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Primary Roof Ventilation Operations for Flat-Roof Structures

BY DANIEL M. TROXELL

Roof operations are among the most important yet sometimes overlooked fireground functions. The actions of the members operating on the roof can make or break the success of a working fire incident at a flat-roof structure (photo 1).



(1) Photos by author.

Flat roofs are common on commercial structures in most areas. However, in older urban areas, flat roofs are also often found on private and multifamily dwellings of ordinary construction, because flat roofs were easier and cheaper to construct on these structures. In Washington, D.C., most of the private dwellings are ordinary construction row structures, built between 1900 and World War II. Many of the multifamily dwellings in older areas of the city also feature this type of construction.

Proper ventilation operations on flat-roof structures can prevent flashover, prevent the spread of fire in cocklofts and attics, and make it easier and safer for members to conduct search operations and locate and extinguish the fire. Therefore, it is critical that the members operating on the roof are experienced firefighters with a thorough understanding of the principles of ventilation, fire behavior, and building construction. They should also be very familiar with the various types and features of roofs found in their response areas and, most importantly, thoroughly understand the steps they must take for successful roof operations.

VENTILATION

Flat-roof ventilation is divided into primary and secondary operations. Primary flat-roof operations (the focus of this article) involve the venting (opening) of existing roof structures such as scuttle hatches, stairway bulkhead doors, skylights, ventilators, top-floor windows, elevator penthouses, and other openings. Secondary flat-roof operations involve cutting holes and trench cuts in the roof to prevent or halt the spread of fire in the cockloft.

Primary ventilation operations are conducted during the initial stages of a fireground operation. In the District of Columbia Fire Department (DCFD), truck company roof teams consisting of the driver and the tillerman usually perform these duties. These operations are designed to immediately relieve interior crews from smoke and heat and to obtain valuable information for the fireground commander and the other operating units.

As with all fireground functions, keep safety in mind, and always wear full personal protective equipment (PPE), including self-contained breathing apparatus (SCBA). Bring the proper equipment, including at a minimum a roof hook, a halligan bar, an ax, and a roof saw. Some of these tools (e.g., the hook, the ax, and the halligan bar) you can mount at the tip of an aerial ladder or in a tower ladder platform so they are readily accessible to the roof team (photo 2). Bring a Class II harness and a rope bag or lifeline and ladder belt (photo 3) to the roof, especially if members are not equipped with personal escape systems (photo 4).



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ROOF ACCESS

For roof access, the DCFD and many other departments primarily use the aerial ladder if it is not needed for any obvious rescues. Proper aerial ladder placement is key to safe roof access. If possible, place the ladder to the roof of an attached exposure (photo 5). This will limit the ladder's exposure to fire or heat from any fire building windows venting and will give the members on the roof a safe means of egress from the roof.



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If it is not possible to place the ladder on an exposure building, try to place it in a position that is not directly over a window or line of windows to prevent exposing the ladder if flames erupt from the windows below. In addition, be sure to extend the ladder at least four or five rungs above the roof or parapet level. This will make it much easier for members to get on and off the ladder and will also make it easier to find the ladder in low-visibility conditions (photo 6). Keep in mind that, when placed properly to a roof, the aerial ladder may also serve as an anchor point if a roof rope rescue is required in the rear of the structure.



(6)

Other methods are available to access a roof, depending on the structure's type and location. For row-type structures, you may access the roof using the interior stairway of one of the attached exposures or that of one of the adjacent exposures if you suspect that fire has already spread to the cockloft. If accessible, these stairs can provide a safe and rapid means of accessing the fire building roof if the exposure roof is the same or almost the same height.

It is not usually a good idea to access the roof by the interior stairs of the fire building. If the stairway is not enclosed or if the fire floor door is open, the stairway conditions may be untenable or become so as the fire progresses, thus preventing the use of the stairs as a means of egress from the roof. You may use fire escapes on the fire building or an attached exposure if present. Fire escapes can often be found on older multifamily occupancies of Type III ordinary construction. However, in Washington, D.C., they are often in poor structural condition because of lack of maintenance. In addition, many of the fire escapes in D.C. are not readily accessible from the front of the structure or, if located in the front, they usually do not have gooseneck ladders that extend from the top-floor landing to the roof (photos 7, 8). As such, fire escapes are not usually a viable alternative to access the roof from the front of the structure.



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ROOF SIZE-UP

Once you have accessed the roof, you must consider several issues. Before dismantling the aerial ladder, conduct a quick roof size-up. Note the location of any hazards such as open shafts or holes; trip hazards such as antenna guy wires, electrical, and cable wires; and security devices such as barbed or razor wire (photo 9). If the aerial is placed to a parapet, always check for the location of the actual roof level, especially when operating under low-visibility conditions. There could be a significant drop of five feet or more to the actual roof deck. Use a hook to probe for the actual location of the roof deck under low-visibility conditions.



