FAÇADE INSPECTIONS AND THE POTENTIAL USE OF DRONES

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NYC Buildings

presented by

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PRESENTATION OVERVIEW

The Department of Buildings (DOB) was tasked by Local Law 102 of 2020 to study the safety and feasibility of permitting building façade inspections to be conducted by unmanned aircraft systems (i.e. drones), in conjunction with hands-on inspections. This training will present DOB's report and its findings.

Drones, and other technologies, are potential tools design professionals and contractors working in façade inspections and repairs can use. As part of this report, DOB researched various aspects of drone use, including, but not limited to, the following:

- Federal, State or local laws regarding drone use;
- public safety, specifically pedestrian safety;

PRESENTATION OVERVIEW

- reducing the use of sidewalk sheds and scaffolding citywide;
- privacy issues such as surveillance, data security and data retention;
- identifying obstacles that would limit or prohibit drone use in façade inspections;
- additional technologies that could increase façade safety.

DOB's report outlines the current rules and regulations in place for façade inspections and how potential drone use could be integrated into the existing framework.

TAKEAWAYS

1. Viewers will review the background for façade inspections required for buildings subject to the Façade Inspection Safety Program (FISP).
2. Viewers will analyze current commercial drone use, learn about current regulations on drone operations and study and discuss potential issues around drone use in the City.
3. Viewers will assess how drones could be used effectively in a FISP inspection campaign.
4. Viewers will learn about alternate technologies that may also assist in façade inspections.

OUTLINE

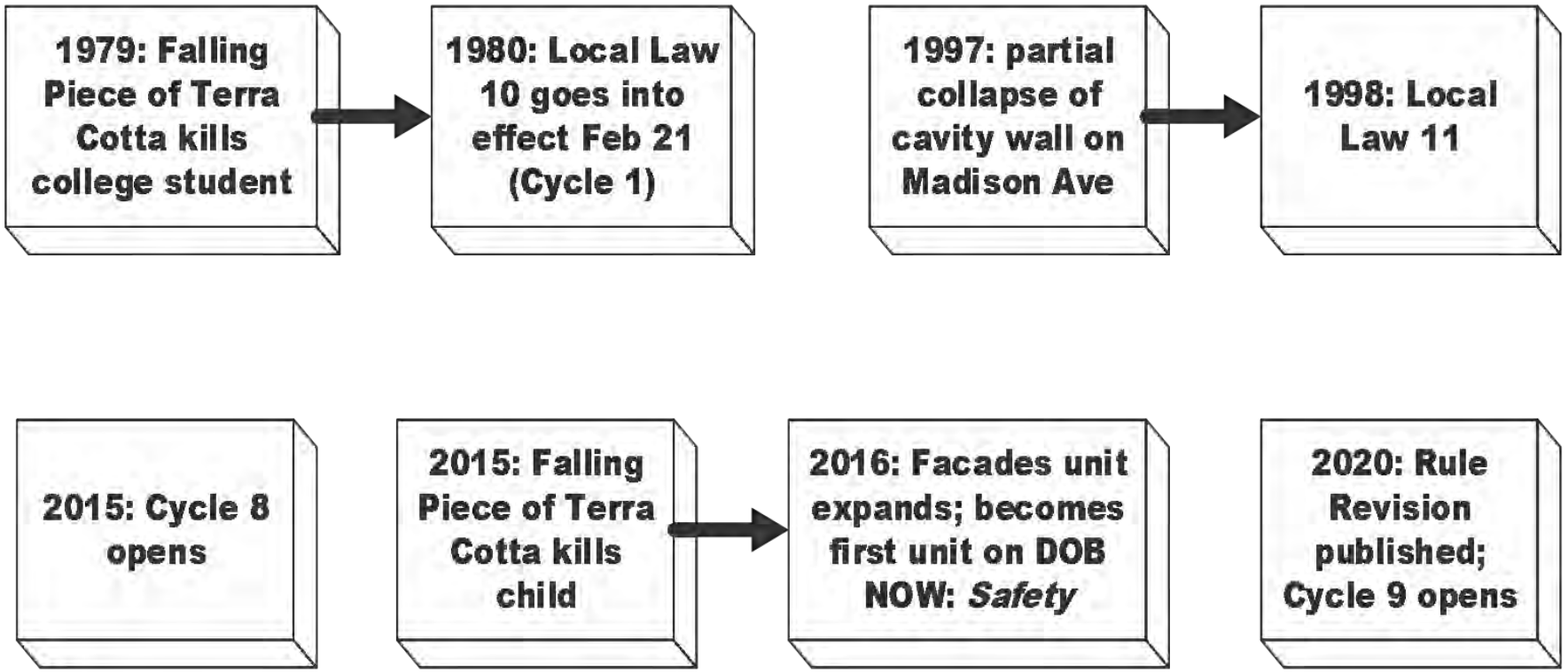
- Introduction
- Where We Are Today
  - Background of Facade Inspection & Safety Program
  - Drones as Tools: History & Use
- Current Landscape for Drone Use
  - Laws and Regulations on Drone Use (Federal, State and Local)
  - Comparison with Other Jurisdictions
- What Could We Expect?
  - Drones in Society: Current Use, Data and Security Obstacles; Economic Benefits; Pedestrian Safety and Sidewalk Sheds
  - Developing Tools: Other Technologies

TERMINOLOGY

- FISP: Façade inspection safety program. A program administered by DOB requiring owners of buildings higher than six (6) stories to have exterior walls and appurtenances inspected every five (5) years and a technical façade report electronically filed with DOB through DOB NOW: *Safety*.
- QEWI: A qualified exterior wall inspector (QEWI) as defined in section 101-07 of the rules of the Department.
- UAS/drone: Unmanned Aircraft System, an unmanned aircraft and associated elements (including communication links and the components that control the unmanned aircraft) that are required for the pilot in command to operate safely and efficiently in the national airspace system. Also known as drones.


