9 SEARCH

9.1 A thoroughly planned and executed primary search shall be completed at all structural fires. To become proficient in search operations, crews should conduct pre-fire planning and conduct extensive training sessions in search techniques and victim removal. Communication is paramount. The incident commander must be kept informed of your progress. The information relayed should consist of the status of the search, any hazards found, fire and smoke conditions.

9.2 The primary search begins with the on scene size-up and will be completed when the companies assigned have expeditiously searched the building. The secondary search is a much more detailed effort and is only concluded when all parts of the structure or area of the fire have been thoroughly checked.

9.3 Normally the primary search is the responsibility of truck and rescue companies. Search crews will be composed of a minimum of two members. Each crew involved in search operations will carry **as a minimum, a radio, lights and set of irons.** If available, a thermal imager should also be carried.

9.4 The primary search is often conducted before the fire is under control. This search is conducted quickly and thoroughly in areas of imminent danger. The search will normally begin in the area where the fire is located (fire floor) or the area directly above the fire, usually the sleeping areas.

9.5 Prior to entering the structure, crews should survey the outside of the building to identify the fire's general location. Crews should report findings and take action to aid victims at windows or in obvious distress. If there are victims at windows this is a strong indication that there may be other victims still inside the building. Crews should be looking for victims that have jumped or fallen from windows as they conduct their exterior size-up.

9.6 Victims who are in the immediate vicinity of the fire, particularly those that have the fire between them and the attack line are in the most severe danger. The area directly over the fire on the floor above, is the second most hazardous area for victims. This applies to wood-frame structures, particularly residential occupancies.

9.7 On the fire floor the primary search should begin as close as possible to the fire area, working away from the fire back to the remainder of the floor.

9.8 When searching the floor above the fire, begin the search upon ascending to the floor above the fire. Search crews should work toward the direction of the fire. Make sure the location of the fire is known before going above, preferably with a charged hose line.

9.9 The incident commander and all other companies operating on the fire scene should be aware that a search is being performed above the fire. Each crew can conduct operations in opposite directions, one crew to the left and one to the right. Search teams should follow standard search patterns such as right wall or left wall. Do not change directions.

9.10 Crew members should maintain verbal contact with each other at all times. When operating above the fire the integrity of the stairs should always be checked, with crews minimizing time on the stairs.

9.11 VES (vent, enter, and search) is a particularly effective means of searching a specific area when normal means of access are blocked. In performing VES, the search crew will enter the structure through a window by means of an exterior ladder. A crewmember enters the structure and searches the room. If interior doors are found open they should be closed to prevent additional heat and smoke to entering the room. All windows in the room shall be opened to remove heat and smoke. The second crewmember remains at the tip of the ladder to assist with victim removal. The ladder should be used to remove victim(s). Search crews should normally NOT proceed to another part of the building. The crew should exit the searched area via the same window through which they entered, and move to another point of entrance. If a victim's location is known prior to entering the structure, the vent, enter, and search (VES) method may be the quickest way to locate and remove that person.

9.12 Crews should keep in mind the need for an alternate escape route (ladders, porch roofs, adjacent apartments or rooms) in the event that crews cannot exit through the entrance that they entered. The unit officer should always notify command when using an alternate route and the reason that they had to exit. If crews are unable to reach the floor above the fire because of high heat conditions, ventilation should be ordered and completed. Crews should check for extension of fire as they search, closing doors and venting windows as the search progresses. Anytime fire is found during the search, a hose line must be requested.

9.13 Important strategies to remember while conducting the primary search should be:

- Routes that occupants normally use to enter and exit the building should always be checked. Victims will attempt to leave through their normal means of egress when faced with an emergency.
- Remember to check behind entry doors and under windows. Many times victims will not be able to either open a door or window because they are panicky and may succumb to the smoke from the fire.
- Bedrooms would be an obvious place to check for victims.
- Children have also been known to hide in closets and under beds. These areas should always be checked thoroughly and expeditiously.

9.14 In occupancies such as apartment houses, high-rises, hotels and motels, doors should be first marked with a slash and unit number, such as "/ T105," to indicate that the room is in the process of being searched and the unit doing the search. Upon completion of the search the officer should complete the "X" to indicate that the search of that area is complete and was completed by that specified unit.

9.15 Furniture should only be moved to check areas under or behind, but should not be randomly moved or scattered to prevent blocking an exit, placing firefighters in danger.

9.16 The axe is an excellent search tool; it is light and unlike the Halligan lays flat. By holding the head of the tool, the handle can be used to sweep and probe large open areas and confined areas (under beds).

9.17 The secondary search(s) is routinely performed after the fire is under control and smoke is in the process of being removed. The areas to be searched shall include those covered by the primary search, but in a much more meticulous manner. Also, areas remote from the fire area both interior and exterior should be checked for any additional victims.

9.18 KEY POINTS TO REMEMBER

- Make sure the portable radio is on the proper channel and monitor other suppression activities.
- Make sure your PASS (personal safety alarm) is operating properly.
- When searching a room and a doorway is found, note where the door is and finish searching the original room. Return to the noted doorway to continue the search.
- If the search crew consists of three members, leave one person at the doorway to communicate with the other crewmembers to assist in their egress.
- Leave your hand-light turned on. This will assist other firefighters who may have to find you.
- If you are in an area with high heat conditions but no visible fire, it might indicate that the fire is below you.
- If the fire is not under control, make sure the hose crews know your location.
- If you are in enough smoke that you cannot see the floor, crawl.
- If you are walking in poor visibility keep your body weight concentrated on your rear foot, this will assist in maintaining your balance if encountering an unexpected hole, also a shuffle type step is recommended as you walk to keep your feet in contact with the ground.
- Feel all doors using the back of your ungloved hand for heat before opening.
- If an obvious fatality (charred victim) that has no chance of survival is found, **Do Not Waste Time.** Leave them in place; your job is locating survivable victims. This will also assist the fire investigation.
- Vent as you search as long as this doesn't intensify the fire.
- Chock doors, do not allow doors to lock behind you.
- If needed you can breech a wall to escape into a known safe area.
- Report the status of your search along with any fire or smoke conditions in the area.

9.19 Searching with Rope

9.19.1 Searching occupancies that have large open areas are difficult and dangerous to search efficiently. These types of structures would include offices, warehouses, restaurants, and auditoriums. If available and practical, it is recommended that crews review pre-plans of the structure prior to conducting the search.

9.19.2 A proper rope search crew consists of a minimum of four members however ideally two companies make this task safer.

9.19.3 Before entering the search area, place a light near the entrance with the light entering the structure. This will assist the crew in locating the exit.

9.19.4 The main search line is secured low to a non-movable object, outside the hazardous environment. One member of the team controls the rope bag. Having the rope attached to the member allows both hands to be free.

9.19.5 The other members carry a short section of rope with snap hooks on each end. As each enters the building they attach their section of rope to themselves and the other end to the main rope or hose. Then begin searching in opposite directions, sweeping in a circular motion.

9.19.6 An option to the main search line would be for a company to advance a charged 1 ¾" hoseline into the structure, attach the rope to the hose, and branch out to search other areas.

9.19.7 After the restricted area has been checked the crew advances approximately 25 feet. Knots are tied in the rope and the crew continues the search. This process is continued until the entire structure has been searched.

9.19.8 Crews should monitor the depth of their advance into the structure by developing a means of marking the main rope. One means of identification is to make a bight in the rope followed by an overhand knot. Make one knot per 25 feet of depth into the structure. This frame of reference would assist a firefighter while exiting the structure by verifying that members are proceeding in the correct direction.

9.19.9 Some units are carrying pre-made search ropes dedicated to rope searches. The main rope would have the 25 feet intervals pre-tied. Each knot would be marked to indicate the distance entered i.e.; 25 feet would have one knot, 50 feet would have 2 knots and so on.

9.19.10 Never let any door close behind you. Several ropes may be required when operating at large structures. When a turn is required, the main rope is tied to a non-movable object to prevent it from being dragged into an area that has not been searched or over a dangerous area such as a pit or stairwell.

9.19.11 Should a victim be located, the main rope is tied off at that location. The victim is removed, the relief crew advances to the location where the rope is tied and continues the search.

9.19.12 When the crew needs to exit the building for any reason and the search has not been completed the main rope is tied off and left in place for the next crew to continue where the original crew stopped. At no time should any crewmember be left alone! If one member needs to exit it may require the entire team to exit together.

9.19.13 A crew should be positioned at the entrance to assist with victim removal and/or relieve the search crew.

9.19.14 Search crews should be tracked for accountability. Relief should be provided every 20 minutes.

9.19.15 This type of search is unique and used in extreme measures. Members are working independent of guides and other landmarks such as walls, doorways and small separate rooms. The rope search is going to require time to plan and implement. It may require several crews to accomplish this tactic. This type search will require significant training by all members.

9.20 Recommended tools to conduct a rope search may include:

- Hand lights
- Search rope
- 2- 25’ ropes with snap hooks
- Portable radios
- 20 Door chocks
- Forcible entry packs
- Thermal imager
- Rabbit tool / Hydro-ram (if staffing permits)

10 RESCUE

10.1 Rescue must be the primary objective of any fire suppression unit. A single firefighter or an entire truck company may accomplish victim removal or rescue. The rescue may involve the removal of occupants using either normal building egresses or fire department ladders. The entire truck company will likely carry out rescue operations.

10.2 Truck company officers must determine whether a rescue needs to be performed or an occupant removed under expedited circumstances. A building occupant exposed to heat, smoke and gases that cannot exit a structure without assistance is known as a rescue (whether conscious or unconscious).

10.3 An individual that is merely inconvenienced and cannot exit through normal means either down the building's stairs or fire department ladders due to fire ground operations is known as a removal. The truck officer must determine the most prudent action. The decision must be made between protecting the occupant(s) in place while extinguishing the fire or removing the victim(s) during fire-fighting operations.

10.4 Factors that must be considered during a truck company rescue size-up may include the following:

- Type of occupancy
- Location and amount of fire or smoke
- Available resources
- Type of construction
- Weather conditions
- Time of day
- Known or potential victims
- Physical and mental state of the victim
- Size and weight of the victim
- Remote areas (alleys, courtyards, side and rear of structures)
- Access points

10.5 A coordinated effort between the truck company and the engine companies is paramount in occupied structures. Alternative tactics to consider regarding victim removal may include:

- Fire attack crews entering the fire apartment through balcony doors.
- Delaying a fire attack through the fire apartment entrance to enable removal of endangered or trapped occupants. This will prevent smoke from filling the corridors and stairways after the fire apartment door is opened. Occupants will exit via interior corridors and stairs. In high rise operations, the occupants must be directed to the **evacuation** stairwell.

10.6 The incident commander must decide early into the incident if it is more prudent to advance an attack line into the fire area via means other than the exit normally used by the occupants (interior hallway or stairs). This tactic has been used many times within the department with noted success.

10.7 Rescue is always the primary objective (tactic) of all suppression units; however, it may not always be the first task performed. Initial appropriate actions may contribute more to the rescue and subsequent overall success of the rescue than the physical removal of the victim(s).

10.8 Rescue of a victim located during a primary search can be a labor-intensive task. Command shall be notified immediately upon locating a victim. The report shall include the floor, quadrant, and side of the structure, method of removal and the need for any assistance. Finally, notifying command will alert E.M.S. personnel to the presence of a victim.

10.9 Removing an unconscious victim as quickly as possible is the primary consideration of the suppression unit that has located that victim. This may best be accomplished by carrying or dragging the victim back the same route the company or firefighter used to locate the victim; however, if an exit is near (i.e. a window or door) victim removal may be best accomplished through these alternative openings.

10.10 The size of the victim and the distance to an exit may need to be considered. A small child or invalid may be quite easy to pass out a window. In the event that the victim is very large, command should be notified immediately. Additional resources may include members, a second ladder, or repositioning of an aerial device. Alteration of suppression tactics may be necessary to enable the rescue.

10.11 The tower ladder is the safest and quickest means to remove a victim from extreme situations if normal egress routes are unavailable. It may be difficult to get the victim to leave the building and enter the basket. It is critical that as a safety precaution the basket controls of the tower ladder should be deactivated while the victim moves into the basket to prevent accidental basket movements that could be more than several feet, which could seriously injure the victims and firefighters.

10.12 Consider the size and extent of the fire. If it is extinguished or will soon be extinguished, the best means of victim removal may be through the building interior, especially if the victim is very large. Consider whether a wall can be breached and the victim passed to an adjacent safe area such as an apartment or room.

10.13 An unconscious victim will require considerable effort and coordination to get out onto a ladder:

- The victim should be placed in a sitting position, with their back against the wall, under the window.
- Place the victim's knees up to their chest.
- Place your feet against theirs, grab the victim under the arms using leverage to lift the victim up and onto the windowsill.
- Once the victim is on the sill, the outside firefighter on the ladder should steady the victim.
- The inside firefighters prepare to swing the victim's legs out through the window by gathering the victim's legs and bringing them up to the victim's chest.
- At this point the victim is rotated out towards the ladder.
- The victim is now resting on the sill with their back towards the inside of the structure.
- The firefighter on the ladder will place their knee into the crotch of the victim, slide their arms under the armpits of the victim and grasp the beams (extension) or the rungs (aerial) depending on the type of ladder.
- Now the firefighter and the victim can begin their decent down the ladder.

