



***Please be courteous to our speakers***

***Turn off all cell phones  
and***

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June 2-5, 2002

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An Energy Efficiency Workshop & Exposition

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Palm Springs, California

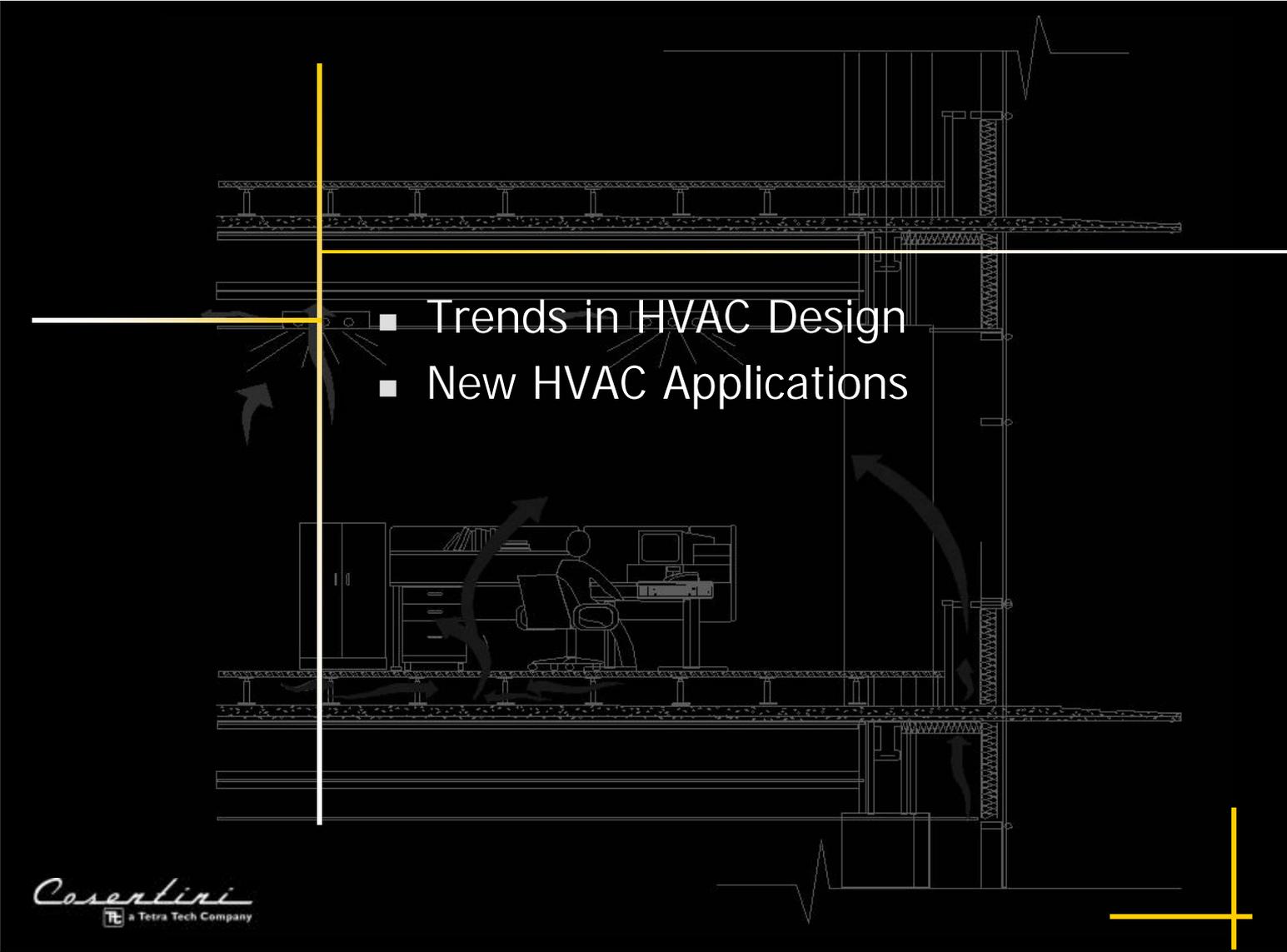
## ***Underfloor Power & Air***

*Douglas Mass, PE*

*President, Cosentini Associates*

June 2-5, 2002

[www.energy2002.ee.doe.gov](http://www.energy2002.ee.doe.gov)

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- The image is a technical architectural cross-section of a building, rendered in white lines on a black background. It shows multiple floors with various HVAC components such as ductwork, coils, and fans. A central room contains a desk with a computer and a person sitting at it. Large, curved arrows indicate the direction of air flow throughout the space. A vertical yellow line and a horizontal white line intersect in the middle-left area, with several arrows pointing towards the central text. In the bottom right corner, there is a yellow L-shaped graphic element.
- Trends in HVAC Design
  - New HVAC Applications

# Changes in HVAC Design Criteria

- Cooling Capacity – 5-6 Watts/sq ft
  - Increased Loads
  - Higher Population Density
  - More Equipment
- Overtime Air Conditioning
  - Reduced Overtime Cooling Cost
  - More Overtime Cooling Needs
  - Flex Hours
- Supplementary and 24 Hour Cooling
  - Special Cooling Needs for Technology Rooms, Conference Rooms, High Load Areas

# Human Factor

- More Fresh Air
  - Recognition of Greener Buildings (LEED)
  - Accommodate Excess Air for Conference/Assembly Areas
  - Accommodate Outside Air During Overtime Hours
- Task Cooling
  - Control One's Own Environment

# Recognition of Changes in Technology/Flexibility

- Changes in Technology = Changes in Load Distribution
- Development of Pathways to Deal with Load Migration
- Modifications to Physical Work Environment
- Fast, Low Cost Changes

# Sustainable Design (Green Buildings)

Being Promoted by Federal & State Governments  
and Private Corporations

- Environment
- Energy
- Materials
- Reuse of Resources
- Renewables
- Future Flexibility

# LEED Building Rating Scale

<u>Category</u>	<u>Maximum Points</u>
Sustainable Sites	14
Water Efficiency	5
Energy & Atmosphere	17
Materials & Resources	13
Indoor Environmental Quality	15
<u>Total Core LEED Rating System Points</u>	<u>64</u>
<u>Innovation and Process Points</u>	<u>5</u>
<u>Total Points Possible</u>	<u>69</u>

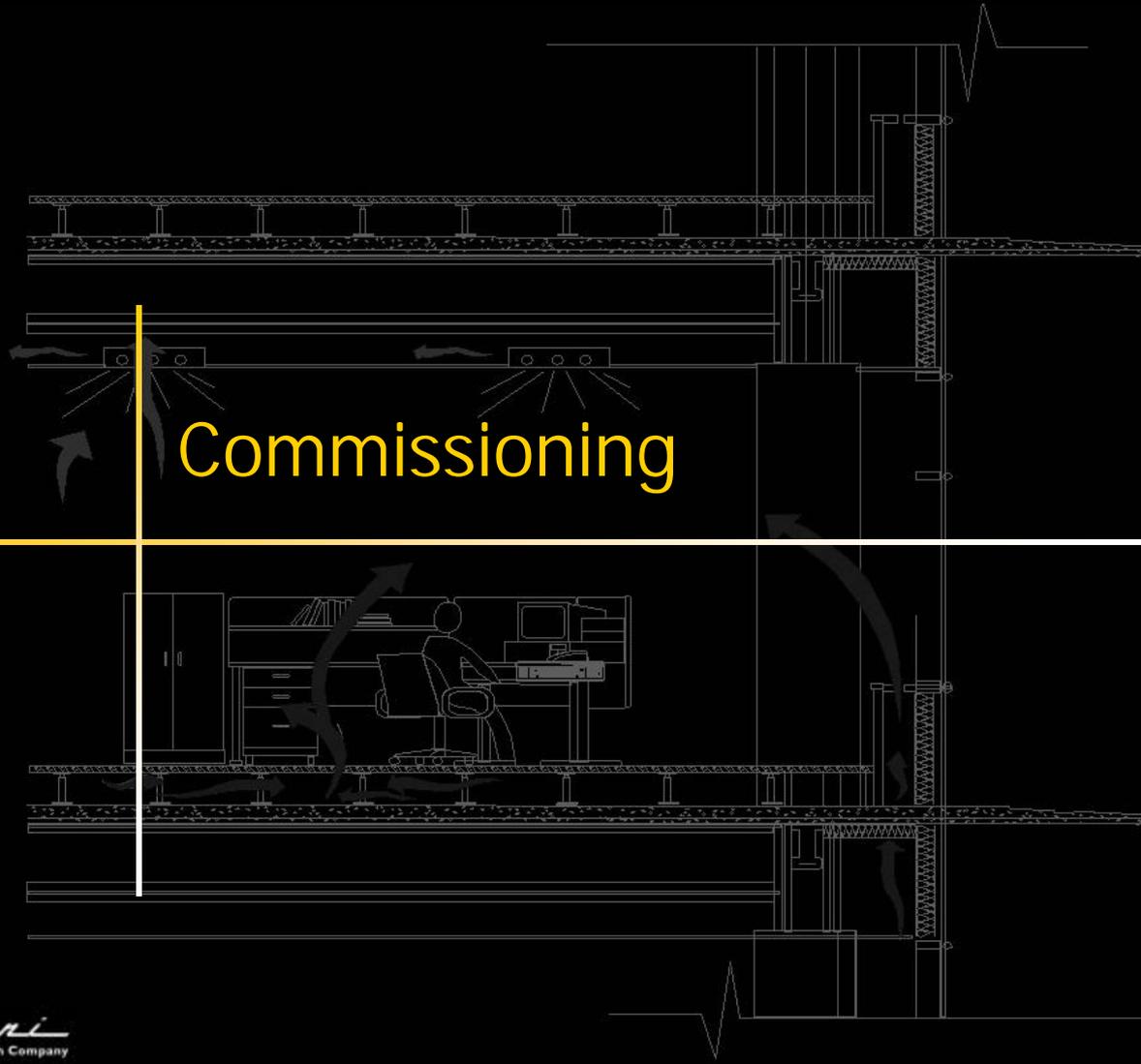
# Innovative Strategies for Sustainable Design

- Fuel Cells
- Dynamic Exterior Wall Systems
- Passive Single Wall Systems
- Underfloor Air Distribution System
- Natural Ventilation
- Wind Power
- Solar Power
- Geothermal
- Peak Shaving (Plant Efficiency)
- Cogeneration
- Office Equipment Power Conservation
- Photovoltaic
- Hybrid Systems

# Building Systems Vulnerability

- Security – Physical, & Electronic
- Security of Infrastructure – Power, data, fuel supplies, etc.
- Security of Water Supply including house tanks
- Security of Air Intakes, Roofs, Machine Rooms
- Special Air Filtration – HEPA, Chemical, Biological Mitigation
- Emergency Response Plans
  - Shut Down of Air Systems
  - Purge Air in Building
  - Response to an Event inside or outside of building

