Amvic® Building System
Residential Energy Study

Presented to:
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Amvic® Building System

Stantec

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1.0 Introduction

Stantec Consulting Ltd. (Kelowna office) was commissioned by Amvic® to provide an outline of the anticipated energy savings using insulated concrete form construction (ICF) in a typical 2,000 sq.ft. residential dwelling.

Opinions stated in this report are based upon conversations with David MacPherson and energy modeling of the construction options.

Lead Stantec Consulting personnel participating in this study included:

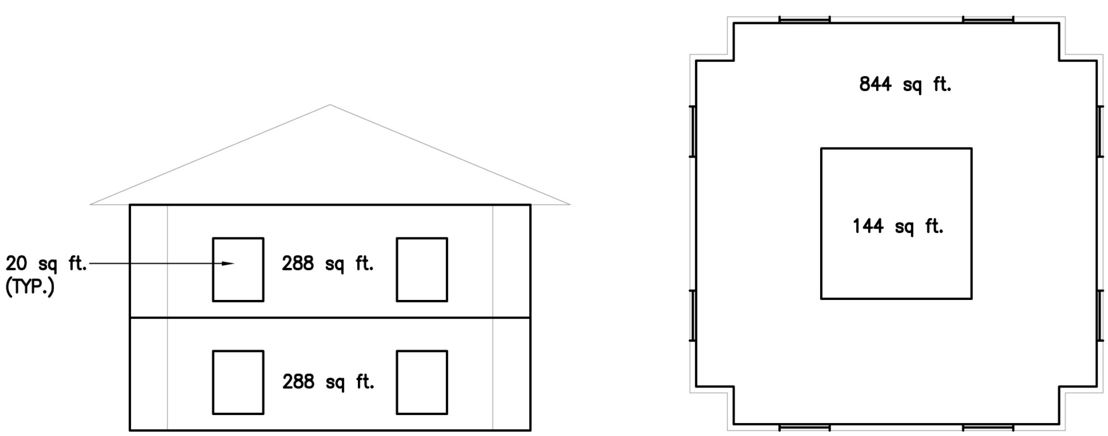
- Emmanuel Lavoie, EIT, LEED AP

The contact for this report is Mr. Emmanuel Lavoie (250-860-3225).

2.0 Study Description & Assumptions

Porch Light Properties® is currently marketing and building residential homes using insulated concrete form construction (ICF) Amvic® walls. Due to high insulation values, increased thermal mass and greater resistance to infiltration, the ICF Amvic® wall construction offers a more efficient type of wall and roof construction.

A typical 2,000 sq.ft. house was created in AutoCad in order to calculate exterior and interior zone areas as well as wall and roof areas. The house model is a slab-on-grade two storey construction and is shown below:



The Trace700 energy and load modeling software was used to obtain peak heating and cooling loads as well as monthly total cooling and heating energy for three building construction alternatives.

Further calculations using up-to-date energy rates were used to achieve annual energy costs for the three alternatives.

The three alternatives studied in this report are presented below:

2.1 #1 - TYPICAL WOOD FRAME CONSTRUCTION

This alternative assumes a typical wood frame construction assuming the following construction insulating values:

1. Low thermal mass wood frame wall with insulating value: R-20 (R-16 effective)
2. Low thermal mass wood frame roof with insulating value: R-32 (R-26 effective)
3. Windows:
    a. U-value: 0.4
    b. Shading Coefficient: 0.6
4. Infiltration assumed to be 0.7 ACH (Air Changes per Hour)
5. Assumed 50 cfm ventilation rate

2.2 #2 - ICF AMVIC® WALL CONSTRUCTION WITH TYPICAL WOOD FRAME ROOF

This alternative assumes insulated concrete form construction to the underside of the roof joists with typical wood frame roof construction assuming the following construction insulating values:

1. High thermal mass ICF Amvic® wall with insulating value: R-23
2. Low thermal mass wood frame roof with insulating value: R-32 (R-26 effective)
3. Windows:
    a. U-value: 0.4
    b. Shading Coefficient: 0.6
4. Infiltration assumed to be 0.4 ACH (Air Changes per Hour)
5. Assumed 50 cfm ventilation rate