10.14 If an unconscious victim is to be removed via a window, a tower ladder is the most efficient and effective way because it provides a stable platform for multiple members on the outside of the window and does not require either the victim or firefighters to be on a ladder. If removal is done with a tower ladder, the top rail of the basket must be positioned even with the windowsill. Two firefighters simply need to pass the victim out the window and into the basket. The victim can then simply be lowered to the ground.

10.15 Placing a victim in a Reeves stretcher prior to moving to the ladder (if time permits) can aid with victim removal, because the Reeves stretcher provides a "handle" on the victim.

10.16 If a Reeves stretcher is not available a webbing girth hitched around the victim's torso and under the arms can make removal more expedient. The victim is then removed from the building via the aerial ladder head first, provided the angle of the ladder is not extreme (over 45 degrees). “Head first” removal prevents the victim’s limbs from getting entangled in ladder rails and rungs.

10.17 When a victim’s location is known, VES is particularly effective. In performing VES, the search crew will enter the structure through a window by means of an exterior ladder. A crewmember enters the structure and searches the room. If interior doors are found open they should be closed to prevent additional heat and smoke to entering the room. All windows in the room shall be opened to remove heat and smoke. A crewmember remains at the tip of the ladder to assist with victim removal. This member also provides the member(s) inside the room a reference point back to the point of exit. The ladder should be used to remove victim(s). Search crews should normally NOT proceed to another part of the building. The crew should exit the searched area via the same window through which they entered, and move to another point of entrance. If a victim’s location is known prior to entering the structure, the vent, enter, and search (VES) method may be utilized.

10.18 It may be possible to remove the victim via the interior stairway. This may have to be considered in some instances but only after confirming that the stairway has been secured.

10.19 If an exit is blocked by fire and there is no other means of egress, breaching a wall to a safe area is a useful tactic. Breaching involves making an opening in the wall and moving the victim to a safe area. A tool will be required to remove drywall and studs to provide enough space. Keep in mind this tactic may also be used for firefighter survival.

10.20 In the event that a lowering system becomes a necessity, at least one company should perform the rope rescue from above and one company from below to assist the victim and rescuer during the descent.

10.21 In the event the area is becoming untenable, and ladders and the building stairs are not available and a lowering system cannot be performed, rappel may be considered as a last resort for escape. This evolution can be dangerous for both firefighters and victims.

11 VENTILATION

11.1 Introduction

11.1.1 Ventilation of a fire building can be defined as the removal of heat and toxic byproducts of combustion.

11.1.2 Ventilation is a primary firefighting tactic. A change in building construction and building contents in recent years has increased the importance of this task.

11.1.3 Energy efficiency leading to tightly sealed structures and the presence of thermo plastics in both residential and commercial occupancies has added to the fuel load creating significantly higher volumes of heat and toxic smoke under fire conditions.

11.1.4 The specific reasons for ventilation will be to vent for life, or vent for fire.

11.1.5 Venting for fire refers to “opening up” the structure to reduce the risk of backdraft or flashover as well as facilitating the advance on the fire by the attack crew. This must be a coordinated effort between the Truck and Engine.

11.1.6 Venting for life involves ventilating a specific area to provide fresh air and improves visibility for the search of occupants.

11.1.7 When, where, and the type ventilation will depend on the location of the fire, life hazard, exposure problem, and the fire department resources available.

11.1.8 There are three methods by which firefighters can accomplish ventilation of the fire building. These are referred to as vertical, horizontal, and mechanical ventilation.

11.1.9 In most working fire situations a combination of these methods are employed.

11.1.10 The method of ventilation called for initially in the incident will depend on the first engine and truck officer’s size-up and experience.

11.2 Vertical (Roof) Ventilation

11.2.1 Timely roof ventilation is capable of reducing accumulated heat, smoke, and fire gases, AND reducing the potential for a flashover. This can mean the difference between confining the fire or losing the entire structure.

11.2.2 As fire progresses within a structure, super heated gases and smoke rise to the highest level and begin to spread horizontally.

11.2.3 Immediate vertical ventilation has saved many lives by drawing fire away from the victims.

11.2.4 This process progresses with a mushrooming effect that quickly fills the entire structure from the top down.

11.2.5 Vertical ventilation is a tactic accomplished by using existing, or fire department created vertical openings at the roof level to let out the heat and smoke in the fire building. This method prevents the horizontal spread or mushrooming of heat, smoke, and fire.

11.2.6 This is analogous with the fire in a fireplace or wood stove, where the damper to the flue is closed. Once the damper is opened, fresh air is brought in at the level of the fire and the smoke and heat are released via the chimney or flue. The results are dramatic. The goal of vertical ventilation is to open the damper to the chimney. It is possible that fire will exit this vent hole and this should not be considered to be a loss of control of the roof.

11.2.7 Vertical ventilation is one means of protecting the interior exposures in a structure, provided the opening is in the correct location and in coordination with the advancing hoseline.

11.2.8 Not every fire is going to require vertical ventilation. However, it should be called for immediately in advanced fires, and top floor or attic fires.

11.2.9 Minor fires with minimal heat buildup may not benefit significantly from opening the roof. Without the heat or convected heat currents carrying the smoke to the upper levels, there is not much reason for vertical ventilation. Horizontal or mechanical ventilation is indicated in this scenario.

11.2.10 An advanced fire at lower levels of a multi story structure can benefit from vertical ventilation in many instances. The key to this tactic is to locate the vertical opening closest to the seat of the fire.

11.2.11 When the lateral spread and mushrooming effect of the smoke and heat are eliminated through vertical ventilation, firefighters have provided support for efforts addressing rescue, confinement, reduction of possible flashover conditions, and salvage (less than one-half of the nation's fire loss is from direct flame involvement. Water, smoke, and heat are the main culprits).

11.2.12 The key element in achieving timely vertical ventilation is getting the first due truck to the roof immediately upon arrival.

11.2.13 The incident commander must identify the need for vertical ventilation within the first minute of size-up.

11.2.14 It will be the truck officer's duty to see that the apparatus is positioned for rapid access to the roof.

11.2.15 The truck must get to the roof independent of the interior stairs of the fire building. The aerial device or via the adjacent building are two of the quickest means of access.

11.2.16 Members at the roof level are in an ideal position to observe the building layout, construction features, and indicators of the progress or location of the fire. A topside situation report is to be communicated to the crews inside via command.

11.2.17 The appropriate complement of tools will be taken to the roof based on the crew's roof construction size-up.

11.2.18 The minimum tool complement will include: ladder belts, pick head axe, halligan, a minimum of a 10 foot hook (a shorter hook may be too short to punch out the ceiling below) and the chainsaw or rotary saw with carbide tip blade for wood roofs, or rotary saw with abrasive metal cutting blade for metal deck.

11.2.19 Members should know the roof construction of the structures in their response area.

11.2.20 Effective roof operations are dependent on training and the knowledge accumulated during the preplanning process. Time and effort must be spent before the fire to determine how you will accomplish various types of roof ventilation operations. Frequent discussion and practice of are essential in making basic operations automatic at a fire.

11.2.21 As with all firefighting tasks, time must be spent performing size-up. Considerations include:

- The type and age of building, residential or commercial occupancy, old or new construction.
- Type and style of roof, old or new construction, gable, arch, flat etc. and its strengths and hazards.
- Location and extension of the fire.
- The best position and type of ladder to access roof.
- Hazards which may impact the operation.

If time has been spent preplanning, this process can be accomplished in very short order.

11.2.22 The roof crew must quickly identify the presence of any natural openings such as bulkhead doors or skylights. These should be utilized for vertical ventilation when located over the area needing ventilation.

11.2.23 The vent hole will be cut high on the pitched roof near the ridgeline and over the fire area as safety permits. The exception to this will be in a multiple dwelling with a pitched roof and a common stairway. The vent hole will need to be down from the ridge and over the stairway.

11.2.24 A flat roof will be cut as close to the seat of the fire as safety permits and/or over the common stairs in the case of the multiple dwelling.

11.2.25 The truck crew has several options concerning the vent opening. The size of the area to be vented will dictate the size of the opening. One rule of thumb is that the vent size is approximately 10% of the area to be ventilated. On these occupancies, crews should start with a 4'X4' opening with the ability to enlarge the hole as conditions (roof stability) allows.

11.2.26 These openings can be accomplished several ways depending on the stability of the roof, the type of construction, and whether fire is present in the cockloft or attic area.

11.3 Basic Rules of Roof Operations

11.3.1 A minimum of two ladders or means of egress for the crew must be established early.

11.3.1.1 A second means of egress can be accomplished by the first and second due trucks placing their aerials to the roof at alternate sides.

11.3.1.2 The aerials may be repositioned once the ventilation is complete.

11.3.1.3 The roof will be laddered and approached from the uninvolved area. Members will then proceed toward the objective over the fire with due caution.

11.3.1.4 Placing an aerial to the roof, on the front gable, upwind of stairway may best access the roof. If the building is short, a ground ladder may be the quickest way of getting to the roof. If it is night, the aerial should be used so the lights from the aerial tip can illuminate the work area. If the pitch is steep and the aerial can be placed so that the angle of elevation parallels the roof pitch, members can work from the aerial to gain a foothold while performing the task. The OIC shall decide on the means to access the roof.

11.3.1.5 A crew of *no less than two* is required for the *roof operation*.

11.3.1.6 The vent hole will be cut quickly and opened. The officer will observe the effect of the vent and provide a report to command. *If this cannot be accomplished within 10 minutes, the officer must notify command of any delay.*

11.3.1.7 The crew must leave the roof by the safest and quickest means available and report for reassignment.

11.3.1.8 The truck officer will keep nonessential members off the roof.

11.3.1.9 The use of an inspection cut is recommended to assess conditions under the deck, assist in locating the structural supports, and verify the construction of the roof decking.

11.3.1.10 An inspection cut is placing the blade or chain (at maximum rpms) of the saw into the decking material creating a triangular hole with overlapping cuts.

Example of an inspection cut

11.3.1.11 The pick end of the axe can be used on many roofs for a smaller and less effective version of the inspection cut.

11.3.1.12 Do not cut through structural components such as rafters, bar joists, etc. Note the three structural members that have been inadvertently cut in the photo below.

11.3.1.13 Keep the wind at your back but do not compromise your means of egress.

11.3.1.14 Never step over or on the cut roof deck.

11.3.1.15 Truck company members must have the ability to use the saws and axes both right and left-handed.

11.3.2 Special Hazards

11.3.2.1 When members are operating on the roof it is very likely that visibility will be restricted due to smoke conditions or lack of light due to night operations. Members must keep aware of where they are stepping. A tool should be used to probe ahead when visibility is impaired. Firefighters have walked off roofs and into light and airshafts while performing roof operations.

11.3.2.2 In lightweight roof construction, where fire is in the attic or cockloft, it is very likely that the roof will burn through relatively quick, venting itself in the process.

11.3.2.3 The presence of lightweight truss or plywood “I” beam construction creates a special concern for truck crews. If fire is present or suspected in the cockloft or attic area and the decision is made to vent the roof, members must be independently supported while venting the area of the roof above the involved area. Independent support of the members in this case means working out of the bucket of a tower ladder or off the end of an aerial. There may also be cases where it is safe to operate on the uninvolved roof area.

11.3.2.4 Crews must sound the roof and be observant as they proceed on all types of roofs. Rotten decking or structural supports, old skylights and old elevator or dumbwaiter shafts that have been covered with light gauge steel or aluminum flashing are examples that have been documented and have contributed to the deaths of firefighters.

11.4 Multiple Dwellings

11.4.1 As members become more familiar with the multiple dwellings in their response district they will find that there are a variety of roof types found on these buildings.

11.4.2 Pitched and flat roofs constructed of wood, flat roofs with metal decking and lightweight concrete as well as pitched roofs installed over original flat roofs can be found in Northern Virginia.

11.4.3 Multiple dwellings contain a common stairwell. This must be ventilated when an advanced fire is present in the structure. This stairwell acts as a chimney, channeling heat and smoke to the upper floors as soon as the fire unit is opened.

11.4.4 Another method of controlling smoke in the common stairwell of a garden apartment building is to use PPV at the front door, leaving the roof and glass intact. This will pressurize the stairwell and minimize the amount of smoke and heat that can push out into the stairwell when apartment doors are opened.

11.4.5 If an advanced fire is located in a top floor living unit, the roof should be opened above the fire rather than the stairwell.

11.4.6 If the fire is in the attic or cockloft, the roof must be opened in an area that can safely hold the vent crew. The fire will be drawn to this opening thereby containing the fire preventing lateral spread. It is possible that fire will exit this vent hole and this should not be considered to be a loss of control of the roof.

11.4.7 A majority of roofs on garden apartment buildings can be opened with a chain saw and one hook to make a center rafter cut and push the top floor stairway ceiling down. This opening must be cut on the stairway side gable. This is almost always the front gable and is easy to spot from the building front; the opening is made over the stairway. The roof must be sized up to estimate what length pike pole will be needed to push down the top floor hall ceiling. This depends on the pitch of the roof and thus the distance from the peak to the ceiling. If the hole is cut but the pike pole is too short, extend the cut towards the gutter to shorten the distance between the roof and ceiling. Another option is to have the ceiling pulled down from inside once the roof cut is made. Remember we are trying to vent the stairway and not necessarily the top floor; the smoke only needs vented from the stairway.

