

INCIDENT COMMAND SYSTEM

Hillside Structure Fires ICS 501



**Firefighting RESources of California
Organized for Potential Emergencies**

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This document is intended be an operational guideline and job aid within the FIRESCOPE ICS 500 Structure Fire Operations series, and contains information relative to the Incident Command System (ICS) component of the National Incident Management System (NIMS). This is the same Incident Command System developed by FIRESCOPE.

Additional information and documentation can be obtained from the following sources:

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FOREWORD

This FIREScope document has been developed as a result of multiple Line of Duty Deaths (LODD) and near miss incidents in the fire service involving structure fires in multi-level residential occupancies built on a hill. Data from multiple sources has been collected to formulate strategy, tactics and tactical watch-outs for fires in hillside homes. While this document has been designed to address specifically hillside homes, these same principles may be applied to any occupancy constructed on steep terrain.

Hillside structures are engineered to reside on steep slopes and provide scenic hillside views. Firefighting operations for these hillside occupancies, both residential and commercial, can be challenging even in favorable circumstances. Structure fires in hillside homes have proven to be some of the most challenging incidents involving firefighting activity.

Successful firefighting operations in hillside homes require consistent standard operating guidelines, strong command, continuous and accurate size-ups, a well communicated strategy, and effective firefighting tactics. Additionally, firefighters often encounter challenges related to extended response times, narrow streets with limited access, water supply, laddering, unusual construction, extreme fire behavior, restricted ventilation, and ultimately, fire suppression.

While these tactical hazards and challenges increase the complexity of the incident, having a thorough knowledge of the response area, pre-fire planning, and properly identifying these types of occupancies in advance, can better prepare fire personnel to safely and successfully mitigate fires in hillside homes.

TYPES

There are several different types of residential structures that may be built into hillside areas. Many of these homes are designed with a focus on capturing as much of the available view as possible. Commonly, they are multi-story homes with an open stairwell, and often consist of split-level floors throughout the occupancy depending on the degree of slope. Consequently, each home is unique, when factoring in voluntary earthquake retrofits, remodel ordinances, and building code variances changing from property to property.

There are three general categories of hillside homes 1.) Descending Hillside, 2.) Cantilever, and 3.) Ascending Hillside. Although fires in Descending Hillside homes have historically been the most dangerous to firefighters, each type of hillside home poses unique challenges and construction features that are important to identify before determining the safest and most effective strategy and tactics.



1. Descending Hillside Homes are built to provide an opportunity for multiple floors and are most often built on the down slope (descending) side of a roadway. Usually a minimum of two stories, the home is constructed to make the most of the sloping topography. These types of multi-level structures offer one full story at street level and usually one story or more below grade. Multi-level descending hillside home plans typically use interior, as well as exterior

access, to the lower levels of the home. Design features of these homes commonly offer options such as large picture windows, as well as overhanging balconies off the lowest level and walkout basements. Access to lower floors is often available via exterior staircases that descend with the hillside and offer portals of entry on multiple sides. Occupancies that are built on a descending slope are the most dangerous because of the possibility that entry from the grade level into the structure could possibly place firefighters above the fire when the fire originates on a lower floor.



2. Cantilever Hillside Homes were originally built in the early 1900's. Also known as stilt homes, they were built on steep vacant hillside lots perched precariously on land that was formerly considered unbuildable. These homes were one story and typically utilized wood construction and heavy timber wood supports tied to the original foundation. Later generation stilt homes were built on a concrete or wood foundation and utilized steel poles to support

the entire home which could cantilever out as much as 75 feet over the hillside. Portals of entry for these types of occupancies are usually from the street side through the front door or garage area.

Modern architecture of cantilever homes utilizes concrete, steel, corrugated metal, and fiberglass, and may have multiple floors hanging over the hillside. The support of these homes is typically concrete pilasters buried into the hillside. Regardless, the portals of entry generally remain the same, through the front of the structure. When a fire is located on sub level floors, it can create one of the most dangerous environments in structural firefighting.



3. Ascending Hillside Homes are built on the upslope side of the roadway. Unlike the descending hillside home, access to the first floor does not present the same hazards unless entry is made from an upper floor. Often, they are cut into the hillside depending on the percentage of slope. On larger properties with shallow slopes, you may find long driveways leading up to a flat pad. Steeper slopes may contain block retaining walls outlining the first floor. The ascending hillside home is usually multi-story with the garage located at grade level representing the first floor. There may be alternative

portals of entry available on each side of the home identified by exterior staircases.