WHERE WE ARE TODAY

TIMELINE OF DEVELOPMENT OF FISP/LL



CURRENT FISP INSPECTION PROCEDURES/MINIMUM REQUIREMENTS

- Any building greater than 6 stories
- Minimum requirements detailed in RCNY 103-04
- File every 5 years as safe, unsafe or SWARMP
- Critical examination = visual inspection
- Physical Examination = close-up inspection ('hands on')
  - See defects not able to be seen from ground
  - 'Sound' the building façade
  - Remove unsafe conditions
  - Probes

MAIN POINTS OF RCNY 103-04
THE FAÇADES RULE

- Owner must retain QEWI every 5 years
- QEWI responsible for inspection program
- Close up inspection not more than 60' intervals on facades fronting a public ROW
- Probes at cavity walls
- Photo documentation/mapping
- File report on DOB NOW: *Safety*

NYC ADMINISTRATIVE CODE §28–301.1 MAINTENANCE OF BUILDINGS: SAFE

CHAPTER 3

MAINTENANCE OF BUILDINGS

ARTICLE 301
GENERAL

§28-301.1 Owner's responsibilities. All buildings and all parts thereof and all other structures shall be maintained in a safe condition. All service equipment, means of egress, materials, devices, and safeguards that are required in a building by the provisions of this code, the 1968 building code or other applicable laws or rules, or that were required by law when the building was erected, altered, or repaired, shall be maintained in good working condition. Whenever persons engaged in building operations have reason to believe in the course of such operations that any building or other structure is dangerous or unsafe, such person shall forthwith report such belief in writing to the department. The owner shall be responsible at all times to maintain the building and its facilities and all other structures regulated by this code in a safe and code-compliant manner and shall comply with the inspection and maintenance requirements of this chapter.

§28-301.2 Filing of reports in writing or electronically. Reports required to be filed under this chapter shall be filed in writing or electronically as the commissioner may require.

CURRENT FAÇADE INSPECTIONS

PHOTO #1: North & West Façades
PHOTO DATE: 3/3/2021

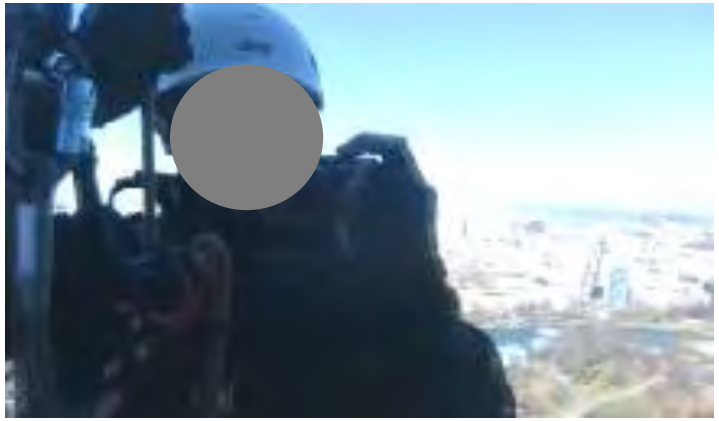
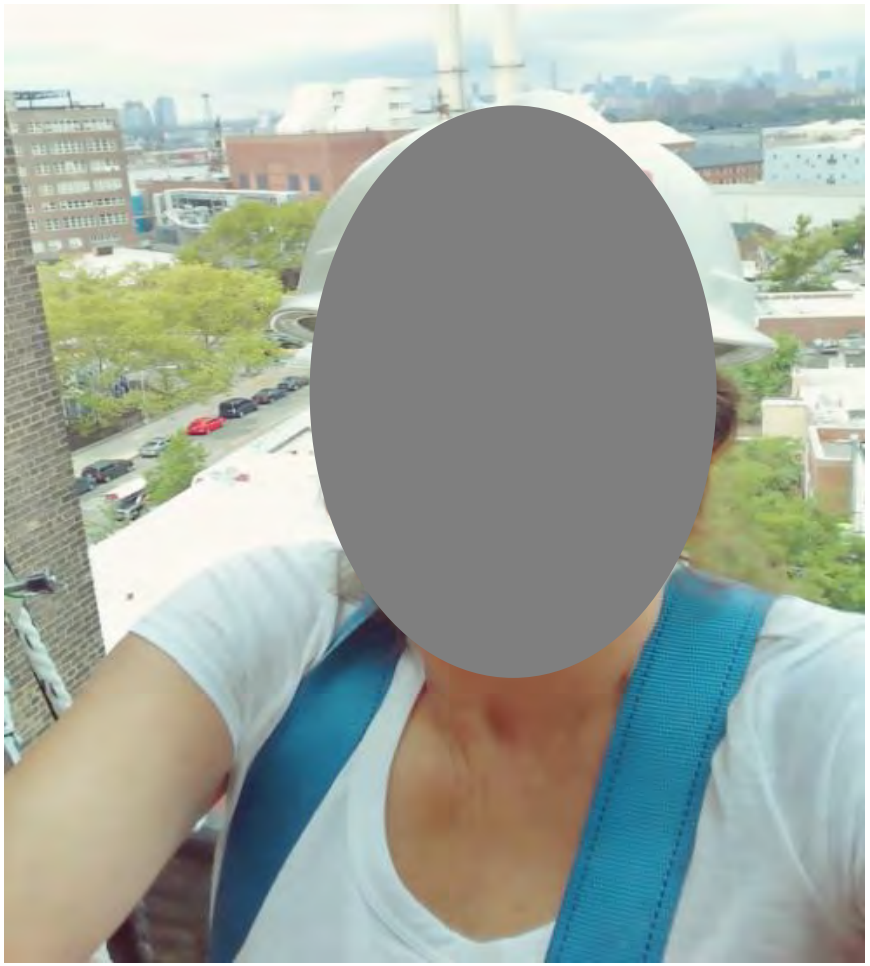


