

How To Review A Savoy Engineering Group's Manual J, S & D Project Summary

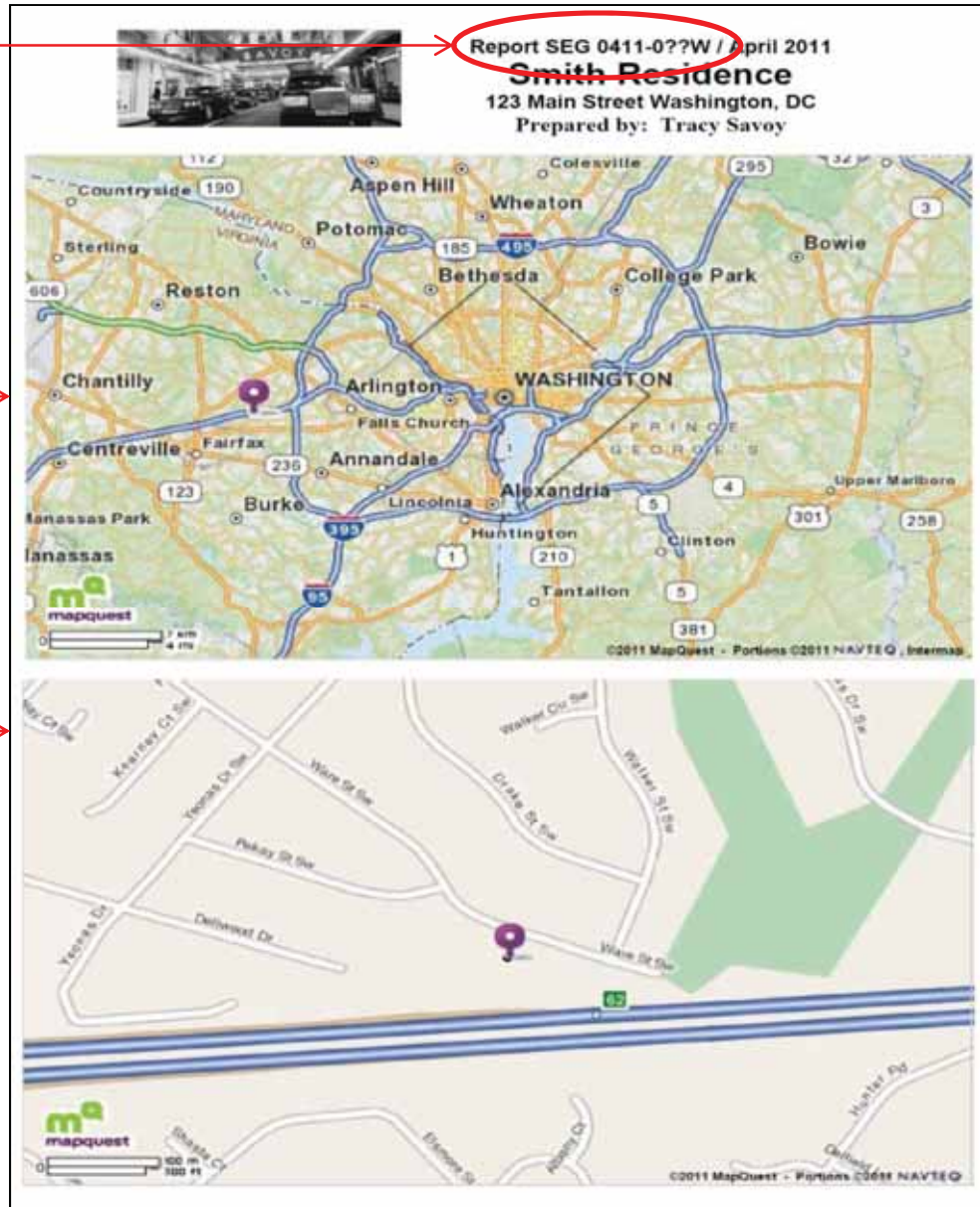


www.load-calculations.com

801-949-5337

Project Summary Title Page

- Project number
- Shows location in relation to ASHRAE 2009 weather location
- Shows project location



Disclaimer

➤ Review of liability

- Carefully review the disclaimer

DISCLAIMER

The following pages summarize the heat gain and heat loss of the building using the ACCA Manual J8 calculation procedure. The calculations are based on the information given to Savoy Engineering Group in the form of drawings, sketches, and interviews. In certain cases, Savoy Engineering Group may make assumptions about design conditions that may or may not be accurate for the location of concern. It is the responsibility of the installing HVAC contractor to verify the design conditions **before** equipment purchase and installation.

Any load calculations provided in the following pages are based upon information provided by the party submitting a particular project to Savoy Engineering Group. Savoy Engineering Group has not and does not independently verify that the data provided to Savoy Engineering Group is correct or complete, and any calculations made by Savoy Engineering Group are based upon the information provided by third parties. Savoy Engineering Group makes no claim that the information given to us is correct or complete.

Savoy Engineering Group utilizes WrightSoft Residential 8.0 which is an ACCA Certified and ASHRAE recommended computer program to determine the heating and cooling loads presented in this report, and is therefore very accurate. If the information given to Savoy Engineering Group is accurate, and the building is built as per the plans submitted, then the load calculations presented in this report can be assumed to be accurate. A licensed mechanical contractor may use these calculations as a starting point in system sizing and selection.

Savoy Engineering Group does not provide architectural or engineering plans or diagrams for the public or for use by contractors or construction companies as final "construction documents". Savoy Engineering Group works with architectural and engineering firms and with contractors in connection with their designs of heating and air conditioning systems.

If the HVAC duct layout installed on-site DOES NOT match the Manual D duct design prepared by Savoy Engineering Group, then Savoy Engineering Group cannot and will not guarantee the performance of any altered duct design.

Final HVAC sizing and selection should be done by a licensed HVAC contractor. Many factors beyond the scope of this report must be considered prior to final system selection and design, such as: exact equipment availability and selections, system controls and location of controls, system air distribution and cycling, Uniform Building Code requirements, Uniform Mechanical Code requirements, and many other standard design conventions as listed by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).

Savoy Engineering Group therefore assumes no liability for final equipment selection or final system design. Various modifications to the information provided to Savoy Engineering Group may have occurred after this Design Support information was prepared, which would require that this Design Support information be modified in order to be accurate. After reviewing Savoy Engineering Group's report, and prior to any system purchase or installation, please inform Savoy Engineering Group in writing of any changes which may alter the assumptions and calculations contained in this report.

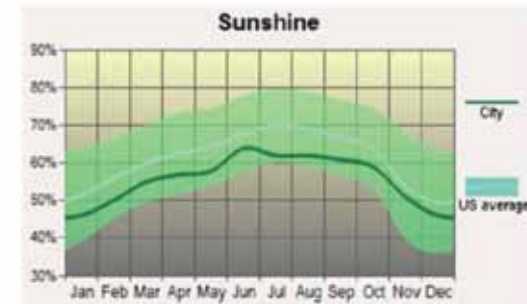
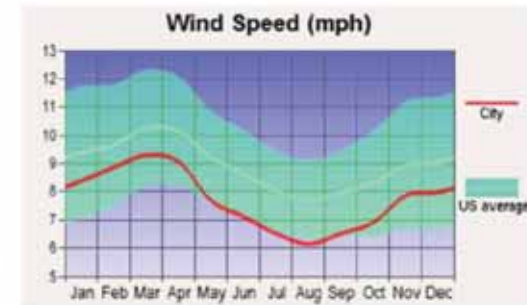
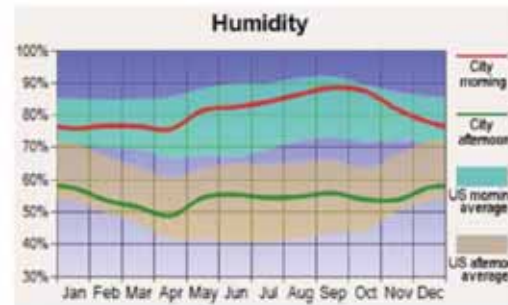
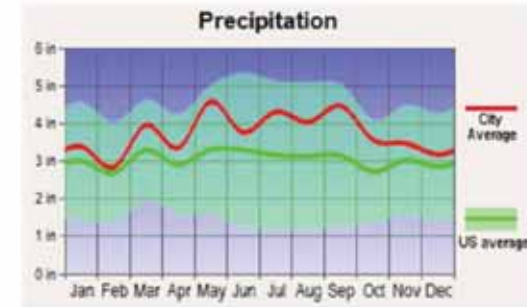
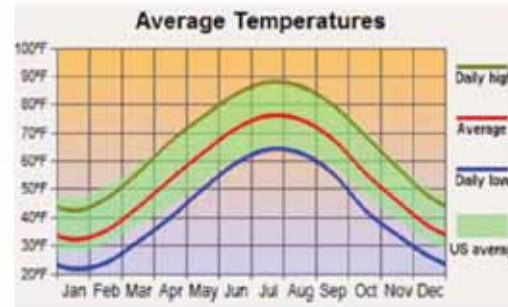
Weather Data

