

Humidity Control In 30 Minutes

Including Advice From Will Rogers and Willie Sutton



Distinguished Lecture



Lew Harriman
Mason-Grant Consulting
Portsmouth, NH
MasonGrant.com

Outline

- 1. Examples of common humidity control problems**
- 2. Misconceptions that lead to problems**
- 3. The path to success - Understanding humidity loads**
- 4. Summary**

Great Clinic building, great HVAC system... So why did it grow mold 3 times in five years?



School - Plenty of system capacity!... Why mold?

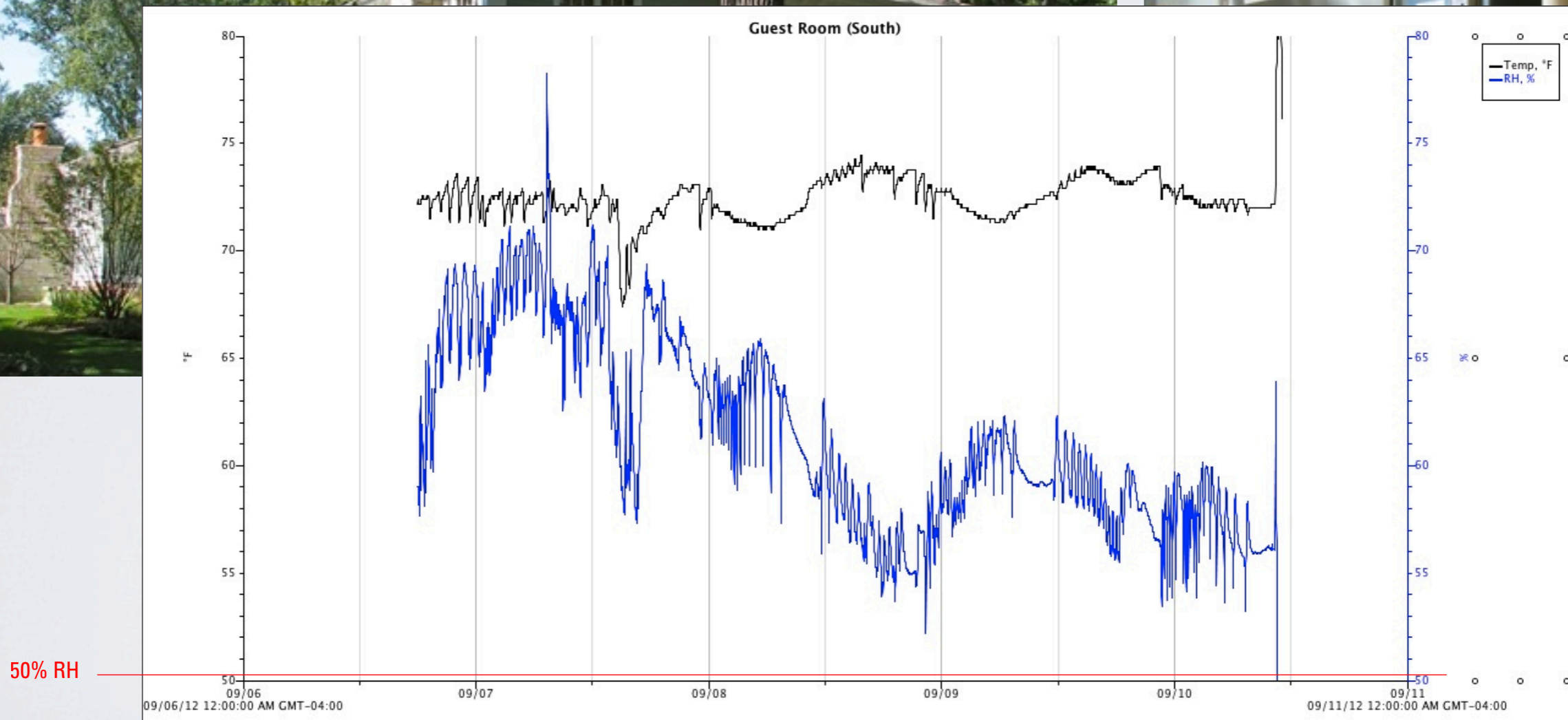
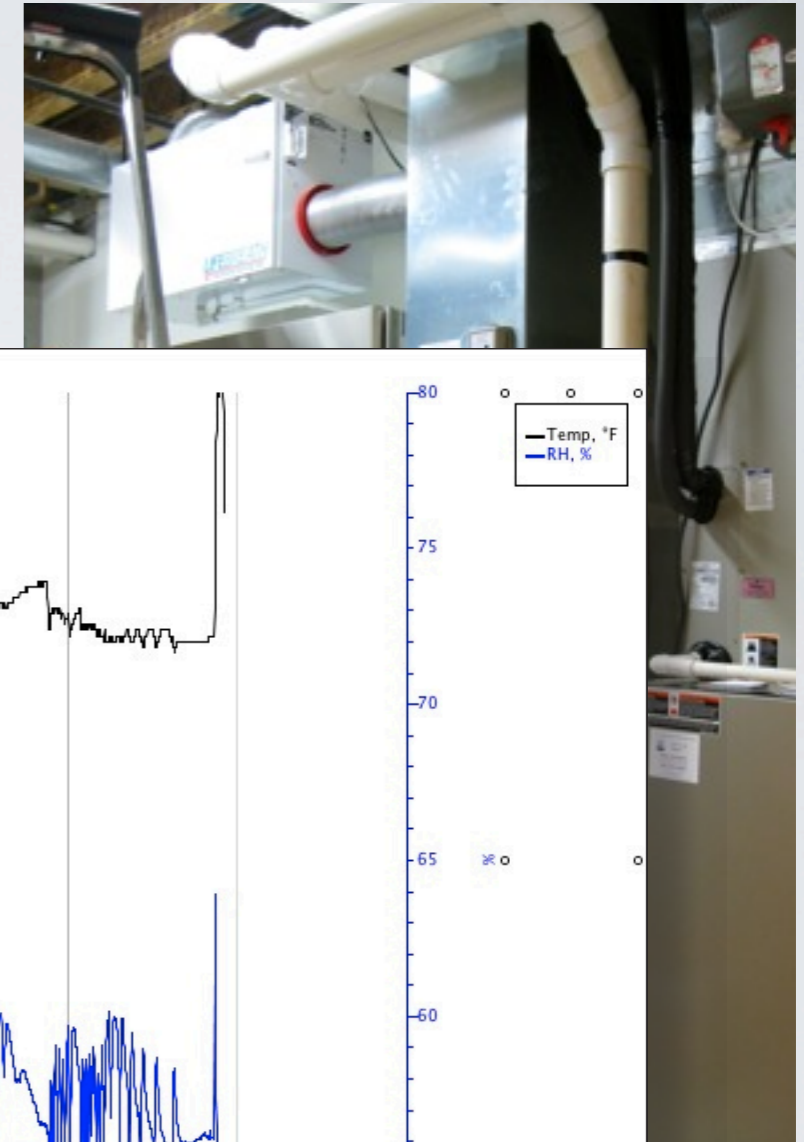
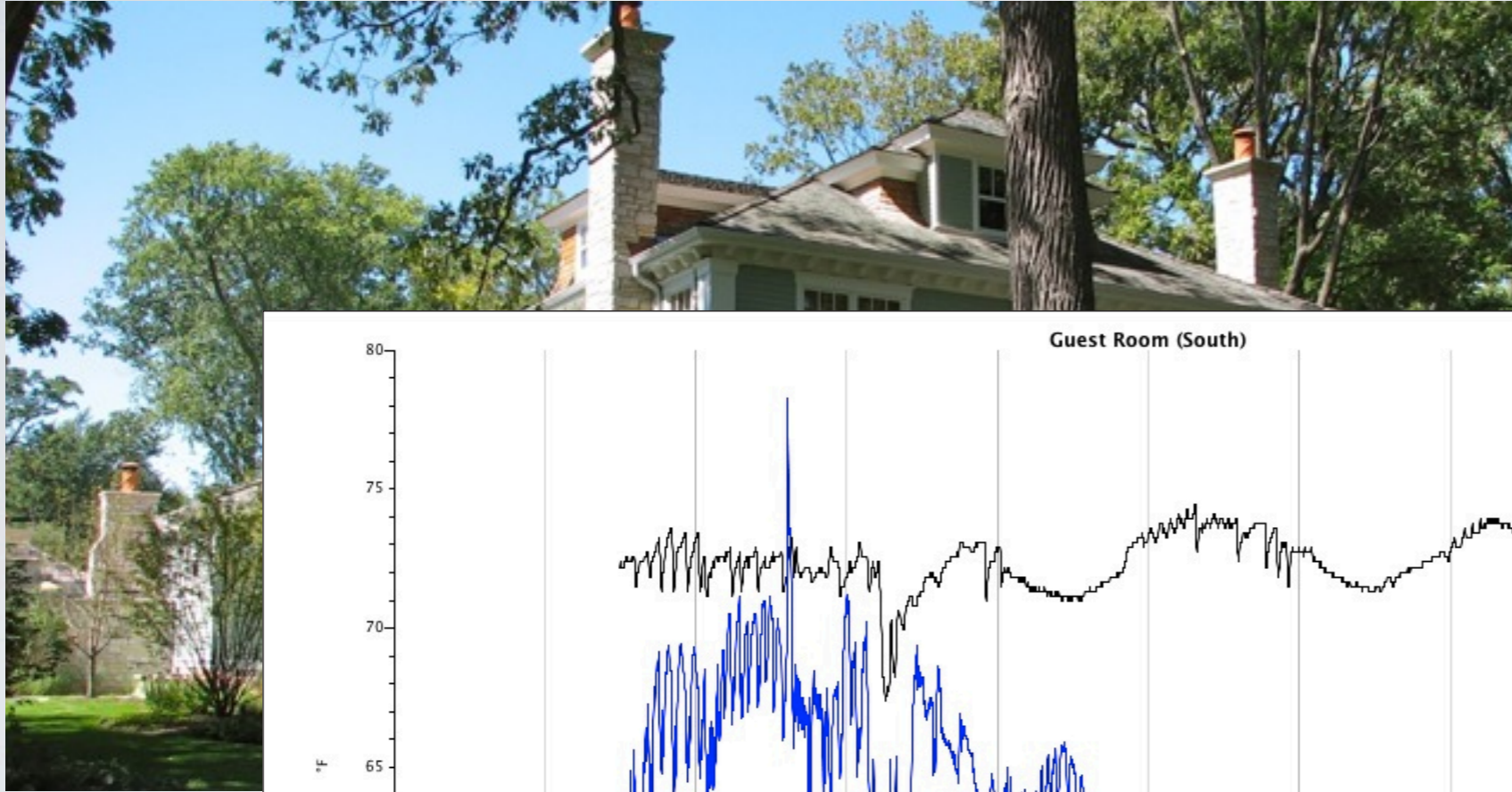


