FIRE AND RESCUE DEPARTMENTS OF NORTHERN VIRGINIA FIREFIGHTING AND EMERGENCY OPERATIONS MANUAL

Single-Family Dwellings

Fourth Edition

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The NOVA Fire Operations Board and a group of subject-matter experts developed the first edition of this manual (released in 2002). The Technical Writing Group revised the manual in 2008 and 2013, and the NOVA Fire Operations Board approved and published the second and third editions. The NOVA Fire Operations Board oversaw the production of this fourth edition with content developed by the Technical Writing Group.

PREFACE

Thousands of U.S. civilians are injured or killed each year by fires in single-family dwellings. In recent years, the advent of lightweight construction materials and techniques has elevated the potential for early collapse in these buildings, increasing the life safety hazards they pose.

The variety of layouts and floor plans found in single-family dwellings requires a size-up that includes viewing as many sides of the structure as possible (i.e., a 360-degree lap). This allows the officer to determine the fire's location within the building as well as potential life hazards, rear conditions, and the involvement of proximal exposures.

The following key changes were made to the fourth edition of the NOVA *Fires in Single Family Dwellings* manual:

- significant content reorganization to improve document structure,
- the inclusion of content related to solar panel installation on residential roofs,
- the inclusion of content related to wind-driven fires, and
- expanded content related to attic fires.

INTRODUCTION

The purpose of this manual is to describe the construction features of single-family dwellings found throughout Northern Virginia.

This manual identifies:

- construction features,
- inherent firefighting problems,
- operational priorities, and
- known risks and hazards.

The manual also establishes a standard operation method for fighting fires in these types of structures.

TABLE OF CONTENTS

TABLE OF FIGURES

DESCRIPTION

The term *single-family dwelling* (SFD) is widely used throughout the fire service to describe a residential building occupied by just one household or family. Broadly, allowances are made for basement suites or in-law suites without changing the description from "single family." However, this description excludes duplexes, townhouses, short-term accommodations (e.g., hotels, motels, inns), and large-scale rental accommodations (e.g., rooming or boarding houses, apartments).

Most SFDs occupy lots larger than the structure itself, adding an area surrounding the house that is commonly called a "yard." This type of structure may also be situated alone in a rural setting; however, most SFDs in the region reside in housing developments surrounded by similar-type dwellings.

General Characteristics

SFDs range in height from one to three floors and may differ in height from front to rear (i.e., two floors on the front and three floors on the rear or vice versa) and can rest on a basement, crawlspace, or slab. SFDs may or may not have a garage, which can store one to four vehicles. A garage can occupy the lowest level in the front, side, or rear, or it can be detached.

Most SFDs have four sides and are rectangular in shape. Two parallel exterior walls are load bearing and the other two are not. These structures generally have one interior load-bearing wall located centrally between and parallel to the exterior load-bearing walls. Except for unusual circumstances, the long wall will be the load-bearing wall.

SFDs may receive service from several utilities as they most often include water, sewer, gas, electric, and communications systems. In larger structures, firefighters may find commercial utility installations or multiple installations of the same utility.

SFDs may have unfinished basements that allow a fire originating in that area to quickly spread to and compromise structural components (e.g., floor joists, plywood I-beams, plywood floors).
Fire department access to these structures may be simple or complex, and interior living space can vary from 1,000 to 15,000 sqft in some areas. Despite the vast range of total square footage available in SFDs, the degree of compartmentation created by the number of separated rooms (e.g., bedrooms, kitchens) makes the individual compartments relatively small.

There has been a regional increase in the occurrence of renovated SFDs with interiors modified to accommodate multifamily use. These homes may have been renovated without proper inspections or permits and can result in unexpected compartmentation and interior layouts.

Construction Styles

Several common SFD styles occur in the Northern Virginia region: Colonial, rambler or ranch, Cape Cod, split foyer, split level, balloon frame, hybrid, estate homes or McMansions, and cluster homes.

Colonial Style

The Colonial style of home usually has two stories above ground. This home may or may not have a basement. The front door leads into the structure's main entryway and stairwell. Living and dining areas are usually located on the first level, with bedrooms on the second floor (see Figure 1).

Figure 1. Typical Colonial-style SFD.

Ranch or Rambler

Ranch or rambler-style homes are usually one story and may or may not have a basement. The floor plan is typically very open, and personnel should expect the presence of large windows.

Additionally, these homes will often have large extended eaves (see Figure 2).

Figure 2. Typical ranch- or rambler-style SFD.

Cape Cod

The Cape-Cod-style home is typically 1 ½ stories above ground. The front door provides access to the main stairwell leading to the upper bedrooms and basement, if present. The top floor will contain knee walls and may contain dormers (see Figure 3).

Figure 3. Typical Cape-Cod-style SFD.

Split Foyer

A typical split-foyer-style home is a two-story SFD characterized by an interior foyer level that leads directly to stairs providing access to both upper and lower levels just inside the home's front door. Split foyer SFDs typically stand no taller than two stories; however, three- and four-story spilt-foyer SFDs can be found in the region.

From the exterior, personnel can identify split-foyer SFDs by comparing the relative height of the windows and the front door on side Alpha. The top of the windows and the top of the door will be offset on split-foyer SFDs (see Figure 4), and these features will align with each other on most other style homes.

Living quarters in split-foyer homes may occur on the basement level.

Figure 4. Typical split-foyer SFD.

Split Level

A typical split-level home is a three-level SFD characterized by front entry to an interior level that is positioned between upper and lower floors; two short sets of stairs provide access from the main entry level to levels above and below. Split level style homes typically incorporate three-level designs, however four- and even five-level spilt-level SFDs can be found in the region.

Bedrooms are typically located on the second floor in these dwellings (see Figure 5).

Figure 5. Typical split-level SFD.

Hybrid

Hybrid-style SFDs represent an increasingly popular new genre and can involve variations of several different styles. Hybrid homes are typically wood frame and provide two separate occupancies separated by a fire wall in a one-story portion of the structure. This space can be a storage shed, garage, or breezeway. Consideration shall be given to potential for extension to exposure occupancy (see Figure 6).

Figure 6. Hybrid SFD from side Alpha (left) and side Charlie (right).

Estate Homes and McMansions

The terms *estate home* and *McMansion* are often used interchangeably to describe large SFDs (see Figure 7). Estate home most often refers to a large SFD situated on a large property. McMansion most often refers to a large SFD situated on an average-sized property. These homes may occur in subdivisions solely devoted to large homes or in subdivisions with much smaller existing homes.

Regardless of their geographic location, these homes share common characteristics that affect fire ground operations. For the purposes of this document, these larger SFDs are referred to as estate homes.

They are typically wood frame with a large amount of open space in the attic area. Additionally, due to the sheer square footage, they can have heating, ventilation, and air conditioning (HVAC) components in the attic area to facilitate the multiple zones necessary to heat and cool the structure. The presence of an HVAC system in the attic creates a dead load that could adversely affect the companies operating below if fire involves this area.

The interior layout of estate homes resembles Colonial-style homes but on a significantly larger scale that usually includes a large open foyer in the home's entranceway. HVAC units, large light fixtures, dormers, and gables create extra loads that pose a collapse hazard when fire enters the area above the open foyer.

The first floor of an estate home typically consists of living and dining areas, with bedrooms located on the upper floors. Most rooms have large, vaulted ceilings that facilitate fire travel. Note that these houses may have more than one kitchen. The newer homes may have one kitchen on the main level and a second one in a basement in-law suite.

Figure 7. An SFD with large square footage, often referred to as an estate home or McMansion.

Cluster Homes

Cluster homes reside in a community of single-family detached homes built in very close proximity to each other (usually 10 ft or less; see Figure 8). These homes are usually constructed of lightweight building materials using the frame method, and they typically have vinyl or wood siding, zero clearance chimneys, and narrow travel lanes separating each structure. These homes are spacious and have well-designed, open floor plans that can facilitate rapid fire spread throughout the structure. Cluster home developments lack firewalls, creating a high potential for lateral fire spread. A higher potential for collapse also exists compared to other residential structures.

Figure 8. Typical cluster homes.

Many types of cluster homes styles occur throughout Northern Virginia. These homes are typically one to three stories in height with windows facing the exposures, leading to rapid horizontal fire spread. First-alarm units encounter many challenges in these communities depending on the involvement of the structure. Fire extension to exposures in adjacent structures presents a major concern due to their proximity.

CONSTRUCTION

SFD design typically involves wood-framed materials and a platform-frame construction method (see Figure 9). The presence of the platform frame and fire stopping limit vertical fire extension in the walls.