BUILDING CONSTRUCTION CONSIDERATIONS

Building construction methods and styles can vary from home to home depending on the era when the home was built, the topography of the concerned property, and the style or design the architect employed. Several features of hillside homes should be taken into consideration when fighting fires in these types of occupancies. Specifically, the **layout, floor plans and floor systems** can affect fire spread and collapse potential.

Modern construction of hillside homes utilizes every opportunity for increased square footage. These contemporary hillside homes can have two or more stories and resemble small commercial buildings based on the size of the property. These mansion type homes have concrete pilasters or step foundations to support the structure regardless of the steepness of slope. Their construction methods are varied, including metal, concrete, masonry, wood frame and stucco and curtain style construction. The changes in construction styles and methods have permitted larger homes to maximize use of the entire square footage of the property, sometimes called “Mansionization.”

One of the biggest challenges with fires in hillside homes is gaining access to lower floors from grade level. Specifically, multi-story cantilever homes are outfitted with an unenclosed interior stairwell that serves all floors, while oftentimes offering no access to lower floors from the exterior. Consequently, any fire located below grade (sub-division levels) is similar to a basement fire causing firefighters to attack the fire from above. Multi-story descending hillside homes may have the same type of unenclosed interior stairwell, but usually provide alternative portals of entry on sub-division levels.

FIRE BEHAVIOR AND ATTACK

Fire behavior associated with a hillside home, regardless of type, generally differs from an ordinary multi-story dwelling. This FIRESCOPE document is focused on fires that are generated below grade level in a multi-story hillside structure. These types of fires have contributed to several LODD's and near miss incidents across the United States and pose the most significant risk to firefighters during emergency operations.

Homes built uphill on a slope (ascending hillside home) can normally be handled with similar strategy and tactics utilized for a traditional single or multi-family dwelling. However, homes built on the downhill side of a roadway (descending hillside home) require unique strategy and tactics for safe and effective fire ground operations.

It is imperative that every attempt be made to conduct a 360-degree survey to determine the fire extent and floor of origin, and to clearly communicate this information to other resources, before initiating interior firefighting operations. In an effort to develop the appropriate level of situational awareness for all responding resources, the first arriving officer should;

1. Give a comprehensive size-up informing the communication center and all incoming resources that this is a hillside home—stating the specific type (ascending, descending, or cantilever) if possible.
2. Prior to the advancement of any hose lines, every attempt should be made to complete a 360-degree survey of the building to further assess the incident, and announce the additional information in a subsequent or follow-up size-up.
 - Type of hillside structure
 - Number of floors (above or below grade)
 - Location, nature, and extent of fire
 - Floor with the lowest elevation of involvement
 - The floor and side of building where initial fire attack lines will be deployed

An example of a subsequent size-up might be:

- *“Communication Center from Engine 82; follow-up size-up, we have a descending 3-story hillside home with 2 floors below grade level. We have a working fire on sub-division 1. Engine 82 will be attacking the fire offensively from a doorway on the Bravo side on sub-division 1, and will be known as Sub-Division 1.”*

This subsequent or follow up size up can be communicated to the communication center as reflected in the example above, or may be communicated to a second officer who has arrived on-scene and assumed command in the role of Incident Commander. If a 360 survey is not possible due to the steepness of the grade, size of the building or other factors, the first arriving officer will attempt to visualize as much of the building as possible and ascertain all of the required information prior to communicating their subsequent size-up.

It is best practice that any hillside home that has one or more floors below grade with access shall be attacked, whenever possible, from a portal of entry at or below the origin of the fire. If the building features make it impossible to attack the fire at or below the lowest level of fire involvement, concerned officers should consider utilizing an exterior attack with limited and focused application of water streams from the exterior, directly through windows with visible fire showing. The focused application of a straight hose stream will significantly reduce interior temperatures and is intended to lessen the potential for flashover. This tactic of applying a water stream from the exterior should only be utilized prior to companies initiating interior operations.

Multi-story cantilever hillside homes that have no doorway access from sub-levels require an operational risk assessment every time before engaging in an offensive operation. The fire attack team should attempt to determine how long the fire has been burning and perform a risk-versus-gain tactical analysis of an offensive fire attack from a floor above the fire versus a defensive attack with water through an opening (such as a window) from the exterior at the identified fire floor. If an offensive attack is considered as the only means, then it is imperative that a backup fire attack team has a hose line in place before descending the interior stairwell.

