CELEBRATING 50 YEARS

GALE

The Benefits of Drone Use in Evaluating the Building Enclosure

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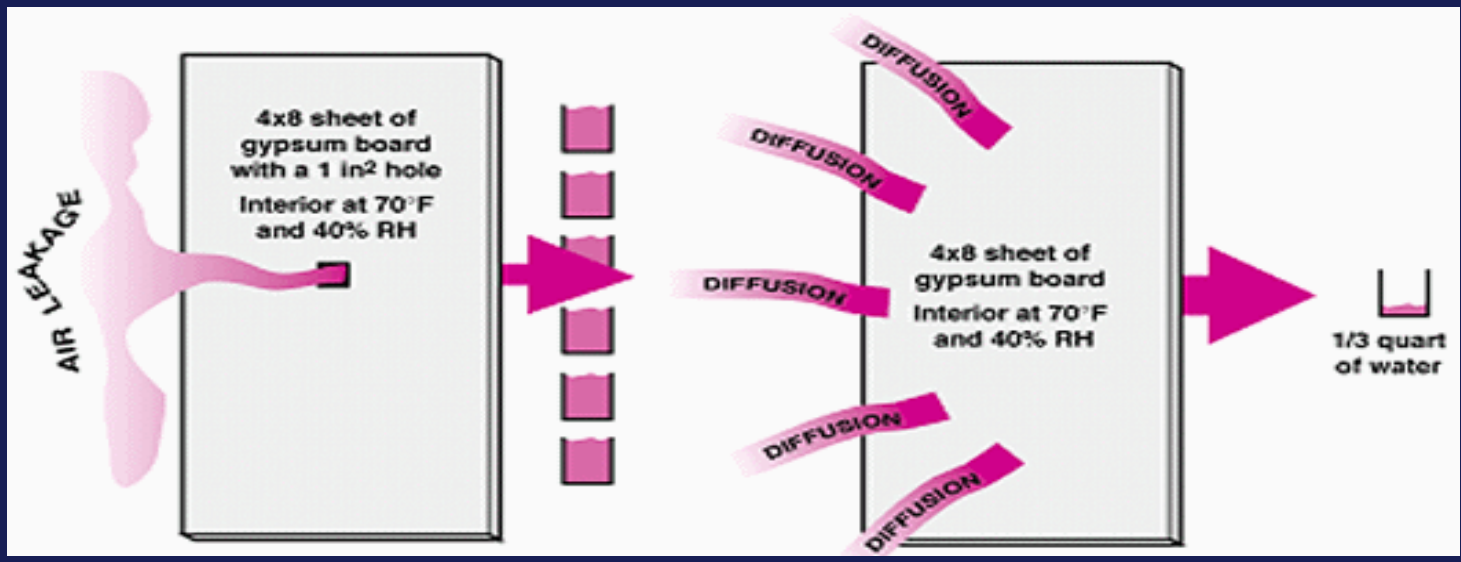
Certified Drone Pilot

Building Enclosure

- **Elements of the building, including all external building materials, windows and walls that enclose the internal space.**

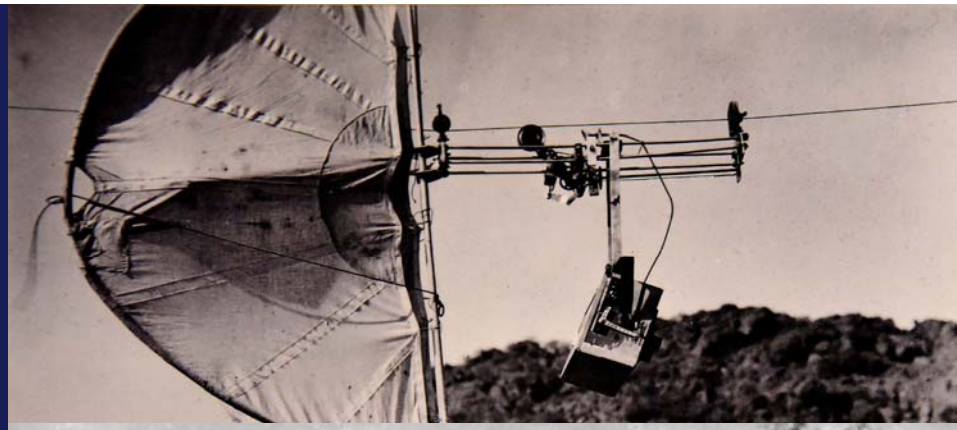
Building Enclosure

- Control heat, air and vapor flow
- Control water penetration
- Control light and solar radiation



