heating (secondary) | 346.44 | 277.81 | 145.78 | 230.77 | 113.44 | 193.50 | 85.10 | 177.29 |
| | Pumps & fans | 175.00 | 175.00 | 415.16 | 175.00 | 415.16 | 175.00 | 476.66 | 175.00 |
| | Lighting* | 599.95 | 349.97 | 349.97 | 349.97 | 349.97 | 349.97 | 359.07 | 359.07 |
| | PV energy input | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2006 methodology | DER | 22.61 | 20.21 | 17.54 | 18.78 | 16.58 | 17.64 | 16.16 | 17.23 |
| | % improvement | 4% | 14% | 26% | 20% | 30% | 25% | 31% | 27% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 581.94 | 581.94 | 581.94 | 581.94 | 581.94 | 581.94 | 581.94 | 581.94 |
| | Space heating (main) | 672.10 | 538.95 | 282.82 | 447.70 | 220.08 | 375.40 | 165.09 | 343.94 |
| | Space heating (secondary) | 148.97 | 119.46 | 62.69 | 99.23 | 48.78 | 83.21 | 36.59 | 76.23 |
| | Pumps & fans | 75.25 | 75.25 | 178.52 | 75.25 | 178.52 | 75.25 | 204.96 | 75.25 |
| | Lighting* | 257.98 | 150.49 | 150.49 | 150.49 | 150.49 | 150.49 | 154.40 | 154.40 |
| | Saved by PV | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 |
| | Adjusted DER | 22.75 | 19.21 | 16.46 | 17.75 | 15.46 | 16.59 | 14.98 | 16.14 |
| | % improvement | 4% | 19% | 30% | 25% | 35% | 30% | 37% | 32% |
| | PV System kWp PV | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

* Without cap on low energy lighting

For 70% Carbon Compliance with Solar Thermal and PV

| SPEC | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV |
|--|---------------------------|-------------------|---------------------|-------------------|----------------------|--------------------|---------------------|-------------------|---------------------|
| | Baseline + 70% | Spec A (NV) + 70% | Spec B (MVHR) + 70% | Spec B (NV) + 70% | Spec C- (MVHR) + 70% | Spec C- (NV) + 70% | Spec C (MVHR) + 70% | Spec C (NV) + 70% | Spec D (MVHR) + 70% |
| Yearly energy demands (kWh/yr) | Hot water | 1492.64 | 1492.64 | 1492.64 | 1492.64 | 1492.64 | 1492.64 | 1492.64 | 1492.64 |
| | Space heating | 3495.39 | 2805.91 | 1475.92 | 2332.25 | 1149.09 | 1957.41 | 862.42 | 1794.54 |
| | Pumps & fans | 250.00 | 250.00 | 490.16 | 250.00 | 490.16 | 250.00 | 551.66 | 250.00 |
| | Lighting* | 599.95 | 349.97 | 349.97 | 349.97 | 349.97 | 349.97 | 359.07 | 359.07 |
| Yearly energy consumption (kWh/yr) | Hot water | 1658.48 | 1658.48 | 1658.48 | 1658.48 | 1658.48 | 1658.48 | 1658.48 | 1658.48 |
| | Space heating (main) | 3495.39 | 2805.91 | 1475.92 | 2332.25 | 1149.09 | 1957.41 | 862.42 | 1794.54 |
| | Space heating (secondary) | 349.54 | 280.59 | 147.59 | 233.22 | 114.91 | 195.74 | 86.24 | 179.45 |
| | Pumps & fans | 250.00 | 250.00 | 490.16 | 250.00 | 490.16 | 250.00 | 551.66 | 250.00 |
| | Lighting* | 599.95 | 349.97 | 349.97 | 349.97 | 349.97 | 349.97 | 359.07 | 359.07 |
| | PV energy input | 2250.72 | 1625.52 | 1125.36 | 1375.44 | 958.64 | 1167.04 | 875.28 | 1083.68 |
| 2006 methodology | DER | 2.96 | 5.20 | 6.11 | 5.62 | 6.49 | 6.03 | 6.69 | 6.24 |
| | % improvement | 87% | 78% | 74% | 76% | 72% | 74% | 72% | 74% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 321.75 | 321.75 | 321.75 | 321.75 | 321.75 | 321.75 | 321.75 | 321.75 |
| | Space heating (main) | 678.11 | 544.35 | 286.33 | 452.46 | 222.92 | 379.74 | 167.31 | 348.14 |
| | Space heating (secondary) | 150.30 | 120.65 | 63.46 | 100.28 | 49.41 | 84.17 | 37.08 | 77.16 |
| | Pumps & fans | 107.50 | 107.50 | 210.77 | 107.50 | 210.77 | 107.50 | 237.21 | 107.50 |
| | Lighting* | 257.98 | 150.49 | 150.49 | 150.49 | 150.49 | 150.49 | 154.40 | 154.40 |
| | Saved by PV | 967.81 | 698.97 | 483.90 | 591.44 | 412.22 | 501.83 | 376.37 | 465.98 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 | 23.69 |
| | Adjusted DER | 7.18 | 7.15 | 7.19 | 7.09 | 7.12 | 7.10 | 7.09 | 7.11 |
| | % improvement | 70% | 70% | 70% | 70% | 70% | 70% | 70% | 70% |
| | PV System kWp PV | 2.70 | 1.95 | 1.35 | 1.65 | 1.15 | 1.40 | 1.05 | 1.30 |

