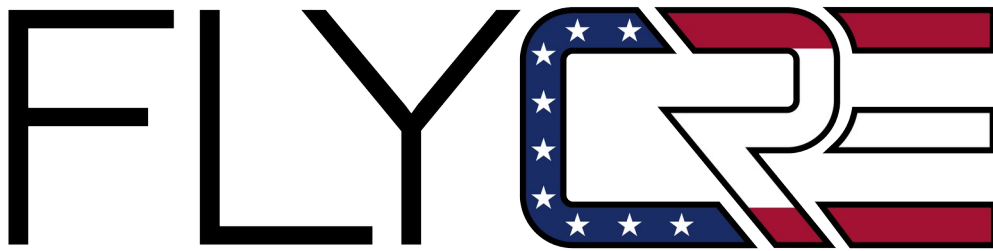




The Safety Advantage: Aerial Roof Documentation as the New Standard



A DIVISION OF BURGE CORPORATION

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Executive Summary

Commercial and public roofs need a current, dated record of their condition. Owners, boards, insurers, and agencies rely on that record to plan maintenance, support claims, and show what a roof looked like on a given day. For decades the only way to build it was to send a person onto the roof with a camera and a notebook.

That approach puts people at height, and falls are the leading cause of death in construction [2]. In 2024 the U.S. Bureau of Labor Statistics recorded 844 fatal falls, slips, and trips across all industries [1]. In private-sector construction, falls, slips, and trips caused 389 of the 1,034 deaths that year, and 95.9 percent of those were falls to a lower level [18], and earlier research found that falls from roofs accounted for about one third of construction fall deaths [3]. Fall protection has been the standard OSHA cites most often for 15 consecutive fiscal years through FY 2025 [4].

Aerial documentation changes where the work happens. FlyCRE captures roof imagery with FAA Part 107 certified pilots operating from the ground. The documentation task no longer requires anyone to climb a ladder, walk a membrane, or stand near a skylight. For the documentation task, this works like elimination in the NIOSH Hierarchy of Controls, the control NIOSH prefers because no exposure can occur [7].

Key points of this paper:

- **Exposure removed for the documentation task:** no one goes onto the roof to photograph it.
- **No added load on the roof:** fragile membranes, skylights, and aging decking are never stepped on.
- **Less environmental exposure:** pilots work from ground level instead of on a hot, exposed surface.
- **A repeatable, dated record:** the same flight plan can be flown each cycle, producing a consistent visual and thermal record over time.
- **Clear scope:** FlyCRE documents conditions. It does not inspect, diagnose, repair, or survey. Interpretation stays with the client's roofing contractor, engineer, or consultant.

For organizations that need regular roof records, aerial documentation is the safer way to get them.

Table of Contents

Executive Summary.....	2
1. Introduction.....	4
2. Hazards of Rooftop Access.....	6
3. Safety Advantages of Ground-Based Aerial Capture.....	8
4. Rooftop Access vs. Aerial Capture: Exposure Comparison.....	9
5. Legal & Regulatory Context.....	10
6. Worker Wellness.....	12
7. Emergency & Contingency Planning.....	13
8. The Cost of Rooftop Exposure.....	14
9. What Aerial Documentation Does Not Replace.....	15
10. Conclusion.....	16
Appendix.....	17
A. Regulatory References.....	17
B. Case Studies: California Skylight Fatalities.....	18
C. Visual Summary.....	20
D. Sources.....	21

1. Introduction

Roofs protect everything beneath them, and many organizations keep records of roof condition for maintenance planning, warranty requirements, insurance, and transactions. Building those records has traditionally meant putting people on the roof.

1.1 Why Roof Condition Records Matter

A dated roof record supports several needs:

- **Maintenance planning:** facilities teams and their contractors use current imagery to schedule work and track changes between visits.
- **Insurance and claims:** a record captured before an event shows what the roof looked like before it happened.
- **Warranty and transactions:** manufacturers, buyers, and lenders often ask for documentation of roof condition.
- **Board and council reporting:** HOA boards and public agencies need records they can attach to a staff report or board packet.

