



# 2019 Rooftop Access Training

March 18<sup>th</sup> , 2019

John Ingenito

# Overview



- Firematics & Operations
- Code Analysis: 2014 NYC Fire Code Sections FC504.4 & FC512
- Common Non-Compliant Installations and Solutions



PLEASE HOLD ALL QUESTIONS  
UNTIL THE END

THANK YOU

# Roof of the Fire Building



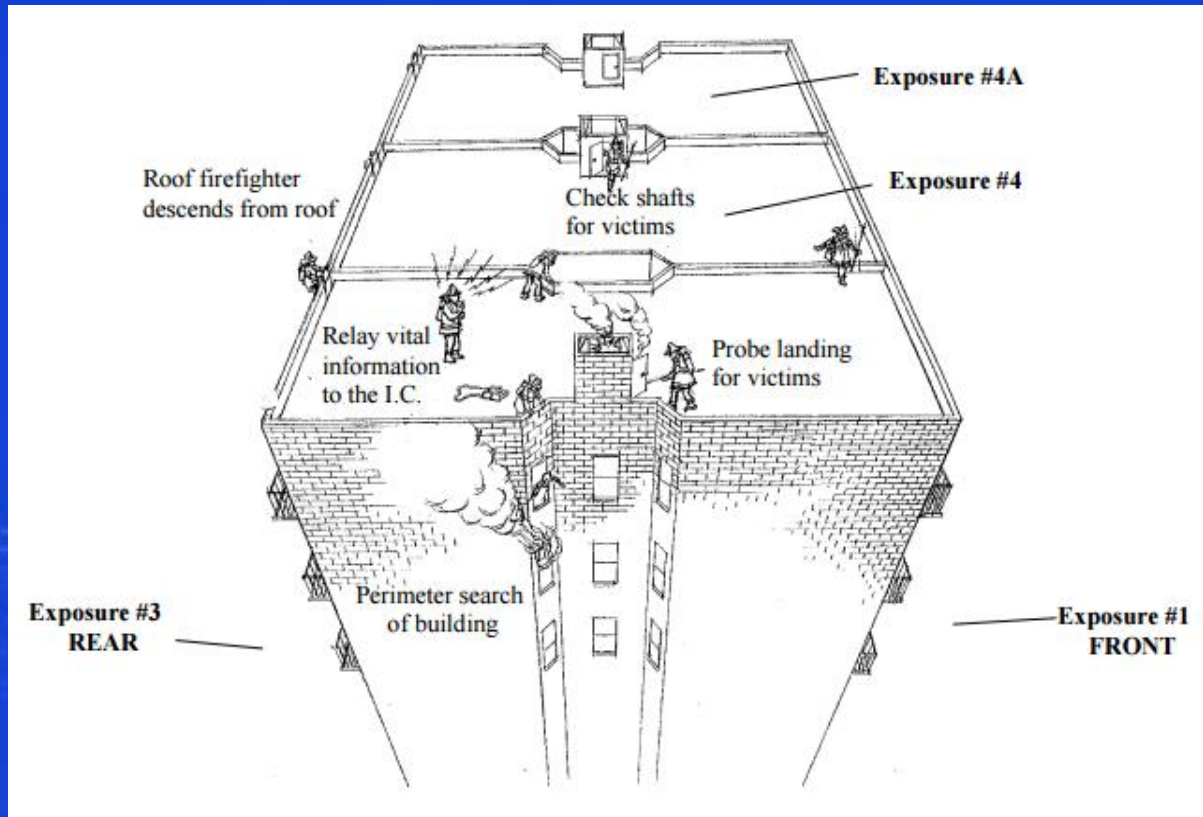
Nothing shall deter the member assigned the roof position from carrying out the assigned duties.







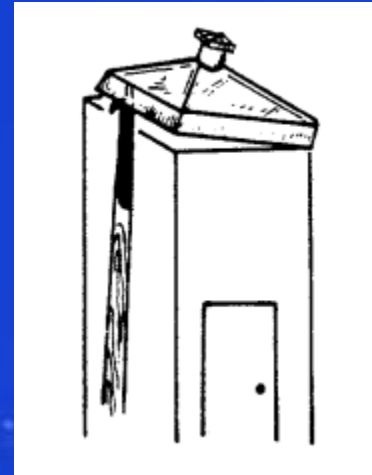
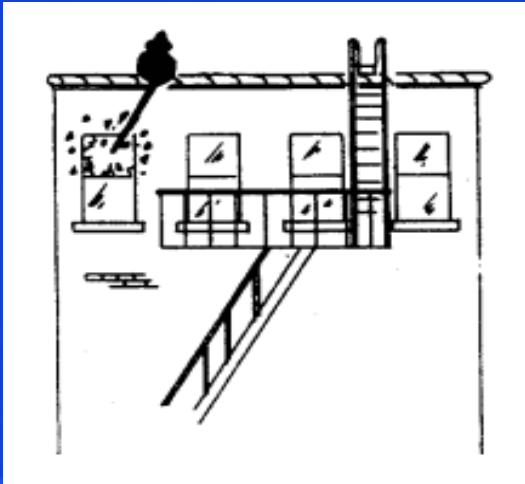
# Roof Position Requirements



