


## UFAD EnergyPlus Model: Room Air Stratification (RAS) Testing and Modeling



**CBE**  
**Tom Webster, Fred Bauman,**  
**Darryl Dickerhoff, Allan Daly,**  
**Wolfgang Lukaschek**

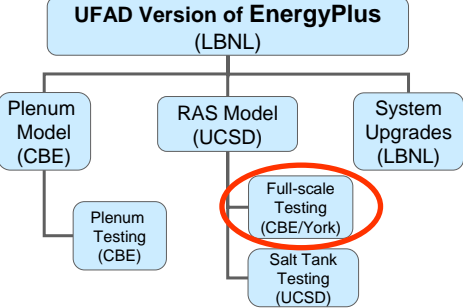
York International  
**Jack Geortner,**  
**Mike Zamalis, Luke Dunton**

UCSD  
**Paul Linden, Anna Liu**

CENTER FOR THE BUILT ENVIRONMENT   APRIL 2005

## Overview

- **Progress**
  - Completed lab testing
  - Completed database
  - Perimeter zone report
  - Continued data analysis
- **Interior Test Results**
  - Study 1: Diffuser throw height
  - Study 2: Load variation
  - Study 3: Floor leakage

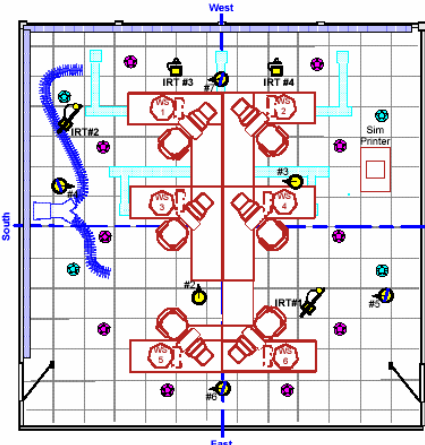


```
graph TD; Root["UFAD Version of EnergyPlus (LBNL)"] --> Plenum["Plenum Model (CBE)"]; Root --> RAS["RAS Model (UCSD)"]; Root --> System["System Upgrades (LBNL)"]; Plenum --> PlenumTest["Plenum Testing (CBE)"]; RAS --> FullScale["Full-scale Testing (CBE/York)"]; RAS --> SaltTank["Salt Tank Testing (UCSD)"]; style FullScale stroke:#f00,stroke-width:2px
```

