SUSTAINABILITY ASSESSMENT REPORT

AT

THE ORANGERY - WITANHURST

FOR

WITANHURST MANAGEMENT COMPANY LIMITED

vectordesign

BUILDING SERVICES CONSULTANTS

Church Farm Barns, Copson Lane, Stadhampton,
Oxfordshire, OX44 7TZ
Tel. 01865 892300 Fax. 01865 892318
Email: *(Recipient's first name)*@vectordesign.co.uk

Report Ref: - 3244/3/4/JW

Date: June 2009

INDEX

Appendix A	Existing buildings heating system's heat loss & carbon emissions calculations.
Appendix B	Proposed buildings heating system's heat loss & carbon emissions calculations.
Appendix C	Proposed buildings heating system's heat loss & carbon emissions calculations, with passive design techniques incorporated.
Appendix D	Proposed buildings heating system's heat loss & carbon emissions calculations, with passive design techniques and renewable energies incorporated.

1.00 INTRODUCTION

1.01 This report is in support of the application for demolition of service wing and consequential restoration of front façade (residential) and forecourt. Construction of 'Orangery' building providing residential accommodation as part of Witanhurst House with linking building, terrace, garden retaining walls and boundary treatment.

1.02 The existing service wing is of poor construction and suffers from inadequate insulation levels, high air leakage rates and an inefficient heating system.

1.03 The client is keen to limit carbon emissions, has briefed the design team to be place a high emphasis on efficient design and to investigate both sustainable designs and potential renewable energies for inclusion within the design where both practical and viable.

1.04 As such the Client has commissioned Vector Design to;-

- Carry out an analysis of the existing building and estimate heating systems carbon emissions.
- Carry out an analysis of the proposed building and estimate heating systems carbon emissions.
- Investigate and recommend measures in respect of building materials for the proposed building.
- Investigate renewable energies and recommend those viable for inclusion to the proposed building.
- Compare the existing buildings heating systems carbon emissions with that of the proposed building and ensure that there is a considerable betterment in this respect.

1.05 This report aims to satisfy these requirements.

2.00 EXECUTIVE SUMMARY

2.01 The existing service wing is poorly constructed, with poor insulation levels, high air leakage rates and an inefficient heating system. This leads to very high carbon emissions as can be seen from the summary of results as below.

2.02 The new build orangery when built to current Building Regulations will be less than that for the existing service wing.

2.03 The new build orangery will include passive design techniques such that it's heating systems carbon emissions will be less than that for a building build to current Building Regulations.

2.04 The new build orangery will include (subject to the provision of the basement) renewable technologies such that it's heating systems carbon emissions will be further reduced.

2.05 less than that for a building build to current Building Regulations

2.06 The comparison of the carbon emissions of the existing service wing and the various phases of design development of the new build orangery is as detailed in this report and can be summarised thus:-

	CO2 - kg	**Betterment - kg**
Existing Building	11,165	N/a
Basic new build	4,902	6,263
New build + passive improvements	3,949	953
New build + passive improvements + renewables	3,372	577
Overall improvement	**70%**	**7,793**

2.07 From the above it can be seen that the proposal to replace the existing service wing with the orangery shows considerable improvements in carbon emissions and quite clearly is a more sustainable building the current service wing.

3.00 METHODOLOGY

3.01 In the first instance the heat losses of the existing service wing have been calculated, these calculations being carried out in accordance with CIBSE recommendations. These calculations are included within Appendix A of this report.

3.02 From these heat loss calculations of the existing buildings heating system's carbon emissions have been calculated. These calculations are also included within Appendix A of this report.

3.03 The heat losses of the proposed building have then been calculated, these calculations being carried out in accordance with CIBSE recommendations, based upon the U values as per part L2(A) of the current Building Regulations. These calculations are included within Appendix B of this report.

3.04 From these heat loss calculations of the proposed buildings heating system's carbon emissions have been calculated. These calculations are included within Appendix B of this report.