- Gives the elevation for the projects city
- Gives weather data for the projects city
 - www.city-data.com
- Always check to make sure correct city was used
 - If your city could not be found the designer will use the closest city available in www.city-data.com

Elevation: 430 feet

Average climate in Vienna, Virginia

Based on data reported by over 4,000 weather stations



Load Summary

- Break down of the heating and cooling load for each Air Handler

	CONDITIONING REQUIREMENTS (BTUh)	
	<u>HEATING</u>	<u>COOLING</u>
Bsmt/1st AHU	42,278	Sensible = 24,758 Latent = 3,603 (2.9 tons)
2 nd Floor AHU	35,205	Sensible = 24,097 Latent = 3,296 (2.9 tons)

- Shows how many people and appliances the load analysis includes

- ASHRAE recommends people load = (# of bedrooms + 1)

The ACCA Certified Load Analysis includes:

- a SHR of 0.70

- The Load Analysis includes 7 (# of bedrooms + 1) people and 7 appliances such as computers, stoves, refrigerators, etc.

- Where the main plenum of the duct for each Air Handler is located

- The Load Analysis includes a duct loss:

- AHU BSMT/1st FL: UNCONDITIONED BASEMENT duct location
- AHU 2nd FL: VENTED ATTIC duct location

- Design temperatures for your load analysis

- Indoor design temperatures based on EnergyStar & LEED recommendation
- Outdoor design temperatures are based on ASHRAE 2009 weather data

DESIGN TEMPERATURES (°F)

	<u>HEATING</u>	<u>COOLING</u>
	INDOOR	70 F
OUTDOOR	10 F	94 F

SHR

- **Explains what the SHR is**
 - **Standard is 70%**

- **Explains why the load analysis might have a higher SHR**

- **Savoy Engineering Group uses 0.07 SHR unless Permit or another reviewing authority dictates**
 - **This is a common place where loads can be biased to obtain a certain tonnage**
 - **Therefore, we retain a 70:30 sensible: latent split**

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The **SHR** is the ratio of the sensible load or capacity to the total (sensible plus latent) load or capacity.

- Most residential equipment has an SHR of around 70%, although some specialized equipment can be lower or higher.
- Buildings can have a much greater SHR than 70%.
 - Occupants and infiltration contribute to latent load with infiltration being the primary contributor.
 - If the house is very tight, there isn't much infiltration and, therefore, not much latent load. In this case, the sensible load is a greater percentage of the total load - sometimes as high as 90-95%.

Conversion Chart

- Savoy Engineering Group designs in round duct
 - This is due to the unlimited number of possible combinations rectangular sizes
- This shows equivalent Rectangular Duct Sizes for the gives Round Duct Sizes

Round to Rectangular Conversion Chart

Air flow - q - (Cubic Feet per Minute, cfm) (m ³ /s)	Rectangular Duct Sizes (Inches)	Equivalent Diameter Round Duct Sizes - d _e - (Inches)	Velocity - v - (ft/min) (m/s)	Friction Loss (Inches water gauge per 100 ft duct)
200 (0.09)	3 x 7 4 x 5	4.9 4.9	1527 (7.8)	0.88
300 (0.14)	4 x 7 5 x 6	5.7 6.0	1635 (8.3)	0.82
400 (0.19)	4 x 9 5 x 7 6 x 6	6.4 6.4 6.6	1736 (8.8)	0.80
500 (0.24)	6 x 7	7.1	1819 (9.2)	0.78
750 (0.35)	5 x 12 6 x 10 7 x 8	8.3 8.4 8.2	1996 (10.1)	0.77

Building Analysis

- Where is the most energy loss in a typical home?
- This page shows where the most energy is lost
 - On this example a significant portion of heat loss occurs in the walls
 - During the summer the sun shine through the windows causes heat gain

Design Conditions					
Location:			Indoor:		
Washington R. Reagan AP, DC, US			Indoor temperature (°F)		
Elevation: 10 ft			70		
Latitude: 39°N			Design TD (°F)		
			70		
			Relative humidity (%)		
			30		
			Moisture difference (gr/lb)		
			28.3		
			40.3		
Outdoor:			Infiltration:		
Dry bulb (°F)	Heating	Cooling	Method		
0	0	95	Simplified		
Daily range (°F)	-	16 (M)	Construction quality		
-	-	76	Semi-tight		
Wet bulb (°F)	15.0	7.5	Fireplaces		
Wind speed (mph)			2 (Semi-tight)		

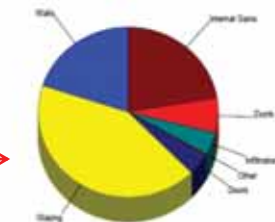
Heating

Component	Btuh/ft²	Btuh	% of load
Walls	6.5	17279	40.9
Glazing	32.6	8382	19.8
Doors	27.3	2260	5.3
Ceilings	0	0	0
Floors	1.5	1995	4.5
Infiltration	3.6	8137	19.2
Ducts		4315	10.2
Piping		0	0
Humidification		0	0
Ventilation		0	0
Adjustments		0	0
Total		42278	100.0



Cooling

Component	Btuh/ft²	Btuh	% of load
Walls	1.9	4964	20.0
Glazing	41.0	10560	42.4
Doors	12.8	1059	4.3
Ceilings	0	0	0
Floors	0.0	59	0.2
Infiltration	0.5	1045	4.2
Ducts		1635	6.6
Ventilation		0	0
Internal gains		5560	22.3
Blower		0	0
Adjustments		0	0
Total		24882	100.0



Latent Cooling Load = 3603 Btuh
 Overall U-value = 0.099 Btuh/ft²-°F

Data entries checked.

AED Assessment

- Load calculations also provide us with clear indicators about the need for multiple thermostats or “zones”
- If there is excessive gain through windows in a certain section of the house, your house is a prime candidate for zoning. This allows you to cool that certain section without causing the rest of the house to over-cool.
 - The same logic applies in the heating months

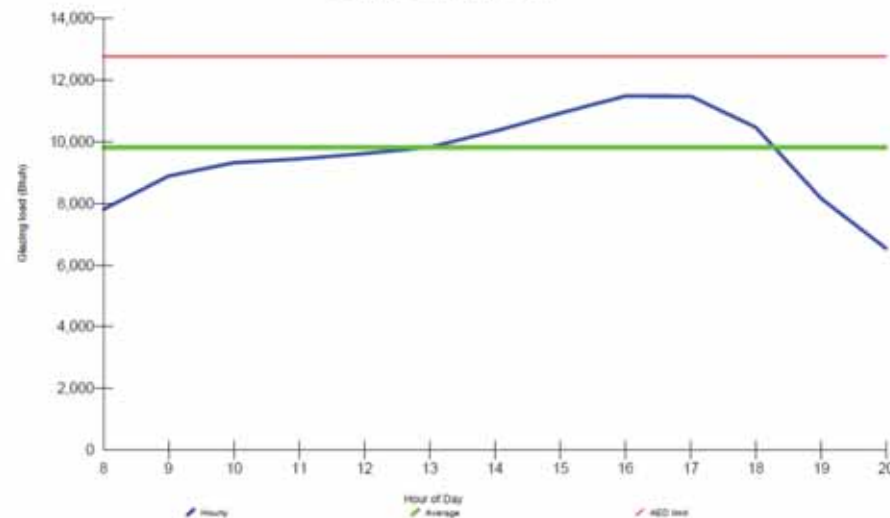
For: Smith Residence
123 Main Street, Washington D.C.

Design Conditions

Location:			Indoor:		Heating	Cooling
Washington R. Reagan AP, DC, US			Indoor temperature (°F)		70	75
Elevation: 10 ft			Design TD (°F)		70	20
Latitude: 39°N			Relative humidity (%)		30	50
Outdoor:			Heating	Cooling	Moisture difference (gr/lb)	
Dry bulb (°F)			0	95	28.3	
Daily range (°F)			-	16 (M)		
Wet bulb (°F)			-	76		
Wind speed (mph)			15.0	7.5		
Infiltration:						

Test for Adequate Exposure Diversity

Hourly Glazing Load



Maximum hourly glazing load exceeds average by 17.0%.

