

Animal Facilities

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Environmental Systems Design



Overview



- Regulatory Agencies and Codes
- Design Standards and Guides
- Animal Laboratory Spaces
- Special Design Consideration
- Case Study: College of Veterinary Medicine –
University of Illinois Urbana-Champaign

Regulatory Agencies and Codes Federal



- Animal Welfare Act – USC Title 7 Sections 2131 to 2159
 - Only Federal law that regulates treatment of animals.
 - Enforced by the USDA, APHIS, Animal Care
 - Local compliance by institution IACUC
- Code of Federal Regulations - Title 9 Animals and Animal Products (9CFR)
- Office of Laboratory Animal Welfare (OLAW)
 - Division of the US National Institute of Health
 - Oversees publicly funded animal studies

Regulatory Agencies and Codes National



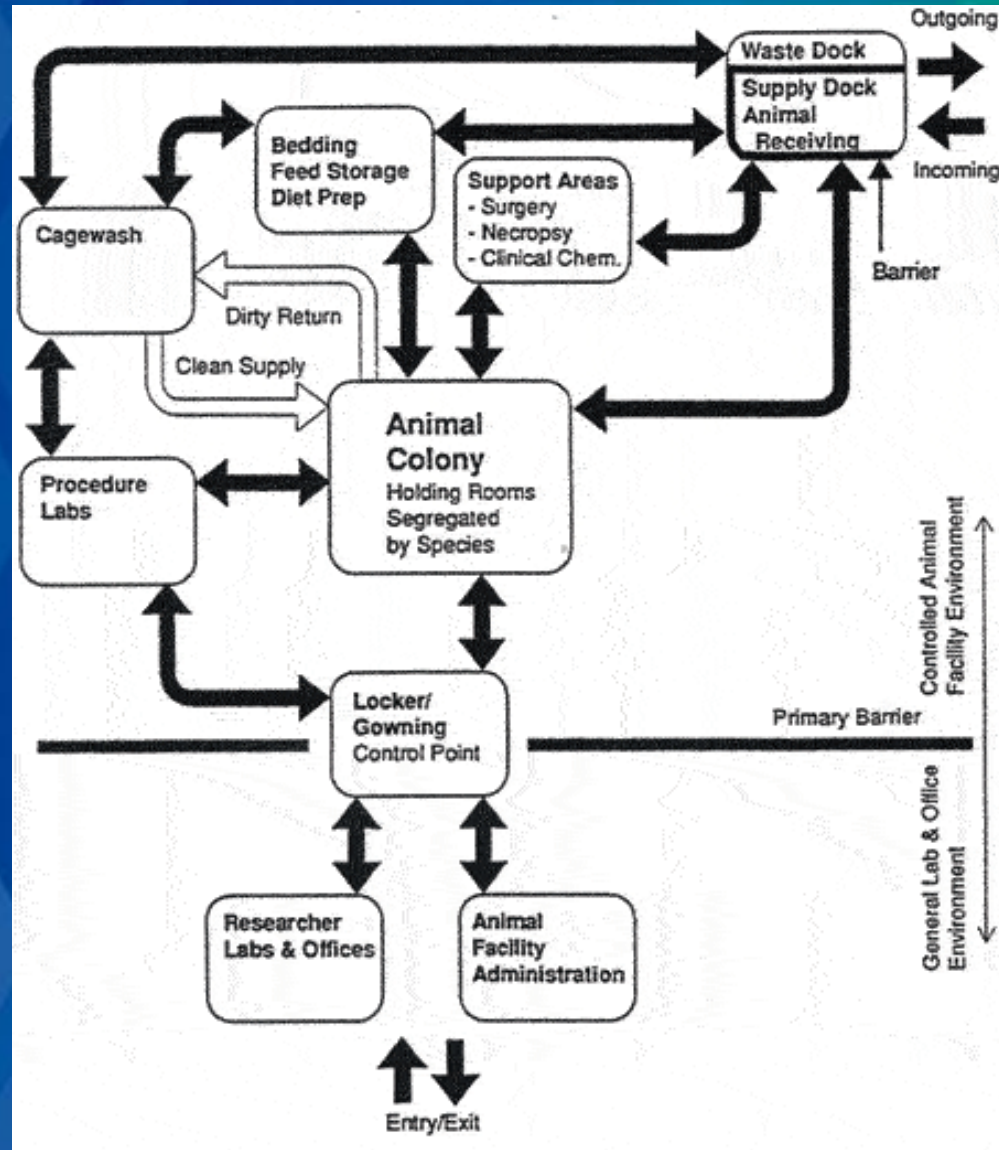
- Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)
 - Accredited organization using the some of the following guides:
 - Guide for the Care and Use of Laboratory Animals (NRC)
 - Guide for the Care and Use of Agricultural Animals in Research and Teaching (FASS)

