Underfloor Air Distribution Cost Analysis

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Overview

- **Goal**
  - Develop comprehensive first-cost and life-cycle cost (LCC) modeling tools for UFAD system cost analyses
- **GSA sponsored**
- **History/schedule**
  - Initial phase – Webcor (Eric Horn), Nash Hurley (Oct 2001)
  - Tate provides cost analysis software (Jul 2002)
  - GSA (Kevin Kampschroer) Project start (Oct 2002)
  - GSA review (May 2004)
  - Cost model workshop (Apr 2005)
  - Scheduled end (Sept 30, 2006)

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Significance

- **Model provides means for:**
  - Systematically determining cost differential between UFAD and overhead (OH) systems
  - Identifying cost drivers and magnitude of differences
  - Flexibility to evaluate impact of different design options
- **There are no comprehensive studies by independent parties; most cost comparisons are anecdotal and project specific**
- **"The devil is in the details"…**

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Progress

- **First cost model sensitivity analyses almost complete**
- **Life-cycle cost (LCC) model progressing**
  - Developing churn scenarios
  - Developing LCC computations methods

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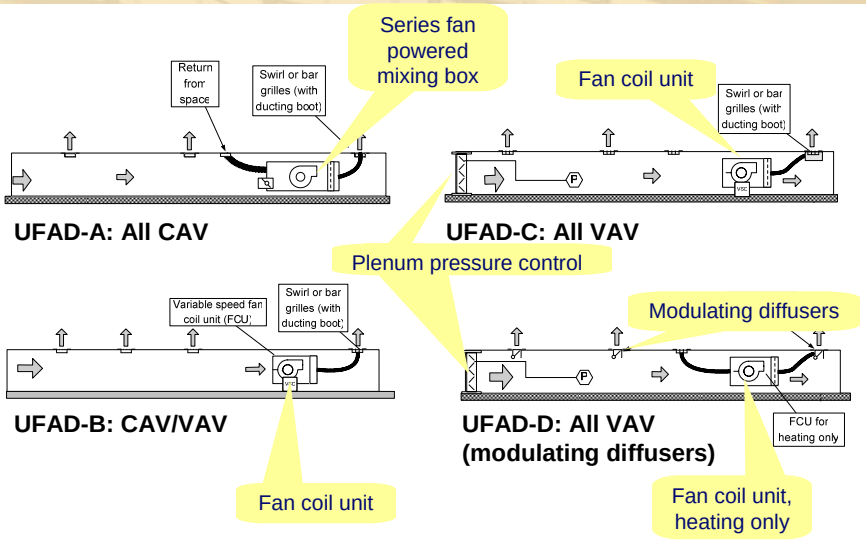
UFAD HVAC system alternatives



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Methods and assumptions

- **Sensitivity study – impact of design options**
  - ~25 parametric studies conducted to date
  - 11 integrated scenario variations
- **Sensitivity study assumptions**
  - Basic building configuration unchanged
  - "Medium" quality overhead system (OH) (lay-in diffusers, VAV/reheat, 16 interior zones)
  - Limit OH VAV boxes to 1500 CFM
  - 14" supply plenum for UFAD
  - Return ducting at terminal units only on UFAD D alternative
  - Equal airflow for overhead and UFAD
  - Non-powered furniture for UFAD

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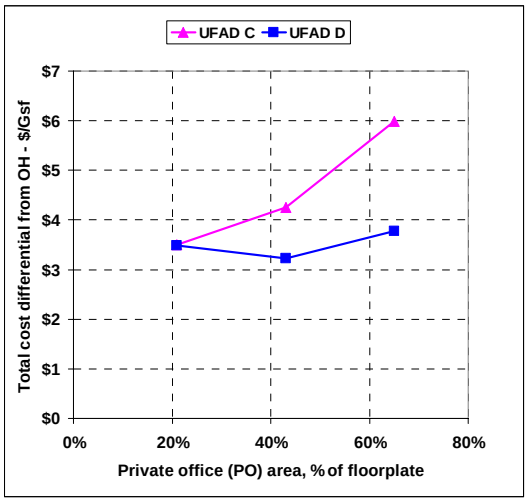
Open plan vs. private offices (PO) example