PHOTO #2: West Façade
PHOTO DATE: 3/3/2021



DRONE FOR FAÇADE INSPECTIONS

SOURCE: https://balmoreuav.co.uk/aerial-inspection-benefits/

SOURCE: https://www.nydailynews.com/resizer/lZA5ttRYnmSSKZDZjeXYz5lhXyk=/415x269/top/arc-anglerfish-arc2-prod-tronc.s3.amazonaws.com/public/LZI5EP77SFAHTJF2C5R3KENPCA.jpg

HISTORY OF DRONES

SOURCE: https://www.economist.com/technology-quarterly/2017-06-08/civilian-drones

- Originally developed for military use
  - de Havilland DH82B Queen Bee inspired *drones*
- Rapid computing growth and consumer electronics sparked hobbyist use
- Commercial applications

DESIGN OF DRONES

Fixed Wing

SOURCE: U.S. Navy photo Lt. Jessica Crownover - This image was released by the United States Navy with the ID 140606-N-IQ177-002

Multi-rotor

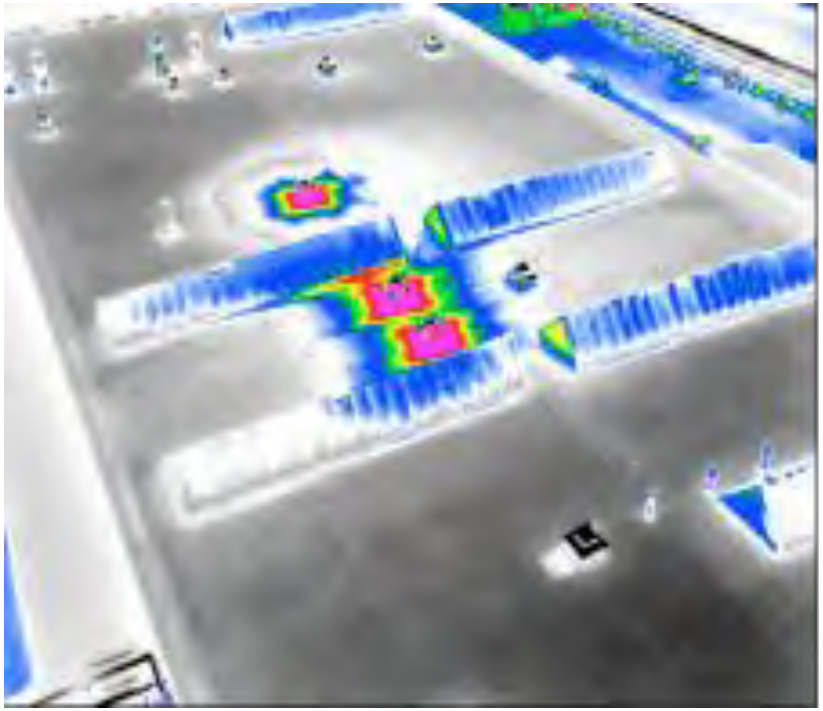
SOURCE: https://www.dji.com/phantom-4-pro

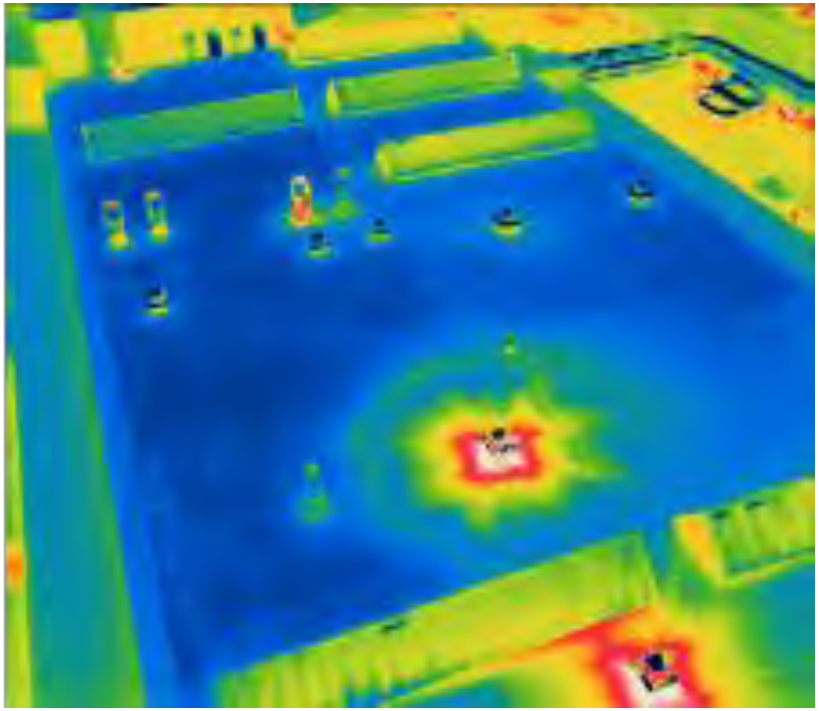
ACCESSORY TECHNOLOGIES

High-resolution Photographs: DOB/FDNY Inspection

ACCESSORY TECHNOLOGIES

Thermal Imaging (IR)