11.4.8 If you are on the roof and are uncertain where the stairwell is located, look down to the front yard for the sidewalk that approaches the building. This landmark will lead to the stairwell. The stairwell in older garden apartments is usually found in the center of the front of the building.

11.4.9 Venting the common stairwell will channel the heat and smoke away from the occupants still inside the building.

11.4.10 Whereas the vertical opening will release the mushrooming heat and smoke, members must remain aware of the fact that the fire will extend in the same direction to varying degrees.

11.4.11 The prevailing wind conditions and the integrity of the door to the fire unit will have a direct effect on the fire extension.

11.4.12 It is imperative that tactics be employed to ensure protection of the stairwell.

11.4.13 Operations between the engine and truck companies must be coordinated and communicated.

11.4.14 As these operations become standard, companies will know what to expect from one another thus enhancing the overall operations.

11.5 Roof Construction

11.5.1 Conventional Wood Construction

11.5.1.1 Conventional construction uses dimensional lumber that relies on its size for strength. The minimum size for support members in this construction is 2 X 6.

11.5.1.2 The greater the span of the structural member, the greater the dimensions of the lumber.

11.5.1.3 Conventional construction does not typically depend on the sum total of all the structural components to support a given load. The individual support member depends on its size for the strength to support the load.

11.5.1.4 Heavy timber or mill construction, and ordinary construction, which utilize lumber for floor joist and rafters, are examples of the conventional construction concept.

11.5.1.5 The larger the structural member the longer it will take to fail when exposed to fire.

11.5.2 Lightweight Construction

11.5.2.1 Unlike conventional construction, lightweight construction does not derive its strength from size.

11.5.2.2 The strength of a truss is the result of structural members that are in compression and tension. According to Brannigan, a truss is defined as “a framed structure consisting of a triangle or group of triangles arranged in a single plane in such a manner that loads applied at the points of intersections of the members will cause only direct stresses in the members. Loads applied between these points cause flexural or bending stresses. “

11.5.2.3 The strength of the entire construction unit is dependent on each component. Should one of these components fail, the potential for total failure of the entire unit is significant.

11.5.2.4 A single structural member that spans 50 feet or more may consist of 2 X 4s in compression and tension that form an integral unit. Although from the engineers viewpoint this structural element strong, the size of the individual members making up the unit are relatively small. This will require less time for a structural collapse when exposed to heat or fire.

11.5.2.5 A common lightweight construction practice uses 2 X 3 or 2 X 4 wood structural members held together by metal gusset plate connectors.

Gusset plates on parallel chord trusses.

Example of a gusset plate that has pulled away from truss members.

11.5.2.6 Metal gusset plate connectors will vary in size, thickness, and depth of penetration. Gusset plates used 35 years ago were commonly heavy gauge steel with ½ inch prongs that penetrated the wood. The modern type of gusset plate today is a stamped out light gauge aluminum with 3/8 inch or less prongs.

11.5.2.7 The truss has replaced the solid floor joist or roof rafter that is found in older conventional construction.

11.5.2.8 Newer roofs use 3/8 or ½ inch plywood and/or chipboard as decking rather than the 1 X 4 or 1 X 6 boards of yesteryear.

11.5.2.9 Plywood and chipboard decking will delaminate, fail, and burn at a faster rate than the 1-inch boards used in the past.

11.5.2.10 The use of trusses equals short burning time and early failure and collapse. Trusses are under tension and compression. When the bottom chord or webbing fails due to the gusset plate pulling out or failure due to fire, the entire truss can fail.

11.5.2.11 In structures where the truss spans large areas, there is the potential for catastrophic collapse under fire conditions.

11.5.2.12 In smaller occupancies such as the SFD, where fire has possession of the truss area, the collapse hazard is significant for members who may be on the roof. Due to the lightweight construction, the fire at a rapid rate is literally consuming the truss components and deck.

11.5.2.13 Members should not be on the roof of a structure where fire is suspected or confirmed in the truss area without being independently supported.

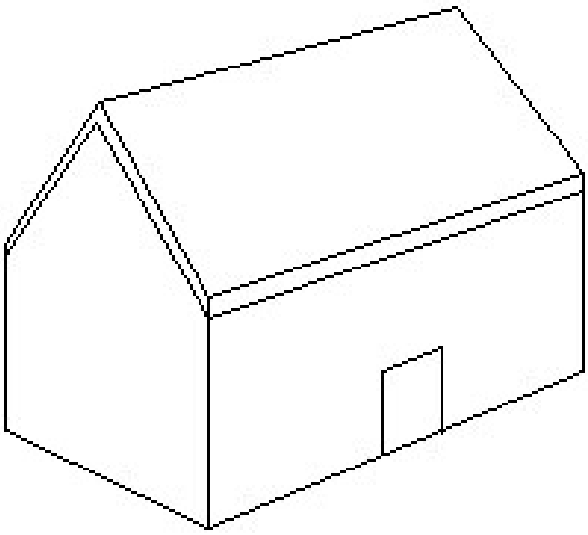
11.5.2.14 The incident commander and truck officer must take these construction methods into account in their overall operation at structure fires.

11.5.2.15 Using your experience and training, the ability to accurately estimate the amount of time that the roof can be considered structurally strong is dependant upon answering the following:

- What is the type of construction and its condition?
- Has the fire entered or taken possession of the cockloft/attic area?
- How long the fire has been burning and its extent?

11.6 Roof Styles. All roof styles can be supported by conventional or lightweight construction.

11.6.1 Gable Roof



11.6.1.1 This style is typically an A-frame type that consists of a ridge board and rafters that extend down to a beam that rests on the outside walls in ordinary or conventional construction.

11.6.1.2 The ridge board and rafters are usually 2 X 6 inches or larger.

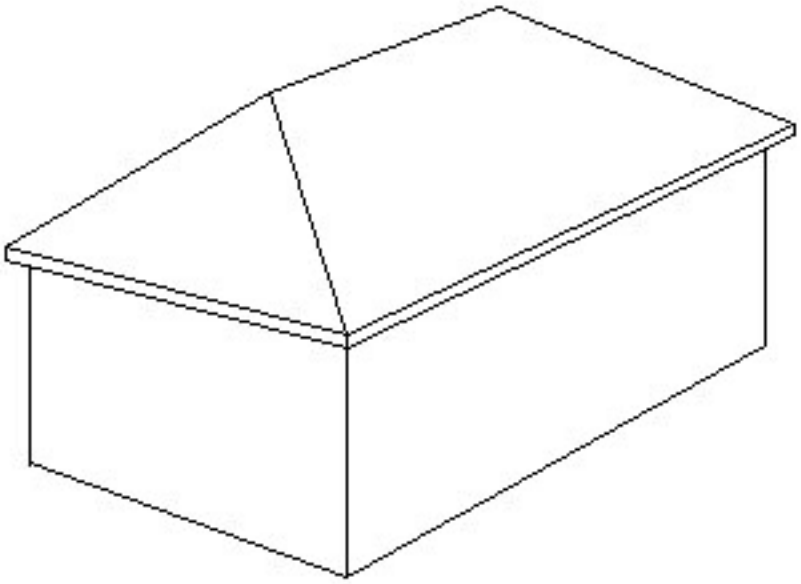
11.6.1.3 Rafters are typically 16 – 24 inches on center and attached to the ceiling joists where they meet at the exterior walls. The spacing of trusses will also be 16 to 24-inches on center.

11.6.1.4 The decking can be 1 X 4 or 1 x 6-inch boards or 4 x 8-foot sheathing of ¾-inch thickness or less.

11.6.1.5 In lightweight construction using an A-frame truss, there will not be a continuous ridgepole. A small section of 2 X 4 may be nailed between each truss as a spacer. In lightweight construction that uses plywood "I" beams or parallel chord trusses as roof rafters, a ridgepole will be used.

11.6.1.6 In truss construction, it is common for a 2-3 inch gap to be covered with an aluminum or vinyl manufactured vent to be present at the ridgeline. This is referred to as a "ridge vent." If there is no vent, this gap will simply be closed with roofing material. A ridge vent is a reliable indicator of truss construction.

11.6.2 Hip Roof



Example of a hip roof

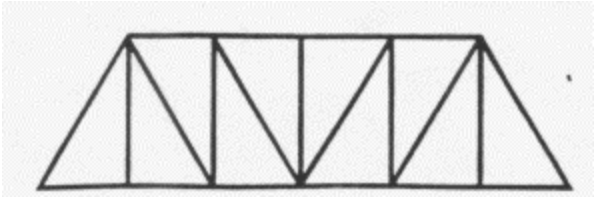
11.6.2.1 Similar to a gable roof. Can be of conventional or lightweight type construction.

11.6.2.2 Conventional or ordinary construction will consist of ridgepole, hip rafters from the ridgepole to the outside walls. Valley rafters are used where the two rooflines join together. Jack and common rafters complete the structural members.

11.6.2.3 Lightweight construction in this style roof will be similar to those used on the gable roof.

11.6.2.4 Decking for the conventional or lightweight construction will be the same as for the gable roof.

11.6.3 Bridge Truss Roof



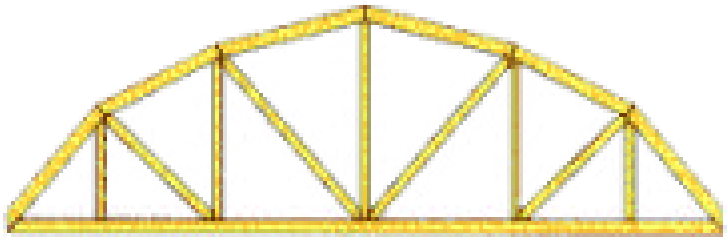
11.6.3.1 These roofs are primarily used on commercial and warehouse buildings. Older roofs are usually of heavy grade construction materials. Wooden top and bottom chords are constructed of 2" X 12" lumber. Metal tie rods may be used for vertical support and the rafters are 1 X 6 or larger covered by 1 X 6 sheathing with a composition roofing material. A bridge truss roof built in recent years may contain lightweight materials.

11.6.3.2 These are well constructed and are easily identified by the characteristic sloping ends.

11.6.3.3 The underside of the roof is exposed in warehouse settings.

11.6.3.4 Like any truss, these can fail as a complete unit. However due to the larger dimension lumber, collapse should not be as early as one would encounter in lightweight construction **but collapse should be expected if fire has entered the truss space**.

11.6.4 Trussed Arch



11.6.4.1 Seen in many small and large commercial buildings built in the 1930s, 1940s, and 1950s. The GSA warehouse facility in Springfield is a prime example of this roof construction.

11.6.4.2 Constructed of 2" X 12" or 2" X 14". Some arch trusses have multiple beams

forming one truss arch.

11.6.4.3 Rafters of 2” X 6” are covered with 1” X 6” sheathing and composition roofing material.

11.6.4.4 The underside of the roof is typically exposed.

11.6.5 Bowstring Arch

Roof supported by a bowstring truss system.

11.6.5.1 This roof is significantly different than the trussed arch in that it is an arched roof that uses metal tie rods and turnbuckles to provide lateral support for the walls of the building. Tie rods are used below each arch member to ensure the arch roof does not push the exterior walls outward.

11.6.5.2 Tie rods may pass through exterior walls to outside plates. These serve as a means of identifying this type roof.

11.6.5.3 Top chords of the arch may utilize laminated 2” X 12” or larger, and 2” X 10” rafters that are covered by 1” X 6” sheathing and composition.

11.6.5.4 The primary hazard associated with this style of roof is the early failure of the tie rods and turnbuckles as a result of exposure to the fire conditions. There have been cases of large-scale collapses in structures with this type roof.

Note the connector on the bottom chord of the truss. Failure of the connector could result in failure of the entire truss.

NOTE: It will be difficult to distinguish between a trussed arch and a bowstring arch at the time of a fire. Tactics should reflect the possibility of a collapse causing the exterior walls to fall outward. Members who are assigned to roof top operations shall be supported independent of the roof.

11.6.5.5 Additional hazards associated with roof support

Note the connectors through the column. Failure of this connector could lead to collapse of the column and roof assembly supported by the column.

The wall is only a curtain wall. The supporting mechanism is the column the wall is built around.

11.6.6 Sawtooth Roof

11.6.6.1 These roofs are used in manufacturing type commercial buildings. Due to the presence of glass they provide natural light to the areas below.

11.6.6.2 These are well-constructed using conventional construction techniques. Rafters with 2" X 8" or larger components and wood or metal bracing. The sloping portion is covered with 1" X 6" sheathing or ½ inch plywood.

11.6.6.3 The undersides of these roofs are typically exposed to the interior.

11.6.6.4 Ventilation is easy due to the glass panels.

11.6.7 Flat Roofs

11.6.7.1 Conventional wood flat roofs contain rafters starting at 2 X 6 inches and larger which are laid across outside and inside bearing walls.