# Commissioning



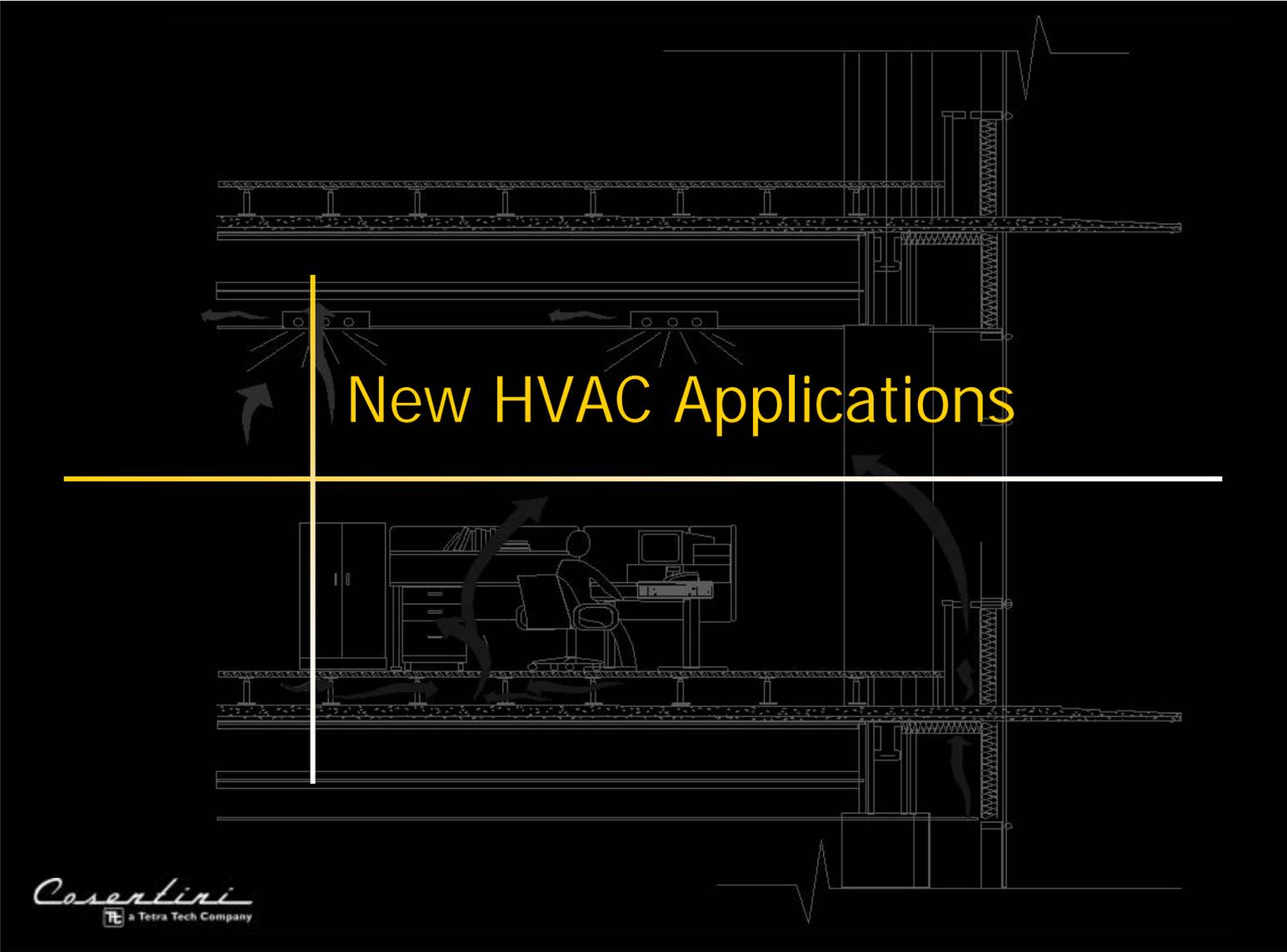


## Commissioning Goals

- Communication Between Designer & Operator
  - To deliver a fully functional and verified HVAC system that complies with the design intent.
  - To provide adequate training to building personnel that will allow them to properly maintain and operate these systems.
  - To turn over proper documentation showing how the system was designed, installed and intended to operate.

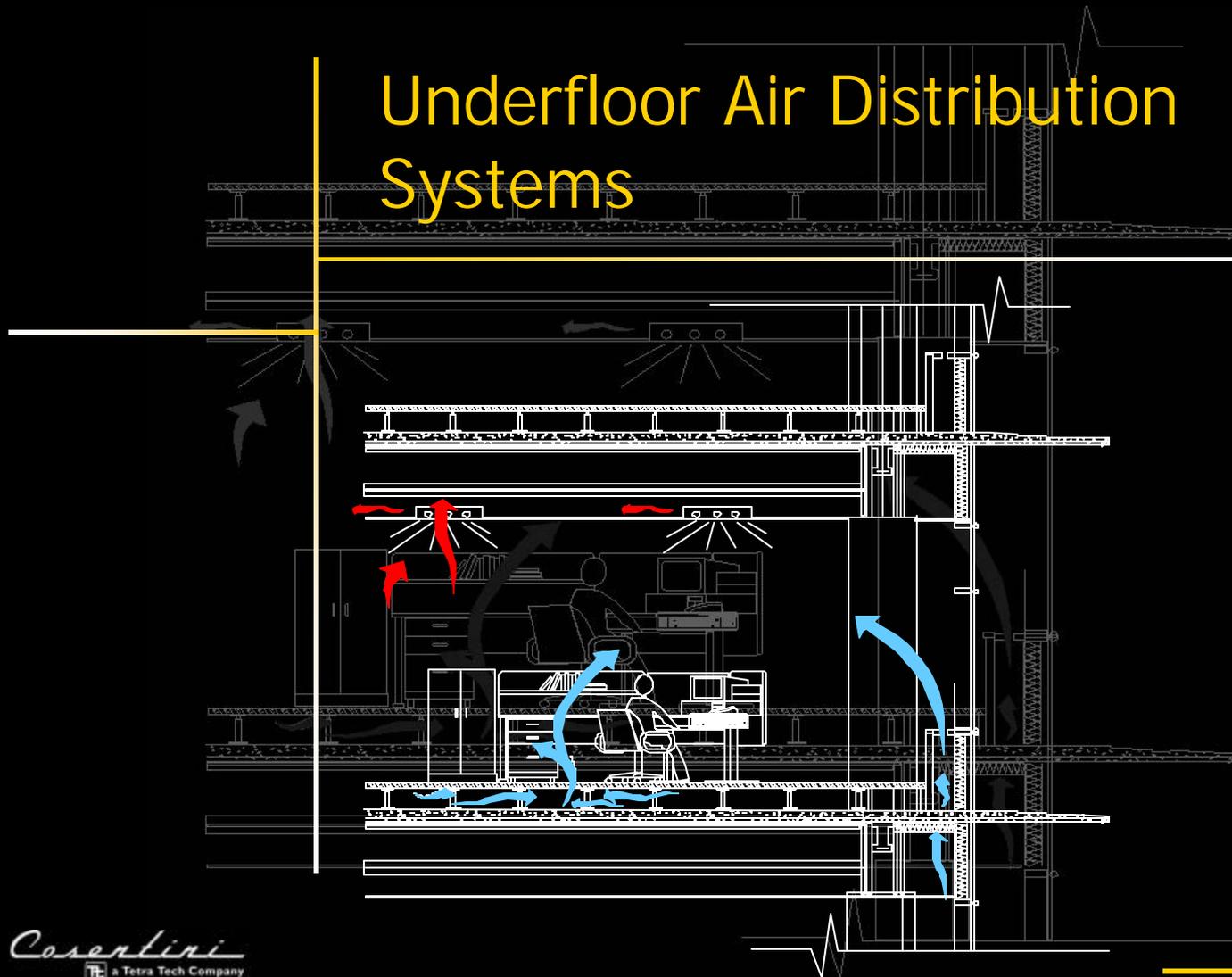
## Benefits

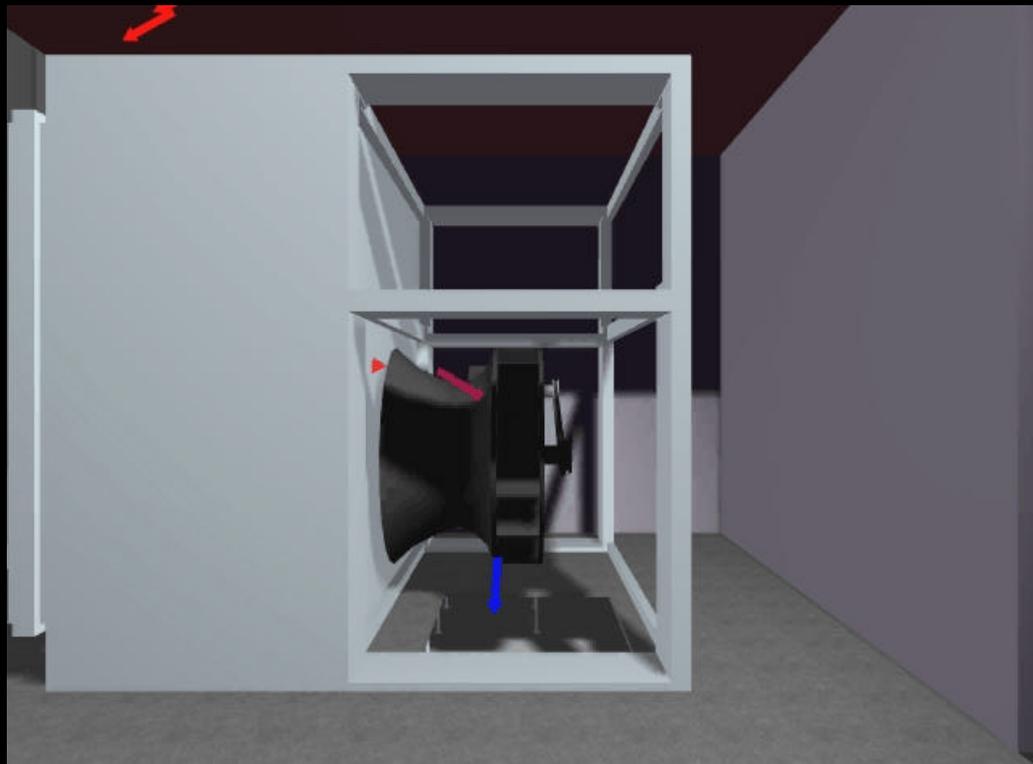
- Training and improved operator knowledge
- System performance
- Reduced downtime
- Improved IAQ and comfort conditions for occupants
- Reduced number of deficiencies during construction
- Properly documented and catalogued records, as-built drawings and O&M manuals.
- Assures Operating Cost Savings