2.3 #3 - ICF AMVIC® WALL CONSTRUCTION WITH AMDECK® ROOF

This alternative assumes insulated concrete form Amvic® wall construction to the underside of the roof joists with Amdeck® roof construction assuming the following construction insulating values:

1. High thermal mass ICF Amvic® wall with insulating value: R-23
2. High thermal mass Amdeck® roof system with insulating value: R-32
3. Windows:
   c. U-value: 0.4
   d. Shading Coefficient: 0.6
4. Infiltration assumed to be 0.4 ACH (Air Changes per Hour)
5. Assumed 50 cfm ventilation rate

2.4 VARIOUS ASSUMPTIONS AND INFORMATION

1. Energy Costs as of March 13, 2007:
   a. Electricity: City of Kelowna Rate Code 101: $0.06651/kWh
   b. Natural Gas: Terasen Gas Residential rate: $11.29/GJ
2. Performance of Cooling Equipment: 10 EER
3. Performance of Heating Furnace: 80% efficiency

3.0 Discussion on Effective R-value Performance

The true R-value of a typical ICF wall is R-23, however they are commonly regarded as having an effective performance rating of R40 to R50. This is not a true R-value of the wall but a comparison of the R-value required by a wooden frame wall to meet the same performance.

Wooden frame walls are comprised of framing, insulation material, electrical outlets and wires. These walls are typically based on the insulation R-value but thermal bridging though the framing and voids in the insulation results in a reduced R-value of the wall. For example, a typical 2x4 wood frame wall would be a nominal R14 but due to thermal bridging this is reduced to an actual R11. The R-value of an ICF wall is the true R-value as there is no thermal bridging through the walls.

Concrete's large thermal mass evens out the temperature fluctuations so less heating is required in the colder hours and vice-versa during the cooling season. This increases the effective performance of the ICF walls.

Since ICF walls are constructed of concrete and foam, the only places for air to infiltrate into the building is around doors and windows. This again reduces the amount of heating required and increases the effective performance.

These characteristics combined create a very efficient wall and would require a nominal R40 or R50 wooden frame wall to achieve the same performance.

