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Basic Design Service Report

**John's Plumbing & Heating**

Project: Example Residence

Prepared: January 1, 2009

April 29, 2009

John's Plumbing & Heating

Attn: John Doe

123 Lincoln Ave

Boston, MA 02101

Office: (800) 888-0001

Fax: (800) 888-0002

**RE: Final GSHP System Design Report for Example Residence**

## Section 1: Manual J Loads, GSHP Schedule, & Operating Cost Comparisons

According to the information provided, the peak loads for the residence were calculated to be as listed in the following table. Several assumptions were employed to estimate the loads, such as internal gain (due to occupancy levels and appliance use), infiltration levels, etc. All loads assume 70/75/50 (heating temp/cooling temp/%-RH) thermostat set points and 0.31 ACH infiltration levels in heating and 0.15 ACH infiltration levels in cooling (average house construction levels). Total conditioned floor area was found to be approximately 4670 ft<sup>2</sup> (assumed use of a forced-air system on all floors, 3 zones).

**Table 1. Peak Loads**

Building Zone	Heating Load	Cooling Load (Sens)	Zone SHF
Basement	16,363 Btu/hr	6,823 Btu/hr	0.804
Main Level	18,562 Btu/hr	15,085 Btu/hr	0.857
Upper Level	22,605 Btu/hr	16,224 Btu/hr	0.854
Totals	57,530 Btu/hr	38,132 Btu/hr	0.846

*All loads calculated using software in compliance with ACCA Manual J and are based on provided construction of the building (insulation levels, window quality, etc.) The loads provided in the table include ventilation loads (assumed use of an energy recovery ventilator (ERV) for provision of 150 cfm outside AFV with 60% effectiveness).*

Based on the calculated peak equipment loads, the recommended heat pump schedule is as follows:

**Table 2. Recommended GSHP Equipment Schedule**

<i>Space</i>	<i>Brand/Model</i>	<i>Htg Cap.</i>	<i>%-Sizing</i>	<i>Water Flow</i>	<i>Air Flow</i>
Basement & Main Level	Climate Master TT049	37.9 MBH	109%	12.0	1650
Upper Level	Climate Master TT026	19.4 MBH	86%	8.0	950

- *Equipment water flow rate measured in gallons per minute (gpm)*
- *Equipment air flow rate measured in cubic feet per minute (cfm)*
- *Equipment capacities based on 30°F minimum EWT from the loopfield and 70°F EAT from the space in heating*
- *Equipment capacities in cooling not listed because of heating dominance for the home*
- *Dual capacity equipment specified for optimum performance at part-load conditions during the majority of the year in heating in addition to superior dehumidification in low-capacity in cooling mode*
- *Installation of 10-kW backup electric resistance heat recommended for emergency heating capabilities*

The ACCA Manual J peak heating and cooling load calculations as well as the GSHP equipment selection information for the residence are displayed in the following pages. The operating cost calculations were based on an estimated electric rate of \$0.12/kWh.



## Project Information

For: John Doe  
123 Lincoln Ave, Boston, MA 20101  
Phone: (888) 800-0001 Fax: (888) 800-0002

## Design Conditions

### Location:

Boston, MA, US  
Elevation: 30 ft  
Latitude: 42 °N

### Outdoor:

Dry bulb (°F)  
Daily range (°F)  
Wet bulb (°F)  
Wind speed (mph)

### Heating

12  
-  
-  
15.0

### Cooling

87  
15 ( L )  
71  
7.5

### Indoor:

Indoor temperature (°F)  
Design TD (°F)  
Relative humidity (%)  
Moisture difference (gr/lb)

### Heating

70  
58  
50  
46.7

### Cooling

75  
12  
50  
25.7

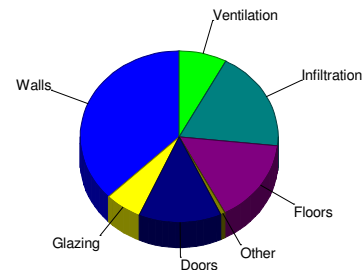
### Infiltration:

Method  
Construction quality  
Fireplaces

Simplified  
Average  
2 (Average)

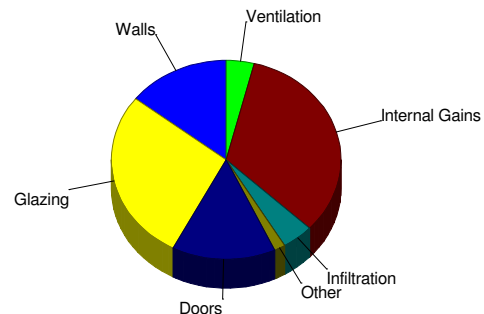
## Heating

Component	Btuh/ft²	Btuh	% of load
Walls	3.5	6104	37.3
Glazing	23.8	991	6.1
Doors	15.1	2217	13.5
Ceilings	1.5	123	0.8
Floors	1.6	2566	15.7
Infiltration	2.9	3087	18.9
Ducts		0	0.0
Piping		0	0.0
Humidification		0	0.0
Ventilation		1275	7.8
Adjustments		0	
<b>Total</b>		<b>16363</b>	<b>100.0</b>



## Cooling

Component	Btuh/ft²	Btuh	% of load
Walls	0.6	984	14.4
Glazing	45.7	1906	27.9
Doors	6.8	996	14.6
Ceilings	1.3	105	1.5
Floors	0.0	0	0.0
Infiltration	0.3	304	4.5
Ducts		0	0.0
Ventilation		268	3.9
Internal gains		2260	33.1
Blower		0	0.0
Adjustments		0	
<b>Total</b>		<b>6823</b>	<b>100.0</b>



Overall U-value = 0.055 Btuh/ft²-°F

WARNING: window to floor area ratio = 2.5% - less than 5%.