VENTILATION

Ventilation on a hillside home can be challenging because of a variety of considerations. Access, building construction, layout and even weather (especially wind) can ultimately affect the desired outcome. Location of the fire, coordination and communication with fire attack and conditions on the interior are the highest priority in determining the proper placement of an initial ventilation hole through vertical or horizontal ventilation.

Hillside homes often incorporate floor plans on one level that have separated access and split-levels creating situations where vertical ventilation can prove ineffective. Considering layout, **it is imperative for first arriving resources to clearly communicate the specific location of the fire.** Ventilation teams are then better equipped to select the location for the heat hole, or may opt to provide a ventilation hole over the stairwell.

Coordinated vertical or horizontal ventilation on a structure fire can assist fire attack companies by removing smoke and hot fire gasses. If these heated fire gasses are not released they will accumulate and begin to bank down and spread laterally. This process, called mushrooming, can be seen in hillside homes as the hotter air travels quickly up through the unenclosed stairwell. Proper ventilation will reduce this mushrooming effect, which will in turn reduce the rate that fire can spread over an area. It is crucial that fire attack and ventilation be coordinated, as premature ventilation can create an undesired flow path with potentially catastrophic consequences. Consideration to a well-timed coordinated fire attack and vertical ventilation is paramount in a hillside home.

As mentioned, every attempt needs to be made to initiate fire attack at the level or below the level of the fire floor. Ventilation teams need to understand that a premature (uncoordinated) ventilation hole over the unenclosed stairwell may cause an accelerated flow path of superheated gasses and smoke, greatly hindering firefighting efforts.

Especially, if a fire attack team is making an attack where there is a fire located on a sub-level and there is no possibility of making entry from an exterior portal below grade. These deteriorating conditions not only cause a more challenging environment for the fire attack team, but also hamper search efforts on the grade level floor. Fire suppression lines must be in place before ventilating the unenclosed stairwell.

If the fire is on the street level or grade level floor, then an offensive heat hole can be established above the origin of the fire with coordinated fire attack from the first floor. If the fire is below grade and the only entry to establish fire attack is from the first floor, then an alternative plan of providing horizontal ventilation should be developed and considered. A ventilation hole over the interior stairwell should only be initiated after the fire attack team has descended the stairwell to the fire floor and communicated the progress of the attack. This is one of the most significant tactical decisions in a descending hillside home event. The impact of creating an accelerated flow path resembling a chimney, to a fire attack team advancing down an interior stairwell, could be devastating.

Opening any doors or windows can change the flow path of the fire and change fire behavior. Careful consideration should be given, and only after communication with fire attack has occurred, before opening any door(s) and/or window(s) on grade level when a fire is located on a sub-level. If fire attack companies are opening doors on the sub-level simultaneously, an extremely dangerous environment is being created within the structure. The mixture of cool air and super-heated gasses from one level to the next can create flashover conditions on the floors above.

TACTICAL WATCH OUTS

360 Degree Size Up (360): One of the most important tactical watch-outs in a multi-story hillside home is the ability to perform a 360-degree survey. A 360 is a term used to provide reconnaissance. The process is imperative and involves the first arriving Officer to remove themselves from the apparatus and obtain as much information about the home as possible by visualizing all sides of the property. Once the Officer has obtained situational awareness, that Officer can direct their company more appropriately on how to attack the fire and provide direction to incoming companies on the proposed strategy. A complete 360 may not be possible on every hillside home; however, identifying a portal of entry (Alpha, Bravo, Charlie, or Delta side) at or below the fire is the highest priority.

Portal of Entry: When engaging in initial fire attack operations it is important to realize the impact of your actions on the fire ground. In a well-developed fire situation, if the initial fire attack team accesses the home from any sub-level and the second arriving company enters through the front door of a descending hillside home, the results can be catastrophic. If a fire exists on any sub-level, the simple act of opening the front door at street level can immediately create an accelerated flow path to the first floor. Combined with introduction of increased flow pressure from the sub-level and an unenclosed stairwell, the mixture of superheated gasses and oxygen ignite, creating a flashover. When engaging in fire attack on a descending hillside home, fire attack, backup fire attack, and all other interior resources shall utilize a common portal of entry and exercise proper door control until water has been applied on the seat of fire.

