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Welcome to the

2019 Annual Conference Educational Sessions

AHRI

Construction Fire Safety Best Practices

- BCD-231

ICC INTERNATIONAL CODE COUNCIL PREFERRED PROVIDER

CONTINUING EDUCATION

- Ray O'Brocki, CBO
- Manager, Fire Service Relations
  American Wood Council

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

CONTINUING EDUCATION

Course description

- This program provides information to assist the Fire Service charged with responsibilities for fire and life safety on a construction site to follow best practices. Builders and building officials will also benefit from the information provided. The purpose is to reduce the risk of injuries and losses from fire. The information applies to the design and planning stages as well as the actual construction phase of buildings. Many hazards can be addressed before they become an issue by adoption of best practices and rigorous code enforcement. The primary focus of this program is on large buildings during construction. Other topics that include demolition, alterations, renovations, repair and maintenance, as well as newly-completed buildings will be discussed. This program provides guidance that is based on compliance with Chapter 33 of the *2018 International Fire Code*, Chapter 33 of the *2018 International Building Code*, and NFPA Standards 1 and 241.

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Learning Objectives

- Upon completion, participants will be better able to:

1. **Risks & Hazards**
   - Identify risks & hazards on constructions sites. Learn the leading causes of fires in structures under construction.
2. **Codes & Standards**
   - Apply model codes and standards that pertain to safety precautions during construction.
3. **Best Practices**
   - Identify best practices regarding housekeeping, hot work, equipment fueling, smoking, food preparation and other hazardous activities on construction sites.
4. **Fire Safety Plans**
   - Identify the components of a good fire safety plan and be able to work with builders to develop a plan.

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CONSTRUCTION FIRE SAFETY COALITION

- www.constructionfiresafety.org

Construction Fire Safety Best Practices

Polling Question

1. **What is your profession?**
   a) Architect
   b) Engineer
   c) Code Official
   d) Fire Service Member
   e) Builder/Product Manufacturer/Other

Construction Fire Safety Best Practices 7

Nature of the Problem

- U.S. fire departments report the following structure fire averages
- 3,750 under construction
- 2,560 during major renovations
- 2,130 under demolition

- Campbell, Richard, NFPA, *Fires in Structures Under Construction, Undergoing Major Renovation, or Being Demolished*, April 2017

Construction Fire Safety Best Practices

Significant Fires During Construction

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Denver, Colorado
March 7, 2018

- Two dead, one missing
- Middle of afternoon
  - Three alarms
  - Six roof exposure fires
- Five-story wood-frame
  - 80-unit multi-family
- Radiant heat melted 40 vehicles
- Undetermined cause

- Courtesy the Denver Post

Courtesy the CBS Denver

College Park, Maryland
April 24, 2017

- Seven-story mixed use
  - Retail/residential
- Sprinkler system installed, but not yet operational
- UMD closed, senior housing evacuated
- $39 million
- Cause: accidental
- Razing top five floors

- Courtesy the Washington Post

Waltham, Massachusetts
July 23, 2017

- Apartment building under construction
  - 264 units
  - Five buildings
- 10 alarms depleted Boston-region fire resources
- High winds affected spread
- Chief Paul Ciccone: “Fire was intentionally set”

- Courtesy Scott Eisen for the Boston Globe

Oakland, California
July 7, 2017

- The Waverly
  - Seven story, mixed use
  - 328,000 ft²
  - 196 units
- Construction crane collapse risk
  - Spinning in thermal column
- 100 neighbors evacuated
- ATF: Undetermined cause
- Similar to other East Bay arson fires

- Photo credit: SF Gate. com

Boston, Massachusetts
June 28, 2017

- Treadmark Building
- 83-unit apartment
  - Occupancy due within 17 days
  - Six stories
- Sprinkler status operational, but not "on"
- 90-minute call delay
- Emergency generator exhaust too close to combustibles

- Photo courtesy Boston.cbs.local.com

Understanding Risks & Hazards

- It's no surprise that construction sites can become an unsafe environment

Sources of ignition

- Smoking Materials
- Cooking
- Open Flames
- Electrical equipment
- Light fixtures
- Heat and Sparks from grinding and cutting metal
- Arson