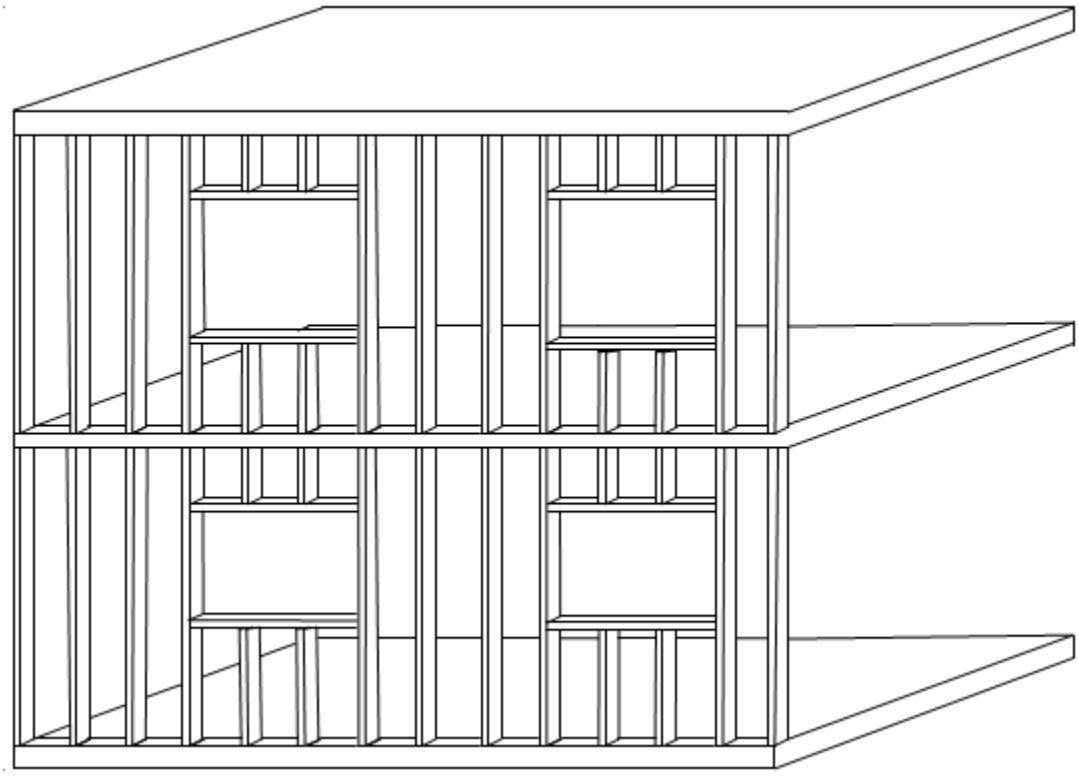

Figure 9. Platform-frame construction.

Alternatively, wood-framed SFDs built prior to the 1930s may have utilized balloon-framed construction methods (see Figure 10). Balloon frame structures are built with long, continuous studs that run from the basement to the attic. The absence of fire stops between floors leads to rapid fire spread.

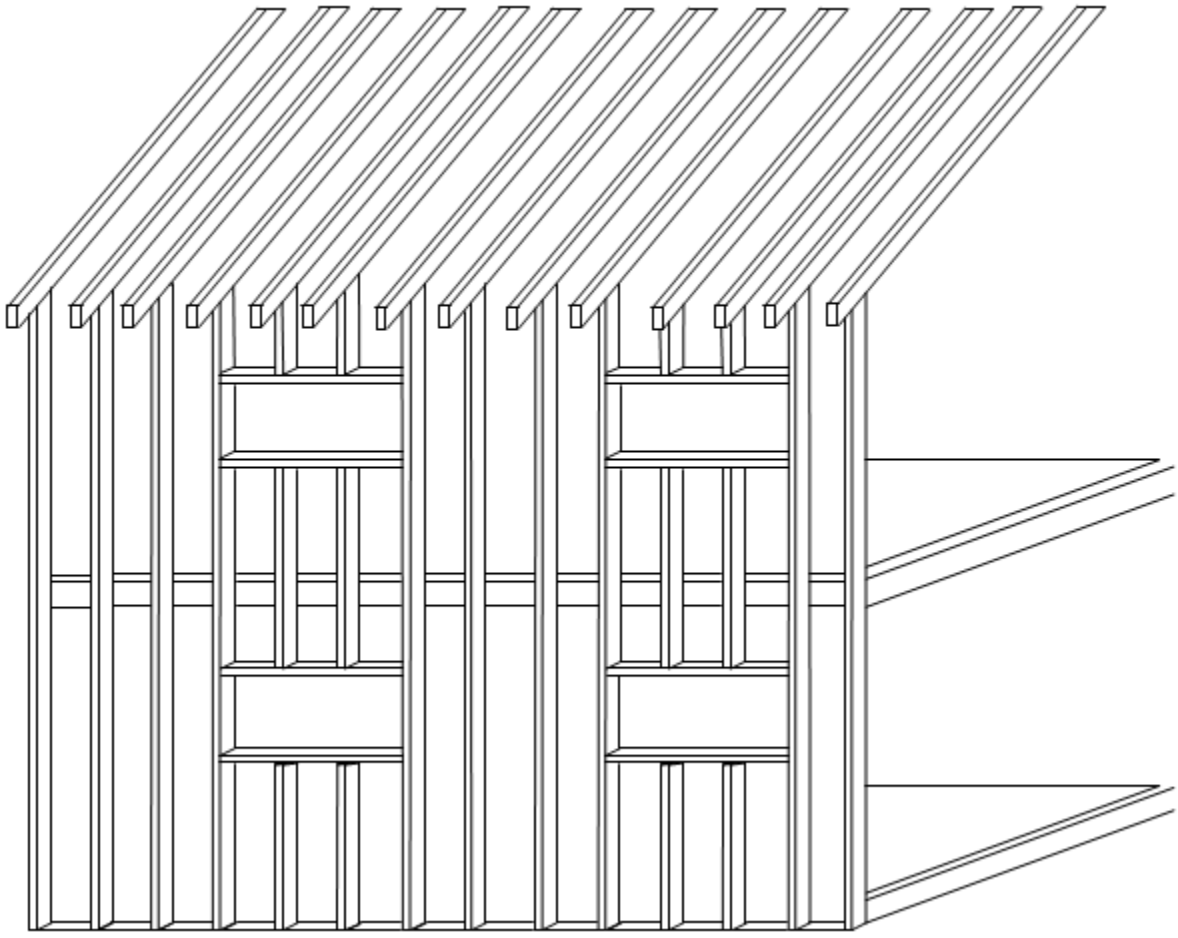

Figure 10. Balloon-frame construction.

Roofs

SFD roofs are typically constructed utilizing one of two basic methods:

- Lightweight. These roofs utilize triangular trusses that rest on load-bearing and non-load-bearing walls on the top floor. Alternatively, parallel chord trusses or plywood I-beams form the roof peak that spans from the front and rear load-bearing walls to a ridge pole.
- Wood frame. These roofs rely on sawn wood rafters that form the roof peak from the front and rear load-bearing walls to a ridgepole.

SFD roof decking is typically constructed with 4' by 8' plywood sheathing or particleboard. Flat roofs may utilize gypsum board integrated with fiberglass for decking. Personnel often refer to this type of gypsum board using the widely recognized industry product names Securock or DensDeck.
Roof decking applied over sawn wood rafters is typically plywood sheathing, although occasionally, 1" by 4" or 1" by 6" boards are found nailed perpendicular to the rafters.
Roof coverings typically involve asphalt shingles; however, slate and wood shingles are not uncommon.

Many SFDs constructed during the 1980s have fire retardant (FR) plywood sheathing roof deck. Over time, early decomposition showed much of this FR plywood to be defective. Some was replaced, but

firefighters should suspect the presence of FR plywood and use caution during fireground operations. Personnel should question the integrity of an FR plywood roof, even before a fire occurs.
SFDs can have numerous roof construction styles. These roofs are typically pitched from a center peak to the front and rear. Occasionally, personnel may find a perpendicular gable or dormer. The presence of a dormer does not always indicate a finished attic. The dormer may be false and only be attached to the exterior roof surface and not connected to the attic. Regardless, personnel must check the dormer area to determine if it contains living space that should be searched.

Although not common, personnel may encounter flat and mansard-style roofs. Firefighters should remain cognizant of the knee walls created by mansard-style roof construction and the inherent potential for fire spread in these void spaces.

Roof coverings will generally be shingle over felt or synthetic paper, or a variation thereof. The vast majority will be either asphalt shingles or cedar shakes. The use of slate and synthetic products has increased in the region.

The installation of solar panels on residential roofs has also increased throughout the region (see Figure 11). Solar panels present firefighters with several operational challenges: additional weight for collapse, presence of stored energy, and limiting areas in which to perform vertical ventilation.

Figure 11. Solar panels installed on residential shingled roof.

Attics

Attics, if present, are usually unfinished, and occupants may use them for storage. Personnel may access this space through a scuttle or pull-down staircase located somewhere in the top-floor ceiling. Such access points may be located inside a bathroom or closet. Attic space can also house water heaters and HVAC units. In some cases, the attic may serve as living space.

The insulation material used within attics is generally fiberglass, wood cellulose, rigid plastic foam, or other blown-in material.

In lieu of an attic, SFDs may have a top-floor vaulted ceiling or loft. The attic may include flooring that makes it difficult to apply fire streams from the floor below.

Walls

Walls are constructed of 2" by 4" lumber and may be load-bearing or non-load-bearing. Occasionally, lightweight aluminum studs appear in non-load-bearing walls. Most walls in SFDs have either 16- or 24-in. on center studs. Members must know or understand this in the event they need to breach a wall in a survival situation.

Knee walls can occur in SFDs with lofts and dormers. Building occupants sometimes use these void spaces for storage. During fire operations, knee walls should be checked early to identify fire extension (see Figure 12). In Cape-Cod-style homes, personnel should suspect the presence of knee walls. These walls can have a drastic effect on firefighting and ventilation, so personnel should identify knee walls and communicate their presence early in an incident.