1.2 The Safety Challenge

Gathering that record by hand requires a person to:

- Climb a ladder, scaffold, or aerial lift to reach the roof.
- Walk surfaces that may be sloped, uneven, wet, or weakened.
- Carry a camera, tablet, or other equipment while keeping their balance.
- Work near roof edges, hatches, skylights, and rooftop equipment.

Each of those steps is a recognized fall exposure. Section 2 covers them in detail.

1.3 The Aerial Documentation Approach

At FlyCRE, we capture roof imagery from the air while the pilot and visual observer stay on the ground. Every flight captures four data layers, delivered in this order:

- **Orthomosaic:** a single, high-resolution overhead image of the roof built from many overlapping photos.

- **Thermal:** a record of surface temperature differences across the roof at the time of capture.
- **Asset Visibility:** close views of rooftop equipment, penetrations, drains, and edges.
- **Multispectral:** additional spectral bands, recorded on every flight so every property has the same set of layers.

Data is delivered through the FlyCRE Intelligence platform as a dated, observational record and stored for comparison over time. Measurements are approximate and intended for condition tracking and reference. They are not survey grade.

1.4 Scope of This Paper

This paper addresses one question: how to produce a roof condition record without exposing people to roof-level hazards. It does not address how to evaluate a roof, what a given image means, or how to repair anything. Those decisions belong to licensed roofing contractors, engineers, and other qualified professionals.

2. Hazards of Rooftop Access

Rooftop work combines several hazards at once. Federal and California data show how often they result in serious injury or death.

2.1 Falls

Falls are the leading cause of death in construction [2]. In 2024, falls, slips, and trips caused 389 of the 1,034 deaths in private-sector construction, and 95.9 percent of those were falls to a lower level [18]. A study of national fatality data found that falls from roofs made up about one third of all construction fall deaths from 1992 to 2009, and that from 2003 to 2009 two thirds (67%) of roof fall deaths occurred in small construction establishments with 1 to 10 employees [3].

In our experience, many of the people who walk roofs to document them are not roofers. They are facilities staff, property managers, adjusters, consultants, and owners of small trade businesses, who may not have the equipment or training of a dedicated roofing crew.

2.2 Skylights and Fragile Surfaces

Skylights are a well documented hazard on commercial roofs. They can look solid and give way under a person's weight. California's general industry safety orders require that any employee approaching within 6 feet of a skylight be protected from falling through it, using skylight screens, covers, guardrails, skylight nets, or personal fall protection [8]. The rule allows a narrow exception for work of short duration and limited exposure, such as measuring or roof inspection, when rigging the protection would take as long as or longer than the task itself and adequate risk control is maintained [8]. That exception lets protection be suspended. It does not remove the person from the hazard. Short rooftop visits are exactly the situations described in Appendix B, which covers two California deaths in which a worker on a roof for a short task fell through an unguarded skylight [11][12].

2.3 Structural Loading

Older roofs can hide weakened decking under an intact surface. A person adds weight to every spot they step on, and the condition of the deck below is often not visible from the surface. An aircraft flying over the roof adds no load at all.

2.4 Heat and Environmental Exposure

Roofs offer little shade and concentrate sun exposure. Cal/OSHA's outdoor heat standard requires shade when temperatures exceed 80°F and, for listed industries including construction, high-heat procedures when temperatures equal or exceed 95°F [9]. Wind, morning dew, and rain add slip and balance hazards on top of heat.

2.5 Getting to the Roof

Reaching the roof is a hazard of its own:

- **Ladders:** In 2011, 113 workers died from ladder falls and an estimated 34,000 were treated in emergency departments for ladder fall injuries [5]. Ladders ranked third on OSHA's most cited standards in fiscal year 2025 [4].
- **Scaffolding:** scaffolding ranked sixth on the same list [4].
- **Aerial lifts:** lifts bring their own hazards, including tip-overs and contact with overhead power lines.

2.6 Human Factors

Fatigue, time pressure from incoming weather, and the distraction of operating a camera all reduce attention to footing and edges. A person focused on photographing a drain or a seam is not watching the skylight a few feet away.