Photograph 1: Mold growth on classroom wall after 72 hours.

New training building and new HVAC equipment... Why mold and equipment failures?



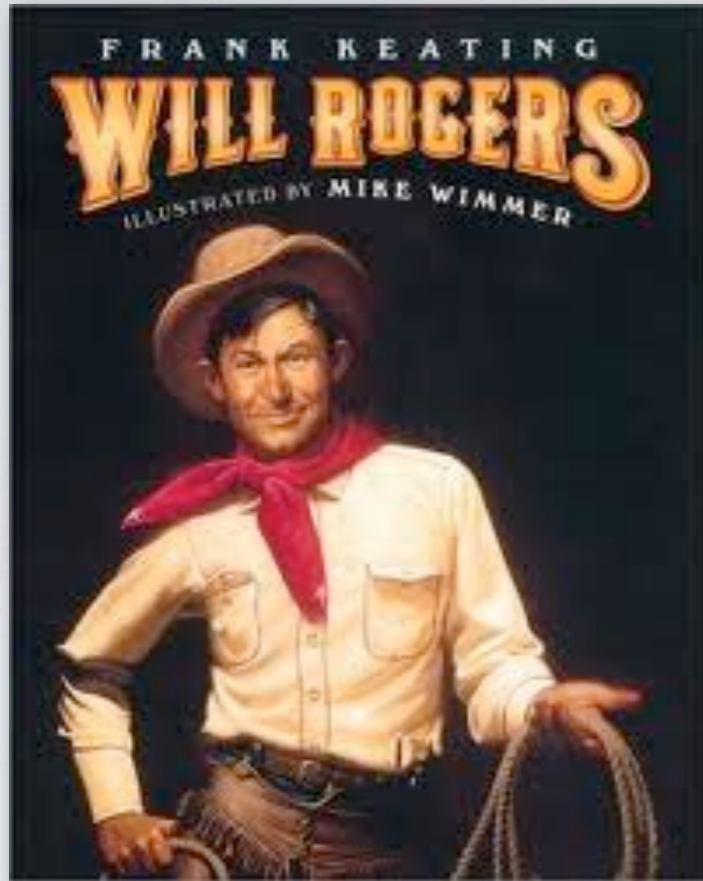
\$6 Million new home, state-of-the-art HVAC... Why is humidity over 65% RH?