3.05 The design team have then considered the inclusion of passive design techniques to minimise energy consumption and carbon emissions as set out in section ?? of this report. The client body completely embraces this approach and the following techniques have been employed on the development:

- Betterment in wall U values
- Betterment in glazing U values
- Betterment in roof U values
- Betterment in glazing specification
- Betterment in air tightness
- Heat recovery ventilation systems
- Advanced controls

3.06 From the decision to invest in these betterments the heat loss calculations and the associated carbon emissions of the proposed buildings heating system's carbon emissions have been re calculated. These calculations are included within Appendix C of this report.

3.07 Following the inclusion of the passive design techniques considerable investigation has been carried out to establish the most appropriate form of renewable energies to be incorporated into the project as set out in section 5 of this report.

3.08 From the decision to invest in these renewable technologies the heat loss calculations and the associated carbon emissions of the proposed buildings heating system's carbon emissions have been re calculated. These calculations are included within Appendix D of this report.

3.09 Finally then a comparison has been made between the existing buildings heating systems carbon emissions with that of the proposed building. These calculations are included within Appendix E of this report.

4.00 MAXIMISE ENERGY EFFICIENCY THROUGH PASSIVE DESIGN

4.01 The aim here is to limit the energy used to complete the construction, and influence the energy consumption of the building in use, measures to be employed would include those set out below.

4.02 Wherever possible materials would be chosen, from the Green Guide. The Green Guide is a Building Research Establishment (BRE) document that has been written as reference document to assist specifers in choosing materials with both low overall "embedded energies" and environmental impact. Each material is gauged against 12 different environmental parameters including; Ozone depletion, fossil fuel depletion, freight transport, waste disposal, mineral extraction etc.

4.03 Furthermore the materials listed have already had a "Life Cycle Assessment" (LCA) carried out and as such this document dovetails very neatly into projects where life cycled costing and environmental impact are high proprieties.

4.04 It has been agreed that wherever possible materials will be chosen from the Green Guide.

4.05 Insulation levels are quite critical. The client has agreed to invest in a considerable upgrade in this respect, improving insulation values to at least 15% above current Building Regulations. Whilst this adds to the costs there are considerable benefits (from an environmental perspective) of his approach.

4.06 Air leakage is a major factor in heat loss and as such carbon emissions. Un controlled air infiltration (leakage) can be combated by an effective mix of good design, attention to detail and sealing on site and a thorough post completion testing regime. The team aims for a leakage rate to be 20% better than that required by building Regulations.

4.07 Careful consideration has been given to the orientation and specification of the glazing, as well the use of roof overhangs etc. Careful design in this respect can greatly assist in the reduction of both heat loss and heat gain in the summer but maximise useful solar gain during the heating season Glazing/overhangs etc

4.08 Controls have a fundamental input to energy and carbon emissions. Whilst a full controls strategy will be developed, with Client input, as the design progresses we would suggest consideration be given to the incorporation of the following aspects

- Zoning - the correct zoning is very important to ensue that only those spaces required for any particular occupation pattern are heated, with other rooms set at a lower temperature. Good controls not only provide good zoning, but also flexible zoning so as to allow moving of rooms to different control zones as the occupants usage pattern evolves.

- Compensation - this ensures that the flow temperature to the heating system is only as hot as it needs to be. For example the flow temperature required to heat the building will be considerably higher if the external temperature is -3°C than if the temperature was+10°C

- Optimisation - this ensures that the heating is turned on at the last possible time, and off at the soonest possible time, by measuring external and internal temperatures For example if a room has to be warm by 8am and the external temperature is -3°C the heating should come on sooner than if the temperature was +10°C

- User interface - a control system that is not user friendly, no matter how good technically, is a poor control system.

4.09 Having reviewed the options its has been agreed to proceed on the basis of the following:-

- Use of BRE Green Guide rated materials wherever possible
- Betterment in wall U values
- Betterment in glazing U values
- Betterment in roof U values
- Betterment in glazing specification
- 20% betterment on air leakage
- Heat recovery ventilation systems
- Advanced controls

5.00 ASSESSMENT OF RENEWABLES ENERGIES

5.01 Following the investigations and adoption of the passive design techniques and in line with the SPG the following systems have been investigated.