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While operating at a taxpayer fire under low-visibility conditions, DCFD's Truck 6 roof team had quite a surprise when it placed its aerial ladder to the roof of an exposure. The team ascended the aerial ladder to discover that what appeared from the street as a second story and parapet was actually a false front, with the roof deck located at the first-floor level, approximately 15 feet below (photos 10, 11).



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After confirming the location of the roof deck, be sure to sound the roof for sturdiness before placing your full weight on it (see photo 6). When traversing a roof, avoid walking in the middle of it; walk near the edges—they are stronger. Note any patched or tarred-over areas on the roof deck; these may be covered-over skylights or other shaft openings and may not be strong enough to support a firefighter's weight (photo 12). In 1985, a member of DCFD's Rescue Squad 1 was lost in the line of duty when he stepped on a tarred-over ventilation shaft cover on the roof of a commercial occupancy and subsequently fell to the basement. If you notice such conditions, report this information by portable radio so all members on the fireground are aware of this danger and can avoid repeating tragic incidents such as the one described above.



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In addition, when operating on a row structure roof under low-visibility conditions, always cross over from an exposure roof at the front of the building. Row building fronts are usually inline, but the roof

lengths may be uneven in the rear because of different building lengths or open air and light shafts. An unsuspecting firefighter may walk off the roof and fall (photo 13). Also, as a rule of thumb, if you can't see while operating on a roof, CRAWL!



(13)

PRIMARY VENTILATION

Once you have accessed and sized up the roof, initiate primary roof operations immediately. The following suggested sequence of operation will allow rapid vertical ventilation and a simultaneous check of the conditions in the rear of the structure.

1 Open the skylights. After sizing up and assessing the conditions, open any skylights that may exist on the roof (photo 14). Opening the skylights will often provide immediate ventilation to the floors below, especially in row dwellings, also known as row houses or row frames, as well as brownstone-type dwellings. Open the larger skylights first, since they are usually over a stairway or hallway. Do this by breaking the glass, removing the individual glass panes from the frames, or removing the entire unit from its frame (photo 15). If breaking out the glass, first notify the companies operating below by portable radio or by first breaking out a small amount of glass. In some situations, the skylights may be tarred or covered over. If so, use the saw to quickly remove the material to provide an opening.



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After breaking out or removing the glass, probe the opening with a hook to remove draft stops or other obstructions. Draft stops are screens or additional panes of glass at the ceiling level on some skylights (photo 16). You must remove or break these out to provide adequate ventilation through a skylight opening. Also open smaller skylights, which are often above bathrooms in private dwellings, if present. If there are no skylights, open the stairway bulkhead door if present, or open the scuttle hatch to provide initial ventilation.



(16)

2 Check the rear, the sides, the light wells, and shafts. It is extremely important that a member of the roof team check the rear and sides of the building as soon as possible to locate trapped occupants and determine the fire's location and conditions. One roof team member can do this as the other team member is conducting initial ventilation. In addition, check vent shafts and light wells, which often are present in older multifamily occupancies (photo 17). Immediately report any conditions observed during these checks to the fireground commander; this information is extremely important to the other members operating on the fireground. Often, the conditions in the rear and the exact location of the fire are not obvious from the front of the building. Occupants may be trapped at windows in the rear or at windows that open into light wells and shafts. The roof team can quickly transmit this information to all members on the fireground using their portable radios, thus allowing companies to quickly advance to the location of the fire or the trapped occupants. Roof team members should also note any heavy mechanical equipment the roof is supporting, which may pose a collapse hazard at a top-floor fire. Report these observations and any other findings to the truck company officer and the fireground commander.



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3 Open the stairway bulkhead door. After checking the sides and rear, open and vent the stairway bulkhead door, if present. The stairway bulkhead is a small structure on the roof located at the point where an interior stairway terminates at the roof level (photo 18). These are often found on older multifamily dwellings and provide an excellent ventilation point for the entire building, especially if the stairways are unenclosed. The bulkhead doors usually open outward and are often locked from the interior. Usually, you must force these doors using conventional forcible entry operations (halligan bar and ax) or the chisel end of a roof hook. After forcing the doors, chock them open or break off the door hinges to prevent the door from closing. Many bulkheads also feature skylights or windows; if so, open them also to provide additional ventilation. After completing the venting of the bulkhead, members should also search just inside the doorway for any victims who may have been overcome after attempting to escape the fire by the roof.