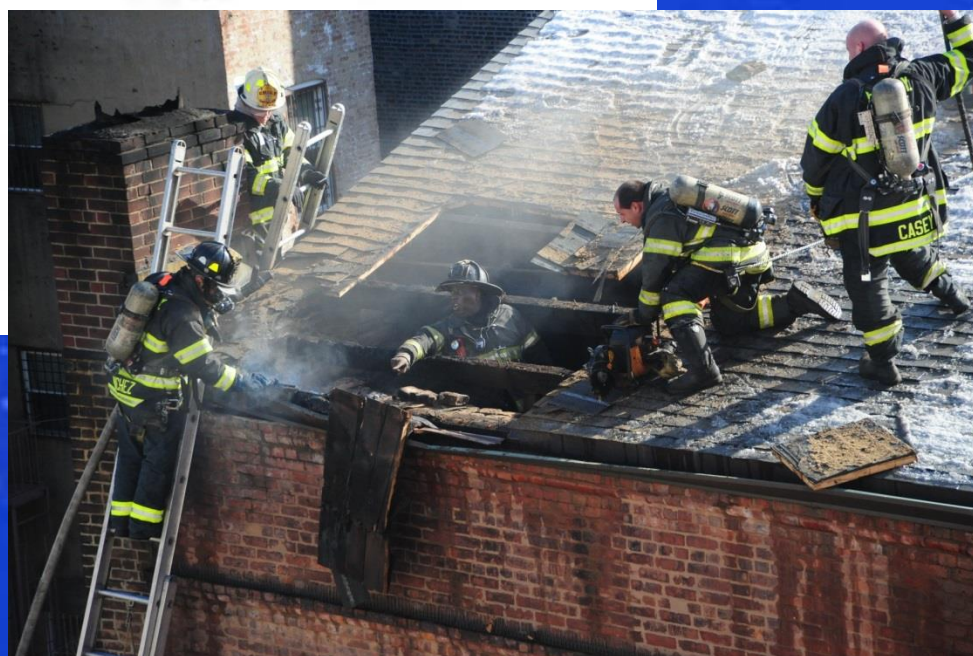
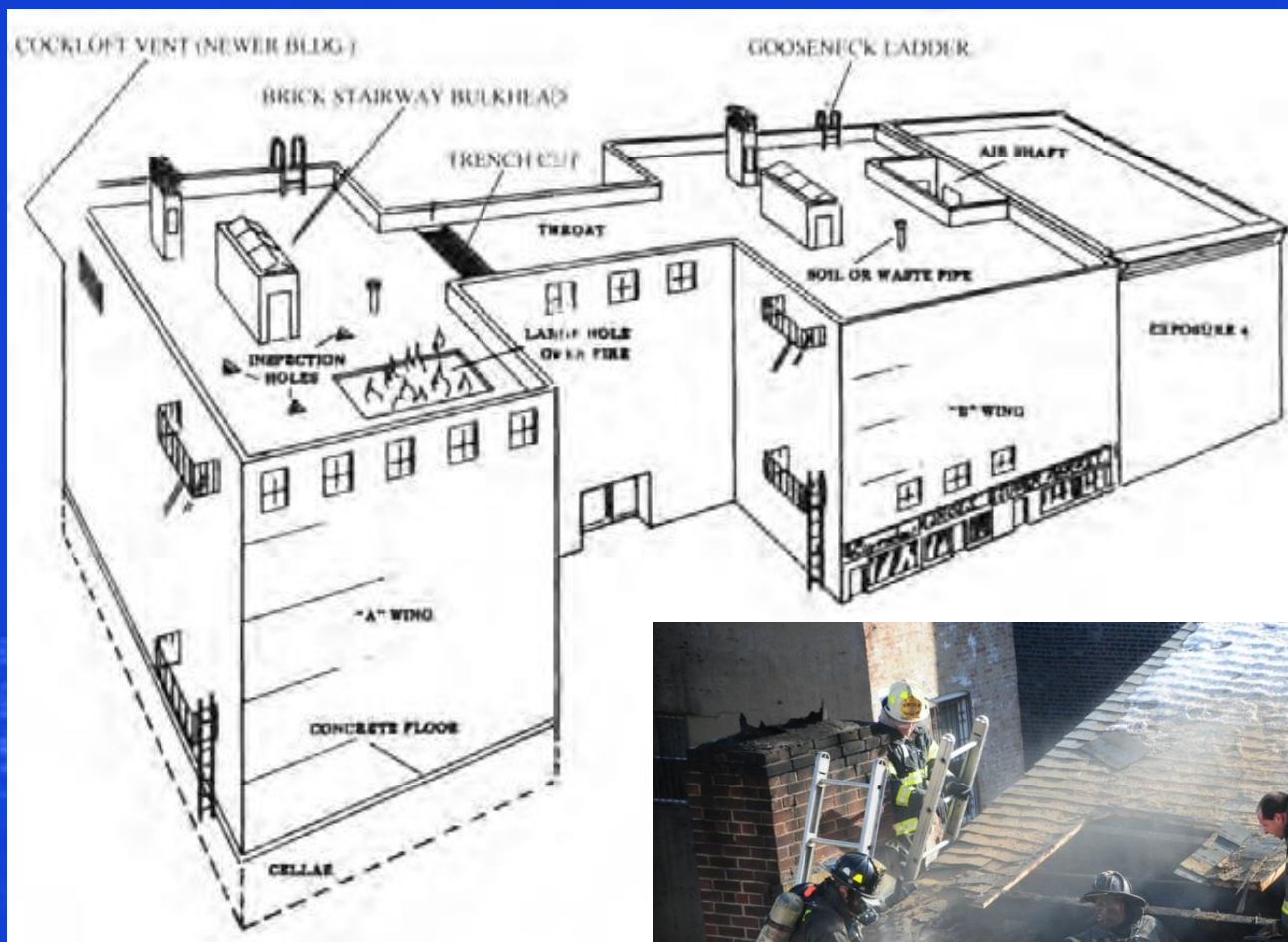
- A **perimeter search** shall include the sides, rear and shafts of the building.
- Transmitting **vital information** to the Incident Commander.



# Roof Position Requirements



- Roof **ventilation** is critical for search, rescue and extinguishment of the fire. Relieves the upper portions of the building of heat, smoke and gases, limiting horizontal spread.



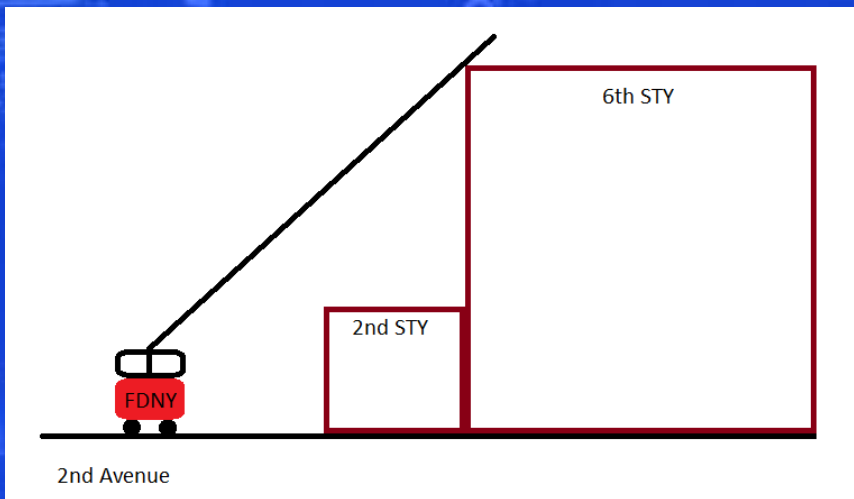


# Overview of FC504.4

## Rooftop Access and Obstructions



- 2014 Fire Code effective as of March 30<sup>th</sup>, 2014
- Buildings that are 100 feet or less in height and have a slope of 20 degrees or less
- Includes the rooftops of building setbacks

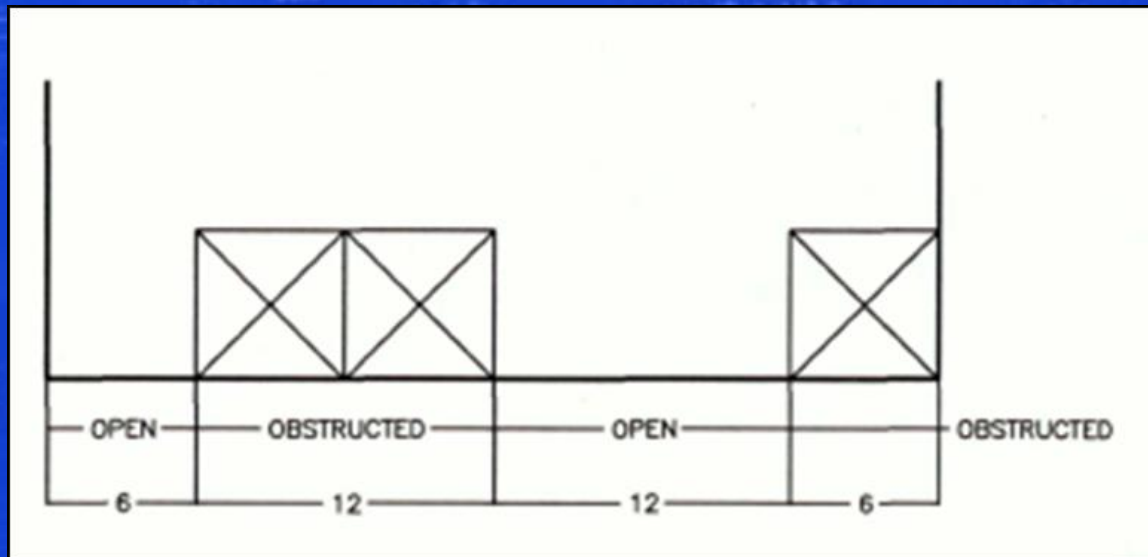






# FC504.4.1 Access Openings

- Every 12 FEET of frontage width requires 6 FEET open
- There can be NO MORE than 12 FEET of obstructed rooftop area between distinct openings
- Pattern depends on building size
- Only calculated for an apparatus accessible exposure
  - Includes side streets, parking lots and exposures where a truck can drive





