Indoor Air Quality Modeling: Basic Information to Support Biosafety Applications

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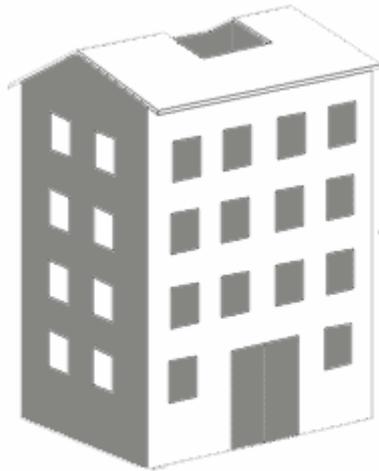
Pacific Northwest National Laboratory
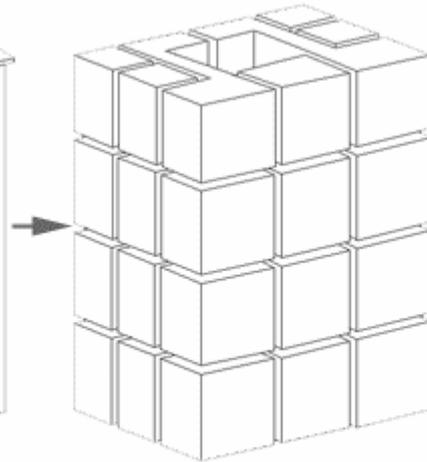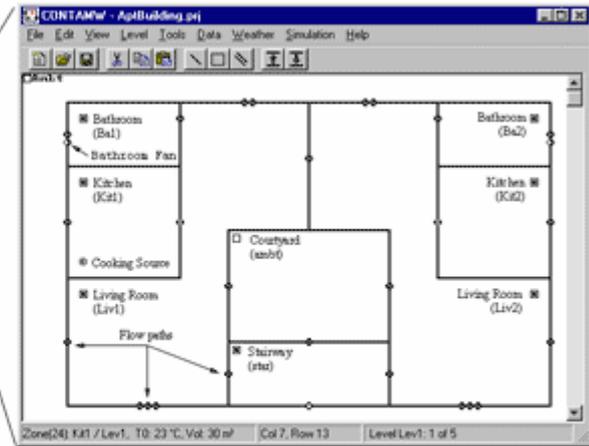
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CONTAM

REAL BUILDING → Idealized Building → CONTAM Building Model

- National Institute of Standards and Technology
- Currently version 2.4B
- Released October, 2006

CONTAM – What is it?

- CONTAM has been developed by the Indoor Air Quality and Ventilation group at NIST

- Predicts airflows and contaminant concentrations in multizone building systems

- CONTAM is used to study the indoor air quality impacts associated with ventilation in large mechanically-ventilated buildings (e.g., offices, schools, labs)

CONTAM – What is it? (cont)

- CONTAM, and other multizone modeling programs, can be useful in a variety of applications to analyze building airflows, pressure differences and contaminant transport.

- CONTAM uses a graphic interface that allows the user to draw floor plans on a "sketchpad" and employ "icons" to represent airflow paths, ventilation system components, and contaminant sources.

CONTAM – What is it? (cont)

- Calculates building airflows and assess building air change rates, "interzonal" airflow rates, and ventilation strategies

- Each zone at each time-step is characterized by a discrete set of steady-state variables, such as temperature, pressure, and contaminant concentration

- The contaminant transport simulation capabilities of CONTAM can be useful for performing indoor air quality analyses including design, contaminant source isolation, forensics, and exposure analysis

CONTAM – Other Features

- CONTAM models the adsorption & desorption of contaminants to building materials

- Modeling deposition on building surfaces can be tricky because the adsorption & desorption parameters are (1) contaminant and material specific **and** (2) are often unknown

