

Why Have a Smoke Control System?

- Reduce the migration of smoke to other areas of the building
 - Extend the time available for people to exit the building.
 - Maintain a tenable environment in the areas of egress.
 - Contribute to the protection of people and property.
 - Assist emergency response personnel.
 - Aid in post-fire smoke removal.

Why Have a Smoke Control System? (cont.)

- IBC requires smoke control systems in the following types of facilities:
 - Atria (3 or more stories).
 - Assembly seating
 - Underground buildings
 - High-rise buildings (>75 ft. above grade)
 - Smokeproof enclosure or pressurized stairway
- Coordination among systems is required by other codes and standards

Coordination Requirements from the Codes – General

■ NFPA 92-2012:

• "6.4.2 Coordination. A single control system shall coordinate the functions provided by the fire alarm system, fire fighters' smoke control station (FSCS), and any other related systems with the operation of the building HVAC systems and dedicated smoke control equipment."

Coordination Req'mts from the Codes – HVAC / Energy Mgt

■ NFPA 92-2012:

- "6.4.3 HVAC System Controls. Operating controls of the HVAC system shall be designed or modified to provide the smoke control mode with the highest priority over all other control modes."
- "6.5 Energy Management. Energy management systems, particularly those that cycle supply, return and exhaust fans for energy conservation, shall be overridden when their control or operation is in conflict with a smoke control mode."

Coordination Requirements from the Codes - Sequencing

■ NFPA 92-2012:

- "6.4.5.3.2 Smoke control systems shall activate individual components, (e.g., dampers, fans) in the sequence necessary to prevent physical damage to the fans, dampers, ducts, and other equipment."
 - + Note: This paragraph implies that dampers and fans cannot be controlled by different systems.

Coordination Req'mts from the Codes – HVAC / Energy Mgt (2)

■ IBC-2012:

"909.4.4 HVAC systems. The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems status. The design shall consider the effects of the fire on the HVAC systems."

What is Sustainability?

- "Provides for the needs of the present without detracting from the ability to fulfill the needs of the future." -ASHRAE GreenGuide (2006)
- Addresses many aspects, including:
 - Energy resource availability
 - Material resource availability and management
 - Effective and efficient usage practices for energy resources and water
 - Air pollution
 - Solid and liquid waste disposal

Measuring Sustainability

- Total Building and Lifestyle Approach
 - LEED
 - IgCC
 - California Title 24
- Energy Efficiency Approach
 - ASHRAE 90.1
 - ASHRAE 189.1

Design Choices for Smoke Ctrl that Impact Sustainability Goals



Negative Impacts

- IBC requires Smoke Control in specific occupancies
- IBC requires automatic weekly self-test
 - Activate system
 - + Runs large fans
 - + Dumps conditioned air to outside
 - Draws outdoor air that must be re-conditioned
 - Highly inefficient from an energy standpoint

Minimizing the Negatives

- Four approaches designers can use
 - Reduce amount of equipment used
 - Downsize required equipment
 - Modify life safety system design
 - Modify building design

Methods to Reduce the Amount of Equipment Used

- Building Automation Systems include control equipment and control circuits to operate fans/dampers for comfort purposes.
- Stand-alone fire protection systems often include control equipment and control circuits to override fans/dampers for life safety.
- Through integration, these controls and control circuits do not need to be duplicated, resulting in fewer materials used on the job.

Methods to Downsize Required **Equipment**

- Workmanship affects sustainability
- Example:
 - , 11 storey stairwell with a winter design temp = 10 °F.

 - If loose construction

 Requires 6050 cfm to pressurize the stairwell
 - Same stairwell if average construction
 - + Requires 2585 cfm to pressurize the stairwell
 - Same stairwell if tight construction
 - Requires 946 cfm to pressurize the stairwell
- Result of sealing cracks, caulking doors/windows, painting walls, aligning doors:
 - Reduced fan size (reduced electricity)
 - Reduced duct size (reduced materials)
 - Less air exhausted during test (less energy to recondition)

Modifications to the Life Safety System Design (Method #1)

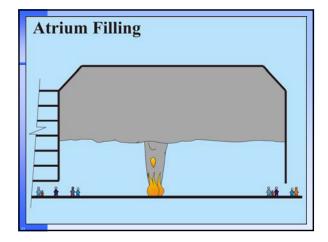
- Use un-conditioned air for pressurization
 - Example 1:
 - + 8 storey stairwell of loose construction
 - + Winter design temperature 10 °F
 - + Pressurize stairwell with conditioned (73 °F) air
 - + Requires 3760 cfm for pressurization
 - Example 2:
 - + Same building
 - + Pressurize stairwell with unconditioned (10 °F) air
 - + Requires 3240 cfm for pressurization
 - Result:
 - + Using unconditioned air saves energy to condition it
 - + Reduces fan size by 500 cfm

Modifications to the Life Safety System Design (Method #2)

- Use deployable barriers to divide building
 - When open stairways are used, all floors connected together are treated as one space
 - + Requires large exhaust and make-up air fans
 - If deployable barriers (roll down doors/smoke curtains) are used, building is divided into smaller spaces
 - + Requires smaller fans
 - + Contains smoke to smaller part of building
 - + Less conditioned air exhausted during tests
 - + Other (non-sustainability) benefits

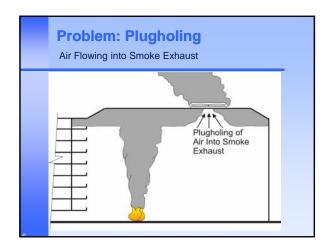
Modifications to the Building Design (Method #1)

- Create a large volume space to collect smoke while people exit.
 - Sometimes called smoke filling approach
- If Evacuation Time is less than the Filling Time, smoke control can be completely passive
 - Passive is most efficient because no energy used



Modifications to the Building Design (Method #2)

- If large volume space is not possible, provide small reservoir to collect smoke while people exit.
 - Increase roof height above top floor walkways
 - Glass walls around top floor walkways
- Allows deeper smoke layer
 - Reduces number of exhaust grilles at ceiling
 - Reduces fan size
 - Prevents plugholing (which causes system failure)



Avoiding Plugholing

- The thinner the smoke layer, the lower the exhaust velocity must be.
 - To reduce velocity at a given location, but maintain total exhaust, must have many grilles
 - ◆ Not always possible
 - + If possible, many more grilles to hide
 - Allowing deeper smoke layer allows higher velocity at each grille
 - ◆ Fewer grilles
 - + Less total fan power vs. system with plugholing

Seeing Integrated BAS and Fire (Smoke Control) in a Positive Light

- Overall goal of smoke control promotes sustainability
 - FM sprinkler test (Oct 2009) proved that controlling/ suppressing fire resulted in much less of building and contents that had to be replaced
 - Smoke control provides similar benefits by further reducing damaged areas of building and contents
 - + Smoke movement is further restricted to areas of building directly involved in fire
 - Building finishes and contents in areas not involved in fire are protected, and do not need to be replaced
 - Protecting the building and contents is much more sustainable than replacing it

Summary

- Integration
 - Building Systems involved
 - Reasons to Provide Integration
- Sustainability
 - Overview of Codes, Standards, and Ratings
 - Negative Impact (required by code)
 - Ways to reduce the Negatives through Design
 - Seeing smoke control as beneficial to sustainability goals