## FC504.4.3

- Perimeter access location shall be a min. of 6' in each direction & connect to clear path
- Fence shall not obstruct access landing and shall provide access to clear path via gate.
- Gates
  - 3' wide, inward swinging
  - May be secured by padlock or chain
  - Able to be cut by standard bolt cutter

# Non-Compliant Fence







# Measurements

- Measurements from inside face of parapet wall
- Raised/Decorative Parapets: Indicate height of all segments



Sloped Parapets: “usable” rooftop space begins where slope meets flat portion of roof





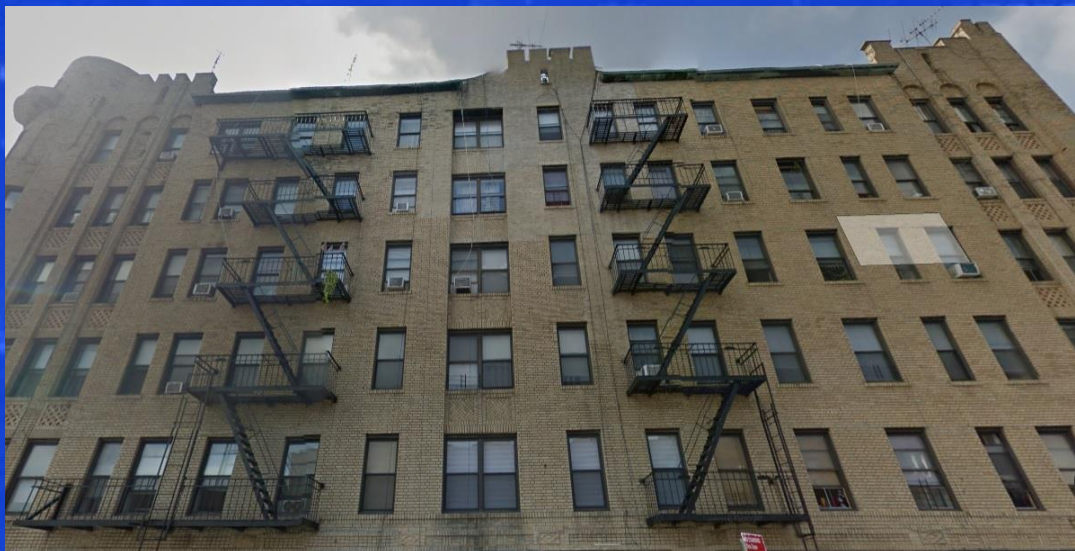


# FC504.4.1[5]



Structures affixed to an exterior building wall below the roof line shall not obstruct fire apparatus aerial ladder access to the rooftop perimeter access locations. Including but not limited to:

- Awnings
- Sun Control Devices
- Solar Panels
- Fire Escapes







# Scaffolding & Signage

- FC504.4.1[6]
  - Existing scaffolding modified to provide access onto rooftop
  - New scaffolding be designed to provide secure landings onto rooftop
- FC504.4.2
  - Rooftop access signs and markings  
TBD by Fire Department through plan examination



# Clear Path Summary

- FC504.4.4
  - Clear path is 6' wide & 9' tall
  - Traverses front to rear & side to side
  - Distinct clear path every 100 linear feet.
- FC504.4.4[1]
  - Clear path connects to access landings
- FC504.4.4[2]
  - Fire escape, bulkhead door, scuttles, skylights shall be accessible from clear path
  - 3' wide access around scuttles & skylights on 3 sides
- FC504.4.4[3] see FC504.4.7
- FC504.4.4[4]
  - Fences crossing clear path shall provide gate(s)

# FC504.4.6



- Required rooftop clearances
  - Roof door: 6' clear radius from hinge
  - Fire Escape & Roof Ladders: 3' clear radius from each side of the ladder or landing





## Code interpretation: Clearance for Scuttle and Skylight “to the maximum extent practicable”

### Summary of the guidelines:

For Rooftops constructed pursuant to plans approved by DOB or the FDNY on or before December 31, 2017 Scuttles and Skylights that do not have 3 feet of clearance on 3 sides will be considered to be in compliance with FC504.4 when clearance is limited by any parapet wall or Qualifying Encroachment :

- Attic ventilator
- Chimney
- Plumbing ventilation pipe
- Freestanding HVAC condenser with a capacity of 5 tons or more.
- Bulkhead
- Hatch
- Scuttle
- Skylight

Note: This does not mean that the Rooftop itself is in compliance with FC504.4. Upon alteration to the rooftop any other non compliant features, including obstructions to the required Scuttles and Skylights clearance that are not listed above, will trigger the requirement to file with the FDNY.

# Code interpretation: Clearance for Scuttle and Skylight “to the maximum extent practicable”



## Frequently Asked Question #37 of Chapter 5 of the Fire Code Guide

<http://www1.nyc.gov/assets/fdny/downloads/pdf/business/nyc-fire-code-guide.pdf>

The skylight and scuttle clearance requirement is intended to provide firefighters access to these building features to allow heat and smoke to be vented from the building during a fire. Such venting facilitates interior firefighting operations and helps control fire spread. Clearance in several directions affords firefighters the maneuverability they need to breach the skylight or open the scuttle, and allows firefighters to remain upwind of the heat and smoke that pours out once they accomplish this task.

By stating “to the maximum extent practicable,” the Fire Code recognizes that an owner’s ability to provide three feet of clearance around rooftop skylights and scuttles may be constrained by the layout of the rooftop. It would be impossible or impracticable to move parapet walls and other permanent building features that lie within three feet of a skylight or scuttle (including most building features termed “Qualifying Encroachments” in Frequently Asked Question #38 of Chapter 5 of the Fire Code Guide).

Accordingly, the Fire Department interprets the “maximum extent practicable” language of FC504.4.4(2) with respect to skylight/scuttle clearance as follows:

**A skylight or scuttle will be deemed in compliance with FC504.4.4(2), even though there is less than three feet of clearance on three of its sides, when:**