Design Standards and Guides



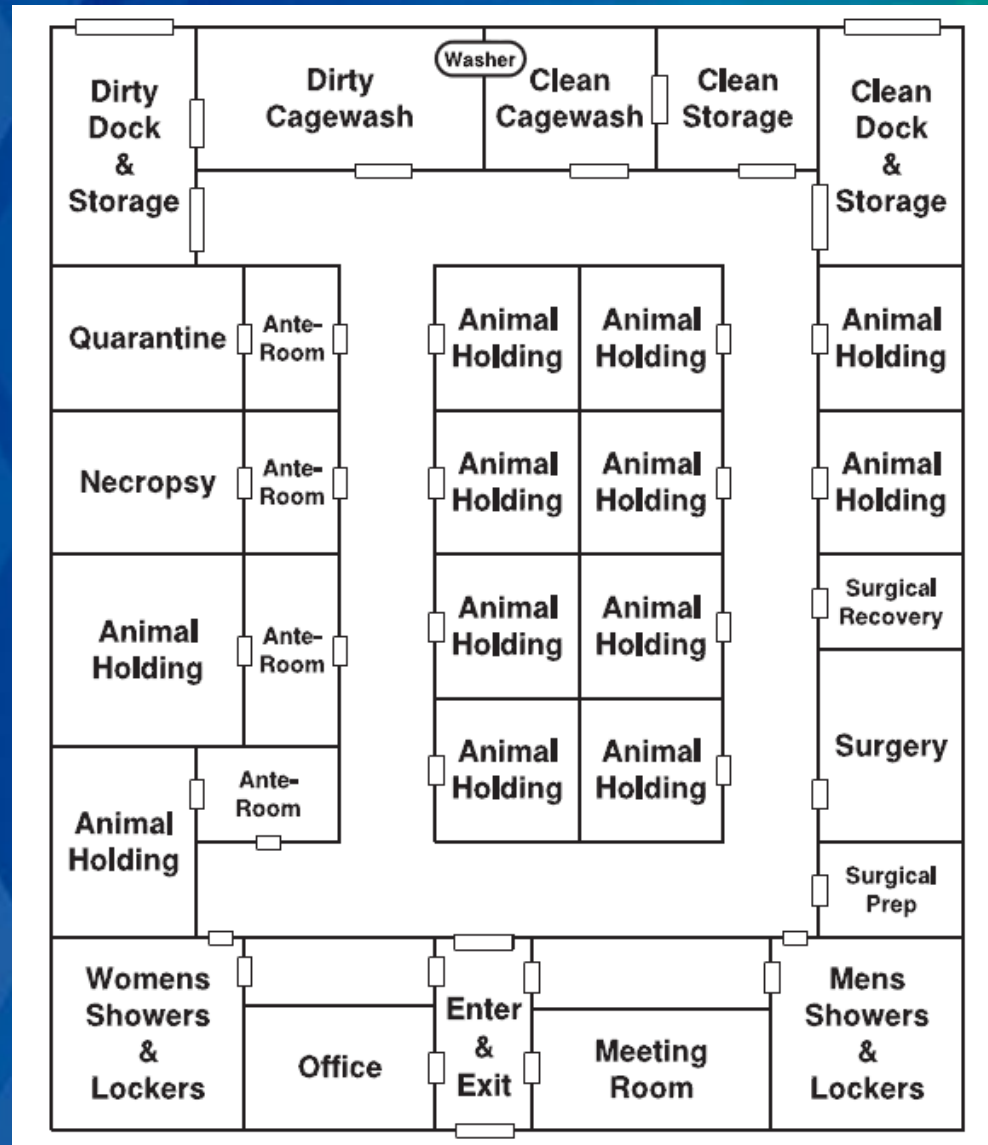
- National Institutes of Health – 2008 Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities
 - Biomedical research laboratories
 - Animal research facilities
- Guidelines for Laboratory Design – Health and Safety Considerations 4th Edition
- ASHRAE Handbook – Applications Chapter 16

Animal Laboratory Spaces



Animal Facility Diagrammatic Model Showing Basic Flows and Spatial Relationships (WBDG Animal Research Facility 2010)

Animal Laboratory Spaces



Preliminary Floor Plan
(Canadian Council on Animal
Care – Guidelines on:
Laboratory Animal Facilities –
Characteristics, Design and
Development 2003)

Quarantine Spaces



- Typically located near animal receiving to evaluate the health of incoming animals.
- No recirculation of air.
- Negative pressure relationship with adjoining spaces.

Animal Holding

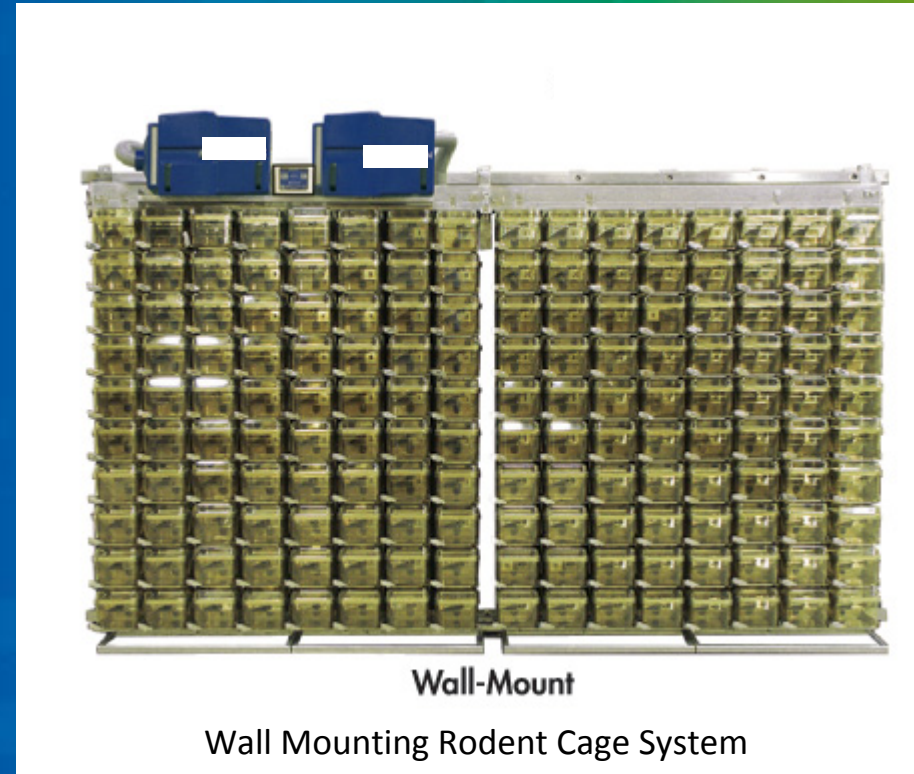


- Area where animals stay after being cleared in quarantine area.
- Macroenvironment vs. Microenvironment
 - Microenvironment – Immediate surroundings such as cages
 - Macroenvironment – Secondary enclosure such as the room where cages are located

