

Appendix B Proposed buildings heating system's heat loss & carbon emissions calculations.

Project Witanhurst
 Client Witanhurst Construction
 File ref 3244//4//1 - Appendix B
 Engineer CVP
 Purpose Heat loss calculations - Orangery standard U values rev a
 Date June-09

ROOM REFERENCE	Lower Ground Floor		Store room	Guest bathroom	Guest bedroom	Family room
Common Variables	Guide	Units				
Ext. Design temp.	-3	°C	6	6	6	6
Int. Design temp.	varies	°C	19	21	21	21
Floor Area		m ²	101.90	16.80	35.75	193.70
Gross ext. wall area		m ²	52.00	22.10	16.90	105.30
Rooflights area		m ²				
Ceiling height	varies	m	2.6	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.7	0.7	0.7	0.7
External wall U value	varies	w/m ² K	0.35	0.35	0.35	0.35
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	2.20	2.20	2.20	2.20
Int. Floor U value	n/a	w/m ² K	0.25	0.25	0.25	0.25
Rooflights U value	varies	w/m ² K	2.20	2.20	2.20	2.20
Ext. Roof U value	varies	w/m ² K	0.20	0.20	0.20	0.20
Glazing Area		m ²	0.00	0.00	8.80	26.40
Nett Ext. Wall area		m ²	52.00	22.10	8.10	78.90
Ext. Roof area		m ²	0.00	0.00	0.00	0.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00
Glazing		Glazing Area x U x Temp. diff.	0.00	0.00	290.40	871.20
External walls		U x wall area x (t _{ai} -t _{ao})	236.60	116.03	42.53	414.23
External Roof		U x roof area x (t _{ai} -t _{ao})	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
Rooflights		U x area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00
Int. Floor		U x floor area x (t _{ai} -t _{ao})	331.18	63.00	134.06	726.38
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	803.57	152.86	325.29	1762.49
		Sub Total	1371.3	331.9	792.3	3774.3
		15% Margin	205.7	49.8	118.8	566.1
TOTAL LOSSES			1577	382	911	4340
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts
			15	23	25	22
			7210			
			1892	458	1093	5209
			8652			



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ROOM REFERENCE		Ground Floor	W C	Bar	cloakroom	Lobby 2	Boots/utility	Living	Media
Common Variables	Guide	Units							
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	19	19	19	19	19	21	21
Floor Area		m ²	1.00	1.20	2.40	4.00	6.00	100.00	65.00
Gross ext. wall area		m ²	2.60	0.00	3.90	5.20	13.20	124.80	49.60
rooflights area		m ²						22.00	
Ceiling height	varies	m	2.6	2.6	2.6	2.6	2.6	5.2	2.6
Infiltration Rate (N)	varies	air ch./h	2	1	1.5	1.5	1	1.5	1.5
External wall U value	varies	w/m ² K	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Ext. Roof U value	varies	w/m ² K	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Glazing Area		m ²	0.00	0.00	0.00	2.10	0.00	61.60	13.20
Nett Ext. Wall area		m ²	2.60	0.00	3.90	3.10	13.20	63.20	36.40
Ext. Roof area		m ²	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Calculation Summary									
Glazing		Glazing Area x U x Temp. diff.	0.00	0.00	0.00	101.64	0.00	3252.48	696.96
External walls		U x wall area x (t _{ai} -t _{ao})	20.02	0.00	30.03	23.87	101.64	530.88	305.76
External Roof		U x roof area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00	0.00	480.00	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} -t _{ao})	0.00	0.00	0.00	0.00	0.00	532.40	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
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	38.13	22.88	68.63	114.39	114.39	6239.38	2027.80
		Sub Total	58.1	22.9	98.7	239.9	216.0	11035.1	3030.5
		15% Margin	8.7	3.4	14.8	36.0	32.4	1655.3	454.6
TOTAL LOSSES			67	26	113	276	248	12690	3485
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts	watts	watts	watts
			67	22	47	69	41	127	54
			16906						
			80	32	136	331	298	15228	4182
			20288						

