

## Case Studies in Building Commissioning (If you don't measure it – Don't believe it)

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Agenda  
 Commissioning vs TAB  
 Air Barriers / Thermal Barriers  
 Duct Leakage  
 Example Commissioning Findings



3/24/04

1

## What is Commissioning?

- Making sure the Owner got what they wanted and paid for
- ASHRAE – “The process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the Owner’s design intent.”
- To be most effective, CX needs to start BEFORE the design

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2

## What is Commissioning?

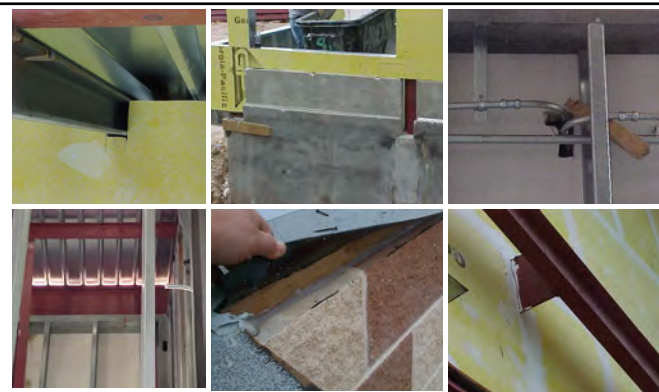
- Making sure the Owner got what they wanted and paid for
- ASHRAE – “The process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the Owner’s design intent.”
- To be most effective, CX needs to start BEFORE the design
- Commissioning is **NOT** punch list and/or Test Adjust & Balance (TAB)



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3

## Air Barrier Commissioning



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4

### Thermal Barrier Commissioning

Rim joist air leak

Kitchen cabinet furr-down  
Insulation level visible

Insulation in contact  
w/ drywall

No insulation contact w/ drywall

5

### New Library Humidity Control

- New 8500 sq ft Library
- 35 tons AC (240 sq ft/ton)
- “Hot” complaints
- Tested ~ 8 ACH50
- Return leaks indicated
- “Return Plenum Ceiling”
- ~2600 cfm of OA with intake blocked!!!

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6

### New Library – After Initial Corrections

- Improved relative humidity and temperature control, but not good
- High relative humidity most nights
- Temperature still inconsistent

Space Temp    Supply Temp    Space RH

77.5  
75.0  
72.5  
70.0  
67.5  
65.0  
62.5  
60.0  
57.5  
55.0  
52.5  
50.0  
47.5  
45.0  
42.5  
40.0  
37.5  
35.0  
32.5  
30.0  
27.5  
25.0  
22.5  
20.0  
17.5  
15.0  
12.5  
10.0  
7.5  
5.0  
2.5  
0.0  
-2.5  
-5.0  
-7.5  
-10.0  
-12.5  
-15.0  
-17.5  
-20.0

80  
70  
60  
50  
40  
30  
20  
10  
0  
-10  
-20  
-30

17 Sun 18 Mon 19 Tue 20 Wed 21 Thu 22 Fri 23 Sat

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7

### New Library – Next Corrections

- Temperature sensor located high in atrium
- Air conditioner responding to wrong temperature requirement
- High night time relative humidity was due to exhaust fan always on

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8

### Senior Assisted Living Center

- ~400,000 sq ft, \$56M property
- ‘Others’ had reported duct leak problems
- Referred to us because was in litigation
- Designed for sheet metal ducts
- Built with flex / ductboard
- Initial job was to inspect & report findings



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### Senior Assisted Living Center

- Then asked to “talk to attorney” (aka 7 hour deposition)
- Oppositions case was that any duct leaks were contained to individual apartment by fire code so leakage didn’t matter
- Owner authorized duct leak testing on sample units...

