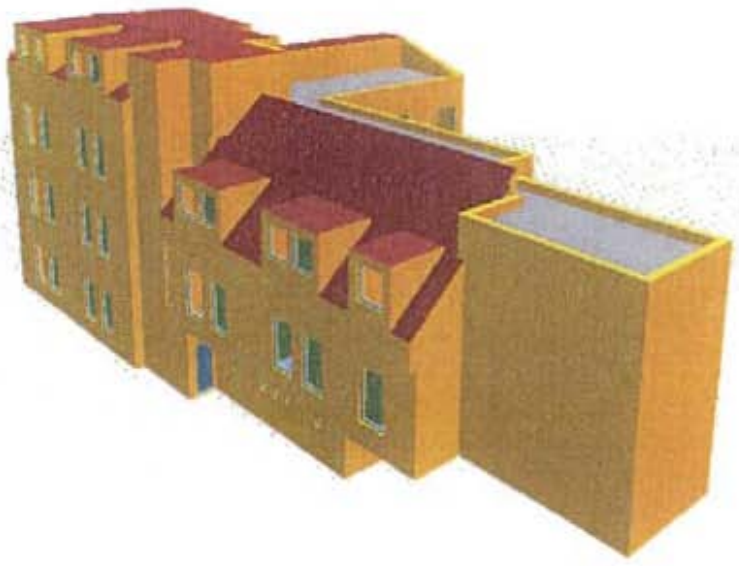
PROJECT NO. 10312

STUDENT HOUSING, PLYMOUTH GROVE

REPORT ON GUIDE TO DEVELOPMENT 2 - FOR PLANNING SUBMISSION



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Project Revision Sheet

Student Housing, Plymouth Grove

Report on Guide to Development 2 – For Planning Submission

Date of Issue: 25/02/08

Prepared by: RP

Revision	Date	Details	Author	Appd
0	25/02/08	First Issue	RP	DF

1. Introduction

This report has been prepared as a result of the Dynamic Thermal Modelling exercise that has been undertaken in respect of the proposed student housing at Plymouth Grove.

The purpose of the report is to predict how the building can be configured so that carbon emission savings and internal temperatures can be achieved to enable compliance with Part L (2006) of the Building Regulations and Part F of the Building Regulations, simultaneously.

Compliance with Manchester City Council's Guide to Development 2 (GtoD2) is also considered, allowing this report to be useful for Planning Submission.

The model has been compared with the requirements of Part L2A (New Buildings other than Dwellings).

This report concludes with a GtoD2 compliant solution and an outline of the proposed M & E Servicing Strategy.

The modelling software used is EDSL's TAS software.

2. Basis of Report

The model has been carried out using the EDSL TAS model version 9.0.9.e

The model is based on the preliminary architectural drawings issued by Johnstone Godfrey & Associates on 25th September 2007

3. Assumptions

The following assumptions have been made:-

- Weather data was applied to the model (using specific annual weather data) with hourly records for temperature, humidity, wind speed and direction, and solar intensity for the Manchester weather station. The weather data is compiled by the CIBSE.
    - The weather data uses an average weather year for the CO_2 compliance (Test Reference Year).
    - The weather data uses the third hottest year in the last 20 years for temperature compliance (Design Summer Year).
- NCM database internal conditions implemented for the following:
    - Operational hours, and hours of heating/cooling (unless otherwise dictated by the Client Brief).
    - Occupancy and Equipment gains (unless otherwise dictated on the issued drawings).
- U values equivalent to those applicable to the materials specified on the Architect's drawings have been used. Where these materials are not given it has been assumed that the building elements comply with current Building Regulations and are constructed using the materials contained in the NCM Constructions Database.
- To ensure simultaneous compliance with Part L and Part F, mechanical ventilation is required.
    - The minimum ventilation requirement for a bedroom located not in a dwelling is 10 Litres per second per person.
    - Natural ventilation will be employed during the warm summer months as the primary source of free cooling; this will be supplemented by mechanical ventilation where required.
    - Toilets and kitchens are equipped with extraction systems only - Part F.
- The building will be constructed to have a maximum infiltration rate of 10 cubic metres of air per hour per square metre of floor area, when pressurised to 50 pascals.