History

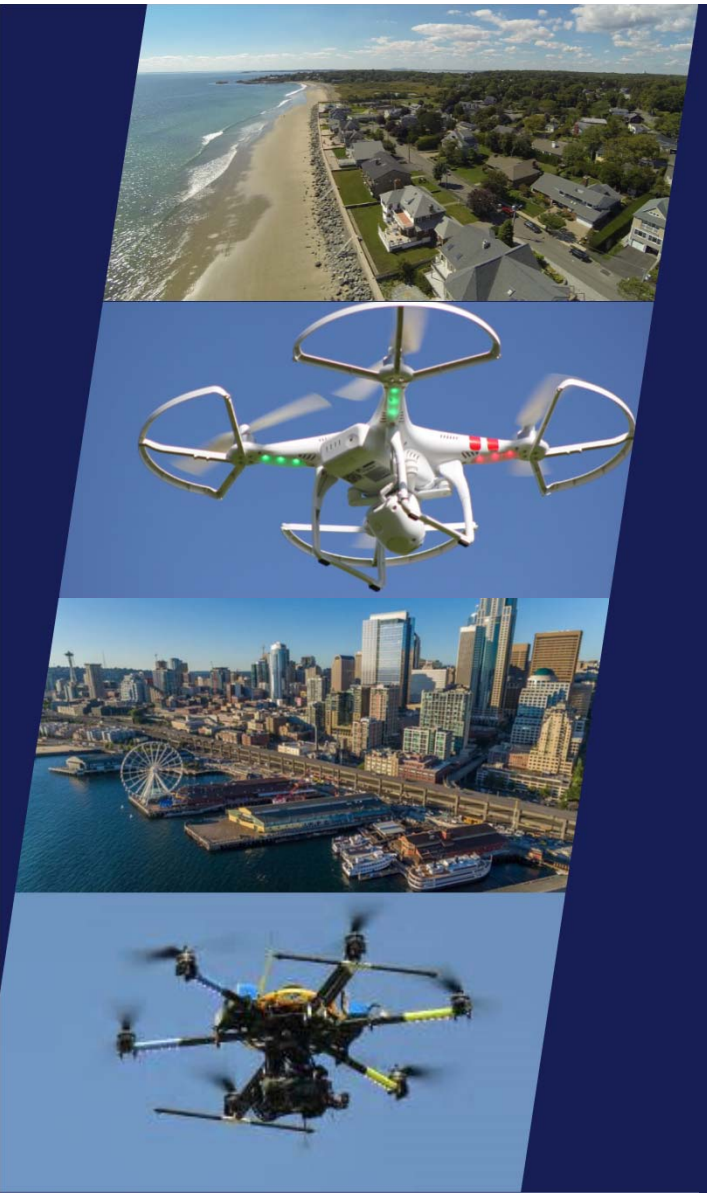
- One of the first recorded uses was by Austrians in July 1849
- 1898 Spanish – American War when the U.S. military fitted a camera to a kite, producing one of the first aerial reconnaissance photographs



History

- The term “drone” originated from the British produced unmanned radio controlled aircraft in 1935 that were used as anti-aircraft practice targets

- A Lightning Bug Drone was used during the Vietnam war, it was one of the first drones used for surveillance by the USAF



History

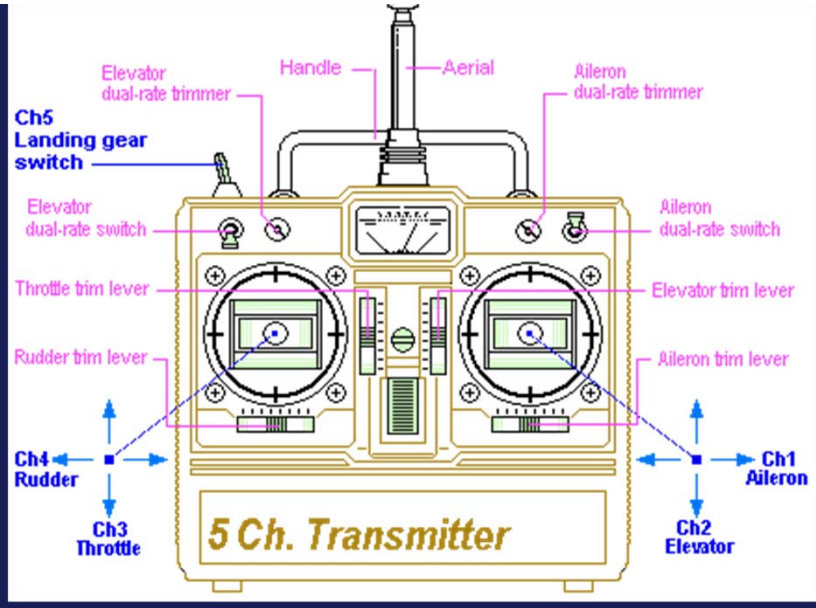
- Whatever the size of the drone, they all perform the same functions:
  - Providing intelligence, surveillance, reconnaissance (ISR) via photographs and/or videos