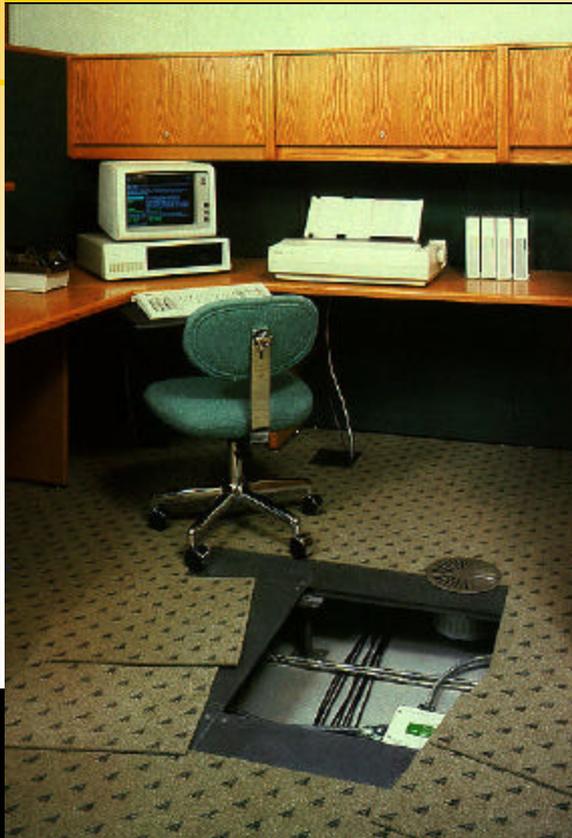


# New HVAC Applications

# Underfloor Air Distribution Systems

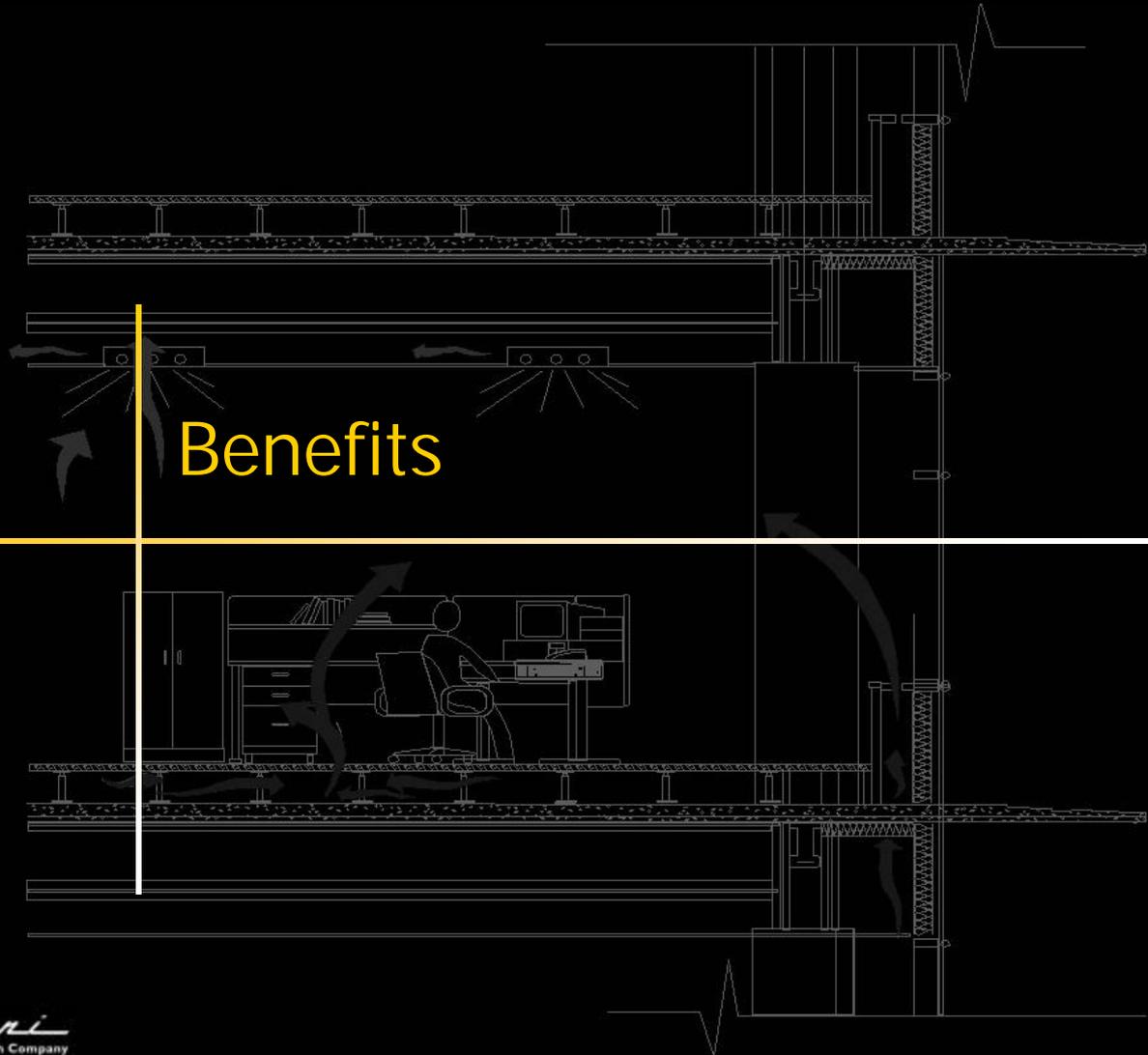






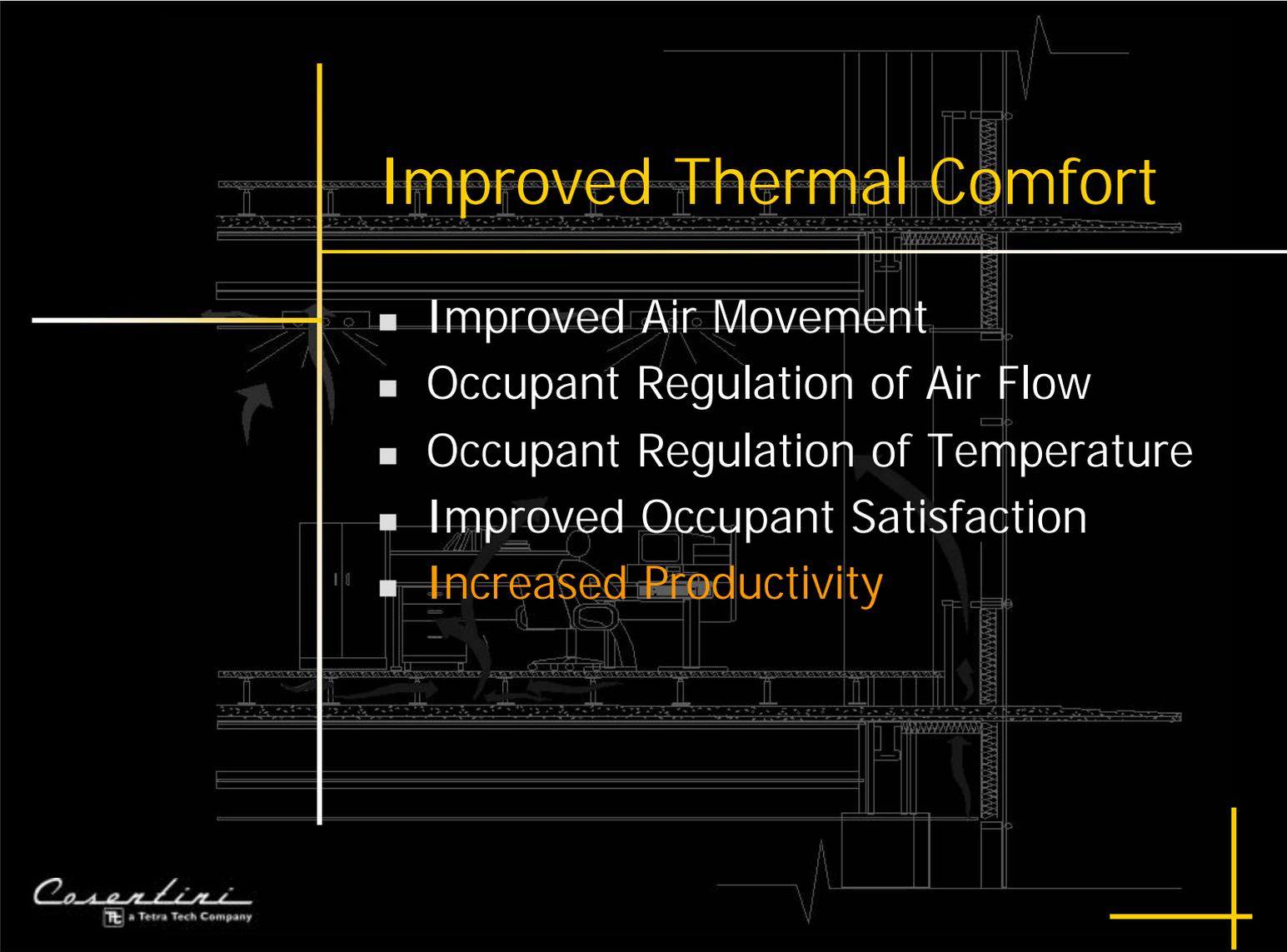
*Cosentini*  
a Tetra Tech Company



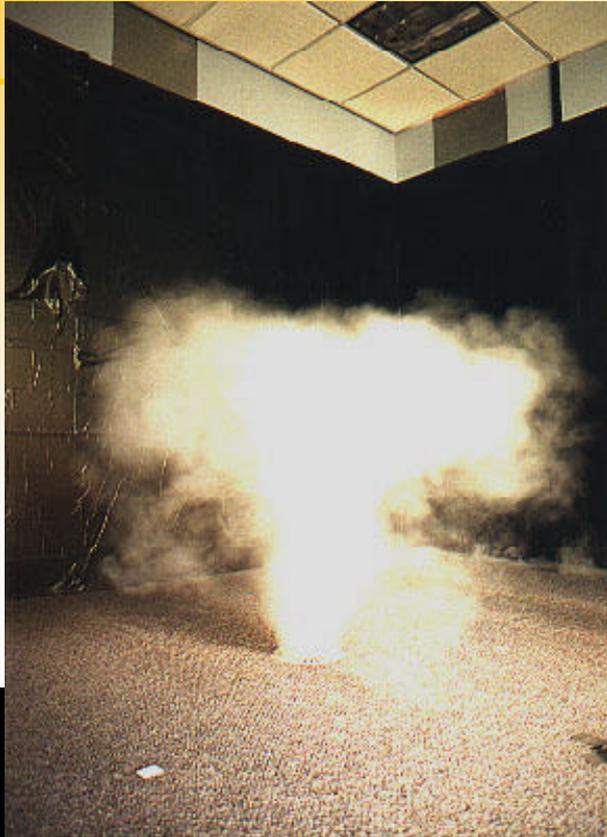


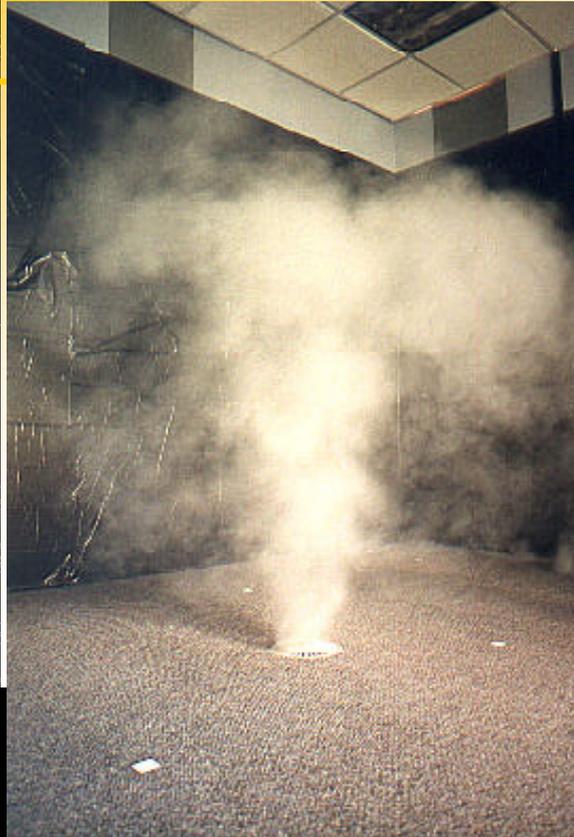
# Benefits

# Improved Thermal Comfort

A technical cross-section diagram of a building facade and interior. The diagram shows a multi-layered wall with various insulation and structural components. On the interior side, there is a desk with a computer monitor and a person sitting at it. Arrows indicate air flow patterns, showing air moving from the interior towards the wall and back into the room. The diagram is overlaid with a grid of white and yellow lines.