4. Methodology

A computer model of the building was constructed and the thermal performance of the building elements entered into the computer database. Internal gains were then entered for each room and the annual weather data for the nearest geographical site (Manchester) was applied to the model to determine how the building is predicted to operate.

The building elements and equipment were then changed / reconfigured and each of these scenarios modelled until a building configuration was established that satisfied the "overheating" requirements of Part L and also the requirements of Part F of the Building Regulations, simultaneously.

Once an acceptable configuration had been established this scenario was modelled to predict its CO_2 emissions and these were compared with the CO_2 emission reduction requirements required to comply with Part L of the Building Regulations.

The building elements and equipment were then further changed / reconfigured, as necessary, to achieve total compliance with Part L.

The building elements and equipment were then further changed / reconfigured as necessary to achieve the standards set out in Manchester City Council's Guide to Development 2.

The results of all the above were collated and summarised with conclusions and comments made on the results.

The report deals with 2 major requirements of Part L2A:-

1) Compliance with over temperature requirements.
2) Compliance with CO_2 emission reduction targets.

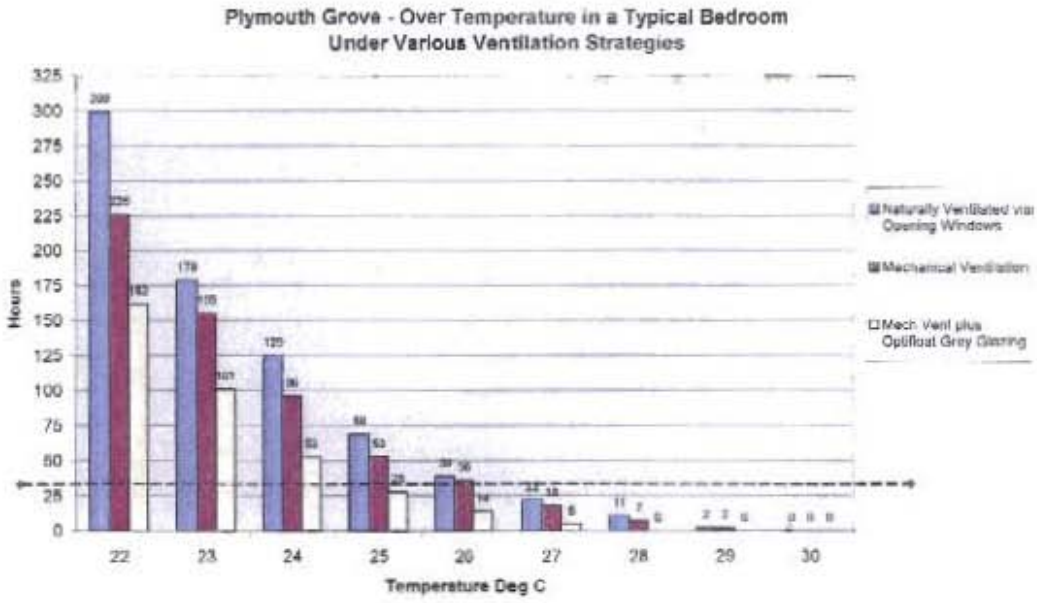
The over–temperature criteria for compliance with Part L2A suggests that in student accommodation bedrooms should not exceed 26°C for more than 1% of the operating hours per annum. Based on a 35 week academic year this has been determined by the design team to be no greater than 34 hours. A scenario that does not overheat was devised before the CO_2 compliance was checked.

5. Report on Differing Strategies

Overheating

Servicing Strategy

- Minimum mechanical ventilation rates employed to satisfy Part F
- Natural ventilation purge (windows opened by occupants).
- High efficiency light fittings



Temperature Result

The building passes the overheating criteria. The graph shows that a naturally ventilated bedroom would spend only 22 hours per year over temperature.