Sources of Fuel

- Combustible refuse and trash
- Building materials
- Flammable gases - e.g. propane
- Flammable liquids
- Packaging materials

Causes of Construction fires

- Cooking Equipment - 27%
- Heating Equipment - 13%
- Intentionally Set Fires - 13%
- Torch, Burner, or Soldering Iron - 6%
- Smoking Materials - 5%
- Exposure Fires - 3%
- Playing with Heating Source - 2%

Campbell, Richard, NFPA, *Fires in Structures Under Construction, Undergoing Major Renovation, or Being Demolished*, April 2017

Fires Occurring During Major Renovation

- Heating Equipment - 15%
- Intentionally Set Fires - 13%
- Torch, Burner, or Soldering Iron - 10%
- Cooking Equipment - 9%
- Smoking Materials - 4%
- Exposure Fires - 3%

Campbell, Richard, NFPA, *Fires in Structures Under Construction, Undergoing Major Renovation, or Being Demolished*, April 2017

Fires Occurring During demolition

- Intentionally Set Fires - 42%
- Torch, Burner, or Soldering Iron - 12%
- Heating Equipment - 3%
- Cooking Equipment - 2%
- Smoking Materials - 2%
- Exposure Fires - 2%

Campbell, Richard, NFPA, *Fires in Structures Under Construction, Undergoing Major Renovation, or Being Demolished*, April 2017

Polling Question

2. What is the leading cause of fires in buildings under construction?

a) Arson
b) Heating equipment
c) Cooking equipment
d) Torch, burner, soldering iron

Codes & standards

- …that pertain to safety precautions during construction

Model Codes that safeguard Construction

Chapter 33

Chapter 16

Chapter 33

Owner Responsibilities

- **Safe work environment** – every owner's primary responsibility
- **Comprehensive management policy** – starts at the top and works down to labor force
- Building owner & general contractor – **high priority on fire safety**
- Builder's primary responsibility – **work closely with AHJ**
  - ensure **all regulatory requirements are met**
  - control **permitting process for hot work**

NFPA – fire safety program

- *"A **fire safety program** shall be included in **all construction, alteration, or demolition contracts**, and the right of the owner to administer and enforce this program shall be established, even if the building is entirely under the jurisdiction of the contractor."* NFPA 241 Sec. 1.3.4
- The **owner must designate** a person who shall be **responsible for the fire prevention program** and **authorize them to enforce** its provisions. NFPA 241 Sec. 7.2

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program manager Responsibilities

- NFPA 241 sec. 7.2.4
- Proper training in the use of fire protection equipment
- Development of pre-fire plan with local FD
- Responsible for presence of adequate fire protection devices
- Supervision of the permitting of hot work
- Weekly self inspection program
- Authorize planned impairments

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program manager Responsibilities

- The pre-fire plan should include, but not necessarily be limited to
- Fire department site access points
- Fire extinguisher and initial attack equipment locations
- Any special provisions for firefighting activities
- Disposition of all built-in fire protection measures
- Emergency escape routes and stairs
- Hydrant positions
- Assembly point locations
- Details of temporary accommodation and storage areas, including hazardous item storage locations (e.g. flammable liquids, gas cylinders, etc.)

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Employee Responsibilities

- Establishment and maintenance of work conditions is management's responsibility
- However, all employees should also be fire and safety conscious
  - Report - all potential fire hazards
  - Observe - all fire safety rules, procedures and codes of safe practice
  - Use - tools, safety equipment and personal protective equipment provided

job site visitor Responsibilities

- Job site visitors must check in with site supervisor for safety reasons
- Visitors must wear appropriate PPE
  - Hard hat and safety vest
  - Goggles
  - Stout shoes

- Visitor safety tips
  - Staying visible
  - Remaining alert
  - Being aware of surroundings
  - Never approaching equipment, unless the operator has acknowledged their presence
  - Not parking vehicles in any way that would block fire department access

AHJ Responsibilities

- Team providing local government representation

1. Building Department – provides enforcement and oversight of building construction process in accordance with state and local statutes
2. Fire Prevention Bureau – enforces adopted Fire Code provisions
3. Fire Suppression Division – develops
   - pre-fire plan, tactics, and strategy
   - site assessment of water supply, access to the area, and exposure protection