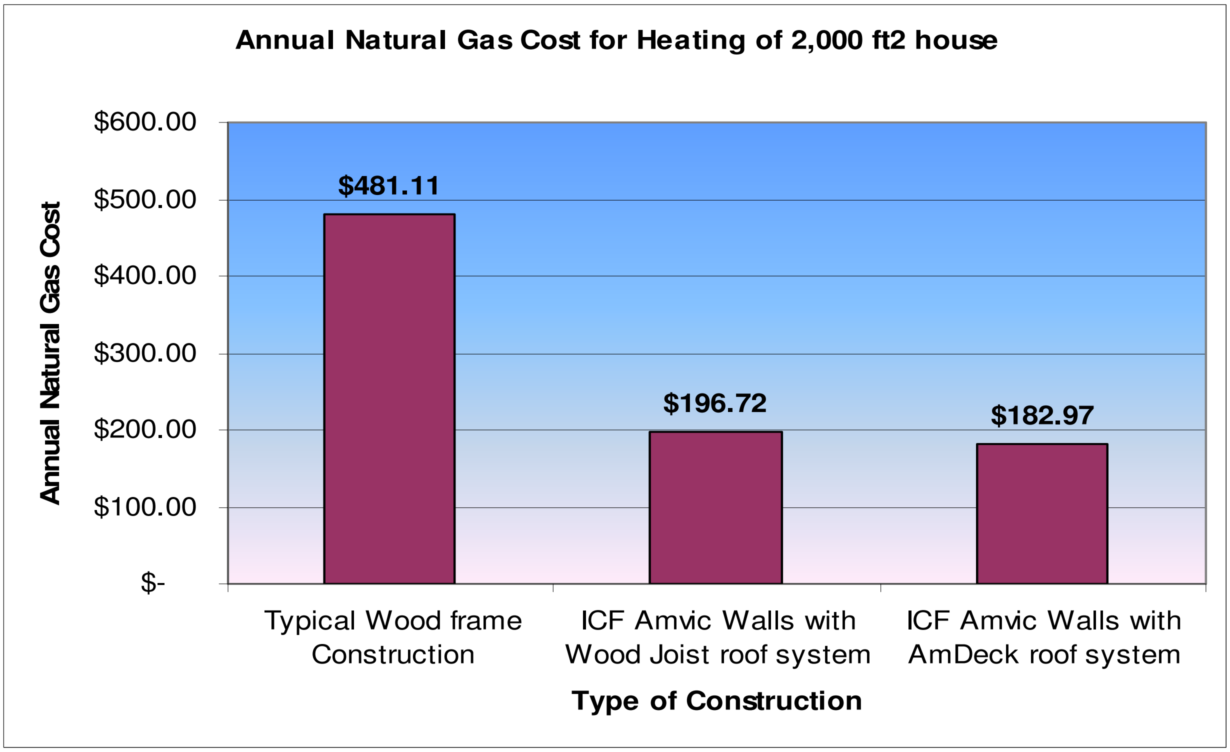
4.0 Energy Comparison

The three alternatives presented in Section 3.0 offer the following peak cooling and heating loads and annual energy/energy cost consumptions:

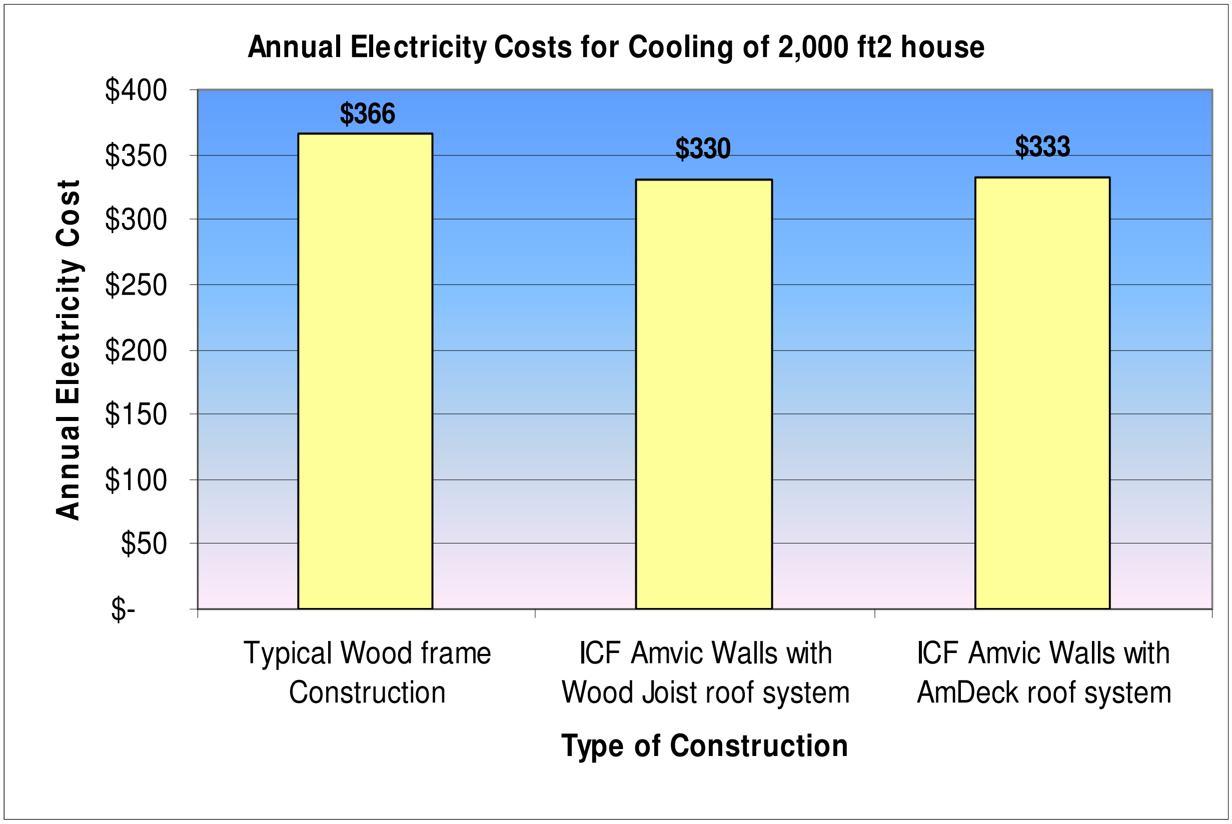
Type of Building Construction	Peak Heat load (Btu/h)	Peak Cooling load (tons)	Heating Annual GJ	Cooling Annual ton*hours	Annual Heating Cost ($)	Annual Cooling Cost ($)
Typical Wood Frame Construction	43,100	3.5	43	4,590	$ 481.11	$ 366
ICF Amvic walls and wood joist roof	30,600	2.9	17	4,140	$ 196.72	$ 330
ICF Amvic walls with Amdeck roofing	30,000	2.9	16	4,171	$ 182.97	$ 333