(18)

4 Open the scuttle hatches/covers. Scuttle hatches or covers can be found on many flat roof buildings. On row houses, they may only provide access to the cockloft area. On garden apartment buildings and some other multifamily dwellings, they are usually locked from the interior and may provide access to the top floor by a scuttle ladder. In any case, they can provide an excellent means of ventilating the public hallway/stairway on garden apartment buildings and the top-floor public hallway on older multifamily dwellings. They are usually not the best means for ventilating row house roofs, since the opening at the top-floor ceiling may be offset from the hatch opening and located in a closet, thus providing little ventilation. It may be possible to reach down through the cockloft and knock the door open with a hook. Exercise caution in doing this, however, since fire may be behind the door.

Remember that if the fire is in the cockloft of a large building and the scuttle cover is not directly above the fire location, it usually should not be opened; opening may spread the fire by drawing it to the scuttle location.

You can force or remove scuttle hatches/covers using the halligan bar or either end of the roof hook (photo 19). Once removed, turn over scuttle hatch covers and leave them on the roof deck next to the opening to alert others to the presence of the opening (photo 20).



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5 Vent the top-floor windows. If the fire is on the top floor, if there are heavy smoke conditions on the upper floors, and autoexposure to soffits and other overhangs above the windows is not an issue, you can often vent the top-floor windows from the roof. There are several methods for accomplishing this. Because there are usually no parapets, a six-foot roof hook is often long enough to reach the windows in the rear. When performing this operation on a roof that has no parapet, members should lie prone on the roof surface and then lean over the roof edge to reach the windows. This will reduce the likelihood of the member's falling. To exert force over a wide surface area, the flat side of the hook should be parallel to the window surface when it makes contact with the glass (photo 21).



(21)

In the front of the structure, the parapet may make it impossible to reach the top-floor windows with a six-foot hook. To overcome this problem, members of DCFD's Truck 6 use a 10-foot roof hook mounted on the tip of the aerial ladder. An alternate method is to use a halligan bar attached to a rope or webbing. The rope or webbing can be attached to the fork end of the halligan with a clove hitch and safety, or with metal clips if the halligan has a loop welded at the fork end (photo 22).



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A good procedure for venting windows in this manner is as follows:

1. If the roof has a parapet, stand behind the parapet and lower the halligan bar over the parapet to the center of the window to be vented.
2. Firmly place a foot on top of the rope lying on the roof and hold it in this position.
3. Pull the rope back up to retrieve the halligan bar while maintaining firm pressure on the rope with the foot.
4. Firmly throw the halligan bar over the parapet and out from the building while maintaining pressure on the rope on the roof with the foot (photo 23).



(23)

5. The halligan bar will swing down and break the window at the center of the window (photo 24).



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6. Repeat the procedure as necessary.
7. If no parapet is present, perform the procedure in the prone position to prevent a fall.

Venting the top-floor windows from the roof in this manner is extremely important if the fire is on the top floor and is not yet showing out of the windows. Venting the windows in the proper location will allow the engine company to push the fire out of the vented windows as it advances into the fire area and will reduce the likelihood of heat and smoke banking back and down on the members while they operate. Keep in mind that the early or indiscriminate venting of windows may cause flashover, backdraft, or wind-driven fire conditions on the interior, thus endangering the attack crews. Therefore, when the engine company is in position to begin attack, vent the windows closest to the fire (i.e., the fire room) first, and then, working away from the fire, vent additional windows as needed. As with all horizontal ventilation operations, coordination and communication with the fire attack crews is imperative. This communication does not necessarily need to be verbal, however. The sound or sight of water flowing from an attack line is usually a good indication that it is OK to begin venting.

6 Check the cockloft. After all venting operations have been completed, check the cockloft (i.e., the area between the top-floor ceiling and the roof decking on a flat-roof building) for smoke conditions and fire extension. You can do this through the scuttle hatch opening or by breaking out the “returns” in the skylight opening, which are gypsum or plaster-and-lath walls that separate the skylight opening and the cockloft (photos 25, 26). If the fire is on a lower floor and may be traveling in void spaces, you can also check the cockloft by making inspection holes in the ceiling on the top floor near common pipe shafts or other vertical chases.



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If you find no fire in the cockloft, primary roof operations are complete, and members can move on to other fireground operations. If you discover fire in the cockloft, members should prepare to commence secondary roof operations. •••

Studies have shown that modern day fires burn hotter, produce more smoke, and reach flashover conditions much faster than the fires of the past. This is mainly the result of the proliferation of polycarbonate-based furnishings and finishes in occupancies of all types. As such, it is extremely important that you conduct the roof operations described herein properly and in a timely fashion to make the conditions less punishing for the firefighters operating inside a structure and to assist them in conducting a safe and effective fire attack.

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