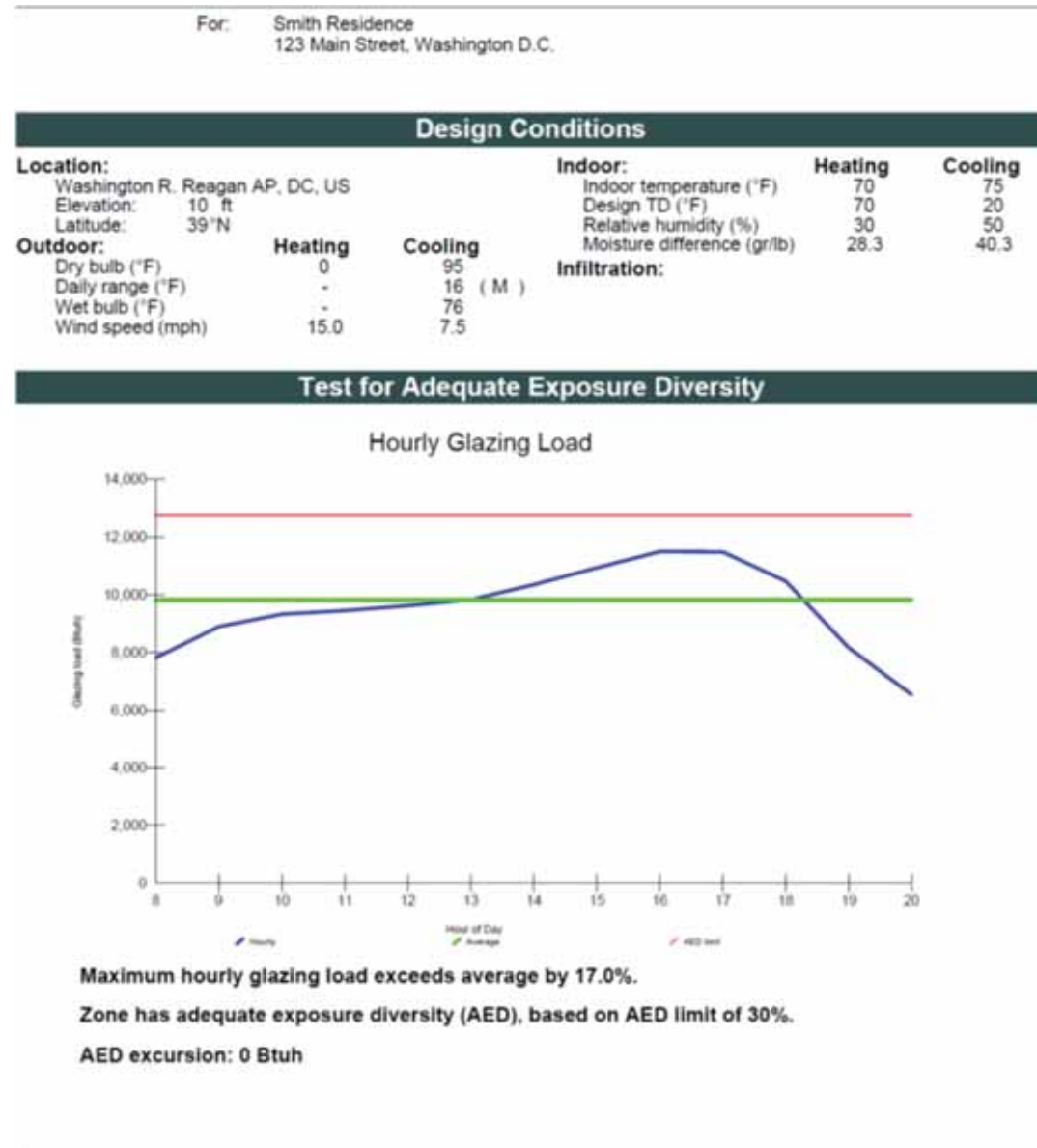
Zone has adequate exposure diversity (AED), based on AED limit of 30%.

AED excursion: 0 Btuh

AED Assessment (cont.)

➤ Adequate Exposure Diversity

- According to Manual J 8 Procedures, a zone is defined as having Adequate Exposure Diversity (AED) if the maximum hourly glazing load (PFG) does not exceed the average glazing load (AFG) by 30%. The amount over 30% of the AFG is defined as the AED Excursion.



Construction Components

- There are hundreds of different construction combinations.
- The construction description should always match the construction plans for the project
- A partition is the wall that separates conditioned space from unconditioned space
 - Example 1: the wall between the house and the garage
 - Example 2: the floor between the garage and second floor
- Always check that overhangs have been accounted for

Construction descriptions	Or	Area ft ²	U-value Btu/h ² ·ft ² ·°F	Insul R ft ² ·h/Btu	Htg HTM Btu/h ²	Loss Btu/h	Clg HTM Btu/h ²	Gain Btu/h
Walls								
12D-0sw: Frm wall, vni ext, 1/2" wood shth, r-15 cav ins, 1/2" gypsum board int fsh, 2"x4" wood frm	ne	327	0.086	15.0	6.02	1966	2.22	724
	se	180	0.086	15.0	6.02	1084	2.22	399
	s	14	0.086	15.0	6.02	85	2.22	31
	sw	136	0.086	15.0	6.02	819	2.22	302
	w	14	0.086	15.0	6.02	85	2.22	31
	nw	382	0.086	15.0	6.02	2300	2.22	848
	all	1053	0.086	15.0	6.02	6338	2.22	2336
14C-0s: Bl wall, 6" thk, 1/2" gypsum board int fsh	ne	262	0.105	0	7.35	1923	1.77	464
	se	115	0.105	0	7.35	845	1.77	204
	sw	176	0.105	0	7.35	1294	1.77	312
	nw	316	0.105	0	7.35	2323	1.77	561
	all	869	0.105	0	7.35	6384	1.77	1541
Partitions								
12D-0sw: Frm wall, 1/2" wood shth, r-15 cav ins, 1/2" gypsum board int fsh, 2"x4" wood frm		757	0.086	15.0	6.02	4557	1.44	1087
Windows								
4A4-2ov: 2 glazing, clr outr, argon gas, insulated vinyl frm mat, clr low-e innr, 1/2" gap, 1/4" thk	ne	47	0.470	0	32.9	1530	37.3	1734
	ne	50	0.470	0	32.9	1645	37.3	1865
	se	25	0.470	0	32.9	823	44.3	1107
	se	25	0.470	0	32.9	823	44.3	1107
	s	7	0.470	0	32.9	233	27.0	191
	sw	39	0.450	0	31.5	1216	50.1	1935
	w	7	0.470	0	32.9	233	51.7	366
	nw	38	0.470	0	32.9	1250	37.3	1417
	nw	20	0.450	0	31.5	630	41.9	838
	all	257	0.450	0	32.6	8382	41.0	10560
Doors								
11D0: Door, wd sc type	ne	42	0.390	0	27.3	1147	12.8	537
	ne	20	0.390	0	27.3	557	12.8	261
	sw	20	0.390	0	27.3	557	12.8	261
	all	83	0.390	0	27.3	2260	12.8	1059

Construction Components (cont.)