### Project Information

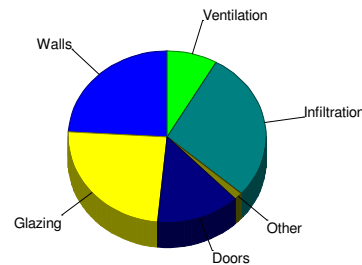
For: John Doe  
 123 Lincoln Ave, Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

### Design Conditions

<b>Location:</b>				<b>Indoor:</b>	<b>Heating</b>	<b>Cooling</b>
Boston, MA, US				Indoor temperature (°F)	70	75
Elevation:	30 ft			Design TD (°F)	58	12
Latitude:	42 °N			Relative humidity (%)	50	50
<b>Outdoor:</b>		<b>Heating</b>	<b>Cooling</b>	Moisture difference (gr/lb)	46.7	25.7
Dry bulb (°F)		12	87	<b>Infiltration:</b>		
Daily range (°F)		-	15 ( L )	Method	Simplified	
Wet bulb (°F)		-	71	Construction quality	Average	
Wind speed (mph)		15.0	7.5	Fireplaces	2 (Average)	

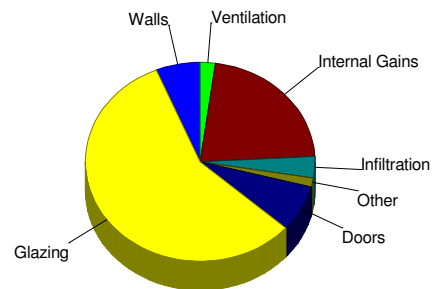
### Heating

Component	Btuh/ft²	Btuh	% of load
Walls	3.0	4469	24.1
Glazing	23.8	4525	24.4
Doors	15.1	2533	13.6
Ceilings	1.5	260	1.4
Floors	0.0	0	0.0
Infiltration	2.9	5245	28.3
Ducts		0	0.0
Piping		0	0.0
Humidification		0	0.0
Ventilation		1530	8.2
Adjustments		0	0.0
<b>Total</b>		<b>18562</b>	<b>100.0</b>



### Cooling

Component	Btuh/ft²	Btuh	% of load
Walls	0.6	944	6.3
Glazing	45.3	8622	57.2
Doors	6.8	1138	7.5
Ceilings	1.3	222	1.5
Floors	0.0	0	0.0
Infiltration	0.3	517	3.4
Ducts		0	0.0
Ventilation		322	2.1
Internal gains		3320	22.0
Blower		0	0.0
Adjustments		0	0.0
<b>Total</b>		<b>15085</b>	<b>100.0</b>



Overall U-value = 0.101 Btuh/ft²-°F

Data entries checked.

## GSHP Selection Information for Basement & Main Level:

<b>Print Zone 1</b>	<b>Basement &amp; Main Level</b>			
<b>PEAK LOAD INFORMATION</b>				
<b>Heating</b>			<b>Cooling</b>	
Peak Heating Load	34,925	Btu/hr (@12°F OAT)	Peak Cooling Load (Total)	26,095
T-Stat Set Point	70	°F	T-Stat Set Point	75
			Zone SHF	0.84
<b>HEAT PUMP SELECTION</b>				
Heat Pump Type <input checked="" type="checkbox"/> Water-Air <input type="checkbox"/> Water-Water		1-1/2-CAP Dual Capacity		
Brand <b>Climate Master</b>		Model / Unit SHF <b>Tranquility TT049</b>		
Htg CAP Correction Factor	1.000	Total Clg CAP Correction Factor	1.000	
Htg DMD Correction Factor	1.000	Sensible Clg CAP Correction Factor	1.000	
No. of Units	1	Clg DMD Correction Factor	1.000	
<b>INSTALLED CAPACITY CHECK</b>				
<b>Heating ( EWTmin = 30°F )</b>			<b>Cooling ( EWTmax = 90°F )</b>	
Installed Capacity	37,900 Btu/hr		Installed Capacity (SC)	36,075 Btu/hr
%-Sizing	109%		%-Oversizing (SC)	+65% --> High Cap (+23% --> Low Cap)
Installed COP <sub>n</sub>	3.79		Installed EER <sub>n</sub>	14.49
System Flowrate	12 gpm		System Flowrate	12 gpm
<i>Installed CAP/COP Based on 70°F EAT, 1650 cfm, &amp; 12 gpm</i>			<i>Installed CAP/EER Based on 80/67°F EAT, 1650 cfm, &amp; 12 gpm</i>	
<b>ENERGY ANALYSIS SUMMARY - ZONE 1</b>				
<b>Heating</b>			<b>Cooling</b>	
HP Energy	5,065	kWh	HP Energy	1,344
Resistance Energy	68	kWh	Low-Cap Run-Time	656
Low-Cap Run-Time	1,934	hrs	High-Cap Run-Time	0
High-Cap Run-Time	275	hrs	Resistance Run-Time	51
Resistance Run-Time	51	hrs	HP Operating Cost	\$161.23
HP Operating Cost	\$607.78	<i>Specify Elec. Rate</i>	Pump Energy	173
Resistance Operating Cost	\$8.10		Pumping Cost	\$20.77
Pump Energy	583	kWh	<b>Total Cooling Cost</b>	<b>\$182.00</b>
Pumping Cost	\$69.98			<i>(Elec. Rate=\$0.12/kWh)</i>
<b>Total Heating Cost</b>	<b>\$685.87</b>	<i>(Elec. Rate=\$0.12/kWh)</i>	Cooling Ground Load (HR)	-27,733,781
Heating Ground Load (HE)	55,352,707	Btu		
<b>GSHP Operating Cost Breakdown for Zone 1</b>				