CENTER FOR THE BUILT ENVIRONMENT   APRIL 2005

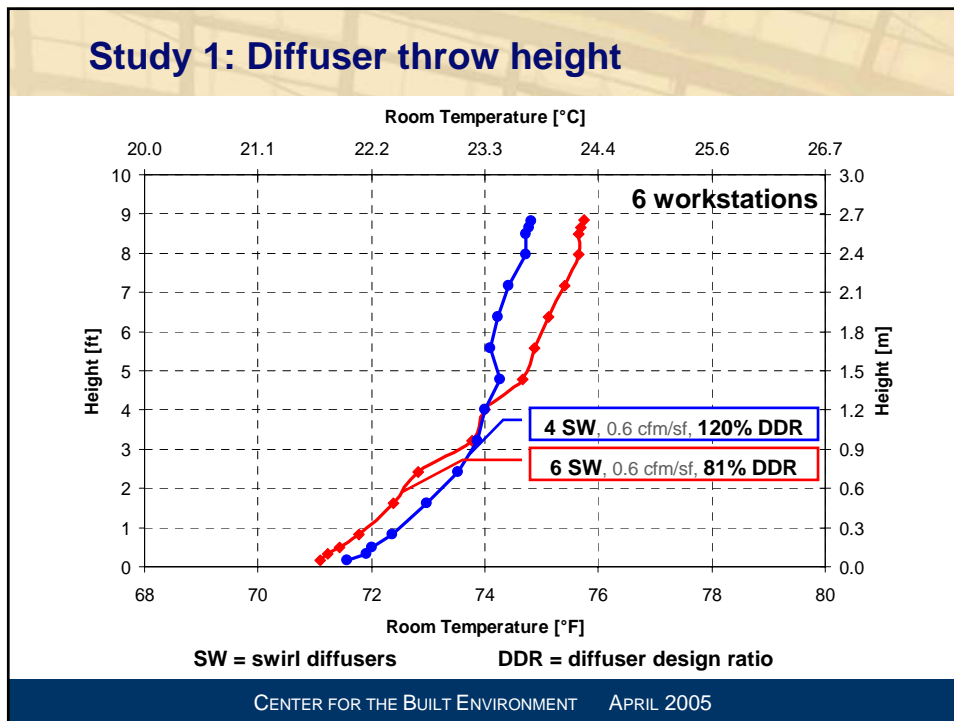
### Study 1: Diffuser throw height

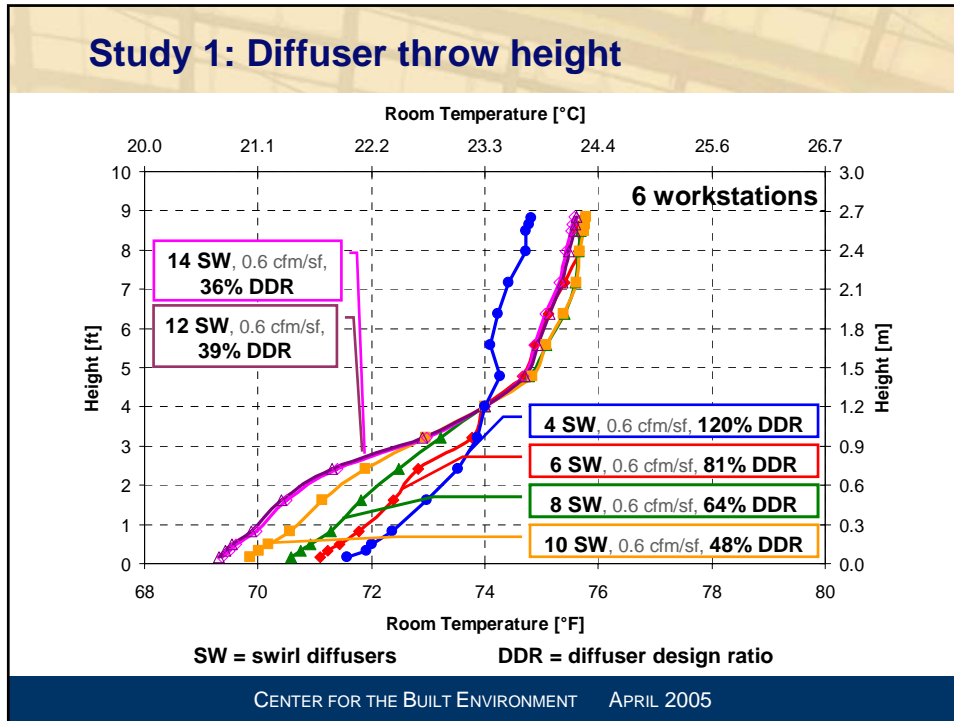
- **Purpose**
  - Impact on RAS of diffuser throw height
- **Methodology**
  - Krantz swirl diffusers
  - Constant internal load (6 workstations)
  - Room temperature setting 74°F
  - Varied number of diffusers from 4 to 14
  - Swirl diffuser throw height indicator – DDR



