Objectives

- Define ventilation
- Identify the principles of ventilation
- Identify the considerations for proper ventilation
- Identify the safety precautions to be taken while ventilating a structure
- Identify the procedure of ventilation
- Identify the advantages and disadvantages of different types of ventilation
Objectives

• Identify the considerations of ventilating roofs of different types
• Identify the signs of potential backdraft
• Identify the types of tools used during ventilation
• Identify the techniques for cleaning and maintaining ventilation equipment
• Identify the factors used to determine roof integrity
Objectives

- Identify the techniques for removing existing roof openings
- Identify the technique for opening windows from the inside and outside with or without tools
- Identify the techniques for breaking window or door glass
- Define the stack effect
- Identify the manual and automatic ventilation devices found within structures
- Identify the techniques for ventilating a lower grade
Define Ventilation

- Ventilation - The process of removing smoke, heat and toxic gases from a building and replacing them with air
Identify the Principles of Ventilation

• To systematically remove and replace the heated air, smoke and gases from a structure with cooler air to:

  – Allow entry by firefighters
  – Improve life safety for rescue
  – Improve visibility
  – Locate trapped occupants faster
  – Fresh air to occupants
  – Advance hose lines more rapidly and safely
  – Reduce backdraft and flashover
  – Limit fire spread
  – Reduce property loss
Identify the Considerations for Proper Ventilation

- Life safety hazards
- Visible smoke conditions
- Type of building involved
- High rise buildings
- Basement and windowless buildings
- Location and extent of the fire
- Selecting a place to ventilate
Identify the Safety Precautions to be Taken While Ventilating a Structure

• Wear full PPE including SCBA
• Evaluate the working area(roof) for safety
  – Melting asphalt
  – Spongy roof
  – Smoke coming from the roof
  – Fire coming from the roof
  – Note the existence of obstructions or excessive weight
• Provide a second means of escape
• Exercise caution in working around electric wires or guy wires
Identify the Safety Precautions to be Taken While Ventilating a Structure

• Work in groups of two, with no more people than absolutely necessary
  – Guard the openings
  – Keep personnel a safe distance from axes and saws
  – Remove personnel as soon as ventilation is complete
• Utilize ladders and other precautions to protect personnel
  – Use lifelines, roof ladders or other means to protect personnel from sliding and falling off the roof
  – When using a roof ladder, make sure it is firmly secured to the peak of the roof before using it
  – Extend ladders at least five rungs above the roof line
Identify the Safety Precautions to be Taken While Ventilating a Structure

• Have a charged hoseline in place
  – Cooling vented gases
  – Extinguishing ash and debris
  – **NEVER** direct stream into vent hole

• Use saws and equipment properly
  – Start power tools on the ground to ensure operation
  – Shut power tools off before carrying them up a ladder
Identify the Safety Precautions to be Taken While Ventilating a Structure

• Always work with the wind to your back or side

• When breaking glass, keep hand above the point of contact

• Watch for possibility of fire spread
  – Observe the wind direction in relation to exposures
  – Watch for fire extension
Identify the Procedure of Ventilation

• Two types of ventilation
  – Horizontal
    • Utilizes horizontal openings in a structure such as doors and windows
  – Vertical
    • Involves openings in the roofs or floors
    • Locate at highest point and over seat of fire
    • One big hole is better than several small ones
    • Minimum size 4' x 4'

• Two methods of ventilation
  – Natural
    • Depends on convection currents, wind, and other natural air movement
  – Mechanical
    • Uses mechanical means to augment natural ventilation
Identify the Procedure of Ventilation

• Mechanical
  – Negative pressure
    • Draw fire gases from the structure
  – Positive pressure
    • Force fire gases from the structure
Identify the Procedure of Ventilation

• Mechanical
  – Negative pressure
    • Creates negative pressure inside to suck out smoke and gases
    • Place ejector at exhaust point
    • Watch for churning action at the exhaust opening
Identify the Procedure of Ventilation

• Mechanical
  – Negative pressure
    • Ways to prevent the churning effect
Identify the Procedure of Ventilation

• Mechanical – Positive Pressure Procedure
  • Blowers positioned so the cone of air covers majority of the entrance opening.
  • Accomplished by varying the distance from the entrance opening
Identify the Procedure of Ventilation

• Mechanical - Positive Pressure Procedure
  – Most efficient when the exhaust opening is 75% to 150% of the entrance opening.