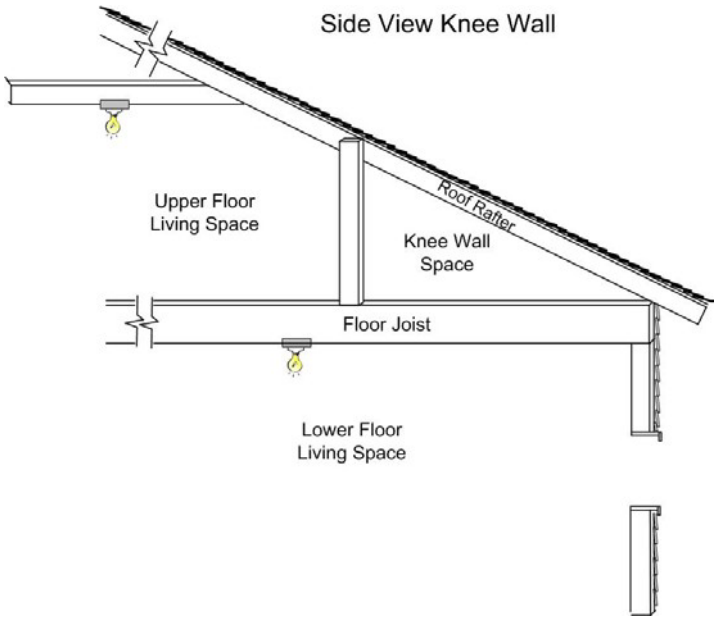

Figure 12. Cross section showing a knee wall.

Exterior walls may be covered with brick veneer, wood, aluminum, or vinyl siding over a thin layer of insulating sheathing. If operationally necessary, aluminum and vinyl siding can be easily breached.

Foundation walls are constructed using either masonry block or a poured reinforced concrete monolithic (i.e., cast-in-place) wall.

Insulation

Insulation can be rolled fiberglass, blown-in rock wool, blown-in cellulose, or spray foam. Insulation occurs in attics, exterior walls, and in some structures, the interior walls.

Floors

Floor decking is usually comprised of ½- or ⅝-in. thick wood boards or wood composite sheets (i.e., plywood or oriented strand board). The decking may be covered with carpet and pad, masonry or vinyl tile, or wood.

The decking material is laid on sawn wood joists, parallel chord trusses, or plywood I-beams (see Figure 13). These joists, trusses, or beams are spaced from 16 to 24 in. apart on center and run side-to-side or front-to-rear.

Basement load-bearing walls typically support side-to-side floor joists. Front-to-rear floor joists may be supported by a basement-level steel girder and Lally column. If these construction features exist in an unfinished SFD basement, they present a collapse hazard when exposed to fire. Engineered I-beams exposed to fire can fail within 5 min. Personnel should determine the level of impingement early in the incident.

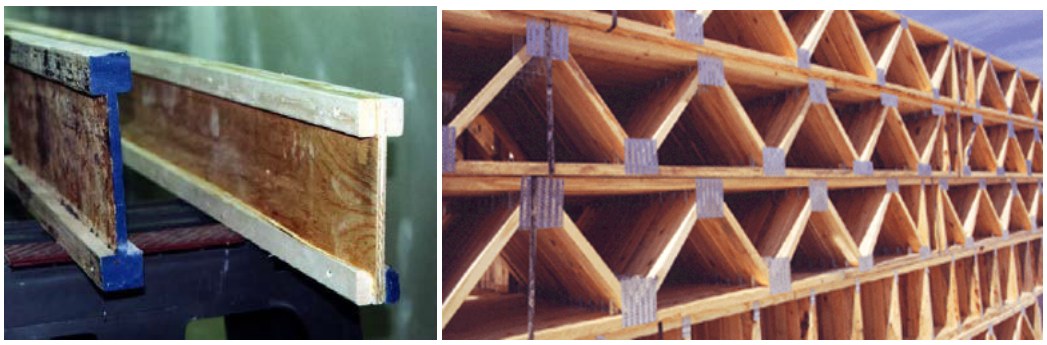

Figure 13. Wooden I-beams and floor trusses.

Windows

The double-hung, sliding sash window represents the most common style of window used in present-day SFDs. The glazing may be of single, double, or triple thickness. Personnel may encounter other window styles and should note them during preplanning and size-up opportunities.

Casement windows create a special hazard. These windows have steel frames set in concrete or masonry. The window must be opened by lifting a latch and rotating a crank. Although breaking the glass in these windows will ventilate the affected area, entrance and exit through the window frame will remain impossible. Removing the frame with force would be very difficult under adverse conditions and would require the use of heavy forcible entry tools. Firefighters should note the presence of these windows in their size-up upon arrival at a structure fire.

Security bars on windows present a specific hazard to both trapped occupants and operating firefighters. Personnel who encounter security bars on an incident scene must immediately communicate their presence over the radio so the truck or rescue company can address them. Once complete, the bars' removal should be verbalized on the incident operations channel to alert all units on the scene.

Doors

Interior doors are commonly constructed of hollow-core wood. Inward-opening doors typically lead to bedrooms and bathrooms. Outward-opening doors usually lead to basement stairs or closets. Different door orientations occur in the region's varying construction styles. In recent years, sliding barn doors have become more common in SFD interiors. Less commonly, personnel may encounter accordion doors, which contributed to at least one close call in the region.

Exterior doors on SFDs may be solid wood, composite, insulated metal, or wood panel. In addition, sliding glass or French doors may exist on the building's rear. Residential exterior doors swing inward.

Three standard locks occur on exterior doors: mortise, rim, and tubular dead bolt.

Stairs

Multilevel SFDs commonly incorporate a stairway. Interior stairways may be open from the lowest living level to the highest. Open stairs allow quick spread of fire and products of combustion to floors above. Stairway design varies, but the most common is a straight run, vertically stacked stairway. Larger homes may have multiple stairways, some of which may be remote from the front entrance (such as access stairs to upper floors from a kitchen area).

Steep, narrow, or spiral stairways can hinder hoseline advancement and rescue operations. Stairs require hoseline protection to maintain access and egress routes. Firefighters should remember that stairways are stacked in most cases.

Basement stairs can be unfinished on the underside, and storage under them is common. A fire originating in this storage area can quickly cause the stairs to collapse.

Garages

Municipal fire codes require garages attached to living spaces to have fire-rated interior walls, doors, doorframes, and hardware. Although surrounded by fire-rated materials, a vehicle, or other contents, fire in a garage can rapidly extend to other areas in an SFD.

The area positioned directly above a garage often contains finished living space. These areas present a serious life hazard when a fire originating in a garage extends to other parts of the dwelling.

The overhead entrance door to the garage and its associated mounting hardware must be fire-rated. When exposed to heat, the overhead garage door, door springs, or chain motor may fail, causing the door to close. Personnel should secure the opened garage door with pike poles, a ladder, or vice grips, or by bending or pinching the roller track.

Chimneys

Chimneys can be either masonry with a tile flue or wood-framed with a metal flue.

The metal flue, also known as a zero clearance or prefabricated chimney, involves a galvanized metal pipe in a wood-framed chimney with siding on the exterior. The wood-framed chimney can lack fire-

stopping and can interconnect to adjoining floor or ceiling voids.

Personnel should recognize this construction feature and anticipate extension into void spaces if fire involves the flue.

Basements

SFDs will rest on a concrete slab or will have a crawl space or full basement underneath, or they will have a combination of both. Basement entry may involve an exterior or interior stairway, or both.

Slab and basement floors are commonly poured concrete. Crawlspace floors will usually be dirt or gravel.

Crawlspace and basement walls are generally built of block or poured concrete. If the basement is finished, personnel may find wood or metal studs covered by drywall or paneling.

Unfinished basements allow the fire to directly attack the building's structural components and quickly enter void spaces.

Some homes may have in-law apartments or rental apartments in the basement, which may or may not have access only from a separate exterior entrance and not from the floor above. A locked door or an illegally constructed wall at the base of the stairway may block access to the basement from the upper floor, obstructing fire department access from the interior.

Sleeping quarters in SFD basements should include egress windows and window wells. Depending on the time of construction and the established building codes, these locations and dimensions will vary. There may be instances where sleeping quarters were created illegally after the dwelling was constructed. During a 360-degree lap, personnel should note the presence of egress windows and the possibility they indicate sleeping quarters (see Figure 14).

Figure 14. Egress window.

HAZARDS

This section describes hazards that may occur in SFDs.

Life Hazards

Most fire-related fatalities in the United States occur in SFDs. Consequently, personnel should strategically prioritize life safety until all occupants have been accounted for.

Occupants can be found on any level of an SFD. The positive pressure generated from a fire can cause smoke to migrate into adjacent areas through open stairways and common voids. Large numbers of occupants often reside in one dwelling. Subleasing may create an additional life hazard as both basement and sub-basement areas may serve as sleeping areas with separate locked entrances.

In an SFD, the potential for trapped occupants always exists, whether day or night. During the period when occupants may be sleeping, their chance of survival decreases due to their inability to quickly detect a fire and flee. The occupants' age, physical abilities, and mental capacities also affect their ability to self-evacuate during a fire.

Although SFDs are intended for residential housing, these structures can be used for other purposes. Firefighters responding to reported SFD fires in the region have found both day-care centers and clandestine drug labs upon arrival.