Animal Holding – Small Animals



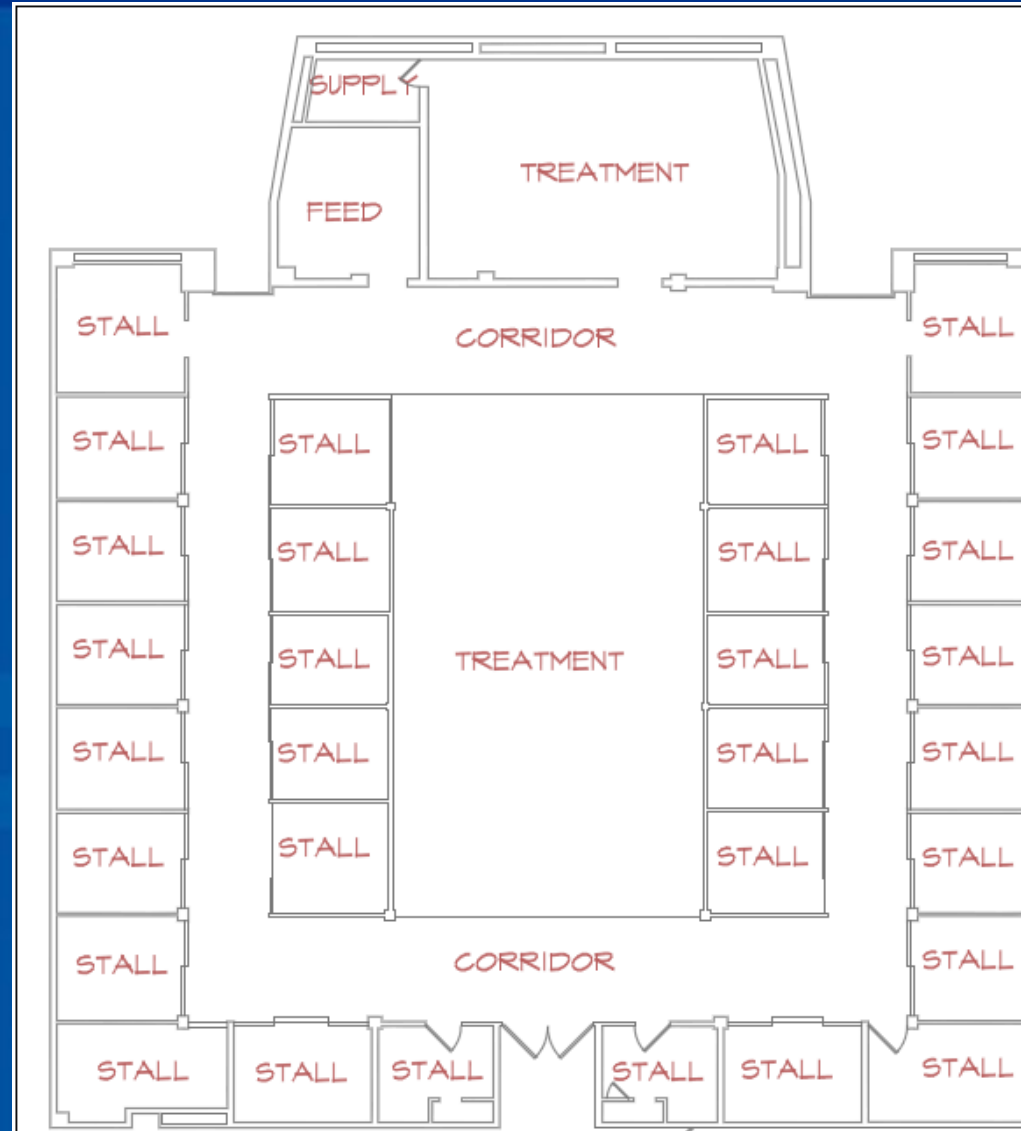
- Caging systems for small animal holding
 - Newer systems utilize dedicated ventilation systems with HEPA filtration
 - Macroenvironment has little influence (ASHRAE research project RP-730)