ROOM REFERENCE		First Floor	Bedroom	Bath wardrobe	WC	Guest room	lobby	WC
Common Variables	Guide	Units						
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	21	21	21	21	19	21
Floor Area		m ²	20.80	10.50	9.00	9.00	4.20	5.00
Gross ext. wall area		m ²	25.74	0.00	7.80	15.60	0.00	7.30
Rooflights area		m ²						
Ceiling height	varies	m	2.6	2.6	2.6	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.5	2	2	0.5	1	2
External wall U value	varies	w/m ² K	0.35	0.35	0.35	0.35	0.35	0.35
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	2.20	2.20	2.20	2.20	2.20	2.20
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	2.20	2.20	2.20	2.20	2.20	2.20
Ext. Roof U value	varies	w/m ² K	0.20	0.20	0.20	0.20	0.20	0.20
Glazing Area		m ²	8.80	0.00	0.00	4.40	0.00	0.00
Nett Ext. Wall area		m ²	16.94	0.00	7.80	11.20	0.00	7.30
Ext. Roof area		m ²	20.80	10.50	9.00	9.00	4.20	5.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00	0.00	0.00
Calculating Losses								
Glazing		Glazing Area x U x Temp. diff.	464.64	0.00	0.00	232.32	0.00	0.00
External walls		U x wall area x (t _{ai} -t _{ao})	142.30	0.00	65.52	94.08	0.00	61.32
External Roof		U x roof area x (t _{ai} -t _{ao})	99.84	50.40	43.20	43.20	18.48	24.00
Ceiling		U x ceiling area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights		U x area x (t _{ai} -t _{ao})	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
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	216.30	436.76	374.36	93.59	80.07	207.98
		Sub Total	923.1	487.2	483.1	463.2	98.6	293.3
		15% Margin	138.5	73.1	72.5	69.5	14.8	44.0
TOTAL LOSSES			1062	560	556	533	113	337
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts	watts	watts
			51	53	62	59	27	67
			3161					
			1274	672	667	639	136	405
			3793					



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Lower ground floor heat loss	20 KW
Ground floor heat loss	9 KW
First floor heat loss	4 KW
Total heat loss	33 KW
Estimated annual consumption	23,829 KWh
Percentage of heating via gas system	100%
Gas system efficiency	70%
Gas system input energy pa	34,042 KWh/pa
Gas fuel factor	0.144 KgCO2/kW
Carbon emissions from gas system	4,902 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

Appendix C Proposed buildings heating system's heat loss & carbon emissions calculations, with passive design techniques incorporated.



Project Witanhurst
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 Engineer CVP
 Purpose Heat loss calculations - Orangery with passive improvements
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ROOM REFERENCE		Lower Ground Floor	Store room	Guest bathroom	Guest bedroom	Family room
Common Variables	Guide	Units				
Ext. Design temp.	-3	°C	6	6	6	6
Int. Design temp.	varies	°C	19	21	21	21
Floor Area		m ²	101.90	16.80	35.75	193.70
Gross ext. wall area		m ²	52.00	22.10	16.90	105.30
Rooflights area		m ²				
Ceiling height	varies	m	2.6	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.5	0.5	0.5	0.5
External wall U value	varies	w/m ² K	0.35	0.35	0.35	0.35
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.21	0.21	0.21	0.21
Rooflights U value	varies	w/m ² K	2.20	3.20	4.20	5.20
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17	0.17
Glazing Area		m ²	0.00	0.00	8.80	26.40
Nett Ext. Wall area		m ²	52.00	22.10	8.10	78.90
Ext. Roof area		m ²	0.00	0.00	0.00	0.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00
Glazing		Glazing Area x U x Temp. diff.	0.00	0.00	246.84	740.52
External walls		U x wall area x (t _{ai} -t _{ao})	236.60	116.03	42.53	414.23
External Roof		U x roof area x (t _{ai} -t _{ao})	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
Rooflights		U x area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00
Int. Floor		U x floor area x (t _{ai} -t _{ao})	281.50	53.55	113.95	617.42
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	573.98	109.19	232.35	1258.92
		Sub Total	1092.1	278.8	635.7	3031.1
		15% Margin	163.8	41.8	95.4	454.7
TOTAL LOSSES			1256	321	731	3486
			watts	watts	watts	watts
			12	19	20	18
loss per m²						
Sheet Total			5793			
Plus 20% for pre heat			1507	385	877	4183
Sheet Total			6952			