Actions to be taken

- What specific things can you do to improve upon fire and life safety on Constructions sites?
  - Understand Fire & Building Code provisions designed to increase safety on-site
  - Understand and implement appropriate NFPA Standards
  - Train, educate, and certify all personnel on what to look for and what to do if a fire occurs
  - Eliminate un-safe practices
  - Identify and follow "best practices"

Polling Question

3. Which code does not safeguard structures under construction?

a) NFPA 241
b) IBC Chapter 33
c) IFC Chapter 33
d) NFPA 1 Chapter 16
e) None of the above

Fire safety program

- All of the following should be addressed in a fire safety program
  - Good housekeeping
  - On-site security
  - Fire protection systems: installation as construction progresses and preservation of existing systems during demolition
  - Training of employees
  - Development of a pre-fire plan w/ local fire department
  - Rapid communication
  - Consider special hazards
  - Protection of existing structures from exposure to fire

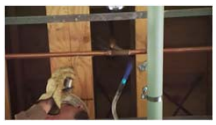
Fire safety plan

- NFPA 241 Chapter 7 / IFC 3308

- Fire prevention plan (FPP) should include
  - Organizational structure and responsibilities for fire safety
  - Name and contact phone number of person(s) responsible for FPP compliance
  - Arrangements for recording fire safety training given to site personnel and visitors, including required actions in case of fire
  - Risk assessments and FPE reports requiring specific fire safety measures
  - Fire safety requirements in compliance with applicable fire and building codes
  - Procedures for reporting emergencies to the fire department
  - Procedures for emergency notification, evacuation and/or relocation of all persons in the building under construction which are aligned with site emergency notification plan

Fire safety plan: Continued

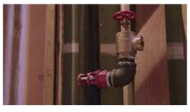
- Fire prevention measures
  - security requirements
  - control of ignition sources
- Procedures for Hot Work permit operations,
- cutting and welding
- Electrical supplies and equipment
- Compliance with 'no smoking' policies
- Plant equipment and vehicles
- Prohibition of open fires
- Control/reduction of combustible materials
- Control flammable liquids and gases
- Proper storage and disposal of waste materials
- Fire department access, facilities and coordination
- Evacuation plan and procedures



Fire safety plan: Continued

- Fire protection provisions
  - portable fire extinguishers
  - standpipes
  - hydrants, hose reels and water supplies
  - automatic fire sprinklers*
  - automatic fire detection and alarm systems*
  - temporary emergency lighting*
- Separation from adjacent buildings and other hazards
- Special provisions if work is being carried out in occupied buildings
- Urban wildland interface clearance requirements, if appropriate

- *These items can only be evaluated during the final stage of construction



Site Security

- Guard service shall be provided when required by the AHJ
- Security fences shall be provided where required by the AHJ
- Entrances to the structure under construction must be secured
- The guard service must be trained in the following
  - Notification procedure
  - Function & operation of fire protection equipment
  - Familiarization of fire hazards
  - Use of construction elevator

Site Security

- Site security plan, based on security assessment, should include:
  - Personal observations
  - Log books
  - Video technology
  - Scheduled patrol routes
  - Proper notification procedures

Separation Distances

- There must be adequate separation between buildings under construction and temporary construction related structures*
- Example from Table 4.2.1
  - 20 feet of temp structure exposing wall length would need to be 30 feet away from building under construction
    - *a 75% distance reduction permitted with automatic sprinkler system in temporary structure

Best practices

- …regarding housekeeping, hot work, equipment fueling, smoking, food preparation and other hazardous activities on construction sites

Best practices - Housekeeping

- Housekeeping "rules" not the same as housekeeping "activity"
- Can quickly deteriorate from lack of action
- Supervisors need to enforce consistently and take action when it is violated
- NFPA 241 deals with waste disposal in Section 5.4
-

Best practices - Housekeeping

- Clear premises of all refuse and process waste
- Remove waste, scrap and debris daily
- Keep all building site areas free of accumulated packing materials (e.g. pallets, paper, etc.)
- Provide appropriate metal bins (or dumpsters with lids) for combustible waste disposal such as oil rags
  - Empty these containers at the end of every shift
  - Take contents off-site