11.6.7.2 Rafters are covered with either 1 X 6 sheathing or plywood and a composite roofing material.

11.6.7.3 Vulnerability to fire conditions is dependent on the size of the rafters; the spacing of the structural members and the type decking utilized.

11.6.7.4 Roofs are covered with plywood rather than 1 X 6-inch sheathing poses a significant problem to firefighters. Decking ranges in thickness from 3/8 inch to ½ inch and offers minimal structural integrity when exposed to fire conditions.

11.6.7.5 The plywood deck may be burned out from underneath without showing signs of weakness from on top. Truck crews must check the roof for stability before stepping onto the roof.

11.6.7.6 Flat roofs are also constructed of lightweight materials using wooden I beams, open web truss, and metal gusset plate truss.

11.6.7.7 The hazards of flat roofs of lightweight construction are numerous. The components offer minimal resistance to fire. The use of 2 X 4-inch trusses

with metal-gusset-plate-connectors equals short burning time and early failure and/or collapse of a roof.

11.6.7.8 Open-web-bar-joist construction uses metal in a wide variety and size of buildings. Top and bottom chords are constructed of 1/8-inch steel and web supports are solid 5/8-inch steel bar.

11.6.7.9 Corrugated metal covered by alternating layers of tar and tarpaper is common decking for flat roofs of steel bar-joist construction. These layers may include an insulating material of composition board or another form of insulation.

11.6.7.10 There may be some instances of wood joists of 2 X 4 and plywood decking with a composite covering placed over bar-joist or wooden beams.

11.6.7.11 There are instances where wood spacers are used with wooden joists. The spacers may vary in dimension but will typically be 2 x 4. When this is done, the spacers run perpendicular to the joists to provide airflow on the underside of the roof deck. This will also allow fire to spread in all directions.

11.6.7.12 Another type of roofing material that truck crews may encounter in buildings, is corrugated metal decking with a lightweight concrete top layer. This consists of an air-entrained mix of sand, cement, and possibly pea gravel to a thickness of three to six inches. A composite roofing material is added for moisture protection. This concrete roof material provides extra insulating properties.

11.7 Facade

11.7.1 The best description of a facade is that it is an external attic that has been attached to a structure.

Note that the name of the store “Petco” is mounted on the façade.

11.7.2 A facade is a horizontal structure on the face of a building designed to improve the appearance.

11.7.3 Facade is used to conceal equipment and machinery on flat roofs. They enhance the exterior of a square building, especially those with a flat roof.

11.7.4 The facade can be, and is used on any kind of building new or old, commercial or residential. Many of the older strip shopping centers, commercial buildings, and malls have been renovated in recent years. In virtually all cases we have seen facades added where they did not exist in the original design.

Façade being added to existing structure.

11.7.5 In newer buildings these facades are very common in the original design of the structure.

11.7.6 The overhang of the facade should be considered. The stability under fire conditions should be suspect. Is it cantilevered or independently supported? What could be the effect of fire in full possession of the attic/cockloft?

11.7.7 Facades normally hide or conceal the roofline. When laddering a facade and the roofline that cannot be seen, the height above the roof must be determined. The best means of accessing the roof in most cases will be via the rear due to the typical absence of facades.

11.7.8 Where a facade surrounds the entire roof, members must maintain alternate means of egress by providing ladders from the roof level to the top of the facade. This must be known in advance so that a ladder is taken aloft initially.

11.7.9 The distance from the top of the facade to the roof deck will vary greatly. To reiterate, members must be familiar with the buildings in their response district. Going to the roof for the first time in smoke and darkness is no time to discover that it is ten feet from the top of the parapet or facade to the roof level.

11.7.10 Many times the facade is open or common to the attic/cockloft area of the building. Crews must anticipate fire extension into this area.

11.7.11 These facades are a means for fire to extend to the attic or cockloft where fire has vented from a storefront or out a window and is exposing the underside of the facade.

11.8 METHODS OF ROOF VENTILATION

11.8.1 CONSIDERATIONS FOR PITCHED ROOFS

11.8.1.1 Pitched roofs are predominantly constructed of wood deck on wood supports (joists, rafters, trusses).

11.8.1.2 When power saws are used to cut a ventilation hole in these roofs, carbide tipped blades and chains must be used to efficiently cut through the roof covering and the deck material.

11.8.1.3 On lower pitch roofs power saws are typically used for the ventilation hole. On steeper pitch power saws can prove to be dangerous. Kickback from the saw can possibly throw a member off balance and perhaps the roof. On these high pitch roofs the power saw should be used from aerial ladder, roof ladder, or the tower ladder basket to make the cut.

11.8.1.4 The use of a roof ladder is dependent on several factors. The pitch of the roof, the roof surface conditions (ice, snow, and wet) truss versus stick built roof support assemblies, and fire in the attic area, are the most important considerations.

11.8.1.5 The purpose of the roof ladder is to distribute the weight and protect the crewmembers. The ends of the roof ladder should generally rest on exterior bearing wall and the ridgeline of the roof (ridgepole in stick built roof assemblies).

11.8.1.6 It is unrealistic to expect a member to cut a 4'x4' hole from the confines of a roof ladder. However having the ladder in place and within reach contributes to the safety of the members.

11.8.1.7 An additional foothold can be accomplished by burying the pick end of a pick headed axe or a halligan bar into the roof surface three feet from the roof ladder. The member performing the cut can step out from the roof ladder with one leg to the foothold. They now have the reach to accomplish the appropriate size ventilation hole.

11.8.1.8 Another option for a foothold would be making a small triangular inspection cut.

11.8.2 CONSIDERATIONS FOR FLAT ROOFS

11.8.2.1 Flat roofs are found predominantly on larger structures such as multi family dwellings, schools, and commercial occupancies.

11.8.2.2 Generally there are two types of flat roofs. The wood flat roof may be found on Type II, Type III, IV, or Type V construction. The common trait is that there will be wood supporting members and roof decking. The surface of the roof may consist of tar and gravel, mopped tar, or a membrane material made of rubber.

11.8.2.3 The metal deck on steel bar joists is the second type of flat roof found on many commercial Type II constructed buildings. These roofs are covered with a bituminous material covered with tar and sometimes gravel.

11.8.2.4 For roofs with metal deck, a composite metal cutting blade will be required. As much of the roof material as possible should be chopped or cut away and removed to get the blade to the metal decking. The carbide tipped blade has also been used to get to through the deck covering to the metal decking with some measure of success. Members can expect to lose a significant number of the carbide teeth on the blade should they take it through the metal deck.

The sample roof section above was cut using a carbide-tip chainsaw.

11.8.2.5 It is very common for roof crews to encounter several layers of insulation materials with a rubberized covering when gaining access to the metal deck. The insulation and covering should be removed at least 12 inches wider than the desired opening so that sufficient room is provided for saw operation on the metal decking.

11.8.2.6 Truck company members need to familiarize themselves with building construction and study their response district.

11.8.3 The ventilation opening

11.8.3.1 The electric service drop (wires) to the structure will always be a potential hazard. The location of wires must be identified during size up of the roof.

11.8.3.2 Power saws with the appropriate blade will typically be faster in cutting the ventilation hole. This does not mean that a pick headed axe should not go to the roof every time. It is very common for saws to shut down as a result of smoke conditions well into the cutting operation. An axe must be available to complete the hole.

11.8.3.3 The location of the ventilation hole is dependent on the location of fire, location of the common stairs, roof construction and stability.

11.8.3.4 On a peaked roof, the hole should generally be made at the uppermost section of the roof where the highest level of smoke and heat has accumulated.

11.8.3.5 A pike pole or hook of sufficient length to reach and punch out the ceiling below must go with the crew to the roof. The hook end is held by the member and the butt end is used to punch out the ceiling below.

11.8.3.6 A minimum of two members must be assigned to perform the task of roof ventilation. The officer must ensure that the roof remains clear of unnecessary personnel.

11.8.3.7 Specific to pitched roofs; the ventilation hole should be placed on the downwind side of the ridge to facilitate movement of the smoke and heat from the building. In windy conditions, if the roof is opened on the windward side, the heat and smoke can be potentially blown back into the area where crews are operating. Typically fire, heat, and smoke take the path of least resistance. Under normal circumstances, with the front door open on the first floor, once the roof ventilation hole is made and ceiling punched through, there will be a profound positive movement of the heat and smoke through the topside ventilation opening.

11.8.3.8 The roof should be opened as close to over the fire as safety permits. In the event that the structural members of the roof are of truss design, an added safety margin must be factored in if fire is suspected in the area at all. The use of a tower ladder for independent support may be the best option if fire has taken possession of the attic area in truss construction.

11.8.3.9 Bubbling tar/melting shingles, steam or condensation (dependant on weather) from hot pipes or a wet roof, melting snow, are indications of where to open up.

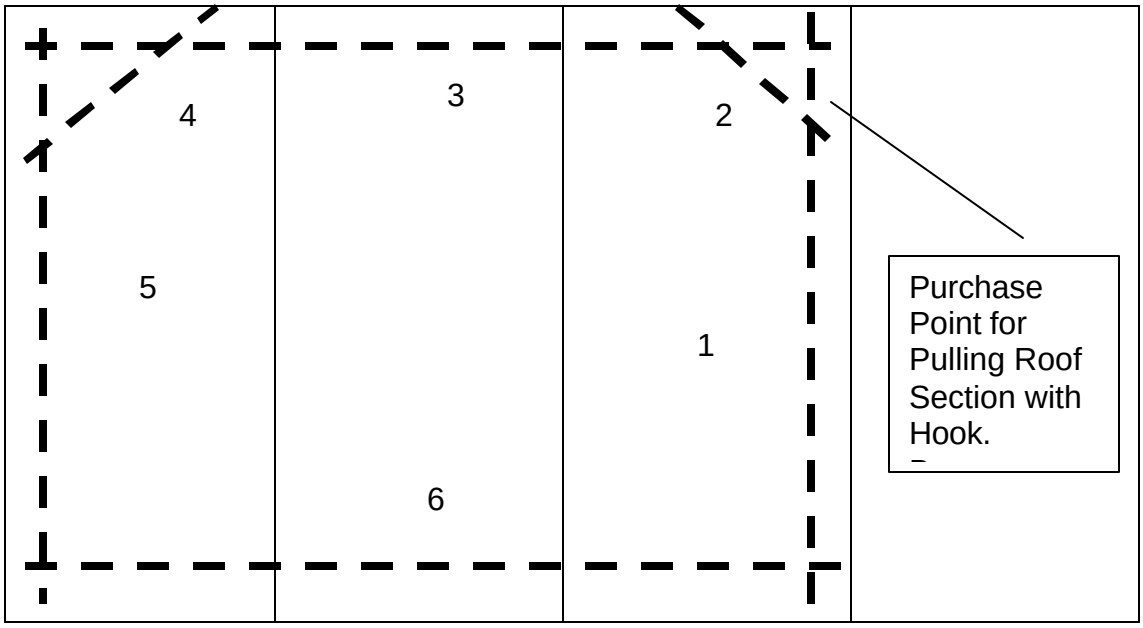
11.8.3.10 Where the seat of the fire is on a lower floor(s), opening up the natural vertical shafts, (plumbing soil pipes, hot water/furnace vents) to include the stairwells, can relieve conditions and limit horizontal spread and/or mushrooming of the byproducts of combustion.

Opening up around the soil pipe.

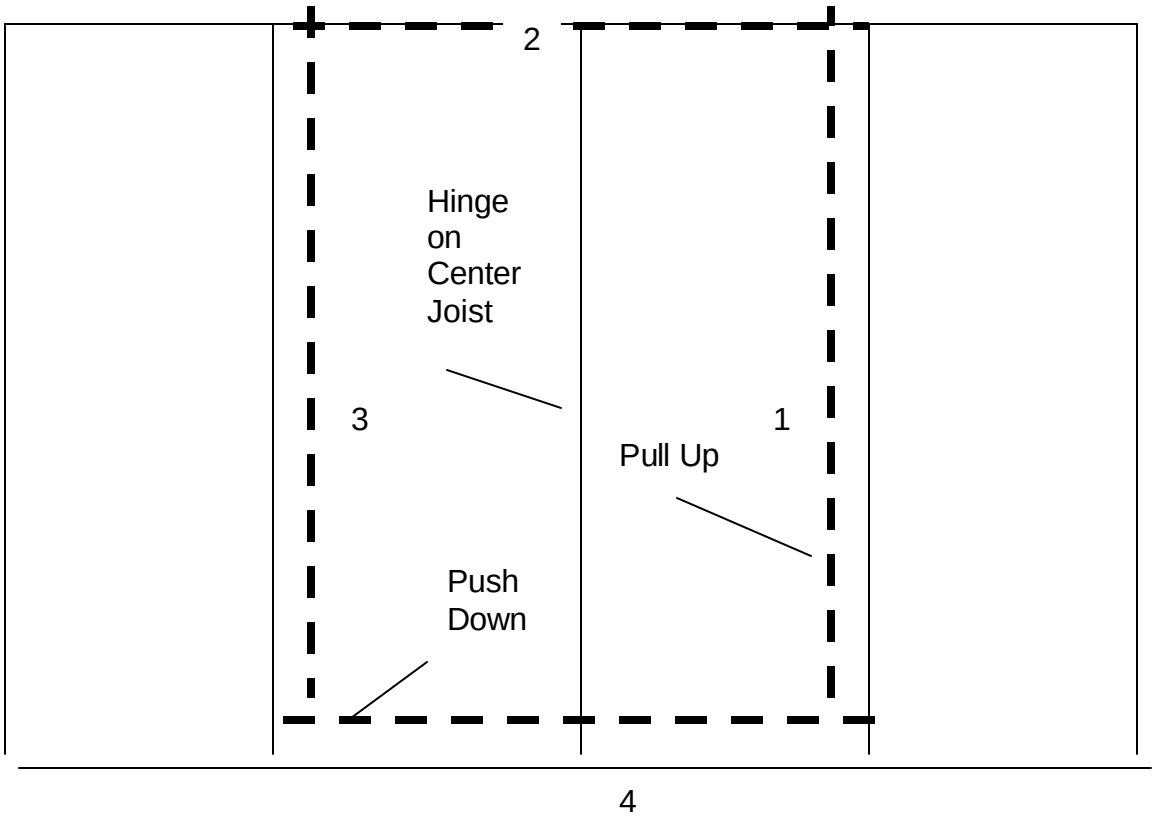
Opening a natural opening, exhaust vent.