$$DDR = \frac{\text{actual airflow}}{\text{diffuser design airflow}}$$

CENTER FOR THE BUILT ENVIRONMENT    APRIL 2005

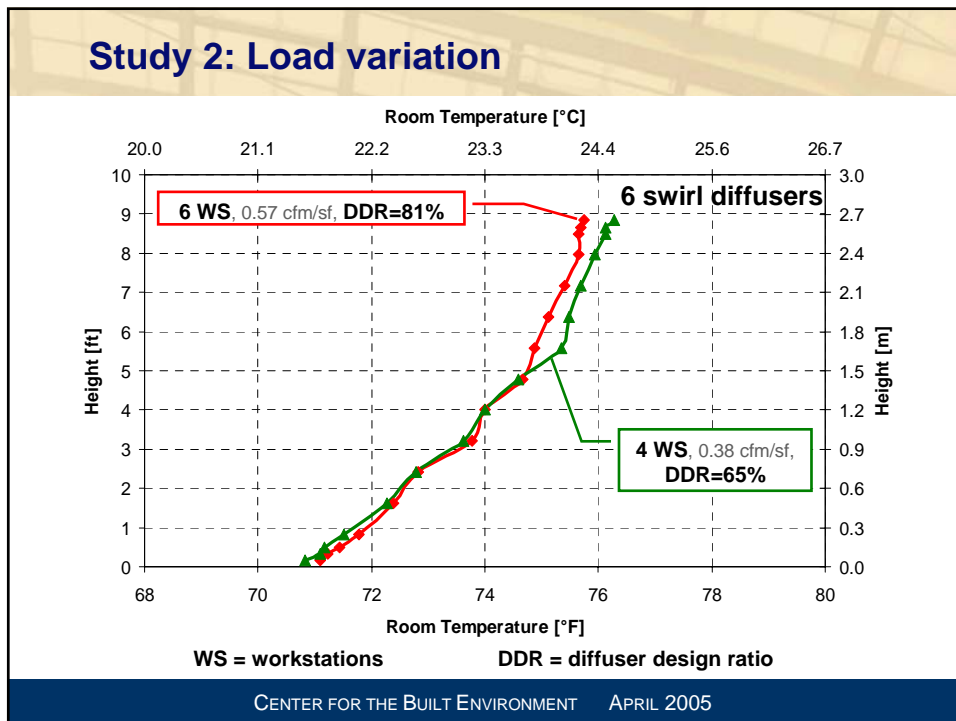
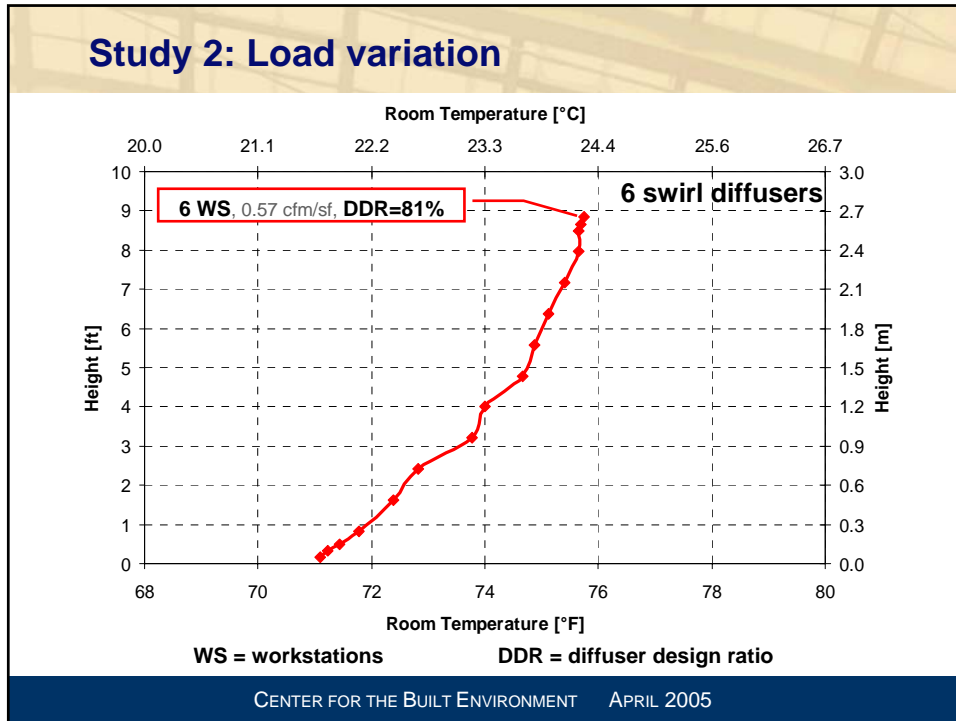