Animal Holding – Large Animals

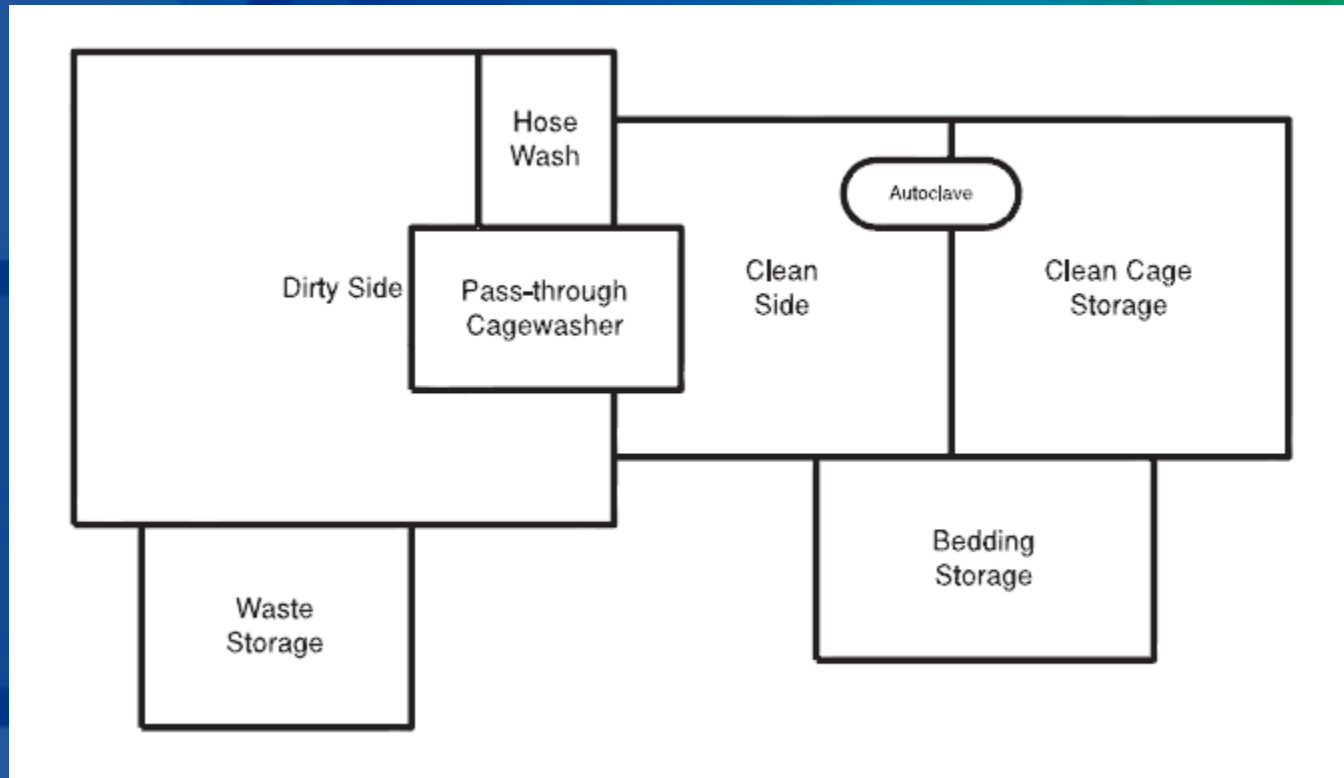


- Pens and Stalls for large animal holding
 - Durable fixtures to withstand damage
 - Avoid ductwork/ devices in stalls
 - Exhaust stalls/ supply corridors



Sanitation Areas

Cage Wash



Cage Wash Area (Canadian Council on Animal Care – Guidelines on: Laboratory Animal Facilities – Characteristics, Design and Development 2003)

- Capture hoods for sterilizers or washers.
- Use corrosive resistant materials such as stainless steel or aluminum for exhaust.
- Do not humidify space if can be avoided.

Storage Areas



- Clean areas that store materials for animal holding areas such as bedding, feed and other supplies for animal care.
- Spaces to remain under positive pressure to prevent contamination.
- Temperature and humidity control to maintain feed supplies.

Laboratory Spaces

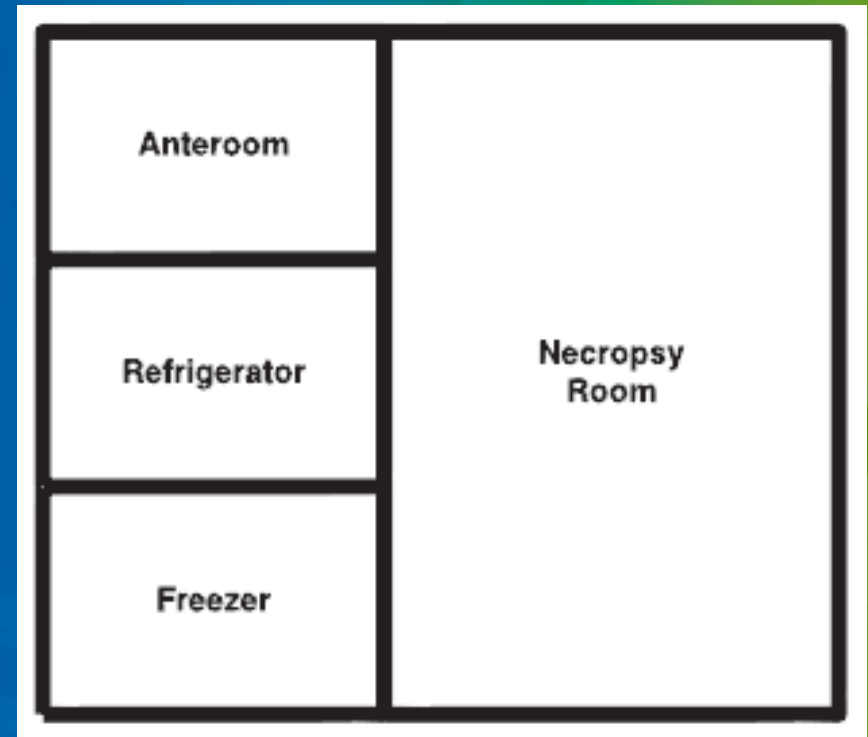


- Space types include surgical areas and diagnostic and experimental treatment labs.
- Surgery Areas:
 - Clean Area under positive pressure
 - Potential exhausting of waste anesthetic gases
- Diagnostic Laboratories
- Treatment Laboratories

Necropsy



- Examination of animal shortly after death
 - Negative pressure suite
 - Refrigerators/freezers for dead animal storage
 - Autopsy tables
 - Exhausting away from people



Necropsy Area (Canadian Council on Animal Care – Guidelines on: Laboratory Animal Facilities – Characteristics, Design and Development 2003)

Design Considerations



- HVAC Design
 - Location of inlets/outlet
 - Filtered exhaust grilles (30% eff.)
 - Locate ductwork to avoid damage
 - HEPA Filtration
 - Supply
 - Exhaust
 - Air Exchanges
 - 10-15 ACH - AAALAC Standard
 - 15-20 ACH - Canadian Standard
 - Design to space loads - ASHRAE

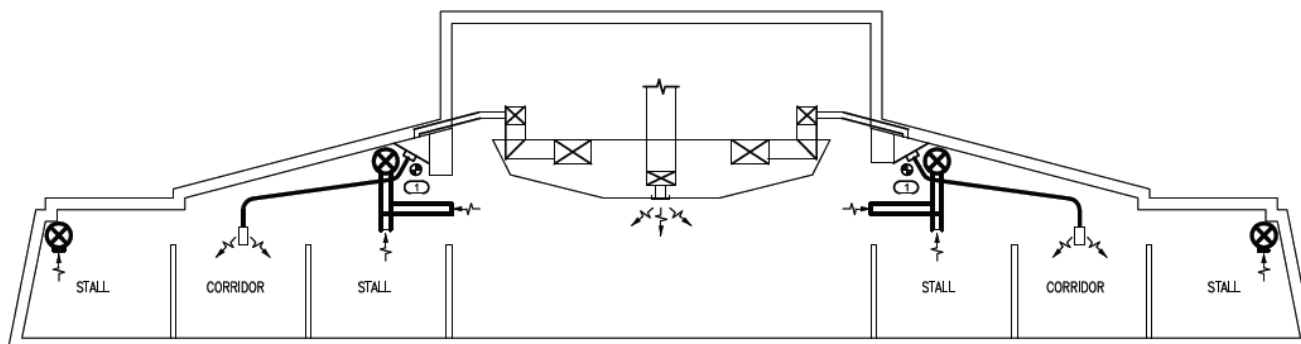
Species	Weight, lb	Heat Generation, Btu/h per Normally Active Animal		
		Sensible	Latent	Total
Mouse	0.046	1.11	0.54	1.65
Hamster	0.260	4.02	1.98	6.00
Rat	0.62	7.77	3.83	11.6
Guinea pig	0.90	10.2	5.03	15.2
Rabbit	5.41	39.2	19.3	58.5
Cat	6.61	45.6	22.5	68.1
Nonhuman primate	12.0	71.3	35.1	106.0
Dog	22.7	105.0	56.4	161.0
Dog	50.0	231.0	124.0	355.0