Best practices - Housekeeping

- Storage places accessible to firefighters
- Clear spaces around stored materials and provide adequate gangways between them
- If a sprinkler system is installed, all material stacks should not impede effective sprinkler operations
- Trash dumpsters located at least 50 feet from the building – the further away the better

Best practices - hot work

- Hot work includes all activity that could initiate fires or explosions by providing a heat source that ignites combustible material
- Definitions
- Hot Work – operations including cutting, welding, thermite welding, brazing, soldering, grinding, thermal spraying, thawing pipe, installation of torch-applied roof system or any other similar activity
- Hot Work Area – the area exposed to sparks, hot slag, radiant heat, or convective heat as a result of the Hot Work
- Hot Work Equipment – electric or gas welding or cutting equipment used for Hot Work

Best practices - hot work

- Hot Work Permits – issued by Permit Authorizing Individual (PAI) under Hot Work Program permitting welding or other Hot Work to be done on locations
- Hot Work Program – a permitted program, carried out by a general contractor allowing them to oversee and issue permits for Hot Work conducted on the job site
- Permit Authorizing Individual – a person trained in safety and fire safety considerations concerned with Hot Work. Responsible for reviewing the site(s) prior to issuing permits as part of the Hot Work permit program and following up as the job progresses
-
- Torch-Applied Roof System – bituminous roofing systems using membranes that are adhered by heating with a torch and melting asphalt back coating instead of mopping hot asphalt for adhesion

Best practices - hot work

- Hot Work should be closely controlled
- Implement a permit system including
-
- Requirements for written permission (a permit) prior to commencement of hot works
- Hot works permits must be specific to a location, activity and work period and must not provide blanket coverage for more than one location activity or work period

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Best practices - hot work

- Other management practices to reduce ignition potential
- Reinforce accountability and ensure constant fire mitigation measures
- Combustible materials at least 35 feet away from Hot Work area
  - If they cannot be moved, cover area with a fire-resistant blanket
  - Sweep floors in these areas of all combustible waste and debris
- Cover all floor and wall openings within 35 feet of a hot work area to prevent hot sparks from entering walls or falling to a lower level
- Hot Works should never be conducted in the presence of flammable gases, vapors, liquids, or dust

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Best practices - hot work

- Provide appropriate fire extinguishers that are properly sized, fully charged, and ready for operation
- Keep evacuation paths clear
- Assign a suitably trained and equipped person to fire watch during hot works until released by the PAI
- PAI to inspect hot works areas at day's end
  - Also by security staff, if reasonably practicable and safe to access the area
- Provide means for communicating an alarm in accordance with Emergency Action Plan

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Best practices - fire watch

- NFPA 241 Sec. 5.1.3
- Fire watch shall be assigned no other duties
- A fire watch shall be posted for the duration of the hot work
- For torch applied roofing operation, fire watch must remain for 2 hours after work is complete

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Best practices - Electrical

- Electrical equipment and transmission systems can be an ignition source during construction
- Care is required to minimize risk
- Install and maintain all electrical systems and equipment, including temporary installations, in accordance with state regulations
- Regularly inspect all portable electrical devices and extension cords
- Remove any faulty or damaged equipment from use immediately, label accordingly, and remove or secure it to prevent future use

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Best practices - Electrical

- Securely fasten any equipment that operates at surface temperatures exceeding 167°F to prevent hot parts from contact with combustible materials
- Equip fragile components, such as temporary lights, with guards to prevent accidental damage where exposed to impact
- Low voltage equipment should be used where practicable
- Remove temporary wiring immediately after completing the job
- Use only metal halide lights with Type O lamps for temporary lighting
  - Do not permit storage of combustible and flammable materials directly below such temporary light fixtures due to catastrophic lamp failure potential

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Best practices - Smoking

- Smoking materials are a significant ignition source for fires on construction sites
- Smoking restrictions should be applied throughout a construction site because hazardous materials, such as flammable liquids and gases, may be used in open as well as enclosed areas
- If provided, designated smoking areas should be constructed of (or protected by) noncombustible materials and separated from buildings under construction by at least 20 feet
  - Also provide safe receptacles for smoking materials
- Smoking restriction zones must be clearly identified, sign-posted and strictly enforced
-