The following figures do <u>not</u> include the domestic hot water energy costs as well as electricity costs for lighting, appliances and general plug loads. These figures were not included in this study as they are identical in all three alternatives and are not influenced by the skin construction. The energy numbers listed in the table above and charts below only account for skin losses and tempering of 50 cfm of ventilation air.

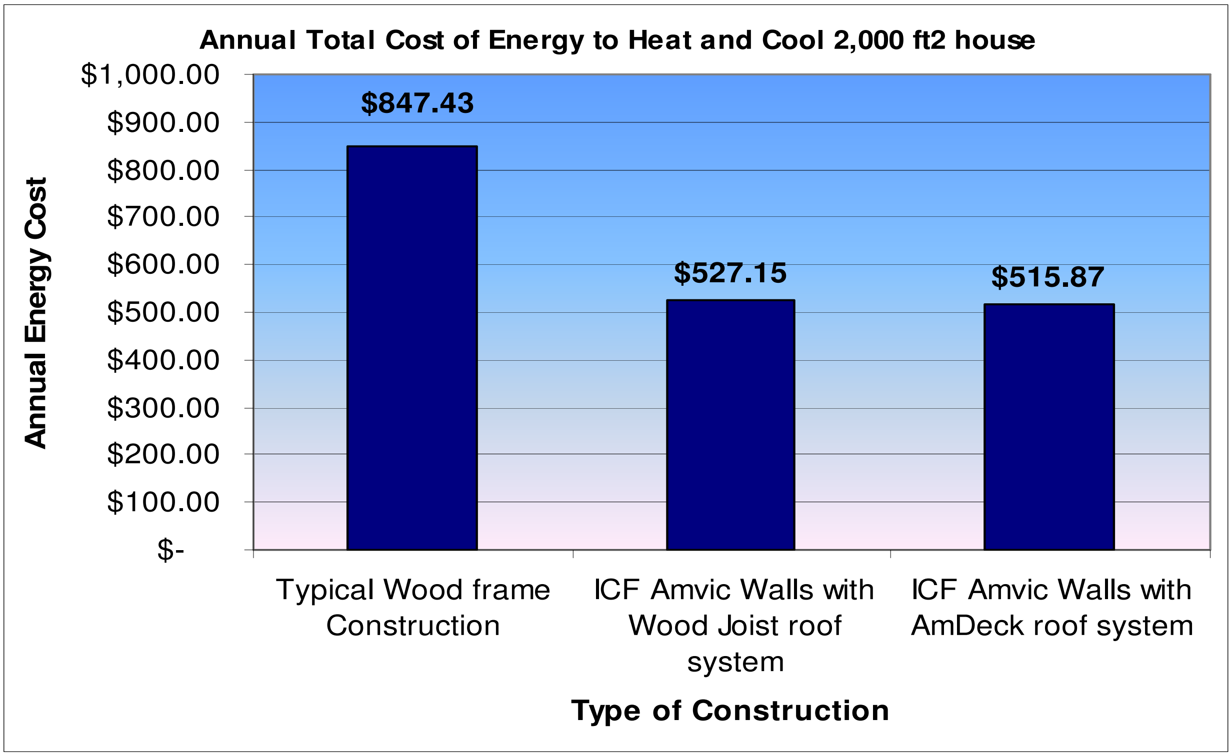
The following chart identifies the total annual heating costs for the three different residential construction alternatives:



The following chart identifies the total annual cooling costs for the three different residential construction alternatives:



The following chart identifies the total annual energy costs for the three different residential construction alternatives:



5.0 Conclusion

A typical 2,000 sq.ft. residential home was modeled in load and energy software to obtain detailed peak heating and cooling loads as well as monthly tabulated energy consumption.

These figures were used to obtain yearly energy costs for cooling and heating a residential home with three different construction alternatives.