ASHRAE Handbook Applications – Heat Generated by Laboratory Animals

Species	ACH
Cat	10-18
Dog	8-12
Gerbil	8-10
Horse	4-8
Mouse	8-12
Non-Human Primate*	10-16
Rat	10-20
Swine	15-20

CCAC – Housing and Environment Appendix C

University of Illinois - Large Animal Clinic
Animal Holding



Special Considerations



- Personal Safety



Special Considerations



- Noise:
 - Location of terminal air devices
 - Air speed at outlets
 - Mechanical room equipment
- Vibration
 - Vibration isolation on equipment
 - Location of equipment

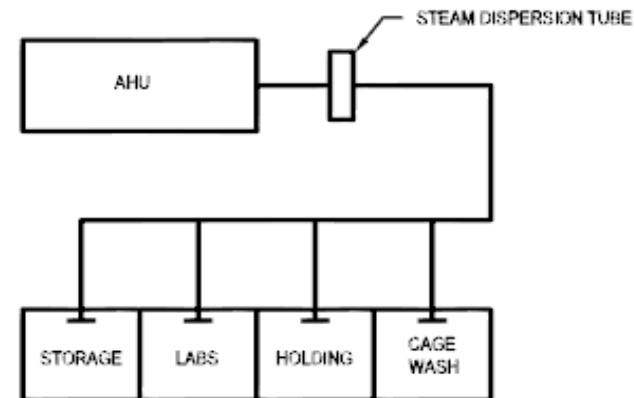


Special Considerations

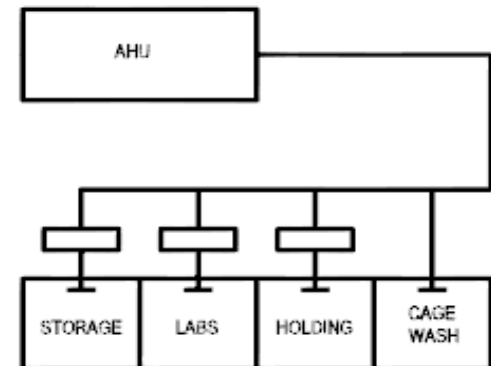


- Humidification – Central vs Dedicated
 - Central
 - Lower first cost
 - Ease of maintenance
 - Consumes more energy
 - Dedicated
 - Higher first cost
 - More maintenance
 - Less energy consumption
 - Better individual space control

HUMIDIFICATION



CENTRAL HUMIDIFICATION



DEDICATED HUMIDIFICATION

Special Considerations

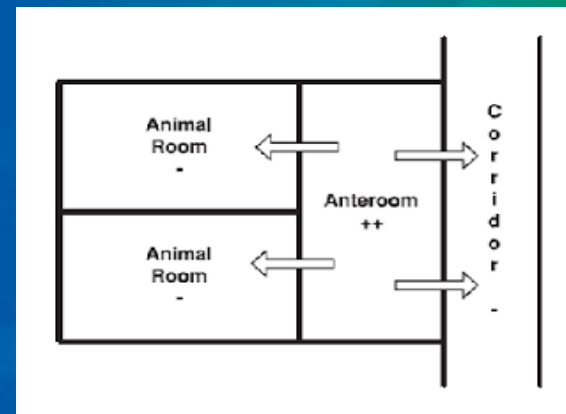
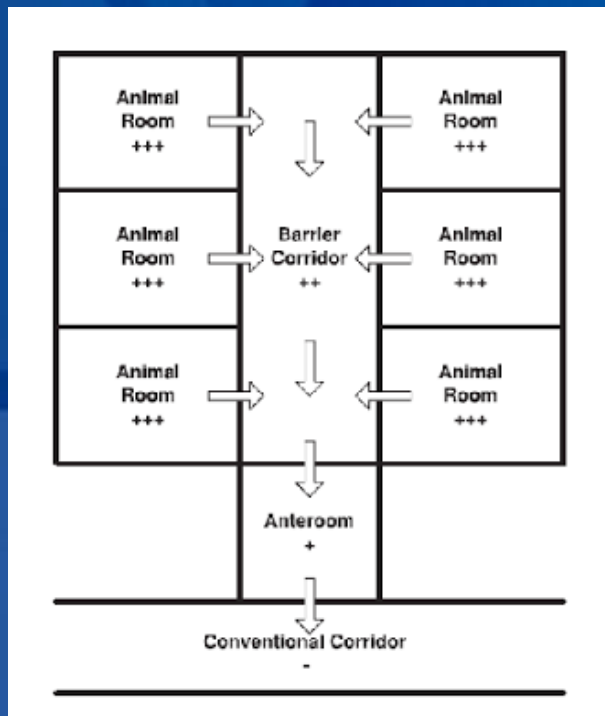


- Humidification Control
 - Prevent large swings in humidity
 - 40-60% RH level and no more than $\pm 5\%$ change
 - Accuracy of humidity sensors

Special Considerations



- Pressurization Control
 - Negative vs positive



Differential pressure cascade effect (Left) barrier effect (Top) (Canadian Council on Animal Care – Guidelines on: Laboratory Animal Facilities – Characteristics, Design and Development 2003)