Table 1 - Verification Results Summary

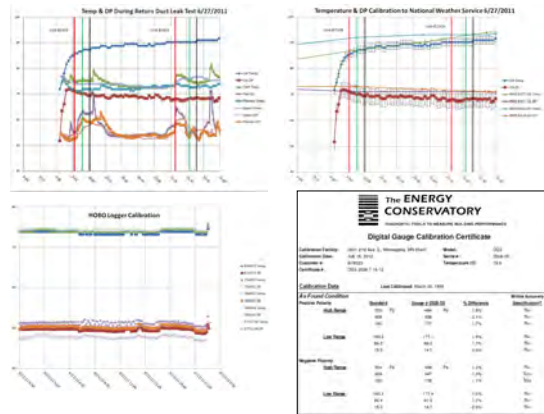
Unit #	Allowables Leakage	Before Remediation				After Remediation			
		Return Duct Leakage Method Ds (Tag)	Return Duct Leakage Method Cs (Tag)	Return Duct Leakage Method Ds (Tag)	Return Duct Leakage Method Cs (Tag)	Return Duct Leakage Method Ds (Total)	Return Duct Leakage Method Cs (External)		
1404a	12"	1056	8800%	463	3860%	485"	54%	196	58%
1606a	6"	452	7860%	280	4870%	N/A	N/A	N/A	N/A
1611a	6"	430	7480%	550	9570%	195	55%	37	93%
1612a	6"	578	10050%	270	4700%	300	48%	102	62%
2309a	6"	692	10250%	430	6370%	263	62%	91	79%
2508a	7"	>1500	N/A	N/A	N/A	410	>73%	65	N/A

Calculations: Reduction = (CFMold - CFMnew) / CFMold

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10

### Assisted Living Center Remediation



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11

### Senior Assisted Living Center

#### Remediation Pictures -





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12

### Stages Duct Leakage Testing

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- Our duct are so good they don't need to be tested
- Ducts can't be leak tested (ASTM E1554)
- The test is WRONG!
- Duct can't possibly be sealed as specified so the current leakage should be accepted as is
- This wasn't included in our bid – it will cost extra (Testing MUST be specified)
- See – I told you we would take care of you

3/24/04 13

### Duct Leak Testing Truths

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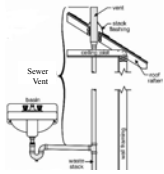
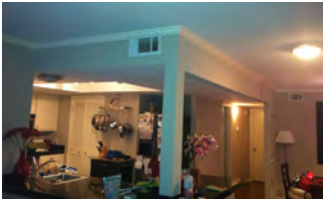
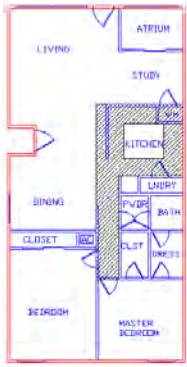
- If the contractor can't show duct leak test experience – that contractor is NOT qualified
- If it can't be sealed as tight as a duct or it can't be tested to be sealed as tight as a duct – the **\*DESIGN\*** should **NOT** show it to be used as a duct (E. G. - plenum ceilings, Under Floor Air Distribution, building cavities, panned joists, etc)
- Duct should be tested at rough-in (for contractor's benefit) and a final (for Owner's benefit)
- Ducts CAN and MUST be sealed – but it requires effort during design, installation and verification

3/24/04 14

### Condo Odor Problem

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- Built as apartment in 1971
- Converted to condos in 2006
- 1320 sq feet, ground level, two story
- Odor got bad in 2006, investigation started in 2010
- Odor traced to 'leaking sewer vent'









3/24/04 15

### Condo Odor

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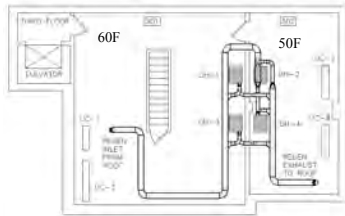
- Sealed HVAC/return plenum as first step
- Upstairs condo owner now interested in corrections
- Smoke test proved leak was in upstairs condo and verified vent stack did NOT penetrate roof
- 2011 Sewer vent thru roof added - problem solved

3/24/04 16

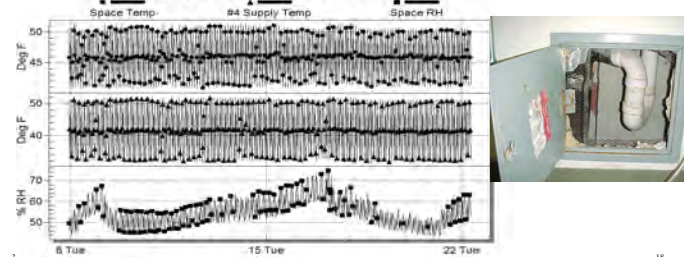
### Archive HVAC

- Poor humidity control
- Dehumidifiers were failing within 1<sup>st</sup> month of installation
- Repeated failures until dehumidifiers were abandoned & replaced with portable dehumidifiers
- Temperature control considered acceptable



17

### Archive



18

### Archive - Emergency Due to Damaged Materials

- Water in regeneration air ducts to be leaking onto collection
- ½" Elastomeric insulation did not keep duct surface temp above OA dew point
- Blocked OA ducts above roof with ductboard