- Deposition information can be particularly useful if you are using the model to estimate the level of effort required for decontamination
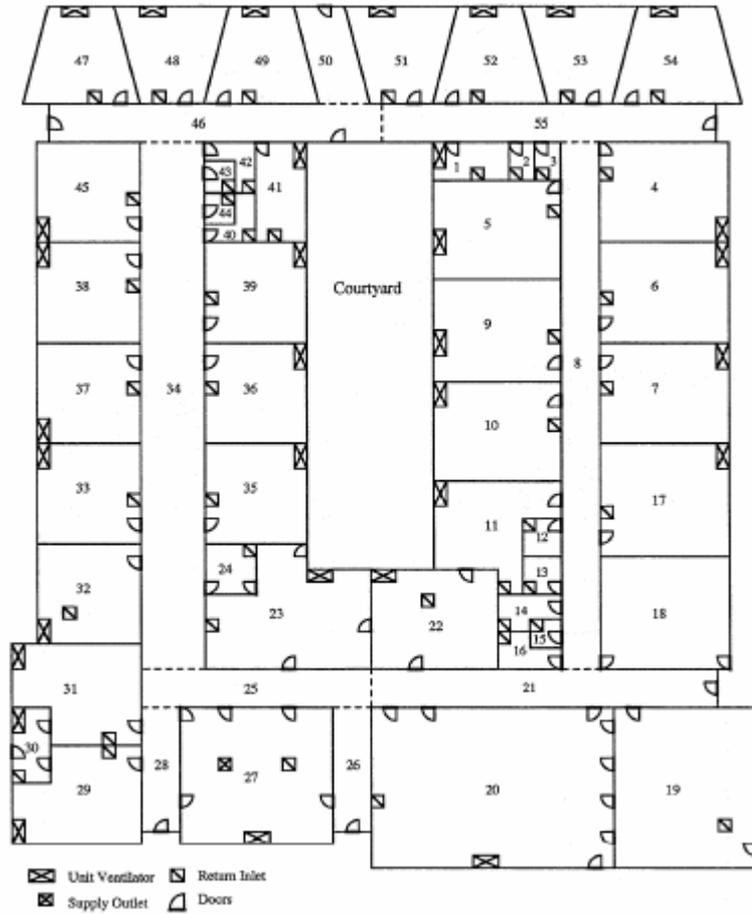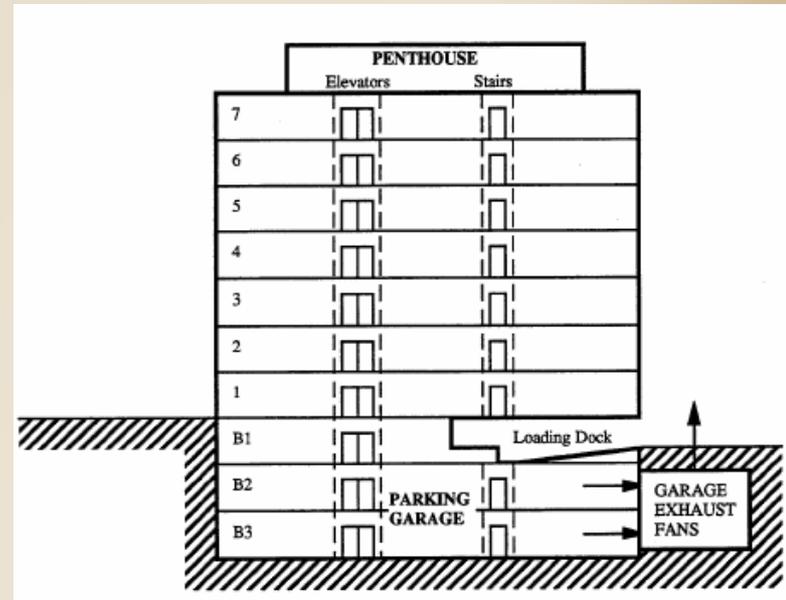
EXPECT THE UNEXPECTED

Sample Application
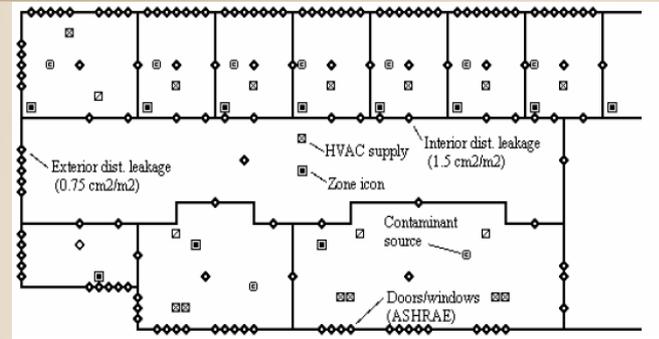
- Rooms are connected to one another and the outdoors via paths that represent leakage sites such as doors and windows.

- Air handling system fans and ductwork are specified.