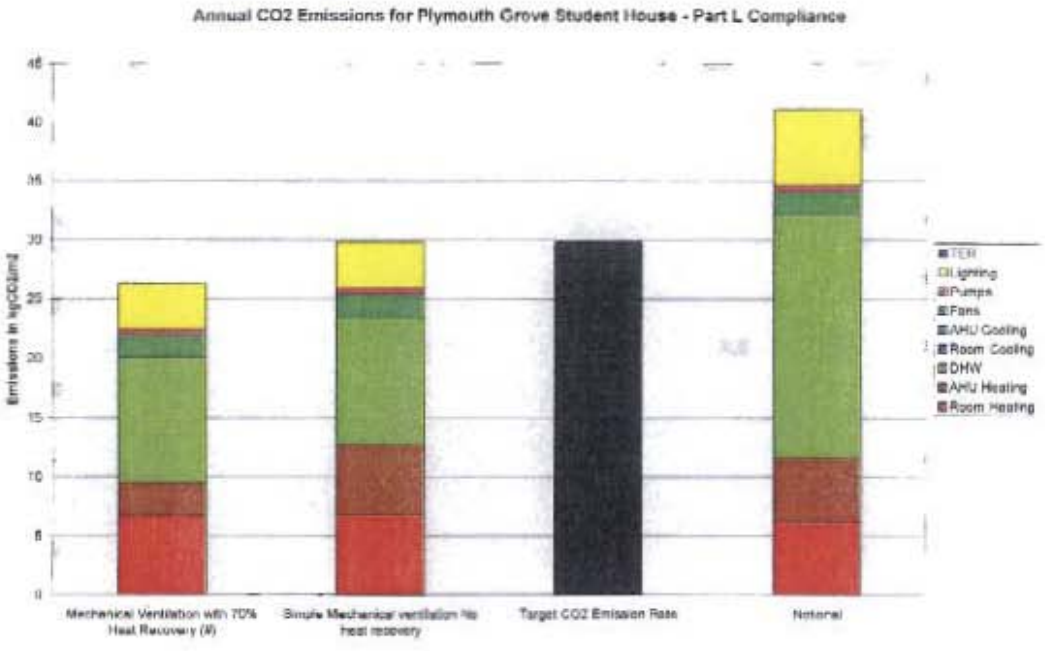
Introducing mechanical ventilation to bedrooms or employing grey tinted solar control glazing would further reduce the hours of over temperature per year resulting in a more comfortable environment.

CO_2 Result - Part L Compliance

The servicing strategy compliant with the over heating criteria was then modelled to predict the CO_2 emissions of the building.

CO2 Scenario

- As over heating scenario
- Typically well maintained light fittings and other electrical equipment
- Typically energy efficient and well maintained mechanical equipment, controlled to be energy efficient
- Power factor correction to 0.95
- Well insulated heating and DHW distribution systems
- Space heating provided by efficient gas fired boilers
- Domestic hot water provided by "efficient" gas fired boilers
- Mechanical ventilation introduced to bedrooms (rates to meet Part F)
- 70% Heat Recovery on extracted clean air



Result

With simple mechanical ventilation the building achieves a very marginal pass (0.2% pass).
Introducing heat recovery achieves a more comfortable 12% pass approximately. BCM would strongly recommend this strategy for Part L Compliance.

CO_2 Result – GtoD2 Compliance

The two relevant targets outlined in GtoD2 are:

Developers should aim for:

- 25% improvement on Part L CO_2 emissions target
- 20% of final site energy demand to be met by onsite renewable technologies

It should be noted that GtoD2 is a planning (as opposed to a building control) requirement and is required on a "seek to achieve" basis and is not mandatory.