Fire Hazards

Most fires in SFDs start in the vicinity of cooking or heating appliances; however, personnel must recognize the potential for ignition exists from many sources, including space heaters, pilot lights, electrical equipment, and smoking materials.

The presence of interior void spaces may add to fire spread. Vertical and horizontal openings allow smoke and fire to enter and attack the structure itself. Fire that has entered these voids will necessitate the opening of floors, ceilings, and walls. This is especially crucial in balloon-frame construction.

The use of combustible interior finishes and the type of furnishings found within these structures contribute to fire loading. A typical SFD has a low fire load, requiring 10 gpm per 100 sqft.

The use of highly combustible exterior siding can greatly affect exterior fire extension. Vinyl and asphalt siding may contribute to vertical and horizontal fire spread and can create a severe exterior exposure problem.

The presence of fireplaces and chimneys may create a potential for fire extension to unwanted areas of the structure. Improper installation or degradation due to age may compromise the integrity of the components, allowing fire or heat to escape and ignite surrounding combustible members.

Rapid Fire Events

The potential exists for flashover to occur in SFDs. The amount and type of combustible materials, rate of the burning materials' heat release, and an adequate supply of oxygen allow a fire to progress rapidly to the flashover stage.

Collapse

In general, most modern SFDs are constructed of lightweight materials that do not withstand degradation from long-term fire exposure.

With the exception of ordinary construction, most of the brick on these buildings is veneer. This single layer of brick may easily collapse under fire and master-stream conditions.

Collapse of the roof members (i.e., trusses) onto the top floor can occur in an attic fire or top-floor fire that has extended to the attic. Interior compartmentalization can provide firefighters operating on the top floor with areas of haven to position and continue firefighting operations. Operating from a hallway or bathroom provides greater safety than working from large open areas prior to and during roof structure collapse.

Roof features such as perpendicular gables and dormers often fall away from the building, creating an exterior collapse hazard.

Basements

Operations in SFD basements can pose hazards due to stairwell design, limited ventilation, and limited means of ingress and egress. These factors hinder hose advancement and search operations in basements.

Fires in unfinished basements rapidly attack and weaken the exposed structural members supporting the floor above. Predominantly finished basements may have unfinished utility rooms. These unfinished areas can be located under an SFD's main entrance. Firefighters directly above floor components weakened by fire operate from an extremely precarious position. The fire service has experienced numerous line-of-duty deaths resulting from firefighters falling through compromised floor systems. The importance of identifying the lowest level of fire involvement, refraining from operating directly above the fire, and testing the stability of the floor prior to advancing cannot be overstated.

Utilities

Personnel should suspect the presence of overhead electrical service wires to a dwelling and assess their integrity. This service often drops into the yard, creating a common hazard. Should this occur, personnel must advise the incident commander (IC), who can inform all operating companies.

The size of estate homes can exceed some commercial structures and may require commercial utility meters to accommodate the large square footage. A commercial electrical transformer box often supplies power to these structures. More than one water meter may also supply these structures, with both together or one at each end of the home. Consequently, the order to control utilities may require more than one unit to shut off water, gas, and electricity.

Interior fuel oil tanks and natural meters can become hazardous if exposed to fire. Firefighters can identify the presence and approximate location of these interior appliances by looking for associated exterior features. A fuel oil tank will have a fill pipe and vent located on an outside wall near the tank. An interior gas meter will have a vent and may have a gray gas pipe going through an exterior wall to the interior meter's location.

FIRE OPERATIONS

Command Considerations

The first command officer to arrive on-scene should establish Command. After confirming an SFD fire, ICs should evaluate the need for additional resources and make requests for additional alarms and rapid intervention team (RIT) resources commensurate with the situation's severity.

Additional command officers may be used in tactical positions. ICs should assign these positions early in an incident to build an effective and efficient command structure. Strategic positions for additional command officers include the following:

- division supervisor,
- group supervisor,
- branch director, and
- section chiefs.

Life Safety

Life safety takes the highest priority in all structure fires, so all operational tactics should be assigned to support this strategic goal. The potential for life loss is most prominent in residential occupancies.

To achieve life safety of SFD occupants, personnel should conduct a thorough primary search and contain and extinguish interior fire. Primary search operations should focus on the area near the fire as well as bedrooms and means of egress.

Once personnel have accounted for the building occupants, they should focus on the strategic goals of firefighter safety and fire extinguishment.

Horizontal Fire Spread

Horizontal fire spread represents a concern in SFDs that are located close to others, specifically cluster homes. Fire can rapidly spread to exposures due to combustible exterior siding.

ICs should consider the time and resources needed to access exposures and check for extension. Personnel should tactically position hoselines to prevent the fire from extending to exposures, causing suppression operations to chase a rapidly spreading fire.

Additional Resources

The following SFD fire situations should cue the IC to request a second alarm:

- known rescues,
- fire in two separate and adjacent SFDs,
- fire in an estate home.

Operational Communications

Personnel should reference the NOVA *Field Communications* manual for information about operational communications. Related information specific to fires in SFDs appears in the following sections.

Water Supply Report

The unit officer of the first-arriving engine company should communicate a water supply report to the second due engine company. The report should identify the location and method of the hose lay.

Personnel should utilize a forward (i.e., straight) hose lay, when possible, while maintaining unimpeded access for subsequently arriving truck companies. In most cases, this means the first-arriving engine company should position an adequate distance past the involved dwelling. If the truck enters the block from a direction opposite to the engine company's, it must stop an adequate distance before the involved dwelling.

Water supply reports should resemble the following:

"Engine 444 from Engine 401. We are forward laying from the hydrant at the corner of Kirby Rd."

On-Scene Report

The first-arriving unit officer, typically that of the first due engine company, should provide the first due command-level officer the following information in the on-scene report:

- unit identification and the side of structure where the apparatus is positioned;
- building height (i.e., number of stories above ground);
- occupancy type; and
- a detailed report of evident conditions, including side of structure where conditions are evident, quadrant location, and conditions description.

On-scene reports should resemble the following:

"Battalion 402 from Engine 401. Engine 401, on-scene, side Alpha of a two-story SFD. Fire showing from a 2nd-floor window on side Delta, quadrant Charlie."

Size-Up and Situation Report

During the size-up, unit officers should complete a 360-degree lap of the structure. The use of a thermal imaging camera during this lap can help determine the fire's location and intensity. The officer should also use the lap to determine the following:

- number of above-grade floors in front;
- number of above-grade floors in rear;
- specific location of fire, if visible;
- presence of a basement, conditions present in the basement, and location of basement access;
- floor labeling;
- hazards observed;

- presence of exposures;
- occupant status (if able to obtain); and
- the need for additional resources.

It may be impractical to complete a 360-degree lap if an incident requires immediate lifesaving actions from the first-arriving officer and crew. If unable to complete a 360-degree lap, first-arriving unit officers must communicate with other responding units to assign this task. A complete size-up and determination of operation mode and associated tactics cannot be made until a 360-degree assessment of the structure has been completed. Personnel should not typically commence interior operations until after receiving a report from side Charlie.

Officers should use the information gathered during their size-up to determine their initial strategies and tactics. This information, as well as actions needed from other units and the need for additional resources, should be communicated to the first due command-level officer in a situation report. Situation reports should resemble the following:

"Battalion 402 from Engine 401. Lap completed. Two in the front, three to the rear. Floors will be labeled basement, 1, and 2. Basement is clear of smoke and fire with access on side Charlie. The fire is located on side Delta, Floor 2, quadrant Charlie. Unable to confirm occupant status. Engine 401 is stretching a 1 ¾" line through the front door with a crew of three. Truck 401 is conducting a primary search on Floor 2 with a crew of two, two remaining outside to throw ground ladders. Dispatch RIT taskforce. Requesting to transfer Command."

CAN Reports

Unit officers should provide ongoing situation reports to ICs as their unit completes their tasks or when they require assistance to achieve their unit's objectives. Ongoing situation reports should take the form of a conditions, actions, needs (CAN) report and should resemble the following:

"Command from Engine 401. [Conditions] Floor 2, we have considerable heat and smoke conditions with a fire in a bedroom. [Actions] Engine 401 has a line on the fire. [Needs] Requesting horizontal ventilation on Floor 2 and a check for extension in the attic."

Hoseline Selection and Advancement

Initial Hoseline

Officers and crews should consider a fire's intensity, size, and location, together with available staffing, when determining the initial hoseline. A typical SFD has a low fire load, requiring 10 gpm per 100 sqft. A larger dwelling, or one with hoarding conditions, may have a medium fire load, requiring 20 gpm per 100 sqft. These gpm requirements can be produced by a variety of nozzles and hoseline combinations.

The initial hoseline for most SFD fires should be the 1 ¾" hoseline, allowing for the needed speed, mobility, and fire flow. The first-arriving engine crew usually takes responsibility for deploying this line. They should position it to protect occupants and the interior stairway and, if possible, to advance it to the seat of the fire for confinement and extinguishment. The crew may also deploy this hoseline to perform a quick exterior knock on the fire before transitioning to the interior.

The most advantageous location for confinement and extinguishment may not always be through the front door (e.g., deck fires, vinyl siding fires). Company officers should make tactical decisions based on the information provided during on-scene and situation reports, as well as from their own ongoing size-up.

When members confront well-advanced fires in SFD structures, they should consider using large-caliber handlines and smooth-bore nozzles. Extinguishing these fires requires delivering enough water to the seat of the fire to cool and stop pyrolysis. Large, well-advanced SFD fires may preclude the use of fog streams for this task because a large fire's thermal energy can evaporate the fog stream before its water reaches the burning material.