Common elements of these four problems

- All designed by experienced professionals
- Client assumed—but did not define—humidity control
- No separate humidity load calculation - HVAC Designer “flying blind”
- All added EXTRA cooling - instead of dedicated dehumidification

Will Rogers' Observation

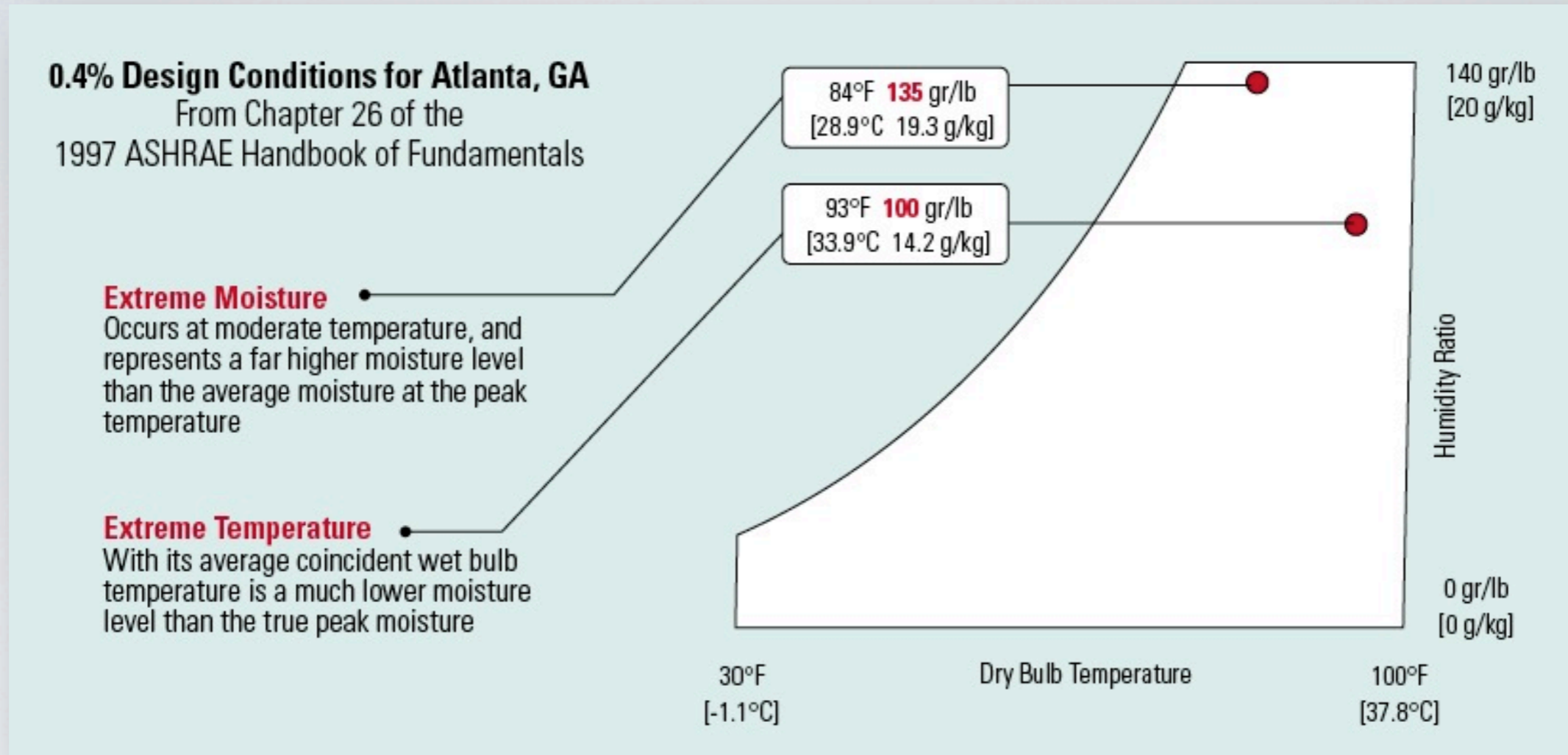


*"It isn't what we
don't know that
gives us trouble,
it's what we know
that ain't so."*

Will Rogers

Peak humidity design conditions

We thought we knew... but it just ain't so



How to find the peak design dew point?

ASHRAE Fundamentals 1997.. or later Climatic Design Chapter

27.7

Climatic Design Information

Table 1B Cooling and Dehumidification Design Conditions—United States

Location	Cooling DB/MWB						Evaporation WB/MDB						Dehumidification DPT/HR/MDB						Range of DB				
	0.4%	1%	2%	3%	4%	5%	0.4%	1%	2%	3%	4%	5%	0.4%	1%	2%	3%	4%	5%					
AKASKA	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Albuquerque	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Birmingham	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.7
Chattanooga	95	76	94	75	92	76	78	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Cincinnati	96	76	94	77	92	76	81	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Cleveland	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Columbus	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Dallas	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Dallas/Ft. Worth	94	75	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Dayton	94	77	92	76	91	76	78	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Denver	96	76	94	77	92	76	81	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Des Moines	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Detroit	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
El Paso	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Fort Worth	94	75	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Houston	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Indianapolis	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Jacksonville	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Las Vegas	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Little Rock	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Los Angeles	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Los Angeles/Anaheim	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Los Angeles/Long Beach	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Los Angeles/Orange	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Los Angeles/Redlands	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Los Angeles/Santa Ana	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Los Angeles/Whittier	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Madison	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Memphis	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Minneapolis	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Mobile	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Montgomery	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Mountain View	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Myrtle Beach/Florence	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Nashville	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
New York	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
New York/Albany	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
New York/Buffalo	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
New York/Rochester	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
New York/Syracuse	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
New York/Yonkers	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Oak Ridge	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Oklahoma City	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Omaha	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Orlando	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Portland	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Portland/Seattle	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Portland/Vancouver	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Portland/Washington	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Portland/Seattle/Tacoma	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Portland/Vancouver/Seattle	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Portland/Washington/Seattle	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Portland/Washington/Seattle/Tacoma	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Portland/Washington/Seattle/Tacoma/Vancouver	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle	94	75	93	76	90	74	79	90	78	88	77	86	75	135	83	74	131	82	73	127	81	19.6	
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Washington	95	76	92	74	90	74	78	89	77	88	76	87	77	144	83	74	130	82	73	126	81	18.5	
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Washington/Seattle	94	77	92	76	91	76	79	91	78	88	78	87	83	76	139	84	75	130	83	76	135	82	18.5
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Washington/Seattle/Vancouver	95	76	94	77	92	76	81	90	79	88	76	86	85	75	133	82	74	130	81	75	130	81	20.0
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle	96	76	94	77	92	76	80	90	79	88	76	87	82	77	142	84	75	134	83	76	138	83	18.0
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Washington	95	77	94	77	92	76	80	90	79	88	78	87	85	77	142	84	75	134	82	75	134	82	19.6
Portland/Washington/Seattle/Tacoma/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Vancouver/Seattle/Washington/Seattle/Washington/Seattle	94	75	93	76	90	74</																	