- Improved Air Movement
- Occupant Regulation of Air Flow
- Occupant Regulation of Temperature
- Improved Occupant Satisfaction
- Increased Productivity





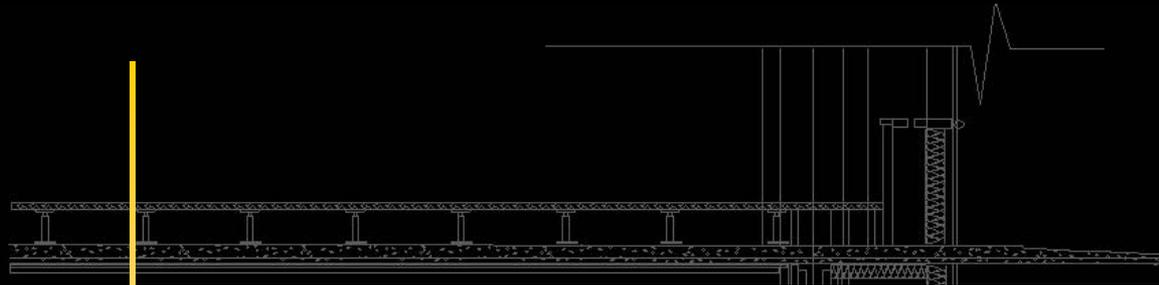
# Indoor Air Quality

A technical cross-section diagram of a building's air handling system. The diagram shows a multi-story building with a central air handling unit (AHU) and ductwork. A person is shown sitting at a desk with a computer monitor, representing an office environment. The diagram illustrates the flow of air through the system, with arrows indicating the direction of air movement. The background is black, and the diagram lines are white. A yellow vertical line is on the left, and a yellow horizontal line is at the top, intersecting at a yellow crosshair. A white horizontal line is also present, intersecting the yellow vertical line.

- Increased Ventilation Effectiveness (Fresh Air)
- Cleaner Environment
- Easy Access for Maintenance of Air Stream
- Additional Air-Side Free Cooling Hours

# System Flexibility

- Ability to Relocate People and Equipment Cost Effectively and Quickly
- Perfect Application for Teaming Concept
- Ability for Task Cooling
- Owens Corning Saved \$500,000 the First Year



*Cosentini*  
a Tetra Tech Company

# Energy/Operating Costs

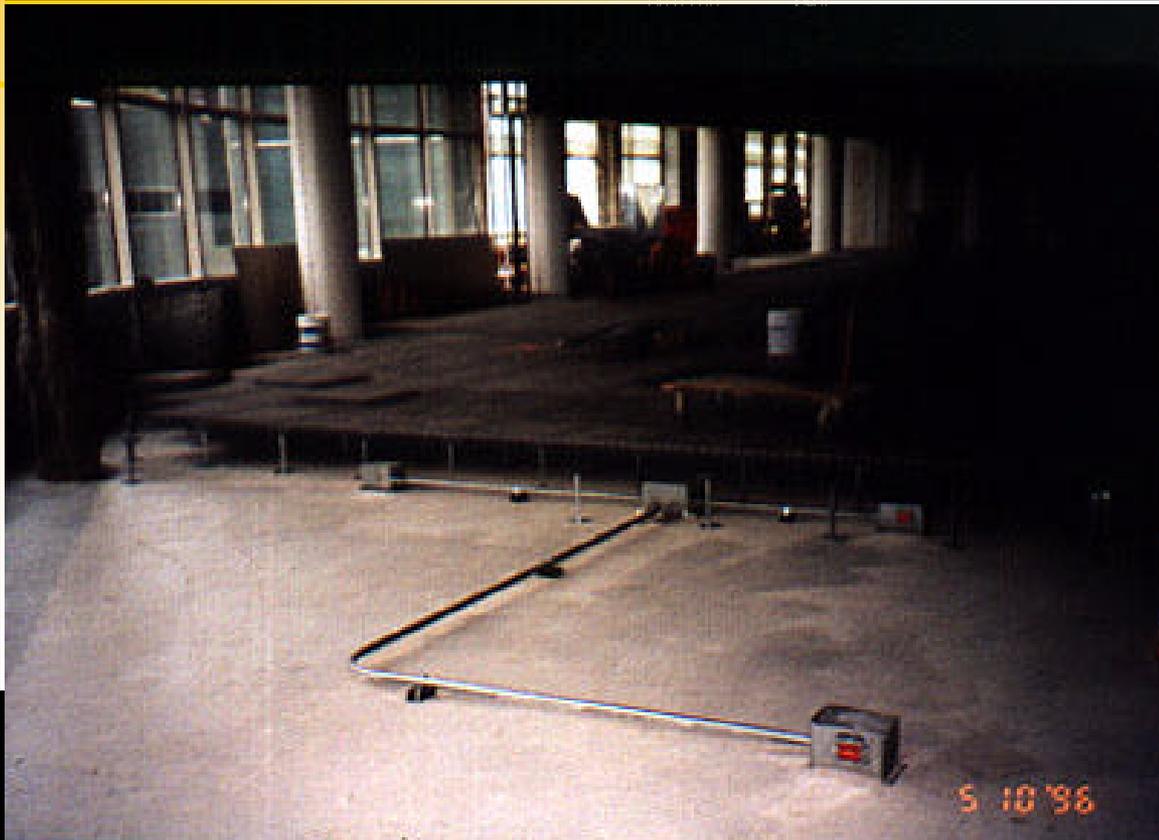
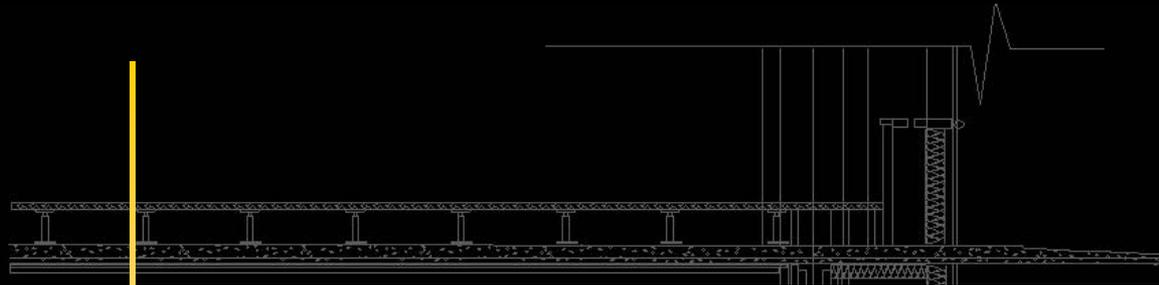
- Reduced Energy Usage
  - Only Cool where People/Equipment are Located
  - Only Condition Heat Load in Comfort Zone
  - Higher Supply Air Temperature
  - More Free Cooling Hours
  - Reduced Refrigeration Energy
  - Lower Overall Air Circulation than Standard
  - Lower Fan Energy
- Lower Maintenance Costs (Less Devices to Maintain)

# Life Cycle Building Cost

- Reduced Life Cycle Building Cost
- Lower Cost to Make Space Changes
- Reduced System Maintenance
- Lower Energy Costs

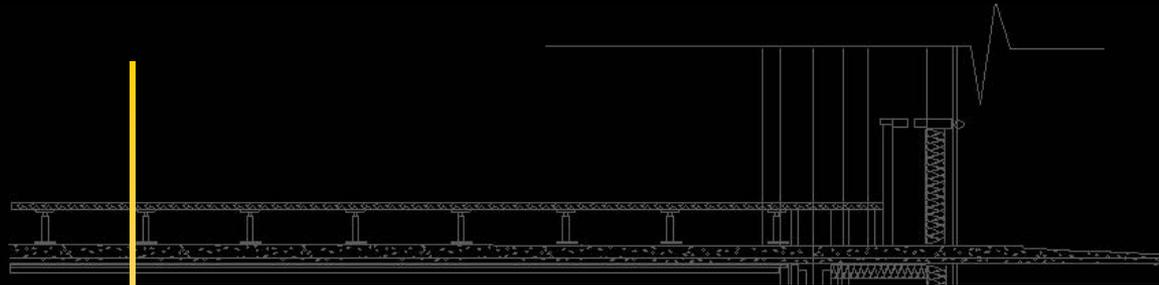
## Additional Benefits

- Electro-Mechanical System Integration
- Modular Power Cabling Distribution
- Modular Data Telecommunications Distribution
- Integration with Furniture/Partition Systems

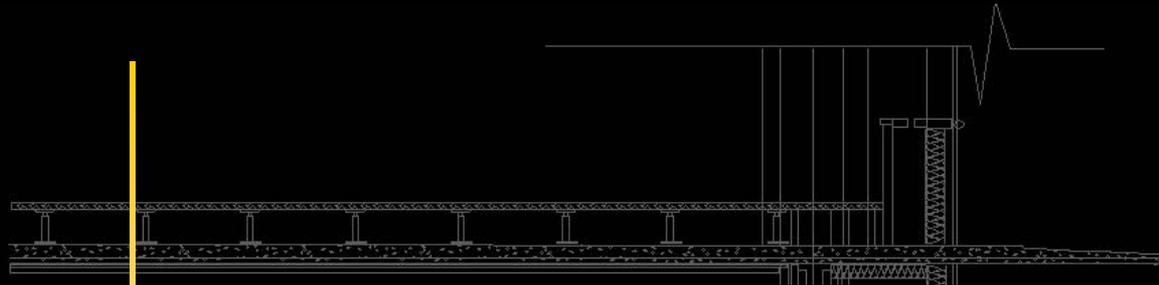


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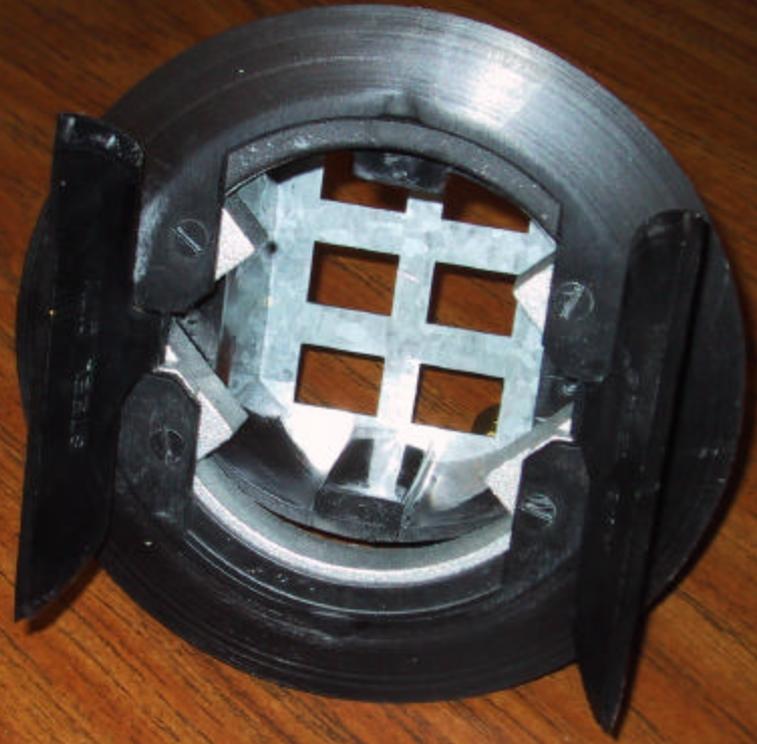
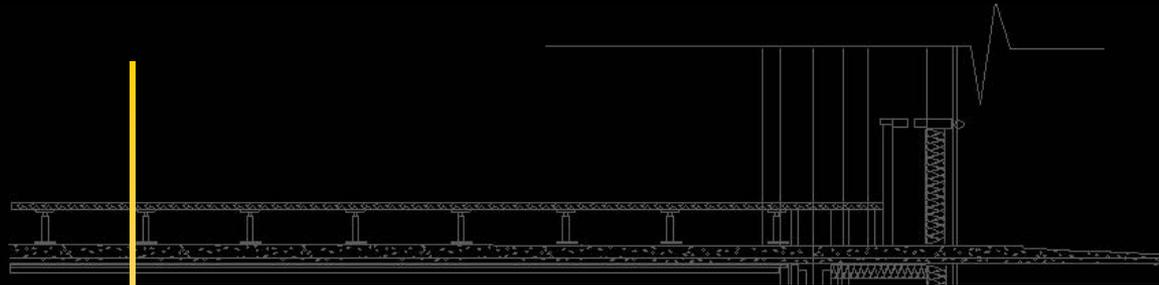
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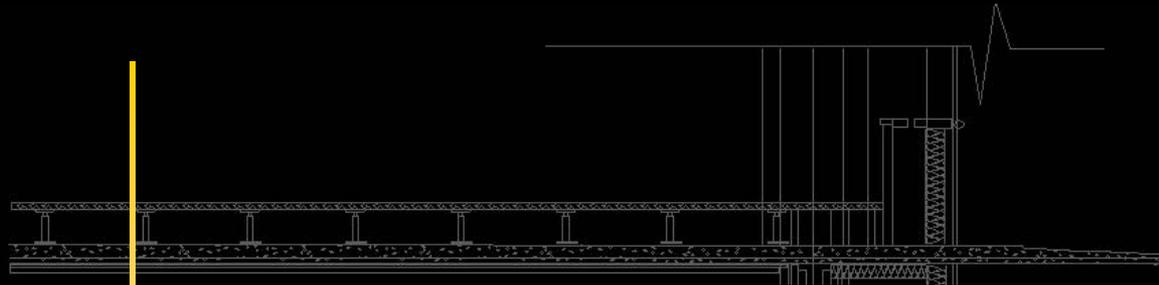
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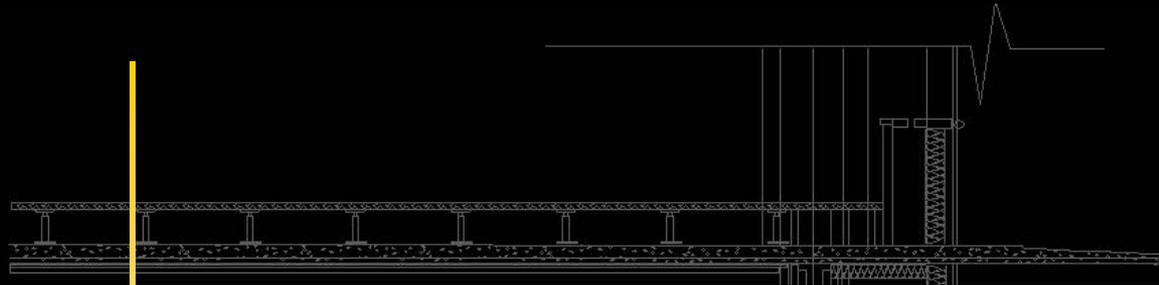