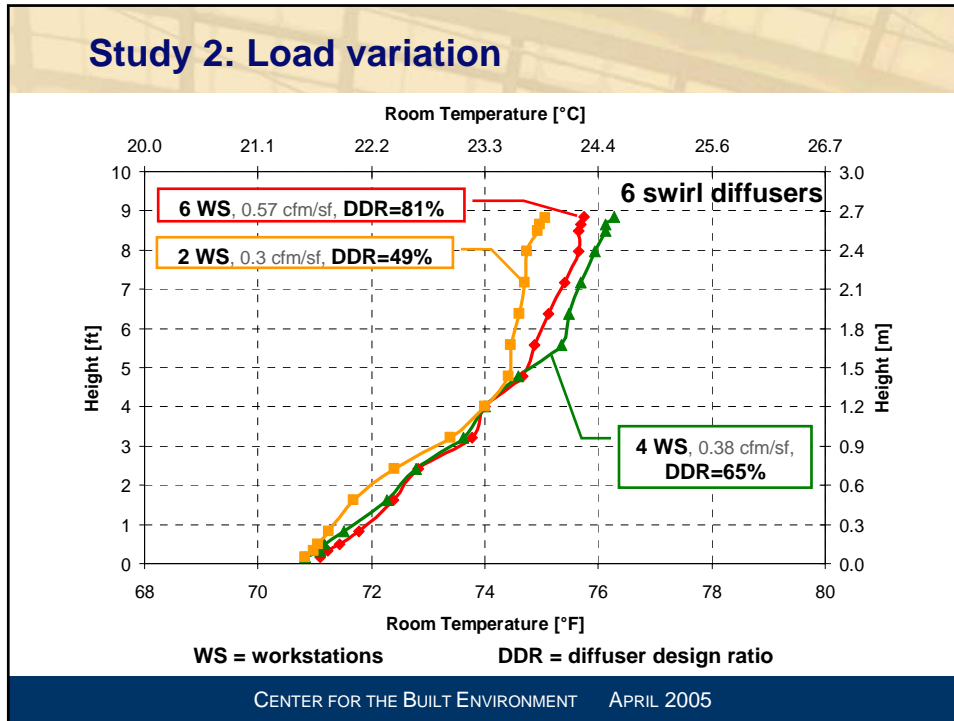


### Study 2: Load variation

- **Purpose**
  - Impact on RAS of different internal loads
- **Methodology**
  - 6 Krantz swirl diffusers
  - Variation of load from 6 workstations to 2 workstations
  - Room temperature setting 74°F
  - Airflow changes in proportion to load