Polling Question

4. For torch-applied roofing systems, how long must the fire watch remain after work ends?

a) 10 minutes
b) 30 minutes
c) 1 hour
d) 2 hours

Best practices - Cooking

- Prohibit food preparation that involves the use of open flames
- Designate areas where meals can be warmed utilizing a microwave or other non-flame producing heat

Best practices - Heavy Equipment & vehicles

- No vehicles should be parked inside of buildings unless fire detection systems are installed and monitored
- No heavy equipment should be stored inside the building without first making sure that the equipment has cooled down and there are no leaks in the fuel or hydraulic system
- Locate equipment and vehicles so that their exhausts discharge away from combustible materials
- Prevent combustible materials coming in contact with hot surfaces or being close to hot surfaces such as flues/exhaust pipes
- Fuel storage and service areas should not be located within structures under construction, alteration, or demolition
- Policies for refueling of tools and equipment should require that the appliance be cool before refilling

Best practices - Waste Materials

- Schedule delivery of combustible materials as close to installation as possible
- Remove combustible waste materials, including dust and debris, from the building and immediate vicinity at shift end
- Store scrap lumber and combustible materials before its disposal as far from buildings as reasonably practicable
  - Store materials susceptible to spontaneous ignition, such as oily rags, in clearly labeled noncombustible containers and remove them from site at shift end
- Unless specific items of vegetation are planned to be retained, remove all dry vegetation 60 feet from buildings under construction and work areas
- Prohibit open fires, including burning of waste materials, on site

Best practices - Heating Equipment

- Locate temporary areas to protect against weather outside of any structure
- Conduct refueling of heating devices outside and safely
- Maintain separation distance from combustible materials
- Require personnel to be in attendance when the heater is running
- Restrain device to minimize risk of knock-over or incorrect location
- Inspect regularly

Best practices - Combustible Material storage

- Where significant volumes of wood framing and other combustible building materials are to be stored on site, they should be stored in a secure area at least 75 feet away from any buildings or partially constructed buildings, as well as, any location where hot work is undertaken

Construction Fire Safety Best Practices 58

Best practices - Combustible Material storage

- If combustible building materials have to be stored within or close to the building under construction, the storage area should
  - Have controlled access
  - Not be in an area where hot works are being carried out
  - Be in either an area covered by the site fire detection system or included on the route of regular fire checks by watchman-guard service
  - Have firefighting equipment close by
  - Be protected from ignition sources where reasonably practicable by fire- preventative coverings (e.g. fire-retardant, fire-resistant, or noncombustible sheeting)

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Best practices - Exposed combustible materials

- For buildings of four or more stories, where the exposed façade is combustible or construction is predominantly of combustible construction, consider additional controls
- Progressively clad exposed combustible materials with fire-resistant coverings
- If sprinklers are to be provided, progressively commission the system

Construction Fire Safety Best Practices 60

Best practices – Passive systems

- Early installation of permanent or temporary fire compartments can limit fire spread
- Address protection of door openings, windows, shafts and service penetrations
- Provide temporary fire alarm system and modified evacuation procedures to address expected fire spread rate
- Provide separation distances or fire barriers between adjacent buildings appropriate to the fire hazard

Best practices - Flammable liquids & Gases

- Storage and use of flammable liquids and gases require specific safety measures that address risks of use in confined spaces and potential explosions, in addition to normal fire risks
- Typical requirements found in NFPA Standards include
- NFPA 30- *Flammable & Combustible Liquids Code*
- NFPA 51- *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*
- NFPA 54- *National Fuel Gas Code*

NATIONAL FIRE PROTECTION ASSOCIATION
The leading information and knowledge resource on fire, electrical and related hazards

Best practices - Gas line purging

- Gas line purging requirements as described by National Fuel Gas Code
- To the outdoors
- Continuously monitored to discharge point, if done indoors then combustible gas detector must be used to monitor discharge point
- Ignition sources kept at least ten feet from discharge point
- Discharge point at least ten feet from openings and 25 feet from intakes
- Evacuate non-purging employees
- Purging stopped when 90 percent gas volume reached