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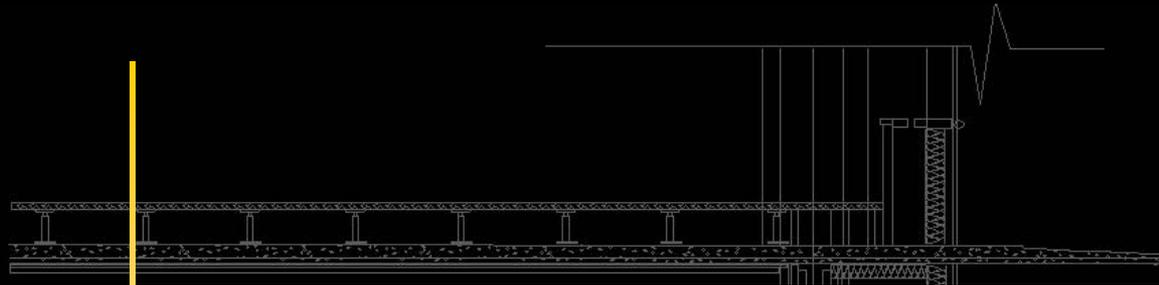


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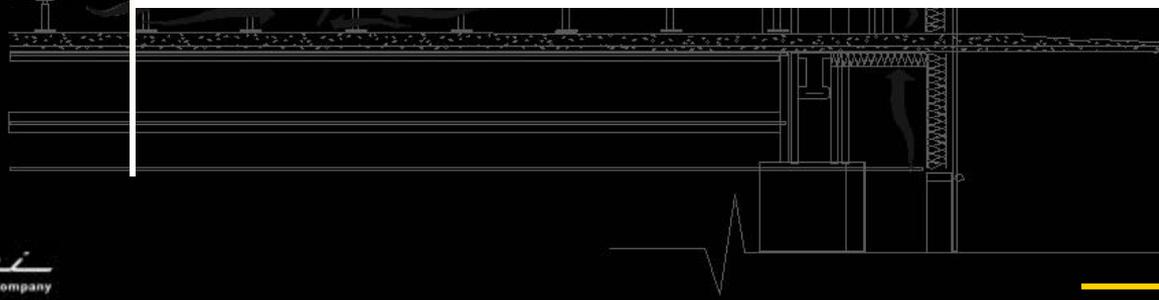
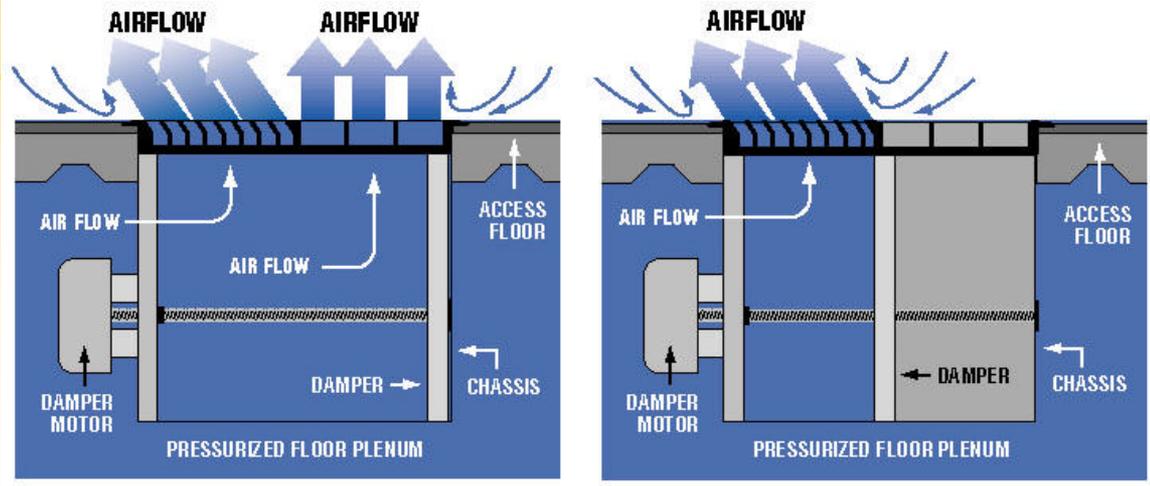
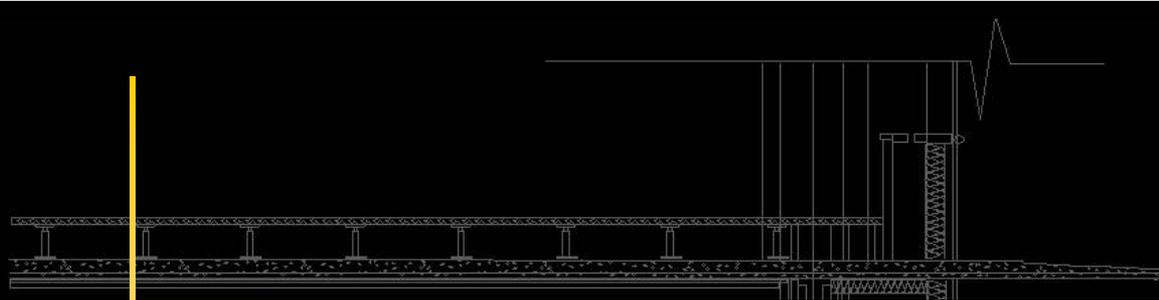




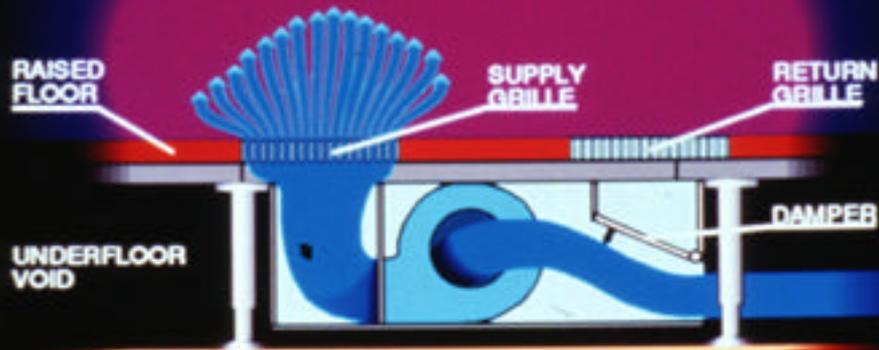
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# FTU Operation Diagram Cooling/Heating Mode



# FTU Operation Diagram Recirculation Mode



# Design Objectives

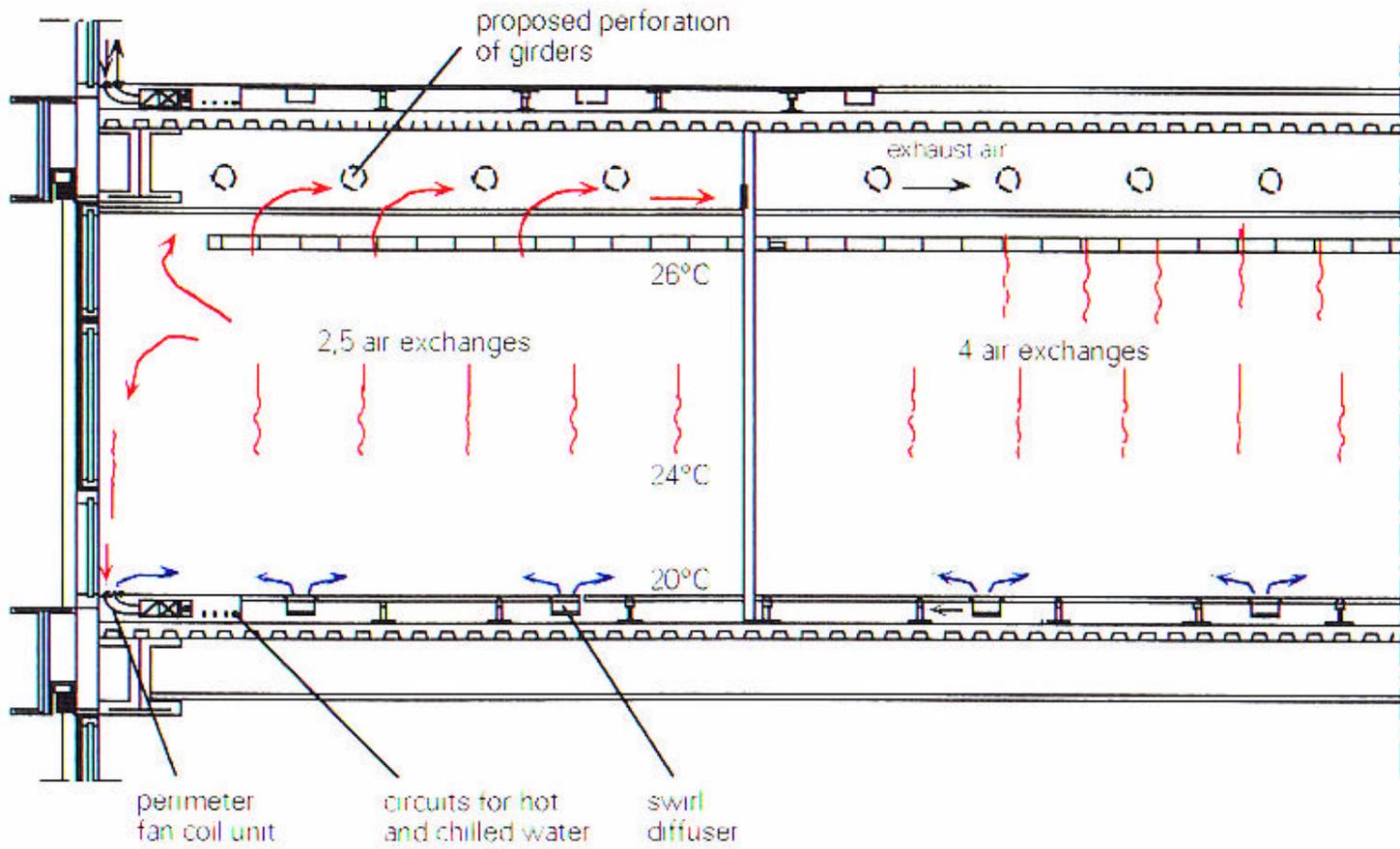
- Space requirements
  - Reduced Ceiling Plenum Requirements for Return Air, Sprinkler and Lighting
  - If No Ceiling, Need to Insure Heat and Contaminants are Above Occupied Zone
  - If No Ceiling and Private Office, Need to Insure Adequate Induction for Return Air
  - Raised Floor Height (10-12 Inch)

