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## **Durable and Sustainable Technologies for more Energy Efficient Facilities**

Advancing Global Health with Durable Solutions

# What is Appropriate Ventilation (HVAC)?



# What is Appropriate Primary Containment?






# Understanding the Challenges



# Understanding the Challenges

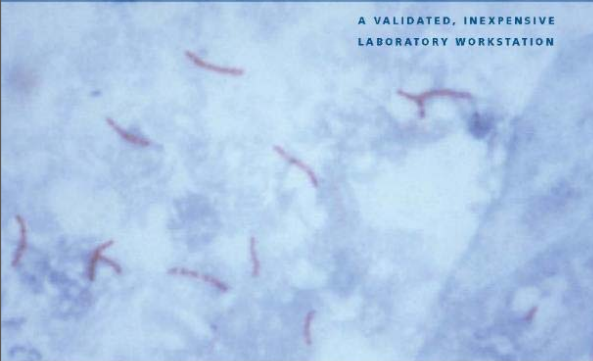







Ventilated Workstation Manual for AFB Smear Microscopy



MANUFACTURING, VALIDATION, AND USER GUIDE

A VALIDATED, INEXPENSIVE LABORATORY WORKSTATION



    International Union Against Tuberculosis and Lung Disease  
MEMBER ORGANIZATION FOR THE YEAR  APHL ASSOCIATION OF PUBLIC HEALTH LABORATORIES

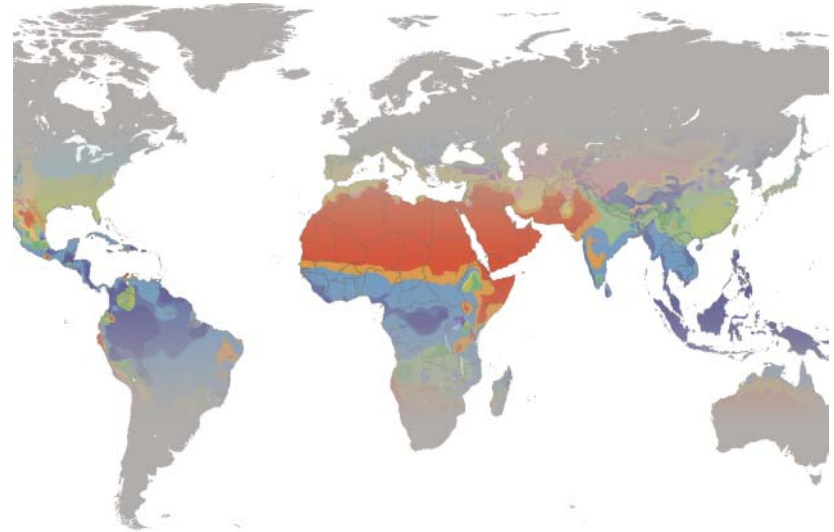


# Appropriate Lab Ventilation Needs to start with Appropriate Primary Containment

**“There is a need to develop effective and appropriate engineering technologies and innovative architectural features to maximize the use of natural ventilation for different climatic conditions worldwide.”**

-“Natural Ventilation for Infection Control in Health-Care Settings”