CENTER FOR THE BUILT ENVIRONMENT    APRIL 2005



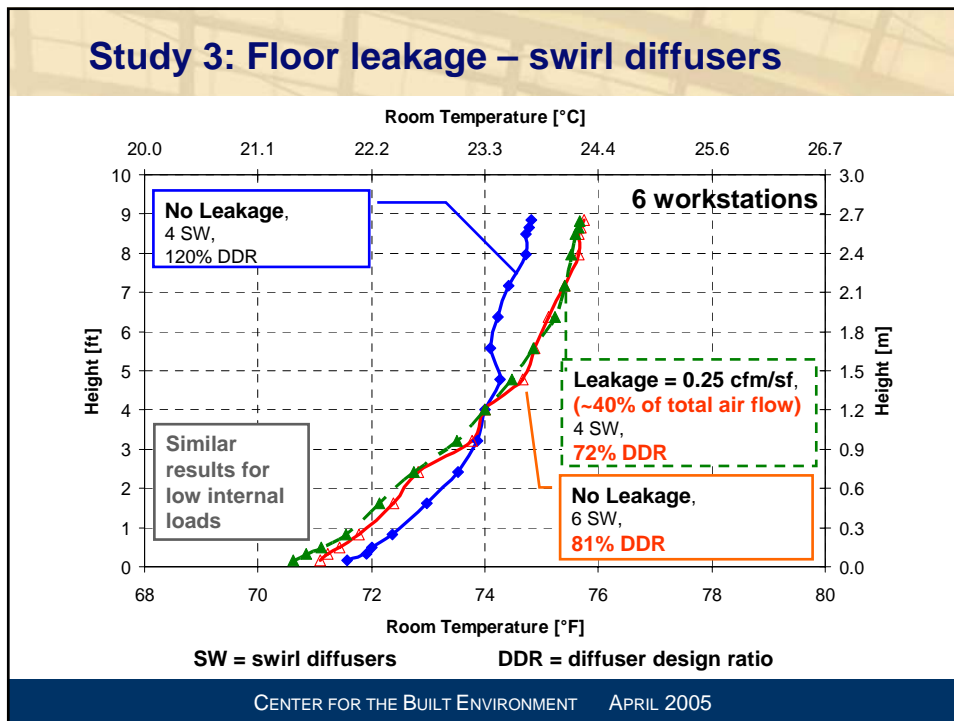
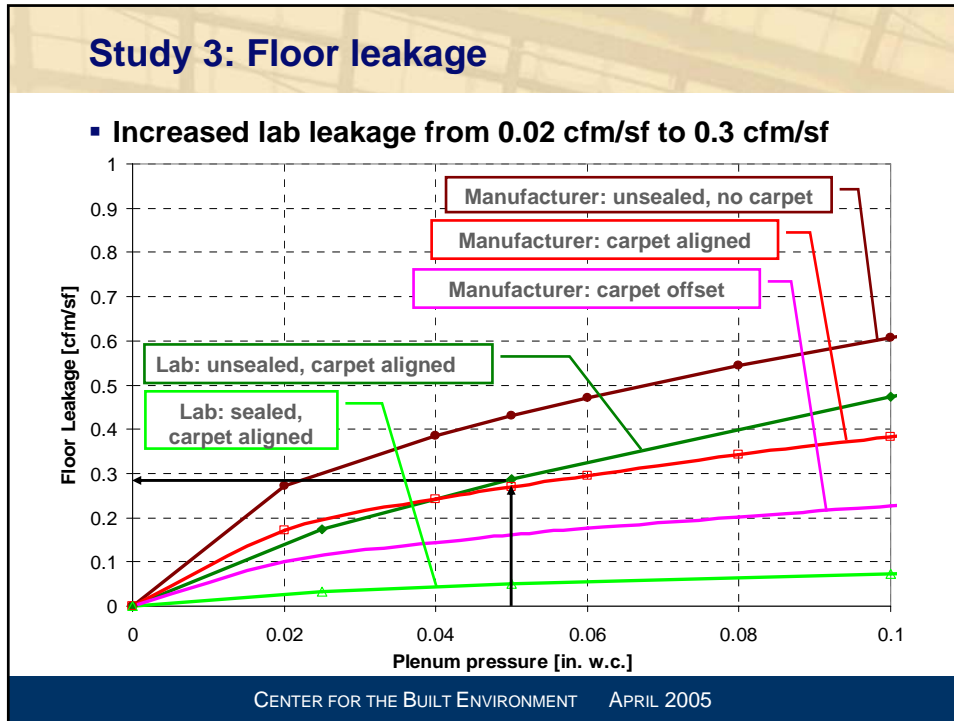