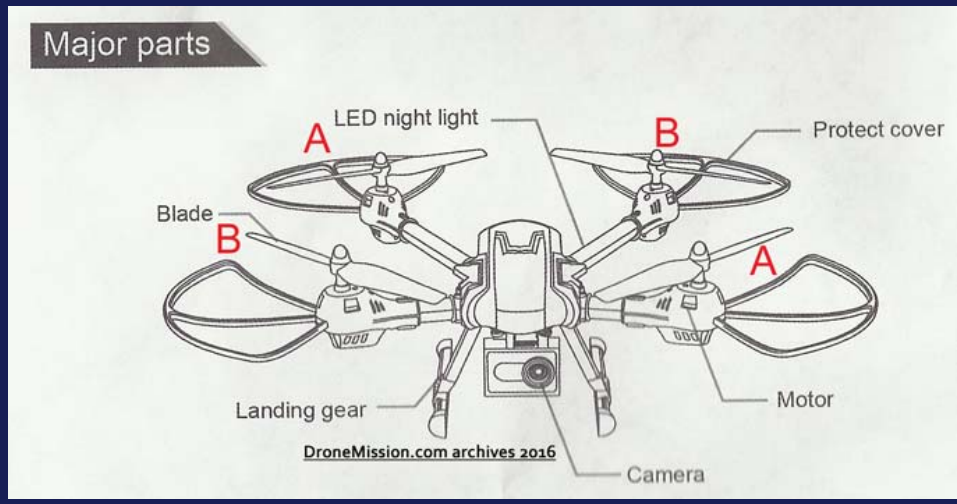
How Does a (sUAS) Drone Work?

An unmanned aerial vehicle system has two main parts: drone itself and control system

Majority of (sUAS) used by hobbyists or for commercial use have multi-rotors

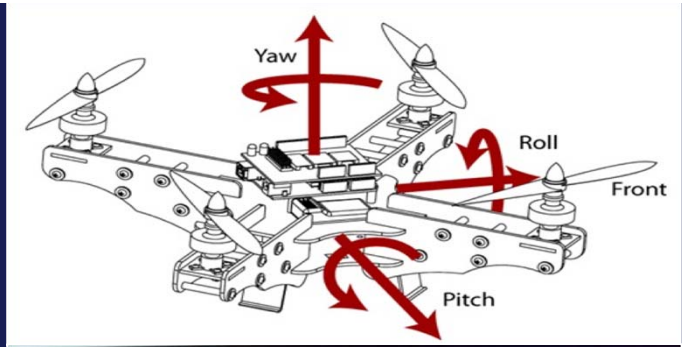
Multi-rotor drones are inherently unstable and require an on-board computer to stabilize flight.

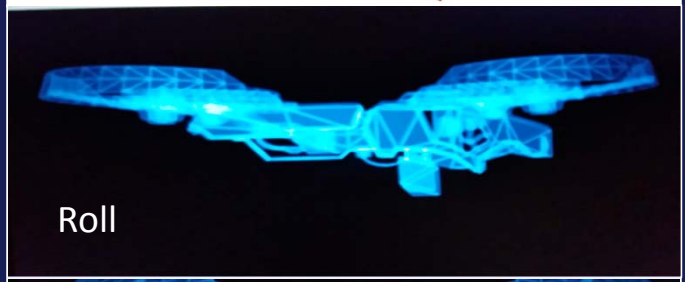


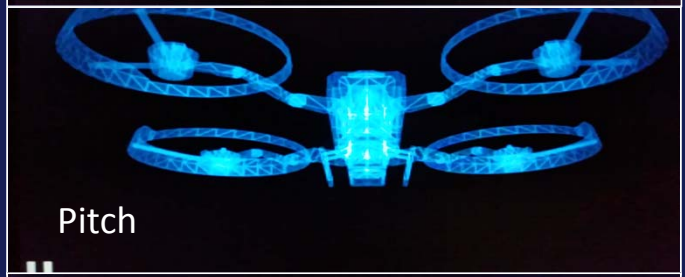


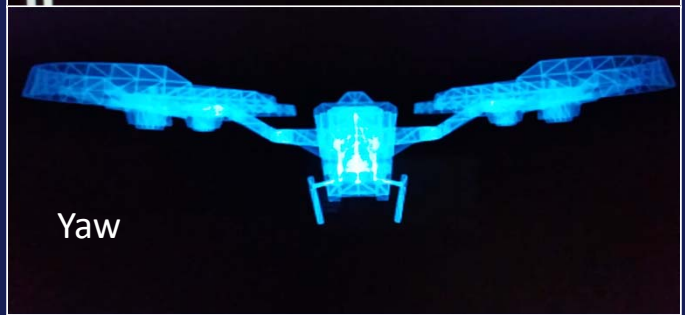
How Does a (sUAS) Drone Work?