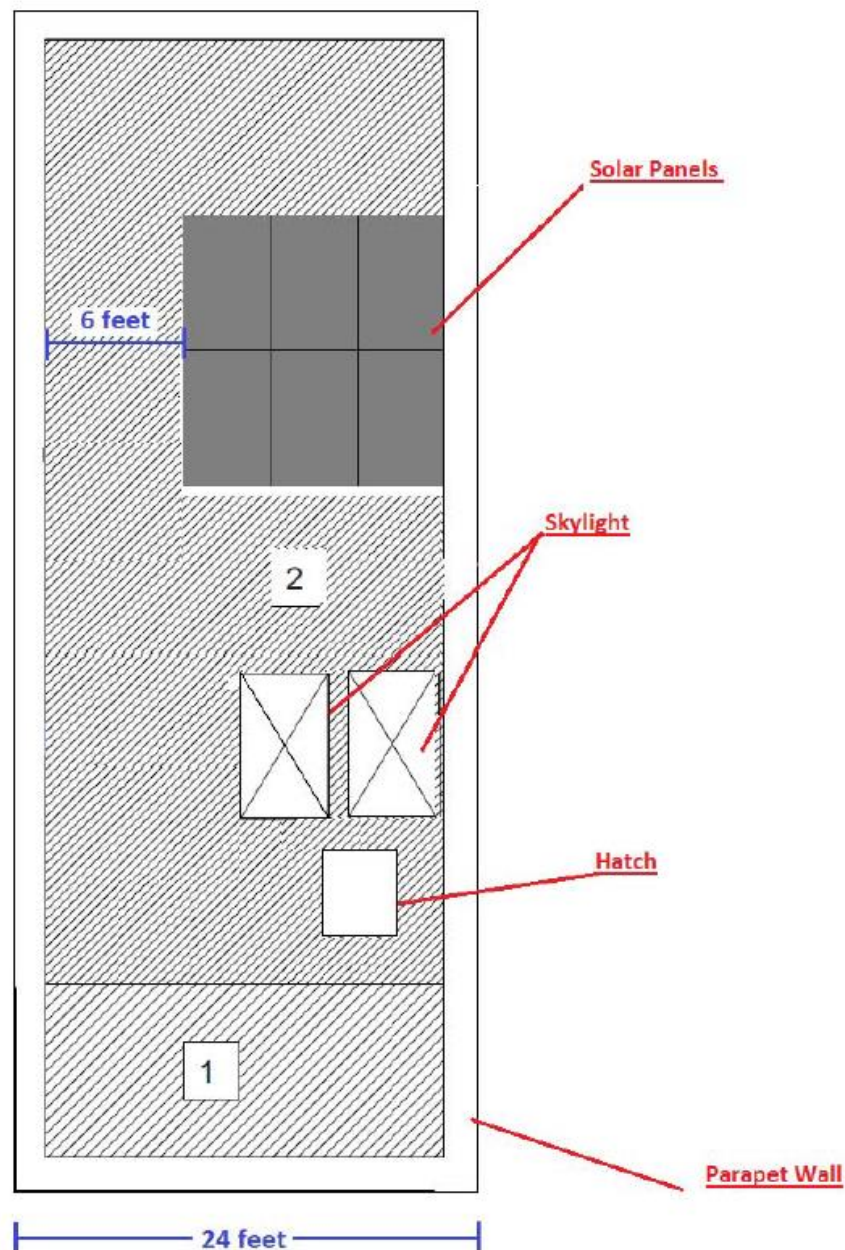
- 1.the rooftop was constructed pursuant to plans approved by the Department of Buildings or Fire Department on or before December 31, 2017; and**
- 2.the clearance is limited by any parapet wall or Qualifying Encroachment – attic ventilator, bulkhead, chimney, hatch, plumbing ventilation pipe, scuttle, skylight, or roof-mounted heating/air conditioning equipment (HVAC) – except a freestanding HVAC condenser with a capacity of 5 tons or less.**

A solar, telecommunications or other rooftop installation will not be disapproved by the Department of Buildings and/or the Fire Department based on the lack of the required skylight/scuttle clearance, provided it meets the foregoing guidelines.

Newly-designed and constructed buildings should provide such clearance or obtain a modification (variance) from the Fire Department in accordance with **FC104.8**. An applicant unable to comply with any other requirement of **FC504.4.4** also may request a modification.

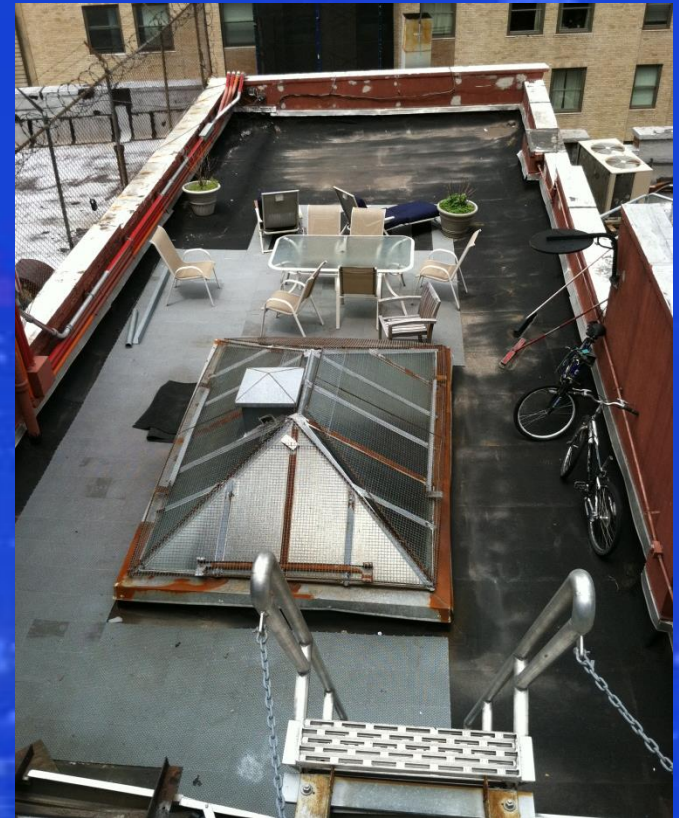


- 1 — UNOBSTRUCTED ROOFTOP ACCESS LOCATIONS AND LANDINGS
- 2 | CLEAR PATH CLEARANCES

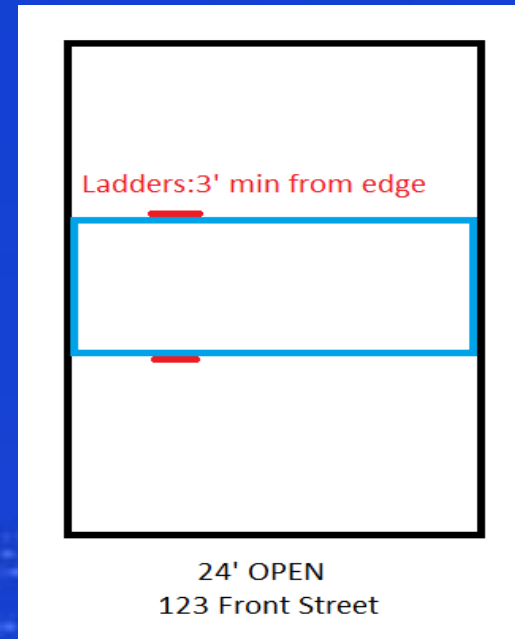




# Clearances



# Clear Path Summary Continued



- FC504.4.4[5], Multiple Roof Levels
  - 1 story difference and less than 16' difference (Ladders)
  - Exception: setback is less than 6' (No ladders)



## FC504.4.4[6]



- Irregular shaped buildings:
  - “H” shaped buildings (additional paths)



# FC504.4.5



## Rooftop clear path protection

Consists of 42" height  
(from roof surface )  
railing, parapet or barrier  
Provide for open shafts,  
building perimeter or  
unprotected elevation  
above rooftop

## Exception:

Height differentials of 6  
feet or less



# Obstructions





# FC504.4.7 & FC504.4.8



- Conduits and Piping FC504.4.7
  - Labeled as required
  - Greater than 12" ht or 24" width, non-combustible crossover
- Telecommunications Installations FC504.4.8
  - Transmitter labeling
  - Signage as required for antennas, powered equipment, and related equipment







# Rooftop Gardens

- FC504.4.9

- Shall not cause obstruction to required rooftop access, clear path, or rooftop door/fire escape clearances
- Vegetation shall not exceed 12" in height

- FC318.5 & Plumbing Code 429.1

- Hose connection to an approved water supply required for square footage exceeding 250 sq ft

# Green Roof



## FC504.4.10



- Rooftop solar installations shall be designed, installed, operated and maintained in accordance with FC512