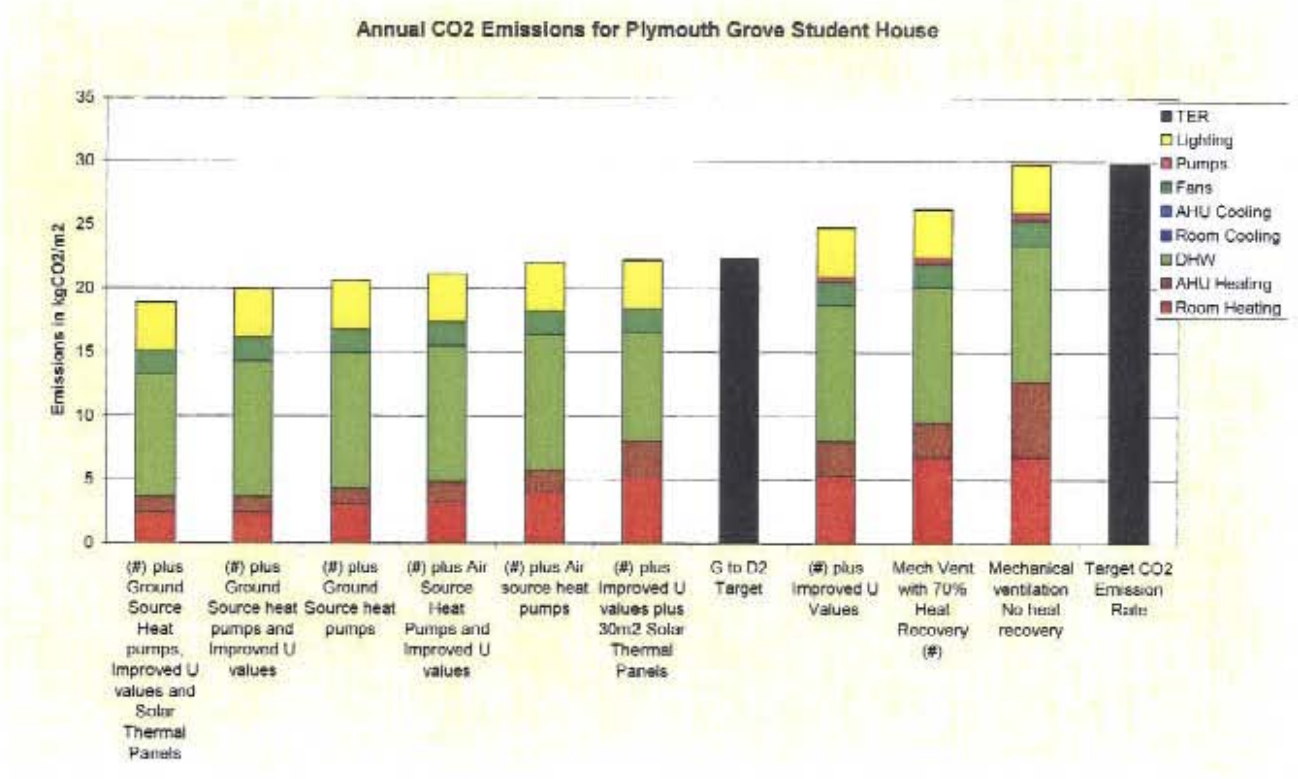
Various technologies have been discounted in determining the feasibility of meeting these targets. These have been summarised below together with the main reasons they are considered to be inappropriate for this project:

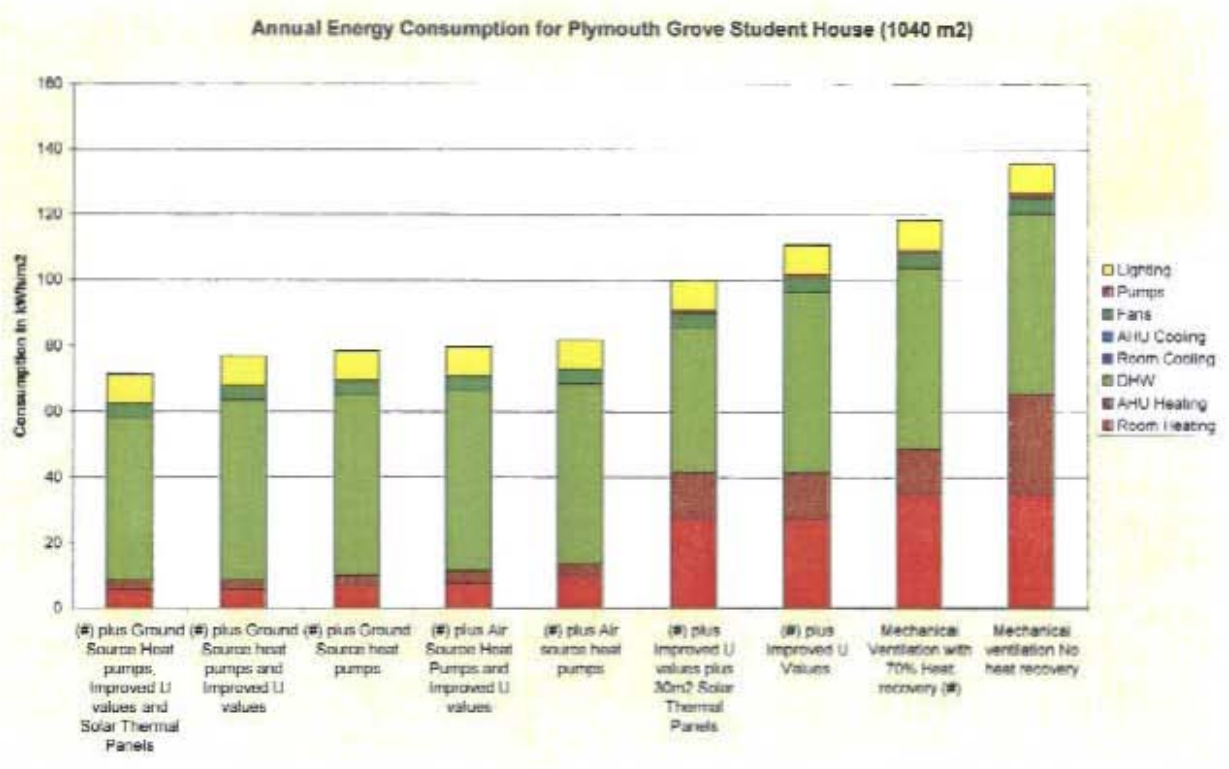
- Photo Voltaics:
  - Low power output
  - Synchronisation issues/costs to connect to electrical system
  - High capital costs

