Concepts Explored

- Stack Effect
Project Overview

• Understanding smoke control and stack effect concepts
• Define design process for smoke management
• Measure airflow and pressure difference with software validation
• Explore case study of real world application of smoke control
Project Approach

Smoke Control

Experiment I, II.

Modeling CONTAMW

Design Process Interviews

Design Process Flow Chart

Case Study: McCormick Place

Validation
Design Process Interviews

Begin

OPR: Owner's Project Reqs. / BOD: Basis of Design

Goals:

Requirement of Smoke control
Building Codes / NFPA Standards / State Requirement

File damper and smoke damper

Smoke control as an alternative method or trade off

Yes

No

Opening Protective

Criteria

Zoning and smoke control areas

Smoke control scenarios

Method Selection

Controls

Building Codes / NFPA Standards / State Requirement

Opening Protective

Fire damper and smoke damper

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Design Process Interviews

Methods

- Mechanical Building HVAC System
  - Determine number & location of make up air outlets
    - Rate of make up air (CFM)
      - Determine number & location of make up air outlets
        - Number & location of equipment
  - Counterflow Pressurization: Stairwells & Corridors
    - Δ Pressure
      - Number & location of equipment
        - Rate of smoke exhaust (CFM)
          - Determine number & location of exhaust inlets
            - Number & location of equipment
              - Heat and smoke vents / Fans / Draft curtains

Supply Air

- Natural
  - Number & location of equipment

Air Flow

- Counterflow
  - Air velocity
    - Number & location of equipment

Complete Functional Test

Stop
Case Study: McCormick Place

- Explore building’s smoke control design techniques
- Integration of various equipment with the smoke control system
- Tour of building and visualize smoke control equipment
Experiments

Experiment 1: evaluate the influence of stack effect on the diffuser’s airflow
Experiments

Experiment 2: validate the first experiment values using CONTAMW software
Software Validation

CONTAMW

Airflow and Contaminant simulation Software
### Experiment 1 Validation

#### Percentage Difference between CONTAM and Experiment 1 Results: Diffuser 2 and Diffuser 3 Sealed

<table>
<thead>
<tr>
<th>Change in Room Pressure (Pa)</th>
<th>Percentage Difference</th>
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#### Values of Q from Fan Found in CONTAM & Experiment 1: Diffuser 2 and 3 Sealed

- **CONTAM Predictions**
- **Experimental Results**
- **Power**

#### Values of Q from Fan Found in CONTAM & Experiment 1: Diffuser 1 and 3 Sealed

- **CONTAM Predictions**
- **Experimental Results**
- **Power**
Experiment 2 Validation

Airflow Through Fan vs DP - Scenario 1
\[ y = 467.26x^{0.481} \]
\[ y = 420.71x^{0.5181} \]

Airflow Through Fan vs DP - Scenario 2
\[ y = 491.67x^{0.4742} \]
\[ y = 444.47x^{0.5223} \]

Airflow Through Fan vs DP - Scenario 3
\[ y = 493.42x^{0.4724} \]
\[ y = 404.61x^{0.5635} \]

Airflow Through Fan vs DP - Scenario 4
\[ y = 464.37x^{0.495} \]
\[ y = 426.26x^{0.5511} \]