- The CONTAM model performs a mass balance calculation to estimate the flow between zones and the concentration of contaminants distributed by this flow

EXPECT THE UNEXPECTED

Sample application

For more information on CONTAM:
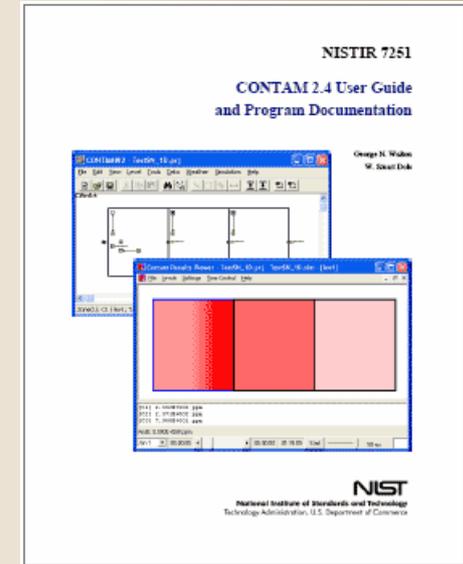
- User information available at:
  http://www.bfrl.nist.gov/IAQanalysis/

- Downloads of the code are available at:
  http://www.bfrl.nist.gov/IAQanalysis/CONTAM/download.htm

- User guide is available at:
 http://www.bfrl.nist.gov/IAQanalysis/CONTAM/userguide.htm

National Lab Support for CONTAM

- A few national labs are proficient in the use of a range of indoor air quality models
- Key national lab contacts:
  - Don Hadley (PNNL) 509.375.3708; don.hadley@pnl.gov)
  - Rich Sextro (LBL) 510.486.6295; RGSextro@lbl.gov

EXPECT THE UNEXPECTED

COMIS Multizone Air Flow Model

- Conjunction Of Multizone Infiltration Specialists

- Developed in 1988-89 by ten scientists from nine countries, during a twelve-month workshop hosted by the Lawrence Berkeley National Laboratory (LBNL)
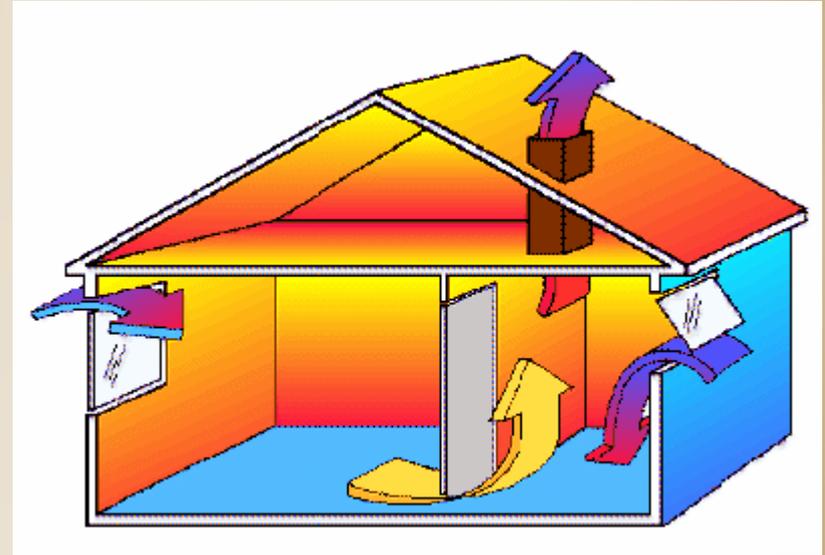
COMIS – What is it?

- COMIS models the air flow and contaminant distributions in buildings.

- Simulates several key components influencing air flow: cracks, ducts, duct fittings, fans, flow controllers, vertical large openings (windows and/or doors), kitchen hoods, passive stacks, and "user-defined components"

- COMIS allows the user to define schedules describing changes in the indoor temperature distribution, fan operation, pollutant concentration in the zones, opening of windows and the weather outside.
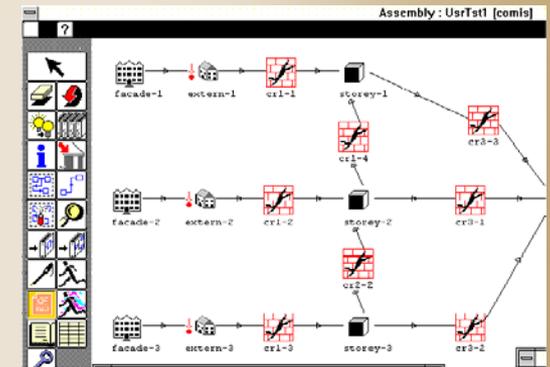
COMIS – What is it? (cont)

- The COMIS air flow calculation assumes steady-state indoor air flows at each time step.

- The contaminant transport is based on a dynamic model and has its own time step, based on the time constant of the most critical zone. The air flow and transport models are coupled.

