

RESNET 2007

The Rater as Quality Assurance Provider

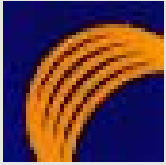
Ben Adams

MaGrann Associates

February 20, 2007

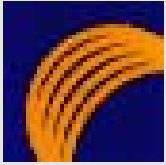
San Diego CA





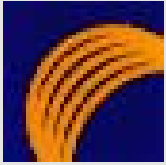
HVAC Challenge #1

- System not sized properly
- Distribution not following any intentional plan
- Not sealed or insulated properly
- Made to fit on site – not integrated with house design
- Different crews responsible for installation of system and ducts
- Judged by how fast and how cheap not how well
- No measure of performance



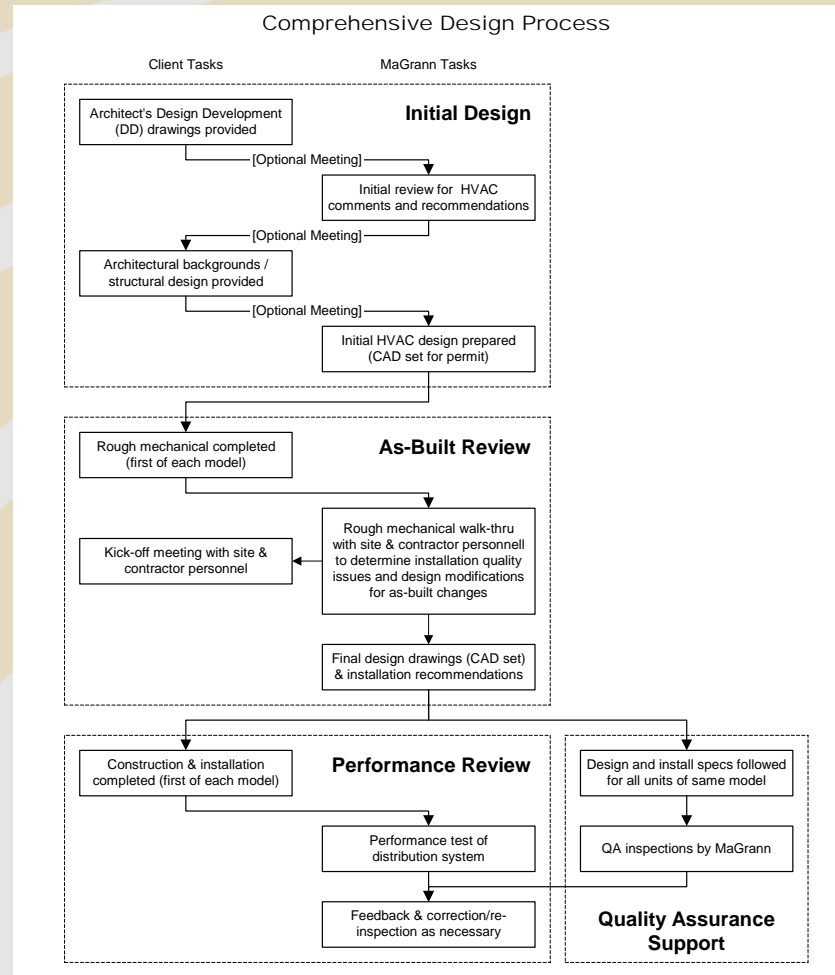
HVAC Challenge #2

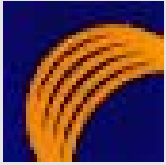
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Solution #2