Best practices - Flammable liquids

- Train workers in storage and handling of dangerous goods
- Keep storage of flammable liquids and gases to a day's supply
- Store flammable liquids and gases in clearly labeled containers compliant with NFPA Standards
- Provide clear signage identifying materials being stored and prohibiting smoking, open flame, hot works, and use of mobile phones

Best practices - Flammable liquids

- Deal with leakage or spillage promptly and safely
- Keep flammable liquid containers and tanks closed when not in use
- Segregate storage of flammable liquids and gases from materials that could intensify fire
- Properly remove flammable materials in approved containers before work is carried out on an empty container or vessel
- Liquids may only be used for their intended purposes
- Consider proximity to flammable liquids and gases in hot work

Best practices - Garbage Chutes

- Construct chutes of noncombustible materials and locate outside building envelope
- Minimize accumulation of combustible materials close to the chute
- Change-out dumpsters frequently to prevent chute clogging
- Protect combustible trash chute interior by a temporary automatic sprinkler within a recess near chute top*
- *Can be connected by a firehose or commercial rubber hose not less than ¾" diameter
-

Built-in fire protection features

- The following components and systems are not considered to be effective in minimizing the risks until they are complete:
  - Fire stairs, including fire-resistant walls
  - Fire-protective materials to structural steel
  - Automatic fire sprinkler systems and other automatic suppression systems
  - Fire compartment boundaries, including fire doors, penetration seals, and general protection of other openings

firefighting access: exterior

- Designate a suitable location as a command post provided with plans, emergency info, keys, and communications
- Every building must be accessible by a road with an all weather driving surface of at least 20' of unobstructed width
- Dead-end roads more than 150' must include a turnaround
- Access road(s) must be within 150' of all exterior 1st floor walls

Firefighting access: Stairs

- Provide at least one useable stairway at all times
- Extended upward as each floor is completed
- Stairways must be lighted
- Enclose stairways once exterior walls are complete
- Provide identification signs to include floor level, stair designation, and exit path direction

Firefighting access: Standpipes

- Maintain in conformity with building progress and ready for use
- Install at least one standpipe, prior to construction exceeding 40', within one floor of the highest point of construction (IFC Section 3313.1)
- Must be conspicuously marked and readily accessible FDC
- One hose outlet on each floor

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Firefighting access: Water supply

- Fire protection water supply (temporary or permanent) shall be available once combustible material accumulates - NFPA 241
- Where underground water main or hydrants are to be provided, they shall be installed, completed, and in service prior to start of construction

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Firefighting access: Water supply

- An approved water supply for fire protection…shall be made available as soon as combustible materials arrive on the site. IFC Sec. 3312
- What is considered an approved water supply that meets the requirements of the IFC or NFPA 241?

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Water supply: example of a local interpretation

- The minimum fire flow required when the contractor brings combustible materials on site is 1,500 gpm at 25 psi.
- At least one hydrant shall be within 500 feet of any combustible materials.
- Contractor is responsible for ensuring that the water supply is available at all times

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Polling Question

5. Fire access roads must be at least ____ feet of unobstructed width?

a) 25 feet
b) 13.6 feet
c) 30 feet
d) 20 feet

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Avalon Bay - Fire Elimination Plan

- Site Security
- Source of ignition reduction
- Detection

AvalonBay COMMUNITIES

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Conclusion

- What is predictable, is preventable!

1. **Risks & Hazards**
   - We have identified causes of construction fires and risks and hazards associated with construction sites!
2. **Codes & Standards**
   - We reviewed safeguards during construction codes in *NFPA 241*, *IFC* Chapter 33, and *NFPA 1*.
3. **Best Practices**
   - We reviewed best practices to mitigate risks and hazards identified.
4. **Fire Safety Plans**
   - We went through components of a well-prepared fire safety plan.

Questions??????????

- Thanks for your attention! Contact me at ROBrocki@awc.org or 410.299.9681

AMERICAN WOOD COUNCIL

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This concludes The American Institute of Architects
Continuing Education Systems Course