Conversely, personnel should consider the power required to efficiently maneuver 2 ½" hoselines. These large-caliber hoselines require two companies to advance efficiently inside a structure.

When fires have reached advanced stages and no life hazard exists, personnel should strongly consider using master streams. Personnel should reference the NOVA *Engine Company Operations* manual for more information about fire behavior and fire-stream application.

Second Line

The second line for most fires in an SFD should be the 1 ¾" handline, allowing for the needed speed, mobility, and fire flow. The line should be of sufficient length to reach the initial attack line's location or to be advanced to the area above the fire, if required.

Personnel should generally stretch the second line from the first due engine company apparatus. In most cases, the second due engine company accomplishes this task. This line should be capable of delivering adequate fire flow for the fire encountered and the task assigned. In the case of a 1 ¾" line, personnel must make adjustments to produce the higher flow. The need for advancement depends on the initial attack line's progress. If personnel on the attack line do not need support from the second line, then the second line may be used as the line above the fire. Personnel must inform Command.

An additional consideration for the second line is to protect the crew searching above. To best ensure the search crew's safety, personnel should place this line at the base of the stairs on the fire floor. From there, the hose crew can observe fire conditions and prevent fire from spreading up those stairs.

Hoseline Advancement

It can be difficult to advance hoselines to upper floors and basements due to narrow staircases involving one or two 90-degree turns. In some instances, these staircases incorporate 180-degree turns. Personnel must be able to deploy hose quickly and efficiently. More information about hoseline advancement appears in the NOVA *Engine Company Operations* manual.

Aerial Master Streams

Aerial master streams provide significantly greater extinguishment potential than smaller caliber hoselines. When members encounter large-volume fires, they should consider utilizing aerial master streams.
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Building characteristics, incident scene geography (e.g., parking lot layout, building set-back), and the IC's operational strategy all influence aerial master-stream placement and positioning. Aerial master-stream nozzle positioning and hose-stream direction may differ with offensive or defensive strategies. If elevated streams become necessary, the IC should request a tower ladder, which is the most effective unit for the task. For this reason, all officers and apparatus operators arriving on-scene should remember to maintain scene access for later arriving trucks.

When ICs utilize aerial master streams, the soffit level often provides the most advantageous nozzle positioning, with the hose stream directed parallel to and along the underside of the pitched roof. The advantages of this positioning may not change, even when fire has self-vented and burned through the roof.

During aerial master-stream operations, personnel should note the amount of runoff flowing out of the building. As personnel direct large volumes of water into the structure, the weight of the water held in the structure may add stress to fire-compromised components, increasing the potential for collapse.

During offensive operations, personnel assigned to operate aerial master streams should pay close attention to hose stream direction and prioritize delivering water to the structure's interior. The impact of these large-caliber hose streams directed against building components (e.g., walls, roofs, facades) can cause structural damage.

The use of aerial master streams for fire attack does not preclude the later interior deployment of smaller caliber handlines to complete extinguishment operations. However, given the potential structural damage caused by large-volume fires and the impact of the water delivered by aerial master streams, personnel should assess structural stability before initiating interior operations.

Attic Fires

SFD fires involving attics can result from several scenarios:

- fires in the living area or basement that extended into the structural components and entered the attic via void spaces;
- interior fire that vented through a window to expose the vented soffit area;
- fire that originated on the dwelling's exterior, involving the siding and exposing the soffit area;
- electrical fires that originated from ceiling or exhaust fans or recessed lighting;
- fire that originated in the attic itself by natural occurrences, such as a lightning strike; and
- fire resulting from the current or prior work of roofers, plumbers, or painters.

The tactics employed to extinguish attic and cockloft fires vary according to construction type and degree of fire involvement. Attic fires can be very fast-moving, so personnel should direct water into the attic space as quickly as possible. Several of the tactics described in this section have been informed by research performed by the Underwriters Laboratories (UL) Fire Safety Research Institute. The institute conducts rigorous research and produces education tools and resources to inform fire ground tactical decision making. Personnel should review UL's Residential Attic Fire Mitigation Tactics and Exterior Fire Spread Hazards on Firefighter Safety material for more information.

Sweeping the Eaves and Soffit Attacks

Eaves are a common structural feature of SFDs. They extend the ends of rafters or trusses of a pitched roof over exterior walls. They are often enclosed by nailing a fascia (i.e., board) to the ends of rafters or trusses and a soffit to the underside. Enclosed eaves typically extend the attic and incorporate ventilation openings, making them vulnerable to fire extension.

Fire burning out of the top-floor windows or up combustible siding is very likely to impinge on and penetrate the soffit, spreading fire into the attic. Eaves hasten fire extension when they are enclosed with lightweight vinyl or sheet-metal soffits.

Exterior fire-stream application can prevent an exterior fire from extending into an attic. Personnel can also use it to begin to confine and extinguish an attic fire.

As indicated by UL's Study of Residential Attic Fire Mitigation Tactics and Exterior Fire Spread Hazards on Fire Fighter Safety, rapid water application to knock down the exterior fire represents a critical part of any attempt to control not only the fire's spread to adjacent structures, but also its migration into an exposed building's interior. Firefighters can prevent fire from extending into the attic by sweeping the eaves with hose streams directed at the underside of the soffit and parallel to the wall. Additionally, water striking the underside of the overhang will cascade down the wall to extinguish burning exterior siding.

Upon arrival, firefighters can rapidly knock down attic fires from the exterior by directing water into the attic through the soffit. This soffit—or eave—attack is illustrated in the UL video, Eave Attack—Get Water in the Eaves for Attic Fires. Personnel may need to remove sections of the soffit to provide an unimpeded path for hose streams. To complete a soffit attack, firefighters should match their hose stream with the roof's pitch and direct water flow under the gutter and through the soffit. A 2 ½" smooth-bore nozzle provides an effective reach and penetration from the structure's exterior.

Interior Attic Fire Operations

If offensive interior operations are appropriate, firefighters should deploy hoselines to the top floor and access the attic as quickly as possible.

The most operationally efficient position for extinguishing attic fires involves opening the top-floor ceiling and attacking the fire horizontally. However, applying hose stream into the attic from below can also successfully confine and begin to extinguish an attic fire.

The interior crew should use hooks to open the ceiling as needed by the attack crew. Personnel should bring salvage covers in to cover contents during this operation, and they should search the top floor prior to pulling down the ceiling.

Officers should make an early request for attic ladders to the top floor when they suspect a fire has entered the attic space. If not available, firefighters can utilize furniture to achieve attic access and horizontal positioning (see Figure 15). Personnel deciding where to locate the attic access point should consider the fire location in the attic and the roof's structural integrity.

Figure 15. Accessing an attic fire.

Figure 16 shows the intentional exposure of several truss bays allowing firefighters to project the hose stream into the attic. Directing hose steams straight up into the space is ineffective. The hose stream should be placed ahead of the fire to cut off its advance. Typically, personnel should keep this line static, directing the stream toward the fire without advancing the line. The 24-in. space between roof joists often hampers the stream angle.

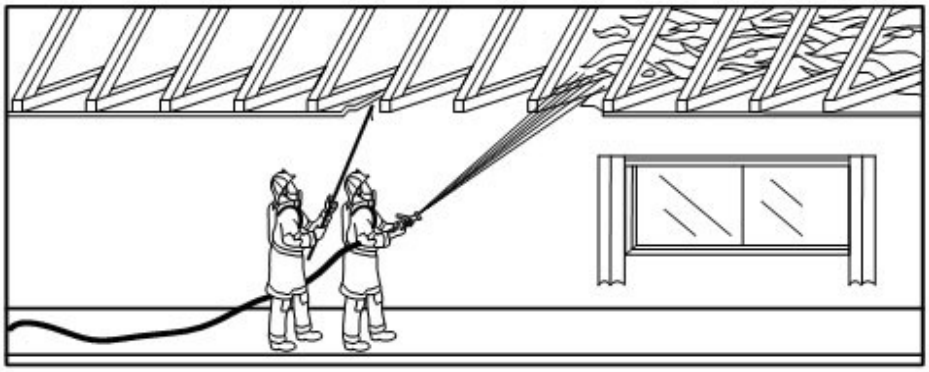

Figure 16. Projecting a hose stream into an attic.

The standard gable roof has staged many spectacular fires. If not quickly extinguished, this roof design tends to burn away. However, it represents a relatively low catastrophic collapse hazard. Companies should consider operating in areas of the structure without large overhead dead loads (e.g., hallways, bathrooms, and bedrooms) because the interior walls give some protection from falling ceiling materials. Units should avoid working under open areas such as foyers due to the long, unsupported span of the truss. Personnel should remember that, with platform construction, the roof itself adds support for the top-floor walls. If the roof has burned away, the walls will be inherently weakened.

Company officers must communicate the conditions in the attic to Command, and Command must advise companies on the top floor of changing exterior conditions. The intensity of an attic fire and progress of fire attack can often appear differently to interior and exterior observers.

The IC must understand the big picture so the correct tactics can be employed or maintained. If the fire overwhelms companies' operating lines on the top floor or structural stability becomes questionable, crews should transition to an exterior attack. Officers should consider using heavy streams, preferably from a tower. They must also consider the construction type and method of roof assembly when weighing options for combating an attic fire.