- Results for air flows and contaminant levels are reported in tables and/or in graphical form

EXPECT THE UNEXPECTED

For more information on COMIS:

- User information available at: http://epb.lbl.gov/comis/index.html

- Downloads of the code and user guide are available at: http://epb.lbl.gov/comis/users.html

- For more information, contact David Lorenzetti (DMLorenzetti@lbl.gov)

A note of caution: the COMIS website has not been updated in over four years!
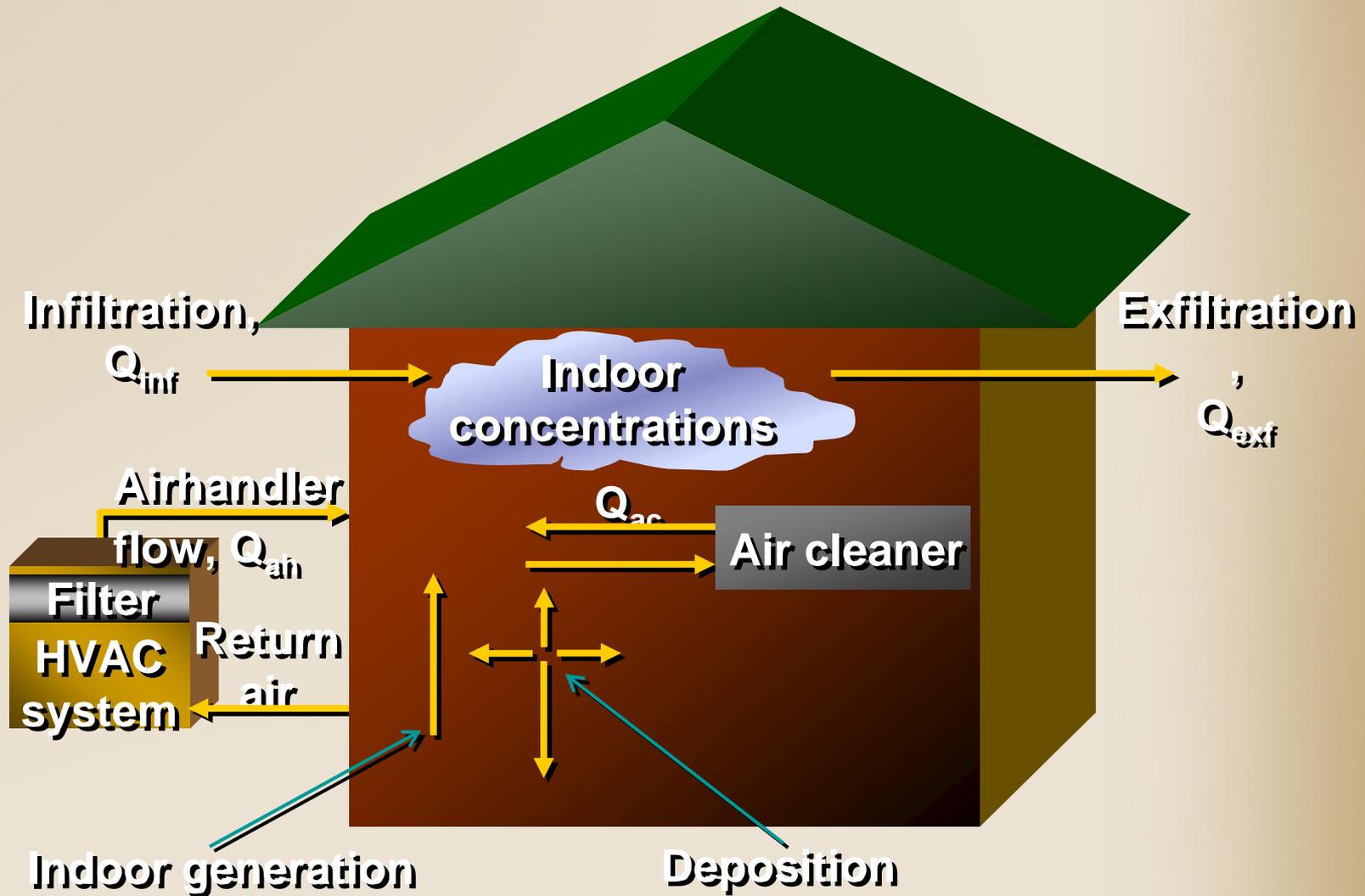
EPA's IAQX Model
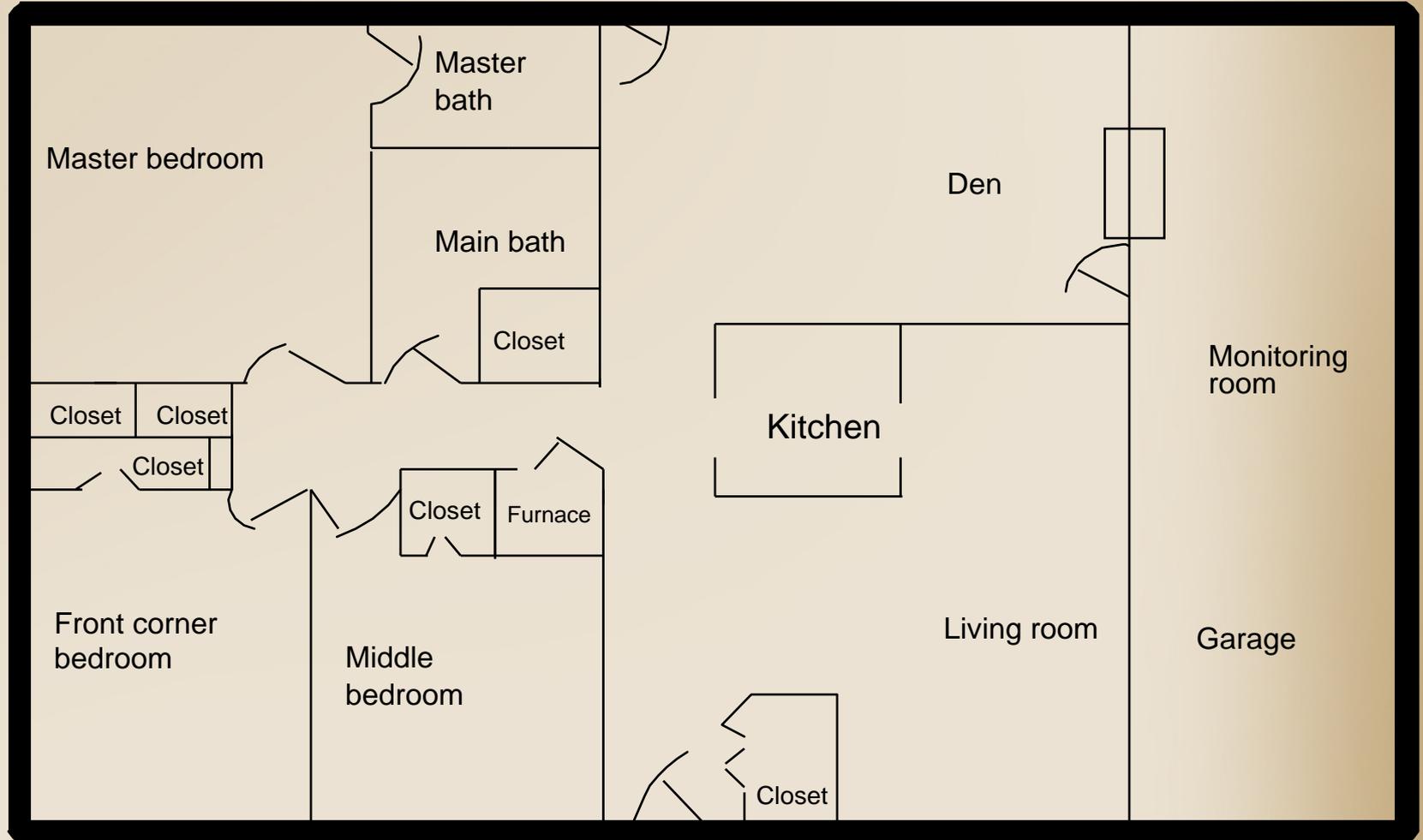
Processes in model…

- Particle size distribution
- Variable outdoor concentration
- Variable ventilation rates
- Penetration as function of particle size
- Indoor deposition rate a function of particle size
- In-room and central air cleaners with efficiency as function of particle size
- Indoor PM sources

http://www.epa.gov/appcdwww/iemb/model.htm

Infiltration,
Q_{inf}

Indoor concentrations

Exfiltration,
Q_{exf}

Airhandler flow, Q_{ah}

Q_{ac}

Air cleaner

Filter

HVAC system

Return air

Indoor generation

Deposition

Indoor Air Quality Modeling Support

- For more sophisticated modeling applications, computational fluid dynamics (CFD) models are available.

- Using a CFD model require another level of effort and experience is a must to do a credible job; however the cost and time required to do CFD modeling is decreasing.