- Roll, pitch, yaw, and thrust can be changed by speeding up or slowing down
  - Roll – moves the UAS side to side
  - Pitch – moves the UAS forward or backwards
  - Yaw – changes the direction the UAS faces



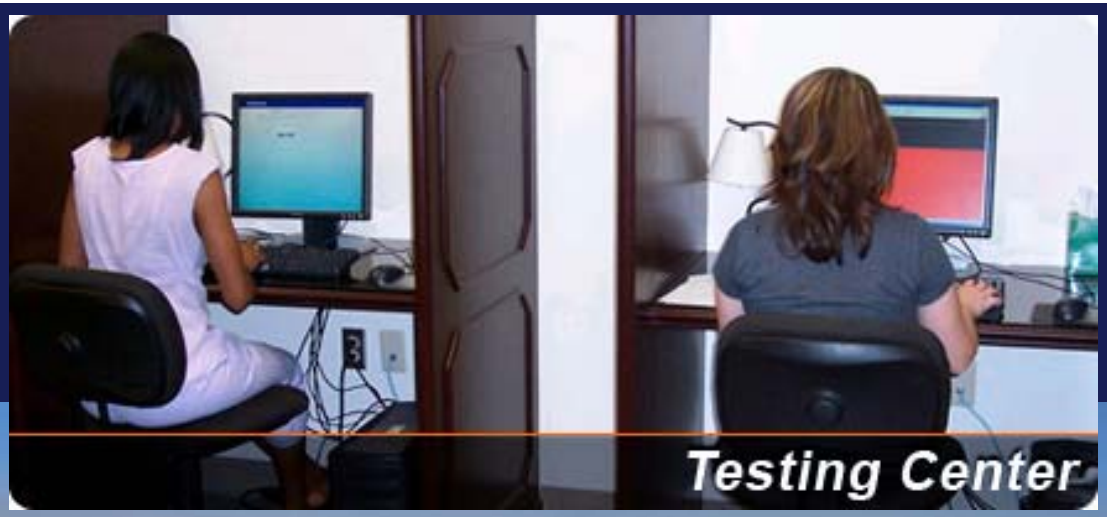






FAA Regulations

- 2015 – FAA created regulations and rules for drone use due to safety concerns
- Ch 14 CFR – Part 107
- Certification was originally required for hobbyist and for commercial pilots (Pilot Certificate)
- As of 2017 certification is only required for commercial pilots



The rules for operating an unmanned aircraft.

	Fly for Fun	Fly for Commercial Use
Pilot Requirements	No pilot requirements	Must have Remote Pilot Airman Certificate Must be at least 16 years old Must pass TSA vetting
Aircraft Requirements	Must be less than 55 lbs. Aircraft does not need to be registered.	Must be less than 55 lbs. Must be registered if over 0.55 lbs. (online) Must undergo pre-flight check to ensure UAS is in condition for safe operation
Location Requirements	5 miles from airports without prior notification to airport and air traffic control	Class G airspace*
Operating Rules	Must ALWAYS yield right of way to manned aircraft Must keep the aircraft in sight (visual line-of-sight) Must follow community-based safety guidelines Must notify airport and air traffic control tower before flying within 5 miles of an airport Must NOT be physiologically impaired	Must keep the aircraft in sight (visual line-of-sight)* Must fly under 400 feet (elevation)* Must fly during the day* Must fly at or below 100 mph* Must yield right of way to manned aircraft* Must NOT fly over people* Must NOT fly from a moving vehicle* Must NOT be physiologically impaired
Example Applications	Educational or recreational flying only	Flying for commercial use (e.g. providing aerial surveying or photography services) Flying incidental to a business (e.g. doing roof inspections or real estate photography)
Legal or Regulatory Basis	Public Law 112-95, Section 336 – Special Rule for Model Aircraft FAA Interpretation of the Special Rule for Model Aircraft	Title 14 of the Code of Federal Regulation (14 CFR) Part 107