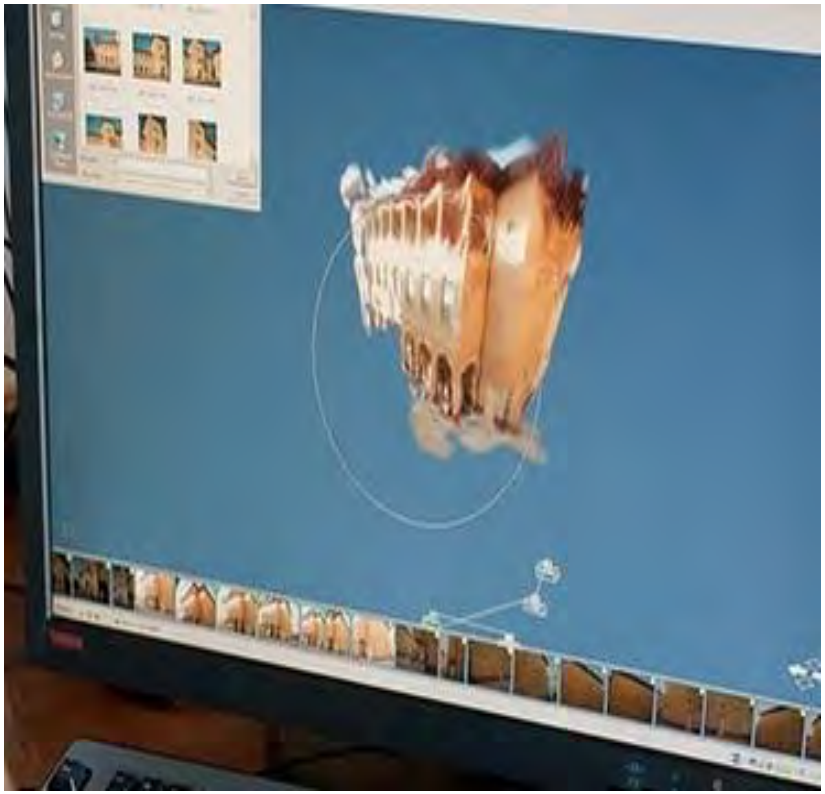




SOURCE: https://www.flir.com/discover/instruments/moisture-restoration/flir-helps-roofing-professionals-find-moisture-with-airborne-inspections/