Dayton - ASHRAE humidity design conditions

0.4% Dry Bulb	0.4% Dew Point	Difference at peak dew point
90° DB 74° MCWB	81°DB 74°MCWB	-9°F DB
98 gr/lb	128 gr/lb	+30 gr/lb

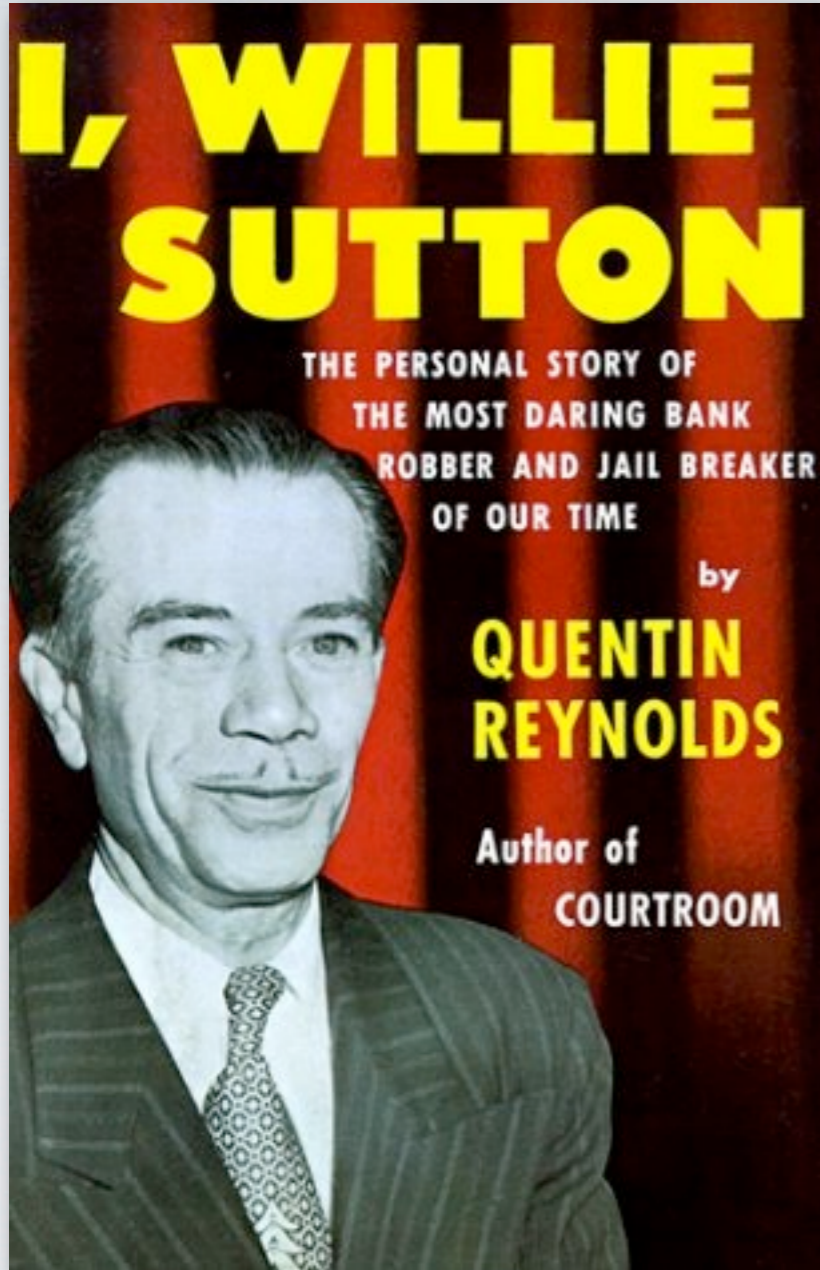
Cincinnati - ASHRAE humidity design conditions

0.4% Dry Bulb	0.4% Dew Point	Difference at peak dew point
93° DB 75° MCWB	83°DB 77°MCWB	-10°F DB
100 gr/lb	134 gr/lb	+34 gr/lb

What do do?

- Track down and quantify the humidity loads
- Dry the supply air to a lower dew point than the control condition
- To avoid overcooling - Dedicate an HVAC component to dehumidification *independent* of cooling equipment and cooling controls