## Project Information

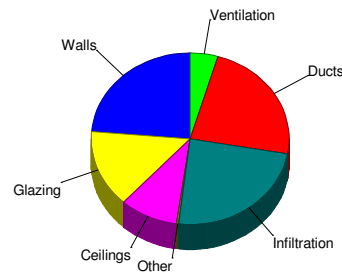
For: John Doe  
 123 Lincoln Ave, Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

## Design Conditions

<b>Location:</b> Boston, MA, US Elevation: 30 ft Latitude: 42 °N		<b>Indoor:</b> Indoor temperature (°F) 70 Design TD (°F) 58 Relative humidity (%) 50 Moisture difference (gr/lb) 46.7	<b>Heating</b> 70	<b>Cooling</b> 75
<b>Outdoor:</b> Dry bulb (°F) 12 Daily range (°F) - Wet bulb (°F) - Wind speed (mph) 15.0	<b>Heating</b> 12	<b>Cooling</b> 87 15 ( L ) 71 7.5		
		<b>Infiltration:</b> Method Simplified Construction quality Average Fireplaces 2 (Average)		

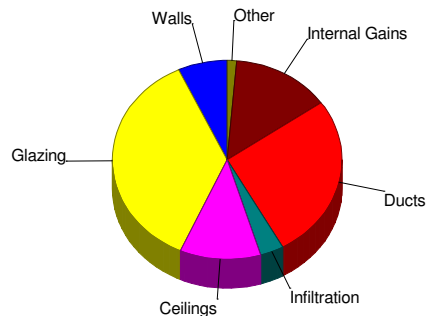
## Heating

Component	Btuh/ft²	Btuh	% of load
Walls	3.0	5341	23.6
Glazing	23.8	3294	14.6
Doors	0.0	0	0.0
Ceilings	1.5	2164	9.6
Floors	1.6	78	0.3
Infiltration	2.9	5444	24.1
Ducts		5265	23.3
Piping		0	0.0
Humidification		0	0.0
Ventilation		1020	4.5
Adjustments		-0	
<b>Total</b>		<b>22605</b>	<b>100.0</b>



## Cooling

Component	Btuh/ft²	Btuh	% of load
Walls	0.6	1128	7.0
Glazing	42.6	5903	36.4
Doors	0.0	0	0.0
Ceilings	1.3	1848	11.4
Floors	0.0	0	0.0
Infiltration	0.3	537	3.3
Ducts		4333	26.7
Ventilation		214	1.3
Internal gains		2260	13.9
Blower		0	0.0
Adjustments		-0	
<b>Total</b>		<b>16224</b>	<b>100.0</b>



Overall U-value = 0.055 Btuh/ft²-°F

Data entries checked.

## GSHP Selection Information for Upper Level:

<small>Print Zone 2</small>	<b>Upper Level</b>			
<b>PEAK LOAD INFORMATION</b>				
<b>Heating</b>			<b>Cooling</b>	
Peak Heating Load	22,605	Btu/hr (@12°F OAT)	Peak Cooling Load (Total)	18,990
T-Stat Set Point	70	°F	T-Stat Set Point	75
			Zone SHF	0.85
<b>HEAT PUMP SELECTION</b>				
Heat Pump Type <input checked="" type="checkbox"/> Water-Air <input type="checkbox"/> Water-Water		1-1/2-CAP Dual Capacity		
Brand <b>Climate Master</b>		Model / Unit SHF <b>Tranquility TT026</b>		
Htg CAP Correction Factor	1.000	Clg CAP Correction Factor	1.000	
Htg DMD Correction Factor	1.000	Sensible Clg CAP Correction Factor	1.000	
No. of Units	1	Clg DMD Correction Factor	1.000	
<b>INSTALLED CAPACITY CHECK</b>				
<b>Heating ( EWTmin = 30°F )</b>			<b>Cooling ( EWTmax = 90°F )</b>	
Installed Capacity	19,400 Btu/hr		Installed Capacity (TC)	21,521 Btu/hr
%-Sizing	86%		%-Oversizing (SC)	+17% --> High Cap (-12% --> Low Cap)
Installed COP <sub>n</sub>	3.82		Installed EER <sub>c</sub>	14.82
System Flowrate	8 gpm		System Flowrate	8 gpm
<b>Installed CAP/COP Based on 70°F EAT, 950 cfm, &amp; 8 gpm</b>			<b>Installed CAP/EER Based on 80/67°F EAT, 950 cfm, &amp; 8 gpm</b>	
<b>ENERGY ANALYSIS SUMMARY - ZONE 2</b>				
<b>Heating</b>			<b>Cooling</b>	
HP Energy	3,109	kWh	HP Energy	923
Resistance Energy	197	kWh	Low-Cap Run-Time	813
Low-Cap Run-Time	2,026	hrs	High-Cap Run-Time	48
High-Cap Run-Time	552	hrs	Resistance Run-Time	--
Resistance Run-Time	136	hrs	HP Operating Cost	\$110.73
HP Operating Cost	\$373.04	<small>Specify Elec. Rate</small>	Pump Energy	158
Resistance Operating Cost	\$23.68		Pumping Cost	\$18.98
Pump Energy	473	kWh	<b>Total Cooling Cost</b>	<b>\$129.71</b>
Pumping Cost	\$56.81	<small>(Elec. Rate=\$0.12/kWh)</small>	Cooling Ground Load (HR)	-20,071,913
<b>Total Heating Cost</b>	<b>\$453.54</b>			
Heating Ground Load (HE)	35,766,622	Btu		