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ROOM REFERENCE		Ground Floor	W C	Bar	Lobby 1	Lobby 2	Boots/utility	Living	Media
Common Variables	Guide	Units							
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	19	19	19	19	19	21	21
Floor Area		m ²	3.27	2.10	7.10	5.30	10.60	107.40	70.70
Gross ext. wall area		m ²	9.10	3.60	7.80	6.20	18.20	119.60	50.20
Rooflights area		m ²						22.00	
Ceiling height	varies	m	2.6	2.6	2.6	2.6	2.6	5.2	2.6
Infiltration Rate (N)	varies	air ch./h	1.6	0.8	1.2	1.2	0.8	1.2	1.2
External wall U value	varies	w/m ² K	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Glazing Area		m ²	0.00	0.00	0.00	2.10	10.20	40.00	14.00
Nett Ext. Wall area		m ²	9.10	3.60	7.80	4.10	8.00	79.60	36.20
Ext. Roof area		m ²	0.00	0.00	0.00	0.00	0.00	107.40	1.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heat Loss Calculations									
Glazing		Glazing Area x U x Temp. diff.	0.00	0.00	0.00	86.39	419.63	1795.20	628.32
External walls		U x wall area x (t _{ai} -t _{ao})	59.56	23.56	51.05	26.83	52.36	568.34	258.47
External Roof		U x roof area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00	0.00	438.19	4.08
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} -t _{ao})	0.00	0.00	0.00	0.00	0.00	452.54	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
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	99.75	32.03	162.43	121.25	161.67	5360.87	1764.50
		Sub Total	159.3	55.6	213.5	234.5	633.7	8615.1	2655.4
		15% Margin	23.9	8.3	32.0	35.2	95.0	1292.3	398.3
TOTAL LOSSES			183	64	246	270	729	9907	3054
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts	watts	watts	
			56	30	35	51	69	92	43
			14452						
			220	77	295	324	874	11889	3664
			17342						



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 Purpose Heat loss calculations - Orangery with passive improvements
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ROOM REFERENCE		First Floor	Bedroom	Room 1	Room 2
Common Variables	Guide	Units			
Ext. Design temp.	-3	°C	-3	-3	-3
Int. Design temp.	varies	°C	21	21	21
Floor Area		m ²	43.00	17.10	6.80
Gross ext. wall area		m ²	50.20	13.80	4.90
Rooflights area		m ²			
Ceiling height	varies	m	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.4	0.4	0.4
External wall U value	varies	w/m ² K	0.30	0.30	0.30
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	1.87	1.87	1.87
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17
Glazing Area		m ²	4.80	0.00	0.00
Nett Ext. Wall area		m ²	45.40	13.80	4.90
Ext. Roof area		m ²	43.00	17.10	6.80
Total ceiling area		m ²	0.00	0.00	0.00
Glazing		Glazing Area x U x Temp. diff.	215.42	0.00	0.00
External walls		U x wall area x (t _{ai} -t _{ao})	324.16	98.53	34.99
External Roof		U x roof area x (t _{ai} -t _{ao})	175.44	69.77	27.74
Ceiling		U x ceiling area x (t _{ai} -t _{ao})	0.00	0.00	0.00
Rooflights		U x area x (t _{ai} -t _o)	0.00	0.00	0.00
Int. Floor		U x floor area x (t _{ai} -t _{ao})	0.00	0.00	0.00
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	357.72	142.26	56.57
		Sub Total	1072.7	310.6	119.3
		15% Margin	160.9	46.6	17.9
TOTAL LOSSES			1234	357	137
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts
			29	21	20
			1728		
			1480	429	165
			2074		



