Commissioning UFAD Systems: Lessons Learned

James D. Anderton, CxA, CPMP, LEED GA
Independent Commissioning Consulting
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UFAD Basics

• What is UFAD? (Under Floor Air Distribution)

- Introduces Air at Low velocities & Low Elevation
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UFAD Basics

• Typical UFAD System Architecture

- Pressurized Plenum OR Ducted Supply
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UFAD Basics

• Typical UFAD System Architecture

- Air delivered thru raised flow plenum via Flow Baskets
- Flow Baskets (Manually Adjustable or Automated VAV)
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UFAD Basics

• How does it work?
  - Utilizes Natural Convection (Thermal Plumes)
  - Carries Heat and Contaminants to Returns High above
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UFAD Basics

• How does it work?

- Minimum induction & mixing = Higher Vent. Effectiveness
- Ventilation Air does not mix with RA at supply outlets resulting in Better IAQ
UFAD Advantages

Why use UFAD?

- Ease of Churn (Reconfiguration of Space Usage)
- Increased Indoor Air Quality (IAQ)
- Higher SA temperatures resulting in Energy Savings from Chiller/AHU operation
- Increased opportunity to utilize economizer cycle
- Potential for Increased Energy Savings, used in tandem with other Green technologies such as Overhead Chilled Beams/Sails providing supplemental heating or cooling
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UFAD Applications
Where UFAD is Applied? (Best Candidates)

- Dry or Non-Humid Climates
- Data Centers, IDF Rooms with extensive cabling
- Large Open Office Spaces where highly-reconfigurable floor space is desirable. (High Churn Rates Expected – *LEED CI Projects*)
- Spaces with High Ceilings such as Auditoriums, Atriums, & Lobby’s
- Universities, County Buildings, Television Stations, Network Television Office Space and Medical Office Buildings (Arguably)
Challenges for Cx UFAD: The HIT List

1. Overall Lack of familiarity with UFAD Systems
2. Under developed Specifications and Installation Details
3. Awareness of Design Best Practices & Control Strategies
4. Multi-disciplined Coordination Issues
5. Maintaining Cleanliness of Plenum during construction & substantial completion
6. Insufficient Training provided to Facilities Operational Staff
Challenges for Cx UFAD: The HIT List

1. Overall Lack of familiarity with UFAD Systems
   ○ General System Knowledge
   ○ Design Knowledge / Experience
   ○ Contractor Experience
   ○ Facilities Management Staff
Challenges for Cx UFAD: The HIT List

2. Under developed Specifications and Installation Details
   - Cohesive & Clear Direction from the Design Team
   - Development by Senior Level Team Members
   - Specifications to address intersections of trades
   - Architectural Installation Detail Development
   - MEP Installation Detail Development
   - Cross disciplinary reviews at Design Phase
Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Understanding Plenum Performance
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Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Use of Fan Coils & Reheat
Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Plenum SA temperatures
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Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Volume Control & Flow Turbulence
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Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Sound Control
Challenges for Cx UFAD: The HIT List

3. Awareness of Design Best Practices & Control Strategies
   ○ Leakage Control
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Challenges for Cx UFAD

- Controlling Plenum Pressure & Leakage
  - Gaskets around rim of floor tiles
  - Offset Configuration
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Challenges for Cx UFAD

- Controlling Plenum Pressure & Leakage

- Plenum Pressures are Typically 0.05”-0.10” WG
- Different Strategies can be used to control leakage
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Challenges for Cx UFAD

• Controlling Plenum Pressure & Leakage
Challenges for Cx UFAD: The HIT List

4. Multi-Discipline Coordination Issues
   ○ Coordination Basics (Some Assembly Required)
   ○ Team Work and Effort
   ○ Continued Coordination Support thru Acceptance
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Challenges for Cx UFAD

• Coordination with Furniture Layout
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Challenges for Cx UFAD

• Coordination of Structural Slab & UFAD
  Finished elevations at Entranceways
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Challenges for Cx UFAD: The HIT List

5. Maintaining Cleanliness of Plenum during construction & substantial completion
   ○ Understand Typical Challenges Encountered
   ○ Set reasonable expectations & Put them in writing
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Challenges for Cx UFAD: The HIT List

5. Maintaining Cleanliness of Plenum during construction & substantial completion
   ○ Develop a UFAD Cleanliness Plan
   ○ Understand Costs & Schedule Impacts
Challenges for Cx UFAD: The HIT List

5. Maintaining Cleanliness of Plenum during construction & substantial completion
   ○ Cleanliness Plan Should be commensurate with the operating environment requirements
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Challenges for Cx UFAD: The HIT List

6. Insufficient Training provided to Facilities Maintenance Staff (FMS)
   ○ Understanding & Conveying Maintenance impacts to the Owner
   ○ Developing meaningful operational troubleshooting and system maintenance procedures
   ○ Teaming with the Engineer of Record, Contractor & Manufacturer to yield better results
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Lessons Learned: Cx UFAD

• Every Picture has a story
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Challenges for Cx UFAD

• Installing the Raised Floor
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Challenges for Cx UFAD

- Installing & Sealing the Sub-Plenum
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Challenges for Cx UFAD

• Pressure Sensor & FCU Installation
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Challenges for Cx UFAD

• Plenum Supply Air with Motorized Damper
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Challenges for Cx UFAD

- Sealing Plenum at Envelope & Partitions
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Challenges for Cx UFAD

• Sealing Floor outlets in preparation for Pressure Testing of Plenum
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Challenges for Cx UFAD

• Pressure Testing of Plenum
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Challenges for Cx UFAD

• Pressure Testing of Plenum
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Challenges for Cx UFAD

- Pressure Testing of Plenum with Smoke Machine to identify & correct leakage
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Challenges for Cx UFAD

• Leakage found in common places
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Challenges for Cx UFAD

• Leaks found in Uncommon Places also!!!
  Leaks occur where permanently mounted fixtures/furniture penetrate walls.
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Challenges for Cx UFAD

• True effort required in removing / servicing floor tiles and equipment located in Plenum
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Challenges for Cx UFAD

• Occupants make use of Floor openings to drop trash, gum, and cigarette butts. Some post occupancy workers removed the flow baskets for additional trash disposal.
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Challenges for Cx UFAD

- Poor coordination or last minute design changes leads to additional flow baskets being cut in after substantial completion of the plenum creating debris which must be removed.
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Resources for Cx UFAD

• Guidelines & Technical publications
  - Facilities Standards for the Public Building Service: PBS P100 by U.S. General Services Administration
  - ASHRAE – Tech. Resource Group #7 for UFAD

• Studies
  ○ CBE UC Berkely – Center for the built environment
    - Designing acoustically successful work places: a case study assessment for the speech privacy and sound isolation of space having underfloor air distribution systems
Thank You

James D. Anderton, CxA, CPMP, LEED GA
Independent Commissioning Consulting

James.anderton@indcxc.com
www.indcxc.com