ACCESSORY TECHNOLOGIES

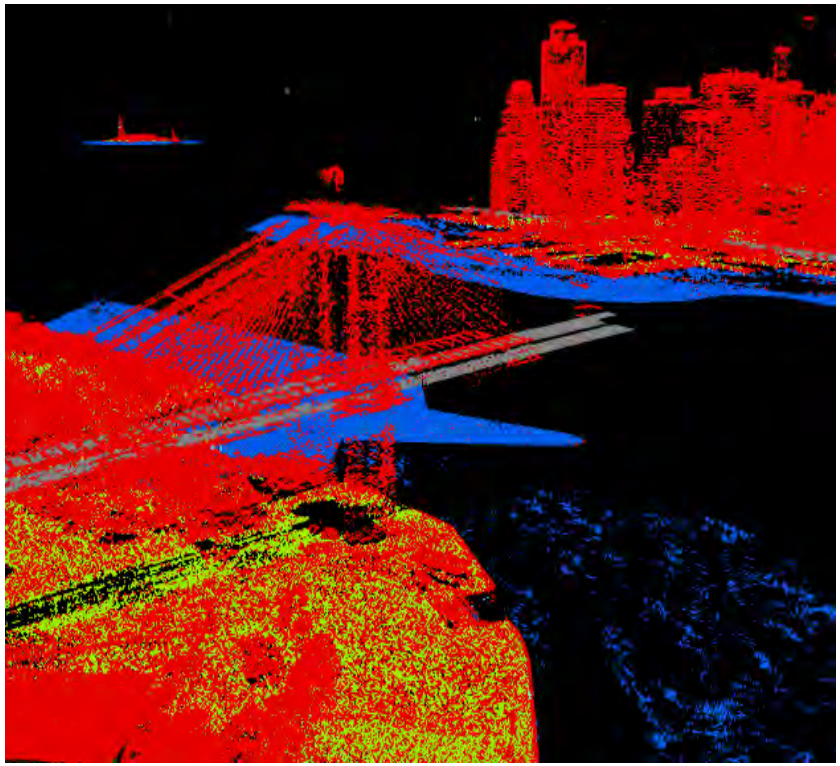
Photogrammetry & Orthomosaics

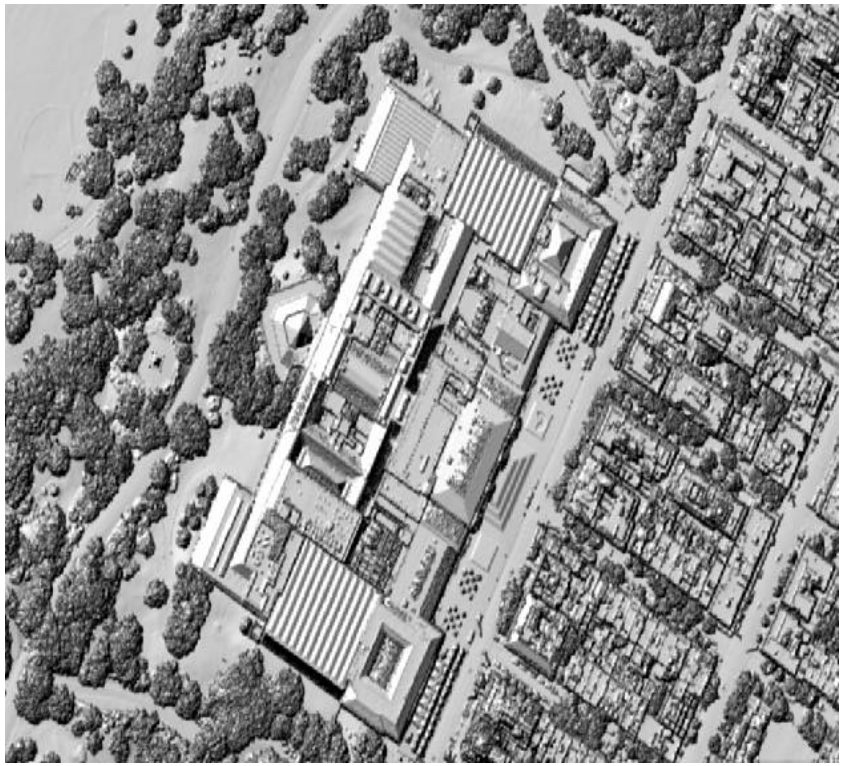


SOURCE: https://www.autodesk.com/solutions/photogrammetry-software

ACCESSORY TECHNOLOGIES

Light Detection & Ranging (LiDAR)





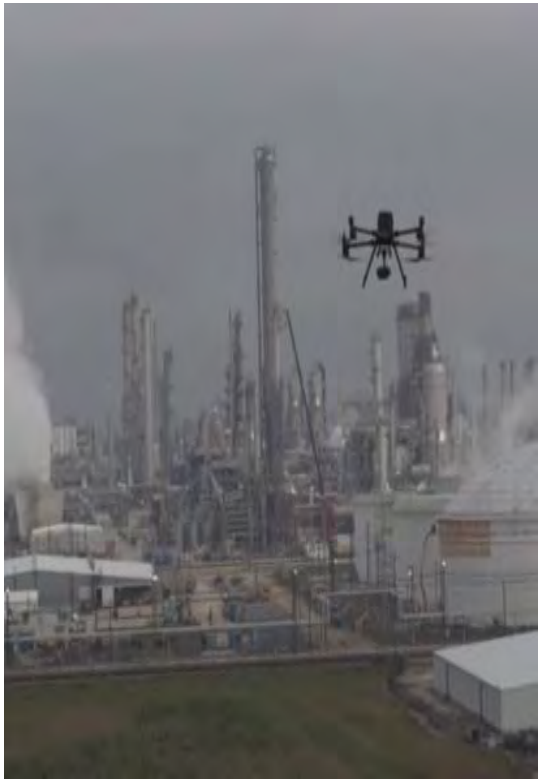
SOURCE: https://maps.nyc.gov/lidar/2017/

DRONE APPLICATIONS

Agriculture, Mining, Oil & Gas

SOURCE: https://ag.dji.com/

SOURCE: https://www.wsj.com/video/self-directed-drones-delve-deep-into-mines/B99DF487-D26B-461A-BBBE-5AB6BE4F9D93.html#



SOURCE: https://enterprise-insights.dji.com/blog/shell-using-drones-for-oil-gas-refinery-inspection

DRONE APPLICATIONS

Emergency Response

SOURCE: https://medium.com/aerial-acuity/drones-assess-the-aftermath-of-a-indonesias-destructive-earthquake-1e60611d0abd