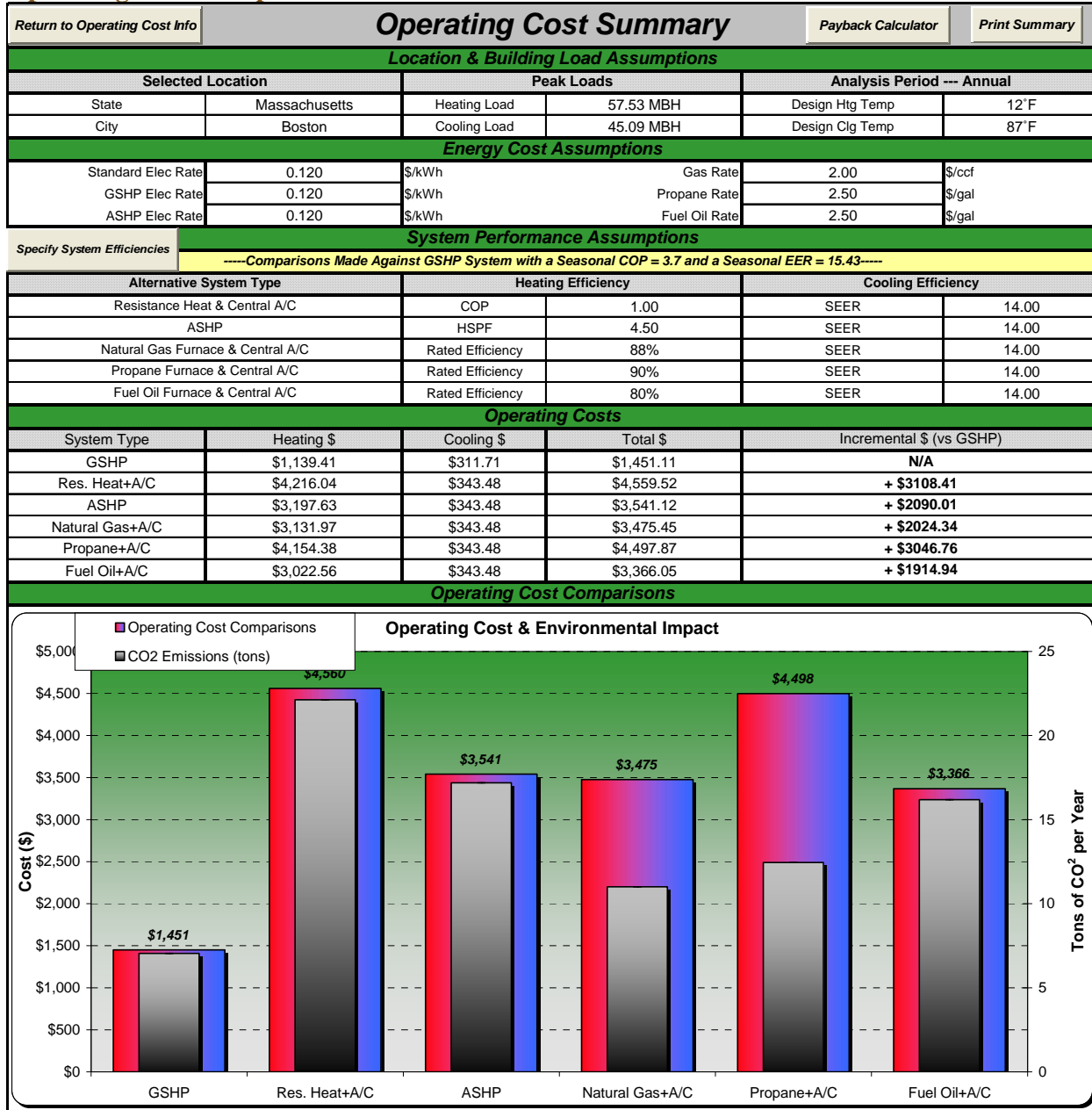
  

**GSHP Operating Cost Breakdown for Zone 2**

■ HP Heating Cost	64%
▨ Resistance Heating Cost	19%
▤ Pumping Cost-Heating	10%
▥ HP Cooling Cost	4%
▧ Pumping Cost-Cooling	3%

Annual energy usage to heat and cool the building was estimated via the bin analysis. Operating cost comparison calculations were performed based on the utility rates and system efficiencies listed in the table below:

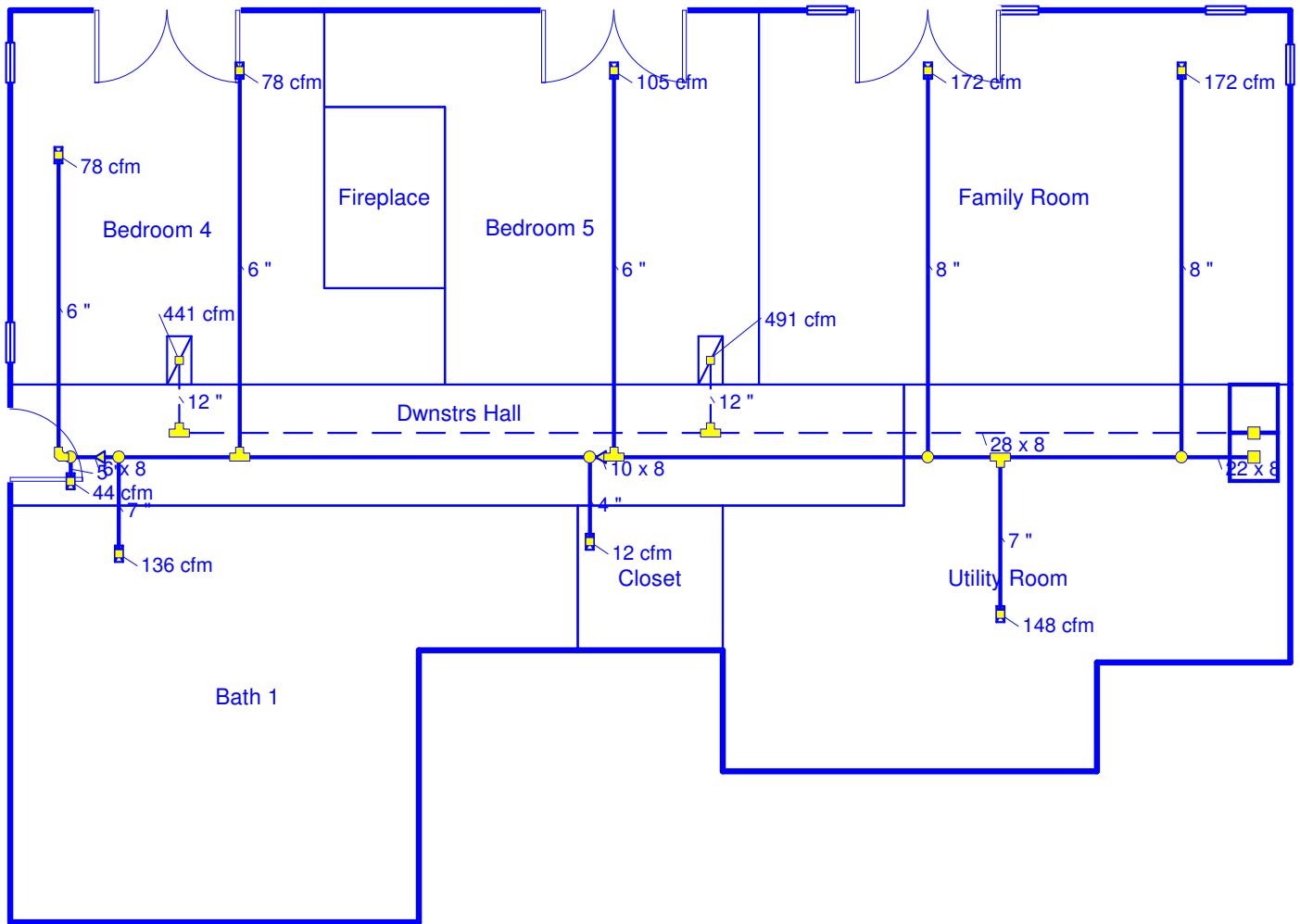
### Operating Cost Comparisons:



### **Section 3: Ductwork Design**

Ductwork layout recommendations & details for the residence are displayed in the following pages. All ductwork design was performed in accordance with ACCA Manual D.

### Basement



**Job #: Example Residence**  
**Performed by JMH for:**  
 John Doe  
 123 Lincoln Ave  
 Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

**Geoconnections, Inc.**  
 302 E. Warehouse St.  
 Elkton, SD 57026  
 Phone: 605-542-5261 Fax: 605-542-1303

Scale: 1 : 88  
 Page 1  
 Right-Suite Residential  
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**Duct System Summary**  
**Basement**  
 Geoconnections, Inc.

Job: Example Residence  
 Date: 1 Jan 2008  
 By: JMH

302 E. Warehouse St., Elkton, SD 57026 Phone: 605-542-5261 Fax: 605-542-1303

**Project Information**

For: John Doe  
 123 Lincoln Ave, Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

	<b>Heating</b>	<b>Cooling</b>
External static pressure	0.25 in H2O	0.25 in H2O
Pressure losses	0.00 in H2O	0.00 in H2O
Available static pressure	0.25 in H2O	0.25 in H2O
Supply / return available pressure	0.14 / 0.11 in H2O	0.14 / 0.11 in H2O
Lowest friction rate	0.059 in/100ft	0.059 in/100ft
Actual air flow	775 cfm	<b>775</b> cfm
Total effective length (TEL)	426 ft	

**Supply Branch Detail Table**

Name	Design (Btuh)	Htg (cfm)	Clg (cfm)	Design FR	Diam (in)	Rect Size (in)	Duct Matl	Actual Ln (ft)	Ftg.Eqv Ln (ft)	Trunk
Bedroom 4-A	h 1524	78	77	0.068	6	0x0	ShMt	58.0	150.0	st3A
Bedroom 4	h 1524	78	77	0.075	6	0x0	ShMt	62.0	125.0	st3B
Bedroom 5	h 2038	105	82	0.082	6	0x0	ShMt	42.5	130.0	st3
Family Room-A	c 1454	105	172	0.067	8	0x0	ShMt	19.0	190.0	st3
Family Room	c 1454	105	172	0.071	8	0x0	ShMt	29.5	170.0	st3
Utility Room	c 1249	112	148	0.084	7	0x0	ShMt	17.0	150.0	st3
Dwnstrs Hall	h 863	44	21	0.059	5	0x0	ShMt	50.0	190.0	st3B
Bath 1	h 2645	136	26	0.064	7	0x0	ShMt	51.0	170.0	st3A
Closet	h 227	12	0	0.064	4	0x0	ShMt	31.0	190.0	st3A