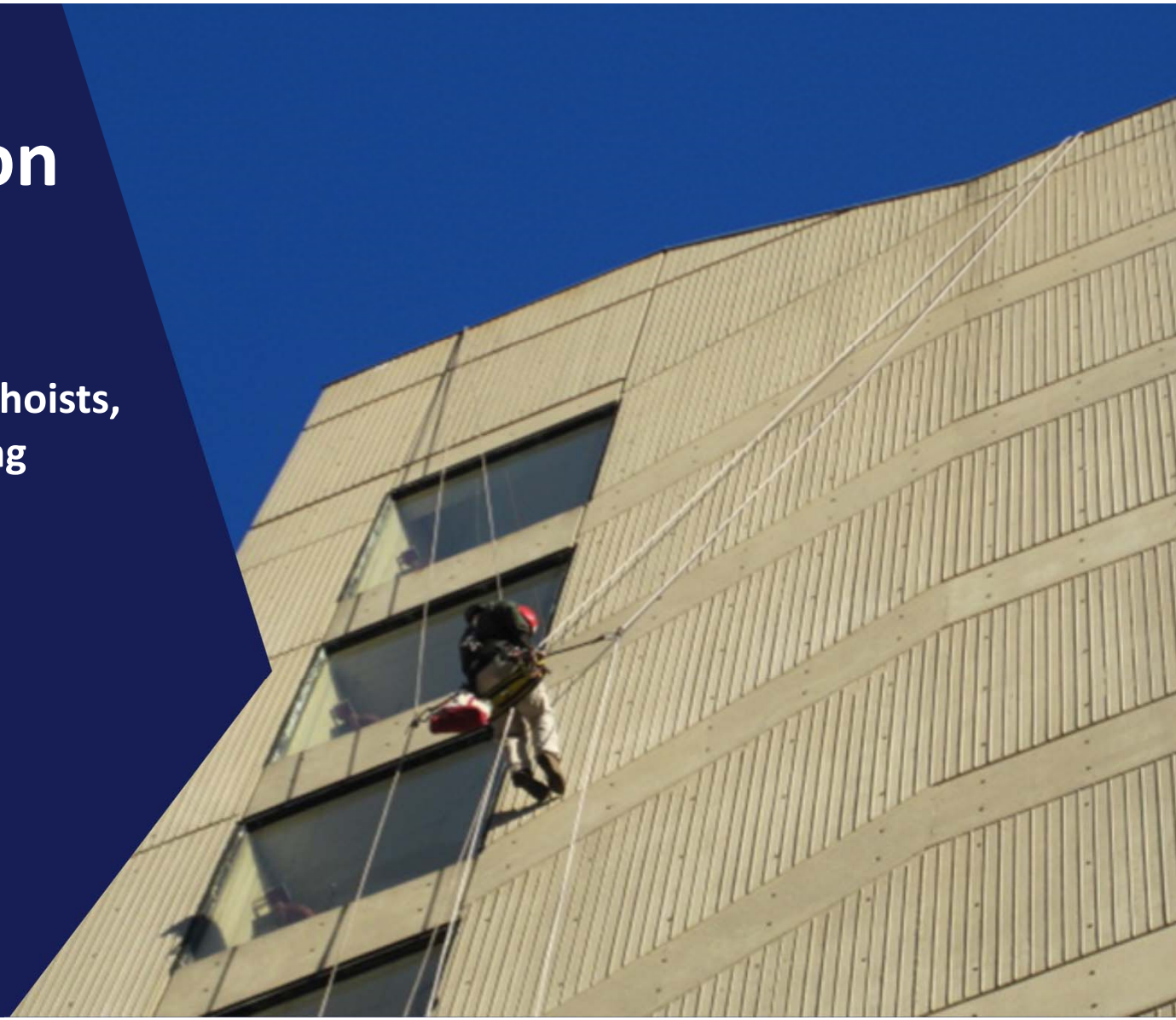
- Commercial sUAS pilots typically operate in Class G Airspace
- Class G airspace extends from the surface to the base of the overlying Class E airspace
- A remote pilot will not need ATC authorization to operate in Class G airspace

Drone Capabilities

- Aerial photography
- Aerial Thermography
- Laser Scanning for As-Builts
- 3D Mapping
- Facade Condition Studies
- Allows Focus on Actual Issues
- Storm Damage Assessments
- Structure Inspections

Facade Inspection Methods

- Typically use ladders, lifts, hoists, rope access or swing staging
- These methods are time consuming and expensive
- The more complex the configuration, the more expensive