SOURCE: https://enterprise-insights.dji.com/blog/thermal-drones-roundup

DRONE APPLICATIONS

Emergency Response: **Fire in Manhattan**

Picture taken by FDNY's Robotics Unit Drone Team

DRONE APPLICATIONS

Emergency Response: **Fire in Manhattan**

Tracked demolition progression after initial incident

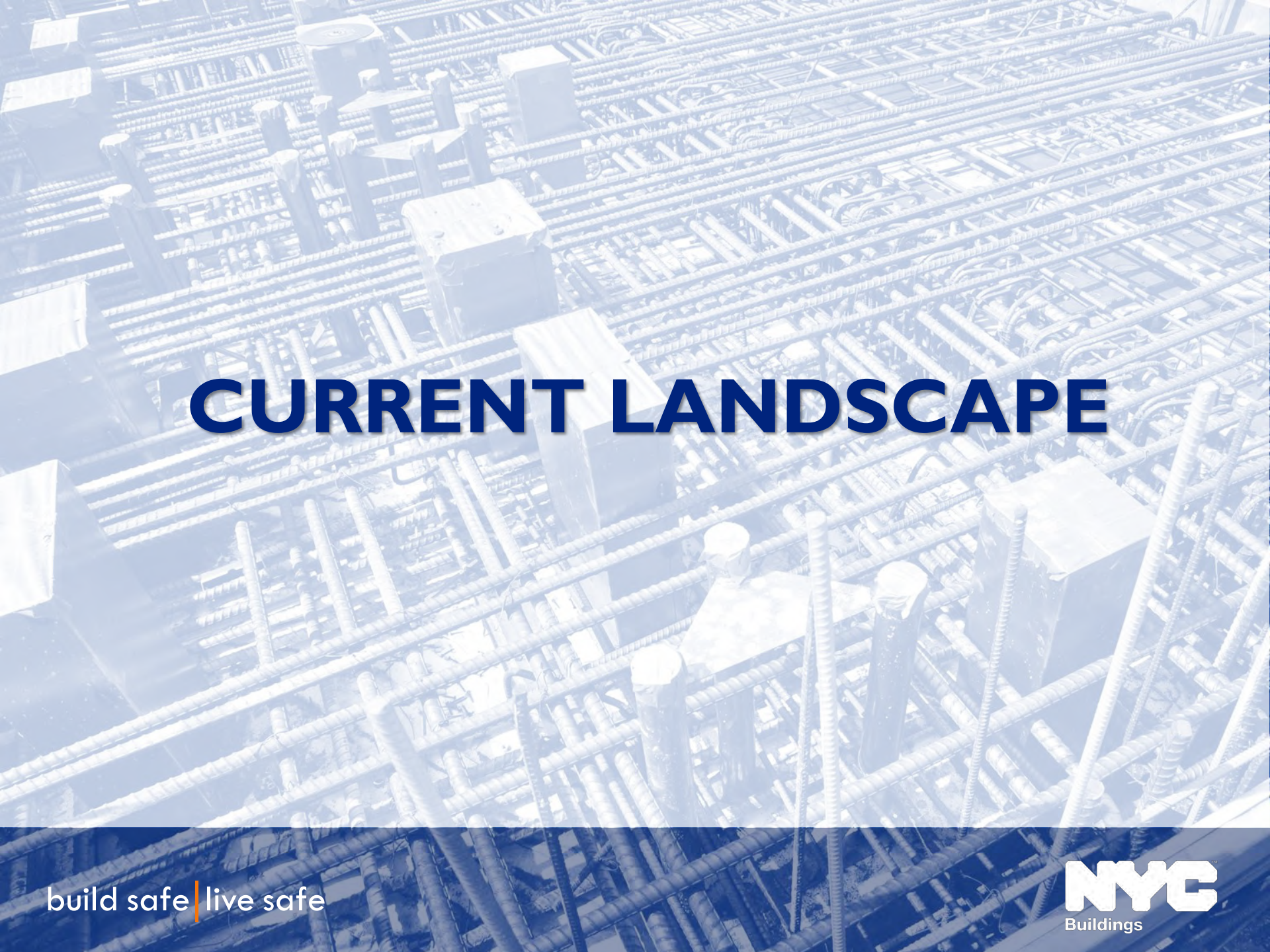
DRONE APPLICATIONS

Construction Management

SOURCE: https://www.denverpost.com/2018/02/01/drones-colorado-construction-sites/

SOURCE: https://news.engineering.arizona.edu/news/robots-and-drones-are-clocking-construction-sites

CURRENT LANDSCAPE



LAWS & REGULATIONS: FEDERAL

Laws & Regulations on Drone Use

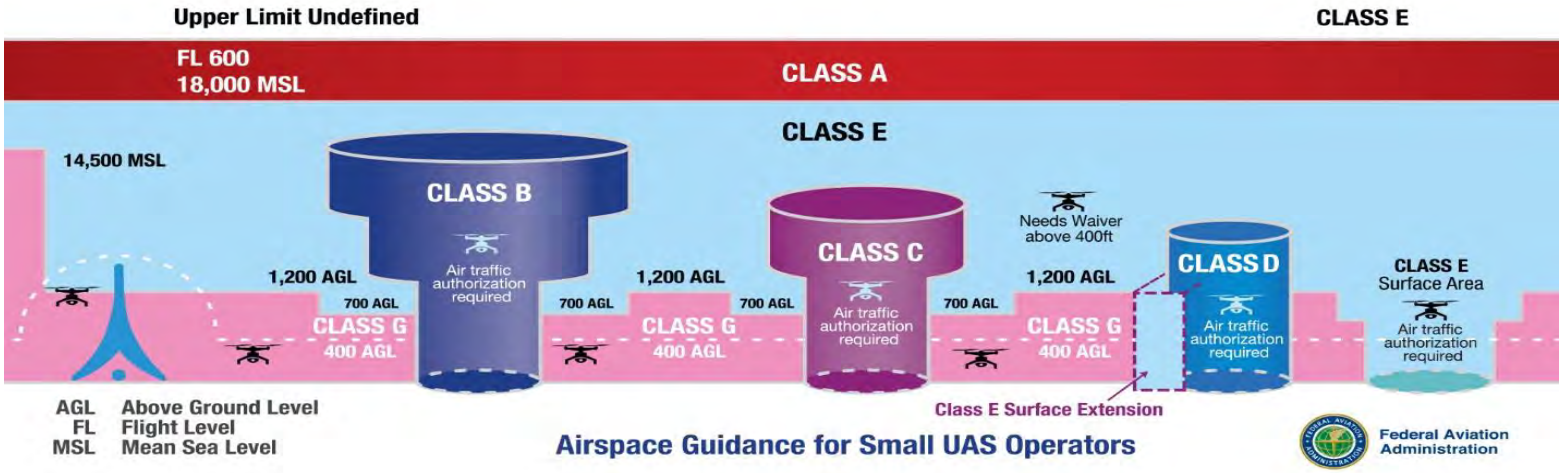
- **FAA**
  - Code of Federal Regulations (CFR) Title14 Part 107, aka Part 107
  - Small UAS (sUAS) for commercial uses
    - 55 pounds weight
  - Pilot certificate and drone registration
  - Safe drone operations