World Health Organization (WHO) 2009



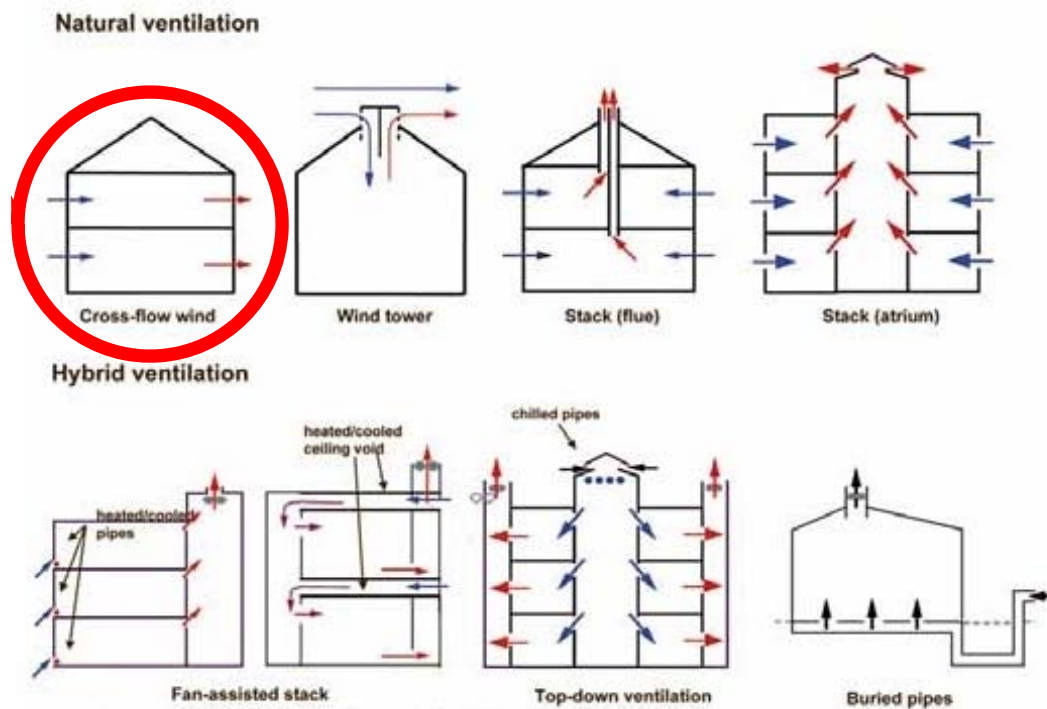
# Naturally Ventilated Laboratory

A Collaborative Effort – PUBLIC, PRIVATE, GOVERNMENT



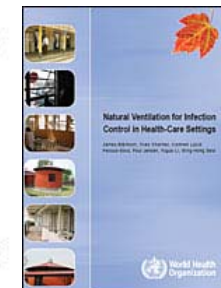


# Natural Ventilation



Source: Courtesy of Professor Martin Liddament, VEETECH, Coventry, UK.