**Supply Trunk Detail Table**

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
st3	Peak AVF	775	775	0.059	634	14	8 x 22	ShtMetl	
st3A	Peak AVF	348	202	0.059	627	10	8 x 10	ShtMetl	st3
st3B	Peak AVF	123	99	0.059	368	7	8 x 6	ShtMetl	st3A

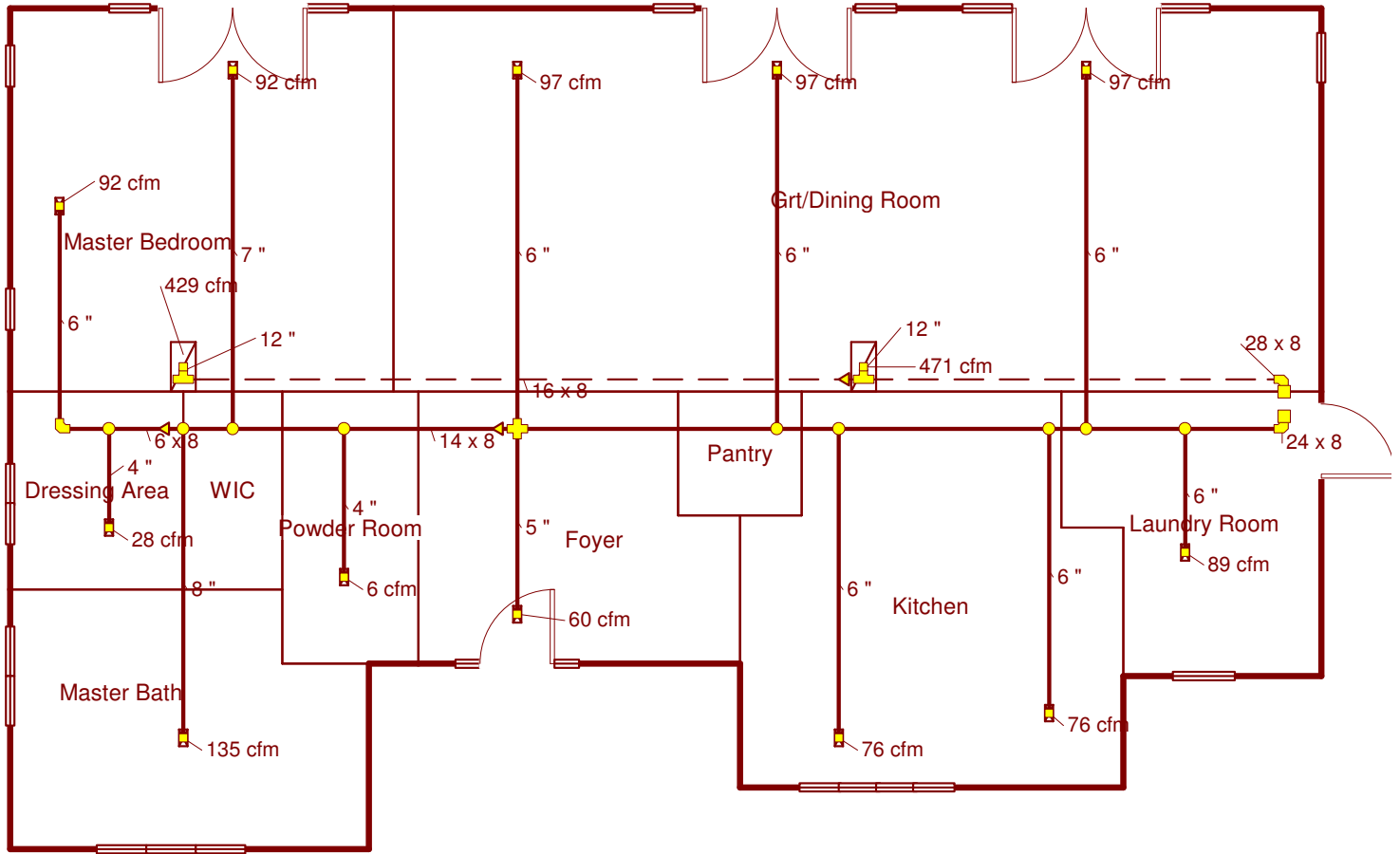
## Return Branch Detail Table

Name	Grill Size (in)	Htg (cfm)	Clg (cfm)	TEL (ft)	Design FR	Veloc (fpm)	Diam (in)	RectSize (in)	Stud/Joist Opening (in)	Duct Matl	Trunk
rb1	0x0	334	491	185.5	0.059	626	12	0x 0		ShMt	rt3
rb4	0x0	441	284	177.5	0.061	562	12	0x 0		ShMt	rt3

## Return Trunk Detail Table

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
rt3	Peak AVF	775	775	0.059	498	16	8 x 28	ShtMetl	

### 1st Floor



**Job #: Example Residence**  
**Performed by JMH for:**  
 John Doe  
 123 Lincoln Ave  
 Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

**Geoconnections, Inc.**  
 302 E. Warehouse St.  
 Elkton, SD 57026  
 Phone: 605-542-5261 Fax: 605-542-1303

**Scale: 1 : 88**  
 Page 2  
 Right-Suite Residential  
 6.0.79 RSR47311  
 2009-Apr-29 16:24:57  
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**Duct System Summary**  
**Main Level**  
 Geoconnections, Inc.

