Welcome to the Webinar!

- We hope you are logged in properly, if you are having trouble call 949-824-5828
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- We can read your comments under the "chat tab" (conversation)
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- We will take questions during the Q&A session

Inter-University Energy and Safety Coalition

Marc Gomez, CIH, CSP, ARM, Interim Assistant Vice Chancellor,
Facilities Management / Environmental Health & Safety
Lisa Mahar, Senior Manager, Occupational Health and Safety, EH&S
Matt Gudorf, LEED-AP, Campus Energy Manager, Facilities Management

UNIVERSITY of CALIFORNIA · IRVINE

Meeting Agenda

- Introductions – Getting to know one another
- Review of Existing Codes Governing Laboratory Ventilation
- Challenges to Energy Conservation/Sustainability
- UCI Low-Flow (High Performance) Fume Hood Permanent Variance Application
  - Overview of Studies and Variance Application Process
  - Next Steps – Variance Hearing, Purchase and Installation Plan, Expansion of Permanent Variance within UCI and other UC Campuses
- UCOP "Center of Excellence" for Energy Conservation and Sustainability
- Discussion

University of California, Irvine

Large research university

$16M annual utilities budget

Lab buildings consume 2/3 of campus energy

Many energy initiatives to reduce carbon footprint

Campus Energy $avings Team Synergy

Safety Management

Engineers

Supportive Users/ Researchers

Visionary & Supportive Upper Management

Patience

Facility Managers

Balancing Lab Safety & Climate Safety

- Create lab buildings that out perform ASHRAE 90.1 / CA Title 24 by 50%

- Combine energy initiatives such as
  - Centralized demand controlled ventilation (CDCV)
  - Low flow (high performance) fume hoods
  - Reduced building exhaust stack airspeeds
  - Energy-efficient lighting

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CA Ventilation Code Requirements:

Code in Effect	Ventilation Requirements	Comments
California Building Code 2001	**B Labs:** 6 ACH **H-8 Labs**: 1 cfm/sf 12 ft ceiling = 5 ACH 10 ft ceiling = 6 ACH 8 ft ceiling = 7.5 ACH	▪ In effect through December, 2007 ▪ Existing Construction
California Mechanical Code 2007	**B "Research" Labs:** 0.43cfm/sf 12 ft ceiling = 3.5 ACH 10 ft ceiling = 4.2 ACH 8 ft ceiling = 5.25 ACH **B"Science Classroom"/L (H-8):** 1 cfm/sf	▪ Effective 1/2008 ▪ Refers to ASHRAE 62.1-2004 ▪ New Construction ▪ No category for university research labs

*Need "Alternative Means of Protection" from CA State Fire Marshal for less than minimum required ventilation

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Challenges to Energy Conservation and Sustainability

- The inability to reduce fume hood face velocity below 100 fpm (Cal-OSHA)
- CBC/CMC Laboratory Ventilation Requirements
- ANSI Z9.5 requirement minimum fume hood flow
- Others?

Question: Is Increased ACH Safer?

- "Specification of Airflow Rates in Laboratories" by Tom Smith, Exposure Control Technologies, Conclusions:
  - ACH as a metric for dilution is "too simplistic".
  - Must consider other factors that lead to exposure, (i.e. contaminant generation rate, air mixing, etc.)
  - "Increased airflow [may increase] contaminant generation and distribution throughout the space"
  - May lead to "false sense of safety"

Answer: Not Necessarily

- Alternatives to simply increasing ACH:
  - Base air exchange rate on contaminant generation
  - Review lab practices
  - Attain proper air mix ratios
  - Reduce overall ACH to save energy and increase ACH as needed via “smart controls”