Soffit collapse presents another hazard associated with a well-involved attic fire. The exterior wall acts as a fulcrum in this situation. As most of the roof burns away, the remaining overhang may collapse onto the balconies or ground below. Firefighters must remain aware of the risk when operating on balconies, towers, ladders, or the ground below this collapse hazard.

In more modern occupancies, the presence of water heaters and HVAC units in the attic space, as well as cosmetic dormers, create significant potential for collapse when fire enters the attic space. Companies should not operate directly under the involved area in these instances.

Basement Fires

Basement or below-grade fires pose unique hazards and challenges due to limited access points and the potential for unimpeded fire impingement on the above floor's structural support.

As with any fire event, size-up at a basement fire is critical. Initial-arriving units must determine the location and extent of the fire, building construction, hazards, and points of basement access. If an officer locates the fire in the basement, they must quickly determine if an exterior basement access exists. If possible, personnel must determine early if the basement is unfinished because fires in unfinished basements have unimpeded access to the structural supports of the floor above.

Firefighters typically need two hoselines to contain and extinguish a basement fire. The officer must coordinate the deployment, positioning, and operation of these hoselines for a successful operation. Similarly, they must coordinate ventilation of the basement and the floors above to effectively support the fire attack.

The first-arriving engine company officer must identify the fire's location and where to deploy the handline to best address the incident's immediate needs. The initial handline may be deployed to

- an exterior basement entrance, if present, for fire attack or
- the front door, utilizing the fire stream reach to protect the interior stairs and upper floors.

The officer must communicate the decision of where to deploy this line on the tactical channel.

For an SFD of balloon-frame construction, personnel should check early for vertical extension through the stud bays in the exterior walls. They should expect fire to extend to all floors and the attic. Other early considerations include siding removal and the deployment of additional handlines to upper floors to check for vertical extension.

Basement Fire With an Exterior Entrance to the Basement

For a basement fire, the preferred point of attack for the initial handline is an exterior entrance leading directly into the basement, allowing personnel to attack the fire at the same level. Personnel should use straight or solid fire streams to avoid unnecessary steam conversion that could force steam and products of combustion up the stairs to the above floor.

Personnel must position a second hoseline to contain fire extending up the interior basement stairs and to protect occupants and firefighters on upper floors. Given the reach and penetration of a 1 ¾" hoseline, positioning the second hoseline at the main entrance threshold to the floor above the basement often achieves this objective. This hoseline should not advance to an interior position on the first floor until personnel have confirmed the structural stability of the first floor (see Figure 17).

If crews operating in the basement confirm the stability of the first floor, the second line can be advanced to the interior. Personnel should communicate this advancement to Command.

Figure 17. Hoseline positioning for a basement fire with an exterior entrance to the basement.

The first-floor door to the basement stairs should be closed, if possible. If the basement door cannot be closed, is nonexistent, or has burned through, firefighters should aim a hose stream with a narrow fog pattern at the ceiling over the stairway to contain fire extending up the stairs. Firefighters must take care not to direct the narrow fog stream downward into the stairwell. The main objective of this line is to stop vertical fire extension.

Basement Fire With No Exterior Entrance to the Basement

When firefighters encounter a basement fire in an SFD without an exterior basement entrance, personnel should consider these methods of applying water to the basement from the exterior to knock down the fire:

- Direct a fire stream through a basement window if present (see Figure 18).
- Remove a section of band board to enable the direction of fire streams into the basement. Band board is the material covering the area where the first-floor floor joists meet the exterior wall. Removing a section of this material with hand tools or a chainsaw creates a space

through which firefighters can direct water into the basement. Personnel may see smoke pushing from behind the band board during some well-involved basement fires.

- If a window is present, perform a window cut-down or extend an existing cut-down by 1 or 2 ft to access the band board and floor joist area on the first floor.
- If equipped with a Bresnan distributor nozzle (i.e., cellar nozzle), personnel can insert this device from the exterior into the structure through a hole over the immediate fire area. Personnel assigned to this task must be proficient in deploying and operating this nozzle.

Figure 18. Hoseline placement for advanced basement fire with no exterior basement entrance.

These methods may not extinguish the fire, but they may cool the basement and contain the fire enough to deploy a crew into the basement.

Basement Fire With No Exterior Entrance or Access

When members encounter a basement fire in an SFD without an exterior entrance and no other exterior basement access can be achieved, the officer may determine the only option involves an attack via the interior basement stairs. Personnel should make every effort to knock down a basement fire prior to attacking via the interior basement stairs.

The officer must determine the prudence of descending the basement stairs for a direct fire attack. The officer must consider structural stability, life hazard, as well as fire and heat conditions at the top of the basement stairs. A second hoseline team should position at the main entrance threshold to the floor above the basement and be prepared to advance prior to commencing the basement fire attack.

The proximity of the basement door to the rear exterior door can prove a hindrance in some SFDs. When these doors are opened, they swing toward each other and can block access to either door (see Figure 19). In this case, personnel should remove one of the doors to aid in hoseline movement.

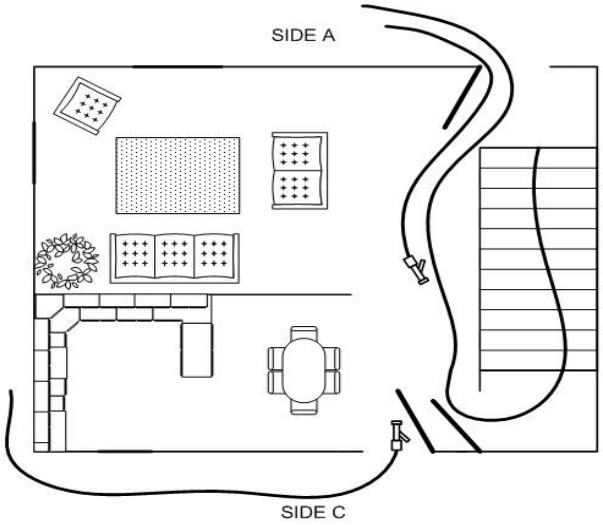

Figure 19. Opened basement door blocking access to rear door. One of these two doors must be completely removed to allow crews unimpeded access to the basement when entering from side Charlie.

Deck Fires

In the event of an SFD deck fire, firefighters should prioritize positioning a hoseline on the structure's deck side to extinguish fire on the deck, soffit, and eaves. If personnel determine the deck is still structurally sound, the first engine may access the fire building through that affected side with the handline to perform a fire extension and extinguishment investigation. It is permissible to move from the burned portion of the structure to the unburned portion in this situation.

Exterior Fires Extending Into the Dwelling

SFD builders throughout the NOVA region have utilized vinyl siding as an exterior covering over lightweight wood construction due to its low installation and maintenance costs and longevity of use. This combination of materials and construction type has significantly impacted fire dynamics, especially when fires originate on the structure's exterior. Exterior fires can quickly ignite vinyl siding and exterior sheathing and run up the exterior, through the soffit, and into the attic space. This fire can also enter the structure through a window or void space in a truss construction floor.

Line-of-duty deaths and close calls have occurred during fires that originated on a structure's exterior and extended via vinyl siding or combustible sheathing. Personnel conducting incident size-ups and developing strategies and tactics for exterior fires must always consider the potential for rapid fire progression to multiple floors.

First-arriving officers must communicate incident dynamics, the mode of operation, initial tactics, and personnel assignments to subsequently arriving units and command officers to safely extinguish this type of fire. Officers from the first engine and the first-arriving special service unit should coordinate tactics and operations before the special service unit enters the building.

Officers should utilize the following tactics when responding to exterior SFD fires extending into the dwelling:

1. Deploy the first hoseline to the fire location on the structure's exterior to quickly knock down the fire.
2. Deploy the second line to the dwelling's interior. The crew must inspect the ceiling area and the floor condition at the entry point. The use of a thermal imaging camera is highly recommended (see Figure 20).
3. After knocking down the exterior fire, redeploy the first hoseline to the interior to assist the interior line or progress to upper floors to attack any fire.

Figure 20. Thermal imaging camera used to check the ceiling area.

Garage Fires

When members encounter an SFD garage fire, they should consider fire conditions, garage location, the presence of windows, and the status of the overhead garage door to determine appropriate fire attack tactics. Members may also communicate the status of the overhead garage door in the on-scene or situation report.

If the overhead garage door is open and fire exists in the garage area, personnel should attack the fire from the exterior by quickly applying water through the open garage door to the seat of the fire. Personnel should deploy a second line through the building's main entrance to check for and extinguish fire that extended beyond the garage. If windows provide access to the garage, personnel should consider directing hose streams through the windows to knock down the garage fire.
If the overhead garage door is closed and the garage does not have windows, crews should access the garage through the building's main entrance and the interior garage door. Personnel should reference the NOVA *Truck Company Book 2 – Forcible Entry* manual for information about breaching overhead garage doors.

When advancing the first hoseline through the main entrance to the interior garage door, crews must be ready to operate the line as they enter the front door. If the interior garage door was left open at the time of the fire, the advancing crew could encounter fire in the living area. Personnel should advance a second line to back up the first or to proceed to the upper floors.

Garage fires often originate inside parked vehicles. Personnel should observe standard precautions associated with all vehicle fires, such as exploding bumper cylinders or ruptured fuel tanks.