Binocular Inspection

Man Lift

Swing Staging

Rope Access Methods

Small Unmanned Aircraft Systems (sUAS) - Drones

Avoids Expensive Access Methods

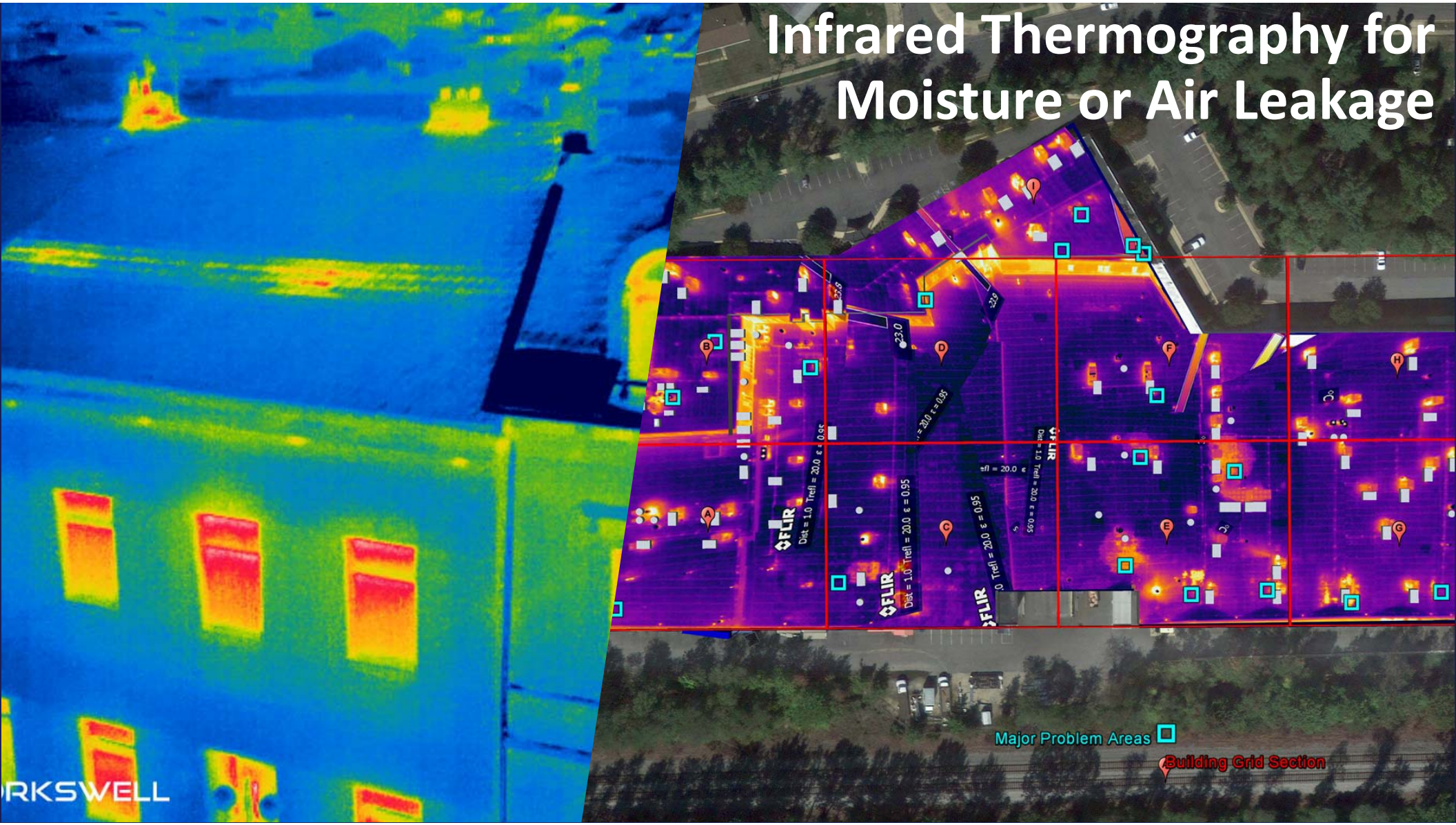
- Allows access to hard to reach locations
- Up to 400 feet above the structure*

Costs for Traditional Access Methods

	Average Costs for Evaluation Use	Limitations
Binoculars	$135 - $300	No ability to capture images observed for later use.
High Reach Equipment	$2,500/120’ lift per week (not including operator or engineer)	Costly, coordination with facility operations critical, potential for mechanical failure. Tremendous attention to safety.
Swing Stage	Initial installation $2,000 Relocate for each drop $1,200 (if on same building level) $1,000 per drop for operator and engineer	Costly, coordination with facility operations critical. Delay in observation due to mobilization and relocation of staging for each drop.
Helicopter	$1500 to $2000 per hour.	Weather and FAA Clearance
Drone	The average cost for drone survey is approximately $3,000-$4000 total (this includes pilot, engineer and report). Exact price may vary depending on your area and project details.	FAA Regulations, Battery Life, Weather (wind, rain, etc.)

Overall View of an Entire Site

Photos for Design and Renderings


Infrared Thermography for Moisture or Air Leakage
Major Problem Areas
Building Grid Section