Sounding the Floor System: Floor systems have the potential to collapse under fire conditions, even when the subfloor may appear solid. Using a sounding tool to check floor integrity can be a false indicator of the stability of the actual entire floor system. An alternative to sounding is using an axe or similar tool to provide an indicator hole as a method of checking for potential fire below you on a hillside home.

Thermal Imaging: Thermal Imaging Cameras (TIC) can be a tremendous advantage on the fire ground. The capabilities and limitations of the TIC are important to consider, and it is important to realize that the thermal imaging cameras only read surface temperatures. A well-developed fire on a sub-level in a hillside home may dangerously compromise the floor system overhead, while the TIC offers little or no indication of this hazard on the floor above the fire.

COMMAND AND CONTROL

Establish Command: **Assume and announce Incident Command and establish an effective Incident Command Post.** This is imperative and should include a comprehensive initial size-up. An example of this is illustrated below.

- *“Communication Center from Engine 27 on scene at 2252 Maravilla Drive. I have an approximately 6,000 square foot, three story descending hillside home with moderate smoke showing from the Alpha side on the first floor. Dispatch a second alarm assignment, I will be known as Maravilla IC. Staging will be located at Castilian Drive and Oporto Drive. Engine 27 is initiating fire attack on sub-division 1 from the Delta side.”*

The hillside home structure fire presents unique challenges to ensuring adequate command and control. A frequent obstacle to ensuring the Incident Commander has up to date situational awareness is the difficult access that is often present in hillside home structure fires. Dependent upon when the first Chief Officer arrives on scene, they may very well be blocked from having any view of the involved structure. The Incident Commander has a variety of options to overcome this obstacle and ensure safe and effective fire ground operations.

Establish a Command Post and Implement Organization

Under this command option, the IC positions the command post in as advantageous a position as possible, and deploys Officers to command functions or geographic areas of the incident to validate the risk profile, strategy, tactics, deployment of resources and organization. The Incident Commander remains responsible for all of the functions of command.

Relocate the Command Post

This tactic involves the Incident Commander relocating their fixed command post to a position where they can validate the risk profile, strategy, tactics, deployment and organization. This tactic may require the Incident Commander to relocate to a work area such as the hood of a convenient vehicle, or other suitable work area with sufficient handy-talkie radios to monitor and communicate on each of the assigned frequencies.

If this option is used, the Command Post must be capable of radio communications with all supervisors/staging and the communication center, capable of managing a Mayday emergency, and be capable of maintaining the incident accountability of all personnel and resources. If the command post is relocated, the communication center and incident personnel must be notified.

Communications: Identify, develop, initiate, maintain and control the communications process and establish a communications plan. For hillside home structure fire incidents consider adding one or two additional tactical channels/frequencies for staging or miscellaneous groups that may need to be established later in the incident. Clear text communication includes conditions, actions and needs and shall be limited to information that affects the outcome or tactical direction of the incident as provided in the following communication sequence.

- *“Engine 27 from Truck 27, I’m on scene and will assume command.”*
- *“Truck 27 from Engine 27; we have established a hose line and are making access on sub-division 1 on the Delta side. This is a three-story, descending hillside home with two floors below grade; we have light smoke on sub-division 1, it appears the fire is located on the first floor, division 1.”*
- *“Engine 27 from Truck 27, I have Truck 27 providing ventilation on the roof. I will get you back up fire attack. I am going to make you Sub-Division 1.”*
- *“IC from Engine 27, Sub Division-1.”*
- *“Communication Center from Truck 27 on scene and assuming command, I concur with Engine 27’s size up and resource request. Additionally, we will need traffic control. The command post will be located at Truck 27. Confirming all resources will stage at Castilian and Oporto.”*

Organization: Develop an effective Incident Command organization based on incident objectives and initiate/maintain a tactical worksheet. Organizing the incident early every time will assist all resources on scene to be able to maintain accountability and provide the Incident Commander with an appropriate span of control through the successful mitigation of the incident. Whenever two resources are assigned to the same geographic area or function at an incident, one of the officers should normally be placed in command of that geographic area or function (e.g. Division/Group Supervisor).