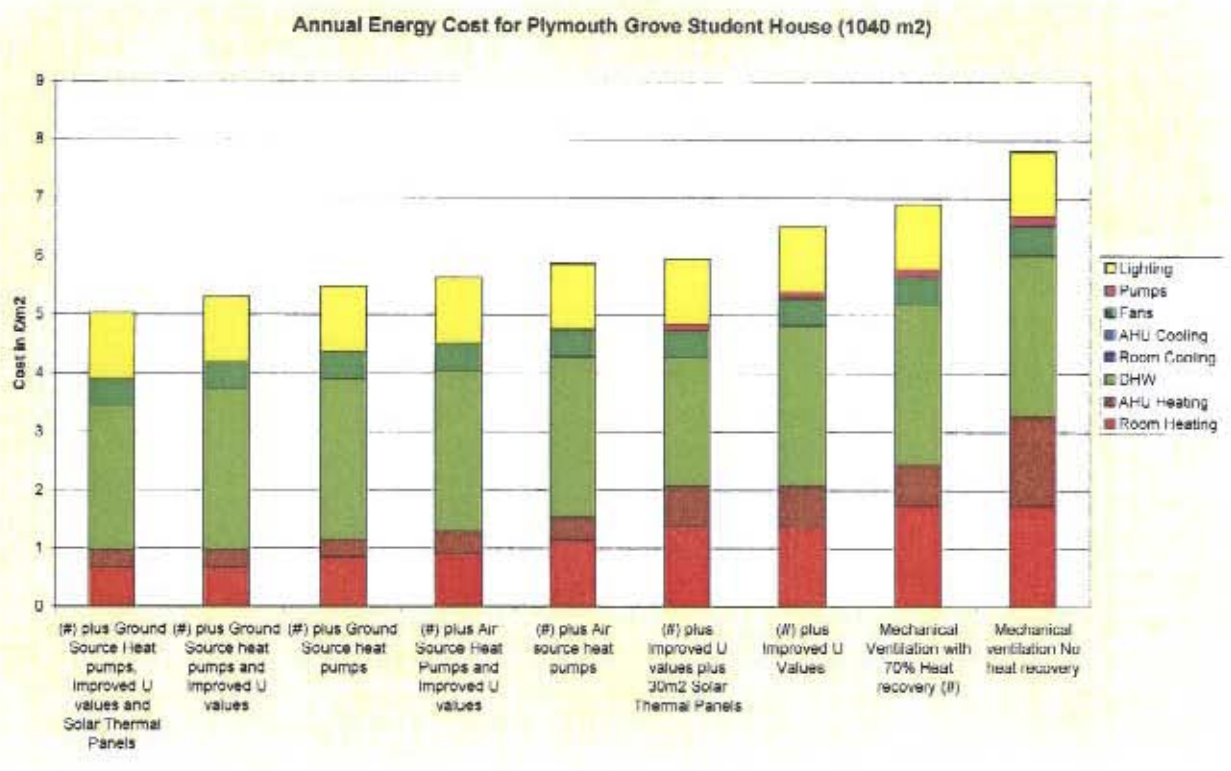
- Wind Turbines:
  - location not appropriate
  - Synchronisation issues/costs to connect to electrical system
  - High capital / maintenance costs

The use of photocells and presence detection lighting controls were considered but deemed inappropriate for use in this type of building.

The following options have then been considered:-


Annual CO2 Emissions for Plymouth Grove Student House
Emissions in kgCO2/m2
35
30
25
20
15
10
5
0
TER
Lighting
Pumps
Fans
AHU Cooling
Room Cooling
DHW
AHU Heating
Room Heating
(#) plus Ground Source Heat pumps, Improved U values and Solar Thermal Panels
(#) plus Ground Source heat pumps and Improved U values
(#) plus Ground Source heat pumps
(#) plus Air Source Heat Pumps and Improved U values
(#) plus Air source heat pumps
(#) plus Improved U values plus 30m2 Solar Thermal Panels
G to D2 Target
(#) plus Improved U Values
Mech Vent with 70% Heat Recovery (#)
Mechanical ventilation No heat recovery
Target CO2 Emission Rate


Annual Energy Consumption for Plymouth Grove Student House (1040 m2)
Consumption in kWh/m2
160
140
120
100
80
60
40
20
0
(#) plus Ground Source Heat pumps, Improved U values and Solar Thermal Panels
(#) plus Ground Source heat pumps and Improved U values
(#) plus Ground Source heat pumps
(#) plus Air Source Heat Pumps and Improved U values
(#) plus Air source heat pumps
(#) plus Improved U values plus 30m2 Solar Thermal Panels
(#) plus Improved U Values
Mechanical Ventilation with 70% Heat recovery (#)
Mechanical ventilation No heat recovery
Lighting
Pumps
Fans
AHU Cooling
Room Cooling
DHW
AHU Heating
Room Heating