* Without cap on low energy lighting

Detached house

How far with Gas system?

| SPEC | GAS | GAS | GAS | GAS | GAS | GAS | GAS | GAS | GAS |
|--|---------------------------|-------------|---------------|-------------|----------------|--------------|---------------|-------------|---------------|
| | Baseline | Spec A (NV) | Spec B (MVHR) | Spec B (NV) | Spec C- (MVHR) | Spec C- (NV) | Spec C (MVHR) | Spec C (NV) | Spec D (MVHR) |
| Yearly energy demands (kWh/yr) | Hot water | 3372.80 | 3372.80 | 3372.80 | 3372.80 | 3372.80 | 3372.80 | 3372.80 | 3372.80 |
| | Space heating | 5708.06 | 4696.86 | 2552.34 | 3785.55 | 1987.03 | 3162.86 | 1470.77 | 2774.15 |
| | Pumps & fans | 175.00 | 175.00 | 534.51 | 175.00 | 534.51 | 175.00 | 637.23 | 175.00 |
| | Lighting* | 881.71 | 529.02 | 529.02 | 529.02 | 529.02 | 529.02 | 538.27 | 538.27 |
| Yearly energy consumption (kWh/yr) | Hot water | 3747.56 | 3747.56 | 3747.56 | 3747.56 | 3747.56 | 3747.56 | 3747.56 | 3747.56 |
| | Space heating (main) | 5708.06 | 4696.86 | 2552.34 | 3785.55 | 1987.03 | 3162.86 | 1470.77 | 2774.15 |
| | Space heating (secondary) | 570.81 | 469.69 | 255.23 | 378.56 | 198.70 | 316.29 | 147.08 | 277.42 |
| | Pumps & fans | 175.00 | 175.00 | 534.51 | 175.00 | 534.51 | 175.00 | 637.23 | 175.00 |
| | Lighting* | 881.71 | 529.02 | 529.02 | 529.02 | 529.02 | 529.02 | 538.27 | 538.27 |
| | PV energy input | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2006 methodology | DER | 21.43 | 19.11 | 16.21 | 17.33 | 15.11 | 16.11 | 14.53 | 15.40 |
| | % improvement | 4% | 15% | 28% | 23% | 33% | 28% | 35% | 40% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 727.03 | 727.03 | 727.03 | 727.03 | 727.03 | 727.03 | 727.03 | 727.03 |
| | Space heating (main) | 1107.36 | 911.19 | 495.15 | 734.40 | 385.48 | 613.59 | 285.33 | 538.19 |
| | Space heating (secondary) | 245.45 | 201.97 | 109.75 | 162.78 | 85.44 | 136.00 | 63.24 | 119.29 |
| | Pumps & fans | 75.25 | 75.25 | 229.84 | 75.25 | 229.84 | 75.25 | 274.01 | 75.25 |
| | Lighting* | 379.14 | 227.48 | 227.48 | 227.48 | 227.48 | 227.48 | 231.46 | 231.46 |
| | Saved by PV | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 |
| | Adjusted DER | 21.49 | 18.17 | 15.17 | 16.34 | 14.04 | 15.09 | 13.41 | 14.34 |
| | % improvement | 5% | 19% | 33% | 27% | 38% | 33% | 40% | 36% |
| PV System | kWp PV | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