The insulated concrete form (ICF) Amvic® construction offers better insulating value, greater thermal mass and reduced infiltration while offering a more durable exterior skin. These advantages combine to offer approximately 40% energy cost savings for the exterior losses only.

For a typical 2,000 sq.ft. residential home owner, this would translate in annual energy cost savings of approximately $320.00 or $25-$30 per month.

Appendix A – Trace Output files

System Checksums

By Stantec Consulting Ltd.

Furncae ALTERNATIVE #1 **Fan Coil**

COOLING COIL PEAK / CLG SPACE PEAK

Cooling Coil Peak — Peaked at Time: Mo/Hr: 7 / 15; Outside Air: OADB/WB/HR: 91 / 68 / 70

CLG Space Peak — Mo/Hr: Sum of; OADB: Peaks

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	CLG Space Sensible Btu/h	CLG Space Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	316	0	316	1	316	1
Glass Solar	16,499	0	16,499	39	16,499	42
Glass Cond	2,315	0	2,315	5	2,315	6
Wall Cond	5,820	0	5,820	14	5,820	15
Partition	0		0	0	0	0
Exposed Floor	0		0	0	0	0
Infiltration	5,780		5,780	14	4,476	11
Sub Total ==>	30,731	0	30,731	73	29,427	74
Internal Loads						
Lights	10,116	0	10,116	24	10,116	26
People	0		0	0	0	0
Misc	0	0	0	0	0	0
Sub Total ==>	10,116	0	10,116	24	10,116	26
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	1,310	3	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	0		0	0	0	0
Exhaust Heat		0	0	0		
Sup. Fan Heat			0	0		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Reheat at Design			0	0		
Grand Total ==>	40,847	0	42,157	100.00	39,543	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design; OADB: -4

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	-2,812	-2,812	6.52
Glass Solar	0	0	0.00
Glass Cond	-9,308	-9,308	21.59
Wall Cond	-9,618	-9,618	22.31
Partition	0	0	0.00
Exposed Floor	0	0	0.00
Infiltration	-17,431	-17,431	40.43
Sub Total ==>	-39,169	-39,169	90.84
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	-3,949	9.16
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Grand Total ==>	-39,169	-43,118	100.00

TEMPERATURES

	Cooling	Heating
SADB	58.4	83.5
Plenum	72.0	70.0
Return	72.0	70.0
Ret/OA	72.4	68.6
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Vent	50	50
Infil	221	221
Supply	2,718	2,718
MinStop/Rh	0	0
Return	2,939	2,939
Exhaust	271	271
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	1.8	1.8
cfm/ft²	1.38	1.38
cfm/ton	773.74	
ft²/ton	562.47	
Btu/hr·ft²	21.33	-21.82
No. People	0	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	3.5	42.2	40.6	2,718.2	72.4	60.1	61.4	58.4	54.6	60.5
Aux Clg	0.0	0.0	0.0	0	0	0	0	0	0	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3.5	42.2								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	1,976		
Part	0		
ExFlr	0		
Roof	988	0	0
Wall	2,560	320	13

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-43.1	2,718.2	68.6	83.5
Aux Htg	0.0	0	0	0
Preheat	0.0	0	0	0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-43.1			

System Checksums
By Stantec Consulting Ltd.

Furncae ALTERNATIVE #2 **Fan Coil**

COOLING COIL PEAK / CLG SPACE PEAK

Peaked at Time: Mo/Hr: 7 / 15 — Outside Air: OADB/WB/HR: 91 / 68 / 70

CLG Space Peak: Mo/Hr: Sum of — OADB: Peaks

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	316	0	316	1	316	1
Glass Solar	16,499	0	16,499	47	16,499	50
Glass Cond	2,315	0	2,315	7	2,315	7
Wall Cond	1,855	0	1,855	5	1,855	6
Partition	0		0	0	0	0
Exposed Floor	0		0	0	0	0
Infiltration	2,473		2,473	7	1,918	6
Sub Total ==>	23,459	0	23,459	67	22,904	69
Internal Loads						
Lights	10,116	0	10,116	29	10,116	31
People	0		0	0	0	0
Misc	0	0	0	0	0	0
Sub Total ==>	10,116	0	10,116	29	10,116	31
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	1,284	4	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	0		0	0	0	0
Exhaust Heat		0	0	0		
Sup. Fan Heat			0	0		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Reheat at Design			0	0		
Grand Total ==>	33,575	0	34,859	100.00	33,020	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design — OADB: -4