Annual Energy Cost for Plymouth Grove Student House (1040 m2)
Cost in £/m2
0
1
2
3
4
5
6
7
8
9
(#) plus Ground Source Heat pumps, Improved U values and Solar Thermal Panels
(#) plus Ground Source heat pumps and Improved U values
(#) plus Ground Source heat pumps
(#) plus Air Source Heat Pumps and Improved U values
(#) plus Air source heat pumps
(#) plus Improved U values plus 30m2 Solar Thermal Panels
(#) plus Improved U Values
Mechanical Ventilation with 70% Heat recovery (#)
Mechanical ventilation No heat recovery
Lighting
Pumps
Fans
AHU Cooling
Room Cooling
DHW
AHU Heating
Room Heating

The graphs show the results from simulating a number of differing scenarios. The energy costs for each of the scenarios are shown as a guide on a comparative basis. The energy costs in reality will be subject to how the occupants use the building and the fluctuating energy tariffs applied at any given time. In order to run the model a typical allowance 12.4 pence / kWh has been used for electricity and 5 pence / kWh for gas. These costs are not definitive predictions of actual energy costs.

As previously seen, Part L compliance can be just achieved using a simple ventilation system. This will have the lowest capital cost for the work but it will also have the highest running cost.

By incorporating heat recovery into the ventilation system the energy efficiency is improved and demonstrates a 12% improvement on Part L legislation. Thus this solution would achieve approximately half of Manchester City Council's desired reduction in CO_2 levels. It also results in a saving of around 45 pence / m2 / annum in energy cost, over simple ventilation.

Improving the U values to 1.5 W/m^2K for the windows and 0.25 W/m^2K on external walls, which in our experience are realistically achievable levels, results in 17% improvement in CO_2 emissions compared with Part L when coupled with heat recovery and therefore is just over half the reduction required to meet the desired GtoD2 CO_2 levels.

By introducing heat pumps into the systems the CO_2 is seen to reduce below the GtoD2 targets. These would operate effectively with under floor heating systems. (The non-heat pump solutions could use traditional wet or under floor heating systems). The air source heat pumps have a lower capital cost and a higher energy cost than the equivalent ground source heat pumps. Ground source heat pumps need to be operated with either boreholes or coils in trenches; both of which can be potentially expensive installations.

Employing solar thermal technology to deliver a portion of the domestic hot water load further reduces running costs and CO_2 emissions.

For full compliance with GtoD2 CO_2 emissions target the options for space heating are ground source heat pumps or air source heat pumps. GtoD2 also requires 20% of total building load to be met by onsite renewable technology. Normally improving the efficiency makes this renewable requirement easier to achieve.

Generally, ground source heat pumps cost more to install but running costs are lower than air source heat pumps.

The total thermal load of the building makes up approximately 40% of the building's energy consumption when employing a gas fired boiler system for space heating and hot water (as used by the Part L compliant solution.) Meeting this load with renewable energy would more than account for the 20% renewable GtoD2 requirement.

From the dynamic thermal model, 20% of the building consumption is estimated at approximately 25 000 kWh per annum.

Air source heat pumps

Using air source heat pumps (with a COP of 3) reduces the CO_2 emissions and passes the GtoD2 target by approximately 1.6%.

Simultaneously, effectively 30% of the building's total load is being met by renewable energy; surpassing GtoD2's 20% requirement.

Ground Source heat pumps

Using ground source heat pumps (with a COP of 4) further reduces the CO_2 emissions and passes the GtoD2 target by approximately 6.5%.

Simultaneously, effectively 33% of the building's total load is being met by renewable energy; surpassing GtoD2's 20% requirement.

Solar Thermal Panels

Solar thermal panels could be used to support the conventional gas boiler for domestic hot water. The solar thermal system uses renewable energy to pre-heat the water, thus reducing the load on the conventional boiler.

A system of $15m^2$ of evacuated tube solar thermal panels would require 500 Litres minimum water storage capacity.

A system of this size would deliver approximately 6000kWh per annum.

6. Summary

It is possible to comply with the "overheating" and CO_2 emissions requirements of Part L and the requirements of Part F, simultaneously, if the building is configured as outlined below.