Special Considerations

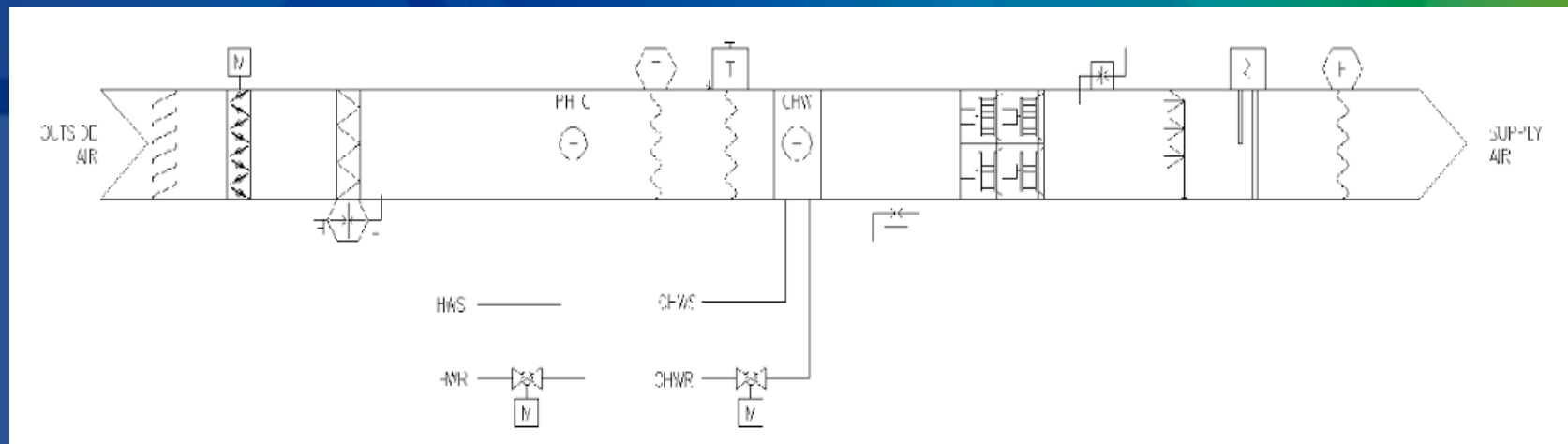


- Emergency Power
 - Mechanical Systems
 - Maintain temperature and humidity for animal well being.
 - Finish surgical operations
 - Should maintain minimum of 24 hours of fuel storage
 - Differential pressures must be maintained
 - Controls
 - Controls should match mechanical
 - Are UPS required during generator startup?

Special Considerations



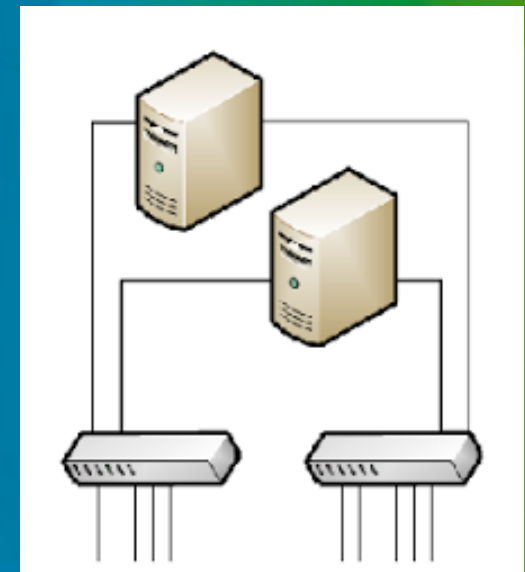
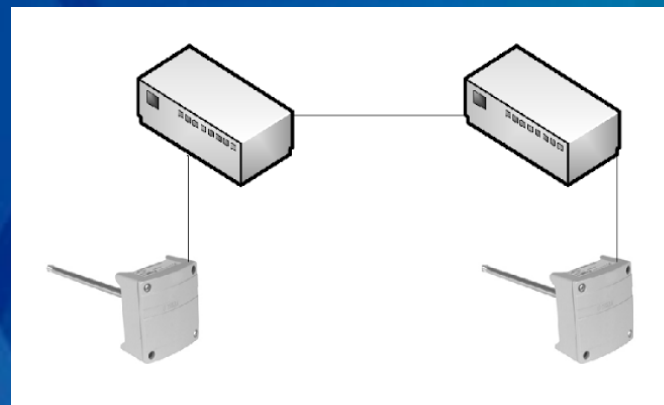
- Failure Scenarios
 - Field devices (normally opened vs closed)
 - Isolation of failed equipment
 - How will other systems be impacted?



Special Considerations



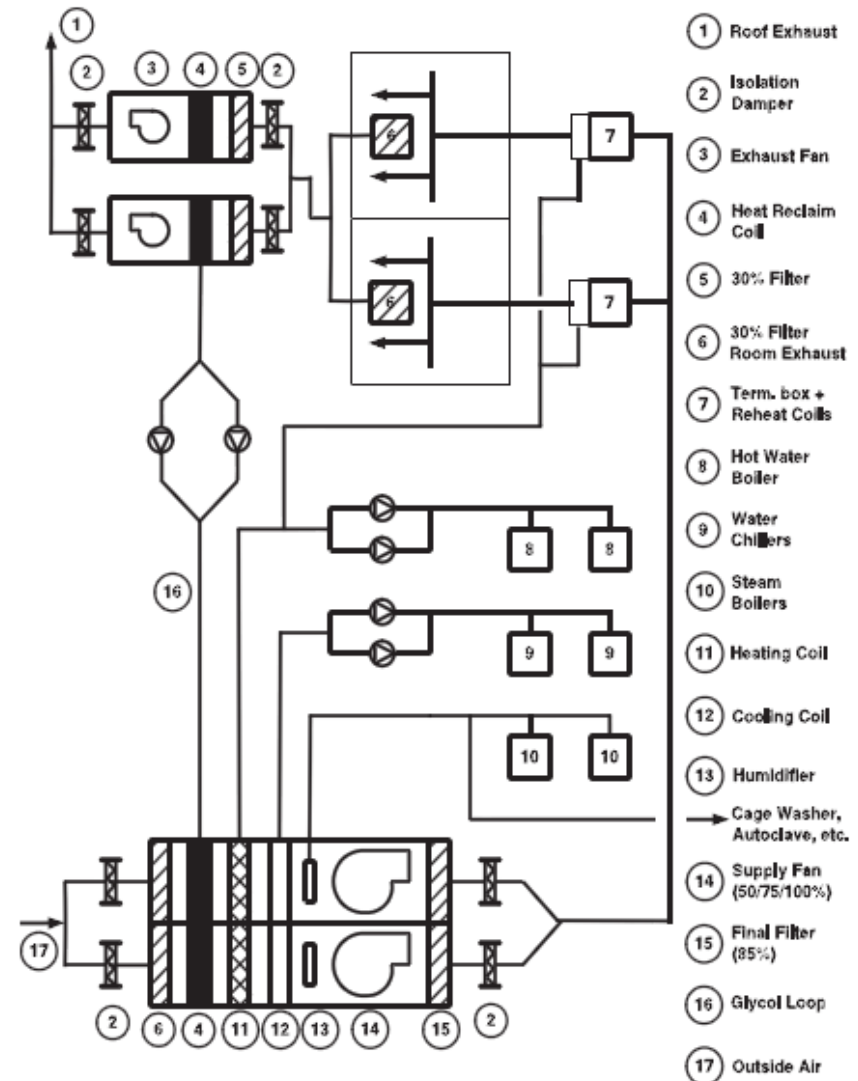
- Controls Redundancy
 - Sensors / Devices
 - Controllers
 - Network