5.02 The choice of energy source, and how this energy is both derived and distributed is critical in an energy conscious project. Renewable technologies generally fall into one of the categories (or sub- categories) below;

- Wave/tidal power
- Wind Generators
- Photovoltaics
- Solar Water Heating
- Biomass Heating
- CHP
- Ground/Water Source Heat
- Rainwater harvesting

5.03 A very brief summary of each of these technologies, together with a comment on their suitability, is as follows.

5.04 Wave/tidal power. In addition to be being truly renewable hydroelectric plant has the advantage of being available almost 24hrs/day throughout the year, unlike other local renewable electrical generation such as photovoltaics or wind turbines. Thus the inclusion of hydroelectric plant should be considered wherever possible.

Being no rapidly moving watercourse than wave/tidal power is not suitable for this development.

5.05 Wind Generators or turbines represent one of the most favoured renewable energy sources, they use no fossil fuels and wind is a truly renewable source. Wind speed increases with height so the best location is to have the turbine high on a mast or tower or, if structure permits, a tall building. Generally speaking the ideal siting is a smooth-top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings. Noise is also an issue, and as such siting is an important consideration Turbines can have a life of up to 20 years but require service checks every few years to ensure they work efficiently.

Witanhurst is an urban site without the attributes required for successful application of wind turbines. Furthermore the aesthetic and noise issues of wind turbines renders this technology unsuitable to the project

5.06 Photovoltaics (PVs) convert the energy produced by the sun into electricity. Daylight hits PV modules (often mounted on the roof), DC electricity is generated, Before this electricity can be used within the building it must be converted to AC electricity, this is done by an inverter. The AC electricity passes directly into the fuse box along with the main supply; the electricity can then be used throughout the building.

Panels come in many different varieties, modular panels which can be fitted to rooftops and can look similar to roof lights.

Photovoltaics should ideally face between South-East and South-West at an elevation of 30-40°. Systems should be placed in a location that will be unshaded at all times of the day.

The orangery has limited roof area, and this is not orientated correctly for PVs. Also and fundamentally Witanhurst is a historic site and it is felt that the aesthetics of PVs makes them unsuitable for this development.

5.07 Solar Water Heating systems uses the sun's energy to heat water. A heat collector is mounted in direct sunlight normally on a roof and fluid runs through the collector gaining heat from the sun.

A heat exchanger transfers the thermal energy to a hot water cylinder, where it is stored until required Collectors should ideally face south at an elevation of between 10° and 60°.

Systems should be placed in a location that will be un-shaded at all times of day. Life expectancy for a solar water heating installation is about 20 years.

The orangery has limited domestic hot water usage. Also the orangery has limited roof area, and this is not orientated correctly for solar water heating. Furthermore and fundamentally Witanhurst is a historic site and it is felt that the aesthetics of solar water heating panels makes them unsuitable for this development.

5.08 Biomass Heating. Biomass boilers use a variety of fuels, including grasses, willow and wood pellets or chips. These systems burn either wood waste (from carpenters shops and the like) or timber grown specifically for this purpose such as willow, willow is usually chosen because it grows fast and for use as a fuel has a 5 year turnaround.

Whilst Biomass systems can offer good reductions in carbon emissions they are very difficult to incorporate into urban sites due to fuel delivery lorries (generally 10-20 tonnes) fuel storage. Also flues need to be much higher (hence more visible) than those for gas boilers and there are residual odour issues, flues and odours. For these reasons Biomass is not considered viable for this development.

5.09 Combined Heat and Power (CHP) systems allow the production of heat and electricity from the same plant. The main components of a combustion engine CHP are engine driven generator, heat recovery equipment that recovers waste heat from engine water cooling jacket and exhaust gases. The CHP unit is designed to provide base electrical or heat load with any shortfall being supplemented by electricity from the grid and heat from boilers.

The orangery is relatively modest in size and the fact that the building U values are very good means that the winter heat load is relatively low. The combination of this with the fact that the electrical load will be both modest and inconsistent lads us to conclude that CHP is not viable for this development

5.10 Ground/Water Source Heat. GSHPs rely upon heat extraction and/or rejection to the surrounding land. This can be either through pipework systems in the ground or via a (static or moving) water feature, i.e. lakes or rivers etc.