- Standard Low E Glazing
- Natural purge ventilation employed (windows opened by occupants) above 24°C
- Energy efficient light fittings employed
- Equipped with well maintained light fittings and other electrical equipment
- Equipped with energy efficient and well maintained mechanical equipment
- Minimum mechanical ventilation rates throughout the building employed to satisfy Part F
- Heat recovery units fitted to all ventilation systems to recover 70% of the heat from extracted clean air
- Heating provided by efficient gas fired boilers (93% efficient or better)
- Domestic hot water provided by efficient gas fired boilers (80% efficient or better)

Having complied with Part L and Part F, It is possible to comply with the more onerous targets set by Manchester City Council's Guide to Development 2 document if the building is configured as above and with the following alterations:

- Heating provided by air to air heat pumps (minimum COP 3)

Or

- Heating provided by ground source heat pumps (minimum COP 4)

Additional options over and above GtoD2 could be considered in order to reduce annual running costs and increase carbon savings:

- Improved U values of external building envelope

And/Or

- Domestic hot water supported by solar thermal panels

7. Conclusions

Based upon undertaking a number of simulations of the building, it has been possible to demonstrate the building configuration that will comply with the requirements of the carbon emissions and temperature criterion of Part L2A, the requirements of Part F and the criteria of Manchester City Council's Guide to Development simultaneously.

Initially, to reach the requirements of Part L and Part F, the "conventional" student accommodation building will need to be additionally equipped / configured as follows:

- Simple opening windows to all bedrooms
- Energy efficient light fittings
- Equipped with well maintained light fittings and other electrical equipment
- Equipped with energy efficient and well maintained mechanical equipment
- Heated by "efficient" LTHW gas fired boiler and radiators
- Domestic hot water provided by "efficient" gas fired boilers
- All occupied areas of the building equipped with mechanical ventilation

Having considered various renewable and low carbon technologies, it has been possible to demonstrate the building configuration options that would comply with requirements outlined in the GtoD2 document.

After consultation with the client and consideration of the options outlined in this report, BCM would recommend that the above Part L compliant solution will need to be additionally equipped / configured as follows:

- Mechanical ventilation with heat recovery
- Air source heat pumps serving a wet heating system
- Improved U values

This servicing strategy will meet the CO2 emissions criteria; surpassing the GtoD2 target by approximately 5%.

The air source heat pumps will meet the onsite renewable energy criteria; providing over 30% of the Part L compliant solution's energy demand.

Appendix A - Certification

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Student Housing, Plymouth Grove

25 February 2008



This certifies that Student Housing, Plymouth Grove has been modelled by Beverley Clifton Morris Ltd for compliance with Part L2A of the Building Regulations.

BCM use one of the accredited Dynamic Thermal Models (EDSL's TAS software) to demonstrate compliance with the Building Regulations.

The models are undertaken within our office by one of our Low Carbon Consultants who have been trained to use the software and meet the CIBSE requirements to be included on the list of Registered Low Carbon Consultants.
This report is for issue to Building Control and records the design intent to be included in the scheme to demonstrate compliance with Part L2A of the Building Regulations.

For any queries regarding the modelling process please contact Andrew Ringland whose CIBSE Register Certificate is attached.

LOW CARBON CONSULTANTS

LOW CARBONCONSULTANTS

This Certificate is to certify that

Andrew Ringland

of

Beverley Clifton Morris
8th Floor, Portland Tower
Portland Street
Manchester M1 3LF

has complied with the requirements of the following
CIBSE Certification Limited Low Carbon Consultants Scheme:

Low Carbon Building Design to comply with the Building Regulations and the EPBD in the UK

and is authorised to use the CIBSE Certification Mark

Date of issue: 1 September 2007
Date of expiry: 31 August 2008
Date of first issue: 1 September 2007

Certificate number: LCCD85636
Issue number: 01

CIBSE Certification Ltd.

Signed on behalf of CIBSE Certification Ltd

Authorised Signatory

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