LAWS & REGULATIONS: FEDERAL

- **Part 107 - Waivers**
  - §107.29 Operation at Night
  - §107.39 Operation over human beings
  - §107.145 Operations Over Moving Vehicles

LAWS & REGULATIONS: FEDERAL

- Where can drones fly?
  - Drones limited to uncontrolled airspace up to 400' in height
  - Authorization required for controlled airspace
  - B4UFLY Mobile App



LAWS & REGULATIONS: NYC

- New York City Administrative Code Section 10-126(c)

  "Take-offs and landings. It shall be unlawful for any person navigating an aircraft to take off or land, except in an emergency, at any place within the limits of the city other than places of landing designated by the department of transportation or the port of New York authority."

FISP RULE & DRONES AS TOOLS

If drones were allowed to fly in NYC, what does it mean for façade inspections?

- QEWI designs inspection program
  - Critical (visual) examination may use various tools and methods, including high-resolution photos from drones
- QEWI determines most deleterious locations and performs physical (hands-on) inspections
  - Drones DO NOT replace this requirement

FISP RULE & DRONES AS TOOLS

If drones were allowed to fly in NYC, what does it mean for façade inspections?

- Probes are required for cavity walls
  - Drones cannot perform this requirement
- All buildings are different – special or additional inspections and/or tests
  - QEWI may use drones to access specific locations
  - QEWI would be required to analyze data from drones to determine defects

OTHER CITIES WITH FACADE PERIODIC INSPECTIONS REQUIREMENTS

City	Enacted	Subject Buildings	Reporting Frequency	Subject Walls	Close-up Inspections
New York, NY	1980	H > 6.5 stories	5 years	All Walls (except w/in 12" of adjacent walls)	1 per 60' along ROW
Boston, MA	1995	H > 70 feet or high rise excluding residential three family or less	5 years (1 year if unoccupied)	All walls	high-rise or >125', one drop per facade
Chicago, IL	1996	H => 80 feet	2 years (critical exam every 4, 8, or 12 years)	50% of walls, 100% corners, all terra cotta	1 drop per public way spanning no less than 24'
Columbus, OH	1985	Age => 20 years w/in 10 feet of right of way excluding residential three family or less	5 years	All walls	downtown special critical observation areas only
Detroit, MI	2003	H => 5 stories	5 years	All walls, projections, and roof mounted structures	as required by BSEED
Milwaukee, WI	2001	H => 5 stories and age => 15 years	5, 8 or 12 years (based on age)	All walls	one scaffold drop per facade
Philadelphia, PA	2010	H => 6 stories or =>60' w/ appurtenances, and >2 story buildings in areas TBD	5 years	All walls and appurtenances	Representative area (no required minimums)
Pittsburgh, PA	2004	All buildings	5 Years	All walls (except buildings in Use Group R-3)	n/a
St. Louis, MO	2009	H > 6 stories	5 Years, or 3 years for balconies, stairs, and fire escapes	All walls	n/a
San Francisco, CA	2016	H=> 5 stories	5 years	All walls	25% of each subject facade
Cincinnati, OH	2016	H=> 5 stories	5, 8, or 12 years (based on type of wall construction)	All walls	one scaffold drop per facade, and any add'l areas requiring investigation
Cleveland, OH	2016	H=> 5 stories or 75'	5 years	All walls	areas found to be deficient

OTHER CITIES WITH FACADE PERIODIC INSPECTIONS REQUIREMENTS

Vary in the following aspects:

- which buildings are subject to the requirements;
- which walls of those buildings are subject to:
  - a) overall inspection requirements; *and*
  - b) close-up inspection requirements;
- when the first inspection report is due; and
- how often an inspection would have to be conducted and a report filed after the initial filing.

COMPARISON WITH SIMILAR JURISDICTIONS

- NYC
  - Façade Ordinance: Robust; in effect continuously for 41 years
  - Drone Use Limited: Prohibition on take offs and landings outside airports or designated heliports
- Chicago, Miami, Philadelphia
  - Façade regulations
  - Permitted drone use
  - Impact on Safety: no other jurisdiction is seeing significant drone use for façade inspections


WHAT COULD WE EXPECT?

NEW YORK CITY EMERGENCY RESPONSE AGENCIES

- FDNY and NYCEM
- Capture and map data during and after emergency events
- Regularly coordinates with teams working closely together to ensure the safety of anyone near the in-flight drones
- NYCEM – combines drones with geographic information system (GIS) software to build a visual understanding of an emergency incident

IMPACT ON PEDESTRIAN SAFETY & REDUCTION OF SIDEWALK SHEDS

37% sidewalk sheds are in place at FISP unsafe buildings or SWARMP buildings being repaired

IMPACT ON PEDESTRIAN SAFETY & REDUCTION OF SIDEWALK SHEDS

- Not required solely for a façade inspection
- Not required for probes provided the site is left in a safe condition and fully enclosed (with approval)
- Would drones highlight more unsafe conditions? (more sheds? Or more precise public protection?)
- Are drones a threat to pedestrian safety?