Guidance from Willie Sutton



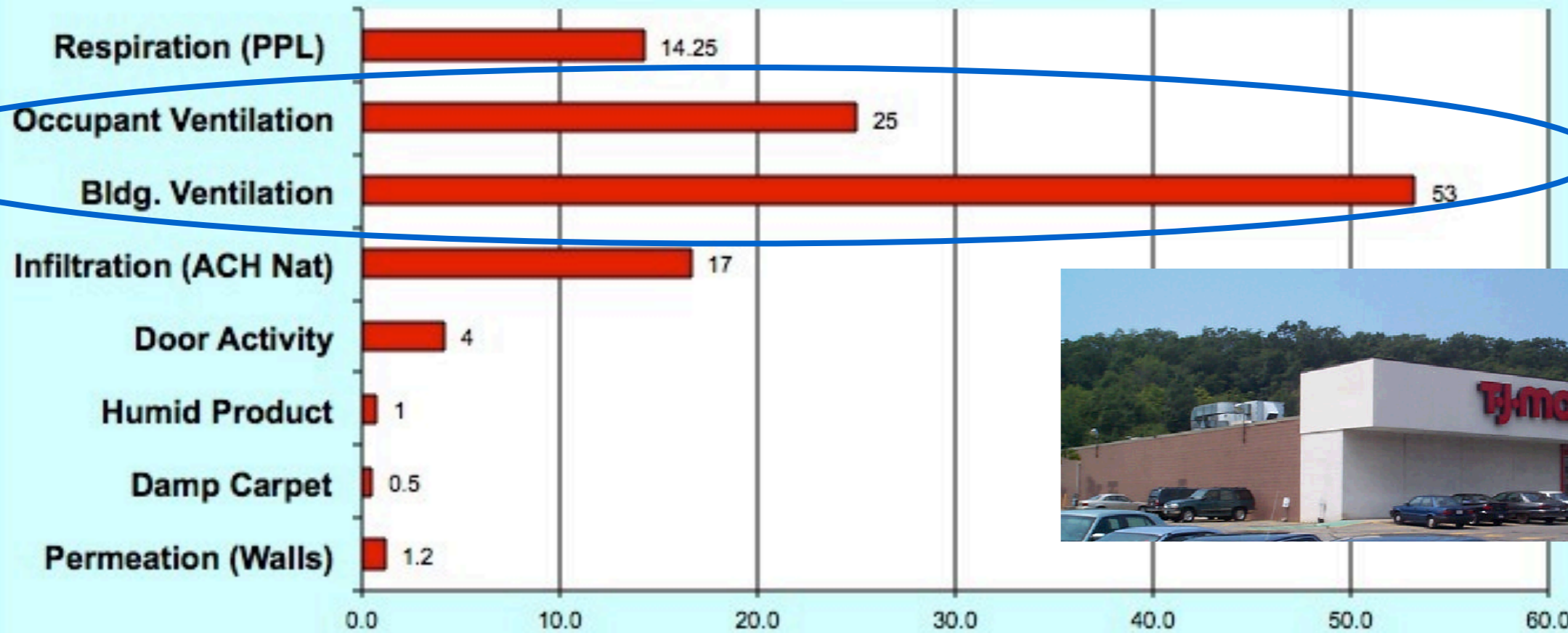
Reporter:

“Willie, it’s a Federal Crime!
why rob BANKS?”



Where's the humidity load?

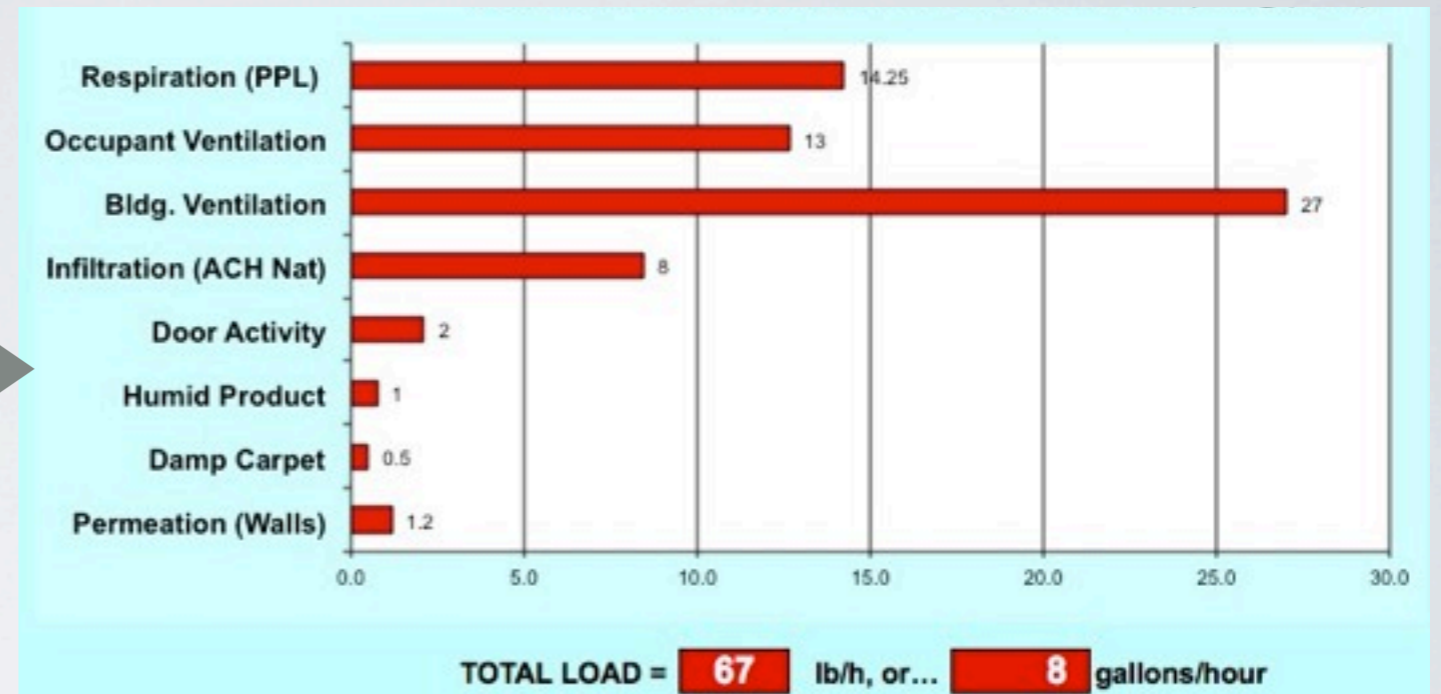
Cincinnati Retail Dehumidification Load (lb/h @ peak)