Job: Example Residence  
 Date: 1 Jan 2008  
 By: JMH

302 E. Warehouse St., Elkton, SD 57026 Phone: 605-542-5261 Fax: 605-542-1303

**Project Information**

For: John Doe  
 123 Lincoln Ave, Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

	<b>Heating</b>	<b>Cooling</b>
External static pressure	0.25 in H2O	0.25 in H2O
Pressure losses	0.00 in H2O	0.00 in H2O
Available static pressure	0.25 in H2O	0.25 in H2O
Supply / return available pressure	0.15 / 0.10 in H2O	0.15 / 0.10 in H2O
Lowest friction rate	0.046 in/100ft	0.046 in/100ft
Actual air flow	875 cfm	<b>875</b> cfm
Total effective length (TEL)	543 ft	

**Supply Branch Detail Table**

Name	Design (Btuh)	Htg (cfm)	Clg (cfm)	Design FR	Diam (in)	Rect Size (in)	Duct Matl	Actual Ln (ft)	Ftg.Eqv Ln (ft)	Trunk	
Master Bedroom	c	1555	84	92	0.047	7	0x0	ShMt	57.5	265.0	st2A
Master Bedroom-A	c	1555	84	92	0.054	6	0x0	ShMt	59.0	220.0	st2B
Laundry Room	c	1497	86	89	0.064	6	0x0	ShMt	9.5	225.0	st2
Kitchen-A	c	1288	57	76	0.065	6	0x0	ShMt	21.5	210.0	st2
Kitchen	c	1288	57	76	0.065	6	0x0	ShMt	31.0	200.0	st2
Foyer	h	1170	60	35	0.069	5	0x0	ShMt	39.0	180.0	st2
Powder Room	h	123	6	1	0.047	4	0x0	ShMt	44.5	275.0	st2A
Dressing Area	h	539	28	9	0.046	4	0x0	ShMt	52.0	275.0	st2B
Master Bath	h	2638	135	112	0.048	8	0x0	ShMt	57.5	255.0	st2A
Grt/Dining Room-A	c	1643	92	97	0.063	6	0x0	ShMt	23.0	215.0	st2
Grt/Dining Room	c	1643	92	97	0.067	6	0x0	ShMt	35.5	190.0	st2
Grt/Dining Room-B	c	1643	92	97	0.067	6	0x0	ShMt	46.0	180.0	st2

**Supply Trunk Detail Table**

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
st2	Peak AVF	875	875	0.046	656	15	8 x 24	ShtMetl	
st2A	Peak AVF	337	307	0.046	433	11	8 x 14	ShtMetl	st2
st2B	Peak AVF	111	102	0.046	334	7	8 x 6	ShtMetl	st2A