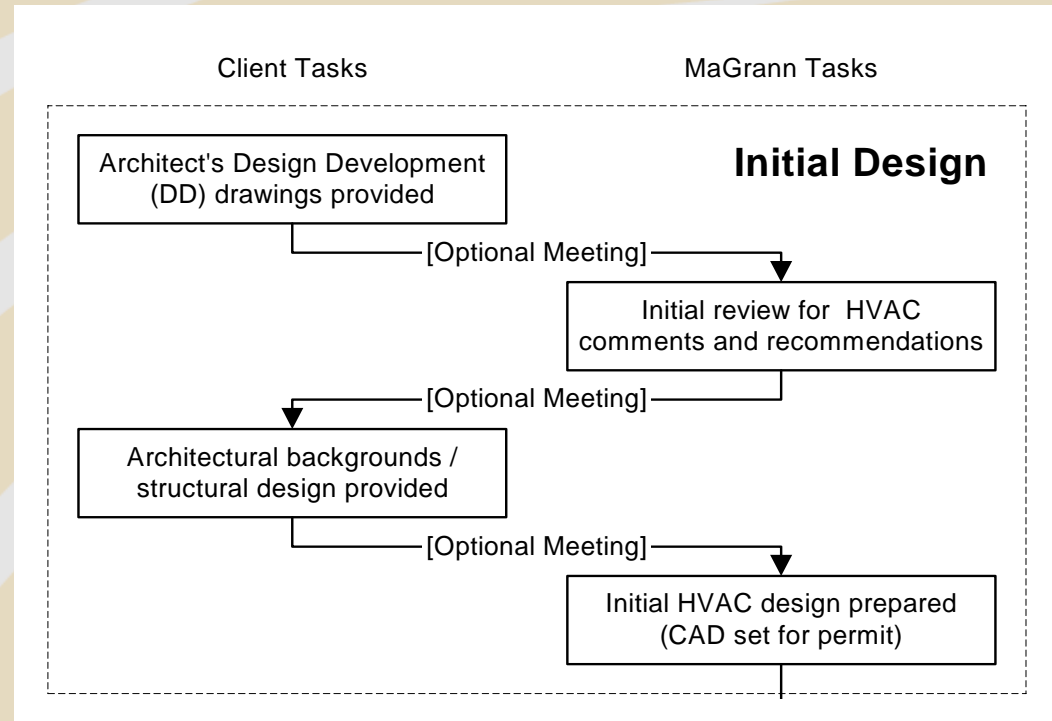
- Offer “Comprehensive HVAC Design”!
(if you’re an engineer)
- Or consulting support
(if not)

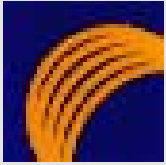




Comprehensive Design

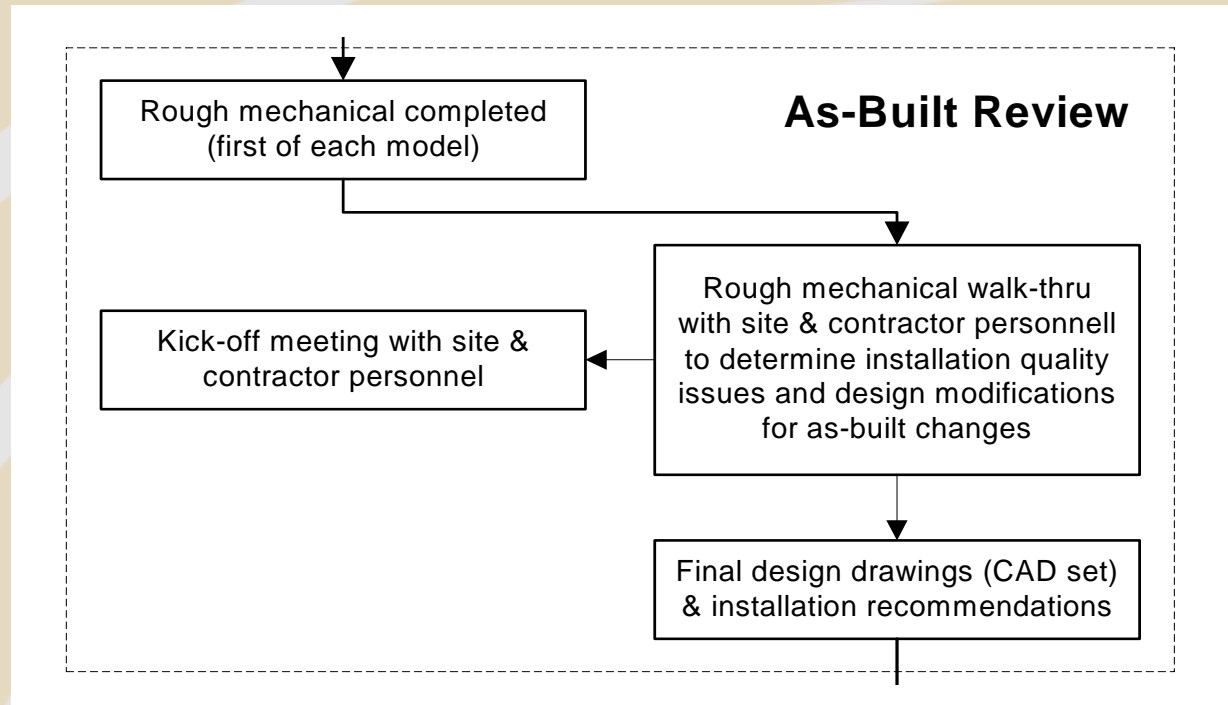
- Be part of the process as early as possible