11.8.3.11 The 4'x4' "Standard Cut" is preferred when the pitch or roof conditions are such that members can safely operate. When the roof decking is constructed of 1"x6" wood planks this method is relatively quick in that each board is relatively easy to dislodged as it is pulled with the hook. Plywood and metal decks can be much more cumbersome and labor intensive.

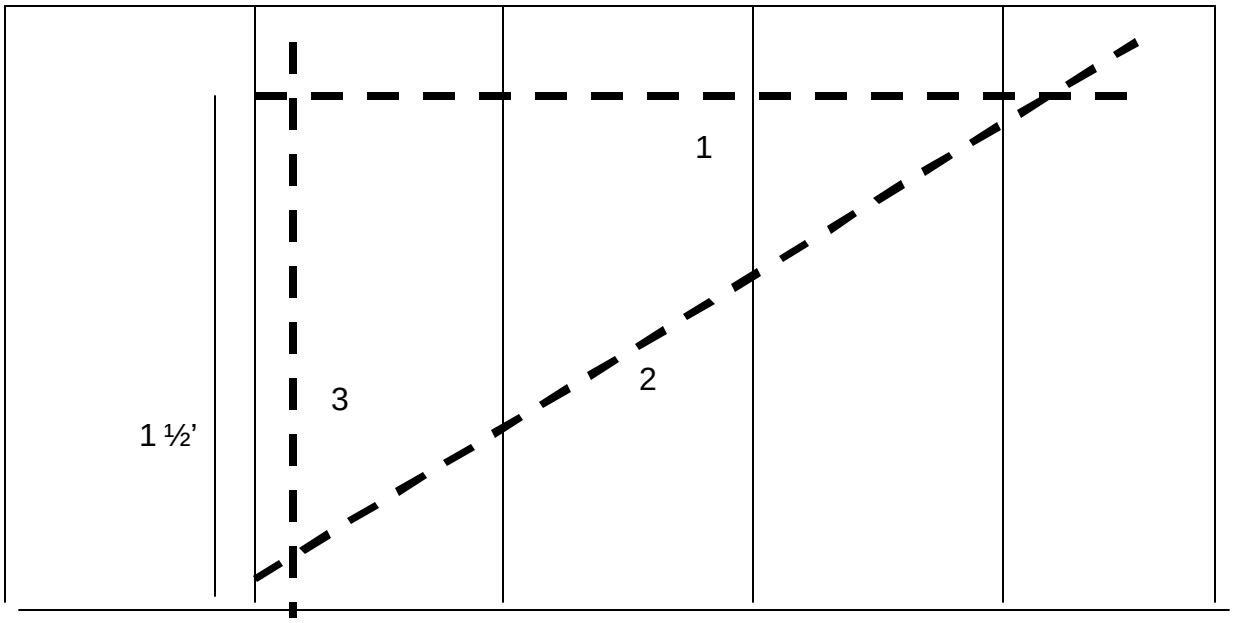
STANDARD 4' X 4' ROOF CUT
(joists 16 inches on center)



11.8.3.12 The “Louver Cut” may be used when time is of the essence. This cut is made on either side of a joist and then louvered open. This method is particularly effective on plywood decking. However it may be used on any roofing material.


2
Hinge
on
Center
Joist
3
1
Pull Up
Push
Down
4

11.8.3.13 The “Basket Cut” refers to a triangular shaped cut made from the basket of the tower ladder, or tip of an aerial ladder. The slope of the roof will dictate how effective and large this hole can be made. On lower pitches or a flat roof, a member with ladder belt and short tether can complete the cut while still supported independent of the roof itself.



11.8.3.14 The Louver Cut and the Basket Cut are very useful when the officer has determined that the ventilation opening must be made from the protection of a roof ladder or the basket of the tower ladder.

11.8.3.15 In all of the methods identified above, it is imperative that all cuts intersect and overlap one another. This ensures that when the time comes to pull or louver the roofing material, there will be no incomplete cuts. It only takes a small amount of material to prevent completion of the opening.

11.8.3.16 There is significant hazard associated with a member going back to finish an incomplete cut and should be avoided. Do it right the first time.

11.8.4 Trench Cut

11.8.4.1 The trench cut (also referred to as strip ventilation) is used on large structures with a common attic or cockloft, where fire has taken possession of the void area under the roof in a portion of the building. This tactic is employed to stop the lateral spread of fire to the remainder of the building by essentially creating a firebreak along the surface of the roof.

11.8.4.2 This is a defensive tactic that is used when the original ventilation opening was insufficient in limiting the lateral spread of the fire, or the roof in the area needing ventilation is untenable and hose streams are unable to contain the fire from underneath.

11.8.4.3 A considerable amount of the roof and building must be written off when the decision has been made to employ this tactic. This is due to the labor-intensive nature and staff requirements to successfully accomplish the cut.

11.8.4.4 The trench cut is used primarily on large long or multi-wing buildings.

11.8.4.5 The officer assigned Ventilation Group Supervisor must plan on at least 4 saws operating, and at least 6 members preparing to pull or louver the roofing materials, and at least one hose stream at the ready.

11.8.4.6 The cut must begin well ahead of the fire. The Vent Group Supervisor must anticipate how long it will take the crews to complete the cut and how fast the fire is traveling.

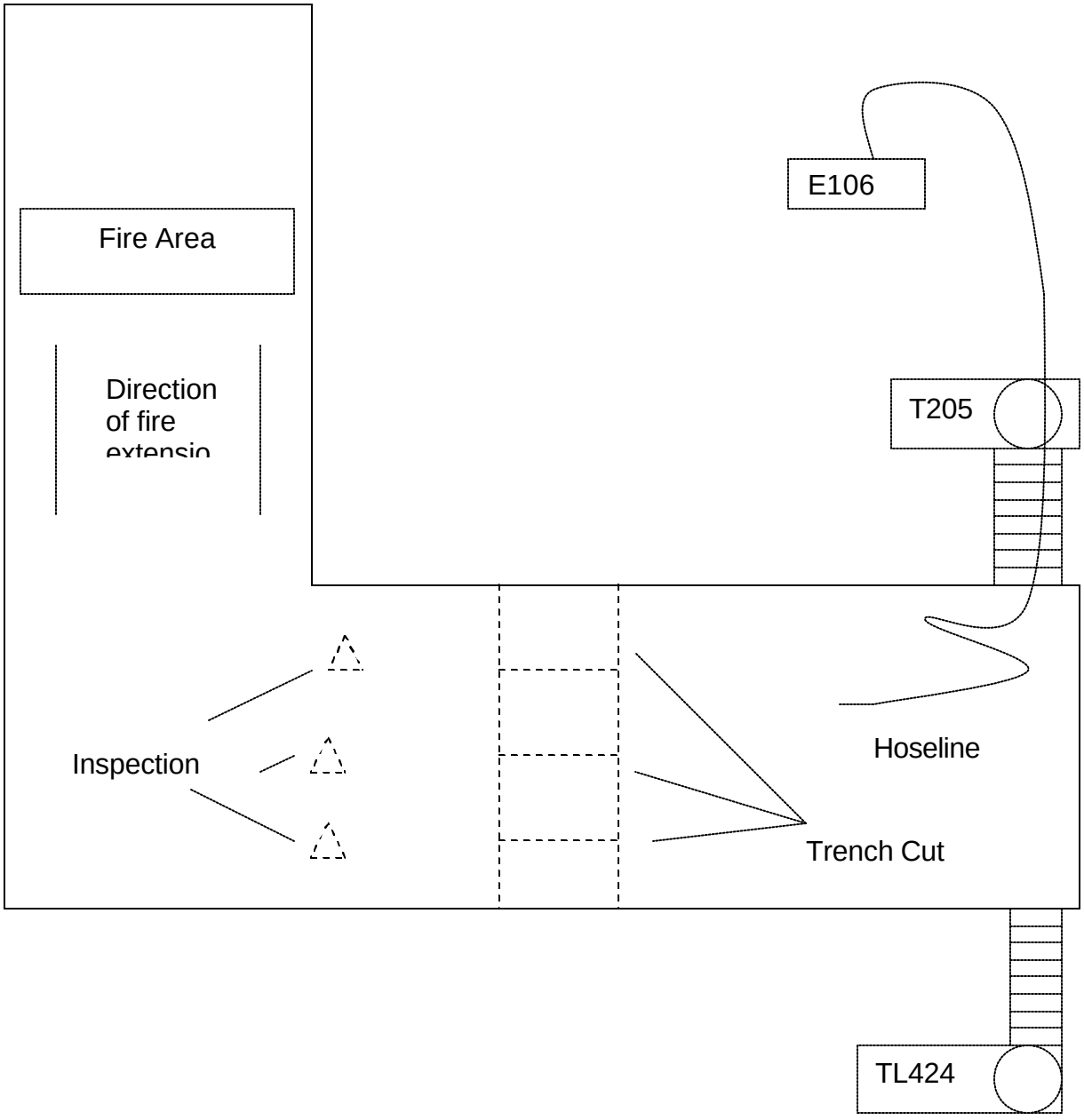
11.8.4.7 The first cuts are several inspection holes on the fire side of the projected trench opening. These are made to check conditions under the roof in the area and to act as early warning as the fire approaches the area.

11.8.4.8 The next cut is made from the front to the rear walls. This followed by several cuts parallel with the front and rear wall to section (4'x4') off the roofing material. The last cut is then made from wall to wall on the exposure side of the opening.

11.8.4.9 Additional inspection holes should be made on the safe side of the trench to identify if fire gets past the opening.

11.8.4.10 A hoseline and two means of egress must be in place for the Vent Group.

The diagram below depicts an example of the trench cut.



12 LADDERING

12.1 Ground Ladders – General

12.1.1 Ground ladders are used to access and exit areas above ground level, and to remove victims from those areas. They may also be used for advancing hose, tools and equipment to areas above ground level and for ventilation. Ground ladders are also used to access areas below grade as well.

12.1.2 The main advantage of ground ladders is their portability. They can be quickly placed in service by a well-trained crew or in some cases an individual.

12.1.3 Truck companies carry a compliment of ladders consisting of single or straight ladders, roof ladders, extension ladders, folding ladders, and combination ladders. All of these have different applications on the fireground, and require practice for their effective use.

12.1.4 Ground ladders require routine maintenance and inspection. The ladders should have the tip painted as per departmental requirement. Ladders are tested at least annually and must be inspected and cleaned monthly as well as after every use.

12.1.5 The main disadvantage of ground ladders is their limited reach. Most of the ground ladder compliments carried on truck companies have a maximum reach of 35ft. – 40ft. This length allows access to the third floor balcony or window or in some cases the third floor roof or fourth floor windows. The effective reach of the ladder will depend on distance from the building and the terrain on which the ladder is placed.

12.1.6 When selecting a ladder for a task, choosing an extension ladder that may be longer than needed is better than one that is too short. A ladder that is fully extended to its maximum reach and placed at a poor climbing angle may result in an accident or injury.

12.1.7 Apparatus positioning on the fire ground must keep the area to the rear of the truck clear to allow for access to the ground ladder bed. A clear area of at least 50 feet must be maintained.

12.1.8 Companies should be familiar with their response districts and be aware of areas where laddering may be a problem.

12.2 Ground Ladder Positioning and Placement

12.2.1 The truck officer and crew should have a specific goal or task in mind when selecting and placing ladders. These include gaining access, providing a means of egress, removing victims, and advancing hose lines.

12.2.2 Ground ladders should be used when the target is within their reach, as opposed to placing the aerial to the same target.

12.2.3 Laddering of a building is dependent upon the type and occupancy of the building as well as the location and extent of fire. The primary reason for general laddering of a building is to provide avenues for firefighter egress. Other factors to consider for laddering a structure include:

- Victim removal
- Access for V.E.S.
- Access for hose line advancement
- Ventilation

12.2.4 Laddering the roof may also have to be accomplished. This should be done in the order of necessity and priority established during size up and the plan of action that has been developed.