# Perimeter Heating/Cooling Options

## ■ Perimeter Heating/Cooling Strategies

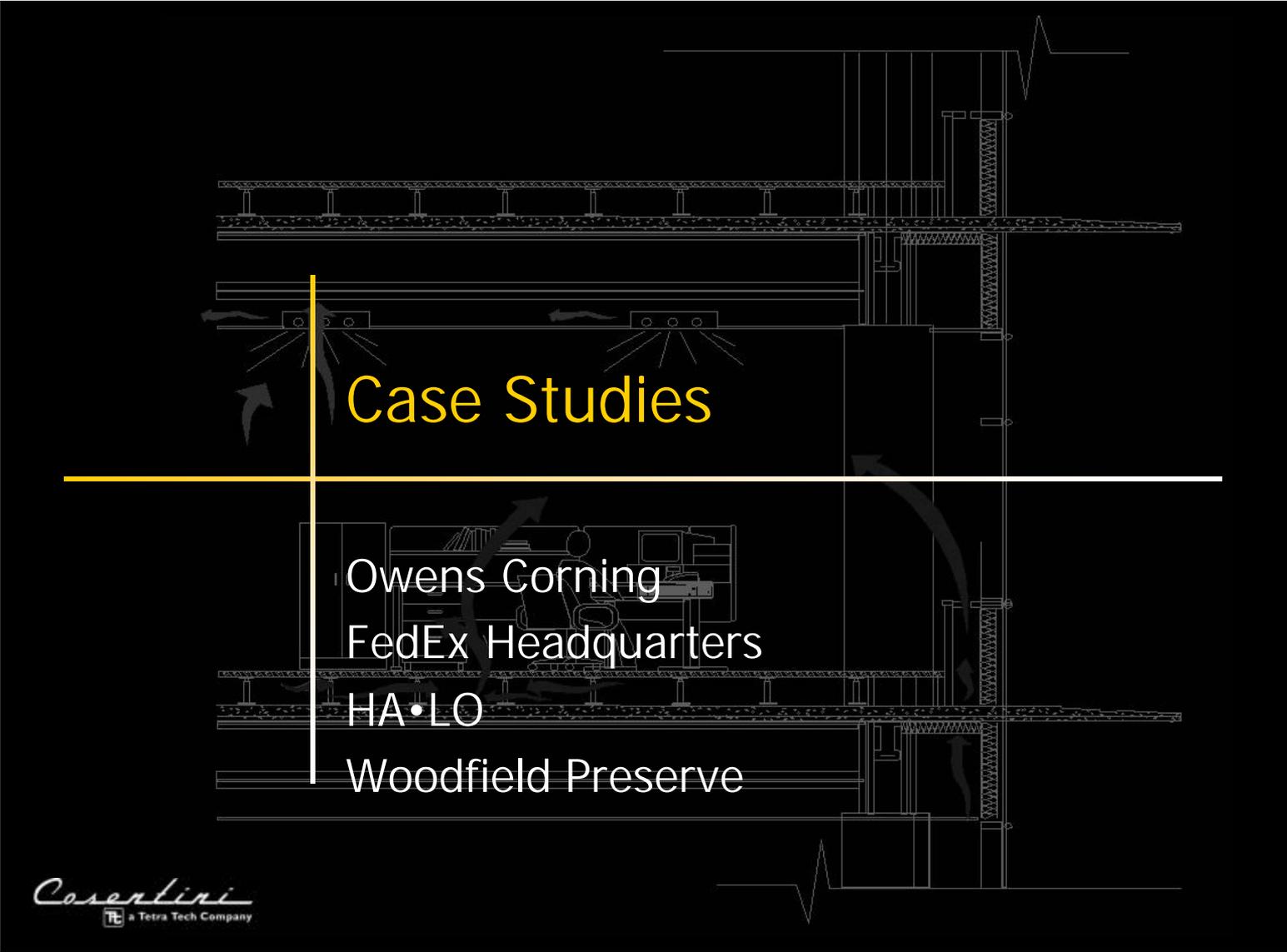
- Reduced Loads
  - Curtain Wall Efficiency (Shading Coeff., U-Value)
  - Type of Shading System
- Common System
  - Use Interior Air with Booster/Static Heating, Radiant, or Heating Coil
- Independent System
  - All Air VAV
  - Air/Water

Summer:



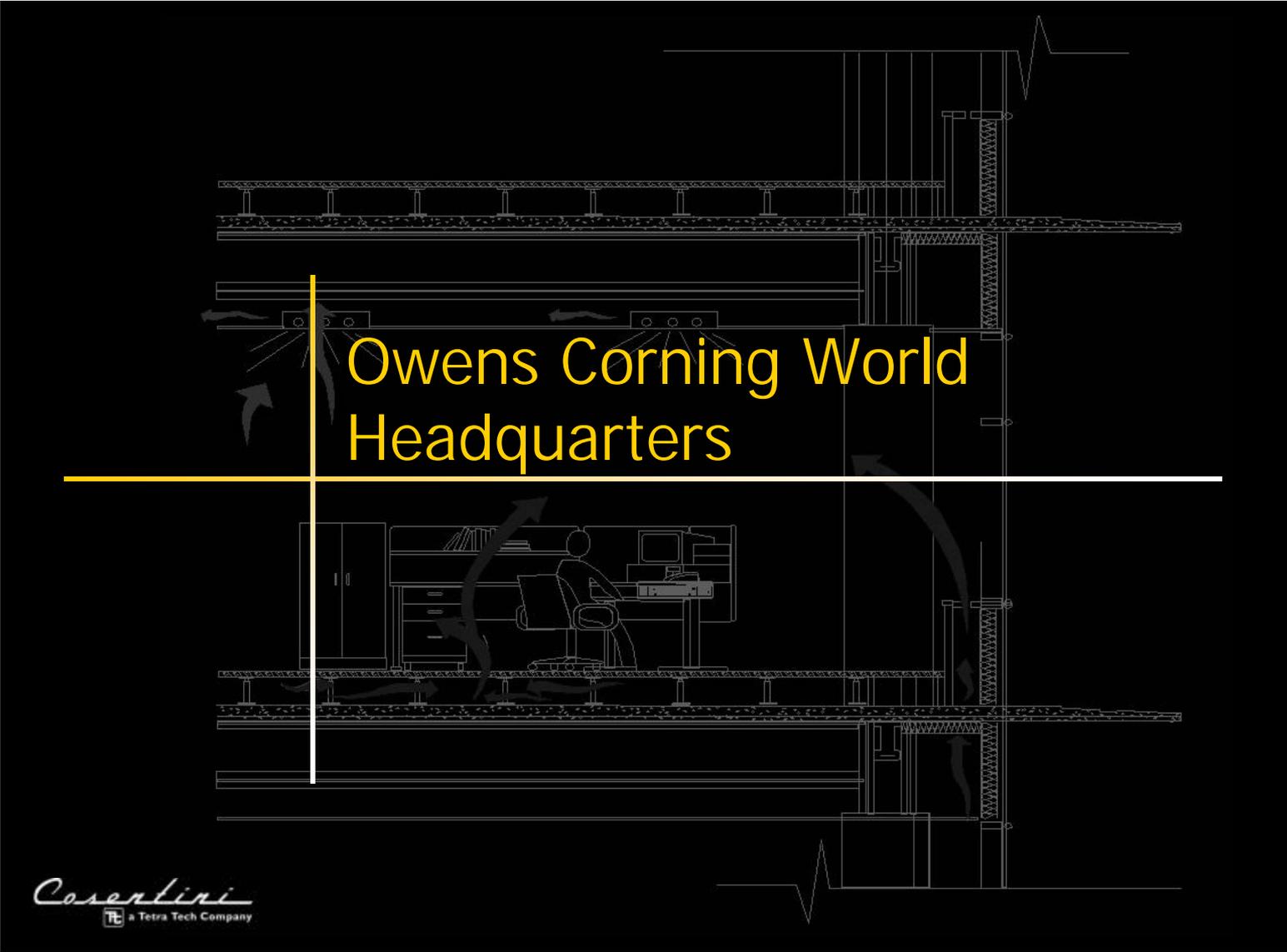
## General Issues

- Overtime A/C Strategy/Under Floor Partitioning
- Multiple Tenants Per Floor
- Integrated Lighting/Sprinkler Configuration Allows for Flexible Partition Relocation
- "Exiting" Strategy - Speculative Office Use