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Basement heat loss	7 KW
Ground floor heat loss	17
First floor heat loss	2 KW
Total heat loss	26 KW
Estimated annual consumption	19,196 KWh
Percentage of heating via gas system	100%
Gas system efficiency	70%
Gas system input energy pa	27,423 KWh/pa
Gas fuel factor	0.144 KgCO2/kW
Carbon emissions from gas system	3,949 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

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



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 Date June-09

ROOM REFERENCE	Lower Ground Floor		Store room	Guest bathroom	Guest bedroom	Family room
Common Variables	Guide	Units				
Ext. Design temp.	-3	°C	6	6	6	6
Int. Design temp.	varies	°C	19	21	21	21
Floor Area		m2	101.90	16.80	35.75	193.70
Gross ext. wall area		m2	52.00	22.10	16.90	105.30
rooflights area		m2				
Ceiling height	varies	m	2.6	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.5	0.5	0.5	0.5
External wall U value	varies	w/m ² K	0.35	0.35	0.35	0.35
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.21	0.21	0.21	0.21
Rooflights U value	varies	w/m ² K	2.20	3.20	4.20	5.20
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17	0.17
Glazing Area		m ²	0.00	0.00	8.80	26.40
Nett Ext. Wall area		m ²	52.00	22.10	8.10	78.90
Ext. Roof area		m ²	0.00	0.00	0.00	0.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00
Glazing	Glazing Area x U x Temp. diff.		0.00	0.00	246.84	740.52
External walls	U x wall area x (t _{ai} -t _{ao})		236.60	116.03	42.53	414.23
External Roof	U x roof area x (t _{ai} -t _{ao})		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
Rooflights	U x area x (t _{ai} -t _o)		0.00	0.00	0.00	0.00
Int. Floor	U x floor area x (t _{ai} -t _{ao})		281.50	53.55	113.95	617.42
Infiltration	Rm Vol.xNx1/3x(t _{ai} -t _{ao})		573.98	109.19	232.35	1258.92
	Sub Total		1092.1	278.8	635.7	3031.1
	15% Margin		163.8	41.8	95.4	454.7
TOTAL LOSSES			1256	321	731	3486
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts
			12	19	20	18
			5793			
			1507	385	877	4183
			6952			



Project Witanhurst
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ROOM REFERENCE		Ground Floor	W C	Bar	Lobby 1	Lobby 2	Boots/utility	Living	Media
Common Variables	Guide	Units							
Ext. Design temp.	-3	°C	-3	-3	-3	-3	-3	-3	-3
Int. Design temp.	varies	°C	19	19	19	19	19	21	21
Floor Area		m ²	3.27	2.10	7.10	5.30	10.60	107.40	70.70
Gross ext. wall area		m ²	9.10	3.60	7.80	6.20	18.20	119.60	50.20
Rooflights area		m ²						22.00	
Ceiling height	varies	m	2.6	2.6	2.6	2.6	2.6	5.2	2.6
Infiltration Rate (N)	varies	air ch./h	1.6	0.8	1.2	1.2	0.8	1.2	1.2
External wall U value	varies	w/m ² K	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Glazing Area		m ²	0.00	0.00	0.00	2.10	10.20	40.00	14.00
Nett Ext. Wall area		m ²	9.10	3.60	7.80	4.10	8.00	79.60	36.20
Ext. Roof area		m ²	0.00	0.00	0.00	0.00	0.00	107.40	1.00
Total ceiling area		m ²	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glazing		Glazing Area x U x Temp. diff.	0.00	0.00	0.00	86.39	419.63	1795.20	628.32
External walls		U x wall area x (t _{ai} -t _{ao})	59.56	23.56	51.05	26.83	52.36	568.34	258.47
External Roof		U x roof area x (t _{ai} -t _{ao})	0.00	0.00	0.00	0.00	0.00	438.19	4.08
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} -t _{ao})	0.00	0.00	0.00	0.00	0.00	452.54	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
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	99.75	32.03	162.43	121.25	161.67	5360.87	1764.50
		Sub Total	159.3	55.6	213.5	234.5	633.7	8615.1	2655.4
		15% Margin	23.9	8.3	32.0	35.2	95.0	1292.3	398.3
TOTAL LOSSES			183	64	246	270	729	9907	3054
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts	watts	watts	watts	
			56	30	35	51	69	92	43
			14452						
			220	77	295	324	874	11889	3664
			17342						