Attached garage fires sometimes extend to upper floors and attics. Crews must perform a quick assessment of extension into these areas.

An SFD garage may be located under, in front of, or behind a living area. Adjacent living areas must be checked early for smoke and fire spread. Companies operating directly above a garage fire should exercise caution because the fire below them may directly access the floor members supporting them.

Wind-Driven Fires

A wind-driven fire is a rapidly developing fire that results from prevailing winds entering a fire-vented location in a structure. The wind pressurizes the interior, so the creation of a second opening in this environment produces a deadly flow-path for blowtorch-effect flames and untenable temperatures. Wind-driven fires in SFDs can create backdrafts, flashovers, or broad fire extension through failed windows. These fires can burn with enough heat and intensity to destroy fire barriers. Numerous firefighter and civilian deaths have resulted from wind-driven fires.

Generally, the taller a structure, the more susceptible its upper stories are to wind-driven fires. The conditions required to create a wind-drive fire can exist with exterior winds as low as 10–20 mph.

Five conditions must exist for a wind-driven fire to occur:

- fire in the structure,
- a failed or opened window or exterior door in the fire area,
- wind on the structure's exterior,
- a secondary failed or opened window or door remote from the fire area, and
- an unobstructed flow path from the fire area to the secondary failed or open window or door.

Street-level recognition of a wind-driven fire along with proper tactical resource deployment are critical for member safety. To aid in sizing up a wind-driven fire, personnel should consider the following:

- the presence and direction of the wind from street level,
- failure of windows to the fire area,
- lack of smoke and flames or intermittent smoke or flames resulting from wind gusts pushing from the failed window, and
- a large volume of fire present within the fire area.

The first-arriving officer should communicate dynamics associated with wind-driven fires to the first-arriving command officer in their on-scene and situation reports.

Special service units advancing ahead of hoseline crews should strategically close interior doors as they advance to interrupt the fire's flow path. Interrupting the flow path of a wind-driven fire may allow companies to advance a hoseline to the fire area.

In the National Institute of Standards and Technology report, Fire Fighting Tactics Under Wind Driven Fire Conditions: 7-Story Building Experiments, authors Daniel M. Madrzykowski and Stephen Kerber demonstrated several successful alternative tactics for use when personnel cannot make entry during a wind-driven fire. These tactics involve the following variations of exterior attack:

- elevated master streams through the fire room window,
- handlines to upper floor windows via portable ladders, and
- large-caliber handlines positioned with the wind to the back of the hose crew.

If officers employ any of these tactics, they must coordinate between interior and exterior companies. The exterior personnel preparing for attack must ensure that no fire department personnel are present in the structure prior to flowing water.

Given the intensity and behavior of wind-driven fires, coordinated ventilation is also critical to effective suppression. If wind-driven fire conditions exist, personnel should not perform horizontal ventilation until directed by Command.

Large-Volume Fires

A large-volume SFD fire can quickly spread to adjacent exposures. In the situation where personnel encounter heavy fire volume in the originating SFD, it may be appropriate for the first-arriving officer to address the exposures first.

The first engine may need to perform a holding action or a quick knockdown on the SFD of origin by using a master-stream device or 2 ½" hoseline. Water supply is paramount in the quick control of a large-volume fire and must be prioritized by arriving engine companies.

Firefighters should stretch the next line in proximity to the most severely threatened exposure, which will most likely be downwind.

Balloon-Frame Construction Fires

Balloon-frame structures are built with long, continuous studs that run from the basement to the attic. The lack of fire stops between floors can lead to rapid fire spread. Fires in SFDs with balloon-frame construction require personnel to check all levels within the structure regardless of where the fire originated or was confined.

Overhaul is often more challenging in balloon-frame dwellings due to the use of plaster and lathe construction.

Estate Home Fires

The tactics employed to fight a fire in a 10,000 sqft estate home (see Figure 21) can vary greatly from those used in a 1,200 sqft ranch home.

Figure 21. SFD with large square footage that may require changed tactics.

The house's large footprint may prevent the first-arriving engine officer from completing a lap, but this must occur before entry to ensure no fire exists below entry level. Early in the incident, the officer should consider having another company view and report on conditions from all available sides to assist in developing a safe and effective firefighting plan.

The roofs and attics of these structures most often are lightweight. All lightweight roof operations must be performed with aerial support for members.

Ceiling collapse presents another consideration. If the fire has accessed the attic, the ceiling will likely collapse. Heavy HVAC units and hot water heaters in the attic and the presence of large chandeliers make serious injuries from collapse a major concern. If the fire has accessed the attic, members should avoid the foyer area. Collapse on other areas of the structure free of large overhead dead loads may be less serious because the interior walls will provide some protection from falling ceiling material.

Estate homes can have expansive open foyers that facilitate rapid smoke and fire spread (see Figure 22). Open foyers and high ceilings also hinder the ability of personnel to use pike poles to access the attic from below.

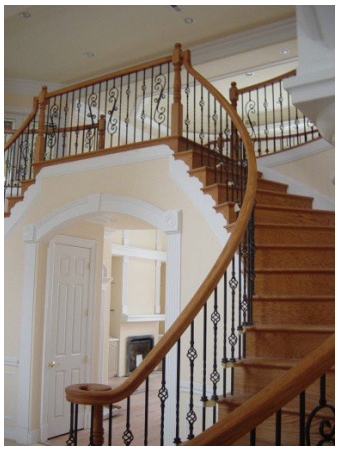

Figure 22. Open area created by high ceiling in an open foyer.

The building components in large homes tend to be more ornate and elaborate, using combustibles such as finished wood.

Options for accessing the fire include advancing lines into windows over ground ladders or using a utility rope to stretch a hoseline from the exterior. A firefighter can drop a rope from upper floors and hoist the hose up to the floor below the fire or to adjacent rooms on the involved floor. Members using these tactics should pull plenty of hose into the room and tie it off so the line does not slide out the window when charged.

Estate homes may have more than one kitchen. Newer homes may have a kitchen on the main level and an in-law suite in the basement. A remodeled home may have been enlarged to accommodate several families, and two full-size kitchens may have been constructed to provide for numerous occupants.

The number of occupants in these homes can range from one individual to multiple members of several families. The tendency to pave the entire front lawn for parking provides a good indication of a structure with numerous occupants.

Larger homes may have multiple stairways, with some located at a distance from the front entrance (e.g., access stairs from the kitchen to upper floors). Some stairways may not lead to all floors and may not access the area of fire involvement. The size of the structure may require multiple fire divisions on each floor. A bottom-to-top foyer may necessitate dividing the floor. For example, the situation may require a second-floor Bravo division and a second-floor Delta division.

Other considerations in estate homes include the following:

- presence of an indoor pool or spa;
- limited access;
- home theaters;
- multicar garages;
- structure height, in particular the upper floors out of reach of ground ladders;
- large, buried propane tanks;
- multiple HVAC units and zones; and
- multiple electrical panels and feeds.

Cluster Home Fires

Cluster homes can challenge the first-alarm assignment depending on the involvement of the structure. Exposures present a major problem due to the proximity of adjacent structures. Personnel should deploy large-diameter attack lines and use fixed master streams to darken down the fire and protect exposures. Members should preplan water supplies because multiple hydrants may be required to move a large volume of water in a very short time period.

Companies likely to be on the first alarm for neighborhoods with cluster homes should preplan for very narrow alleys that can limit access by large aerial devices. Preplanning ensures companies can address the fire building as well as the immediate exposures.

Street frontage is often limited in these neighborhoods, with very little access on the Charlie side. These narrow streets provide little room for deploying outriggers, which will make placement of the aerial device challenging. Coordinated apparatus positioning can ensure room adequate room for an aerial apparatus positioned on side Alpha of the fire building. Fire conditions may make it impossible to accomplish this without risking damage to the apparatus.

RESOURCES FOR FIRES IN SINGLE-FAMILY DWELLINGS

The minimum initial alarm assignment for an SFD fire consists of the following:

- four engines,
- two trucks,
- one rescue,
- one emergency medical services (EMS) unit,
- two battalion chiefs, and
- one EMS supervisor.

The unit assignments outlined in this document are based on common tasks performed in a logical order. Officers may need to adjust assignments according to an incident's specific challenges.

Unless otherwise directed by the IC, companies should position and report according to the following sections.

The assigned resources for SFD fires in areas without hydrants should be modified to include a tanker task force early in the incident. This task force includes:

- three tankers,
- one engine company, and
- one battalion chief.

Personnel should reference the NOVA *Water Supply for Suburban and Rural Firefighting* manual for more information related to positioning and operations during SFD fires in areas without hydrants.

First Due Engine

The first due engine company's responsibilities are as follows:

- View as much of the structure as possible during approach.
- Communicate primary water supply report to the second due engine.
- Position to allow for rapid hoseline advancement while maintaining priority positioning for truck companies. In most cases, this means the first engine pulls an adequate distance past the involved unit.
- Communicate an on-scene report to the first due command-level officer.
- Complete a 360-degree lap of the structure and communicate a situation report to the first due command-level officer.
- Deploy initial hoseline and begin fire suppression operations in coordination with Command.

The first due engine officer must identify and verify the fire's location, if possible. Taking time to quickly gather this pertinent information saves time in the long run.

The first engine and all other engine companies should bring forcible entry tools if they arrive significantly before the first-arriving truck or rescue companies.