- WrightSoft has a command to turn the house in the direction with the highest loads. It is not unusual for production builders to do this.
- All of the Manual J formulas boil down to an HTM. The HTM times the area equal the heat loss or gain.
 - HTM – Heat Transfer Modifier
- This page is useful to verify areas and that the design engineer is sizing based on the as-built component construction values rather than using the default minimum local building code

Construction descriptions	Or	Area ft ²	U-value Btu/h ² °F	Insul R h ² °F/Btu	Htg HTM Btu/h ²	Loss Btu/h	Clg HTM Btu/h ²	Gain Btu/h
Walls								
12D-0sw: Fm wall, vnl ext, 1/2" wood shth, r-15 cav ins, 1/2" gypsum board int fsh, 2"x4" wood frm	ne	306	0.086	15.0	6.02	1839	2.22	678
	se	344	0.086	15.0	6.02	2071	2.22	763
	s	12	0.086	15.0	6.02	72	2.22	27
	sw	263	0.086	15.0	6.02	1580	2.22	582
	w	12	0.086	15.0	6.02	72	2.22	27
	nw	329	0.086	15.0	6.02	1981	2.22	730
	all	1265	0.086	15.0	6.02	7615	2.22	2807
Partitions (none)								
Windows								
4A4-2ov: 2 glazing, cir outr, argon gas, insulated vinyl frm mat, cir low-e innr, 1/2" gap, 1/4" thk	ne	68	0.470	0	32.9	2237	37.3	2536
	se	34	0.470	0	32.9	1119	44.3	1505
	s	7	0.470	0	32.9	233	27.0	191
	sw	59	0.470	0	32.9	1941	44.3	2612
	sw	25	0.450	0	31.5	788	50.1	1253
	w	7	0.470	0	32.9	233	51.7	366
	nw	49	0.470	0	32.9	1612	37.3	1827
	all	249	0.450	0	32.8	8163	41.3	10291
Doors (none)								
Ceilings								
16B-38ad: Attic ceiling, asphalt shingles roof mat, r-38 cell ins, 1/2" gypsum board int fsh		1687	0.026	38.0	1.82	3070	1.46	2469
Floors								
20P-15t: Fir floor, frm fir, 6" thkns, r-15 cav ins, gar ovr		409	0.061	15.0	4.27	1744	0.99	406

Load Short Form

- A Manual J load calculation accurately determines the amount of heating/cooling that need to be added or removed to keep your home warm in the winter and cool and dry in the summer
- Heating and cooling needs are calculated in BTU's
 - BTU – British Thermal Unit
- Size of heat pumps is typically described in “tons”
 - A ton equals 12,000 BTU/h of heat
- Furnaces are generally sized in 20 kBTU/h increments, from 40-120 kBTU/h

Project Information						
For: Smith Residence 123 Main Street, Washington D.C.						
Design Information						
Outside db (°F)	Htg	Cig	Method	Infiltration	Simplified	
Inside db (°F)	0	95	Construction quality		Semi-tight	
Design TD (°F)	70	75	Fireplaces		2 (Semi-tight)	
Daily range	-	M				
Inside humidity (%)	30	50				
Moisture difference (gr/lb)	28	40				
HEATING EQUIPMENT			COOLING EQUIPMENT			
Make	Allied Air Enterprises		Make	Ducane, Excel Comfort Systems		
Trade	DUCANE		Trade	4AC13		
Model	CG95TB060D12B-****		Cond	4AC13*42P-3		
AHRI ref no.	2000427		Coil	BCS2M42C****P		
Efficiency	95 AFUE		Efficiency	11.0 EER, 13 SEER		
Heating input	60000 Btuh		Sensible cooling	28000 Btuh		
Heating output	57000 Btuh		Latent cooling	12000 Btuh		
Temperature rise	50 °F		Total cooling	40000 Btuh		
Actual air flow	1039 cfm		Actual air flow	1333 cfm		
Air flow factor	0.025 cfm/Btuh		Air flow factor	0.054 cfm/Btuh		
Static pressure	0.50 in H2O		Static pressure	0.50 in H2O		
Space thermostat			Load sensible heat ratio	0.87		
ROOM NAME	Area (ft²)	Htg load (Btuh)	Cig load (Btuh)	Htg AVF (cfm)	Cig AVF (cfm)	
Guest Bed	208	3939	1637	97	88	
CL 5	19	0	0	0	0	
Office	189	2889	1525	71	82	
Guest Bath	35	441	79	11	4	
CL 6	19	0	0	0	0	
Guest Bed 2	189	5261	2905	129	156	
Game Room	456	6567	2537	161	136	
Strs	48	0	0	0	0	
Rest Room	35	254	38	6	2	
Kitchen	171	3882	2846	95	152	
Butlers Pantry	36	0	0	0	0	
Powder Rm	27	0	0	0	0	
Breakfast	109	2389	801	59	43	
Family Room	323	7196	4599	177	246	
Dining Room	151	1833	878	45	47	
CL	23	0	0	0	0	
Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.						
CL 2	10	0	0	0	0	
Living Room	162	4261	3504	105	188	
Lobby	57	3366	3533	83	189	
Stairs	62	0	0	0	0	
Hall	148	0	0	0	0	
Bsmt/1st AHU	d	2477	42278	24882	1039	1333
Other equip loads			0			
Equip. @ 1.00 RSM			24758			
Latent cooling			3603			
TOTALS	2477	42278	28361	1039	1333	

Load Short Form (cont.)

- **Must be the 99% outdoor cooling design temperature as published in the ASHRAE Handbook of Fundamentals (tables begin at pg. 27)**
 - Not necessarily 95 °F – varies with location
- **Must be 75 °F indoor temperature per EnergyStar and ASHRAE recommendations**
- **Infiltration rate shall be selected as “tight” or equivalent ter. This will be a judgment call based on typical performance testing of the builder practice.**
- **Actual orientation of a single home or worst-case orientation for multiple family and multiple building projects**

Design Information			
Outside db (°F)	Htg	Clg	Method Construction quality Fireplaces
Inside db (°F)	70	95	
Design TD (°F)	70	20	Infiltration Simplified Semi-tight 2 (Semi-tight)
Daily range	-	M	
Inside humidity (%)	30	50	
Moisture difference (gr/lb)	28	40	
HEATING EQUIPMENT		COOLING EQUIPMENT	
Make	Allied Air Enterprises	Make	Ducane, Excel Comfort Systems
Trade	DUCANE	Trade	4AC13
Model	CG95TB060D12B*-**	Cond	4AC13*42P-3
AHRI ref no.	2000427	Coil	BCS2M42C****P
Efficiency	95 AFUE	AHRI ref no.	3764974
Heating input	60000 Btuh	Efficiency	11.0 EER, 13 SEER
Heating output	57000 Btuh	Sensible cooling	28000 Btuh
Temperature rise	50 °F	Latent cooling	12000 Btuh
Actual air flow	1039 cfm	Total cooling	40000 Btuh
Air flow factor	0.025 cfm/Btuh	Actual air flow	1333 cfm
Static pressure	0.50 in H2O	Air flow factor	0.054 cfm/Btuh
Space thermostat		Static pressure	0.50 in H2O
		Load sensible heat ratio	0.87

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

E:\SEG 2\Power Point SEG\SmithPPT.rup Calc = MJ8 Front Door faces: SW

Load Short Form (cont.)

➤ This page breaks down the heating and cooling Room x Room load based on square footage of the room

ROOM NAME	Area (ft ²)	Htg load (Btuh)	Clg load (Btuh)	Htg AVF (cfm)	Clg AVF (cfm)
Bedroom 2	238	6212	3994	122	188
Master Bath	152	2818	1600	55	75
Master Bed	280	8063	5020	159	236
Mstr W.I.C 2	46	0	0	0	0
Mstr W.I.C	42	0	0	0	0
Hall 2	162	0	0	0	0
Store	20	0	0	0	0
Bath	106	2055	1163	40	55
W.I.C 1	25	0	0	0	0
Bedroom 3	217	6131	5295	121	249
CL 3	28	0	0	0	0
Stairs 2	52	0	0	0	0
OTB	87	2741	3010	54	142
Bedroom 4	150	3742	2258	74	106
Bath 2	56	3442	1878	68	88
CL 4	28	0	0	0	0

Worksheets

➤ Worksheets break down the load room by room

➤ Shows people and appliances per room

- 230 btus per each person, per ACCA Manual J 8

1	Room name	Bsmt/1st AHU				Guest Bed							
2	Exposed wall	250.7 ft				30.5 ft							
3	Ceiling height	9.0 ft				8.0 ft							
4	Room dimensions	1.0 x 208.3 ft				1.0 x 208.3 ft							
5	Room area	2477.3 ft ²				208.3 ft ²							
Ty	Construction number	U-value (Btuh/ft ² ·°F)	Or	HTM (Btuh/ft ²)		Load (Btuh)		Area (ft ²) or perimeter (ft)		Load (Btuh)			
				Heat	Cool	Heat	Cool	Gross	N/P/S	Heat	Cool		
6	c) AED excursion						0				-91		
	Envelope loss/gain					29826	16642			2646	1187		
12	a) Infiltration					8137	1045			878	113		
	b) Room ventilation					0	0			0	0		
13	Internal gains:												
	Occupants @ 230			2						460	230		
	Appliances/other									5100	0		
	Subtotal (lines 6 to 13)					37963	23248			3524	1530		
	Less external load					0	0			0	0		
	Less transfer					0	0			0	0		
	Redistribution					0	0			13	0		
14	Subtotal					37963	23248			3537	1530		
15	Duct loads					11%	7%	4315	1635	11%	7%	402	108
	Total room load							42278	24882			3939	1637
	Air required (cfm)							1039	1333			97	88