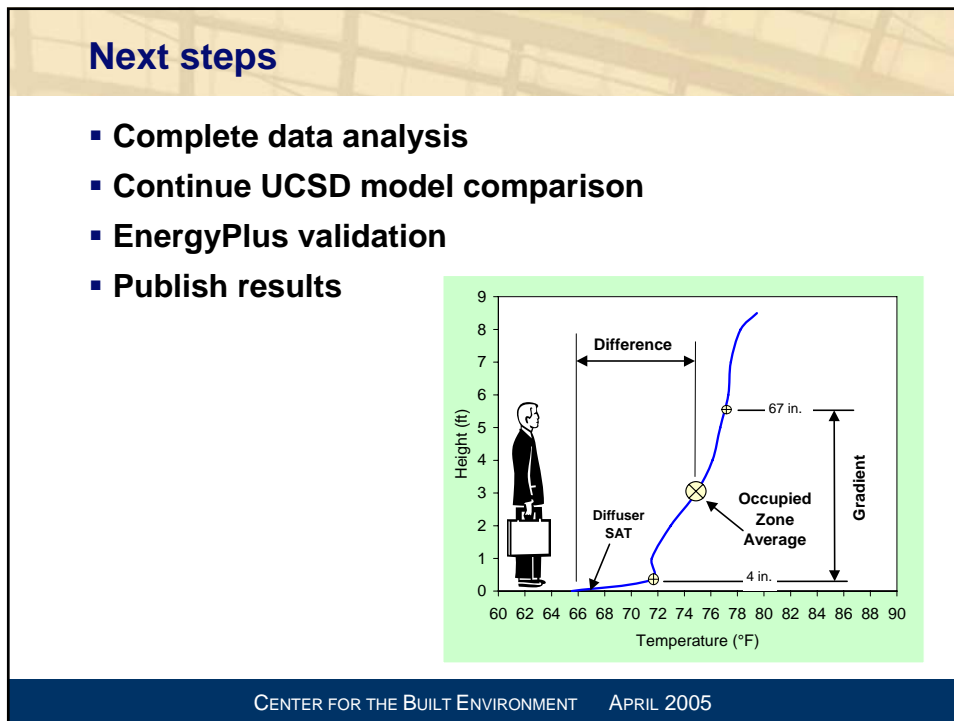
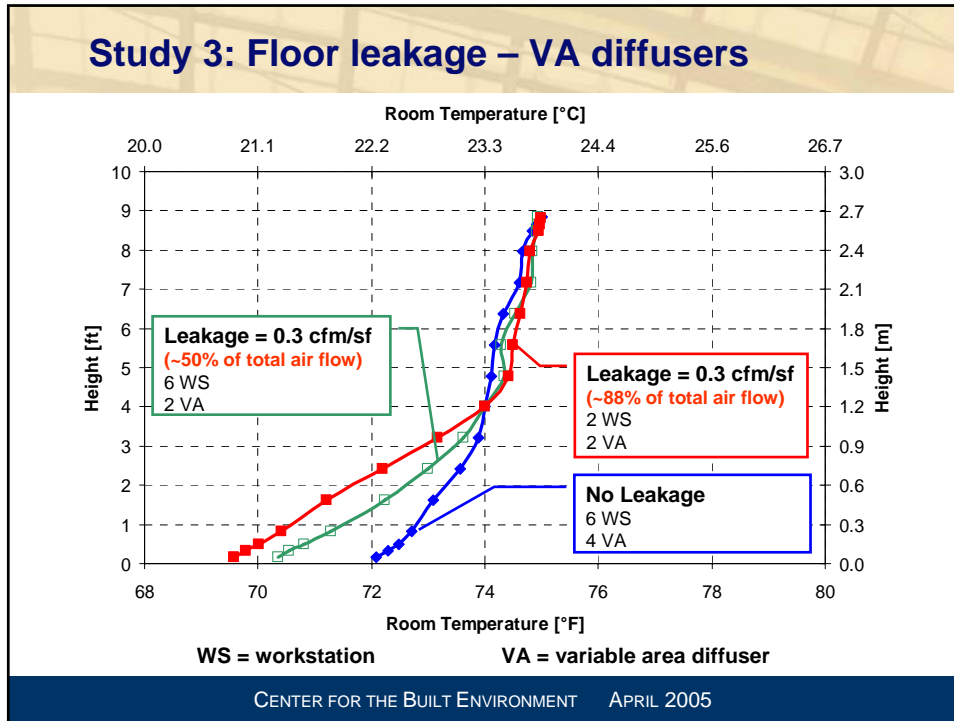
### Study 3: Floor leakage

- **Purpose**
  - Impact on RAS of floor leakage
- **Methodology**
  - Unsealed gaps between floor panels
  - Carpet tiles aligned with floor panels
- **Diffuser Characteristics**
  - Swirl diffusers
    - Constant outlet area (effective area)
    - Variable plenum pressure with airflow requirements
  - Variable area (VA) diffusers
    - Variable outlet area (effective area)
    - Constant plenum pressure



CENTER FOR THE BUILT ENVIRONMENT    APRIL 2005





## Questions?

**Tom Webster**

[twebster@berkeley.edu](mailto:twebster@berkeley.edu)

**Fred Bauman**

[fbauman@berkeley.edu](mailto:fbauman@berkeley.edu)

**Wolfgang Lukaschek**

[wolfgang.lukaschek@aon.at](mailto:wolfgang.lukaschek@aon.at)

CENTER FOR THE BUILT ENVIRONMENT    APRIL 2005