In ground systems fall into two main sub categories, vertical or horizontal, both of which rely upon the extraction of heat energy from the surrounding soil.

Horizontal systems rely upon the installation of a pipework grid relatively shallow, c2m often referred to as slinkies, whilst vertical systems rely upon deep boreholes sunk around the site.

Horizontal systems are more cost effective but do require a larger plan area, although once installed the land over can be used for most uses save actual building footprint. Generally speaking boreholes require less plan area, but are considerably more costly than horizontal systems.

There are no watercourses/features associated with this application and as such this option is not available. The site footprint associated with this application is very small in relation to the built area. As such neither slinkies or conventional bore holes are viable. That said there is an approach that may allow the use of GSHP within the orangery. The orangery (and associated larger basement which is the subject of a separate application) will require piled foundations. It may be feasible to use "thermal plies" This involves the thermal coupling pipework being installed within the pile cage, this then being similar to using bore holes. Subject to detailed technical appraisal it is proposed to include GSHP via thermal piles into the scheme for the orangery.

5.11 Rainwater harvesting The operation of rainwater collection is quite straightforward. Rainwater is collected as normal from the roofed areas via rainwater down pipes and is either collected in small scale collection devises above ground or larger below ground holding tanks., and into the below ground drainage system.

Within the below ground system a large holding tank is installed which collects the rainwater. Once full the rainwater collects as normal, and simply reverts back to the normal below ground system. A mains water top up can also be taken to the tank to top the tank up as required.

Storm water reclamation offers considerable environmental benefits. In the first instance the rainwater is collected when used for garden irrigation displaces the use of mains water for this use. Reclamation by default provides the added advantage of attenuation of the storm water run, helping to prevent surface water flooding.

The orangery has limited roof area, thus there would be very little rainwater to be collected. It is considered that the limited advantage of such a system would be outweighed by the environmental impact of the manufacture, transportation and installation of a rainwater reclamation system.

5.12 Vector have examined the technologies in relation to Witanhurst Orangery and we believe the technologies should be taken forward can be summarised thus

Technology	**Viability**
Wave/tidal power	Not appropriate, should not be examined in detail
Wind Generators	Not appropriate, should not be examined in detail
Photovoltaics	Unlikely to be appropriate, should not be examined in detail unless there are other on site factors
Solar Water Heating	Unlikely to be appropriate, should not be examined in detail unless there are other on site factors
Biomass Heating	Unlikely to be appropriate, should not be examined in detail unless there are other on site factors
Combined heat & power	Not appropriate, should not be examined in detail
Ground/Water Source Heat	Quite possibly appropriate, should be examined in detail
Rainwater harvesting	Unlikely to be appropriate, should not be examined in detail unless there are other on site factors

6.00 CONCLUSIONS & RECOMMENDATIONS

6.01 The existing service wing is of poor construction and has an extremely high heat loss. This high heat loss leads to excessively high carbon emissions.

6.02 The new build orangery will incorporate materials from the BRE's Green Guide wherever practical to limit the environmental impact of the building.

6.03 The new build orangery will be build with insulation levels that exceed current Building Regulations to limit energy usage and carbon emissions.

6.04 The new build orangery will be have air leakage rates that are lower than current Building Regulations to limit energy usage and carbon emissions.

6.05 The new build orangery will incorporate heat recovery ventilation systems to limit energy usage and carbon emissions.

6.06 The new build orangery will incorporate advanced controls to limit energy usage and carbon emissions.

6.07 The addition of a GSHP being considered for the new build orangery will make considerable reductions in carbon emissions

6.08 The replacement of the existing service wing with the new build orangery offers an excellent opportunity to replace a poorly constructed aged building with a new sustainable building with excellent carbon reducing qualities and by so doing reduce site's carbon emissions by 7,793 Kg per year or circa 70%

Appendix A Existing buildings heating system's heat loss & carbon emissions calculations.

vectordesign

Project Witanhurst
Client Witanhurst Construction Management ltd
File ref 3244//4//1 - Appendix A
Engineer CVP
Purpose Heat loss calculations - Service wing existing
Date June-09