Establish an Operations Section Chief

In an effort to ensure the appropriate risk profile, strategy, tactics, deployment of resources, and organization are developed, the Incident Commander may remain at a fixed command post location and assign an initial arriving Captain, or the second arriving Chief Officer, as the Operations Section Chief. Another option is to pass Incident Command to the next arriving Chief Officer and deploy as the Operations Section Chief to supervise and validate tactical operations. This option can only occur if the Chief Officer is already on-scene. The Incident Commander remains responsible for the functions of command, but delegates the management of tactical operations to the Operations Section Chief.

Hillside homes present a challenge organizationally, even more so when they are located on a descending hillside. Regardless of a Cantilever construction or a Descending Hillside Home, the organization is the same. Any occupancy having a floor at street or grade level would become the first floor or Division 1. The next level below grade would become Sub-Division 1 and sequentially below that floor would become Sub-Division 2 (See Figure 1).

A hillside home on the ascending side would follow normal terminology. The first floor at street or grade level would become Division 1. The next level above the first floor would become Division 2 and sequentially above that floor would become Division 3. It is possible to have numbered Divisions and lettered Divisions coexist at the same incident. Exposures (in hillside homes) would likely be handled as lettered divisions. Usually, they would consist of Bravo, Charlie and Delta Divisions as geographical areas surrounding the involved occupancies.



Figure 1

CONCLUSION

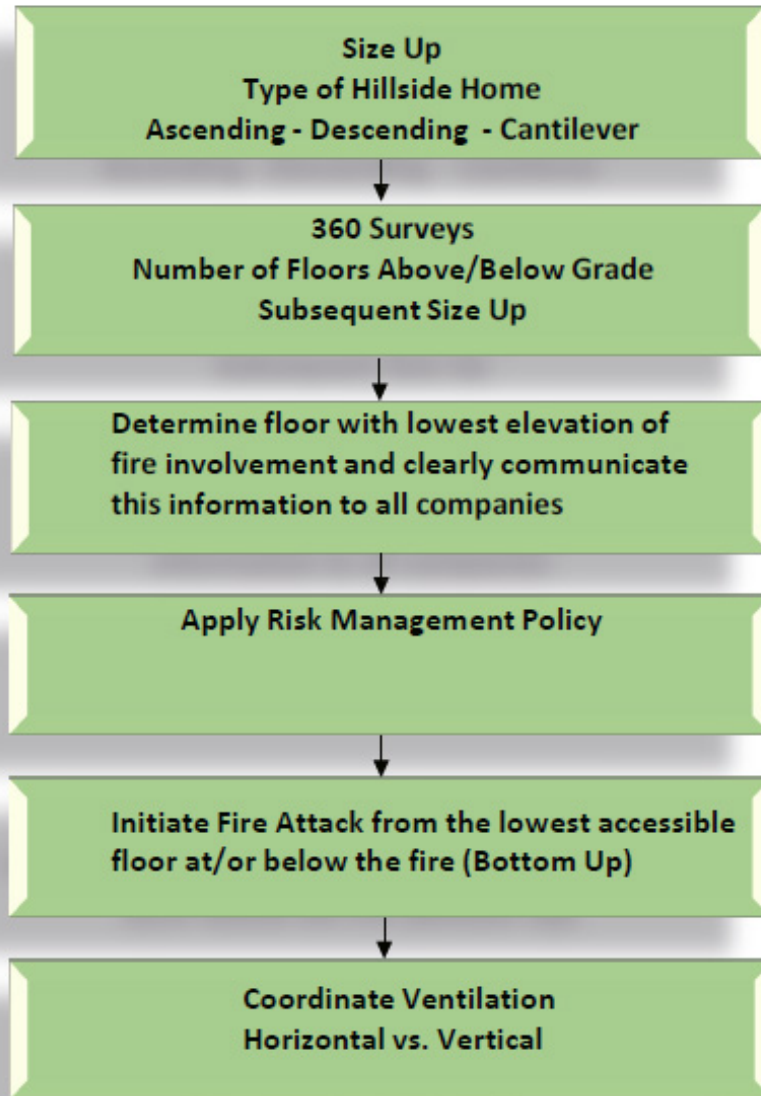
The three general categories of hillside homes all possess unique features that require fire personnel to identify them specifically before determining the correct strategy and tactics. When encountering fire in a multi-story hillside structure, firefighting operations must be initiated at or below the floor of origin whenever possible.