Project Summary

- Daily range is the average difference between the daily high and the low dry bulb temperature at a particular location
 - Low(L) – swing less than 16 °F
 - Medium(M) – swing between 16 °F and 25 °F
 - High(H) – swing exceeds 25 °F

- Moisture difference is the absolute humidity differential between the outdoor air and the indoor air
 - Expressed in grains of water per pound of air

Design Information

Weather: Washington R. Reagan AP, DC, US

Winter Design Conditions

Outside db	0 °F
Inside db	70 °F
Design TD	70 °F

Summer Design Conditions

Outside db	95 °F
Inside db	75 °F
Design TD	20 °F
Daily range	M
Relative humidity	50 %
Moisture difference	40 gr/lb

Heating Summary

Structure	26041 Btuh
Ducts	9164 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	35205 Btuh

Infiltration

Method	Simplified	
Construction quality	Semi-tight	
Fireplaces	2 (Semi-tight)	
	Heating	Cooling
Area (ft ²)	1687	1687
Volume (ft ³)	15183	15183
Air changes/hour	0.28	0.13
Equiv. AVF (cfm)	71	33

Heating Equipment Summary

Make	Aire-Flo
Trade	AIRE-FLO
Model	CG95TB040D12B***
AHRI ref no.	2009022
Efficiency	95 AFUE
Heating input	40000 Btuh
Heating output	38000 Btuh
Temperature rise	50 °F
Actual air flow	693 cfm
Air flow factor	0.020 cfm/Btuh
Static pressure	0.50 in H ₂ O
Space thermostat	

Sensible Cooling Equipment Load Sizing

Structure	17931 Btuh
Ducts	6287 Btuh
Central vent (0 cfm)	0 Btuh
Blower	0 Btuh
Use manufacturer's data	n
Rate/swing multiplier	1.00
Equipment sensible load	24097 Btuh

Latent Cooling Equipment Load Sizing

Structure	1895 Btuh
Ducts	1401 Btuh
Central vent (0 cfm)	0 Btuh
Equipment latent load	3296 Btuh
Equipment total load	27393 Btuh
Req. total capacity at 0.70 SHR	2.9 ton

Cooling Equipment Summary

Make	Ducane, Excel Comfort Systems
Trade	4AC13
Cond	4AC13*36
Coil	RBCS2M36C****T
AHRI ref no.	3016710
Efficiency	11.5 EER, 13.5 SEER
Sensible cooling	23940 Btuh
Latent cooling	10260 Btuh
Total cooling	34200 Btuh
Actual air flow	1140 cfm
Air flow factor	0.047 cfm/Btuh
Static pressure	0.50 in H ₂ O
Load sensible heat ratio	0.88

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Design Information

Project Summary (cont.)

- Central vent is a result of ventilation and infiltration air
 - Outside Air
 - ERV – Energy Recovery
 - HRV – Heat Recovery
- Ducts that have no load are located entirely inside the buildings thermal barrier
- Volume is the above grade volume
- Air changes per hour for heating is 15 mph and 7.5 mph for cooling
- AVF – Air Volume Flow

Weather: Washington R. Reagan AP, DC, US

Winter Design Conditions

Outside db	0 °F
Inside db	70 °F
Design TD	70 °F

Summer Design Conditions

Outside db	95 °F
Inside db	75 °F
Design TD	20 °F
Daily range	M
Relative humidity	50 %
Moisture difference	40 gr/lb

Heating Summary

Structure	26041 Btuh
Ducts	9164 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	35205 Btuh

Sensible Cooling Equipment Load Sizing

Structure	17931 Btuh
Ducts	6287 Btuh
Central vent (0 cfm)	0 Btuh
Blower	0 Btuh
Use manufacturer's data	n
Rate/swing multiplier	1.00
Equipment sensible load	24097 Btuh

Infiltration

Method	Simplified	
Construction quality	Semi-tight	
Fireplaces	2 (Semi-tight)	
	Heating	Cooling
Area (ft²)	1687	1687
Volume (ft³)	15183	15183
Air changes/hour	0.28	0.13
Equiv. AVF (cfm)	71	33

Latent Cooling Equipment Load Sizing

Structure	1895 Btuh
Ducts	1401 Btuh
Central vent (0 cfm)	0 Btuh
Equipment latent load	3296 Btuh
Equipment total load	27393 Btuh
Req. total capacity at 0.70 SHR	2.9 ton

Heating Equipment Summary

Make	Aire-Flo
Trade	AIRE-FLO
Model	CG95TB040D12B*-***
AHRI ref no.	2009022
Efficiency	95 AFUE
Heating input	40000 Btuh
Heating output	38000 Btuh
Temperature rise	50 °F
Actual air flow	693 cfm
Air flow factor	0.020 cfm/Btuh
Static pressure	0.50 in H2O
Space thermostat	

Cooling Equipment Summary

Make	Ducane, Excel Comfort Systems
Trade	4AC13
Cond	4AC13*36
Coil	RBCS2M36C****T
AHRI ref no.	3016710
Efficiency	11.5 EER, 13.5 SEER
Sensible cooling	23940 Btuh
Latent cooling	10260 Btuh
Total cooling	34200 Btuh
Actual air flow	1140 cfm
Air flow factor	0.047 cfm/Btuh
Static pressure	0.50 in H2O
Load sensible heat ratio	0.88

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Project Summary (cont.)

- The heat gain of the home due to conduction, infiltration, solar radiation, appliances and people
 - Burning a light bulb only adds sensible load to the house
 - The sensible load raises the dry bulb
- The net amount of moisture added to the inside air by plants, people, cooking, infiltration and any other moisture source
 - SHR – Sensible Heat Ratio; the ratio of sensible load to total load
- Actual Air flow is from the manufacturers performance data at a specified static pressure

Design Information

Weather: Washington R. Reagan AP, DC, US

Winter Design Conditions

Outside db	0 °F
Inside db	70 °F
Design TD	70 °F

Summer Design Conditions

Outside db	95 °F
Inside db	75 °F
Design TD	20 °F
Daily range	M
Relative humidity	50 %
Moisture difference	40 gr/lb

Heating Summary

Structure	26041 Btuh
Ducts	9164 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	35205 Btuh

Sensible Cooling Equipment Load Sizing

Structure	17931 Btuh
Ducts	6287 Btuh
Central vent (0 cfm)	0 Btuh
Blower	0 Btuh
Use manufacturer's data	n
Rate/swing multiplier	1.00
Equipment sensible load	24097 Btuh

Infiltration

Method	Simplified	
Construction quality	Semi-tight	
Fireplaces	2 (Semi-tight)	
	Heating	Cooling
Area (ft ²)	1687	1687
Volume (ft ³)	15183	15183
Air changes/hour	0.28	0.13
Equiv. AVF (cfm)	71	33

Latent Cooling Equipment Load Sizing

Structure	1895 Btuh
Ducts	1401 Btuh
Central vent (0 cfm)	0 Btuh
Equipment latent load	3296 Btuh
Equipment total load	27393 Btuh
Req. total capacity at 0.70 SHR	2.9 ton

Heating Equipment Summary

Make	Aire-Flo
Trade	AIRE-FLO
Model	CG95TB040D12B*.*.*
AHRI ref no.	2009022

Efficiency	95 AFUE
Heating input	40000 Btuh
Heating output	38000 Btuh
Temperature rise	50 °F
Actual air flow	693 cfm
Air flow factor	0.020 cfm/Btuh
Static pressure	0.50 in H2O
Space thermostat	

Cooling Equipment Summary

Make	Ducane, Excel Comfort Systems
Trade	4AC13
Cond	4AC13*36
Coil	RBCS2M36C****T
AHRI ref no.	3016710
Efficiency	11.5 EER, 13.5 SEER
Sensible cooling	23940 Btuh
Latent cooling	10260 Btuh
Total cooling	34200 Btuh
Actual air flow	1140 cfm
Air flow factor	0.047 cfm/Btuh
Static pressure	0.50 in H2O
Load sensible heat ratio	0.88

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Project Summary (cont.)