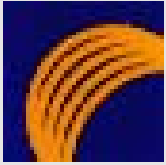




Comprehensive Design

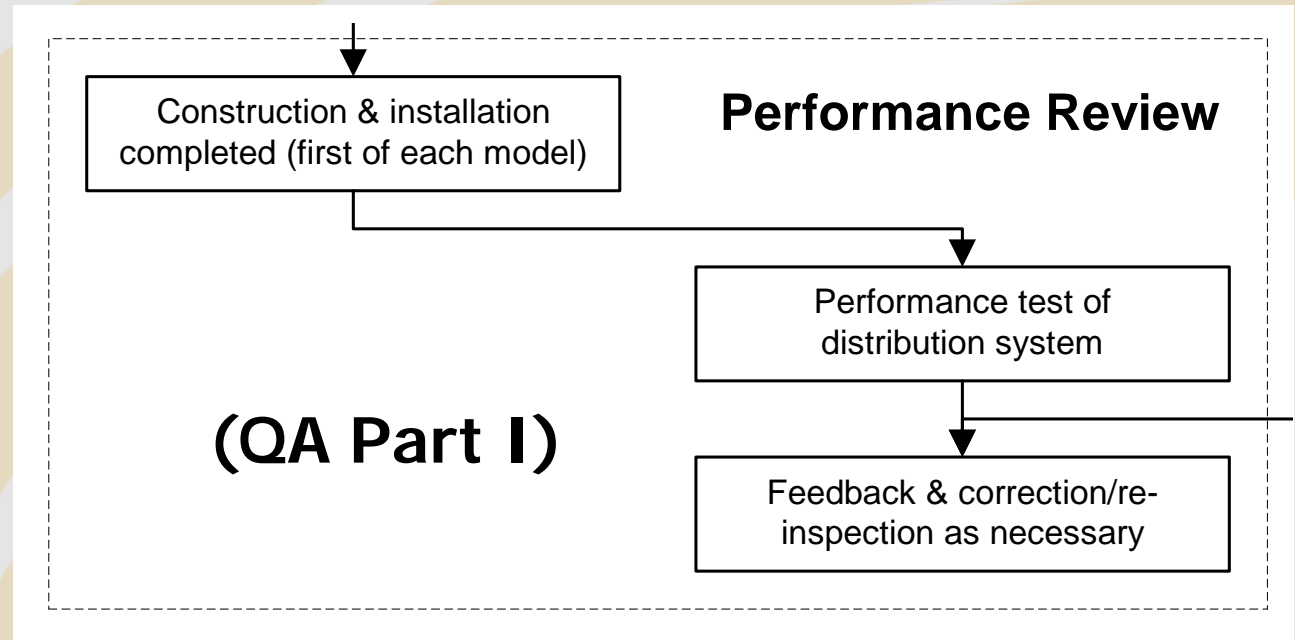
- **Stuff happens**
 - plan to find and deal with it as part of the design process
- **Feedback!**
 - construction
 - installation



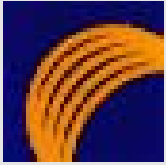


Comprehensive Design

- **Test** the first unit of each model
- **Feedback!**
- Establish the **baseline**