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19

### Archive – 6/24/2013

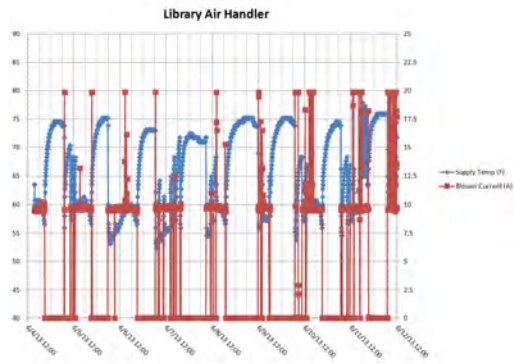
- Electrical compartment full of water again
- Ductboard had failed



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20

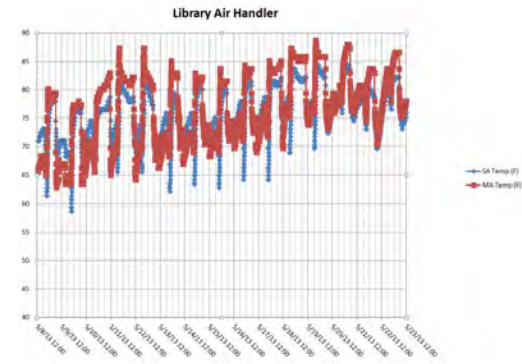
### What's Wrong Here?



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21

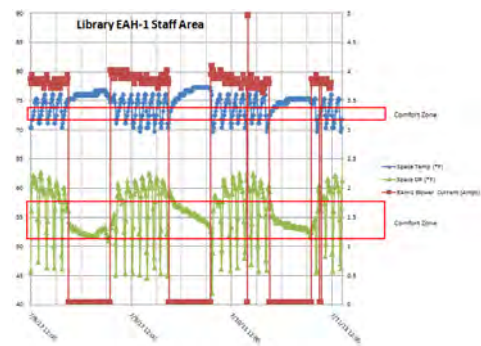
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22

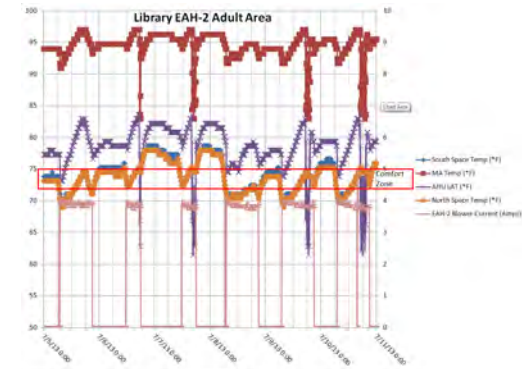
### What's Wrong Here?



8/05/13

23

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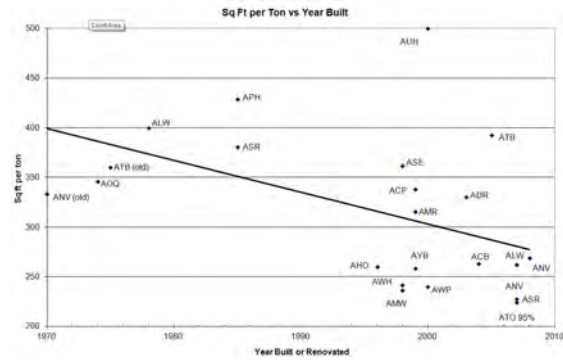


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24

### Sq Ft per ton Metric

- Why as we build more energy efficient buildings – do they need MORE air conditioning???

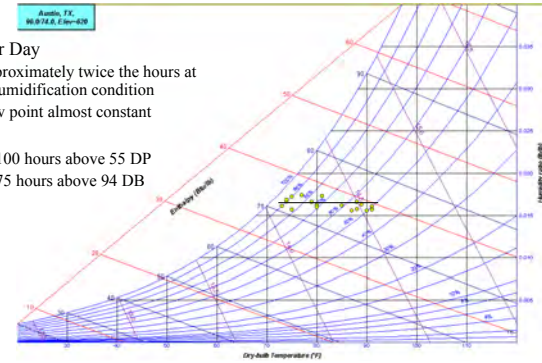


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25

### OA Conditions for Austin Texas

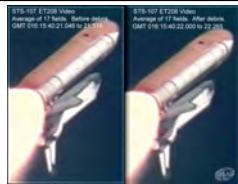
- Summer Day
  - Approximately twice the hours at dehumidification condition
  - Dew point almost constant
- Annual
  - ~ 4100 hours above 55 DP
  - ~ 175 hours above 94 DB



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26

### Recommendations



3/24/04

27