Design Information

Weather: Washington R. Reagan AP, DC, US

Winter Design Conditions

Outside db 0 °F

Ins De

**Manual S HVAC
Equipment
Selection –
HEATING
Supplied by the
client**

Str :uh
Du :uh
Ce :uh
Hu :uh
Pip :uh
Eq :uh

Method Construction quality Fireplaces Simplified Semi-tight 2 (Semi-tight)

	Heating	Cooling
Area (ft ²)	1687	1687
Volume (ft ³)	15183	15183
Air changes/hour	0.28	0.13
Equip. AVE (cfm)	71	33

Heating Equipment Summary

Make Aire-Flo
Trade AIRE-FLO
Model CG95TB040D12B*-***
AHRI ref no.2009022

Efficiency 95 AFUE
Heating input 40000 Btuh
Heating output 38000 Btuh
Temperature rise 50 °F
Actual air flow 693 cfm
Air flow factor 0.020 cfm/Btuh
Static pressure 0.50 in H2O
Space thermostat

Summer Design Conditions

Outside db 95 °F

Inside db 75 °F

Design TD 20 °F

Daily range M

Relative humidity 50 %

Moisture difference 40 gr/lb

Sensible Cooling Equipment Load Sizing

Structure 17931 Btuh
Ducts 6287 Btuh
Central vent (0 cfm) 0 Btuh
Blower 0 Btuh

Use manufacturer's data n
Rate/swing multiplier 1.00
Equipment sensible load 24097 Btuh

Latent Cooling Equipment Load Sizing

Structure 1895 Btuh
Ducts 1401 Btuh
Central vent (0 cfm) 0 Btuh
Equipment latent load 3296 Btuh

Equipment total load 27393 Btuh
Req. total capacity at 0.70 SHR 2.9 ton

Cooling Equipment Summary

Make Ducane, Excel Comfort Systems
Trade 4AC13
Cond 4AC13*36
Coil RBCS2M36C****T
AHRI ref no.3016710
Efficiency 11.5 EER, 13.5 SEER
Sensible cooling 23940 Btuh
Latent cooling 10260 Btuh
Total cooling 34200 Btuh
Actual air flow 1140 cfm
Air flow factor 0.047 cfm/Btuh
Static pressure 0.50 in H2O
Load sensible heat ratio 0.88

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Project Summary (cont.)

Design Information

Weather: Washington R. Reagan AP, DC, US

Winter Design Conditions

Outside db	0 °F
Inside db	70 °F
Design TD	70 °F

Summer Design Conditions

Outside db	95 °F
Inside db	75 °F
Design TD	20 °F
Humidity Ratio	80 M
Wet Bulb	60 %
Grain Equiv	40 gr/lb

Heating Summary

Structure	26041 Btuh
Ducts	9164 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	35205 Btuh

Infiltration

Method	Simplified	
Construction quality	Semi-tight	
Fireplaces	2 (Semi-tight)	
	Heating	Cooling
Area (ft ²)	1687	1687
Volume (ft ³)	15183	15183
Air changes/hour	0.28	0.13
Equiv. AVF (cfm)	71	33

Heating Equipment Summary

Make	Aire-Flo
Trade	AIRE-FLO
Model	CG95TB040D12B*-***
AHRI ref no.	2009022
Efficiency	95 AFUE
Heating input	40000 Btuh
Heating output	38000 Btuh
Temperature rise	50 °F
Actual air flow	693 cfm
Air flow factor	0.020 cfm/Btuh
Static pressure	0.50 in H2O
Space thermostat	

**Manual S HVAC
Equipment
Selection –
COOLING
Supplied by the
client**

Load Sizing

Structure	31 Btuh
Ducts	37 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	n
Infiltration	00
Total	97 Btuh

Latent Cooling Equipment Load Sizing

Structure	1895 Btuh
Ducts	1401 Btuh
Central vent (0 cfm)	0 Btuh
Equipment latent load	3296 Btuh
Equipment total load	27393 Btuh
Req. total capacity at 0.70 SHR	2.9 ton

Cooling Equipment Summary

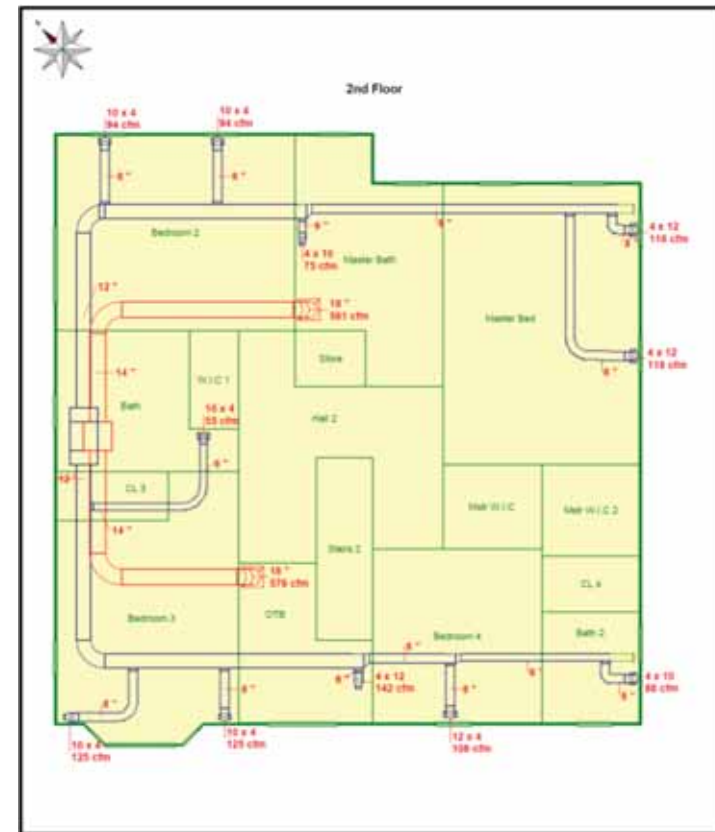
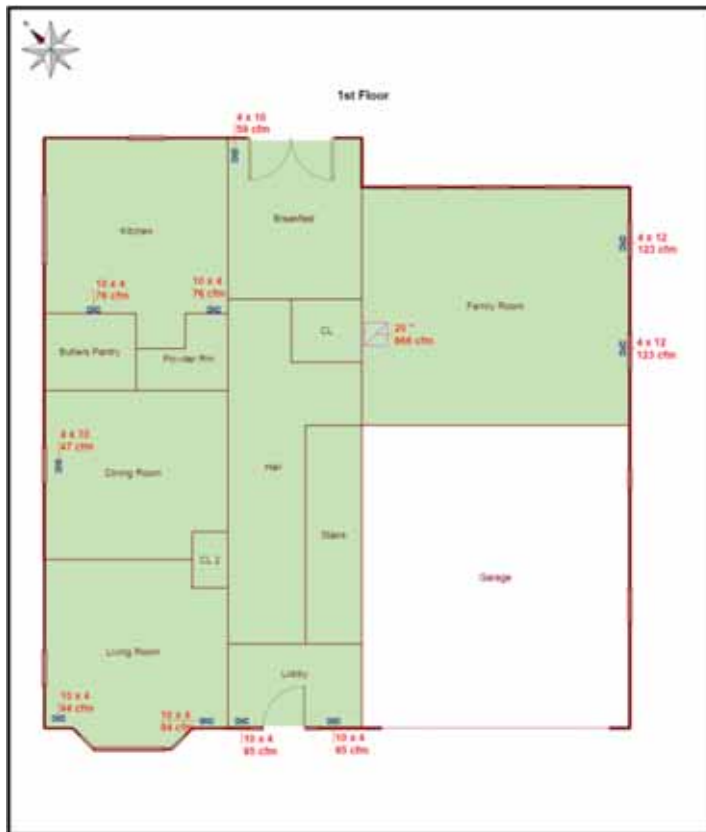
Make	Ducane, Excel Comfort Systems	
Trade	4AC13	
Cond	4AC13*36	
Coil	RBCS2M36C****T	
AHRI ref no.	3016710	
Efficiency	11.5 EER, 13.5 SEER	
Sensible cooling	23940 Btuh	
Latent cooling	10260 Btuh	
Total cooling	34200 Btuh	
Actual air flow	1140 cfm	
Air flow factor	0.047 cfm/Btuh	
Static pressure	0.50 in H2O	
Load sensible heat ratio	0.88	