3D Modeling

Orthomosaic

Building Enclosure Evaluations

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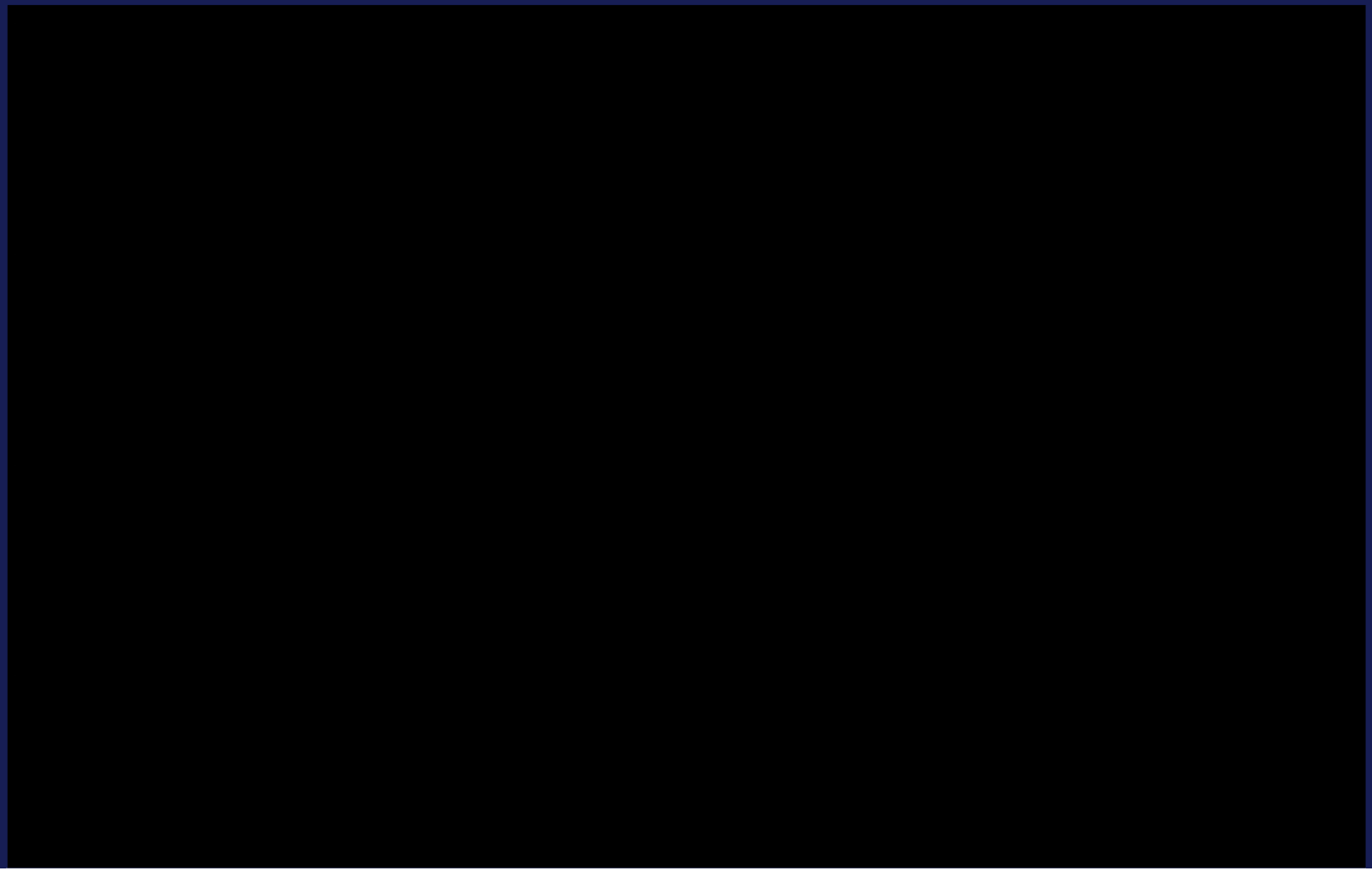
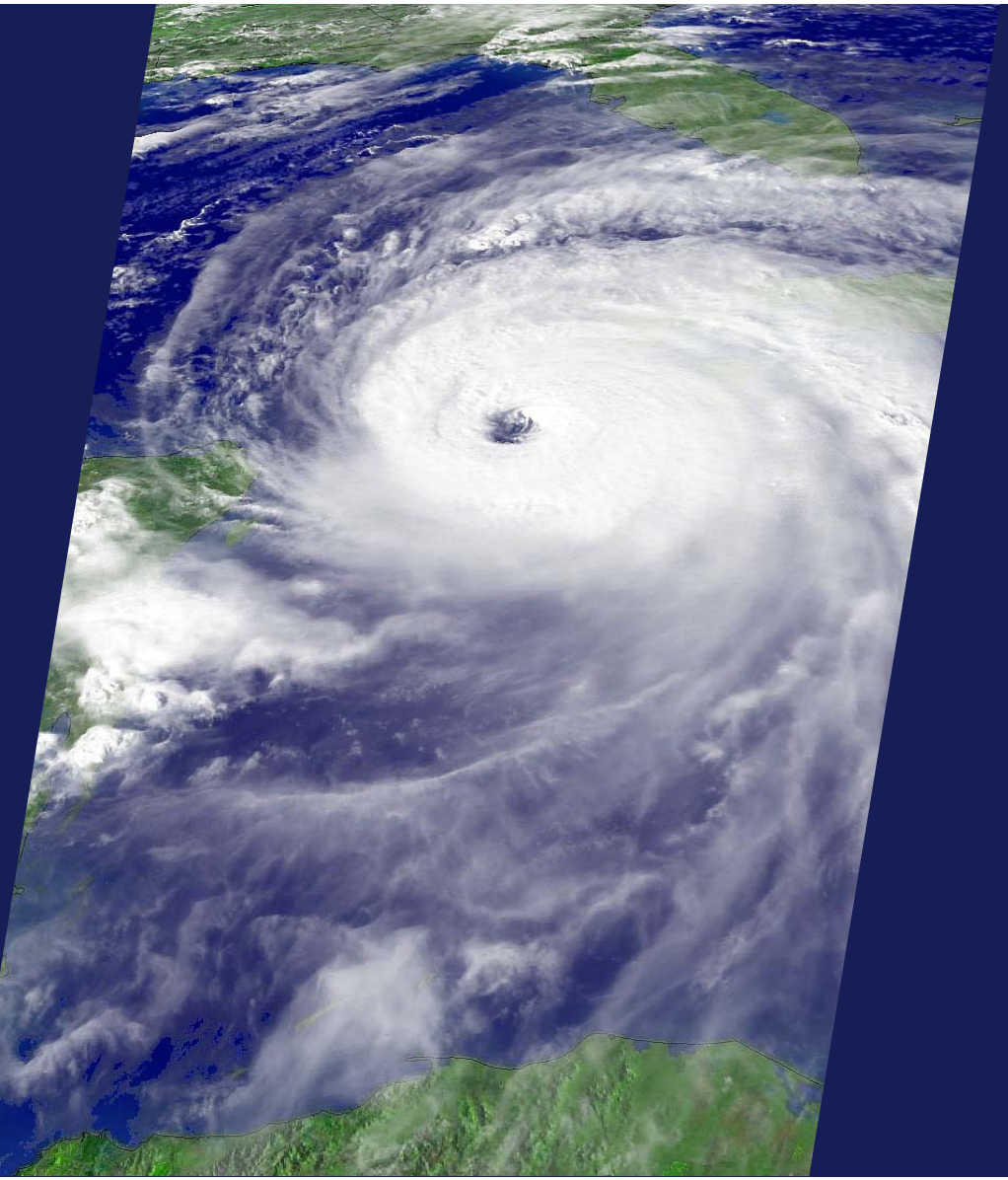
Drone Sample Evaluation