ROOM REFERENCE		**Basement**	B13 boiler room	B06 corridor	B14 gym	B15 hall	B15 corridor	B18 sauna	B17 wc
Common Variables	**Guide**	**Units**							
Ext. Design temp.	-3	°C	6	6	6	6	6	6	6
Int. Design temp.	varies	°C	19	19	19	19	19	21	21
Floor Area		m2	49.20	32.00	52.00	18.10	4.90	4.80	6.00
Gross ext. wall area		m2	13.00	31.20	14.00	21.80	0.00	4.90	6.00
rooflights area		m2						0.00	
Ceiling height	varies	m	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	1	1.5	1.5	1.5	1.5	1.5	2
External wall U value	varies	w/m^2K	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Ceiling U value	n/a	w/m^2K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m^2K	5.52	5.52	5.52	5.52	5.52	5.52	5.52
basement Floor U value	0.25	w/m^2K	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Rooflights U value	varies	w/m^2K	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Ext. Roof U value	varies	w/m^2K	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Glazing Area		m^2	4.00	3.00	2.00	0.00	0.00	0.00	0.00
Nett Ext. Wall area		m^2	9.00	28.20	12.00	21.80	0.00	4.90	6.00
Ext. Roof area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total ceiling area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]		**Calculation Procedure**							
Glazing		Glazing Area x U x Temp. diff.	287.04	215.28	143.52	0.00	0.00	0.00	0.00
External walls		U x wall area x $(t_{ai}-t_{ao})$	245.70	769.86	327.60	595.14	0.00	154.35	189.00
External Roof		U x roof area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ceiling		U x ceiling area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights		U x area x (t_{ai-10})	0.00	0.00	0.00	0.00	0.00	0.00	0.00
basement. Floor		U x floor area x $(t_{ai}-t_{ao})$	159.90	104.00	169.00	58.83	15.93	18.00	22.50
Infiltration		Rm Vol.xNx1/3x$(t_{ai}-t_{ao})$	554.26	540.75	878.71	305.86	82.80	93.59	155.98
		Sub Total	**1246.9**	**1629.9**	**1518.8**	**959.8**	**98.7**	**265.9**	**367.5**
		15% Margin	**187.0**	**244.5**	**227.8**	**144.0**	**14.8**	**39.9**	**55.1**
TOTAL LOSSES			1434	1874	1747	1104	114	306	423
			watts	watts	watts	watts	watts	watts	watts
		loss per m^2	29	59	34	61	23	64	70
		Sheet Total	7001						
		Plus 20% for pre heat	1721	2249	2096	1325	136	367	507
		Sheet Total	**8401**						

vectordesign

Project Witanhurst
Client Witanhurst Construction Management ltd
File ref 3244//4//1 - Appendix A
Engineer CVP
Purpose Heat loss calculations - Service wing existing
Date June-09