  (Hint: we don't know)

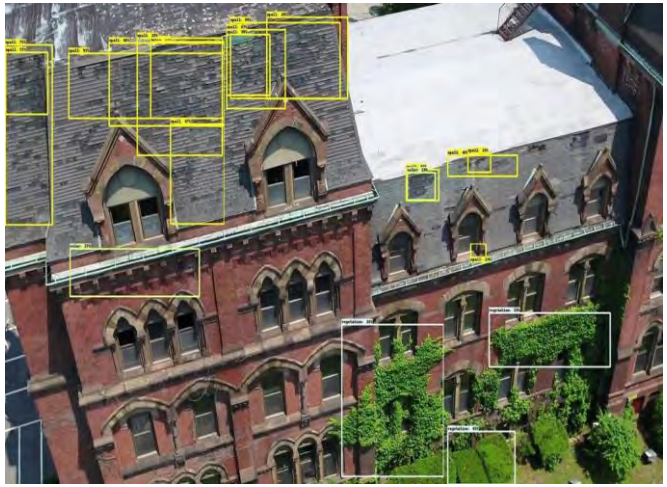
DRONES IN SOCIETY

- Potential Data Collection and Security Obstacles Related to UAVs
  - collect and transmit data in new and more efficient ways
  - data collected for a FISP inspection similar to what is currently collected and submitted.
  - Too much data?
- Economic Benefits for façade inspections
  - Hard to determine
  - Probes and hands-on inspections still required

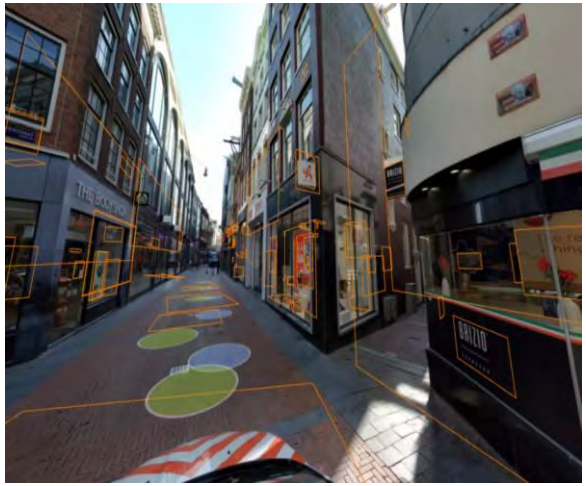
  (Hint: we don't know)

ALTERNATE TECHNOLOGIES

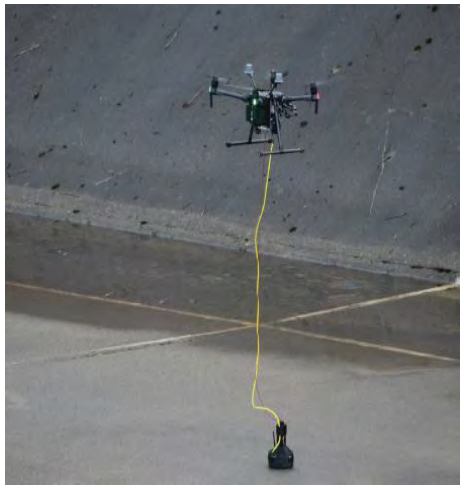
- Street Level Visualizations
- Imaging Robots/Robotic Camera Mounts
- Artificial Intelligence/Learning Software
- Acoustic Sensors



SOURCE: https://www.thorntontomasetti.com/capability/t2d2



SOURCE: https://www.cyclomedia.com/en/product/data-insights/data-insights



SOURCE: https://www.niricson.com/

FINDINGS & RECOMMENDATIONS

FINDINGS

- Drones are useful for collecting visual data
  - Photos, videos, thermal imagery
- Façade Inspections need more than just visual images
  - Physical examinations are required
- Façade inspections and repair are more than just data collection
  - Information needs to be reviewed by a professional
- Regulations for drone operation are outside of DOB's purview
- Lack of data and experience with using drones for façade inspections
  - There are not extensive cases of drone use for façade inspections

RECOMMENDATION: PILOT PROGRAM

Further study via a pilot program to allow us to study:

- Time and Costs – would drone use reduce time spent on the visual observation; expedite repairs?
- Types of Deficiencies – are certain types of deficiencies easier to identify with a drone? Are certain types harder?

RECOMMENDATION: PILOT PROGRAM

Further study via a pilot program to allow us to study:

- Additional or targeted inspections – would additional hands-on inspections be required or can areas be better targeted?
- Frequency of drone inspections
- Types of buildings – are some building's facades more suitable for a drone inspection?

RECOMMENDATIONS: OTHER USES

Drones may be useful in other aspects of DOB's work:

- Aid DOB in emergency response
- Identify open roofs of structurally compromised buildings
- Drones with thermal imaging cameras may be used to highlight energy efficiency of building envelopes and assist in retro-commissioning efforts

Further evaluation of these specific topics could prove beneficial to the Department in areas outside of just façade inspections.

build safe | live safe

NYC Buildings