Aerial Views for Measure Ups



Evaluation after a Major Weather Event

- FAA issued 137 authorizations to local, state and federal agencies for support to Hurricane Harvey Recovery
- Insurance, utility, and AE firms used drones to assess damage

Storm Damage Assessment

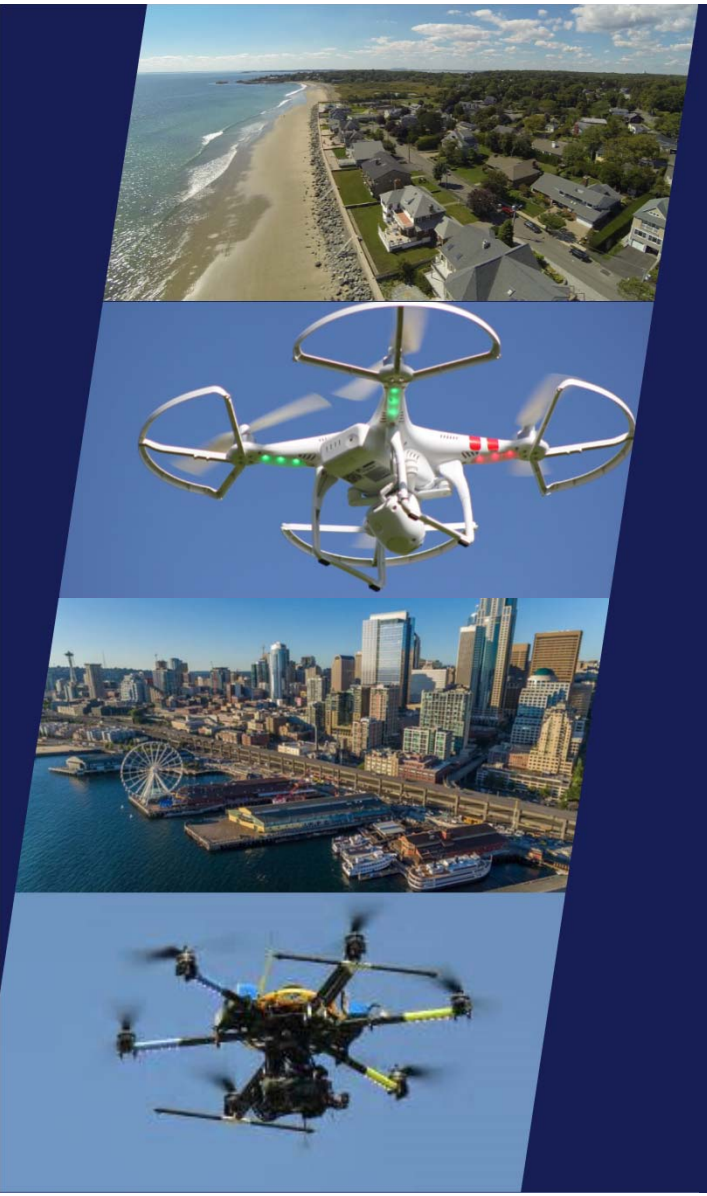
- Quickly assess damage to facilities
- Easy access
- Minimal safety issues

Additional Uses

- Amazon announced it was exploring using drones to deliver packages in 2014
- Exploration of delivering medicine
- Law Enforcement & Emergency Rescue
  - Used to deliver life jackets to flood victims
  - Use IR on Drones for Search & Rescue
  - Disaster Relief
- Real Estate Surveys
- Mining and Transportation – Site Assessments and Geological Mapping
- Used in Africa for Anti-Poaching Missions
- Agriculture – Crop Monitoring

Limitations

- sUAS should be considered a tool and not a solution to a problem
- Professionals are needed to analysis and interpret the data
- Visibility: drone must be in line of sight of the pilot
- Weather: cannot be flown in 20+ mph
- Night Time Flight Approval
- Flight over the public



Conclusion

"The Drone Age" is here to stay

- They inspect hard to reach places
- They can be deployed quickly
- They are popular – multiple uses
- Evaluating building enclosures can be performed annually at lower costs

Thank You