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Manual D

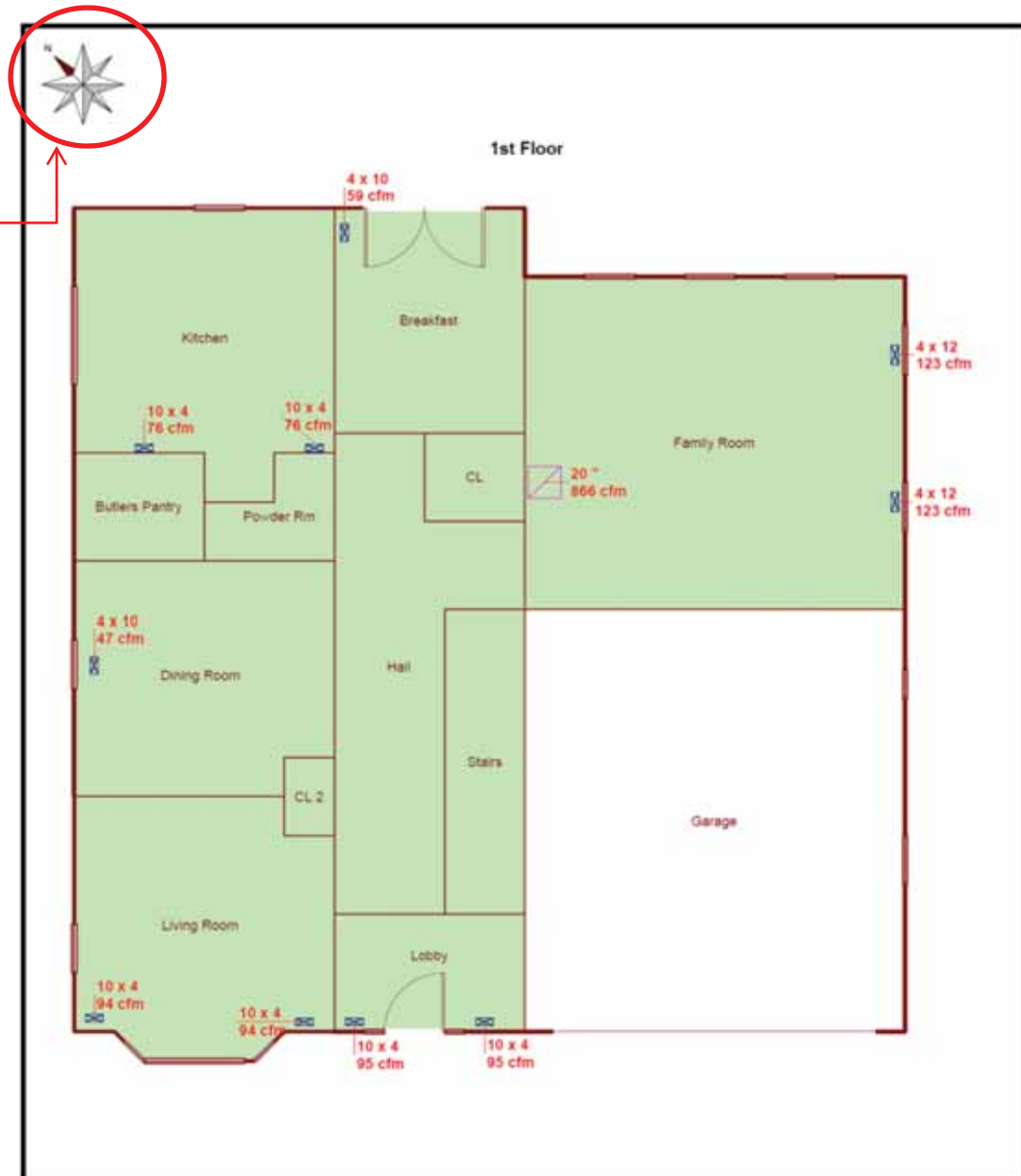
- Each zone is represented in different colors
- Each area will have a sensor to monitor temperature and humidity

- Variable speed blowers allow excellent control of airflow quantities to each zone
- Improper installation can result in excessive noise do to high airflow velocities



Manual D (cont.)

- Always check the building orientation is correct
- Each room has its own heating and cooling needs based on the homes insulation levels, window type, solar orientation, air infiltration rates, etc...
- Knowing how much air each room requires takes the guess work out of choosing a system that can maintain your comfort without the concern of over sizing



Manual D Duct Sizing

➤ **A reasonably well designed system will be within these parameters**

- Total system flow will be = 5% of design flow
- Room flow will = 10% of design flow
- Total system static should be within 0.10 IWC of design
- Duct velocities are within Manual D Recommendations

Recommended Velocities (FPM)								
	Supply Side				Return Side			
	Recommended		Maximum		Recommended		Maximum	
	Rigid	Flex	Rigid	Flex	Rigid	Flex	Rigid	Flex
Trunk Ducts	700	600	900	700	600	600	700	700
Branch Ducts	600	600	900	700	400	400	700	700
Supply Outlet Face Velocity	Size for throw		700		-----		-----	
Return Grille Face Velocity	-----		-----		-----		500	
Filter Grille Face Velocity	-----		-----		-----		300	

Copy of Table 3-1 from ACCA Manual D

Manual D Duct Sizing

- The required cfm to each room is relative to the rooms calculated load. If the room requires 5% of the equipment's capacity the room will need 5% of the blower cfm.
- To determine the required cfm per room you must calculate the heating and cooling factors. (WrightSoft labels this as "Air Flow Factor")
 - Heating Factor = Blower CFM/MJ8 Heat Loss (for structure)
 - Cooling Factor = Blower CFM/MJ8 Sensible Load (for structure)
- Solve for today's house
 - Heating Factor = $693/26,041=0.020$
 - Cooling Factor = $1,140/17,931=0.047$

Heating Equipment Summary

Make	Aire-Flo
Trade	AIRE-FLO
Model	CG95TB040D12B*-***
AHRI ref no.	2009022
Efficiency	95 AFUE
Heating input	40000 Btuh
Heating output	38000 Btuh
Temperature rise	50 °F
Actual air flow	693 cfm
Air flow factor	0.020 cfm/Btuh
Static pressure	0.50 in H2O
Space thermostat	

Cooling Equipment Summary

Make	Ducane, Excel Comfort Systems
Trade	4AC13
Cond	4AC13*36
Coil	RBCS2M36C****T
AHRI ref no.	3016710
Efficiency	11.5 EER, 13.5 SEER
Sensible cooling	23940 Btuh
Latent cooling	10260 Btuh
Total cooling	34200 Btuh
Actual air flow	1140 cfm
Air flow factor	0.047 cfm/Btuh
Static pressure	0.50 in H2O
Load sensible heat ratio	0.88

Heating Summary

Structure	26041 Btuh
Ducts	9164 Btuh
Central vent (0 cfm)	0 Btuh
Humidification	0 Btuh
Piping	0 Btuh
Equipment load	35205 Btuh

Infiltration

Sensible Cooling Equipment Load Sizing

Structure	17931 Btuh
Ducts	6287 Btuh
Central vent (0 cfm)	0 Btuh
Blower	0 Btuh
Use manufacturer's data	n
Rate/swing multiplier	1.00
Equipment sensible load	24097 Btuh

Duct System Summary

Project Information

Residence
Main Street, Washington D.C.

Per Manual D the Friction Rate must not be <0.06 and >0.18

The 0.114 in the heating and cooling columns is the Friction Rate for the entire system