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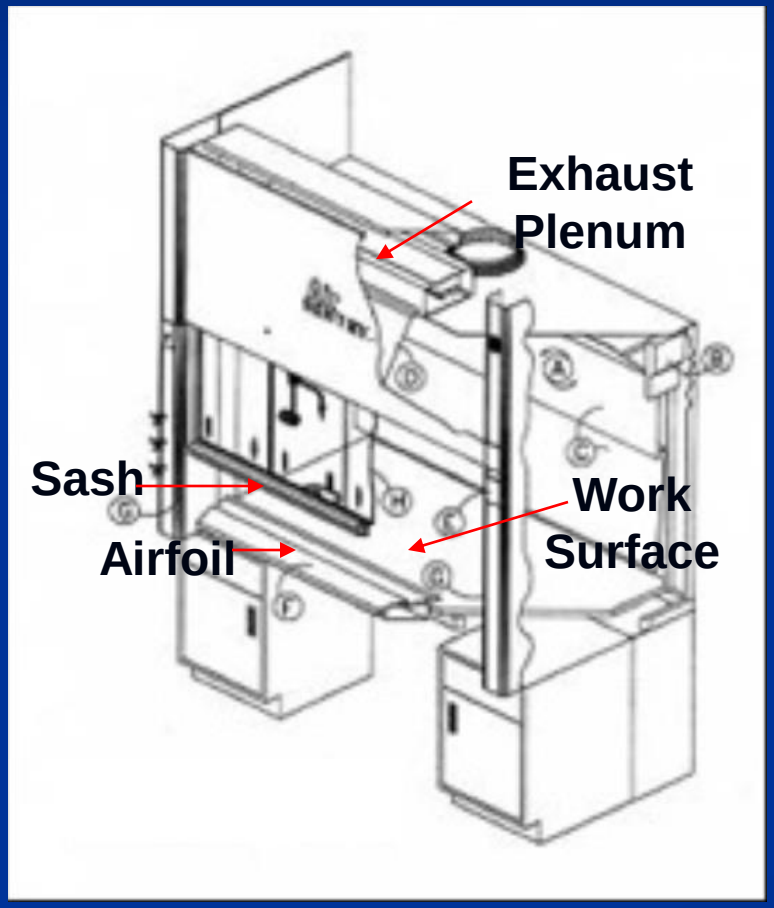
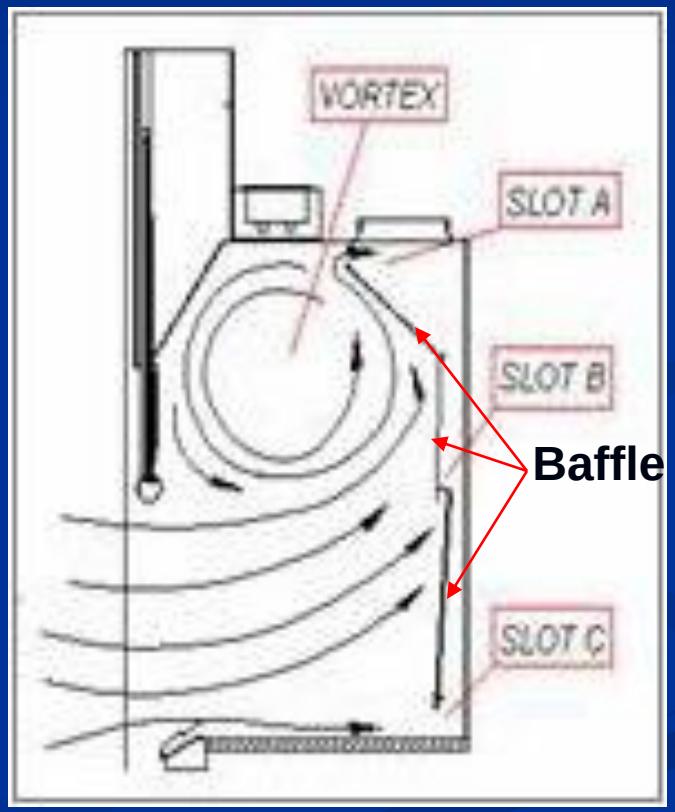
Low Flow (high performance) Fume Hoods

Operate safely at lower face velocities (i.e. 70 FPM rather than 100 FPM)





UCI Low Flow Fume Hood Study 2008

- Both traditional and low flow fume hoods were subjected to 168 ASHRAE 110 tests
- Low flow hoods performed better than standard hoods at 80 & 100 fpm - fully open sash
  - Tracer gas results were well below the 0.1ppm "as used" ASHRAE criteria
  - Low flow hoods save energy, particularly in constant volume systems
  - Low flow hoods may also be a good solution in buildings with limited HVAC capacity