# Overview of FC512 Rooftop Solar Panel Installations





# Summary of FC512

- Solar Panel on Flat Roofs shall comply with all requirements of FC504.4
  - **Exception to the clear path requirement:**
    - **Approved** hinged mechanism for **clear path** obstructed by solar panels, NEEDS FD Certificate of Approval, TM-2 App. (FC 512.2[1])
    - Acceptable encroachments on the **clear path** for narrow buildings, 25 feet or less (FC 512.2[2])

# Clarification of FC512.2[2]



## Summary of the guidelines:

FC512.2[2] allows for “Qualifying Encroachments” to encroach upon the clear path to a limited extent and under the following circumstances:

- 1.The building rooftop must be 25 feet or less in width and/or depth
- 2.The design of the solar panel installation necessitates substantial rooftop coverage
- 3.The encroachment does not reduce the width of the clear path beyond the amount approved by the Fire Department. [minimum width of 4 feet]
- 4.Qualifying Encroachments may not limit the perimeter access landing areas or any required rooftop clearances other than the clear path unless otherwise permitted under separate FDNY guidelines.
- 5.Proposed installation must be filed with DOB or the FDNY for full plan review.
  - Professional certification may not be used in lieu of plan review
- 6.Installation must comply with all other requirements of the fire code including those of FC504.4



# Clarification of FC512.2[2]



## Qualifying Encroachments :

- Attic ventilator
- Chimney
- Plumbing ventilation pipe
- Freestanding HVAC condenser with a capacity of 5 tons or more.
- Bulkhead
- Hatch
- Scuttle
- Skylight

Solar Panels are NOT considered to be a Qualifying Encroachment and may not limit the clear path

Pending code revision or rule promulgation, the Fire Department will implement FC512.2 by applying the following interim guidelines to rooftop clear path encroachments by permanent building features:



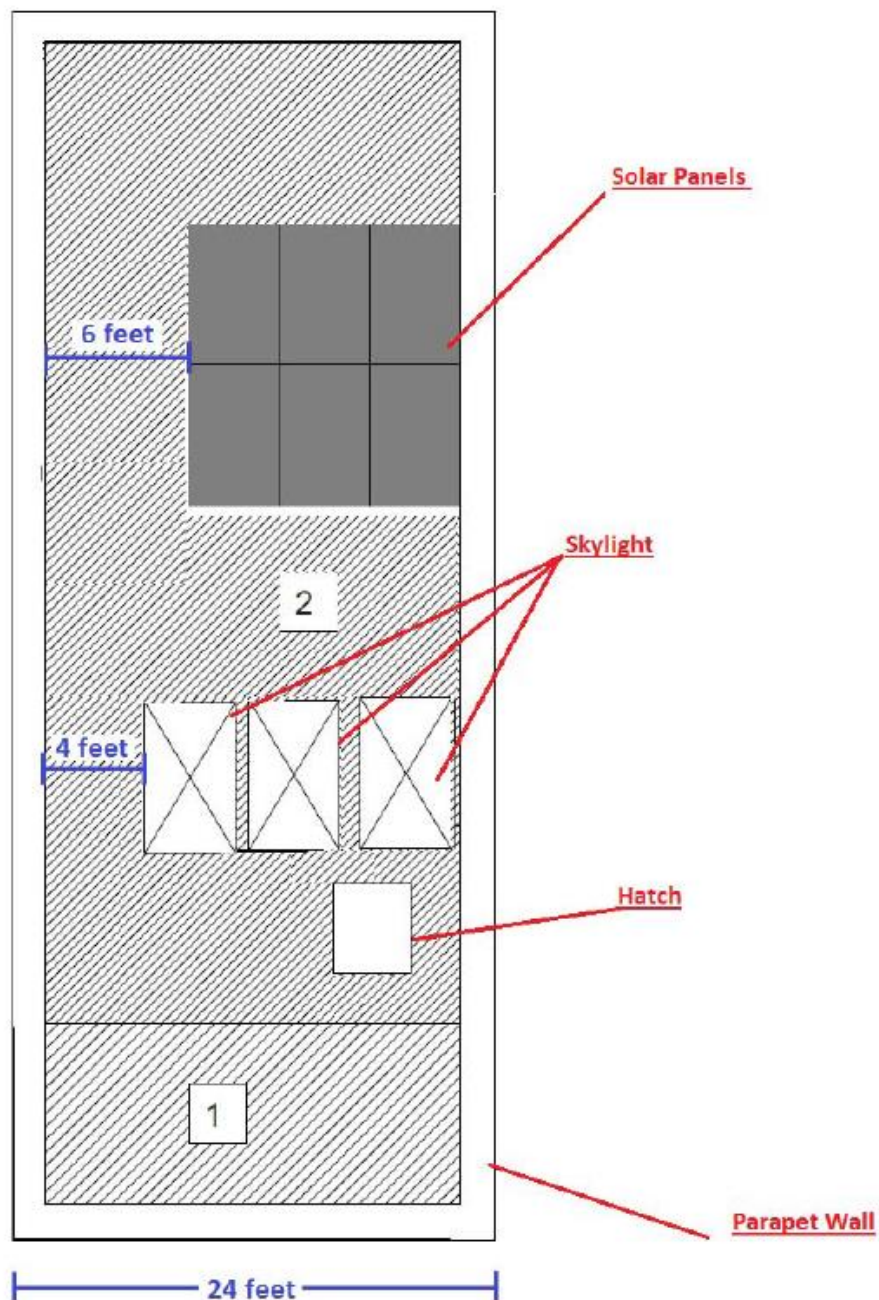
Frequently Asked Question #39 of Chapter 5 of the Fire Code Guide  
<http://www1.nyc.gov/assets/fdny/downloads/pdf/business/nyc-fire-code-guide.pdf>

1. The building rooftop has a width or depth of not more than 25 feet; and
2. The filed plans indicate (in a note or other approved manner) that encroachment on the clear path is necessary to accommodate the design of the solar installation, which requires coverage across all or substantially all of one or more of the rooftop dimensions; and
3. Only the following permanent obstructions ("Qualifying Encroachments") may encroach upon and thereby reduce the clear path width at one or more locations: attic ventilators; bulkheads; chimneys; hatches; plumbing ventilation pipes; scuttles; skylights; and roof-mounted heating, air conditioning equipment; and
4. The 6-foot rooftop clear path width required by **FC504.4** shall be provided and maintained across the rooftop in accordance with **FC504.4**, except that Qualifying Encroachments may encroach upon and reduce the width of such clear path up to 2 feet (24 inches). The Qualifying Encroachments are not limited in length or height, but shall not reduce the width of the clear path at any point to less than 4 feet (48 inches); and
5. The Qualifying Encroachments may not encroach upon the rooftop landing areas required by **FC504.4.3**, which shall be kept free of obstructions for the required six-foot by six-foot dimension; and
6. The rooftop solar panel installation is filed with the New York City Department of Buildings for full plan review in accordance with that agency's filing procedures (not under professional certification in lieu of plan review), or is filed with the Fire Department's Bureau of Fire Prevention for plan review in accordance with Fire Department filing procedures; and
7. The solar panel installation complies with all other Fire Code requirements, including all other requirements of **FC504.4**.

The Department of Buildings will approve a solar panel installation with Qualifying Encroachments in the clear path (and the Fire Department will approve a rooftop access plan with such encroachments) if the plan meets these guidelines.