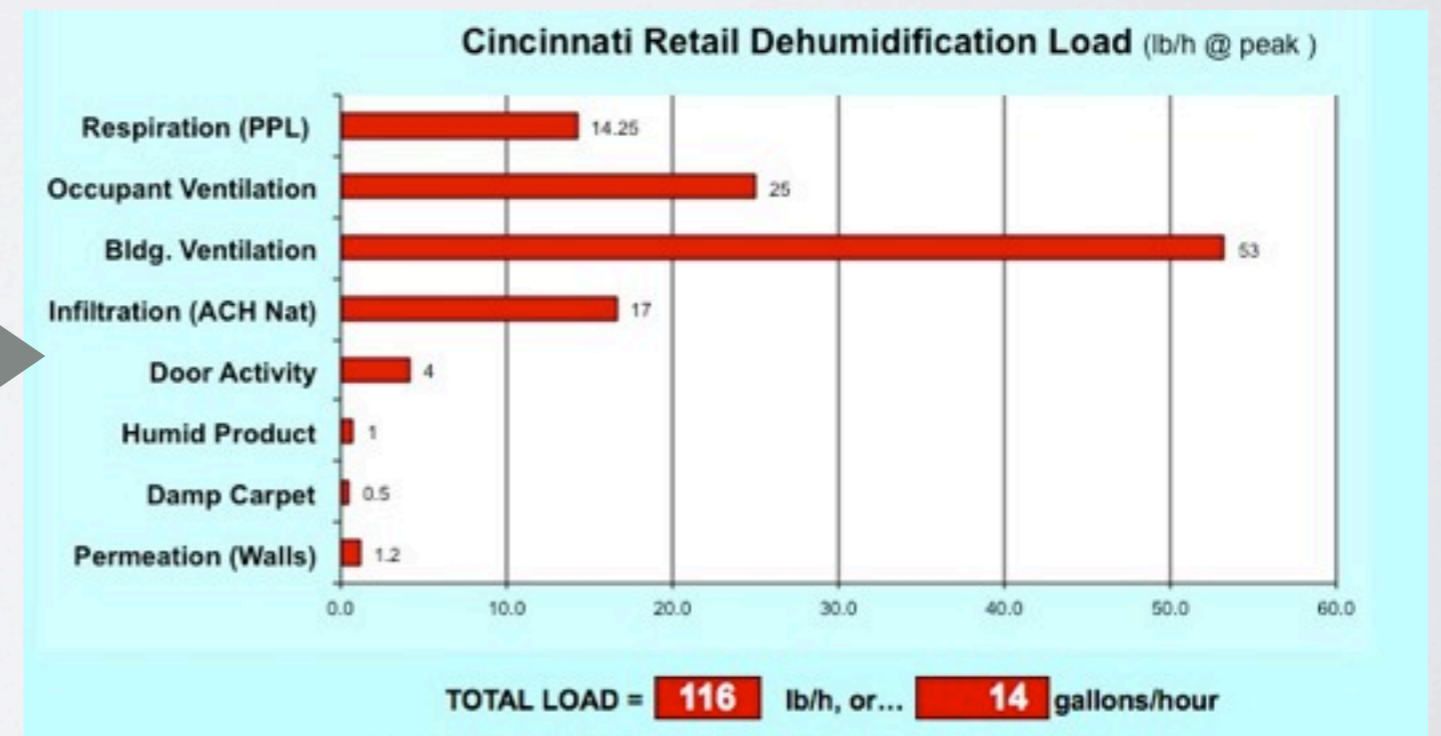
TOTAL LOAD = **116** lb/h, or... **14** gallons/hour