Understanding the effects of ventilation on fire behavior and the coordination of fire attack and vertical or horizontal ventilation is imperative in providing for firefighter safety. Being aware of additional considerations and tactical watch outs from lessons learned will help to ensure safe and effective fire ground operations.

Establishing clear and decisive command, and an appropriate span of control utilizing the Incident Command System along with developing a set of tactical priorities, will assist the Incident Commander with the tools necessary to effectively mitigate the incident.

Hillside structures will always pose significant challenges to firefighters. Training and pre-fire planning cannot be overemphasized. Consistent standard operating procedures and continual education is the key to safe, effective and successful navigation of hillside home structure fires.

Hillside Home Decision Process



Appendix A Quick Reference Guide

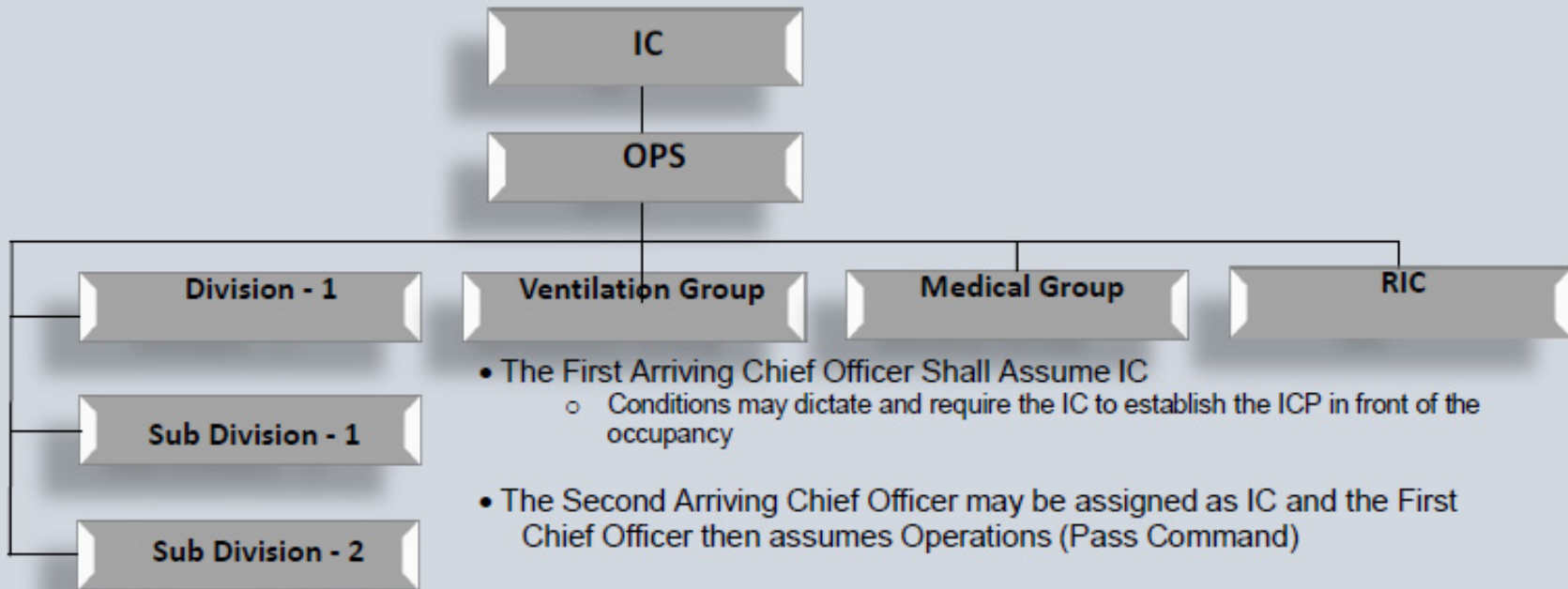


Descending



Cantilever

Command Considerations



- The First Arriving Chief Officer Shall Assume IC
 - Conditions may dictate and require the IC to establish the ICP in front of the occupancy
- The Second Arriving Chief Officer may be assigned as IC and the First Chief Officer then assumes Operations (Pass Command)
- Establish Division and/or Groups as needed
 - When two or more companies are working in a common geographic location – one of the officers shall be placed in charge
- Divisions on any sub-level building may be communicated in an abbreviated form as "Sub Division 1", "Sub Division 2" etc.
- Exposures and other external geographic areas of the building may be assigned as lettered divisions i.e. Division Alpha, Bravo etc.