

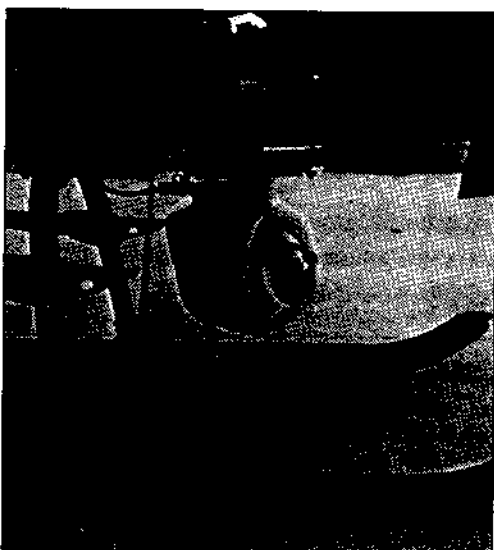
# Aerial roof surveys prove to be accurate and fast

**T**he U.S. Army has 300,000 buildings to maintain, many of which have low-slope membrane roofs. Membrane roofs have had many problems over the past two decades. Moisture is the primary enemy; it commonly enters through flaws in the waterproofing membrane, most of which occur at flashings and penetrations. Even if these roofs are inspected periodically, it is often impossible to locate flaws visually. This is why non-destructive roof moisture surveys are useful.

## Technically speaking

Commercially available nuclear, capacitance, and infrared devices<sup>1</sup> can detect moisture in roofs. In the Army, most roof moisture surveys are conducted by walking on roofs with hand-held infrared scanners. This technique allows 100 percent of the roof's surface to be examined. The scanner can find small areas of wet insulation that a nuclear or capacitance grid survey may miss.

Infrared surveys are also much faster than the other two methods. For several years, an Army team has used this technique to survey millions of square feet of roofs. But the Army's roof inventory is so large that a more rapid survey technique is needed.

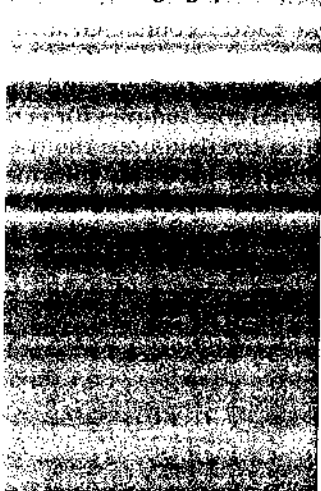


## Army's tests show system can fly

by Wayne Tobiasson, PE.



A helicopter-mounted infrared imaging system.



Several airborne infrared scanning techniques were evaluated some years ago. This included surveys using infrared line scanners in aircraft and hand-held systems angled out of the window or open doorway of helicopters. The consensus of these early studies was that airborne roof moisture surveys were valuable for reconnaissance, but follow-up, on-the-roof surveys with hand-held infrared scanners were needed to accurately locate all wet areas.

In 1983, additional studies were conducted by the Army's Cold Regions Research and Engineering Laboratory (CRREL) to determine the value of airborne infrared surveys with scanning systems that look straight down. Because the detectors in the hand-held scanners were cooled with liquid nitrogen in vented dewars, it was not possible to simply point them straight down; the liquid would spill out of the dewars. A system of mirrors was devised to obtain straight-down imagery of mapping quality.

A new scanner, designed for external mounting on helicopters and fixed-wing aircraft, was also evaluated. This scanner's detector is cooled by pressurized argon, allowing it to be used in any orientation. It is gimbal-mounted and can be pointed in different directions from inside the aircraft by an electronic joystick control.

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**Airborne infrared roof moisture surveys appear to be cost-effective where numerous roofs in close proximity need to be surveyed.**

The new system accurately located 82 percent of the wet areas found by subsequent on-the-roof infrared surveys; the other airborne techniques detected only 60 to 75 percent. It was concluded that, with practice, the best airborne techniques would be about as effective as the much slower on-the-roof method. Details of this study are presented in a CRREL paper<sup>1</sup>.

The only drawback of this system was that, to achieve the spatial accuracy necessary, the helicopter had to fly so low and so slowly that the flights were on the fringe of being hazardous.

A gimbal-mounted, joystick-controlled airborne infrared system with better spatial resolution was ordered in 1984 to allow higher altitude airborne surveys. This improved system has a normal lens and a narrow-field-of-view (i.e., telephoto) lens. The normal lens is used to spot the proper building some distance away. Once the helicopter is overhead, a flick of the switch allows a detailed roof moisture survey to be conducted with the narrow-field-of-view lens.

#### **Allow us to demonstrate**

CRREL demonstrated airborne roof moisture surveys at Fort Wainwright, Alaska in the spring of 1984. A total of 78 roofs were surveyed in a couple of hours—a job that would have taken about a month by walking on the roof with an infrared scanner. The roofs were then inspected visually, and 247 2-inch-diameter core samples of the membranes and insulations were taken to verify the infrared findings. Several roofs were also cross-checked with an infrared scanner on the roof. The airborne findings proved to be excellent. Based on these findings, plans were initiated to repair and replace the deficient roofs.

Another demonstration involved a private firm for follow-up work on 16 roofs at Fort Detrick, Md. CRREL conducted an airborne infrared survey on these roofs in January 1985. The survey findings and the location of potential core samples for verification were then overlaid onto the roof plans. The contractor used this information to complete the survey and draft a report.

During the spring of 1985, CRREL conducted repeat airborne roof moisture surveys at Fort Wainwright and Fort Greeley, Alaska. The objective of this ongoing work is to determine how often repeat surveys should be conducted. A demonstration at an Army installation in the South is planned to show that airborne roof moisture surveys are not limited to cold regions.

#### **Just pennies per square foot**

Roofs cost several dollars a square foot to replace. No new or replacement roof is perfect; periodic roof moisture surveys, which cost a few pennies a square foot, are effective in detecting problems. The techniques developed for mapping-quality airborne infrared roof moisture surveys appear to be cost-effective where numerous roofs in close proximity need to be surveyed. By periodically investing a small amount of money in roof moisture surveys, visual inspections and preventive maintenance, the cost of replacing membrane roofs that fail prematurely can be avoided.

#### **Resources**

Numerous research and case study reports on roof moisture surveys are available from several agencies. Information on these reports can be obtained from the author at CRREL, 72 Lyme Road, Hanover, N.H., 03755-1290. A brochure on "Roofing Systems Analysis" is available from Al Knechans, FESA-EB, Fort Belvoir, Va., 20060. The Roofing Industry Educational Institute (RIEI) offers a short course on "Roof Inspection, Diagnosis and Repair" several times a year at various locations. Contact: RIEI, 6851 S. Holly Circle, Suite 100, Englewood, Colo. 80112.

#### **Notes**

<sup>1</sup>"Roof Moisture Surveys: Yesterday, Today and Tomorrow," CRREL Miscellaneous Paper, Sept. 1985.

<sup>2</sup>"Comparison of Aerial to On-the-Roof Infrared Moisture Surveys," CRREL Miscellaneous Paper, Oct. 1983.