Humidity load at peak dry bulb vs. peak dew point

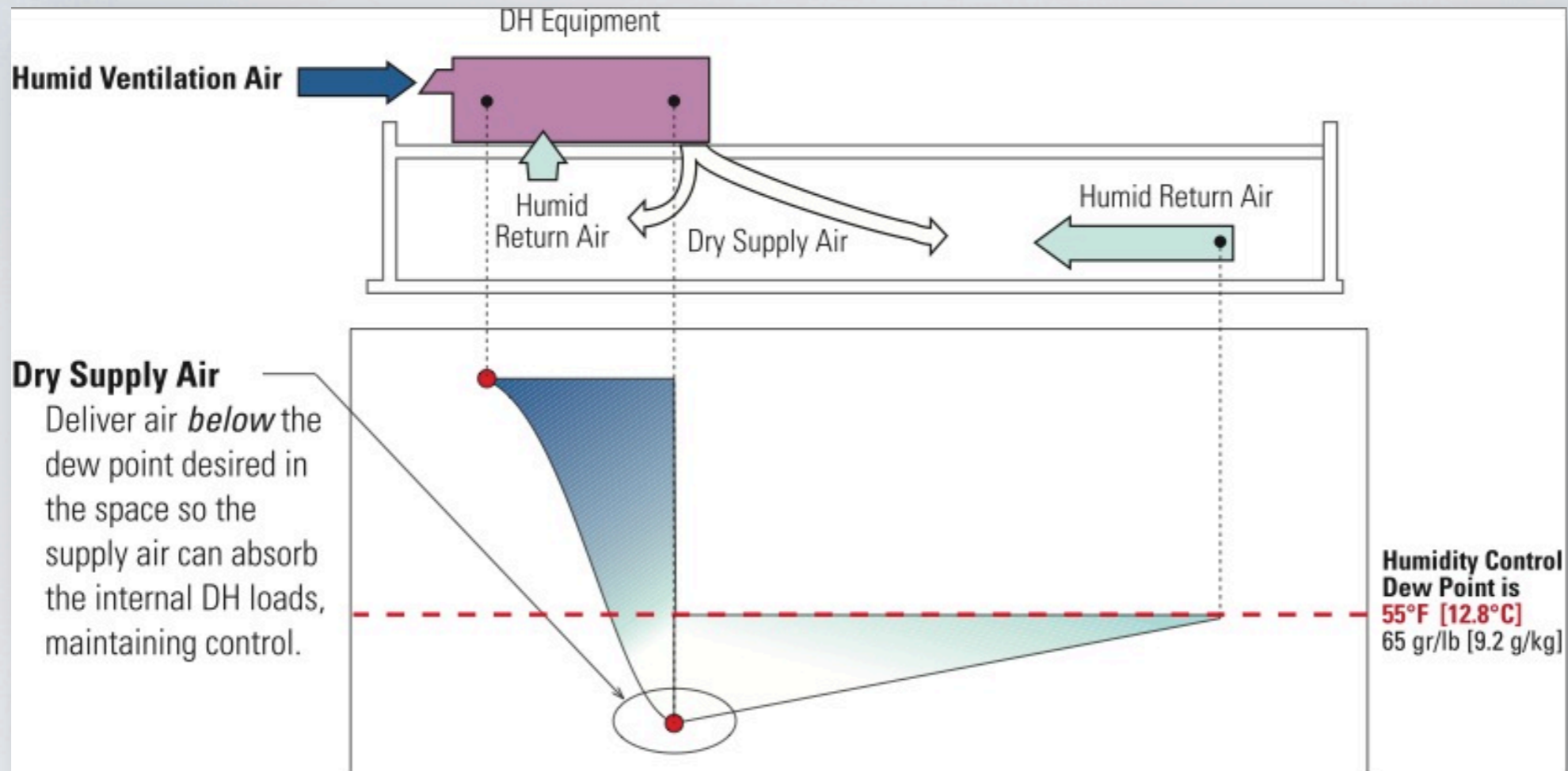
67 lb/h at peak Dry Bulb



116 lb/h at peak Dew Point

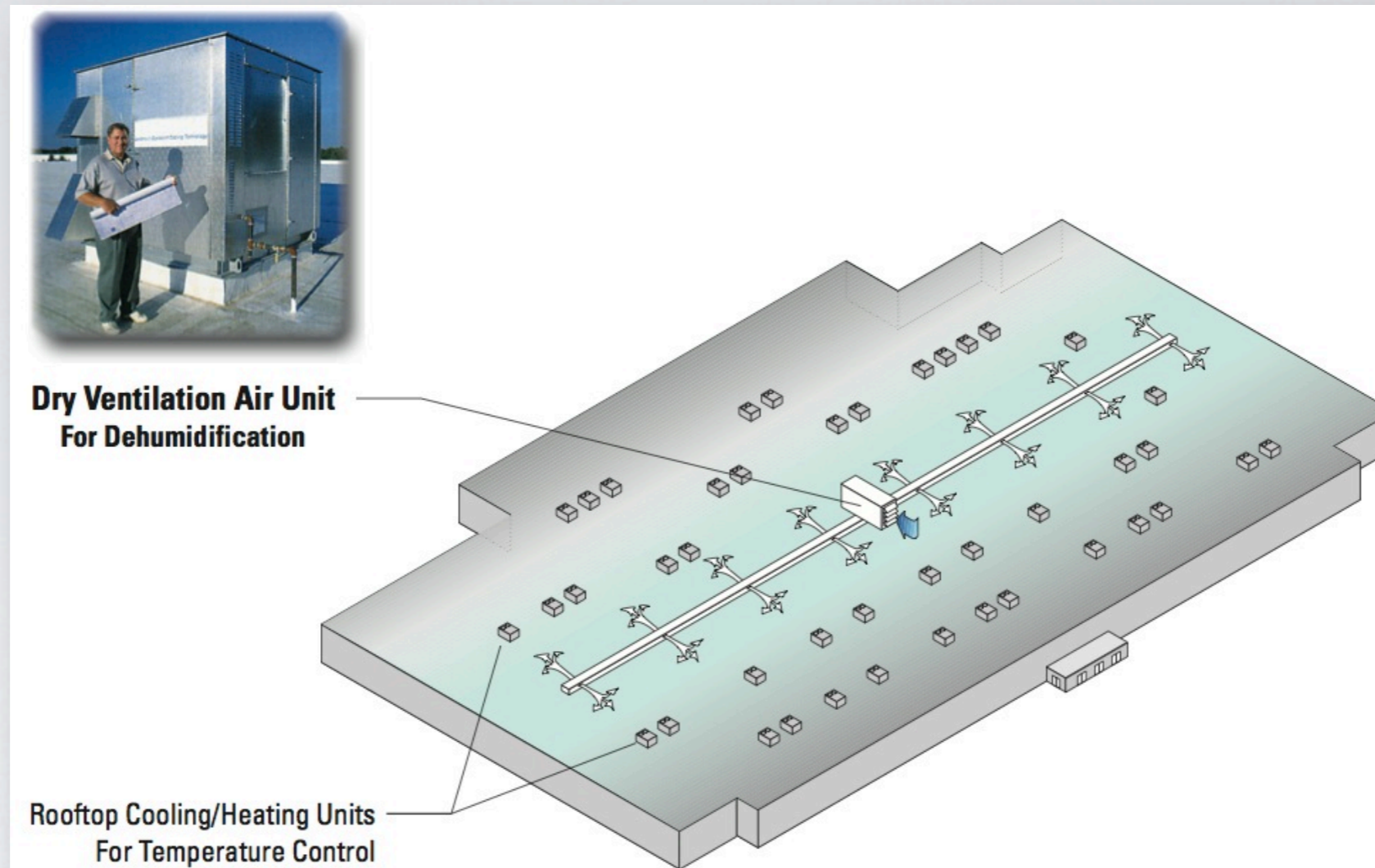


Dry where the load is - DOAS controls humidity



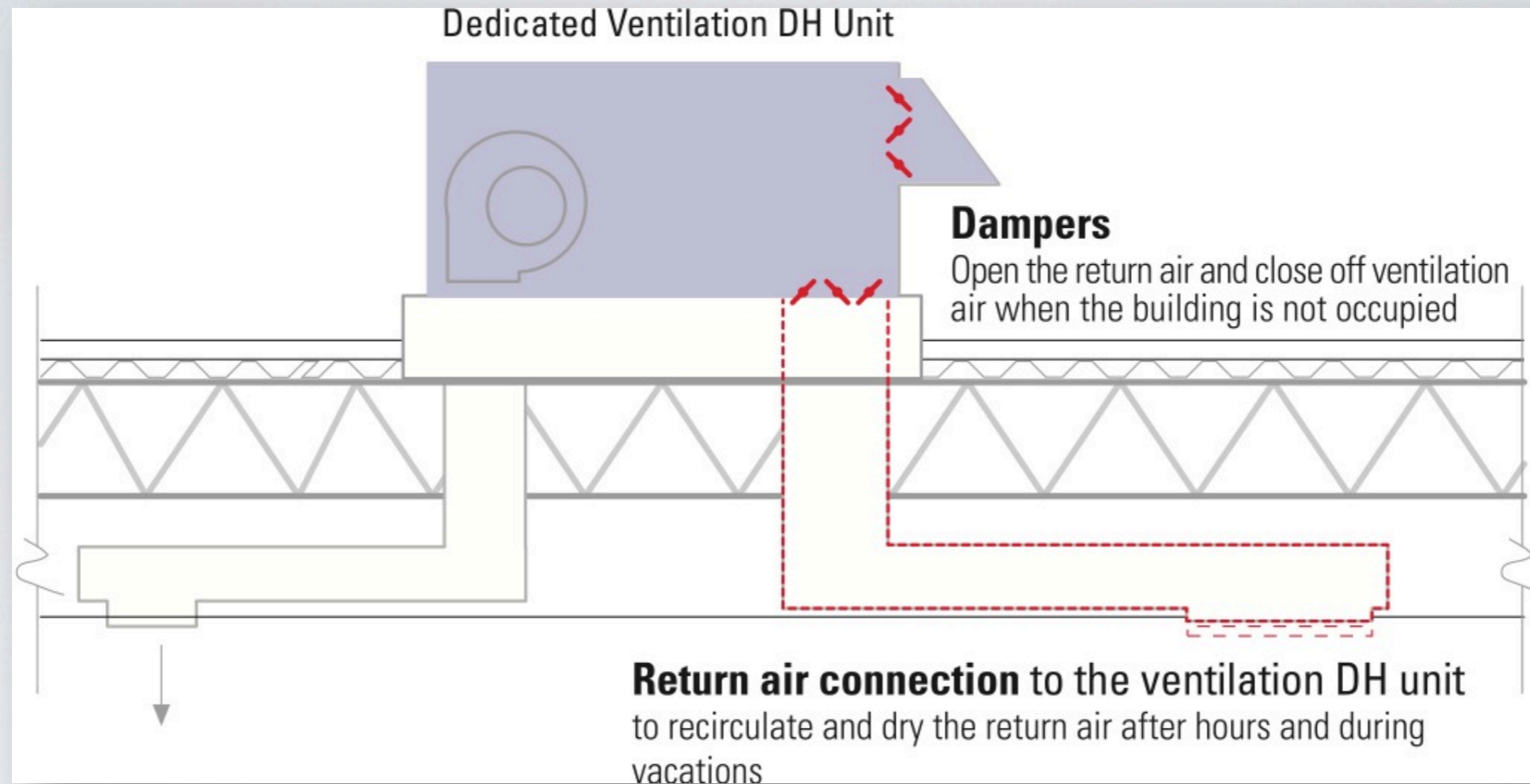
Source: ASHRAE Humidity Control Design Guide - 2006