Second Due Engine

The second due engine company's responsibilities are as follows:

- Establish primary water supply to the first due engine.
- Assist the first engine with initial hoseline, if needed.
- Prepare to deploy a second hoseline. Depending on fire conditions, this hoseline can be advanced into the fire area as a second hoseline or directed to another floor or area.

Third Due Engine

The third due engine company's responsibilities are as follows:

- Establish a secondary water supply and coordinate with the fourth due engine, if needed.
- Position to gain access to the rear of the structure, if possible.
- Report to Command via radio:
  - evident conditions on side Charlie;
  - number of stories present in the rear;
  - changes in the location, volume, and characteristics of any fire or smoke; and
  - the presence of any persons in distress.
- Deploy a side-Charlie hoseline.
- Coordinate suppression operations and hoseline advancement through rear entrances to the dwelling with units operating on side Alpha.

Fourth Due Engine

The fourth due engine company's responsibilities are as follows:

- Help the third due engine establish a secondary water supply, if needed.
- Establish the initial RIT.

First Due Truck

The first due truck company's responsibilities are as follows:

- Position at the most strategic location for rapid ladder placement and entry into the structure.
- Deploy ground ladders.
- Gain access or force entry on side Alpha.
- Assist with advancing 2 ½" hoseline, if needed.
- Search for victims prioritized by incident dynamics.
- Locate the fire, if needed.
- Control utilities.
- Perform ventilation operations.
- Establish scene lighting.

If necessary, truck company officers may request to split crews and create an interior and exterior (i.e., x-ray) crew to complete multiple tasks at once. Command must be notified and must approve requests to splits crews into two teams working in two distinctly separate areas or functions in the immediately dangerous to life or health (IDLH) environment.

If the fire location is not readily apparent, the truck company should search for it while the engine crew stands by, ready to advance. At this point, the engine crew operates as the rescue team for the truck, if needed. Once the truck crew has located the fire and the engine company has advanced the hoseline, the truck crew should begin searching the rest of the area for victims.

Second Due Truck

The second due truck company's responsibilities are as follows:

- Attempt to position in the rear or in a position to cover the rear.
- Deploy ground ladders on side Charlie with the primary goal of providing access and egress for personnel operating on upper floors.
- Light the roof and rear area early.

Rescue

The rescue company's responsibilities are as follows:

- Position to afford rapid access to the structure without blocking other companies.
- Search for victims prioritized by incident dynamics.
- Gain access or force entry, if needed.
- Assist with advancing 2 ½" hoseline, if needed.
- Locate the fire, if needed.
- Control utilities.
- Perform ventilation operations.

If necessary, rescue company officers may request to split crews and create an interior and exterior (i.e., x-ray) crew to complete multiple tasks at once. Command must be notified and approve requests to splits crews into two teams to work in two distinctly separate areas or functions in the IDLH environment.

Depending on the number and type of handlines deployed, rescue personnel may assist in hoseline movement and operation. Specifically, the 2 ½" hoseline requires additional personnel for successful deployment.

EMS Units

Transport personnel should not routinely be assigned suppression duties or non-EMS functions such as RIT. Transport units should park as close as possible to the incident, allowing for rapid care of any injured persons, emergency departures, and equipment access while providing a sheltered environment, if needed.

Transport personnel should not routinely don personal protective equipment and self-contained breathing apparatus unless the IC deems them necessary for a suppression task. When a Mayday has occurred or people have been reported trapped or injured, EMS personnel should leave their personal protective equipment and self-contained breathing apparatus on the unit and rapidly report to the incident scene with their EMS equipment.

When Command receives reports of trapped occupants or multiple victims, they should consider assigning additional advanced life support units.

Battalion Chiefs

The first chief officer should position the vehicle to facilitate effective incident command without blocking firefighting units.

The second chief officer should avoid blocking firefighting units while positioning the vehicle to support Command, enabling members to most easily report to the IC with their full personal protective equipment, including self-contained breathing apparatus.

OTHER CONSIDERATIONS

Forcible Entry

Personnel should reference the NOVA *Truck Company Book 2 – Forcible Entry* manual for information about various forcible entry techniques appropriate for SFDs. Related information specific to fires in townhouses appears in this section.

Crews can easily enter an SFD using conventional methods. Personnel should remain cognizant that forcible entry creates ventilation that can adversely impact the fire's path and intensity. The engine company's access point is almost always the front door. Depending on the fire's location, this access point may change with attempts to attack from the unburned part of the structure. In situations where personnel determine the front door is not the primary access point, they should force it and leave it closed. Personnel also must access attached exposures, which may also require forcible entry.

Ladder Deployment

Personnel should reference the NOVA *Truck Company Book 3 – Ladders* manual for information about various techniques appropriate for SFDs. Related information specific to fires in SFDs appears in this section.

Laddering at an SFD fire should be performed on all available sides of all above-ground floors with attention to bedroom windows. Personnel can generally accomplish this with ladders of less than 35 ft, which they can find on most apparatus on the incident scene.

Aerial ladder deployment should typically follow ground ladder deployment. When aerial ladders are deployed, personnel should position supply hoseline to facilitate the use of aerial master streams to address rapid changes in conditions or tactics.

Search and Rescue

Personnel should reference the NOVA *Truck Company Book 4 – Search and Rescue* manual for information about various techniques appropriate for SFDs. Related information specific to fires in SFDs appears in this section.

The area closest to the fire on the fire floor and the area directly above the fire comprise the two most dangerous areas. Means of egress and sleeping areas are generally considered to be the most critical areas to search. Personnel conducting a primary search should check these areas first.

Due to the relatively small areas within most SFDs, execution of the primary search occurs quickly. Support for the primary search should include ladders to upper story windows and hoselines engaged on the fire. When accessing the fire floor, crews should begin the search while making their way to the fire area. Crews going to the floor above the fire must also begin searching immediately, beginning at the area over the fire and then searching outward from that point.

If personnel use the vent-enter-isolate-search tactic, they must notify the IC to avoid duplicating efforts. Crews must report the outcome of the primary search to the IC because this is the primary strategic focus of the operation.

Ventilation

Fire department personnel should manage the openings (i.e., doors, windows) to the structure to limit fire growth and spread and to control the flow path of inlet air and fire gases during tactical operations.

Members must coordinate all ventilation with suppression activities because uncontrolled ventilation allows additional oxygen into the structure. This can rapidly elevate heat release rates, expand the fire, and increase the hazards associated with it. A variety of actions (e.g., forcible entry) can facilitate ventilation, even when not intended. Personnel must force entry to access the seat of the fire, but without the proper water application, this form of ventilation can negatively affect life safety, incident stability, and property conservation.

Members must use door control and coordinated ventilation to control flow paths during the search. Crews must remember to close any open doors along their path to the fire location. Closing doors serves a multitude of purposes, including limiting airflow that feeds the fire and reducing the ability of unchecked fires to spread rapidly. Also, the closed door can provide refuge for trapped occupants by reducing temperatures and fire spread in their area.

Ventilation on the fireground can be one of the most dangerous and important tasks performed by firefighters. The technique of horizontal ventilation involves opening or removing windows. This accomplishes several objectives that aid in fire extinguishment. By allowing heat and smoke to escape through the newly created openings, horizontal ventilation reduces the danger of heat or fire passing over or around the nozzle team, permitting the crew to rapidly advance the attack hoseline to the fire area.

Officers must coordinate all horizontal ventilation measures taken by the inside or outside ventilation teams and the advancing hose team. Uncoordinated, poorly located, or ill-timed horizontal ventilation can cause the fire to spread rapidly, subjecting personnel inside to extreme heat and flashover conditions. The introduction of *any* additional ventilation into the structure increases fire intensity and spread. Firefighters must remain vigilant regarding the fire's ventilation status. Failure to recognize changes in the ventilation status can catch personnel in a rapid fire or flashover event.

Before any ventilation takes place, the ventilation team must answer the following questions:

- What is the fire's location?
- What is the current ventilation status?
- Will adding ventilation openings affect fire conditions?
- Where is the hoseline?

Vertical Ventilation

When ordered by Command, personnel should accomplish vertical, rooftop ventilation using common methods. The discovery of a lightweight trussed roof should be communicated and reacted to appropriately. Members must be independently supported when operating on lightweight construction. A viable and safer option involves venting the ends of a gable roof.

The majority of NOVA SFD roofs are of truss construction, so members should take appropriate safety precautions. Crews ordered to perform rooftop ventilation in lightweight construction must be independently supported by an aerial device or a roof ladder.

Hoarding Conditions

Compulsive hoarding disorder refers to the accumulation of a large number of belongings that have little-to-no apparent value.

Clues that hoarding conditions exist may be noticeable to members arriving on-scene or while completing the 360-degree size-up. Examples include cluttered front yards, cars filled with belongings, excessive accumulation of personal items or trash, and backyard privacy fences that hide large numbers of items. Members may notice excessive belongings through windows, or they may notice window coverings designed to hide clutter from public view.

Notable challenges to mitigating incidents involving hoarding conditions include:

- access and egress issues,
- increased fire load,
- collapse concerns due to weight and load shifting,
- delays in extinguishment and rescue operations, or
- long burn times and vent-limited fires.

Tactical considerations include:

- alternate means of access to perform operations (e.g., line-over-ladder and vent-enter-search-isolate),
- exterior water application and use of extinguishing foam to minimize added weight, and
- the summons of additional units due to the amount of work necessary to complete tasks.