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	-2,812	-2,812	9.20
Glass Solar	0	0	0.00
Glass Cond	-9,308	-9,308	30.45
Wall Cond	-7,027	-7,027	22.99
Partition	0	0	0.00
Exposed Floor	0	0	0.00
Infiltration	-7,470	-7,470	24.44
Sub Total ==>	-26,617	-26,617	87.08
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	-3,949	12.92
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Grand Total ==>	-26,617	-30,567	100.00

TEMPERATURES

	Cooling	Heating
SADB	59.1	80.4
Plenum	72.0	70.0
Return	72.0	70.0
Ret/OA	72.4	68.5
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Vent	50	50
Infil	95	95
Supply	2,391	2,391
MinStop/Rh	0	0
Return	2,486	2,486
Exhaust	145	145
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	2.1	2.1
cfm/ft²	1.21	1.21
cfm/ton	823.06	
ft²/ton	680.22	
Btu/hr·ft²	17.64	-15.47
No. People	0	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	2.9	34.9	34.0	2,391.0	72.4	60.1	61.5	59.1	55.0	60.9
Aux Clg	0.0	0.0	0.0	0	0	0	0	0	0	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.9	34.9								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	1,976		
Part	0		
ExFlr	0		
Roof	988	0	0
Wall	2,560	320	13

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-30.6	2,391.0	68.5	80.4
Aux Htg	0.0	0	0	0
Preheat	0.0	0	0	0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-30.6			

System Checksums

By Stantec Consulting Ltd.

Furncae ALTERNATIVE #3 **Fan Coil**

COOLING COIL PEAK / CLG SPACE PEAK

Cooling Coil Peak — Peaked at Time: Mo/Hr: 7 / 15; Outside Air: OADB/WB/HR: 91 / 68 / 70

CLG Space Peak — Mo/Hr: Sum of; OADB: Peaks

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	298	0	298	1	298	1
Glass Solar	16,499	0	16,499	47	16,499	50
Glass Cond	2,315	0	2,315	7	2,315	7
Wall Cond	1,855	0	1,855	5	1,855	6
Partition	0		0	0	0	0
Exposed Floor	0		0	0	0	0
Infiltration	2,473		2,473	7	1,918	6
Sub Total ==>	23,440	0	23,440	67	22,885	69
Internal Loads						
Lights	10,116	0	10,116	29	10,116	31
People	0		0	0	0	0
Misc	0	0	0	0	0	0
Sub Total ==>	10,116	0	10,116	29	10,116	31
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	1,284	4	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	0		0	0	0	0
Exhaust Heat		0	0	0		
Sup. Fan Heat			0	0		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Reheat at Design			0	0		
Grand Total ==>	33,556	0	34,840	100.00	33,001	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design; OADB: -4

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	-2,285	-2,285	7.61
Glass Solar	0	0	0.00
Glass Cond	-9,308	-9,308	30.98
Wall Cond	-7,027	-7,027	23.39
Partition	0	0	0.00
Exposed Floor	0	0	0.00
Infiltration	-7,470	-7,470	24.87
Sub Total ==>	-26,090	-26,090	86.85
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	-3,949	13.15
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Grand Total ==>	-26,090	-30,040	100.00

TEMPERATURES

	Cooling	Heating
SADB	59.1	80.2
Plenum	72.0	70.0
Return	72.0	70.0
Ret/OA	72.4	68.5
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Vent	50	50
Infil	95	95
Supply	2,390	2,390
MinStop/Rh	0	0
Return	2,484	2,484
Exhaust	145	145
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	2.1	2.1
cfm/ft²	1.21	1.21
cfm/ton	823.01	
ft²/ton	680.59	
Btu/hr·ft²	17.63	-15.20
No. People	0	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	2.9	34.8	34.0	2,389.5	72.4	60.1	61.5	59.1	55.0	60.9
Aux Clg	0.0	0.0	0.0	0	0	0	0	0	0	0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.9	34.8								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	1,976		
Part	0		
ExFlr	0		
Roof	988	0	0
Wall	2,560	320	13

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-30.0	2,389.5	68.5	80.2
Aux Htg	0.0	0	0	0
Preheat	0.0	0	0	0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-30.0			