## Case Studies

Owens Corning  
FedEx Headquarters  
HA•LO  
Woodfield Preserve



# Owens Corning World Headquarters

# Owens Corning World Headquarters

1997 – Occupied  
450,000 sq ft  
Toledo, OH



# Owens Corning World Headquarters



# Owens Corning World Headquarters



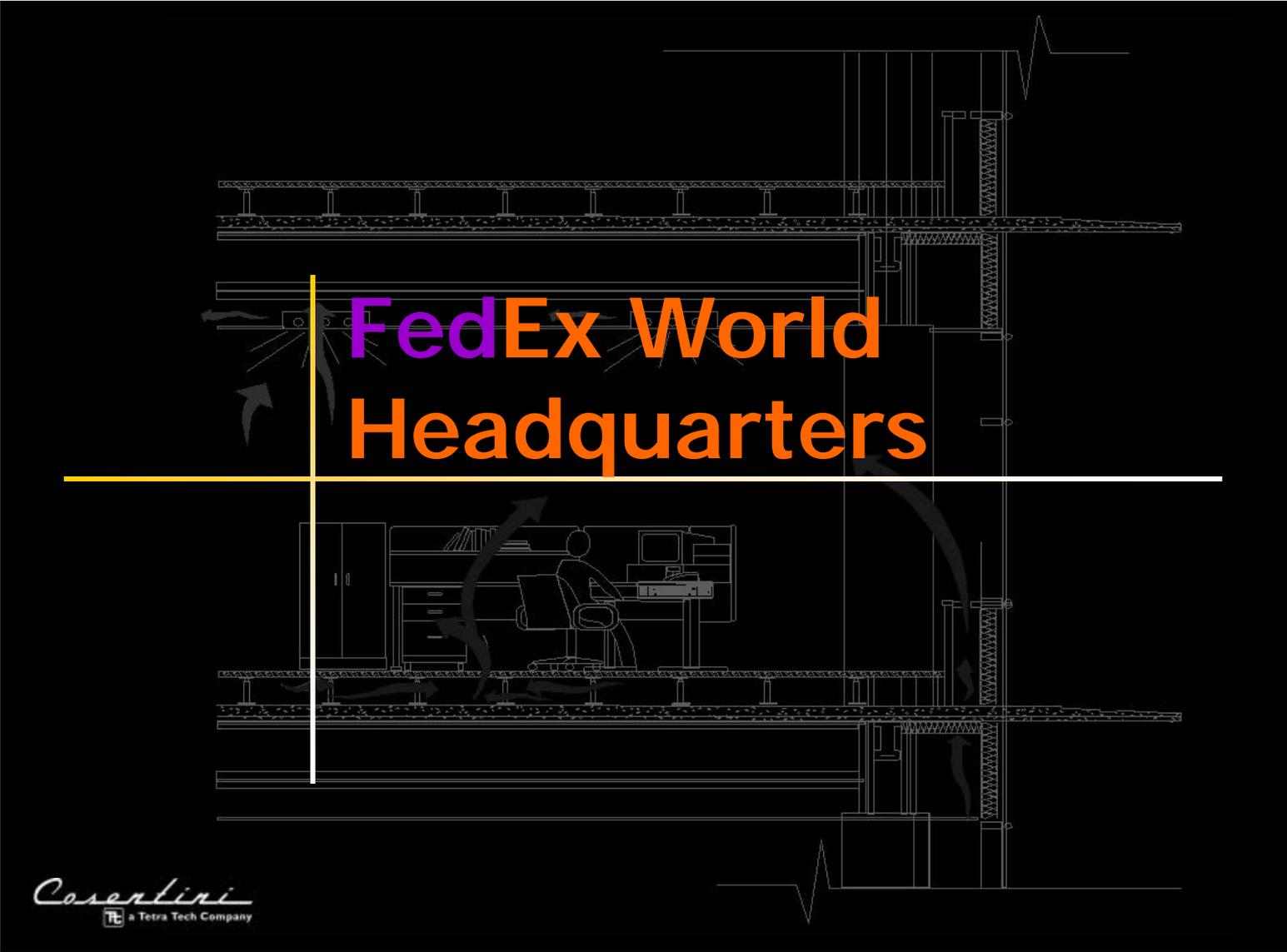
# Owens Corning World Headquarters





"The benefits - comfortable workspace, flexibility, energy savings, and quality environment - of underfloor distribution make the system choice a true success for Owens Corning."

Jim Eckert, director of Corporate Facilities,  
Owens Corning Headquarters



# FedEx World Headquarters

# FedEx World Headquarters

2001 – Occupied  
1.1 Million sq ft  
Memphis, TN



# FedEx World Headquarters



# The Project

- 1.1 Million Sq Ft
- 3800 Employees
- 18% Private Offices-82% Open Plan Workstations
- FedEx owned and maintained

