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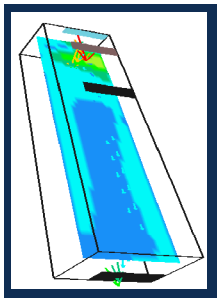

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Enhancing Building Airflow Modeling for Homeland Security Applications

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Mentor: Nerayo Teclemariam

Org: 8116

Sandia Intern Symposium

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U.S. DEPARTMENT OF ENERGY

NNSA

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Content

- Project Overview
- Basics of CONTAM
- The CFD0 Editor
- Test Results
- Conclusion

Project Overview

- Main Focus: Air flow models
- Sub-focuses:
  - CFDO Editor
  - Ducts
  - BioWatch Indoor Reachback Center

Basics of CONTAM

- An indoor air quality and ventilation program
- Calculates airflow and contaminant concentration
- Air circulation quality assessment
- Building Design Evaluation
- Personal Exposure

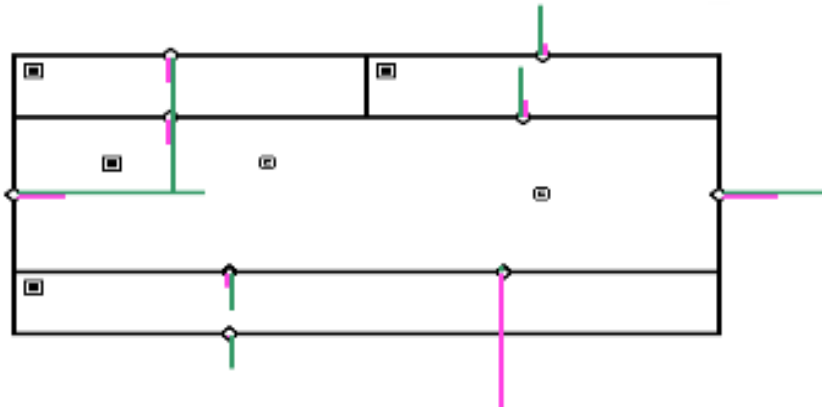


Figure 1: CONTAM model example

The CFD0 Editor is Relatively Accurate

- Computational Fluid Dynamics (CFD)- Fluid mechanics technique for flow analysis
- Root Mean Square (RMS) of divergence:
  - 9.6% Air Speed,
  - 3.2% Temperature
  - 13% Contaminant Concentration

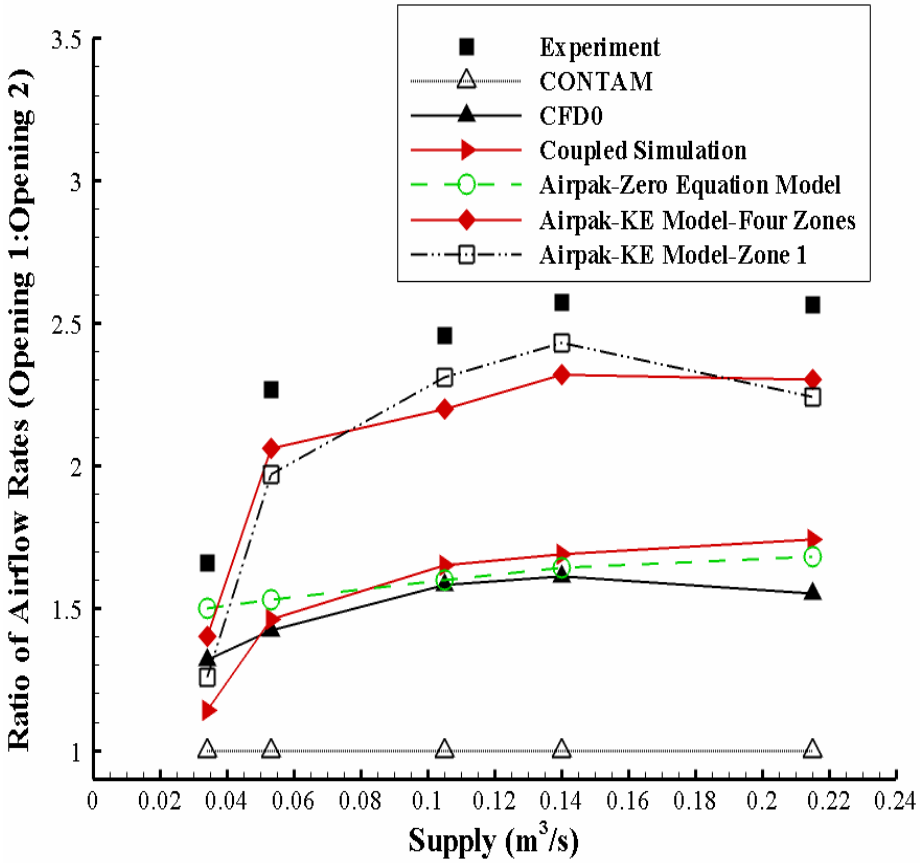


Figure 2: Comparison of various models (Wang, 2007)