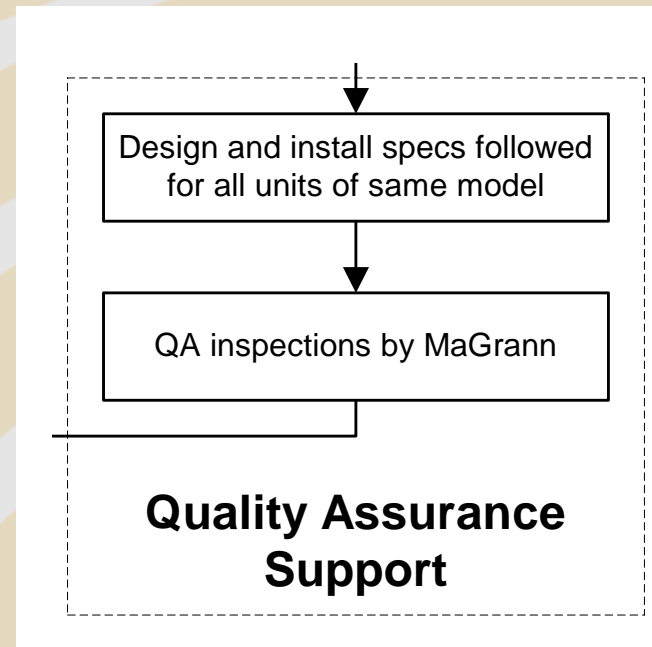


This concludes the design/support process

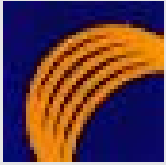


Comprehensive Design

- **QA II: Verify going forward!**
- Crews change
- People forget
- Or don't care



This is the ongoing Quality Assurance process



What Defines Optimal?

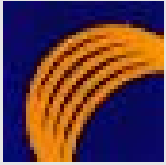
Builder

- Purchase & installation cost
- Process efficiency
- System efficiency

Customer

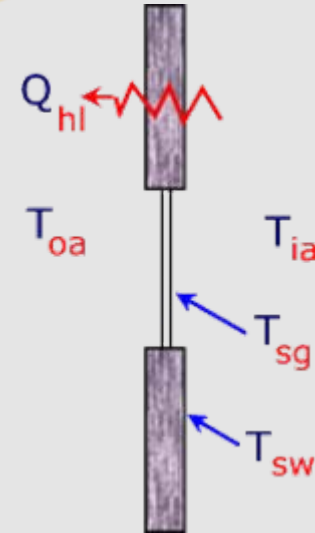
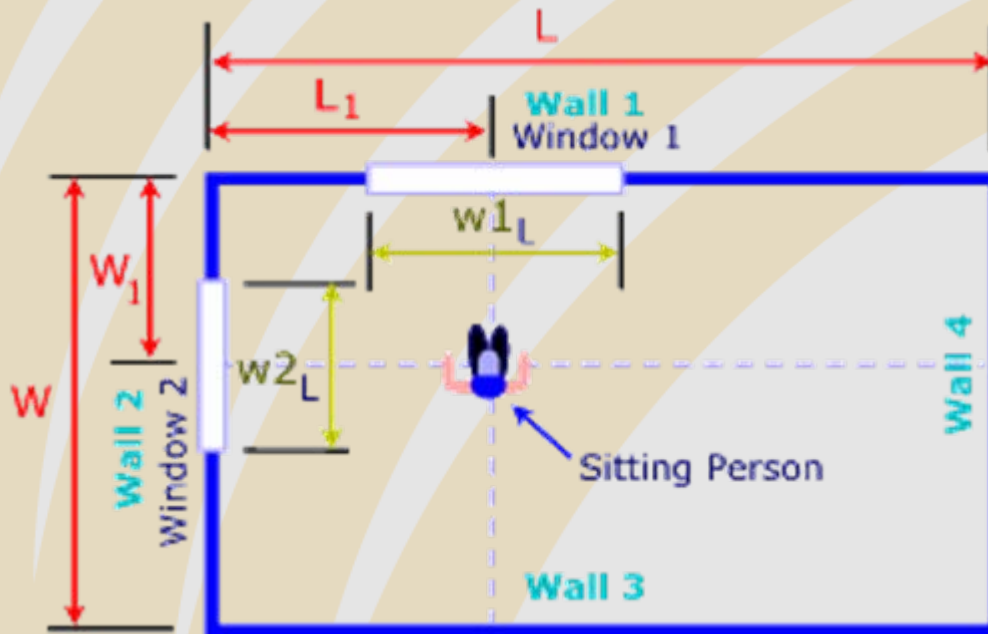
- Operating cost
- Satisfaction
- Value