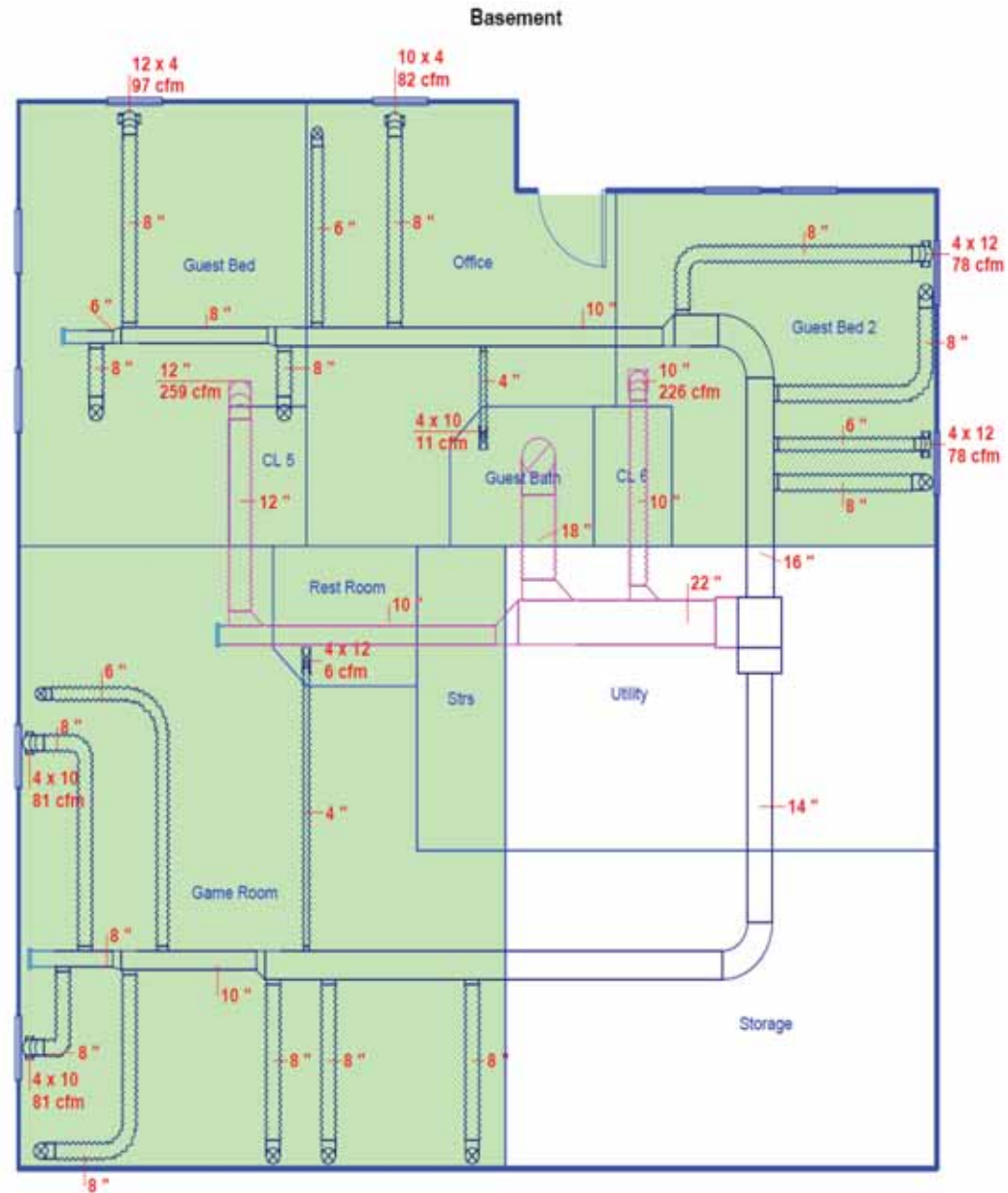
	Heating	Cooling
External static pressure	0.50 in H2O	0.50 in H2O
Pressure losses	0.13 in H2O	0.13 in H2O
Available static pressure	0.37 in H2O	0.37 in H2O
Supply / return available pressure	0.26 / 0.11 in H2O	0.26 / 0.11 in H2O
Lowest friction rate	0.114 in/100ft	0.114 in/100ft
Actual air flow	693 cfm	1140 cfm
Total effective length (TEL)	323 ft	

Supply Branch Detail Table

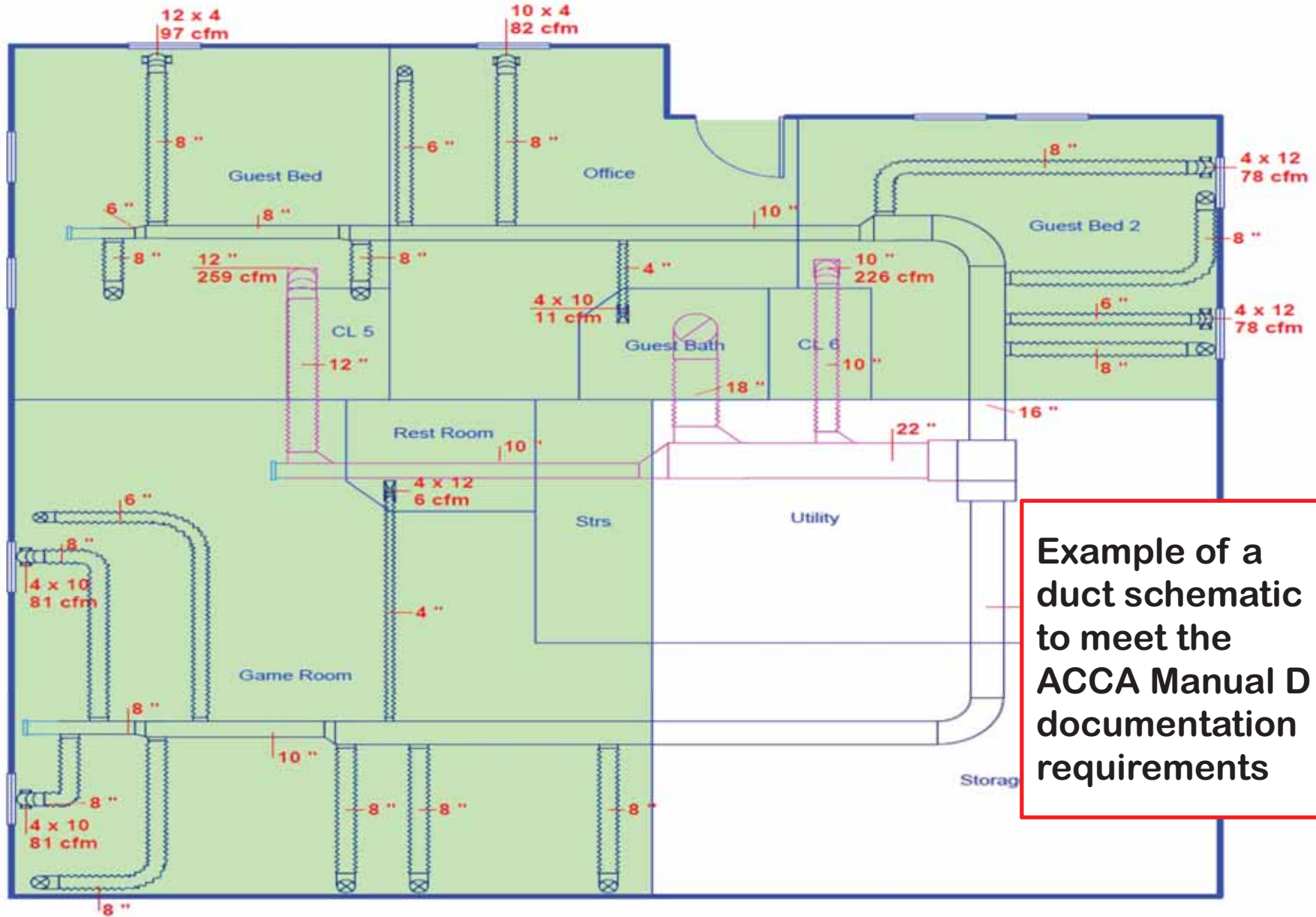
Name	Design (Btuh)	Htg (cfm)	Clg (cfm)	Design FR	Diam (in)	H x W (in)	Duct Matl	Actual Ln (ft)	Ftg.Eqv Ln (ft)	Trunk
Bath	c 1163	40	55	0.162	6.0	0x0	VIFx	17.5	145.0	st2
Bath 2	c 1878	68	88	0.119	8.0	0x0	VIFx	55.5	165.0	st2B
Bedroom 2	c 1997	61	94	0.146	8.0	0x0	VIFx	29.5	150.0	st1
Bedroom 2-A	c 1997	61	94	0.145	8.0	0x0	VIFx	21.5	160.0	st1
Bedroom 3	c 2647	60	125	0.137	8.0	0x0	VIFx	27.0	165.0	st2
Bedroom 3-A	c 2647	60	125	0.147	8.0	0x0	VIFx	29.0	150.0	st2
Bedroom 4	c 2258	74	106	0.135	8.0	0x0	VIFx	45.0	150.0	st2A
Master Bath	c 1600	55	75	0.152	6.0	0x0	VIFx	32.5	140.0	st1
Master Bed	c 2510	79	118	0.125	8.0	0x0	VIFx	55.4	155.0	st1A
Master Bed-A	c 2510	79	118	0.114	8.0	0x0	VIFx	64.4	165.0	st1A
OTB	c 3010	54	142	0.149	8.0	0x0	VIFx	36.0	140.0	st2

Manual D Example

- Duct work is an extremely important component of a heating and cooling system
- An ACCA Manual D duct design ensures that the ductwork is properly sized to deliver maximum comfort and peak efficiency
- Informed builders and home owners complete a duct layout and design **before** requesting bids for their project
- This plan is used to make sure contractors are providing apples to apples bids on a **quality system**



Basement



Example of a duct schematic to meet the ACCA Manual D documentation requirements