Figure 5.1 Different natural ventilation and hybrid ventilation systems

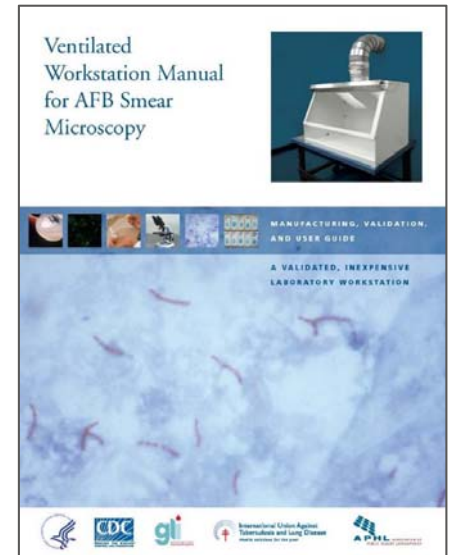




# Primary Containment for this Project

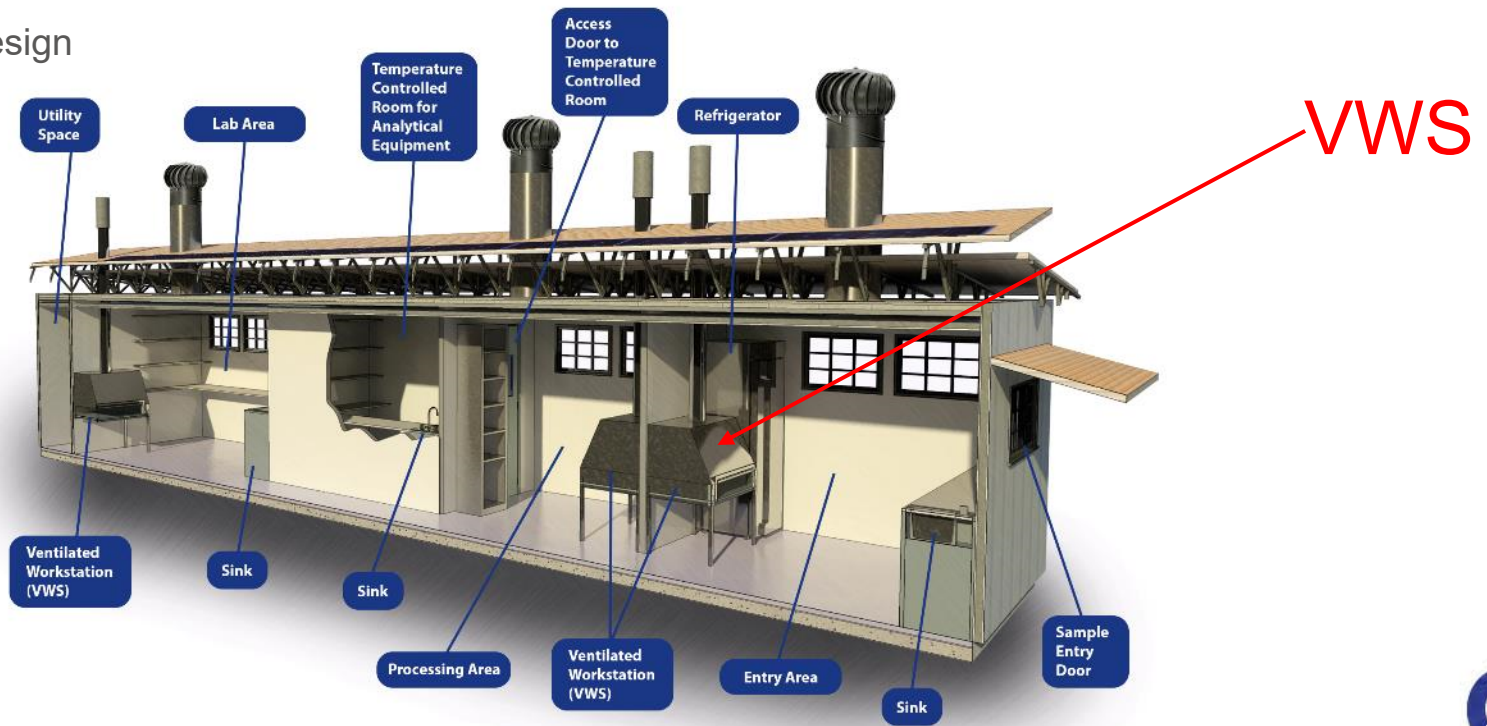
Ventilated Workstation (Class I BSC)

- Developed in partnership with the Stop TB Partnership, WHO, the Union, FIND and the CDC
- Open Source to aid Global Health