3. Safety Advantages of Ground-Based Aerial Capture

The NIOSH Hierarchy of Controls ranks protective measures from most to least effective: elimination, substitution, engineering controls, administrative controls, and personal protective equipment [7]. NIOSH describes elimination as the preferred solution because no exposure can occur [7]. Guardrails, harnesses, and training all reduce risk. Removing the person from the roof removes the exposure.

3.1 Removing Exposure for the Documentation Task

When the roof record is captured from the air, no one needs to be on the roof to create it. No ladder is set, no harness is worn, and no one walks near an edge or skylight for the purpose of documentation.

3.2 No Load on the Roof

The aircraft never touches the roof. Membranes, coatings, skylights, and solar arrays are not walked on, and weakened decking is never asked to carry a person's weight.

3.3 Less Environmental Exposure

Pilots work from ground level, where they can use shade, water, and rest areas. Flights are planned around wind, precipitation, and visibility limits, and paused when conditions change.

3.4 Access to Complex Roofs

- **Steep and high roofs** can be captured without scaffolding or lifts.
- **Rooftop equipment areas** near HVAC units, vents, and conduit can be recorded at a safe standoff distance.
- **Multi-building campuses** can be captured in a single planned sequence instead of repeated climbs.

3.5 A Repeatable, Dated Record

Saved flight plans let us fly the same route each cycle, capturing comparable views from one visit to the next. Every image is timestamped and georeferenced. Because the full roof is captured on each flight, fewer return trips are needed to answer follow-up questions, which further limits exposure.

4. Rooftop Access vs. Aerial Capture: Exposure Comparison

The table below compares the two ways of producing a roof condition record.

Factor	Documentation by Rooftop Access	Documentation by Aerial Capture
Fall exposure	Present at edges, openings, and skylights; managed with fall protection	None for the documentation task; personnel stay on the ground
Load on roof	Body weight plus equipment on every step	None
Access equipment	Ladder, scaffold, or lift required	None; aircraft launches from the ground
Heat and weather	Full exposure on the roof surface	Ground level, with shade and rest available
Consistency between visits	Depends on the person and the route walked	Saved flight plans repeat the same coverage
Record produced	Handheld photos and notes	Dated orthomosaic, thermal, asset, and multispectral layers

Aerial capture does not remove every hazard from a building's life cycle. Repairs and hands-on work still require roof access with appropriate fall protection. Section 9 covers that boundary.

5. Legal & Regulatory Context

This section summarizes the rules that apply to rooftop work and to commercial drone operations. It is general information, not legal advice. Organizations should confirm their obligations with their own safety and legal advisors.

5.1 OSHA and Cal/OSHA

- **Federal general industry standard:** 29 CFR 1910.28 requires employers to protect employees on unprotected sides and edges 4 feet or more above a lower level, and from falling through holes, including skylights, 4 feet or more above a lower level. It also sets specific rules for work on low-slope roofs [16].
- **Federal construction standard:** 29 CFR 1926.501 requires employers to protect construction employees from falls of 6 feet or more to lower levels, and from falls through holes, including skylights, more than 6 feet above lower levels [13].
- **California construction standard:** Title 8, Section 1670 governs personal fall arrest, restraint, and positioning systems in construction work [14].
- **California general industry standard:** Title 8, Section 3212 requires guarding of roof openings and protection for employees within 6 feet of a skylight or routinely approaching within 6 feet of a roof edge [8].

Which federal standard applies depends on whether the work is construction or general industry, such as maintenance. Either way, these rules apply when an employee is exposed to the hazard. When the documentation task is performed from the ground, no employee is exposed to a roof-level fall hazard during that task. The rules still apply in full to any employer whose employees later go onto the roof for repairs or other work.

5.2 FAA Part 107

Every FlyCRE flight is flown under 14 CFR Part 107 [10]:

- **Certified pilots:** every remote pilot in command holds an FAA Remote Pilot Certificate [10].
- **Altitude:** flights stay at or below 400 feet above ground level, except when flown within a 400-foot radius of a structure and no higher than 400 feet above its top [10].
- **Visual line of sight:** the aircraft remains within sight of the pilot or visual observer throughout the flight [10].