Flow & Cost Comparison

HVAC System Type and Fume Hood Equipment	Flow at 100 fpm nominal face velocity Annual Cost at $5 per CFM	Flow at 80 fpm nominal face velocity Annual Cost at $5 per CFM	Flow at 70 fpm nominal face velocity Annual Cost at $5 per CFM
Constant Air Volume	900 CFM $4500	720 CFM $3600	630 CFM $3150
Variable Air Volume (VAV)	Good: 682 CFM/$3410 Poor: 851 CFM/$4255	Good: 568 CFM/$2840 Poor: 686 CFM/$3430	Good: 511 CFM/$2555 Poor: 604 CFM/$3020
VAV with ZPS	Good: 492 CFM/$2460 Poor: 558 CFM/$2790	Good: 470 CFM/$2350 Poor: 539 CFM/$2695	Good: 462 CFM/$2310 Poor: 530 CFM/$2650
VAV with ASC	361 CFM $1,805	343 CFM $1,715	335 CFM $1,675
VAV with Perfect Sash Management	343 CFM $1,715	331 CFM $1,655	325 CFM $1,625

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Study #1 Conclusions
Face Velocity & Sash Height

- All hoods - performed best at 18” sash height
  - All tracer gas results were well under 0.1ppm “as used” ASHRAE criteria
  - At 100, 80, and 60 fpm
- All low flow hoods performed better than standard hood at 80 & 100 fpm full open sash

Study #2 – Exposure Monitoring

- Low flow fume hoods again passed ASHRAE 110 tests
- ASHRAE 110 Tests Confirmed Findings from Study #1
- All samples were below published Cal-OSHA limits

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Permanent Variance – Next Steps

- Permanent Variance was requested for 3 UCI research buildings
- Must make presentation before the Cal-OSHA Standards Board
- Awaiting hearing date – make take up to 1 year
- Future plan: Expand permanent variance to cover all of UCI
- Stretch goal: Extend permanent variance to cover all UC campuses.

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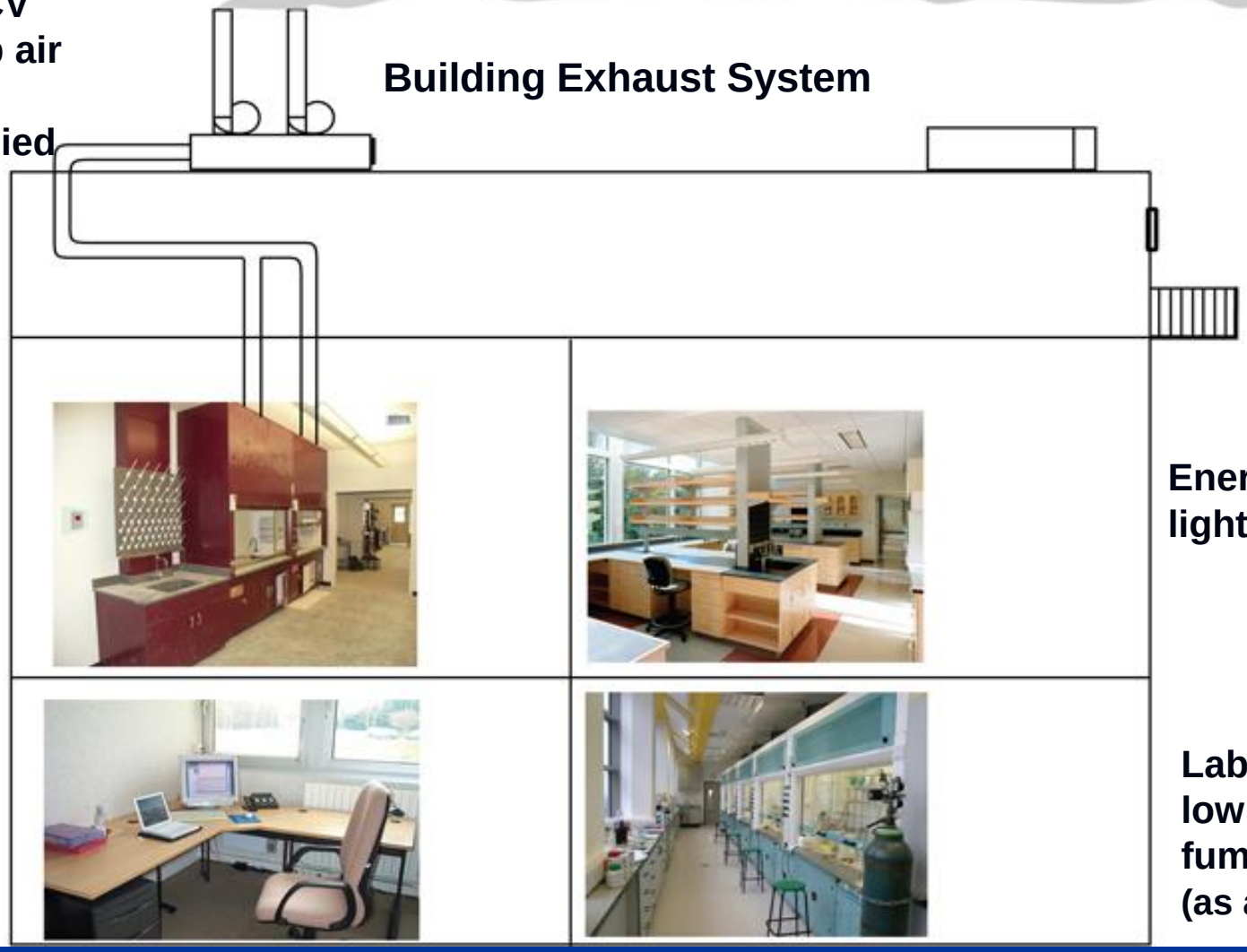
Smart Lab Building Concept