# Placement of Primary Containment (VWS) and exhaust stacks properly Ventilate the Laboratory

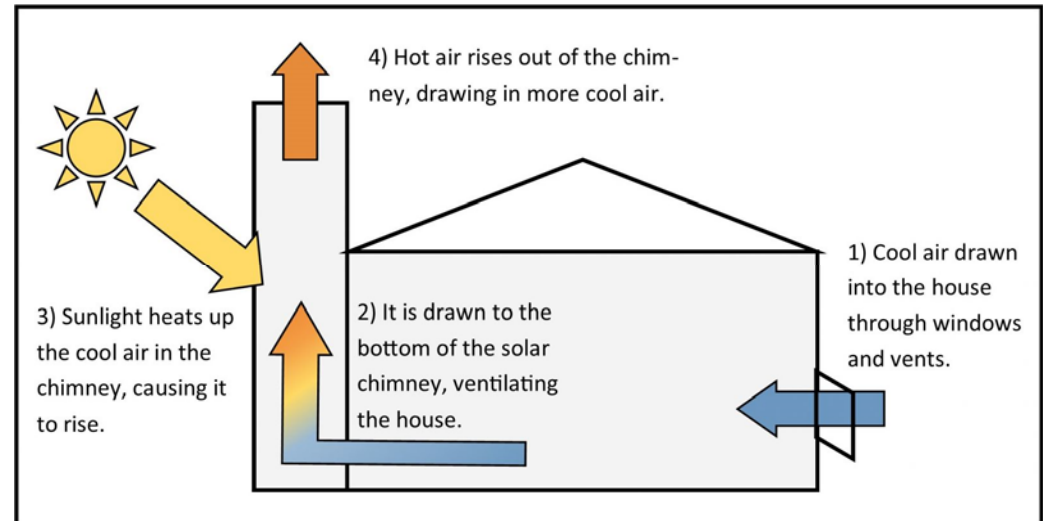
Conceptual design



# VWS Tested with Solar Thermal Stack



# Solar Thermal Stacks





# Lab Ventilation Design based on Primary Containment (VWS)



# Whirlybirds (Wind Turbines)



# Renewable Energy





# Electrical Generated from Solar

Electrical Storage  
requires batteries



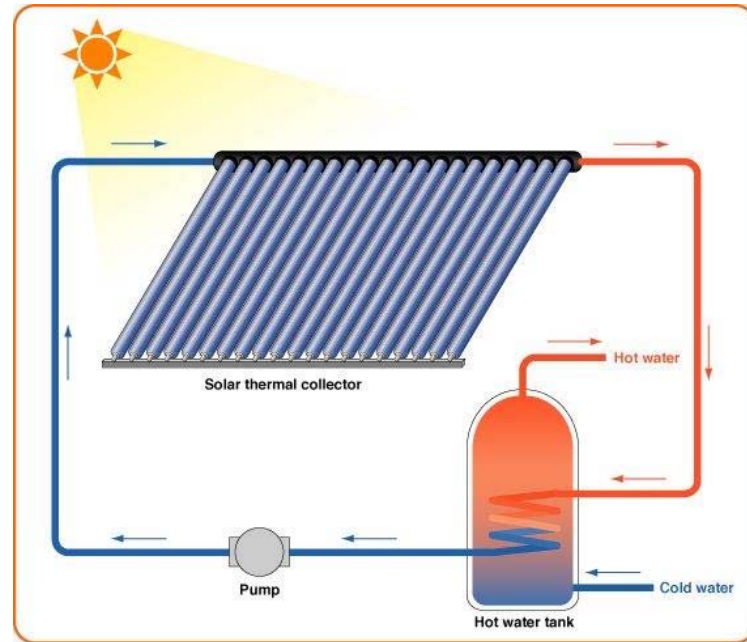


# Electrical Generated from Wind

Electrical storage requires batteries



# Solar Thermal Tubes for Hot Water



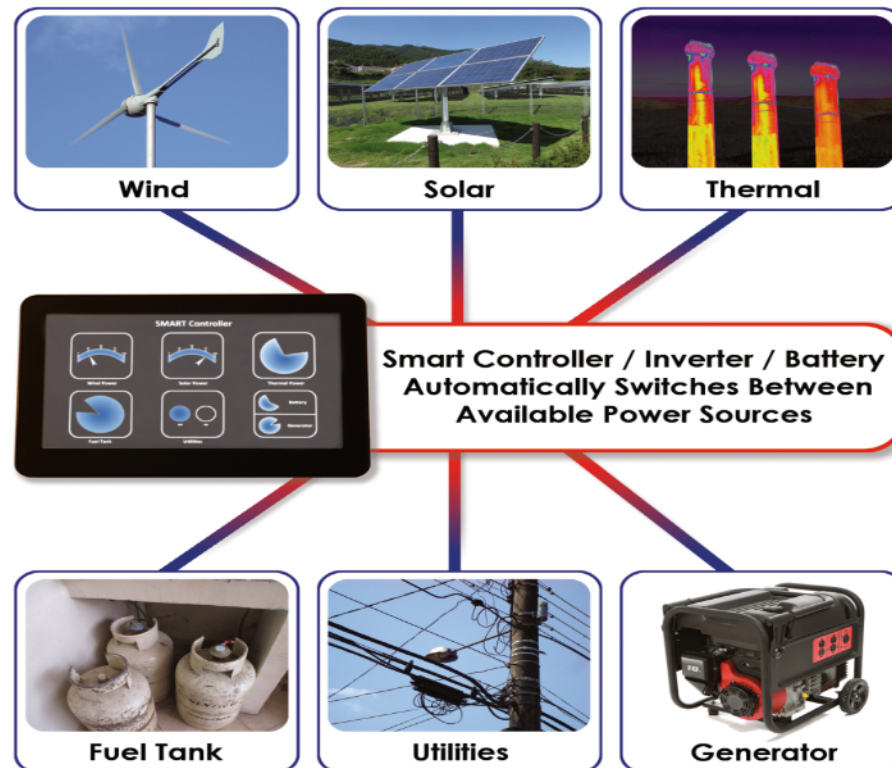
# Solar Thermal Tubes

Hot water storage is efficient





# Utilize Multiple Energy Sources based on Availability and Storage

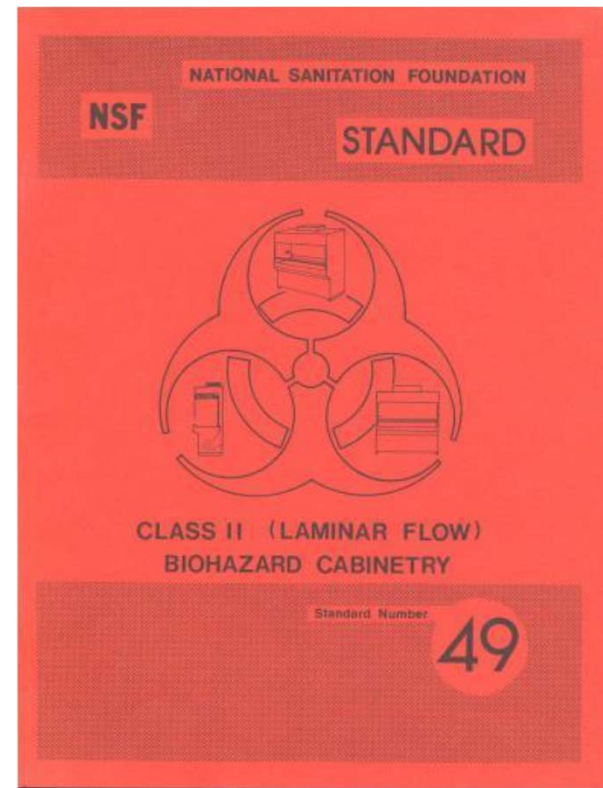




# Primary Containment: Biological Safety Cabinets (BSC)

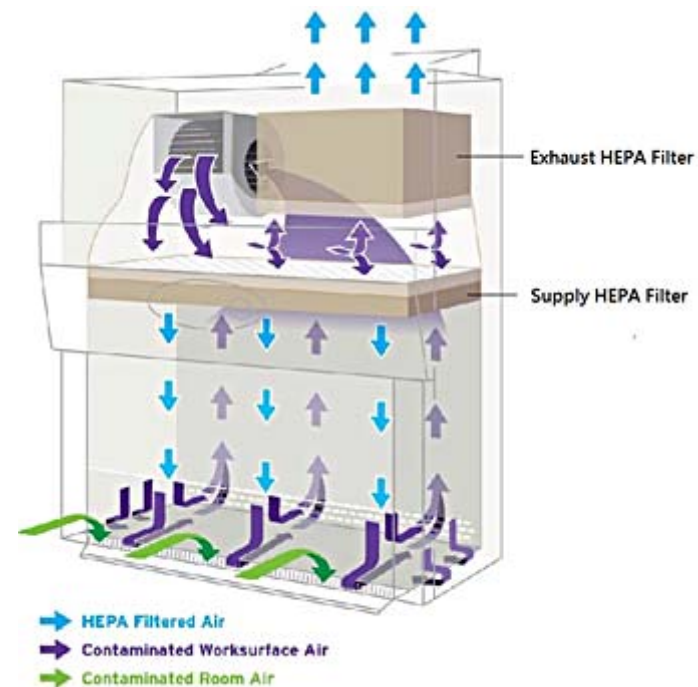
Biological Safety Cabinet:

- Class I and III BSC have not functionally changed since major development in the 1940's.
- Class II development has been “frozen in time” since the 1970's by NSF 49 standard.



# Primary Containment: Biological Safety Cabinets (BSC)

- Class II BSC are energy efficient.
- Especially when not ducted/vented.
- The labs they are placed in are not.
- Why is this?



# Secondary Containment Biological Safety Levels (BSL)



## **HVAC/Filtration/Pressure Systems:**

When did Secondary Containment become so complicated?

Why did Secondary Containment get so complicated?





## **Future Considerations:**

BSL- labs of today are NOT suitable for operation in low-resource areas utilizing sustainable energy sources.

Large volume's of conditioned air required by BSL labs needs to be reviewed.



# Future Considerations:

- Are BSL-3 lab HVAC/Filtration/Pressure systems engineered to “protect” the antiquated Class II BSC?
- Is the Class II BSC antiquated?
- Is there a need to re-develop primary containment so it can operate with less complex HVAC secondary containment?
- Primary and secondary containment systems need to be developed to match emerging sustainable energy sources.



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