* Without cap on low energy lighting

For 70% Carbon Compliance with Solar Thermal and PV

| SPEC | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV | ST & PV |
|--|---------------------------|-------------------|---------------------|-------------------|----------------------|--------------------|---------------------|-------------------|---------------------|
| | Baseline + 70% | Spec A (NV) + 70% | Spec B (MVHR) + 70% | Spec B (NV) + 70% | Spec C- (MVHR) + 70% | Spec C- (NV) + 70% | Spec C (MVHR) + 70% | Spec C (NV) + 70% | Spec D (MVHR) + 70% |
| Yearly energy demands (kWh/yr) | Hot water | 1991.47 | 1991.47 | 1991.47 | 1991.47 | 1991.47 | 1991.47 | 1991.47 | 1991.47 |
| | Space heating | 5743.74 | 4730.17 | 2574.48 | 3814.22 | 2005.19 | 3189.05 | 1485.33 | 2799.04 |
| | Pumps & fans | 250.00 | 250.00 | 609.51 | 250.00 | 609.51 | 250.00 | 712.23 | 250.00 |
| | Lighting* | 881.71 | 529.02 | 529.02 | 529.02 | 529.02 | 529.02 | 538.27 | 538.27 |
| Yearly energy consumption (kWh/yr) | Hot water | 2212.75 | 2212.75 | 2212.75 | 2212.75 | 2212.75 | 2212.75 | 2212.75 | 2212.75 |
| | Space heating (main) | 5743.74 | 4730.17 | 2574.48 | 3814.22 | 2005.19 | 3189.05 | 1485.33 | 2799.04 |
| | Space heating (secondary) | 574.37 | 473.02 | 257.45 | 381.42 | 200.52 | 318.91 | 148.53 | 279.90 |
| | Pumps & fans | 250.00 | 250.00 | 609.51 | 250.00 | 609.51 | 250.00 | 712.23 | 250.00 |
| | Lighting* | 881.71 | 529.02 | 529.02 | 529.02 | 529.02 | 529.02 | 538.27 | 538.27 |
| | PV energy input | 3417.76 | 2500.80 | 1708.88 | 2000.64 | 1375.44 | 1667.20 | 1208.72 | 1458.80 |
| 2006 methodology | DER | 2.78 | 4.88 | 5.76 | 5.49 | 6.27 | 5.87 | 6.48 | 6.93 |
| | % improvement | 88% | 78% | 74% | 76% | 72% | 74% | 71% | 69% |
| ZC ConDoc Adjusted CO ₂ emissions (kgCO ₂ /yr) | Hot water | 429.27 | 429.27 | 429.27 | 429.27 | 429.27 | 429.27 | 429.27 | 429.27 |
| | Space heating (main) | 1114.29 | 917.65 | 499.45 | 739.96 | 389.01 | 618.68 | 288.15 | 543.01 |
| | Space heating (secondary) | 246.98 | 203.40 | 110.70 | 164.01 | 86.22 | 137.13 | 63.87 | 120.36 |
| | Pumps & fans | 107.50 | 107.50 | 262.09 | 107.50 | 262.09 | 107.50 | 306.26 | 107.50 |
| | Lighting* | 379.14 | 227.48 | 227.48 | 227.48 | 227.48 | 227.48 | 231.46 | 231.46 |
| | Saved by PV | 1469.64 | 1075.34 | 734.82 | 860.28 | 591.44 | 716.90 | 519.75 | 627.28 |
| Adjusted CO ₂ emissions (kgCO ₂ /m ² /yr) | Adjusted TER | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 | 22.53 |
| | Adjusted DER | 6.85 | 6.87 | 6.73 | 6.85 | 6.81 | 6.81 | 6.78 | 6.82 |
| | % improvement | 70% | 70% | 70% | 70% | 70% | 70% | 70% | 70% |
| PV System | kWp PV | 4.10 | 3.00 | 2.05 | 2.40 | 1.65 | 2.00 | 1.45 | 1.75 |

* Without cap on low energy lighting

Comparisons of Specs to Part L 2010 (consultation version) compliance

Negative numbers indicate non-compliance (i.e. DER>TER). Positive numbers indicate compliance (i.e. DER<TER)

| | Mid terrace house | | Semi-detached house | | Detached house | | Small ground floor apartment | |
|---|-------------------|------|---------------------|------|----------------|------|------------------------------|------|
| | Flat | Agg. | Flat | Agg. | Flat | Agg. | Flat | Agg. |
| Baseline | -29 | -41% | -24% | -24% | -19% | -10% | -18% | -18% |
| Baseline (No heat loss through party wall) | -1% | -10% | -11% | -10% | -19% | -10% | -4% | -3% |
| Spec A (NV) | 16% | 9% | 7% | 7% | 4% | 12% | 12% | 12% |
| Spec B (NV) | 23% | 17% | 18% | 19% | 15% | 21% | 18% | 18% |
| Spec C- (NV) | 28% | 22% | 24% | 24% | 21% | 27% | 23% | 24% |
| Spec C (NV) | 30% | 24% | 26% | 26% | 24% | 30% | 26% | 26% |

Note: Improvement of DER over TER, assuming gas boiler. Flat refers to the flat approach for calculating the TER; Agg. refers to the aggregate approach to calculating the TER.