ROOM REFERENCE		Ground Floor	G22 dining room	G23 kitchen	G25 utility	G24 store	G25 wc	G21 hall	G28 store	G29 wc	G30 kitchen
Common Variables	**Guide**	**Units**									
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	21	19	19	19	21	19	19	21	19
Floor Area		m2	29.30	54.20	25.20	4.90	7.60	51.00	12.70	9.90	19.70
Gross ext. wall area		m2	14.96	23.10	0.00	5.30	7.60	54.70	12.90	9.50	36.40
rooflights area		m2									
Ceiling height	varies	m	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	2.6
Infiltration Rate (N)	varies	air ch./h	1	2	1.5	1	2	1.5	1	2	2
External wall U value	varies	w/m^2K	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Ceiling U value	n/a	w/m^2K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m^2K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Int. Floor U value	n/a	w/m^2K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m^2K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Ext. Roof U value	varies	w/m^2K	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Glazing Area		m^2	4.40	8.80	0.00	2.20	2.20	16.10	2.40	0.36	3.00
Nett Ext. Wall area		m^2	10.56	14.30	0.00	3.10	5.40	38.60	10.50	9.14	33.40
Ext. Roof area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	12.70	9.90	19.70
Total ceiling area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]		[illegible]									
Glazing		Glazing Area x U x Temp. diff.	582.91	1068.67	0.00	267.17	291.46	1955.18	291.46	47.69	364.32
External walls		U x wall area x $(t_{ai}-t_{ao})$	532.22	660.66	0.00	143.22	272.16	1783.32	485.10	460.66	1543.08
External Roof		U x roof area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	502.92	427.68	780.12
Ceiling		U x ceiling area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights		U x area x (t_{ai-10})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Int. Floor		U x floor area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Infiltration		Rm Vol.xNx1/3x$(t_{ai}-t_{ao})$	796.88	2702.50	942.39	122.16	413.40	1907.21	316.62	538.51	751.15
		Sub Total	**1912.0**	**4431.8**	**942.4**	**532.5**	**977.0**	**5645.7**	**1596.1**	**1474.5**	**3438.7**
		15% Margin	**286.8**	**664.8**	**141.4**	**79.9**	**146.6**	**846.9**	**239.4**	**221.2**	**515.8**
TOTAL LOSSES			2199	5097	1084	612	1124	6493	1836	1696	3954
			watts	watts	watts	watts	watts	watts	watts	watts	watts
		loss per m^2	75	94	43	125	148	127	145	171	201
		Sheet Total	24093								
		Plus 20% for pre heat	2639	6116	1300	735	1348	7791	2203	2035	4745
		Sheet Total	28912								

vectordesign

Project Witanhurst
Client Witanhurst Construction Management ltd
File ref 3244//4//1 - Appendix A
Engineer CVP
Purpose Heat loss calculations - Service wing existing
Date June-09

ROOM REFERENCE		First Floor	F14 hall	F22 Bedroom	F21 Bedroom	F20 Bedroom	F19 Bedroom	F18 bathroom	F15 Bedroom	F16 Bedroom	F17 Bedroom
Common Variables	**Guide**	**Units**									
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	21	21	21	21	21	21	21	21	21
Floor Area		m2	34.00	17.60	17.60	17.50	7.90	9.00	24.20	27.20	23.00
Gross ext. wall area		m2	7.20	10.00	10.00	10.00	16.80	10.80	22.80	16.20	28.50
rooflights area		m2									
Ceiling height	varies	m	3	3	3	3	3	3	3	3	3
Infiltration Rate (N)	varies	air ch./h	1.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5
External wall U value	varies	w/m^{2}K	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Ceiling U value	n/a	w/m^{2}K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m^{2}K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Int. Floor U value	n/a	w/m^{2}K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m^{2}K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Ext. Roof U value	varies	w/m^{2}K	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Glazing Area		m^2	1.80	3.60	3.60	3.60	1.80	3.60	5.30	5.30	5.30
Nett Ext. Wall area		m^2	5.40	6.40	6.40	6.40	15.00	7.20	17.50	10.90	23.20
Ext. Roof area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total ceiling area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]		[illegible]									
Glazing		Glazing Area x U x Temp. diff.	238.46	476.93	476.93	476.93	238.46	476.93	702.14	702.14	702.14
External walls		U x wall area x $(t_{ai}-t_{ao})$	272.16	322.56	322.56	322.56	756.00	362.88	882.00	549.36	1169.28
External Roof		U x roof area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ceiling		U x ceiling area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights		U x area x (t_{ai-10})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Int. Floor		U x floor area x $(t_{ai}-t_{ao})$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Infiltration		Rm Vol.xNx1/3x$(t_{ai}-t_{ao})$	1223.88	211.18	211.18	209.98	94.79	431.96	290.37	326.37	275.97
		Sub Total	**1734.5**	**1010.7**	**1010.7**	**1009.5**	**1089.3**	**1271.8**	**1874.5**	**1577.9**	**2147.4**
		15% Margin	**260.2**	**151.6**	**151.6**	**151.4**	**163.4**	**190.8**	**281.2**	**236.7**	**322.1**
TOTAL LOSSES			1995	1162	1162	1161	1253	1463	2156	1815	2470
			watts	watts	watts	watts	watts	watts	watts	watts	watts
		loss per m^2	59	66	66	66	159	163	89	67	107
		Sheet Total	14635								
		Plus 20% for pre heat	2394	1395	1395	1393	1503	1755	2587	2177	2963
		Sheet Total	17562								

vectordesign

Project Witanhurst
Client Witanhurst Construction Management ltd
File ref 3244//4//1 - Appendix A
Engineer CVP
Purpose Heat loss calculations - Service wing existing
Date June-09