- **Twilight and night:** operations outside daylight use anti-collision lighting visible for at least 3 statute miles [10].
- **Airspace:** flights in controlled airspace receive FAA authorization before takeoff, through LAANC or the FAA DroneZone, as required by 14 CFR 107.41 [10].
- **Remote ID:** aircraft broadcast identification as required by 14 CFR Part 89 [15].

5.3 Recordkeeping and Liability

A dated, georeferenced record gives owners, boards, and insurers a clear account of what a roof looked like on a given day. Moving the documentation task off the roof also means one fewer reason to put an employee, contractor, or visitor at height. Organizations should discuss any effect on their own insurance or risk programs with their broker or carrier.

6. Worker Wellness

Beyond fall risk, routine rooftop documentation takes a physical toll: repeated ladder climbs, kneeling and crouching to photograph details, and long periods in the sun. Ground-based aerial capture replaces that with work at ground level in a neutral posture. It also gives facilities staff a reason to stay off the roof unless hands-on work is actually needed.

7. Emergency & Contingency Planning

Aircraft carry their own risks, and a professional operation plans for them before anyone takes off. Our flight procedures include:

- **Emergency landing zones:** clear landing areas are identified and briefed before every flight, away from roadways, walkways, and fragile roof surfaces.
- **Spare equipment:** spare flight batteries and backup aircraft are available so that no one is tempted to finish a flight on a weak battery or a faulty aircraft.
- **Failsafe settings:** return-to-home altitude and low-battery thresholds are set before takeoff for each site.
- **Weather limits:** wind, precipitation, lightning, and visibility are checked before flight and monitored during it, with flights paused or ended when limits are reached.
- **Crew communication:** the pilot and visual observer stay in contact throughout the flight, and public areas are kept clear of the operating area.
- **Incident logging:** any anomaly is logged and reviewed, and lessons are folded back into procedures.

FlyCRE is insured, plans flights at altitudes that avoid disrupting operations or residents, and does not capture data of private residences or private property we are not hired to document.

8. The Cost of Rooftop Exposure

Fall incidents carry human costs first. They also carry regulatory and financial consequences:

- **Federal penalties:** OSHA's maximum penalty for a serious violation is \$16,550 per violation, and for a willful or repeated violation \$165,514 per violation, for penalties assessed after January 15, 2026 [6]. These are the 2025 amounts, carried into 2026 after OSHA announced there would be no 2026 inflation adjustment [17].
- **California penalties:** California runs its own state plan, so most private employers in California are cited by Cal/OSHA. For citations issued on or after January 1, 2025, Cal/OSHA's maximum is \$25,000 for a serious violation and \$162,851 for a willful or repeat violation [19].
- **Citation frequency:** OSHA cited 6,992 violations of its fall protection general requirements standard (29 CFR 1926.501) in fiscal year 2025, the most of any standard [4].

Workers' compensation claims, lost time, investigations, and litigation follow serious falls as well. The amounts vary widely by case, so this paper does not estimate them. Taking the documentation task off the roof reduces how often anyone is exposed to those outcomes.

9. What Aerial Documentation Does Not Replace

FlyCRE provides aerial site documentation, and we are deliberate about where that service ends:

- **Not an inspection:** FlyCRE records conditions. It does not inspect, evaluate, or certify a roof.
- **Not a diagnosis:** thermal imagery records surface temperature differences at the time of capture. It does not determine their cause. Interpretation belongs to the client's roofing contractor, engineer, or consultant.
- **Not a survey:** measurements are approximate and intended for condition tracking and reference. They are not survey grade and are not certified by a California licensed land surveyor. Survey grade work, if needed, is performed by a licensed surveyor under a separate agreement.
- **Not repair or maintenance:** hands-on work still requires roof access with the fall protection the law requires.