Special Considerations



- Redundancy
 - Multiple AHUs or Coils
 - N+1 Plant Design
 - Multiple exhaust systems



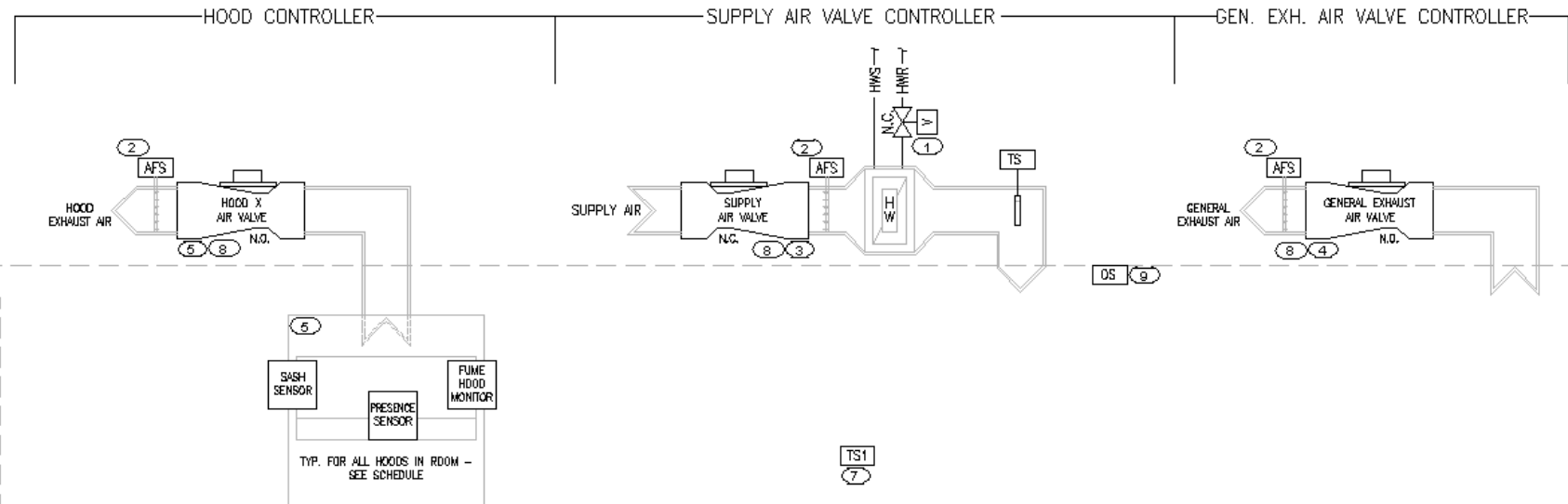
Special Considerations



- Cleaning and Maintenance - Controls
 - Sensor placement
 - Future access
 - Prevent damage
 - Recalibration of sensors
 - Humidity
 - Gas detection
 - Animal dander on sensors
 - Cleaning airflow stations
 - Enclosed sensors for protection