Entrance Exhaust Opening =
Identify the Procedure of Ventilation

• Mechanical –Positive Pressure Procedure
  – It is imperative that the flow or path of pressurized air between the entrance opening and the exhaust opening be **controlled and directed** to achieve effective ventilation
Identify the Procedure of Ventilation

- Mechanical – Positive Pressure Procedure
Identify the Procedure of Ventilation

• Mechanical – Positive Pressure Procedure
  – Break the structure down into smaller parts
  – Allows the maximum amount of pressurized air to ventilate each area
Identify the Procedure of Ventilation

• Mechanical
  – Hydraulic
    • Direct a fog stream out the opening to draw gases out of structure
    • Fog stream “cone” should just touch the edges of the opening
Identify the Advantages and Disadvantages of Different Types of Ventilation

• Natural – Horizontal
  – Advantages
    • Uses existing openings
    • Uses natural air currents
  – Disadvantages
    • Depends on natural air currents
    • Routing may expose other parts of the building
    • Same routes used for ventilation may also be used by occupants trying to escape
    • Danger of released gases igniting higher portions of the building
Identify the Advantages and Disadvantages of Different Types of Ventilation

• Mechanical – Vertical
  – Advantages
    • Prevents a backdraft
    • Usually assists in confining the fire
  – Disadvantages
    • Requires firefighters to work above the ground
    • Possibility of roof failure
    • Requires close communication
Identify the Advantages and Disadvantages of Different Types of Ventilation

• Mechanical – Trench or Strip
  – Advantages
    • Aids in stopping the horizontal spread of fire
  – Disadvantages
    • Must be cut well ahead of the advancing fire
    • Must be a minimum of four foot wide which requires lots of time and manpower
Identify the Advantages and Disadvantages of Different Types of Ventilation

• Mechanical – Forced
  – Advantages
    • Ensures a positive control
    • Supplements natural ventilation
    • Facilitates a more rapid rescue under safer conditions
    • Reduces smoke damage
    • Promotes good public relations
    • Can be setup without firefighters having to enter the smoke filled environment
    • Equally effective with vertical or horizontal ventilation
    • Allows more efficient removal of smoke and heat
    • Air exchange is faster than negative pressure ventilation
    • Placement of blower does not interfere with ingress or egress
Identify the Advantages and Disadvantages of Different Types of Ventilation

• Mechanical – Forced
  – Disadvantages
    • Introduction of air can cause the fire to intensify and spread
    • Dependent upon a power source
    • Requires special equipment
Identify the Advantages and Disadvantages of Different Types of Ventilation

- **Hydraulic**
  - **Advantages**
    - May be used in situations in which other types of ventilation are not applicable
    - Takes advantage of the air drawn into the fog stream
  - **Disadvantages**
    - May increase the amount of water damage inside the structure
    - Puts a drain on the available water supply
    - Increases the ice problem during freezing weather
    - Firefighters operating the nozzle must remain in the heated contaminated area
    - Operation may be interrupted when crew goes for fresh SCBA bottles
Identify the Considerations for Ventilating Roofs of Different Types

• Flat Roofs
  – Use existing openings first
  – Look for obstacles and excess weights on roof, such as HVAC systems, skylights, vent pipes, other openings
Identify the Considerations for Ventilating Roofs of Different Types

• Pitched Roofs
  – Work from a roof ladder
  – Look for hot spots or sagging of the roof area PRIOR to walking on surface and CONTINUALLY during ventilation
  – Always sound roof PRIOR to walking on surface and continually during ventilation
  – Look for roof additions or changes, such as overhangs, inverted flat roofs, security measures, parapet walls
  – Look for obstacles and excess weights on roof, such as HVAC systems, skylights, vent pipes, other openings
Identify the Considerations for Ventilating Roofs of Different Types

• Curved / Arched Roofs
  – Be conscious of the danger of sudden and total collapse
  – Roof ladders are useless, recommend aerial devices
  – Be aware of concealed voids, such as cocklofts and attic spaces covered by ceilings
  – Provide two means of escape from the roof, should be remote from each other
Identify the Signs of Potential Backdraft

• **Definition:** The explosive change of superheated gases in an oxygen deficient atmosphere to an inferno with the addition of oxygen

• **Signs**
  – Smoke stained windows
  – Smoke puffing at intervals from building (breathing)
  – Pressurized smoke coming from small cracks
  – Little or no visible flame from the exterior
  – Color of smoke changes

  *Black smoke becoming dense gray yellow*
Types of Roof Cuts

• Rectangular Cut
  – Requires four cuts completely through the decking
  – Use care to not cut structural supports.
  – Stand upwind and have a safe exit.
  – Can use a triangular cut to help pry up
  – If several layers exist, may have to peel a layer at a time
Types of Roof Cuts

• Louver Cut
  – Used for flat or sloping roofs with plywood decking
  – Power saw or axe used to make the cuts
  – Can quickly create a large opening
Types of Roof Cuts

• Triangular cut
  – Used to prevent metal decking from rolling away as it is cut
  – A saw or axe is used
  – Several may be needed because of their small size
Types of Roof Cuts