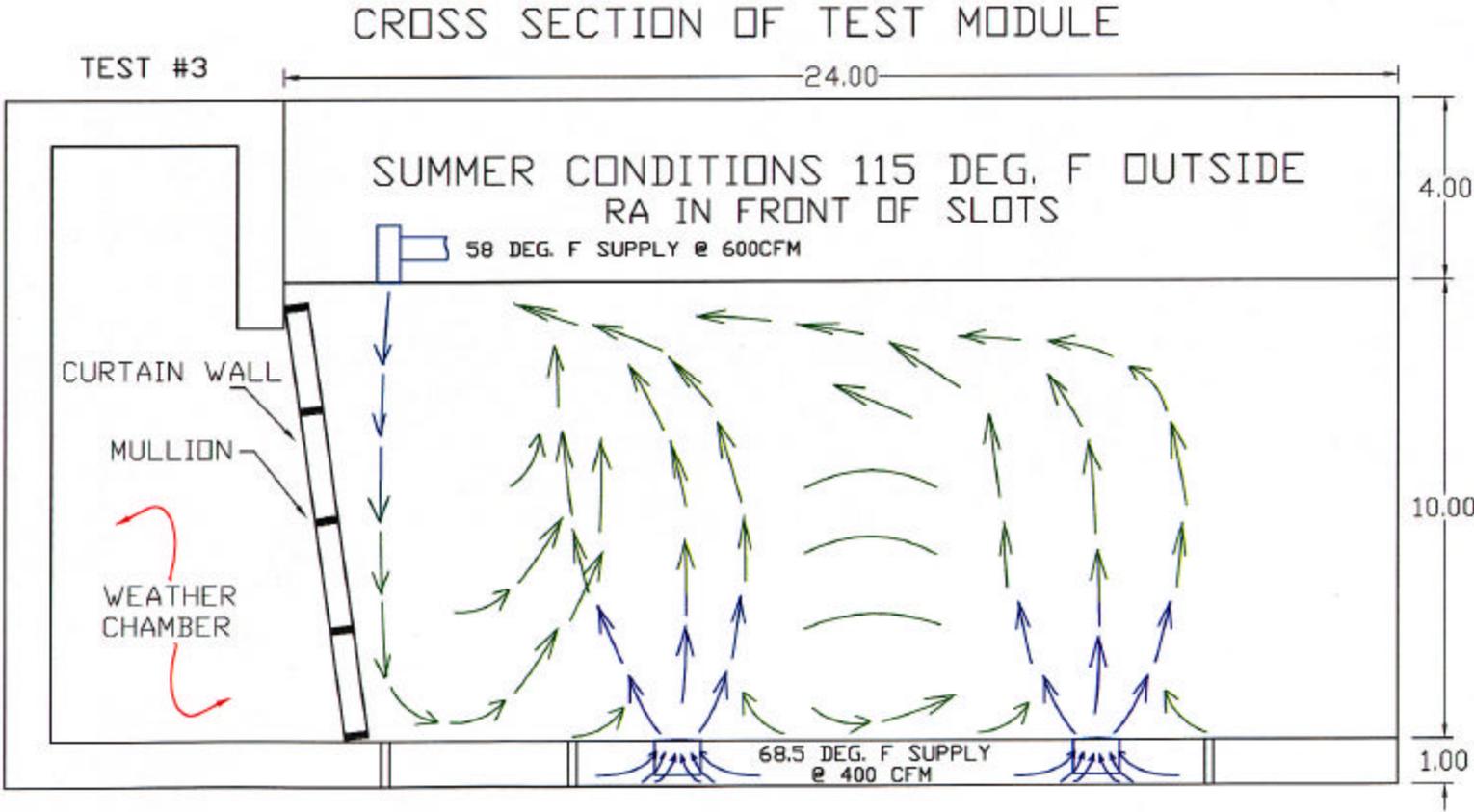
# FedEx World Headquarters



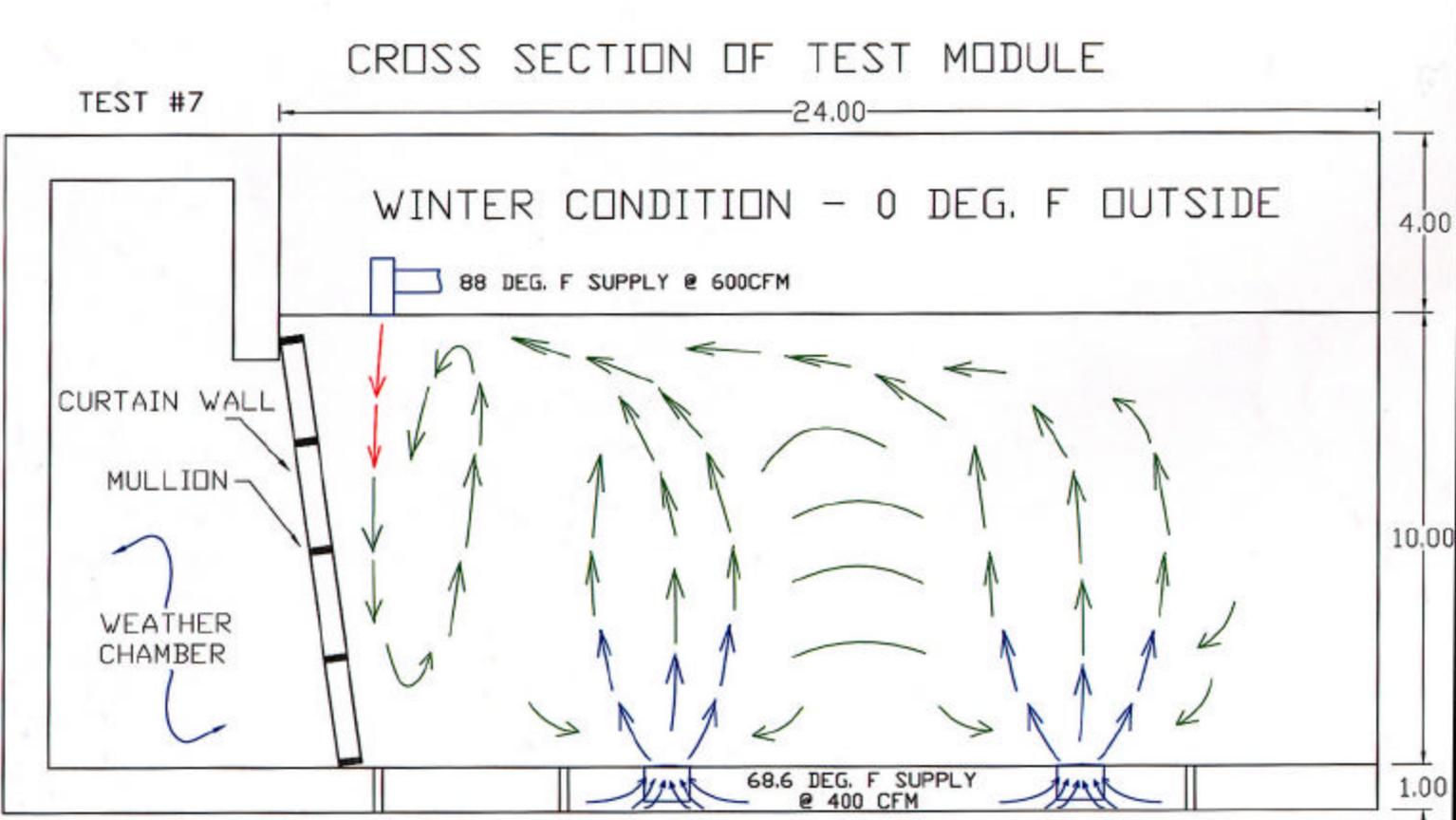
# FedEx World Headquarters



# FedEx Mockup Test



# FedEx Mockup Test



# FedEx World Headquarters



# FedEx World Headquarters



# FedEx World Headquarters



# FedEx World Headquarters



# FedEx World Headquarters



# FedEx World Headquarters

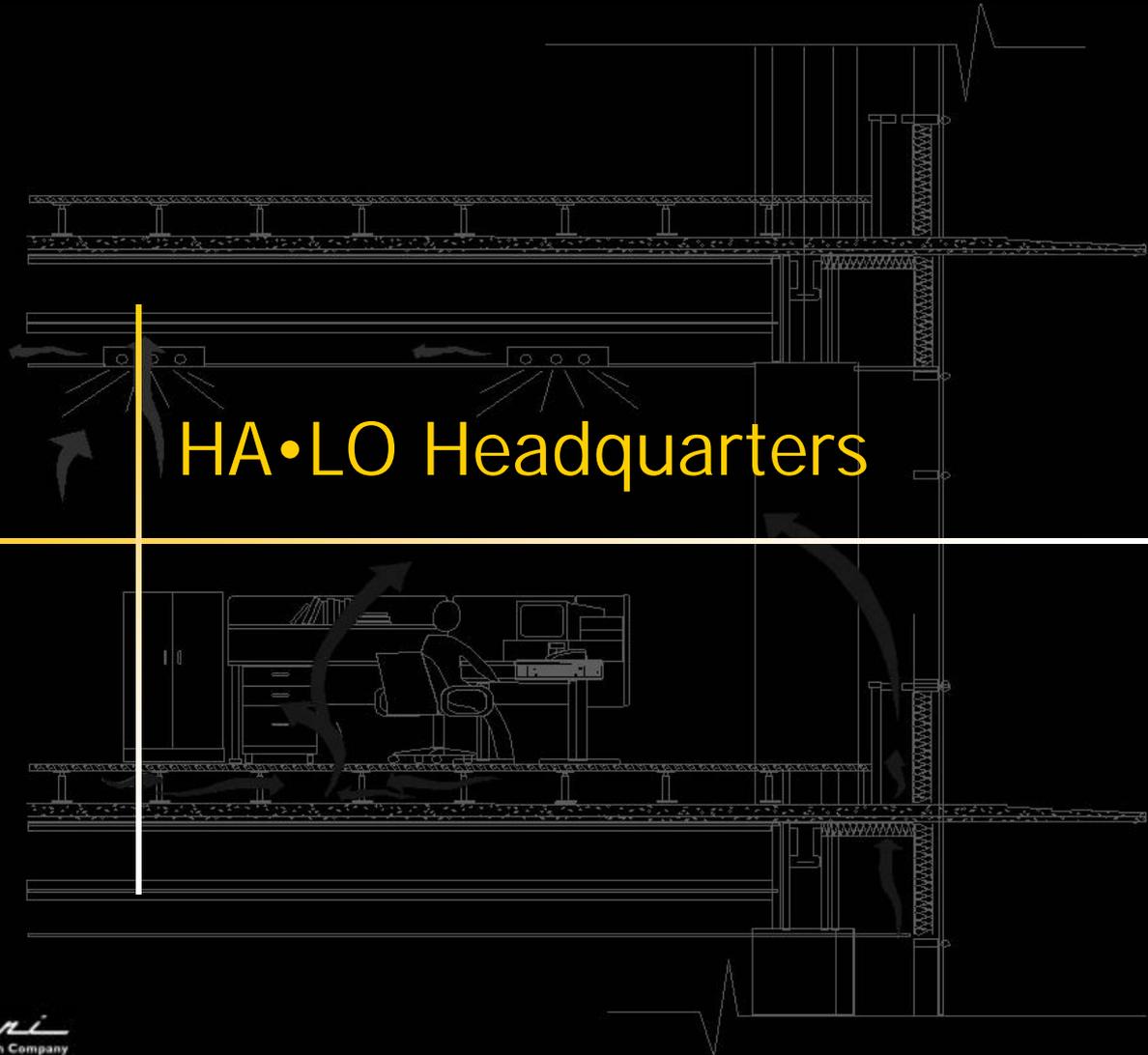


# FedEx World Headquarters



# FedEx World Headquarters





# HA•LO Headquarters

# HA•LO Headquarters

2001 – Occupied  
235,000 sq ft  
Niles, IL



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters



# HA•LO Headquarters





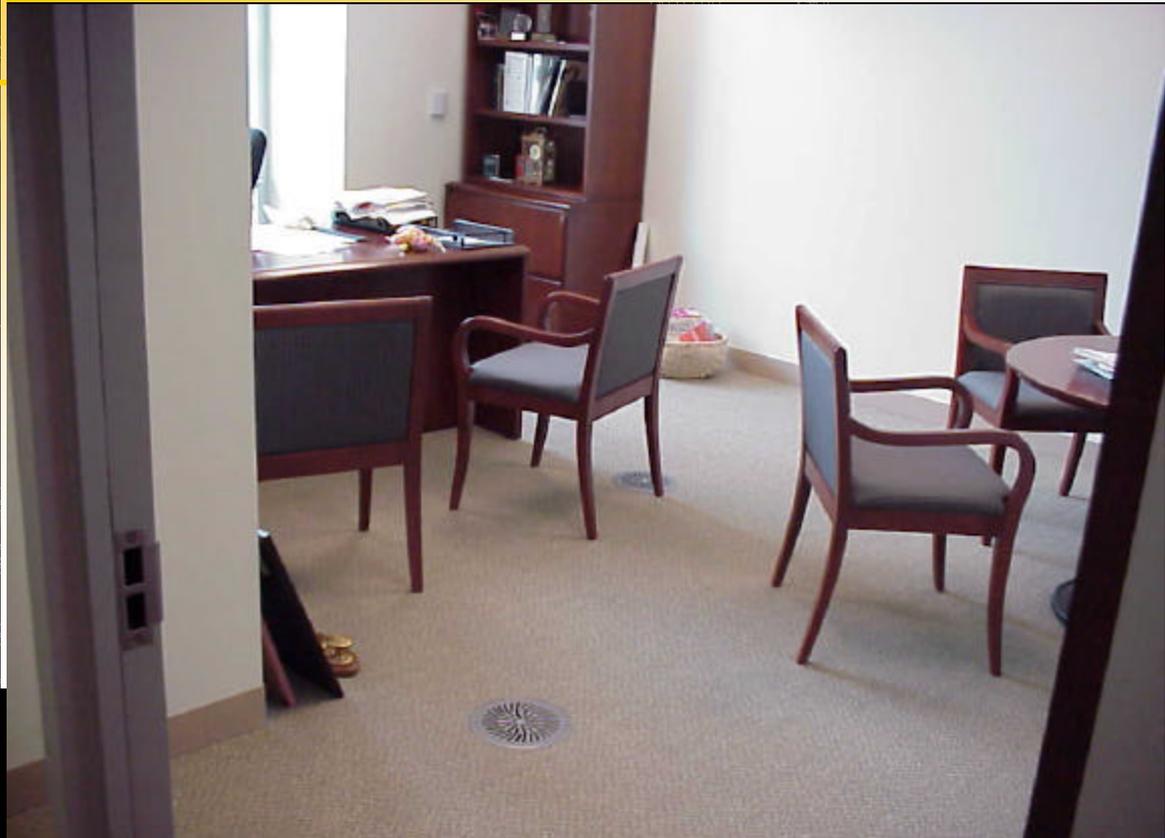
Woodfield Preserve Office  
Park

# Woodfield Preserve Office Park

- 2001 – Occupied
- 600,000 sq ft
- Schaumburg, IL



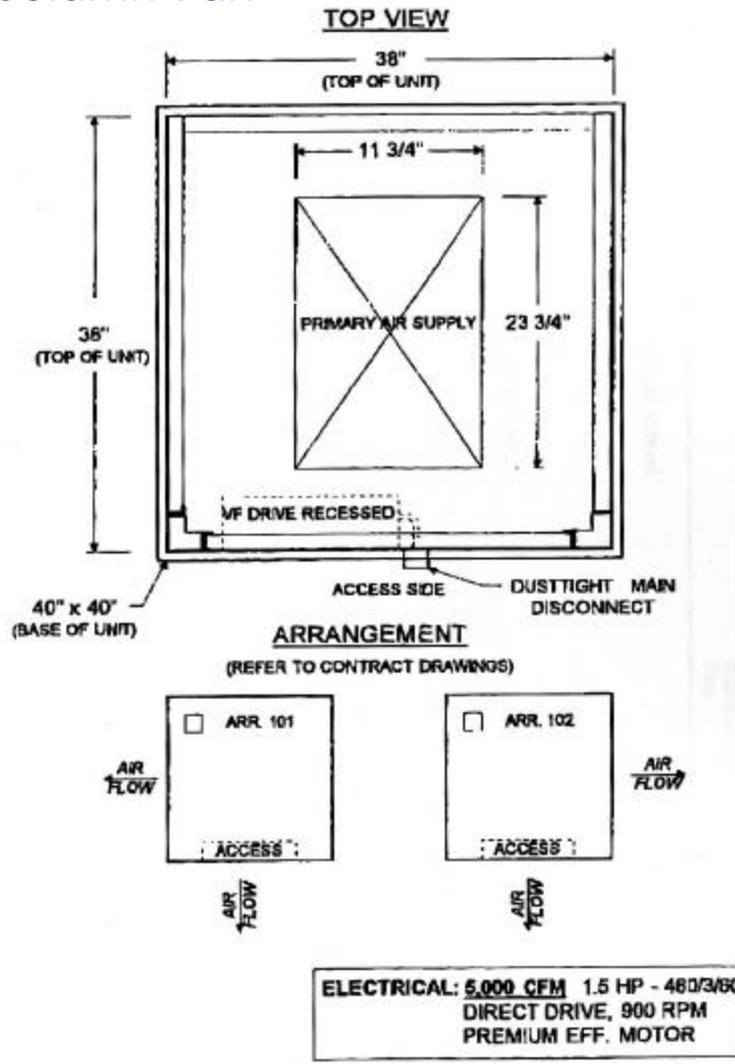
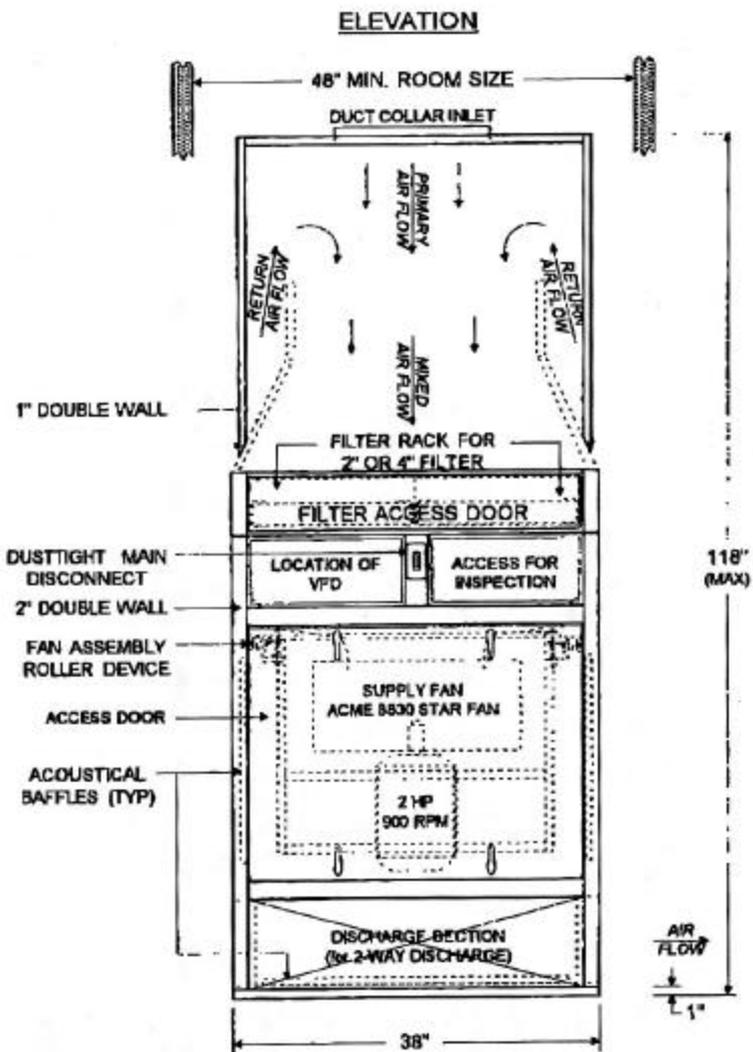
# Woodfield Preserve Office Park



# Woodfield Preserve Office Park



# Vertical Air Column Fan



# Woodfield Preserve Office Park



# Woodfield Preserve Office Park



# Woodfield Preserve Office Park



# Woodfield Preserve Office Park





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