12.2.5 Two ladders to the roof may be necessary when crews are operating on the roof to provide secondary means of egress.

12.2.6 Select a ground ladder of the appropriate length for the task to be accomplished. Normally estimate 9 feet per floor in residential occupancies and 12 feet per floor in commercial occupancies. Some common applications are as follows:

• Second floor windows – residential	14 or 16 straight ladder
• Second floor windows – commercial	16 or 20 ft. straight ladder
• Two story residential structure roof	20 ft. straight ladder 24 ft. extension ladder
• Two story commercial roof	28 ft. extension ladder
• Third floor windows – residential	24 ft. extension ladder 28 ft. extension ladder
• Third floor windows – commercial	35 ft. extension ladder
• Three story residential structure roof	35 ft. extension ladder
• Three story commercial structure roof	39 ft. extension ladder
• Fourth floor windows – residential	39 ft. extension ladder

- Fourth floor windows – commercial Aerial device

- For targets higher than the fourth floor windows on any type of structure, the aerial device must be used.
- For fires in a basement, an attic ladder may be placed into the window if the size of the opening permits for egress.
- The aerial can be used for accessing any roof, window or balcony within its reach.

12.2.7 Position the ladder with your objective in mind.

- Place the ladder with the fly out for all operations.
- Place the tip of the ladder next to and upwind of the opening for ventilation.
- Place the tip of the ladder at or slightly below the sill, and in the center of the opening for rescue and alternative egress.
- Place the tip of the ladder 3 – 5 rungs above the edge of a roof.
- Place the tip of the ladder above and in the center of the opening for hose stream operation.
- Place the tip of the ladder at or slightly under the sill for hose line advancement.
- Place the tip of the ladder one rung above and near the end of the railing on a balcony where the railing is flush with the exterior wall.
- Place the tip of the ladder against the wall to the upwind side of a balcony that is cantilevered out from the exterior wall. The tip should be 1 - 2 rungs above the railing height.

12.2.8 Ground ladders should not be placed directly in front of an entry or exit route or openings with fire venting.

12.2.9 Once a ground ladder is in place, it should not be moved. If, however, an emergency requires a ladder to be moved, a ladder must be returned to the original location.

12.2.10 Roof ladders should be used on most pitched or sloped roofs, or where footing is questionable. The roof ladder offers support should the roof deck become weak or collapse.

12.2.11 When a high parapet is encountered an additional roof or straight ladder should be used to descend onto the flat roof. The second ladder should be carried up the first ladder heel first.

Parapet protruding above the front wall of a shopping center.

Typical parapet as they appear from the front of a shopping center.

12.2.12 When crews are operating on the roof, they should be advised of the location of all ladders that have been placed to the roof for escape.

12.2.13 Always check overhead for obstructions and electrical wires when placing ladders.

12.3 Aerial Ladders/Tower Ladders – General

12.3.1 Aerial and tower ladders can be used for the same purposes as ground ladders, and also provide a means to operate movable elevated streams.

12.3.2 Aerial apparatus provides greater reach and a more stable platform for operations than ground ladders. When performing tasks that require the firefighter to be supported independently, the tower ladder is the best tool to accomplish the job.

12.3.3 All aerial apparatus have specific operational guidelines that must be followed as described by the manufacturer. As with every operation, safety must be the primary consideration when utilizing the aerial. The operator must be trained and competent in this area.

12.4 Aerial and Tower Ladder Placement

12.4.1 Positioning for the aerial will be dependent on the intended use of the device. The uses include gaining access to windows, roofs, victims, positioning hose lines, and flowing master streams.

12.4.2 The position of the tip of the aerial will be similar to those stated in the section above on ground ladders.

12.4.3 Basket placement should be so the basket rail is level with a windowsill or railing, and just above a roof edge. When smoke is not a problem, the basket may be positioned with the floor of the basket even with the sill. This allows for a victim to crawl out of the window and through the basket door onto the floor of the basket.

12.4.4 Remember, when moving any aerial device from the roof, the first maneuver is to elevate to prevent the aerial device from striking the building.

12.4.5 The mode of operation, offensive or defensive, will also be a factor when positioning, as the assignment may be to protect an exposure with the ladder pipe.

12.4.6 The type of aerial and type of truck it is mounted on will also influence the position of the Truck company. The distance required for the stabilization system to be deployed will require a certain amount of clearance when positioning. **(See diagrams).**

12.4.7 The existence of predetermined assignments set forth in other operational manuals or specific location pre plans, may determine where the Truck company will be positioned.

12.4.8 The topography and wind direction must be taken into consideration when positioning. (Refer to manufacturer's recommendations).

12.4.9 The area that the aerial device can cover is known as the 'Scrub Surface'.

12.4.10 The proper distance from any objective is the distance that affords the maximum stability and the best climbing angle.

12.4.11 The truck company positioning for elevated streams is discussed in another part of this manual. Positioning for access/egress to windows and roofs will be as follows and in accordance to specific types of structures as found in the operations manuals of Volume II.

- The side of the structure where the fire is located, suspected or known should be covered first, then the opposite side.
- When there is limited or restricted access to a side(s) of a structure, the Truck company should position at the best position available and communicate their decision.
- When a specific target has been identified for placement of the aerial ladder or platform, the turntable should be positioned in line with the target if possible. The vehicle should be positioned parallel with the side of the building which the truck is operating on.
- When access to the roof is the target, position the turntable near a corner of the structure, again keeping the vehicle parallel with the side of the building.
- When no specific target has been identified, the Truck company should remain in an uncommitted location and the driver left to reposition if required.
- Whether the vehicle should be back in for rear, or nosed in for midship mounted aerial devices is discussed in another section.
- When wind is a factor and is causing fire or smoke to be blown across the side of a building, position the turntable slightly upwind of the target.
- When the slope of the terrain is a factor, position the vehicle so the slope either runs through the ends of the vehicle or through the sides. Avoid positioning so the turntable cannot be leveled by the stabilizing system.
- When multiple targets are known, position the turntable to be able to reach as many of the targets as possible. A priority must be assigned to the targets and reached in that order. Reaching all the targets in a timely manner may require multiple Truck Companies to be positioned on the same side.
- When collapse is a factor, position the vehicle in the safe area at the corners of the building.

12.4.12 During roof operations at night, the lights on the tip of the aerial may be helpful.

12.5 Window Ventilation

12.5.1 Ventilation of a window from a ladder or basket is a common fire ground practice that can be accomplished by one person, or a team of firefighters.

12.5.2 Positioning of the ladder tip or basket upwind and slightly higher is to avoid falling glass and to remain clear of smoke or fire that may be issuing from the window opening.

12.5.3 A ground ladder may be used as the striking tool for venting a glass window. This method can quickly ventilate several upper floor windows and result in a ladder being placed at the final window for access or egress. At some point all obstructions in and around the vented windows should be removed, such as screens, blinds, glass, and curtains.

12.5.4 The aerial ladder may be used as the striking tool also. This provides a quick and effective method for venting windows that are beyond the reach of ground ladders.

12.5.5 The targets are identified and the turntable is positioned accordingly. The aerial is raised and rotated towards the target window. The ladder is extended to a point slightly above the window and then **LOWERED** into the opening to break the glass. This may have to be repeated to accomplish the task. This tactic is typically used for double-hung windows and should NOT be used on casement windows and windows that have heavy steel cross members that will damage the ladder.

12.5.6 The aerial should not be rotated into the glass, as this could cause significant damage to the aerial device.

12.5.7 When using the tip of a ground ladder for ventilation, position as if it was going to be climbed. Extend the ladder to a length so the tip will strike the top sash of the window. The ladder is then quickly and forcibly lowered while standing on the bottom rung, breaking the glass. Rotating the ladder in place on the widow sill will grab window material and break glass for removal. This may have to be repeated to provide a large enough opening.

12.5.8 Be cautious of glass sliding down the beams of the ladder.

12.6 Alternative Uses for Ladders

12.7 Bridging is a method for getting from one place to another over some type of obstacle using ladders.

12.7.1 Ladders can be used to bridge a separation from one building to another, or to access the roof of another building in a row where the roof is at a different level.

12.7.2 Ladders can also be used as a bridge to get over a fence or wall remembering to carry the second ladder up the first heel first.

12.7.3 Ladders can also be used in place of stairs in buildings under construction, or where stairs have been damaged by fire.

12.7.4 They can also be used to cover (elevator) shafts or open floor areas.

12.7.5 Ladders can be used to construct chutes or pits for water retention.

12.7.6 Ladders can be used for forcing entry through doors. Place the butt against the doors with several members applying steady force to break the lock or door. This is an example where entry is needed, but conditions require crews to operate a safe distance from the building.

12.7.7 Ladders can be used during ice rescue operations to distribute the weight of a firefighter who is working on the ice or as a tool for the victim to grab.

12.7.8 Ladders can also be used when rigging for rope operations requiring an alternative anchor point, such as an “A” frame configuration.

12.7.9 A roof ladder with folding hooks can be used to climb from a lower balcony to balcony on the next floor.

12.7.10 A ladder can be used in a fashion where it is raised and extended but the tip does not rest against the structure. Ropes attached to the tip and held fast by firefighters stabilize the ladder. This is known as an ‘Auditorium Raise’.

12.7.11 The aerial may be raised to the roof of a building and used as an anchor for a lowering operation on the opposite side.

12.7.12 The combination ladder, also known by many manufacturer names such as ‘Little Giant’, has many applications.

12.7.13 Many other alternative ladder techniques can be found in ‘IFSTA Ground Ladder Practices’.

13 ELEVATED STREAMS

13.1 Although infrequent, the truck company may on arrival, immediately deploy an elevated stream for exposure protection or fire attack. This task may become necessary later in an operation and may even require the repositioning of apparatus after conditions have changed. This task typically involves the entire crew and must be coordinated with the engine company/companies supplying water.

13.2 GENERAL

13.2.1 Turntable placement is critical. The officer must estimate the fire's growth in order to have the stream operating at or ahead of the fire's forward progress. This requires knowledge of the time it takes the truck company to deploy it's elevated stream, and fire spread and growth. An idea of the amount of time it takes for the stream to begin operating is gained from constant multi-company training. Knowledge of fire growth and spread is gained from experience and good judgment.

13.2.2 Turntable placement is the responsibility of the officer and shall be accomplished through communication and coordination of the officer and the driver.

13.2.3 Depending on building construction type, condition of the structure and the amount of fire, a potential exists for full or partial collapse of the structure. As a general rule, if the apparatus is to be used for its elevated stream and there is potential for collapse, it shall be parked away from the structure 1 ½ times as the structure's height, or on an outside corner.

13.2.4 This is not to imply that on every fire apparatus is positioned a remote distance from the affected structure. When no hazard exists for collapse, position the aerial device in front of the fire so that the elevated stream will be effective.

13.2.5 If the elevated stream is prepared to flow onto the fire but water is not yet at the nozzle, it shall NOT be rotated into attack position until water is flowing to prevent fire damage to the aerial. However, it is important to realize where the stream will go as the ladder is rotating into attack position.

13.2.6 A protective stream from a handline may be flowed onto the truck or the aerial to protect it from exposure to heat and fire. This may be necessary when the water supply for the elevated stream is delayed, interrupted or conditions have worsened.

13.2.7 It is recommended that the smooth bore nozzle be pre-attached. In Fairfax County, this is the standard for all master stream devices. The stream from a smooth bore nozzle has the ability to carry through intense heat and fire as well as to resist the effects of wind. These capabilities are far superior to a fog stream in master stream applications. In addition, the horizontal and vertical reach of the solid stream exceeds that of the straight stream from a fog nozzle at the same flow rates. This enables the solid stream to reach its target, even when the truck must take a position a safe distance from the building when collapse is a possibility.

13.2.8 All elevated streams using smooth bore tips should begin with the largest tip available within manufacturer's specifications, unless directed otherwise or if it is known that the municipal water supply will not support it.

13.2.9 In order to achieve the maximum reach or penetration of any stream, the stream should be directed upward at approximately a 30-degree angle.

13.2.10 If a large volume of fire is on several floors, attack the fire on the lowest floor first, then move up, attacking each successive floor.

13.2.11 If a large fire is spreading horizontally, stop its horizontal progress first and extinguish back towards its apparent origin. Tower ladders are best suited for this. They can sweep quickly from one end of a burning building to the other.

13.2.12 The nozzle should be at the level of the fire floor so that the stream can operate directly onto the seat of the fire.

13.2.13 If directing the stream into a window, the nozzle should be placed as close to the window as possible. The nozzle should be positioned low in the window opening near the window sill to achieve maximum stream penetration. In some cases, it may be possible to place the nozzle inside the window opening.

13.2.14 If the nozzle cannot position through the window it should position at the level of the sill and flow at an upward angle.

13.2.15 Elevated streams shall **NOT** be directed into vent holes in the roof.

13.2.16 Controlling the flow of water to the nozzle is done at the gated inlets for pre-piped waterways. Regardless of whose responsibility it is, someone must be positioned to open the gated inlets one at a time as each line is charged. This prevents water from flowing back to the supply engine through the other line should the supply engine only have one supply hose connected and charged.