The CFD0 Editor Provides Great Visuals

- CFD0 coupled simulation-

  Uses CFD in a zone for a CONTAM simulation

- Graphical Representation

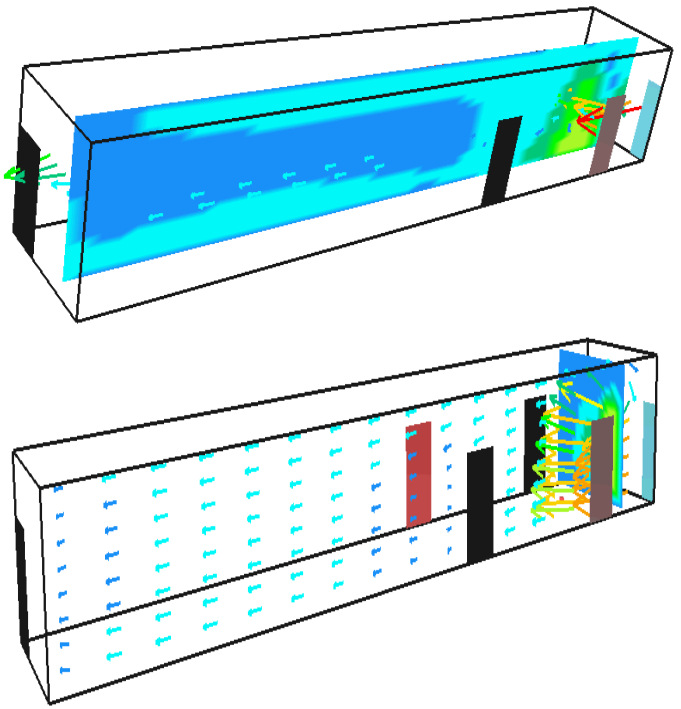
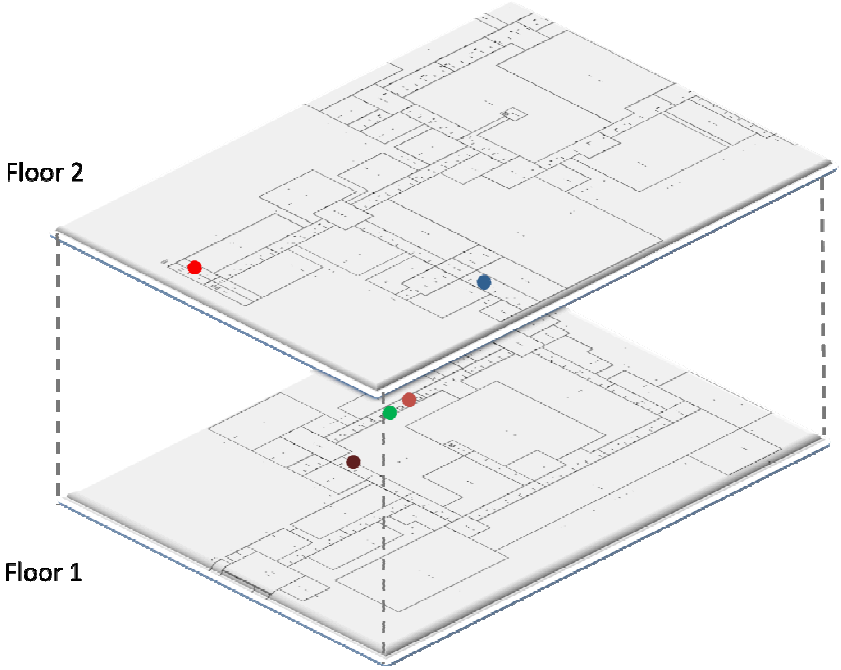