Within those limits, aerial capture lets the qualified professionals who do evaluate and repair roofs start from a complete, dated record, and go onto the roof only when the work requires it.

10. Conclusion

Roof records are necessary. Sending people up to create them no longer is. Falls remain the leading cause of death in construction, roofs have accounted for about one third of those falls in national data, and California investigations have documented skylight deaths of people who were on the roof only briefly.

Ground-based aerial capture applies the control NIOSH ranks first: for the documentation task, no one is exposed to the roof at all. We pair that with FAA Part 107 operations, written flight procedures, and a dated record delivered in the same format on every visit.

Documented Today, Defensible Tomorrow.

Appendix

A. Regulatory References

- **OSHA 29 CFR 1910.28, Duty to Have Fall Protection and Falling Object Protection:** general industry fall protection, including holes, skylights, and low-slope roofs [16].
- **OSHA 29 CFR 1926.501, Duty to Have Fall Protection:** requires fall protection for construction employees exposed to falls of 6 feet or more to lower levels, and through holes, including skylights, more than 6 feet above lower levels [13].
- **OSHA 29 CFR 1926.1053, Ladders:** sets requirements for the design and use of ladders in construction.
- **Cal/OSHA Title 8, Section 1670:** governs personal fall arrest, restraint, and positioning systems in construction [14].
- **Cal/OSHA Title 8, Section 3212:** requires guarding of floor and roof openings, skylights, and roof edges in general industry [8].
- **Cal/OSHA Title 8, Section 3395:** heat illness prevention for outdoor places of employment [9].
- **14 CFR Part 107:** operating rules for small unmanned aircraft systems [10].
- **14 CFR Part 89:** Remote ID requirements for unmanned aircraft [15].

B. Case Studies: California Skylight Fatalities

The following cases are drawn from the California Fatality Assessment and Control Evaluation (FACE) program, which investigates workplace deaths and publishes prevention recommendations. Both involved a short task on a commercial roof.

Case Study 1: HVAC Contractor Falls Through a Skylight (FACE Report 16CA005)

- **Incident:** On July 27, 2016, the 33 year old owner of a one person HVAC business went onto the flat roof of a converted warehouse to look at an air conditioning unit and determine whether more ductwork could be added [11].
- **Hazard:** The roof had six skylights, and the unit sat about 5 feet from one of them. The skylight was unguarded [11].
- **Outcome:** He fell about 20 feet through the skylight to the concrete floor and died 19 days later [11].
- **Investigator recommendations:** perform a daily jobsite hazard analysis that treats skylights as a fall hazard even for short tasks, and have building owners install safety nets, screens, covers, or guardrails around skylights within 6 feet of HVAC equipment [11].
- **Relevance:** The purpose of the visit was to look at rooftop conditions. A visual record of the roof and its equipment is the kind of information aerial capture can provide without anyone walking near the skylight.

Case Study 2: Solar Company Owner Falls Through a Skylight (FACE Report 17CA005)

- **Incident:** The owner of a solar company was alone on a warehouse roof, setting up a drone to photograph work progress [12].
- **Hazard:** The skylight had no cover, screen, or guardrail, and he was not using personal fall protection [12].
- **Outcome:** He fell about 40 feet to the concrete floor and died at the hospital the same day [12].
- **Investigator recommendations:** protect employees within 6 feet of any skylight with screens, covers, guardrails, nets, or personal fall protection, including for short tasks such as periodic inspections [12].

- **Relevance:** This case shows that using a drone is not enough on its own. The aircraft must be launched and operated from the ground, away from roof hazards. FlyCRE launches every flight from a ground-level takeoff area.

C. Visual Summary

Documentation by Rooftop Access

- Personnel exposed to edges, skylights, and weakened decking.
- Ladders, scaffolds, or lifts required to reach the roof.
- Fall protection, training, and supervision required for every visit.
- Record quality depends on the person and the route walked.

Documentation by Aerial Capture

- Personnel remain on the ground for the documentation task.
- No access equipment and no load on the roof.
- Flights conducted under FAA Part 107 with documented procedures.
- A dated, repeatable record in the same format on every visit.

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