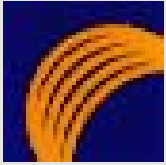
**But in the end, it all comes
down to customer COMFORT...**



The Physiology of Comfort

Actual Temperature
Mean Radiant Temperature
ASHRAE Comfort Zone

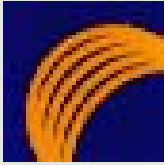




Measuring Performance

- Static pressure drop across coil and filter
- True-Flow® measure of actual system airflow at return trunk
- Flow hood measurements at registers and grilles
- Compare with system air flow & design air flow
- If there's a problem:
 - Temp rise & drop
 - Room air temps (ASHRAE standards)
 - Mean radiant temp diagnostics
 - Infrared
 - Pressure boundaries (ZPT)

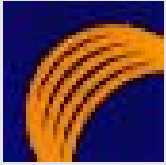




Tracking the Results

BUILDER	PROJECT	MIS FILE NUMBER	MODEL	INSPECTION DATE	High AC Flow	Low AC Flow	Coil Drop	Filter Drop	High Heat Flow	Low Heat Flow	Supply Leak	Return Leak	Cooling Speed	Cooling ESP	Cooling Coil Drop	Cooling Filter Drop	Cooling System Airflow	CFM/kon	Heating Speed	Heating ESP	Heating Coil Drop	Heating Temperature Rise	Heating System Airflow	Measured Supply Airflow	System/Measured Supply %	Measured Return Airflow	System/Measured Return %
Builder 1	Model 1	JS-P41-A2	Hawthorne	10/16/2006	X								L	0.71	0.28	0.09	991	283	M	0.75	0.31	65	1,001	1,257	27%	953	-4%
			Stockton	10/16/2006			X					X	H	1.12	0.51	0.10	1,402	350	M	0.89	0.39	74	1,215	1,397	0%	1,259	-10%
			Churchill System 1	10/16/2006								X	L	0.52	0.21	0.14	722	361	M	0.65	0.33	56	928	795	10%	651	-10%
			Churchill System 2	10/16/2006		X							H	0.68	0.25	0.11	896	299	M	0.63	0.26	62	831	1,028	15%	917	2%
	Model 2	JS-P37-A2	Cedarbrook	10/11/2006	X						X	X	H	0.77	0.15	0.11	1,048	524	M	0.73	0.13	57	1,050	982	-6%	799	-24%
			Woodridge	10/11/2006	X			X			X	X	H	0.83	0.23	0.22	1,127	451	M	0.72	0.20	58	1,022	1,003	-11%	861	-24%
			Oakwood	10/11/2006	X				X				H	0.77	0.19	0.15	1,003	501	M	0.65	0.17	65	916	1,042	4%	954	-5%
			Brookfield	10/11/2006	X						X	X	H	0.91	0.13	0.14	1,066	533	M	0.82	0.12	60	992	764	-28%	755	-29%
	Model 3	JS-P43-A2	Westerly System 1	10/9/2006		X	X		X				L	0.68	0.33	0.10	780	312	M	0.63	0.27	75	690	828	6%	743	-5%
			Westerly System 2	10/9/2006			X					X	MH	0.75	0.31	0.10	821	411	ML	0.60	0.24	52	750	834	2%	747	-9%
			Fleetwood System 1	10/9/2006			X				X	X	H	0.87	0.40	0.13	1,073	429	M	0.71	0.33	64	1,017	835	-22%	733	-32%
			Fleetwood System 2	10/9/2006		X	X					X	MH	0.82	0.35	0.13	842	337	ML	0.56	0.53	50	774	903	7%	731	-13%
			Marston System 1	10/9/2006		X	X		X				M	0.71	0.35	0.18	829	332	L	0.44	0.27	98	661	896	8%	828	0%
			Marston System 2	10/9/2006		X	X						ML	0.62	0.30	0.08	725	290	ML	0.76	0.34	49	793	958	32%	753	4%
			Yarmouth System 1	10/9/2006		X					X		L	0.60	0.29	0.12	736	295	M	0.75	0.36	68	955	718	-2%	628	-15%
			Yarmouth System 2	10/9/2006		X	X				X		MH	0.69	0.32	0.08	874	350	ML	0.56	0.26	51	769	921	5%	730	-16%