Project Witanhurst
 Client Witanhurst Construction Management Ltd
 File ref 3244//4//1 - Appendix D
 Engineer CVP
 Purpose Heat loss calculations - Orangery with passive improvements & GSHP
 Date June-09

ROOM REFERENCE		First Floor	Bedroom	Room 1	Room 2
Common Variables	Guide	Units			
Ext. Design temp.	-3	°C	-3	-3	-3
Int. Design temp.	varies	°C	21	21	21
Floor Area		m ²	43.00	17.10	6.80
Gross ext. wall area		m ²	50.20	13.80	4.90
Rooflights area		m ²			
Ceiling height	varies	m	2.6	2.6	2.6
Infiltration Rate (N)	varies	air ch./h	0.4	0.4	0.4
External wall U value	varies	w/m ² K	0.30	0.30	0.30
Ceiling U value	n/a	w/m ² K	0.00	0.00	0.00
Glazing U value	varies	w/m ² K	1.87	1.87	1.87
Int. Floor U value	n/a	w/m ² K	0.00	0.00	0.00
Rooflights U value	varies	w/m ² K	1.87	1.87	1.87
Ext. Roof U value	varies	w/m ² K	0.17	0.17	0.17
Glazing Area		m ²	4.80	0.00	0.00
Nett Ext. Wall area		m ²	45.40	13.80	4.90
Ext. Roof area		m ²	43.00	17.10	6.80
Total ceiling area		m ²	0.00	0.00	0.00
Glazing		Glazing Area x U x Temp. diff.	215.42	0.00	0.00
External walls		U x wall area x (t _{ai} -t _{ao})	324.16	98.53	34.99
External Roof		U x roof area x (t _{ai} -t _{ao})	175.44	69.77	27.74
Ceiling		U x ceiling area x (t _{ai} -t _{ao})	0.00	0.00	0.00
Rooflights		U x area x (t _{ai} -t _{ao})	0.00	0.00	0.00
Int. Floor		U x floor area x (t _{ai} -t _{ao})	0.00	0.00	0.00
Infiltration		Rm Vol.xNx1/3x(t _{ai} -t _{ao})	357.72	142.26	56.57
		Sub Total	1072.7	310.6	119.3
		15% Margin	160.9	46.6	17.9
TOTAL LOSSES			1234	357	137
loss per m ² Sheet Total Plus 20% for pre heat Sheet Total			watts	watts	watts
			29	21	20
			1728		
			1480	429	165
			2074		



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Basement heat loss	7 KW
Ground floor heat loss	17
First floor heat loss	2 KW
Total heat loss	26 KW
Estimated annual consumption	19,196 KWh
Percentage of heating via gas system	70%
Gas system efficiency	70%
Gas system input energy pa	19,196 KWh/pa
Gas fuel factor	0.144 KgCO ₂ /kW
Carbon emissions from gas system	2,764 KgCO ₂
Percentage of heating via GSHP system	30%
GSHP CoP (system efficiency)	400%
GSHP system input energy pa	1,440 KWh/pa
Electrical fuel factor	0.422 KgCO ₂ /kW
Carbon emissions from GSHP system	608 KgCO ₂