- **Total cost differential for equal OH, UFAD zoning**



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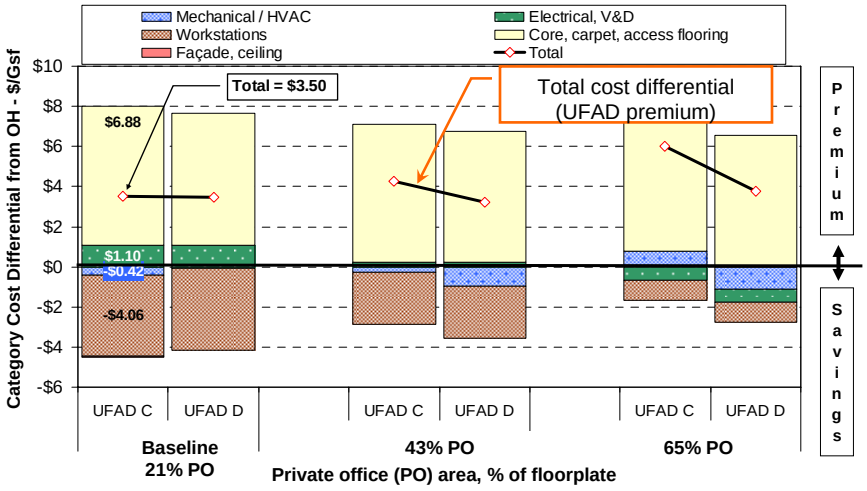
Open plan vs. private offices (PO)

- **Increase interior and perimeter zoning**



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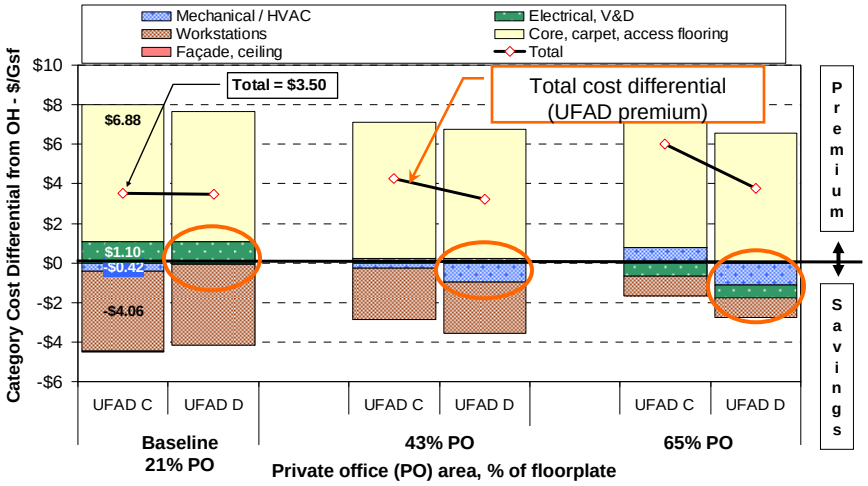
Open plan vs. private offices (PO)

- **Increase interior and perimeter zoning**
- **Electrical and HVAC differentials decrease…**