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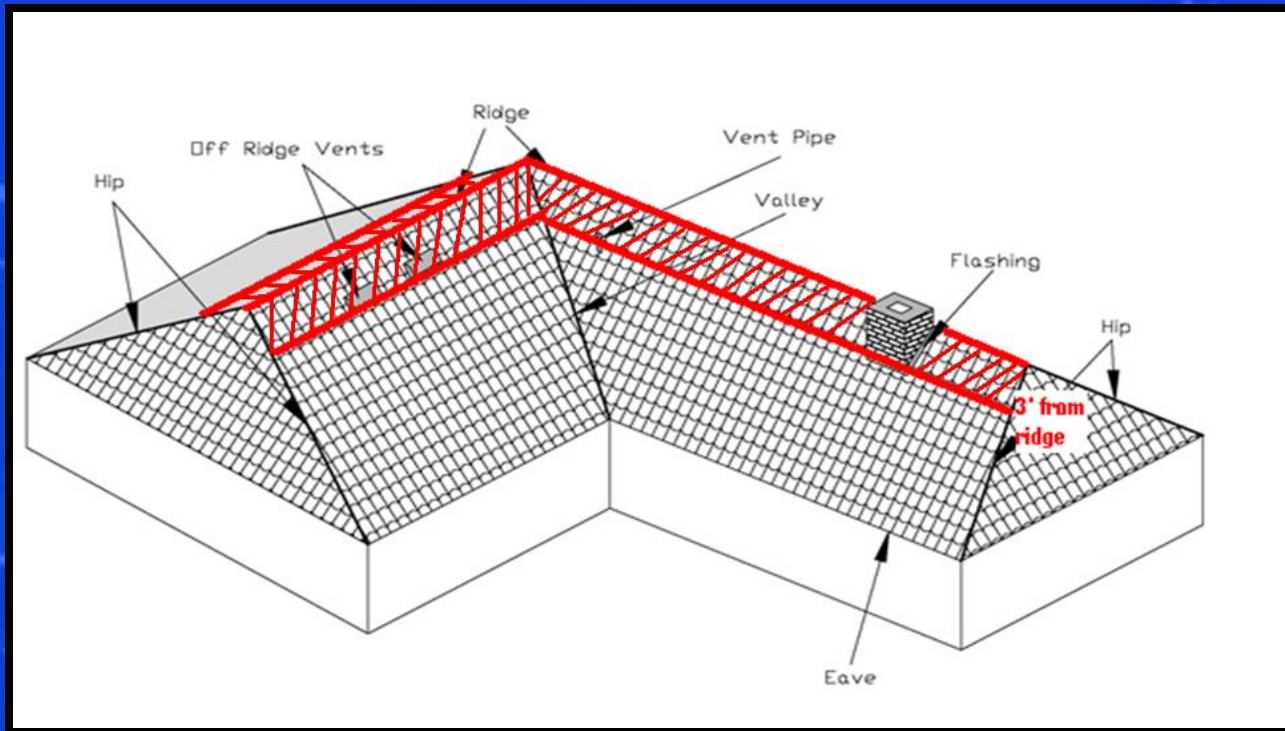






# FC512 Continued

- Solar Panels on Pitched Roofs, greater than 20°
  - Provide 3 feet of clearance along BOTH sides of the ridgeline of each roof (FC 512.3.1 & FC 512.3.2)





## Allowance for one or two family dwelling

Summary of the guidelines:

One or two family dwelling whose slope is 9.5 degrees or greater do not have to comply with the requirements FC504.4; these rooftops instead must comply with FC512.3. Specifically solar panels shall not be installed within 3 feet of both sides of any ridgeline.

Accordingly, pending code revision or promulgation of a rule, the Fire Department will interpret FC504.4 and FC512.3 in accordance with the following interim guidelines:



Frequently Asked Question #35 of Chapter 5 of the Fire Code Guide

<http://www1.nyc.gov/assets/fdny/downloads/pdf/business/nyc-fire-code-guide.pdf>

1. A one or two-family home with a shallow-pitched roof (a roof slope of not less than 2/12, or 9.5%) shall comply with FC512.3, not FC504.4.
2. A one or two family dwelling that is primarily a flat-roof building shall comply with FC504.4, even if a portion of the roof is shallow-pitched or has a pitch exceeding 20%. For example, a brownstone-type building shall comply with FC504.4, not FC512.3, notwithstanding it having a pitched roof element (such as a mansard) or a penthouse or bulkhead with a pitched roof.
3. A shallow-pitched or pitched portion of the building rooftop must be kept free of obstructions if it can be traversed to gain access onto, or across, the otherwise flat roof. Owners may request guidance from the Bureau of Fire Prevention as to the appropriate treatment of shallow-pitched or pitched portions of flat-roofed buildings.
- 4.3. This interim guideline shall not apply to shallow-pitched roofs on buildings other than one or two family dwellings (Occupancy Group R-3).





# FC512 Continued

- Location of Panels & Markings (FC 512.4)
  - Locate conduits along dips and valleys away from ridge line (peaked roofs)
  - Solar panel equipment shall be labeled:  
“WARNING: PHOTOVOLTAIC POWER SOURCE”  
in white capital letters no less than 3/8” in height  
on a red background

# Non-Compliant Solar Roof



# What requires an application?



Non-compliance, whether existing or proposed

- New equipment on a rooftop including: Cell Sites, Solar/PV Arrays, HVAC, Fencing
- Vertical Enlargements (penthouses, bulkheads, new floors)
- Accessory/Incidental use of roof: deck, bar, greenhouse
- Green Roofs, Blue Roofs



# What does not require an application?



- Rooftop work on buildings over 100' in height
- Ordinary repair and maintenance on roofs which includes but not limited to:
  - Reroofing
  - Repair parapet
  - Façade repair
  - Like for like replacement of equipment NOT upgrade of equipment

# To File An Application



- TM-5 Application
- \$420 plan examination fee
  - No new fee is required for resubmissions submitted within 6 months of the objection letter date.
- 11"x17" plans original seal & signature (3 sets)
- Narrative for scope of work
- Photographs of current conditions on rooftop

Submit at Window #8, 9 Metrotech Center, Brooklyn, NY 11201

[http://www.nyc.gov/html/fdny/pdf/fire\\_prevention/TM5.pdf](http://www.nyc.gov/html/fdny/pdf/fire_prevention/TM5.pdf)



NEW YORK CITY FIRE DEPARTMENT  
BUREAU OF FIRE PREVENTION

TM-5, rev 07/15

9 METROTECH CENTER, BROOKLYN, NY 11201-3857

TM-5: APPLICATION FOR ROOFTOP ACCESS VARIANCE/PLAN REVIEW

- FDNY TM-5 must be typewritten, submitted with supporting documentation including a narrative (see Item 8 below), signed and sealed 11"X17" plan set for review, and photographs of the existing/proposed conditions on the rooftop.
- Section 11 must be signed by the owner.
- Fee for Plan Examination: \$420 made in money order or check, payable to NYC Fire Department.
- Submit completed application in person at Window #8 on the first floor of FDNY Headquarters, 9 METROTECH CENTER, BROOKLYN, NY 11201-3857.
- Consult the [FDNY Technology Management Bulletin #2/2011](#) for specific plan preparation instructions.