13.2.17 The preferred method of controlling the flow of water to a clamp-on ladder pipe is by placing a 2 ½" gate valve to the clappered siamese and assigning someone to open the gate valve when ready for water or after water arrives at the siamese. Some truck companies still use a hose clamp to control the flow. If a hose clamp is used, it shall be left in place after it is opened with the single hose going up the ladder lying between the clamp's jaws. This will provide a means to quickly shut down the flow of water to the nozzle in an emergency. It is not necessary to use both a clamp and a gate.

13.2.18 The ideal way to shut down the flow of water to an elevated stream is to have the supply engine shut down the supply lines.

13.2.19 If placing an elevated stream into operation after a change in strategic modes (offensive to defensive), ensure through command that members are out of the area where the stream will operate and that it is safe to begin.

13.2.20 Use extreme caution when operating elevated streams in the vicinity of overhead electric wires. Assume all wires are dangerous. There is always a chance it may arc to the aerial. When operating the stream, avoid striking wires or any electric equipment.

13.2.21 All members on the aerial operating any elevated stream shall be in full PPE and SCBA. A life belt shall be worn and fastened to a substantial part of the aerial (rung, top rail of basket, top rail of aerial beam) when operating the pipe.

13.2.22 When the stream is directed to one side of the ladder, nozzle reaction will cause the ladder or platform to move in the opposite direction and possibly cause it to strike an object. This is particularly important when working near wires, buildings, or other obstacles. The formula for calculating nozzle reaction is:

$$1.5 \times D^2 \times NP = \text{nozzle reaction for smooth bores}$$

$$.0505 \times Q \times v NP = \text{nozzle reaction for fog nozzles}$$

13.3 Tower Ladders

13.3.1 Tower ladders have a gate valve in the basket for controlling the flow to the nozzle. THIS VALVE SHALL NOT BE CLOSED any time the ladder or boom is being retracted. If this valve is closed and the aerial accidentally retracted, damage will occur to the waterway.

13.3.2 The tower ladder is the most versatile master stream. When elevated streams are going to be used, incident commanders should consider transmitting a special alarm for tower ladders if now already on the assignment.

13.3.3 Tower ladders provide a highly mobile master stream. It is realistic to expect the tower to fight fire through multiple windows, floors and when possible on 2 adjacent sides. "Hit and move tactics" must be used for the tower or any fire stream to be most effective. This means nothing more than keeping the stream mobile. Darken the fire in one location, repositioning the bucket to the next best location, and flow the stream so that it can again darken down fire.

13.3.4 The platforms on tower ladders automatically maintain the same level with the turntable regardless of the angle of the aerial. However, the platform level can be changed while the aerial is in operation. This has the effect of increasing the range of the up and down nozzle movement. This enables the stream to cover a larger area.

13.3.5 If tower ladders are special called for elevated stream operations, consideration for the effective position for the tower must be given. This may require the repositioning of other apparatus. This must be done quickly, efficiently and must be practiced regularly by truck companies.

13.3.6 When operating the tower from the basket, the operator must constantly be aware of the basket's surroundings for other obstructions.

13.3.7 The turntable operator and the crew in the basket must communicate via the intercom. Regardless of the company's task, the intercom shall be turned on immediately when the crew enters the basket. This same rule applies to all truck companies. When the operator opens the pedestal lid, the intercom shall be turned on as a matter of routine. The entire crew needs to continue to monitor radio traffic.

13.3.8 The operator must communicate all intended movements to the members in the basket, i.e. "rotating right", "retracting", etc.

13.3.9 A high flow foam nozzle can be placed on the nozzle of the tower to safely flow foam onto a flammable liquid spill or fire from a distance. A greater measure of safety can be achieved by operating the tower basket and nozzle remotely from the turntable.

13.3.10 Some firefighting situations such as a well-advanced fire in a strip shopping center or warehouse may require a mobile master stream to be operated into the first floor. The tower ladder is best suited for this application because of its flow capabilities, ability to operate at grade level or below, and the fact that firefighters can be positioned in the basket behind the nozzle to view its effectiveness.

13.3.11 Some towers have two nozzles at the basket that can be operated simultaneously for firefighting.

13.4 Ladder Pipes

13.4.1 Positioning a firefighter at the tip of an aerial to maneuver the nozzle can be beneficial. The firefighter may be able to better aim the stream onto a target. The movement of the aerial must be limited mostly to careful rotation and elevation changes only in accordance with the load chart. The firefighter at the tip shall be belted-in to the ladder. The aerial operator shall communicate all intended movements.

13.4.2 Trucks with pre-piped waterways have controls to maneuver the stream from either the turntable or the tip of the aerial at a position behind the nozzle.

13.4.3 Trucks with clamp-on ladder pipes are the least effective from the viewpoint of getting water flowing quickly and stream maneuverability. However, a well-trained crew may improve the efficiency of this operation.

13.4.4 Aerial ladders can be carefully maneuvered while operating their elevated stream. This careful maneuvering (elevating, rotating and extending) takes some skill and judgment and should be practiced regularly. **The aerial shall NOT be extended or retracted if a firefighter is on the ladder.**

13.4.5 Clamp-on ladder pipes controlled by halyards will be more maneuverable than those controlled by a firefighter positioned at the tip because the aerial can be maneuvered in all modes (elevate to change the angle of stream, rotate to another window or building, or extended to another floor). This procedure is safer because it does not require a firefighter at the tip.

13.4.6 One halyard is laid on the rungs up the aerial to control the handle. The other halyard is attached to the tip of the pipe and is positioned under the aerial after it is raised. If one halyard is run under the aerial, it can regain control of the pipe because the halyard can be pulled from the ground if necessary in forward motion.

13.4.7 The retracted aerial with the ladder pipe attached will extend without damaging the aerial. Damage can occur from an improperly placed rope hose tool.

13.4.8 A rope hose tool placed just below the ladder pipe should be hooked over the top most rung and not through the aerial. It is recommended that additional measures be taken to secure the hose to the ladder at intermediate points or just below any couplings. In order to ensure the rope hose tool does not create a constriction in the hose, water should be started at a low pressure until discharged from the tip. Once the hose is charged, the rope hose tool should then be attached to the hose just below a coupling and lifted to the rung above to take the weight off the coupling.

13.4.9 It is suggested that the halyards be kept in bags attached to the pipe and the pipe be stored in the position of function, not folded. In this manner, the handle does not need to be adjusted in most cases. The handle should be approximately 180 degrees from the nozzle. It will need to be adjusted to less of an angle if the aerial will be operating at an angle lower than approximately 45 degrees. It is recognized that storing the pipe in this manner is not possible on some trucks.

13.4.10 Truck drivers must be familiar with the characteristics of their unit in order to provide necessary information to pump operators for proper water supply. Pumpers are not required to be within 100 feet of the truck any longer. The only limitation on the location of the engine that is supplying water to the truck is the ability to provide proper volume and pressure to the nozzle.

13.4.11 The starting pressure for any elevated stream is 150 psi at the pumper to get water started. Communications between the truck crew and engine is needed to provide the engine operator with information for proper pump pressure to be calculated.

13.4.12 A truck crew should be able to have water flowing from its elevated stream in less than 3 ½ minutes with an engine company and water supply nearby.

13.5 Specific Situations

13.5.1 A situation is occasionally encountered in buildings with peaked roofs where fire has possession of the cockloft and extinguishment from the interior is not possible. If the decision is to go to elevated streams, they shall be applied through the top floor ceiling via the windows or through the eaves and into the attic; not from above through the vent hole the fire has created.

14 CHECKING FOR EXTENSION

14.1 The initial check for fire extension is often performed by the officer and crew from the first arriving truck while carrying out the primary search under conditions of high heat with limited ventilation and visibility. This is often conducted without the protection of a hose line.

14.2 Officers should gather as much information as possible through radio reports and their observations before entering the structure. They should be looking for obvious signs of fire extension such as:

- Open doors and windows that could accelerate auto-exposure.
- Radiant heat conditions that may threaten adjacent exposures.

NOTE: Auto exposure is the extension of fire upward as a result of fire venting out of a window or other opening. The radiant heat from that fire then ignites materials inside another opening above or beside.

14.3 These observations may determine the best entry point to check for interior extension.

14.4 Truck crews will help to limit or control fire extension by closing doors or windows until the engine crew begins their attack on the fire.

14.5 The initial check for fire extension is usually done in conjunction with the initial fire attack to ensure that fire has not extended into adjacent rooms or occupancies, walls, ceilings, attics or shafts. This requires crews to work quickly often checking several rooms or floors in succession, often ahead of the attack line. Anytime a working fire is encountered inside a structure, firefighters should suspect that the fire has entered concealed spaces until they have determined otherwise.

14.6 Knowledge of building construction and fire behavior is essential. The intensity and location of the fire in the structure will assist in determining areas that should be checked for fire extension.

14.7 Knowledge of the type of occupancy obtained during pre-fire planning, building familiarization tours, and any renovations that have been done to the structure will be an advantage in limiting fire extension.

14.8 If a building has been renovated, you may suspect that additional interior walls have been added or removed. The removal or the relocation of a wall may not limit fire extension as well as an original wall.

14.9 You may also encounter a suspended ceiling with another ceiling or multiple ceilings above.

14.10 In multi story occupancies, checking for extension may require opening walls and pulling ceilings on several floors above the fire as well as checking attics, cocklofts, shafts and the roof. This should be an indication that a more thorough check will be necessary and additional truck crews will be needed.

14.11 Truck crews should have a charged hose line available when checking for extension, especially if they will be going above the fire. However, in the initial stages of firefighting operations this may not always be possible.

14.12 Truck crews must report the location of fire extension so that an attack line can be repositioned or additional lines can be placed in service.

14.13 Crews should always monitor fireground radio traffic and have an alternate means of egress should conditions deteriorate.

14.14 Attics and cocklofts should be checked as soon as possible for any signs of fire extension.

14.15 In multi-family occupancies like garden apartments or high rise buildings, utility shafts normally run vertically through the entire building. Kitchens, bathrooms and HVAC units are normally stacked from the ground to the top floor often placed back to back. It is possible, depending on construction to have fire extension several floors above the fire floor and nothing on the floors in between.

14.16 In older single family dwellings, officers should be aware of the possibility of balloon frame construction. Balloon framing may not have built in fire stops between floors, and allows fire to travel upward through the exterior walls. A fire originating in the basement or a lower floor can rapidly extend up past other floors to the attic. Crews should be aware that there can be fire extension in the attic and the fire may never show on the floors in-between. They should open exterior walls on all floors above the fire including the attic to cut off fire spread.

15 UTILITY CONTROL

15.1 General information

15.1.1 Control of utilities (gas, electric and water) is normally a duty of the truck or rescue company. There are times when it is necessary to shut down utilities before an incident can be controlled. Incidents have been encountered where a fire could not be extinguished because it involved an inside gas meter or electric panel. Truck and rescue companies should attempt to shut off gas and electric as soon as possible.

15.1.2 Companies should note the location of gas meters, electric panels, water meters, and shut offs during pre-plan and building familiarization tours. They should also be familiar with which utility companies provide service in their response areas. Usually gas and electric meters are located outside on the perimeter of the structure, but many older homes and commercial buildings have gas and electric meters in basements or utility rooms. In some multiple occupancies, there may be a master gas or electric meter for the entire building or complex and others may have individual meters for each occupant. The meters may or may not be marked as to which occupancy they supply. Truck crews should also be cognizant of the possibility of more than one meter serving a single family dwelling, which would indicate a renovation of the house to a multiple occupancy.

15.1.3 Firefighters assigned to utility control at residential occupancies should have a basic understanding of utility systems and how to control them. It is not always possible to control utilities without assistance from the utility company. If you are given this assignment and are unable to complete it, notify the incident commander or division officer stating why they cannot be shut off and request appropriate assistance. Do not operate any valve unless you are sure what it controls. Conversely, if there are multiple valves and you are not sure which one is the appropriate control, shut all the valves. The system can be restored by the appropriate utility company once the incident is terminated.

15.1.4 Any time a company encounters a utility related hazard, the incident commander and all companies working in the immediate area shall be notified.

15.1.5 Fires involving gas meters may have to be confined and exposures protected until the utility company shuts off the utilities at a distant location. Extinguishment before the utility is controlled can create a more serious problem than allowing the fire to burn if the flow of the fuel cannot be immediately and safely stopped.

15.2 SHUTTING OFF UTILITY SERVICE

15.2.1 Under routine conditions, closing a valve on an appliance, piping, or meter, or turning off breakers in the panel box is all that is required to control utilities. **Once the fire department has turned a valve off, only the utility company should restore the service.**

15.2.2 Firefighters should be familiar with residential gas meters. Normally operating the quarter turn valve to the upper left side of the meter will shut off gas service. Before closing the valve, note the sound of gas flowing through the meter and look for movement of the numbers on the face of the meter. After the valve has been closed, the sound and movement should stop.

15.2.3 Commercial gas meters are usually much larger and operate at higher pressures than residential meters. Operating the wrong valve may create a more serious problem. Commercial occupancies may have several valves. If it is not obvious which valve is the shutoff, it should not be operated. Call for and stand by for the gas company. Larry to do more research and photos here.