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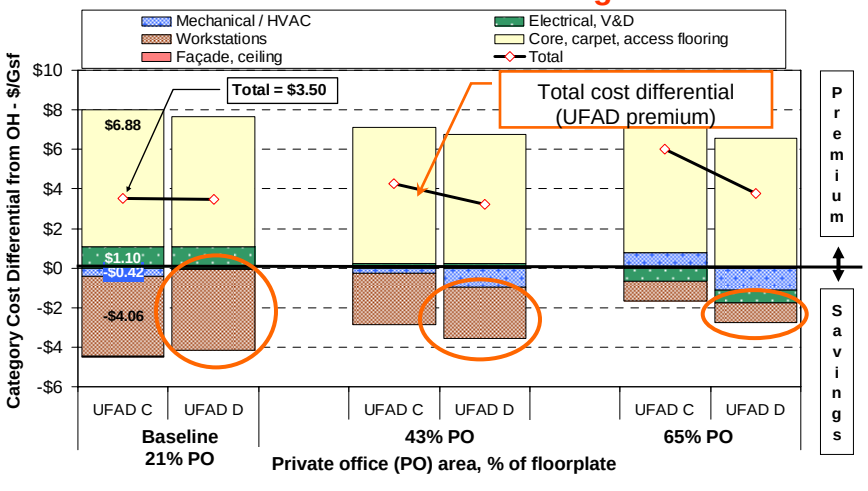
Open plan vs. private offices (PO)

- **Increase interior and perimeter zoning**
- **…while workstation furniture savings decrease**



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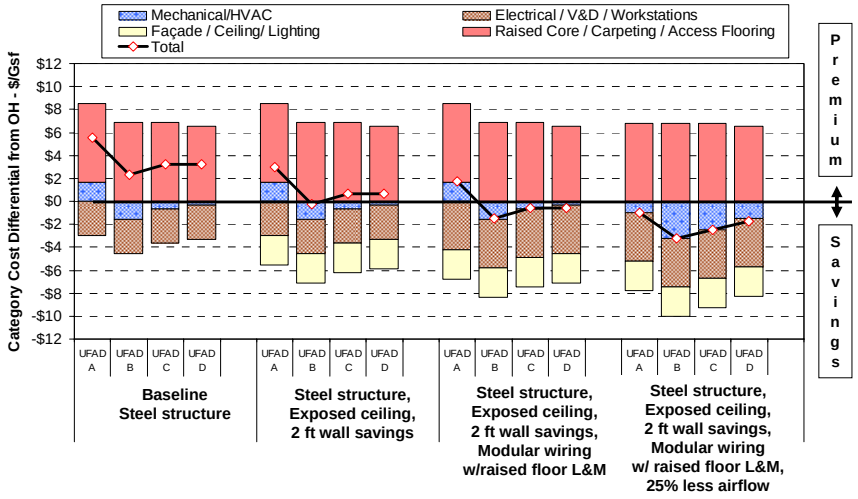
Integrated scenarios

- **Combined options**



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Additional findings

- **Floor height savings ~$1.65/Gsf/ft of wall height saved**
- **HVAC**
  - Airflow uncertainty (±30%), add/subtract ~$2/Gsf
  - Limit OH VAV boxes to 1500 cfm, add $2/Gsf to OH (lowers premium)
  - UFAD C vs UFAD D:
    - UFAD C, add return ducting to FCU at perimeter; add ~$2/Gsf
    - UFAD C, increase interior zones from 1 to 16; add ~$2/Gsf
- **Small effects, $1/Gsf or less**

Item	Change in baseline premium
Increase floorplates (20K to 50K)	lower
Increase % core or increase % raised core	higher
Delete mains ducting (direct to plenum)	lower
Increase wall thermal quality	lower

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Summary and conclusions

- **Based on study assumptions, overall UFAD C, D baseline premiums ~$3-6/Gsf**
  - Premium most affected by HVAC (airflow), wall height/quality, electrical, and workstation (WS) furniture assumptions
- **HVAC zoning**
  - Cost impact depends on system type & zoning assumptions (~$2/Gsf)
- **Electrical**
  - Modular wiring labor vs. material tradeoff yields no cost difference
  - Modular wiring might offer greater opportunities for lower labor rates
  - Non-powered furniture yields large advantage for UFAD WS costs
  - With powered furniture, UFAD electrical is cheaper than OH power pole

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Next steps

- **Complete first cost analysis**
  - Equivalent zoning
  - Identify ranges
  - Write report/journal article
- **Continue life-cycle cost (LCC) model development**
  - Churn
  - Maintenance and repair
  - Energy
  - Tax savings
- **Seeking partner assistance with LCC**

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