1	<b>Filing Status</b> (required for all applications):			
Variance Sought for: <input type="checkbox"/> Proposed and/or <input type="checkbox"/> Existing Condition(s)				
<input type="checkbox"/> Initial Filing <input type="checkbox"/> Resubmission (provide previously assigned FPIMS number, and attach copy of objection letter): FPIMS No(s):				
2	<b>Premises Information</b> (required for all applications):			
House No(s):		Street Name:		
Borough:		ZIP:	Block:	Lot:
BIN:		Affected Floors:		
3	<b>Applicant Information</b> (required for all applications):			
Last Name:		First Name:	Middle Initial:	
Business Name:		Business Tel:		
Business Address:		City:	State:	ZIP:
E-Mail:		License No:		
Choose One: <input type="checkbox"/> P.E. <input type="checkbox"/> R.A.				
4	<b>Owner Information</b> (required for all applications):			
Last Name:		First Name:	Middle Initial:	
Business Name:		Business Tel:		
Business Address:		City:	State:	ZIP:
E-Mail:		Mobile Tel:		
5	<b>Filing Representative</b> (if applicable):			
Last Name:		First Name:	Middle Initial:	
Business Name:		Business Tel:		
Business Address:		City:	State:	ZIP:
E-Mail:		Expeditor Registration No:		







<b>6 Job Type</b> <i>(required for all applications, choose all that apply):</i>	
<input type="checkbox"/> Telecommunications Antennas and/or Equipment <i>Company Name:</i> _____ <input type="checkbox"/> Solar Array and/or Equipment <i>Size of Array (No. of Panels):</i> _____ <input type="checkbox"/> HVAC/MEP Equipment <input type="checkbox"/> Green Roof/ Blue Roof	<input type="checkbox"/> Penthouse/New Floor(s) <i>Number of Floors(if applicable):</i> _____ <input type="checkbox"/> Occupiable Rooftop <input type="checkbox"/> Rooftop Deck <input type="checkbox"/> Rooftop Restaurant/Bar <input type="checkbox"/> Other <i>(if needed):</i> _____

<b>7 DOB Filing Status</b> <i>(required for all applications):</i>	
Filed with DOB? <input type="checkbox"/> NO <input type="checkbox"/> YES   ▶ <input type="checkbox"/> Copy of PW-1, Schedule A and Certificate of Occupancy attached?	
<i>(If yes above):</i> DOB Application No(s): _____	

<b>8 Nature of Modification</b> <i>(required for all applications):</i>			
<i>Compose a narrative description that addresses items 8a and 8b. Append the separate narrative to your submission packet.</i>			
<b>8a</b> Explain, in detail, the specific nature of the modification sought, and describe the difficulty in complying with the requirements of the Fire Code or Fire Department Rule(s).			
<b>8b</b> Explain, in detail, how you propose to mitigate the effect of modifying the code or rule requirement. Include all measures intended to ensure public safety.			
<b>8c</b> Previously filed FDNY Variance Application(s) for the aforementioned prop erty. Indicate either FPIMS No(s) or FPIN(s), and status of filing (granted/objections/denied):			
<b>8d</b> Application submitted in response to an FDNY-issued violation, specifically for Rooftop Access/Obstructions? <input type="checkbox"/> NO <input type="checkbox"/> YES: (if yes, complete below the fields below) ▼			
NOV/VO/Summons	Number	Description	Disposition

<b>9 Building Characteristics and Fire Protection Features</b> <i>(required for all applications):</i>			
Occupancy Classification: _____	Building Height (ft): _____	<input type="checkbox"/> Fully Sprinklered <input type="checkbox"/> Partially Sprinklered <input type="checkbox"/> Non-Sprinklered <input type="checkbox"/> Standpipe <input type="checkbox"/> Fire Alarm	
Construction Classification: _____	Building Stories (No): _____	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO	
Construction Date: _____	Stairs Leading to Roof (No): _____	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO	
	Fire Escape(s) to Roof?	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO	
	Interior/Exterior Stair to Roof?	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO	

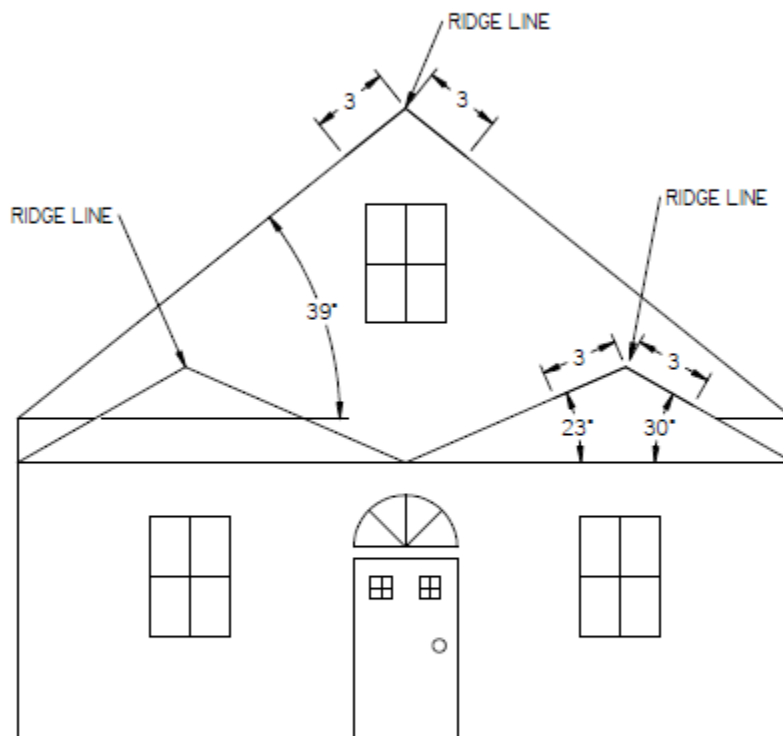
<b>10 Applicant Certification</b> <i>(required for all applications):</i>	
Under penalty of perjury, I certify that the information contained in this application is true, to the best of my knowledge.	
Applicant Name (please print): _____	
Signature ▶ _____	Date: _____

<b>11 Owner Statement</b> <i>(required for all applications, must be signed by owner):</i>	
I have authorized the applicant to file this modification with respect to the premises.	
Owner Name (please print): _____	
Signature ▶ _____	Date: _____



- Entire rooftop, not only area of work proposed
- Label all existing building features
- Label all proposed work as “Proposed”
- Label all apparatus accessible exposures including parking lots
- Demonstrating compliance, showing required clearances
- State areas of non-compliance
- Proposed mitigation for non-compliance
- **All submitted plans must have an original signature and PE/RA stamp**