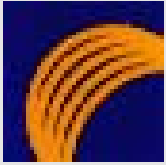


Using the Results - Examples

Measured Supply Airflow	System/ Measured Supply %	Measured Return Airflow	System/ Measured Return %
794	-26%	580	-46%
853	-30%	447	-63%
702	-41%	470	-61%
1,079	-14%	692	-45%
761	-29%	610	-43%
839	-29%	574	-51%
828	-23%	492	-54%

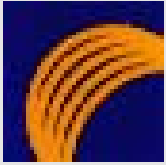
Unsealed Supply Plenum	Unsealed Supply Trunk Connections	Unsealed Return Plenum	Unsealed Return Trunk Connections	Unsealed Collars, Boots, Takeoffs	Unsealed Coil Box	Unsealed Return Trunk
X	X	X	X	X	X	X
X	X	X	X	X	X	X
		X	X	X		X
X	X	X	X		X	X
X		X	X			
X		X	X			

- Comparing the measured airflow at supply and return registers to measured airflow produced by the system will indicate areas of the duct system that need to be addressed.



Using the Results – Examples

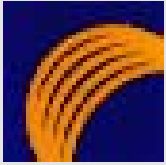
Room	Measured Return CFM	Designed Return CFM	Measured Supply CFM	Designed Supply CFM	CFM Difference	CFM % Difference
Foyer			59	50	9	18%
Dining Room			72	75	-3	-4%
			46	75	-29	-39%
Living Room			37	75	-38	-51%
			77	75	2	3%
Kitchen			73	50	23	46%
Breakfast Nook	770	800	163	120	43	36%
Family Room			163	120	43	36%
			113	75	38	51%
Totals	770	800	803	715	88	12%



Using the Results – Examples

Cooling ESP	Cooling Coil Drop	Cooling Filter Drop	Cooling System Airflow
0.82	0.35	0.13	842
0.71	0.35	0.18	829
0.62	0.30	0.08	725
0.60	0.29	0.12	736
0.69	0.32	0.08	874

- Cooling equipment is a 2.5 ton system rated for maximum external static pressure of 0.50 in. of WC
- A pressure drop across the coil that exceeds 0.30 in. of WC can increase external static pressure, reducing system airflow and performance
- Cause: Blocked coil

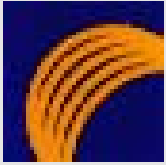


Using the Results - Examples

Heating ESP	Heating Coil Drop	Heating Temperature Rise	Heating System Airflow
1.11	0.59	108	881
0.76	0.16	100	950
0.79	0.14	109	878
0.90	0.41	85	1,128
1.09	0.54	96	996
0.88	0.32	84	1,136
0.53	0.20	86	1,103

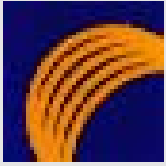
- Installed heating equipment is over sized. Heating capacity exceeds calculated load by 40%.
- System is being undersupplied for heating air causing heating temperature rises above 75°F.
- System will go off on high limit causing temperatures to vary and a direct impact on occupant comfort





Selling It – Take 1

- You want to do what???
- I can't afford an additional \$xxx per house
- Once the house is sold it's a warranty issue
- The contractor is responsible
- It's the customer
- Put in a bigger system



Selling It – Take 2

- Do you want your customer being your QA provider?
- Who do you want finding the problems?
- When do you want to fix them?
- How much do you want to spend at the end of the day?
- How important are referrals?
- How much fun are you having?