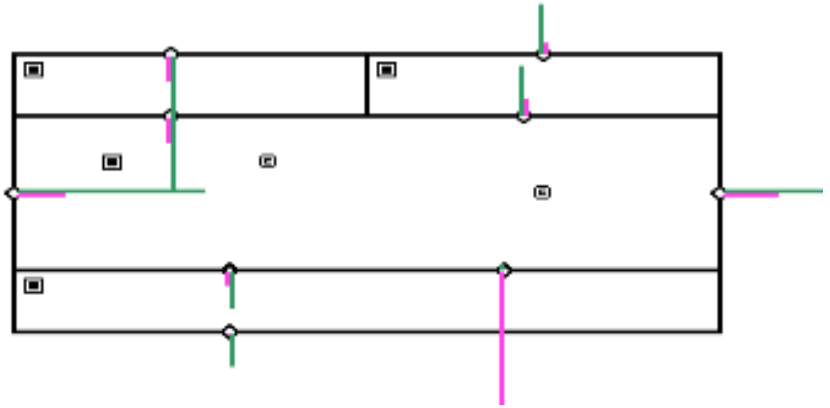
Figure 3: CFD0 outputs

A Simpler Model is Necessary

- Real Facility Case
  - 2 floors
  - 111 zones
  - 88 contaminants



- Simple Case :
  - 1 floor
  - 4 zones
  - 2 contaminants



Simulation Parameters Greatly Affect Simulation Time and Accuracy

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Table of Different Simulations

Model	# of zones	Transient/steady	#Contaminants	Run time (min)
Simple Case 1	4	Steady	2	~1
Simple Case 1	4	Transient	2	~180
Simple Case 1	4	Transient	3	~210
Simple Case 2	5	Transient	2	~210
Real Facility Case	111	Transient	88	Did not complete

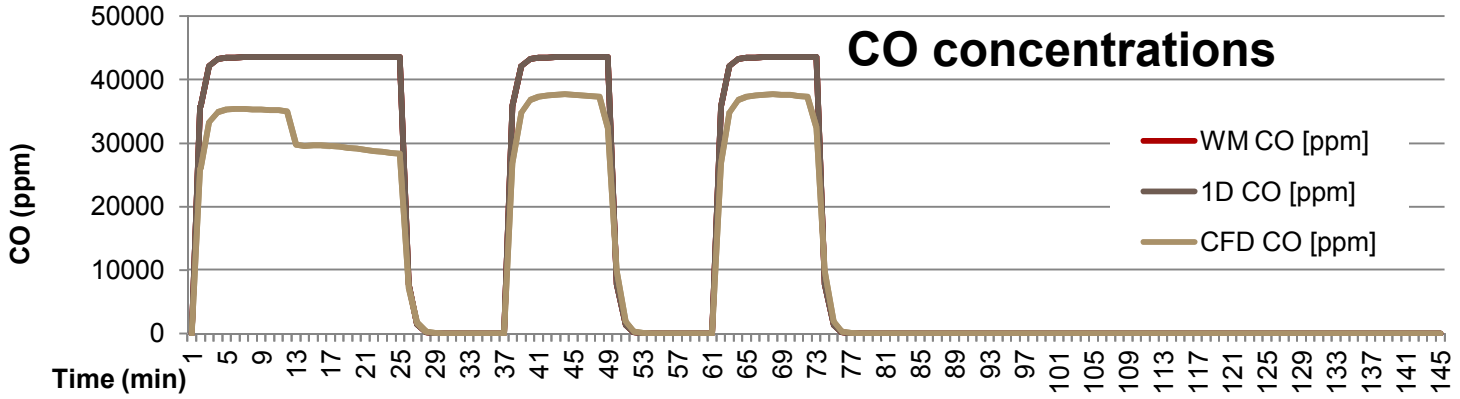

Figure 6: Comparison of WM, 1D, and CFD for simple case

Conclusions

- CFD0 Editor is relatively accurate; however, limitations exist including:
  - Low CFD zone and contaminant capacity
  - Restrictions on flow paths
  - Inadequate Geometries
  - Time

- Recommend waiting to use CFDO capability in CONTAM
  - Future improvement in accuracy, speed, and ductwork compatibility needed
  - Possible ways to bypass limitations

Questions?

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Reference

- Wang, Liangzhu. *Coupling of Multizone and CFD Programs for Building Airflow and Contaminant*. Thesis. PURDUE UNIVERSITY, 2007. West Lafayette: Purdue University, 2007. Print.