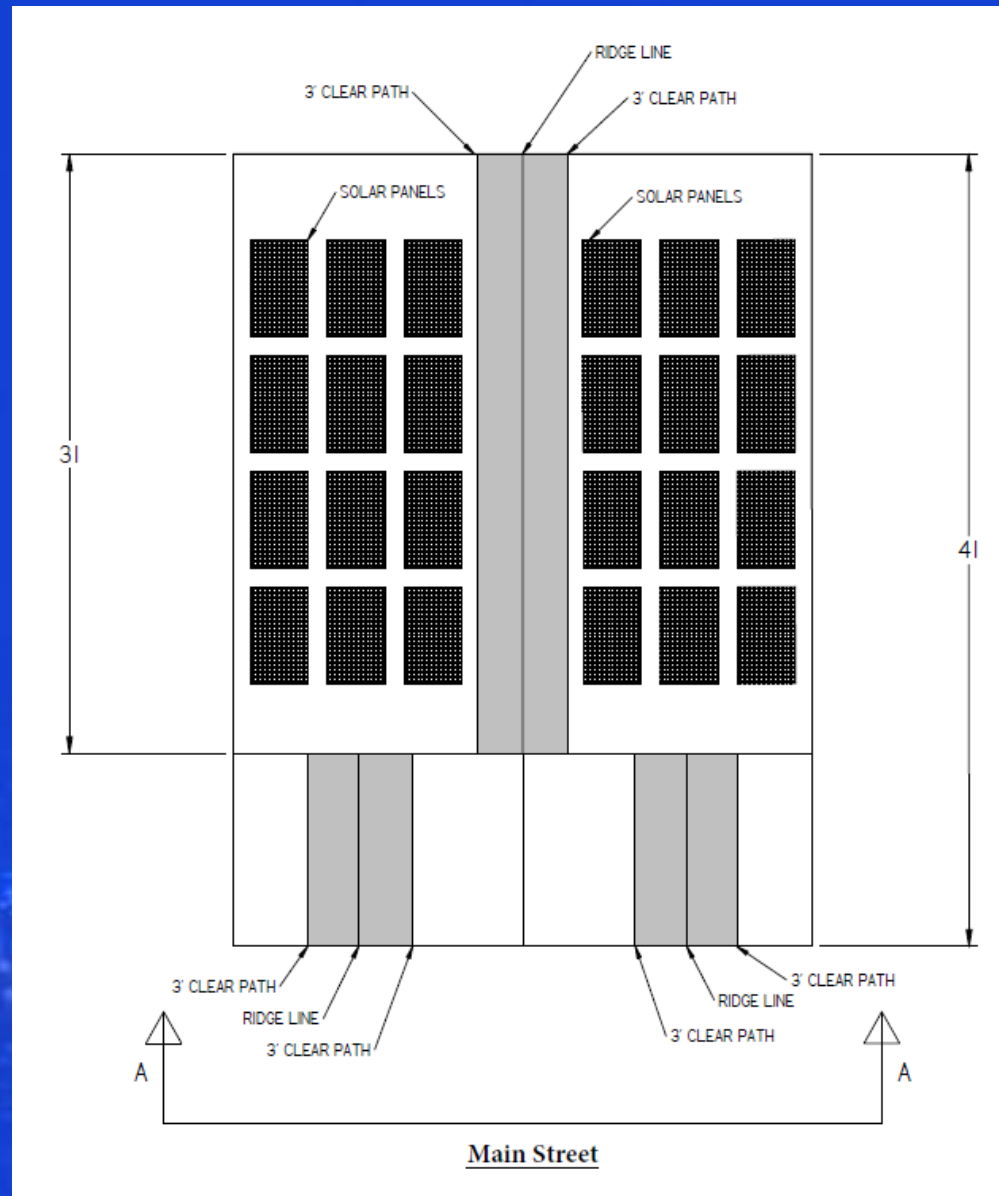
# Sample Plan – Pitched Roof



VIEW A-A



# Sample Plan – Pitched Roof





# Reference material to determine Fire Code Compliance and prepare TM-5 Application:

- Fire Code – Section FC504 and Section FC512: in the NYC Fire Code, specifically regarding rooftop access and clear path.
- New York City Fire Code Guide (Formerly FAQs): posted on the Fire Department's web site in response to many of the industry's questions.
- Office of Technology Management Bulletin #2/2011 (Rev. 4/2016): This is a guidance document for the convenience of the public. It does not substitute for any applicable laws, rules or regulations.

# Unit Contact Information



- Rooftop Access Unit Hotline: 718-999-1648
- Chief of Technology Management: Chief Thomas Pigott
- Supervisor of Rooftop Access Unit: Winnie Lei, P.E.
- Plan Examiners: John Ingenito, Fares Rezk, Gennadiy Lak and Erik Perez.
- FDNY Website (for bulletin and application)
- Mailing Address: Rooftop Access Unit, Tech MGMT, Room 3W-2, 9 MetroTech Center, Brooklyn, NY 11201-3857





# Resilient Solar (Solar + Battery Storage)

## FDNY Filing Procedures

March 18<sup>th</sup>, 2019

Nicholas Petrakis, P.E.

# Resilient Solar (Solar + Storage)



CUNY in conjunction with FDNY has drafted permitting process guidelines for Valve-Regulated Lead Acid (VRLA) and Outdoor Lithium Ion (available online)

Other chemistries will follow similar procedure, but pertinent information will vary based on technology

Each application evaluated on site by site basis



# Information and supporting Documentation



- Things that need to be taken into account
  - Size (what's needed and what hazards that would pose)
  - All nearby exposures
  - Gas Hazards (Toxicity and Deflagration)
  - Fire Protection Systems
    - FDNY connections?
    - FDNY response? (clean agent and water)
  - Certificate of Fitness Holder and SME
  - Emergency Response
    - Shutdown
    - Emergency signals
    - Actual emergencies
  - Vehicles
  - Disposal



# Filing An Application

(can be submitted in parallel with DOB)



- TM-1 Application
- \$420 examination fee
- Plans Showing Proposed Location
- Narrative for scope of work
- Cut-sheets of system components
- Installation manuals
- UL Listings
- Other pertinent information



# Types of Applications

- Outdoors
  - VRLA, Li-ion, flow batteries, etc.
  - Outdoor cells, cabinets and containers
- Indoors
  - VRLA and Lead Acid only





# Review Process

1. Applicant submits all required paperwork
2. Once submitted, the application will be reviewed by FDNY
3. FDNY will contact the applicant to set up a joint site visit, conducted by Tech-Management and HazMat
4. FDNY will notify applicant of decision; if approved, a Letter of No Objection will be issued

Approval shall be obtained from NYC Department of Buildings (DOB) and all other agencies having jurisdiction



# Information and supporting Documentation



**These requirements are subject to change**

## Building Information

- Building Construction type (Non-Combustible)
- Building Use and Occupancy
- Description of where ESS will be located (indoor, outdoor etc.)
- Use of proposed ESS location (parking garage, etc.)
- Available FDNY access to ESS
- Description of Ventilation system for entire building and in direct vicinity of proposed ESS location

# Information and supporting Documentation



## Building Fire Protection Systems

- Description of water based suppression system, and for location of ESS (may require additional protection depending on technology)
- Standpipe hose outlet locations in close proximity to installation
- Emergency exit locations
- Fire hydrant locations



# Information and supporting Documentation



## ESS Description

- System size (kWh and KW)
- Applicable product standards met
- Battery specific:
  - Number of Batteries
  - Chemistry
  - Voltage
  - UL Listings (UL 1973, UL 9540 etc.)
  - Cascading Protection



# Information and supporting Documentation



- Battery Encasement:
  - Number and type of racks
  - Cabinet information (if provided)
  - Ventilation for off gassing (if required)
- Inverter:
  - Size
  - Type
  - UL Listing
  - Monitors for: over current, over temperature, etc.



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# Information and supporting Documentation



- Battery Management System (BMS):
  - Description of system
  - Monitors for: battery voltages, temperatures, current, etc.
- Safety measures:
  - Additional safety monitors not captured in the system description
    - Ex. Hydrogen sensors, ground fault protection, etc.
  - Sequence of events if malfunction happens at battery or system level
    - Explain how software detects malfunctions
  - Arc Fault Protection As per NEC 2014

# Information and supporting Documentation



- Process to shut down system
  - Rapid Shutdown As per NEC 2014
  - Location of Rapid Shutdown Switch
  - Use of software to shut down
  - List who has access to these systems
  - Specify any existing dangers
    - Ex. Isolation of the system does not remove any charge present in the batteries.
- Commissioning and De-commissioning plan



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# Unit Contact Information



- Director of Technology Management: Tamara Saakian, P.E.
- Administrative Project Manager : Leo Subbarao
- HazMat: Chief Richard Schlueck  
Lieutenant Mark Becker
- Associate Project Manager : Nicholas Petrakis, P.E.
- Engineers: Eric Nette, P.E.  
Yusef Esa  
Ratan Roy, P.E.  
Alexander Banc
- Tech Management Hotline: (718) 999 2405

Mailing Address: Fire Department of City of New York  
Bureau of Fire Prevention  
Technology Management  
9 MetroTech Center, Third Floor, Room 3W-2  
Brooklyn, NY 11201-3857