ROOM REFERENCE		Second floor	S29 hall	S31 bedroom	S32 bedroom	S34 bedroom	S36 bathroom	S30 bedroom	S33 bedroom	S35 bedroom
Common Variables	**Guide**	**Units**								
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	19	21	21	21	21	21	21	21
Floor Area		m2	34.90	12.90	9.40	14.90	11.70	13.80	23.60	14.80
Gross ext. wall area		m2	12.20	8.90	6.90	10.00	17.60	9.40	17.80	19.70
rooflights area		m2								
Ceiling height	varies	m	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Infiltration Rate (N)	varies	air ch./h	1.5	0.5	0.5	0.5	2	0.5	0.5	0.5
External wall U value	varies	w/m^{2}K	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Ceiling U value	n/a	w/m^{2}K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m^{2}K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Int. Floor U value	N/a	w/m^{2}K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m^{2}K	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Ext. Roof U value	varies	w/m^{2}K	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Glazing Area		m^2	2.00	1.00	1.00	1.00	1.00	0.00	3.00	2.00
Nett Ext. Wall area		m^2	10.20	7.90	5.90	9.00	16.60	9.40	14.80	17.70
Ext. Roof area		m^2	34.90	12.90	9.40	14.90	11.70	13.80	23.60	14.80
Total ceiling area		m^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]		Calculation Procedure								
Glazing		Glazing Area x U x Temp. diff.	242.88	132.48	132.48	132.48	132.48	0.00	397.44	264.96
External walls		U x wall area x (t_{ai}-t_{ao})	471.24	398.16	297.36	453.60	836.64	473.76	745.92	892.08
External Roof		U x roof area x (t_{ai}-t_{ao})	1382.04	557.28	406.08	643.68	505.44	596.16	1019.52	639.36
Ceiling		U x ceiling area x (t_{ai}-t_{ao})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights		U x area x (t_{ai-10})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Int. Floor		U x floor area x (t_{ai}-t_{ao})	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Infiltration		Rm Vol.xNx1/3x(t_{ai}-t_{ao})	1036.43	139.31	101.51	160.90	505.39	149.03	254.85	159.82
		Sub Total	**3132.6**	**1227.2**	**937.4**	**1390.7**	**1979.9**	**1218.9**	**2417.7**	**1956.2**
		15% Margin	**469.9**	**184.1**	**140.6**	**208.6**	**297.0**	**182.8**	**362.7**	**293.4**
TOTAL LOSSES			3602	1411	1078	1599	2277	1402	2780	2250
			watts	watts	watts	watts	watts	watts	watts	watts
		loss per m^2	103	109	115	107	195	102	118	152
		Sheet Total	16400							
		Plus 20% for pre heat	4323	1694	1294	1919	2732	1682	3336	2700
		Sheet Total	**19680**							

vectordesign

Project	Witanhurst
Client	Witanhurst Construction Management ltd
File ref	3244//4//1 - Appendix A
Engineer	JW
Purpose	Carbon emissions calculations - Service wing existing
Date	June-09

Basement floor heat loss	8	KW
Ground floor heat loss	29	KW
First floor heat loss	18	KW
Second floor heat loss	20	KW
Total heat loss	75	KW
Estimated annual consumption	54,276	KWh
Percentage of heating via gas system	100%	
Gas system efficiency	70%	
Gas system input energy pa	77,537	KWh/pa
Gas fuel factor	0.144	KgCO2/kW
Carbon emissions from gas system	11,165	KgCO2
Percentage of heating via GSHP system	0%	
GSHP CoP (system efficiency)	400%	
GSHP system input energy pa	0	KWh/pa
Electrical fuel factor	0.422	KgCO2/kW
Carbon emissions from GSHP system	0	KgCO2
[illegible]	[illegible]	KgCO2