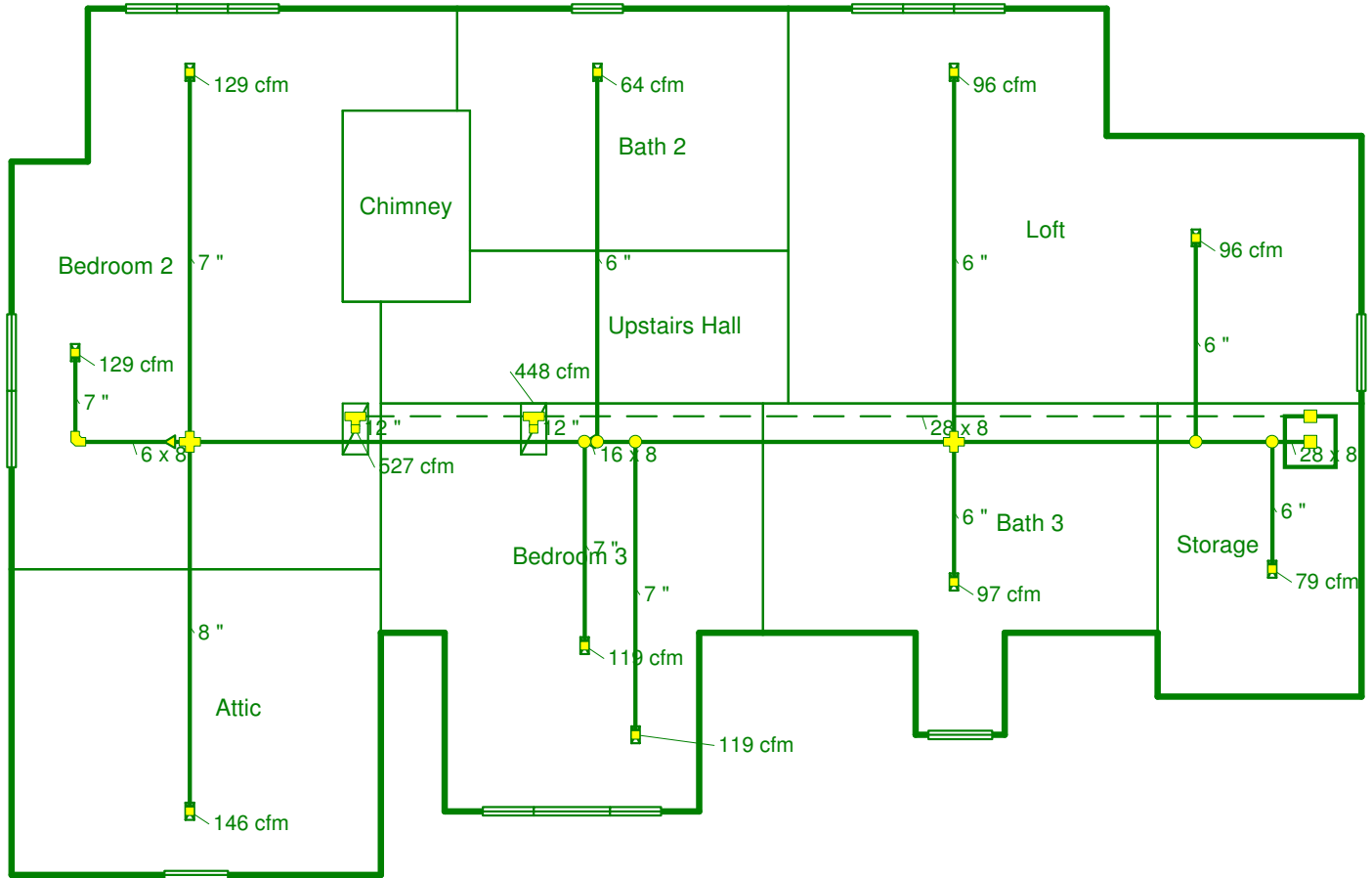
## Return Branch Detail Table

Name	Grill Size (in)	Htg (cfm)	Clg (cfm)	TEL (ft)	Design FR	Veloc (fpm)	Diam (in)	RectSize (in)	Stud/Joist Opening (in)	Duct Matl	Trunk
rb2	0x0	446	471	198.0	0.050	599	12	0x 0		ShMt	rt2
rb5	0x0	429	404	215.5	0.046	546	12	0x 0		ShMt	rt2A

## Return Trunk Detail Table

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
rt2	Peak AVF	875	875	0.046	563	16	8 x 28	ShtMetl	rt2
rt2A	Peak AVF	429	404	0.046	483	12	8 x 16	ShtMetl	

## 2nd Floor



**Job #: Example Residence**  
**Performed by JMH for:**

John Doe  
 123 Lincoln Ave  
 Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

**Geoconnections, Inc.**

302 E. Warehouse St.  
 Elkton, SD 57026  
 Phone: 605-542-5261 Fax: 605-542-1303

Scale: 1 : 88

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**Duct System Summary**  
**Upper Level**  
 Geoconnections, Inc.

Job: Example Residence  
 Date: 1 Jan 2008  
 By: JMH

302 E. Warehouse St., Elkton, SD 57026 Phone: 605-542-5261 Fax: 605-542-1303

**Project Information**

For: John Doe  
 123 Lincoln Ave, Boston, MA 20101  
 Phone: (888) 800-0001 Fax: (888) 800-0002

	<b>Heating</b>	<b>Cooling</b>
External static pressure	0.25 in H2O	0.25 in H2O
Pressure losses	0.00 in H2O	0.00 in H2O
Available static pressure	0.25 in H2O	0.25 in H2O
Supply / return available pressure	0.16 / 0.09 in H2O	0.16 / 0.09 in H2O
Lowest friction rate	0.047 in/100ft	0.047 in/100ft
Actual air flow	950 cfm	<b>950</b> cfm
Total effective length (TEL)	528 ft	

**Supply Branch Detail Table**

Name	Design (Btuh)	Htg (cfm)	Clg (cfm)	Design FR	Diam (in)	Rect Size (in)	Duct Matl	Actual Ln (ft)	Ftg.Eqv Ln (ft)	Trunk
Loft	h 2186	96	91	0.079	6	0x0	ShMt	12.5	190.0	st1
Loft-A	h 2186	96	91	0.077	6	0x0	ShMt	28.5	180.0	st1
Bath 2	h 1449	64	62	0.056	6	0x0	ShMt	42.5	245.0	st1
Bedroom 2	c 2181	107	129	0.051	7	0x0	ShMt	58.5	255.0	st1A
Bedroom 2-A	c 2181	107	129	0.047	7	0x0	ShMt	52.0	285.0	st1B
Attic	h 3310	146	88	0.051	8	0x0	ShMt	58.5	255.0	st1A
Bedroom 3-A	c 2004	79	119	0.053	7	0x0	ShMt	36.5	265.0	st1A
Bedroom 3	c 2004	79	119	0.054	7	0x0	ShMt	38.0	255.0	st1
Storage	h 1805	79	66	0.079	6	0x0	ShMt	6.5	195.0	st1
Bath 3	h 2215	97	57	0.080	6	0x0	ShMt	19.5	180.0	st1

**Supply Trunk Detail Table**

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
st1	Peak AVF	950	950	0.047	611	16	8 x 28	ShtMetl	
st1A	Peak AVF	438	466	0.047	524	12	8 x 16	ShtMetl	st1
st1B	Peak AVF	107	129	0.047	388	7	8 x 6	ShtMetl	st1A

## Return Branch Detail Table

Name	Grill Size (in)	Htg (cfm)	Clg (cfm)	TEL (ft)	Design FR	Veloc (fpm)	Diam (in)	RectSize (in)	Stud/Joist Opening (in)	Duct Matl	Trunk
rb3	0x0	502	527	168.0	0.054	671	12	0x 0		ShMt	rt1
rb6	0x0	448	423	191.0	0.047	571	12	0x 0		ShMt	rt1

## Return Trunk Detail Table

Name	Trunk Type	Htg (cfm)	Clg (cfm)	Design FR	Veloc (fpm)	Diam (in)	Rect Duct Size (in)	Duct Material	Trunk
rt1	Peak AVF	950	950	0.047	611	16	8 x 28	ShtMetl	