15.2.4 If an interior gas meter is involved and cannot be shut off, there should be a control valve in a curb box, which is usually located in front of the building next to the street. Truck and rescue companies carry gas shut off keys that may be used to close this valve and control the gas. Be aware the locating and using the curb box may be a difficult and time-consuming process.

15.2.5 The differences between a street box and curb box are that the curb box is located between the street itself and the building and usually controls only building. A street box is located out in the street and will serve a series of buildings. This valve should not be operated by fire department members. Only gas company personnel should operate these valves.

15.2.6 There are some older neighborhoods where a curb box controls two addresses.

15.2.7 Control of the curb box is not always possible with the “T” handle. Ground settling around the sleeve can make the valve inaccessible. It may be necessary to dig down to the valve itself to operate the valve

Curb box lower left center next to curb.

15.2.8 Many occupancies utilize propane gas for heating and as fuel for emergency generators. Propane tanks vary in size and are normally located outside the structure.

15.2.9 The procedure for controlling propane will be same as for natural gas installations. Shut off the gas at the appliance or close the main valve on the tank.

15.2.10 In these situations remember the vapor density differences between propane and natural gas. Propane being heavier than air and natural gas being lighter than air.

15.2.11 If an electric panel box is involved and cannot be shut off, do not attempt to control the electric by removing the meter. Pulling an electric meter presents a serious shock and burn hazard to firefighters and should only be done by electric company personnel. In fact, in many occupancies removing the meter will not shut off the power. Controlling electric service to a building will require electric company personnel to cut the service line on a utility pole.

15.2.12 Use of a dry chemical or CO2 extinguisher may contain small fires involving an electric panel box until the power is shut off.

15.2.13 If unsure whether power has been controlled, a volt meter or other available means shall be used.

15.2.14 Water service to residential occupancies can normally be controlled by closing the main supply valve in the basement or utility room, or by closing the valve at the meter in the curb box. Controlling water service in commercial buildings may require closing several valves in different locations and will require assistance from the building engineer or the water company.

15.3 NOTIFICATIONS

15.3.1 When utility control is completed, command shall be notified that the service was shut off and how or where it was done, i.e. gas shut off at the meter or electric to the apartment shut off at the main breaker.

15.3.2 Any time the fire department shuts off gas, water or electric to the property, on the meter side to the street, the utility company must be notified. Utility companies normally respond within a reasonable length of time. If it is not practical to wait for the utility company to arrive on scene, the unit officer shall fill out a red utility shut off tag and attach it to the affected meter.

15.3.3 Should the gas, water, or electric be controlled in a specific area or at the specific appliance, the officer in charge should provide recommendations to the owner or occupant to seek out a licensed or certified technician to restore the area or appliance to working order.

16 OVERHAUL

16.1 Overhaul is a thorough and deliberate check for fire extension. The fire area is essentially stripped to its frame and contents are removed. Time and speed are not normally critical so overhaul operations should be planned and systematic. It is mandatory that the condition and stability of the structure be evaluated before overhaul begins. Utility service should have already been shut down, but this would be a good time to confirm that it has been done.

16.1.1 It is important to note that overhaul will be delayed in the area of fire origin until an investigator can survey the scene. At some incidents, especially if they involve a fatality or appear to be suspicious, overhaul may be delayed until the investigation is complete.

16.1.2 Truck companies will often be required to remain on scene after other units have cleared to assist the investigators and provide lights, tools and ventilation.

16.2 AREAS TO CHECK

16.2.1 Overhaul should begin in the area of heaviest fire involvement by pulling ceilings and opening walls damaged by the fire. Check areas around normal openings:

- light fixtures
- ducts and vents
- doors
- windows

16.2.2 If the fire is on a lower floor, crews should open baseboards and check plumbing and utility shafts of the floor above as well as where they terminate on the top floor, in the attic or on the roof.

16.2.3 Fire can also travel horizontally through the spaces between ceilings and floors (truss voids), through false or drop ceilings, knee walls, cocklofts and through and along ducts and conduits. Fire can also extend horizontally between attached occupancies or buildings, through “poke-throughs” in ceiling spaces, walls and attics or cocklofts.

16.2.4 In fires involving kitchens and bathrooms, soffits above cabinets and appliances, and pipe chases under or behind sinks and counters should be opened. Fire damage in these areas may require removing cabinets, appliances or plumbing fixtures.

16.2.5 If there is a working fire inside a building, fire fighters should assume that the fire has entered concealed spaces until they determine otherwise. Truck crews should look for obvious signs of fire extension that would indicate the presence of fire or heat inside a wall or other concealed space. These include:

- Visible smoke or flames.
- Blistering, streaking or discoloration on walls.
- Walls hot to the touch.
- Crackling, popping or sizzling noises.

16.2.6 Crews should use the Thermal Imager to assist them in checking for possible extension, but they should know that the camera will show all types of heat and that the white image on the screen is not necessarily an indication of active fire in an enclosed area.

16.2.7 At many fire incidents, overhaul is often the most strenuous and time-consuming part of the incident. Many firefighter injuries and deaths occur during overhaul operations. Whenever possible, incident commanders should assign fresh crews to perform overhaul operations. Crews performing overhaul should be rotated frequently, especially if it will be an extended operation.

16.2.8 Make inspection holes in areas of suspected fire extension. If fire is found, do not enlarge the opening until a charged hose line is available. When the line is in position, enlarge the opening until the area of extension is exposed and then wash it down. If fire has extended up past the opening, the area or floor above it must also be checked.

16.2.9 Overhaul may require the removal of insulation from attics and walls. If the blown-in cellulose insulation is encountered, officers should remember that it is possible for this material to smolder for up to several days without visible combustion. Removal of all insulation, even a considerable distance from the fire area may be required. Crews should check the area with the thermal imager in an attempt to locate hot spots rather than indiscriminately opening ceilings. If it is necessary to remove the ceiling, crews should consider spreading a salvage cover on the floor to catch the cellulose insulation.

16.2.10 If cellulose insulation is encountered and must be removed, Incident commanders should consider calling for the Insulation Vac. This equipment will make the job of removing insulation much easier and faster. If the Insulation Vac is not available, consider calling for a unit with Class A foam capability to wet down the area with foam to limit possible extension.

16.2.11 Methods of removing insulation include:

- Removal of one of the 4 x 8-foot sheets of plywood from the roof near the bottom of the pitch. This will allow removal of the insulation without causing further damage to contents on the floor below. This hole is also easily repaired once the operation is complete.
- Cutting a hole in the gable end of the attic.
- Remove a section of the ceiling and remove the insulation through that opening. When possible, it is best to make this hole in a room such as a bathroom and make certain to protect the contents in the area of the floor near the opening. This minimizes the collateral damage that will be caused by the operation.

16.2.12 Furniture, especially mattresses and stuffed chairs and sofas may have to be wet down inside before being removed to the outside for overhaul.

16.2.13 If there is extensive structural damage that limits or prohibits extensive overhaul or if the building is overloaded with stock affected by fire or fire control, companies may be required to return to the scene at regular intervals to wet down the area and check for rekindle.

16.2.14 Firefighters should view the fire building as if it is their own property. Overhaul should not be performed indiscriminately. If time is not a factor and it will not interfere with fire control, remove the occupant's personal effects to a safe area before starting overhaul operations. We may consider these objects insignificant but they may be valuable to the property owner or occupant.

16.3 TOOLS FOR OVERHAUL

16.3.1 All truck companies carry a variety of pike poles and other pulling tools. Normally a six-foot hook will be the tool of choice for use in a residential occupancy. However 10', 12' or longer hooks may be needed to open ceilings in commercial occupancies and churches, and in some new residential construction.

16.3.2 The closet or short hooks, halligan tools, and axes are ideal for opening walls. Axes and halligans work well for removing baseboards and wood trim around doors and windows. Care should be used when opening walls and ceilings due to possible electrical hazards.

16.3.3 Other tools that can be used by crews performing overhaul may include:

- Thermal Imager
- Portable lights
- Pressurized water extinguishers
- PPV and electric fans
- Power and electric saws
- Buckets and tubs
- Salvage covers
- Carbon monoxide meters

16.4 Safety Considerations during Overhaul Operations

16.4.1 Officers and crews should remember that even though the actual emergency has been controlled, many firefighter deaths, long-term illnesses, and injuries occur during overhaul operations.

16.4.2 A safety survey should be done before overhaul operations begin. Crews performing overhaul operations should be looking for signs of:

- weakened floors
- weakened and burned stairs
- spalling concrete
- weakened and burned through wood trusses and joists
- sagging steel roof trusses
- loose or leaning veneer walls
- cracks or shifts in floors and walls
- loose or leaning parapet walls
- sagging floors and roofs
- sounds of structural stress

16.4.3 Firefighters should listen for cracking noises and look for movement of any structural members.

16.4.4 Be aware of excessive loads on weakened floors due to storage, firefighting operations, standing water, and the weight of firefighters. Members should be aware of any concentrated loads of building contents. Efforts should be made to facilitate drainage of standing water when possible and can be accomplished safely. Remember that one cubic foot of water weighs 62½ pounds.

16.4.5 Any structural damage should be reported and all members operating in the structure should be made aware of them.

16.4.6 Hazards should be well lighted and marked with fire line tape or other barrier where appropriate. Ladders can be placed over holes, weakened floors, and stairways.

16.4.7 If extensive structural damage is found, overhaul operations may have to be delayed until floors or walls can be braced or shored. Crews may have to wet down the building from outside until cranes or other heavy equipment is brought in to remove damaged structural members or contents.

16.4.8 Crews performing overhaul operations should always wear full protective clothing. SCBA must be used until air monitoring has determined that the atmosphere is safe.

16.4.9 Officers must remember that all suppression units have the capability to monitor for carbon monoxide in the atmosphere if the safety officer is not on the scene. SCBA must be used if the carbon monoxide level is 35 ppm or greater.

16.4.10 Members must bear in mind that many toxic gases are produced during the combustion of various materials. An example of this is the release of hydrogen cyanide when pressure treated lumber, often used on outdoor decks, burns.

16.4.11 A particle mask should be used if crews will be removing insulation. Eye protection is mandatory, especially when pulling ceilings.

16.4.12 Crews should be aware of falling objects inside and outside of the structure.

16.4.13 Beware of the grid work and wires from suspended ceilings. They present trip and entanglement hazards.

16.4.14 Firefighters should never stand directly under the ceiling that they are pulling. Large pieces of drywall may fall and injure you. When possible start pulling ceilings from the safety of a doorway.

16.4.15 Firefighters checking for fire extension in attics of residential occupancies should use caution if the pull-down attic stairs are used for access, since the firefighter with full protective equipment may exceed the weight limit of the stairs.

16.4.16 Never attempt to pull down damaged structural members. This could create a collapse of the roof or floor in the damaged area.

16.4.17 Crews should consider using bathtubs to immerse small objects or place them in salvage tubs and remove to the outside. Large objects like stuffed furniture and mattresses should be wet down and removed to outside to complete overhaul. Large objects can become wedged in doorways and flare up, possibly trapping and injuring firefighters.

16.4.18 Do not throw objects out of upper floor windows unless a safety zone has been established outside. The debris pile should be watered down and be kept away from the structure.

16.4.19 Crews should know where the safe areas and exit points are in case they have to evacuate. Officers must closely monitor the physical condition of their crew. Fatigue is a significant contributing factor in fireground injuries during the overhaul phase of the operation.

17 SALVAGE

17.1 Simply stated, salvage is property conservation. Limiting damage from the fire or the fire-control efforts and is often done in conjunction with firefighting efforts.

17.2 Keeping doors closed helps to prevent smoke spread.

17.3 Spreading a salvage cover before hooking a ceiling to extinguish an attic fire is a simple measure to take during firefighting efforts to limit damage to property.

17.4 All members operating on the fireground are responsible for loss control and property conservation efforts. However, the OIC should ensure specific actions and tasks are taken to minimize damage.

17.5 Salvage tools and equipment should include debris buckets, salvage covers, and hall runners.

17.6 Salvage may require moving building contents to an unaffected area or covering it in its place.

17.7 Firefighters should consider the fire building and its contents as if it were their own home. Regard papers and other personal items found during salvage as significant, especially photos, as these may be extremely important to the homeowner.

17.8 When time permits and it will not interfere with fire control operations, protect as much property as possible. Before pulling ceilings, stack items on beds or tables and cover them with salvage covers or plastic. Small items on dressers or tables can be placed in drawers.

17.9 Use of a hose line to wet down the materials should be limited. Keep in mind that a thorough check of the structure should be conducted to prevent re-kindle.

17.10 Drain hose lines outside whenever possible or break couplings and drain the hose into a sink or tub, especially if the floor below the fire is occupied or has not been affected by the fire.

17.11 Taking a little extra time and effort to perform salvage will help reduce the property owner's losses and enhance the department's image.

17.12 Personal belongings such as jewelry, money, photos and other valuables should be turned over to the homeowner or secured and handed over to the fire investigator or police.

18 POST INCIDENT REVIEW

18.1 Before leaving the incident scene members of the company may want to gather and discuss any unique problems which may have taken place.

18.2 The goal is to improve individual and company performance.

18.3 Once back at quarters, a more detailed discussion of the overall operation should take place if needed.