Typical layout - Big box retail



Source: ASHRAE Humidity Control Design Guide - 2006

Add return air connection for humidity control during unoccupied hours and vacations

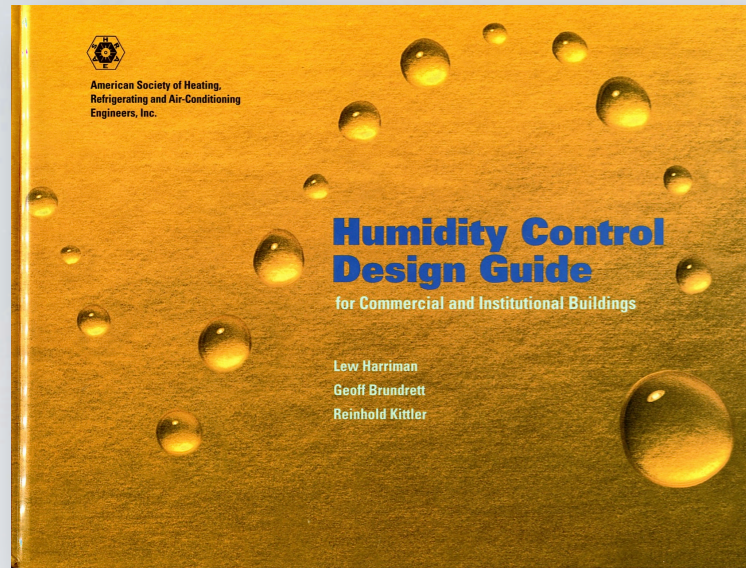


Source: ASHRAE Guide for Buildings in Hot & Humid Climates - 2009

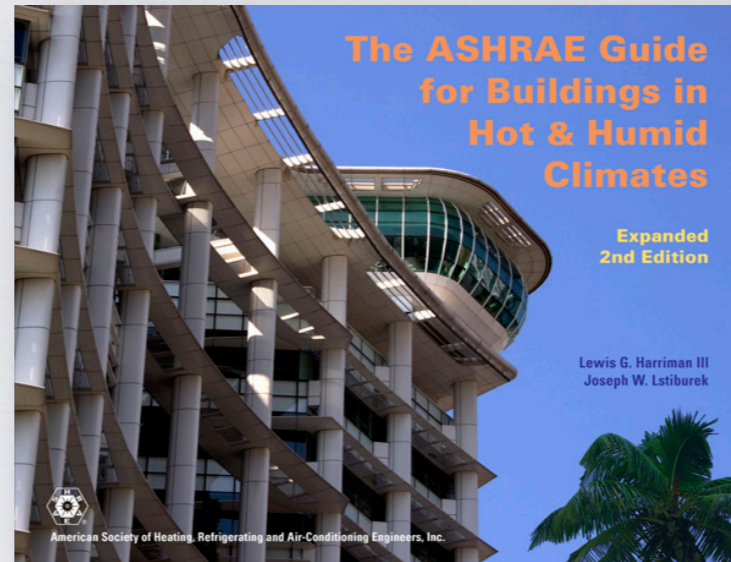
Summary - Humidity Control in 30 Minutes

- Extra cooling does not mean humidity control
- Since 1997 we know humidity peaks when outdoor temperatures are moderate—not hot.
≈ **70% more humidity load at ASHRAE peak dew point.**
- Biggest humidity load?... Ventilation and makeup air, BY FAR the largest loads
- For easy humidity control - Dry the incoming air in a dedicated outdoor air system (DOAS)

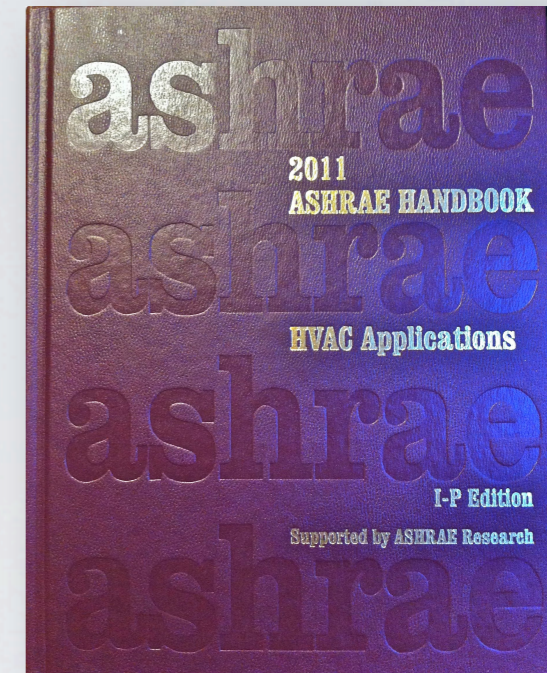
Further ASHRAE Resources



**Humidity Control
Design Guide**



**Guide for Buildings in
Hot and Humid Climates**



**ASHRAE Handbook
(Applications)**



Lew Harriman
Chair, ASHRAE TC 1.12
(603) 431-0635