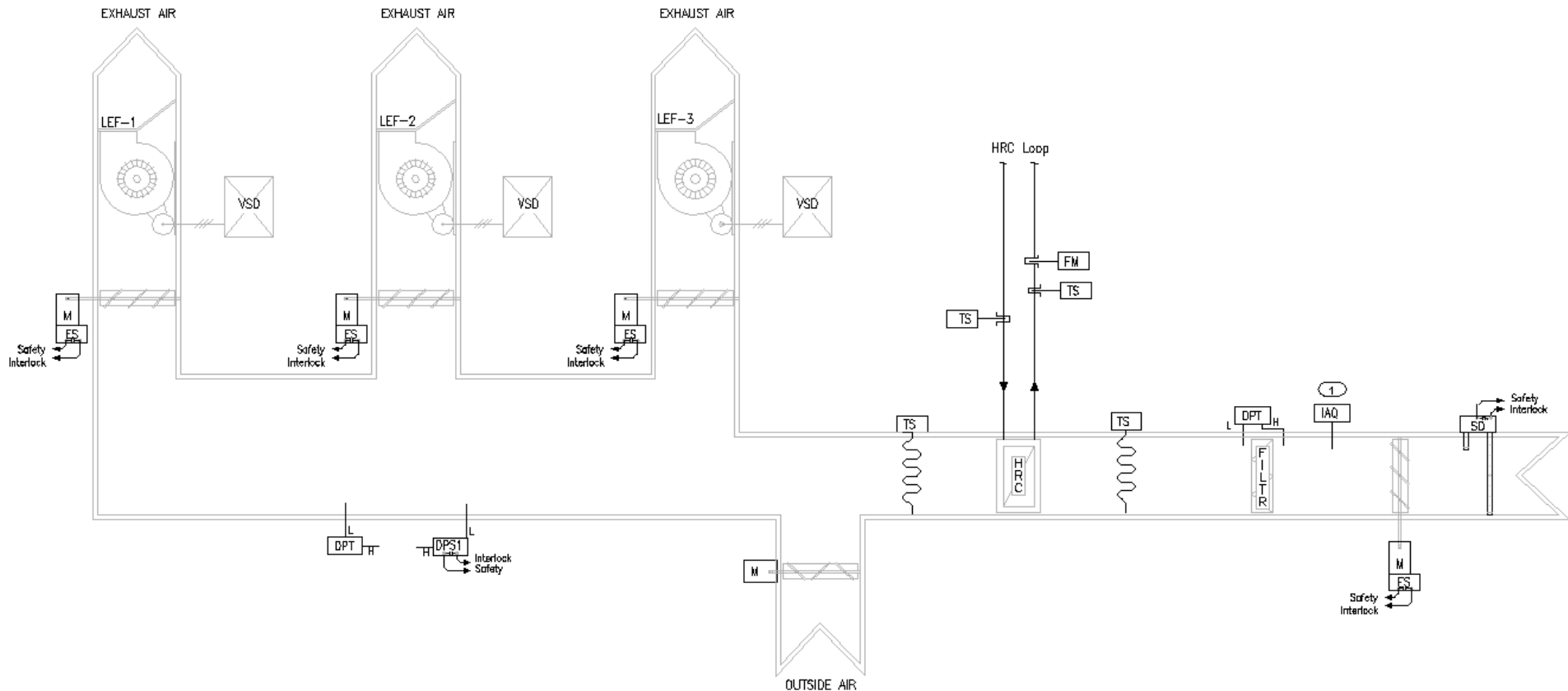


Case Study – UIUC College of Veterinary Medicine



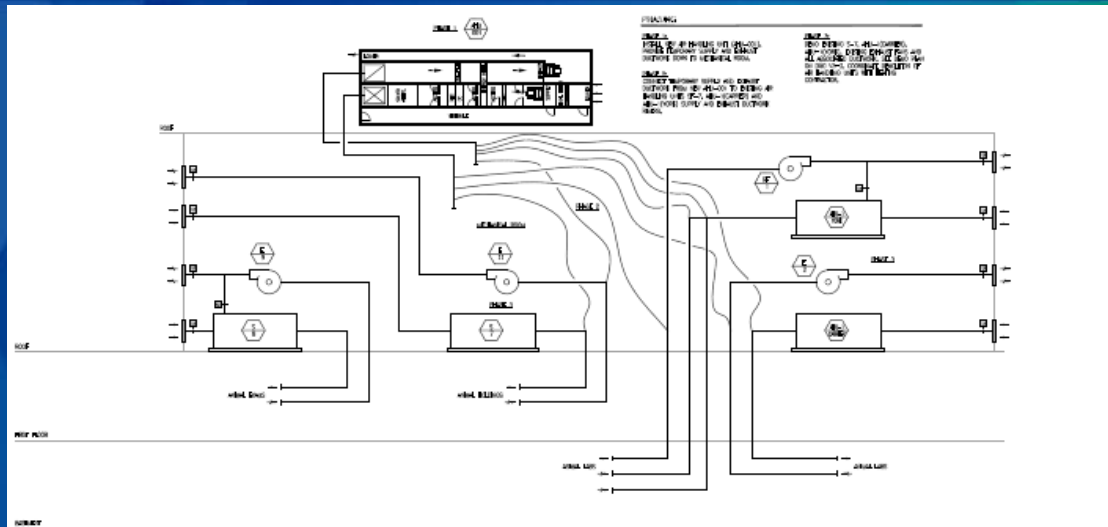
UIUC BSB– College of Veterinary Medicine – Pressurization Control

Case Study – UIUC College of Veterinary Medicine

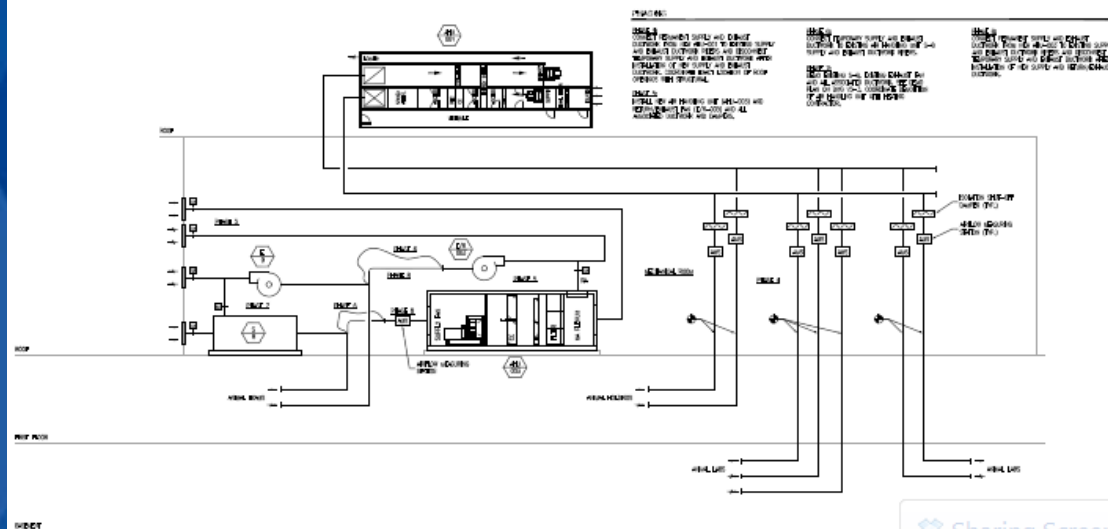


UIUC BSB– College of Veterinary Medicine – Laboratory Exhaust Fan Control

Case Study – UIUC College of Veterinary Medicine



1 EAST WING AIR FLOW RISER DIAGRAM - NEW WORK



2 EAST WING AIR FLOW RISER DIAGRAM - NEW WORK