Labs w/CDCV real time lab air monitoring 4 ach occupied 2 ach unoccupied

Building Exhaust System



Energy efficient lighting

Labs with low flow fume hoods (as appropriate)

Smart Lab Parameters

	Current Best Practice	Smart Lab Parameters
Air-handler/filtration airspeeds	400 ft/min. max	350 ft/min. max
Total system (supply + exhaust) pressure-drop	6 in. w.g.	<5 in. w.g. (incl. dirty filter allow.)
Duct noise attenuators	Few	None
Occupied lab air-changes/hr. (ACH)	6 ACH	4 ACH w/contaminant sensing
Night air-change setback (unoccupied)	No setback	2 ACH w/occupancy + contaminant sensing + no thermal inputs during setbacks
Low-flow/high-performance fume hoods	No	Yes, where hood density warrants
Fume hood face-velocities	100 FPM	70 FPM (low-flow hoods)
Fume hood face-velocities (unoccupied)	100 FPM	40 FPM (low-flow hoods)
Fume hood auto-closers	None	Where hood density high
Exhaust stack discharge velocity	~3,500 FPM	Reduce or eliminate bypass air, wind responsive controls
Lab illumination power-density	0.9 watt/SF	0 .6 watt/SF w/LED task lighting
Fixtures near windows on daylight sensors	No	Yes
Energy Star freezers & refrigerators	No	Yes
Out-perform CA Title 24	20-25%	50%

Bill & Sue Gross Hall
A Smart & Sustainable Design

Gross Hall Features

- **Centralized Demand Controlled Ventilation -** real-time indoor air quality monitoring, varies the ventilation rate
- **Occupancy Based Controls -** controls both ventilation system & lighting
- **Natural Ventilation -** operable windows linked with mechanical ventilation
- **Smart Lighting Controls -** daylighting sensors used with perforated blinds
- **Energy Star Equipment -** freezers, refrigerators, ice machines & copiers
- **Air Handling System -** larger air handlers accommodate low pressure-drop filtration
- **Building Exhaust -** right sized exhaust system eliminates bypass air

Exceeding Title 24

Gross Hall Project	Exceeded Title 24 By	Time Dependant Value
As Submitted to Utilities	38%	TDV Office Bldg
Using Code Chiller	50%	TDV 24/7
Using UCI Central Plant with TES	57%	TDV 24/7

Estimated annual energy savings:

- **890,080** kWh electrical with **193** kW demand reduction
- **22,464** therms of natural gas

Estimated annual energy cost savings:

- $**110,980** at $0.105/kWh and $0.78/therm

Savings by Design payment of $**397,836**
Exceeding Title 24 by 50%

Bid as a LEED New Construction (NC) Silver
Design Build contractor proposed to increase the sustainable features to achieve LEED NC Gold certification

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