• Peak cut
  – Used for peaked roofs with plywood sheeting
  – A tool is used to reveal the roof covering along the peak
  – A power saw or axe is used to make a series of vertical cuts
  – Individual panels are then louvered or removed
Identify the Types of Tools Used During Ventilation

- Chain Saw
- Circular Saw
- Reciprocating Saw
- Metal Cutter
Identify the Techniques for Cleaning and Maintaining Ventilation Equipment

• Visual Inspection
• Wipe down and clean
• Fuel power equipment
• Sharpen blades as needed
• Repair or remove from service damaged equipment
• Sand and apply boiled linseed oil to wood parts
Identify the Factors Used to Determine Roof Integrity

• Sounding
  – Before stepping onto and while moving, strike roof with a heavy tool sledge hammer
  – Listen for a solid sound with little vibration
  – NOT RELIABLE ON TRUSS ROOFS
Identify the Factors Used to Determine Roof Integrity

• Observation of an unsafe roof
  – “Spongy” roof
  – Melting asphalt
  – Smoke coming from roof
  – Fire coming from roof
  – Excess weight (ex. HVAC)
  – Elapsed time of fire

  The longer the fire has been burning, the less the roof integrity
Identify the Techniques for Removing Existing Roof Openings

- Skylights, rooftop stairway, exit doors, ventilators
  - Should be first consideration for ventilation
  - Easier to open / remove then roof
  - Less expensive
  - May have release on inside or outside
    - May be locked
      - Unlock or cut lock
    - May need to be pried / forced
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

• Double hung
  – Two sashes move up and down
  – Common in residences
  – One center lock or one on either side
  – Open or break locking mechanism to force entry
  – Place a prying tool under the lower sash and force it up
  – May be cheaper and easier to break glass then to damage frame
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

- Single hung
  - Upper sash is fixed—only lower sash moves
  - Locking mechanism is the same
  - May be difficult to distinguish from exterior
  - Use same technique as forced entry through double-hung window
  - Breaking glass and opening the window is generally easier
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

- **Awning / Jalousie**
  - Adjustable, overlapping sections of tempered glass
  - Operated by hand crank
  - Difficult to force
  - Avoid if possible
  - Break lower panel and operate crank
  - Break out panels
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

• Horizontal sliding with lock in the center
  – Similar to sliding doors
  – Rods and poles are placed to prevent break-ins
  – Force in the same manner as sliding doors (use pry bar to break latch)
  – Attempt to locate another window if a security rod is present
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

• Casement
  – Steel- or wood-frame windows that crank open
  – Similar to jalousie or awning windows
  – Should be avoid because they are difficult to open
  – To force, break glass, unlock, and open manually
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

• Projected
  – Also called factory windows
  – Avoid forcing entry
  – To force entry, break a pane, unlock, and open the window manually
  – If opening is not large enough, break out entire assembly
Identify the Technique for Opening Windows from the Inside and Outside With or Without Tools

• Barred or screened
  – Break glass through the bars or remove screen
  – Open window and remove the screen
Identify the Techniques for Breaking Window or Door Glass

• Plate
  – Stronger and thicker than ordinary glass
  – Being replaced by tempered glass
  – Easily broken with a sharp object
  – Large sharp pieces
Identify the Techniques for Breaking Window or Door Glass

• Tempered
  – Four times stronger than regular glass
  – Breaks with a sharp object to the corner near the frame
  – Small pieces that are not sharp
Identify the Techniques for Breaking Window or Door Glass

• Plexiglass
  – Stronger than Tempered glass
  – Plastic glass
  – Difficult to break – saw may be tool of choice
  – Very large piece
Define the Stack Effect

- **Winter Stack Effect**
  - Outside temperature is lower than the internal temperature
  - Smoke rises to the upper levels

- **Summer Stack Effect**
  - Outside temperature is higher than the internal temperature
  - Smoke drops to the lower levels
Define the Stack Effect

- High rise buildings
  - Smoke and fire spread
    • Pipe shafts
    • Stairways
    • Elevator shafts
  - Many have hard to break sealed windows.
  - Unique smoke patterns with stack effect.
  - Newer buildings have smoke management in the HVAC.
  - Designate one stairwell as a rescue route.
  - Positive-pressure fans can keep smoke out of the stairs
Identify the Manual and Automatic Ventilation Devices Found Within Structures

• Manual – Existing Roof Openings
  – Scuttle hatches
  – Skylights
  – Monitors
  – Ventilating shafts
  – Stair way doors
Identify the Manual and Automatic Ventilation Devices Found Within Structures

- Automatic
  - HVAC systems
  - Fusible link
Identify Techniques for Ventilating a Lower Grade

- Basement / Cellar
- Crawl Space
- Below grade void

- Create as many openings on one side of the structure as possible and allow firefighters to enter from the opposite side
- Ventilate through the floor over the fire
- Firefighters must descend the stairs through the venting combustion products
Q & A