# ELECTRIC FIELD VECTOR MAPPING (EFVM)

By Chris Eichhorn, RRO

## INTRODUCTION

**Electric Field Vector Mapping (EFVM) is a new and powerful tool for improving quality control on waterproofing systems. Although this method is unfamiliar to most North Americans, it has already achieved a long record of success in Europe. Unlike most other leak detection methods, it can locate the point of entry quickly and accurately. Another unique aspect of this technique is that a pinhole (too small to find visually) is as easy to locate as a large tear or failed seam. Alternative approaches, like infrared surveys, can determine where water has accumulated in the roof insulation but may not be as useful in actually finding the waterproofing defect. The traditional flood test also has its practical problems. If the membrane is not watertight, the roofing substrate could become saturated and permanently damaged. After the water is drained off, the punctures still have to be located. Therefore, the EFVM test has become Europe's most widely-used, non-destructive test method for detecting leaks in membrane roofs.**

## Operation Principle

The EFVM technique uses water as an electrically conductive medium; therefore, it is essential that the surface to be tested is wet. If it is not raining at the time of the survey, then water needs to be sprayed over the area. Once the area is suitable for the test, the survey technician installs an un-insulated wire loop around the perimeter of the area and connects the electrical pulse generator to the wire. The electrical pulse generator delivers a 40-volt potential for one second every three seconds. The pulsating potential on the wet roof surface forms an "electrical plate." The grounded structural deck is the other "electrical plate," while the membrane separating the two plates acts as the insulator. If moisture enters a breach in the membrane, an electrical contact is established between the two plates (i.e., an electrical ground).

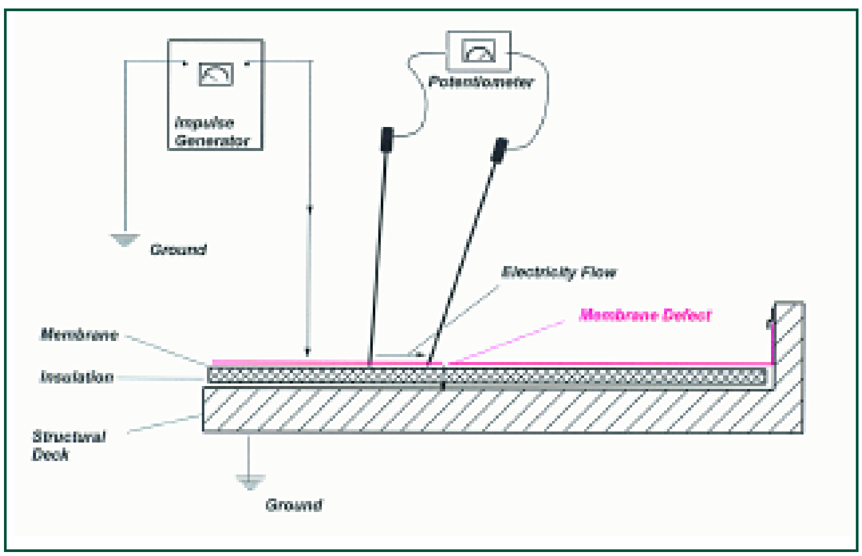


*Figure 1: EFVM operation principles.*

Using a potentiometer connected to two probes, the survey technician steps into the


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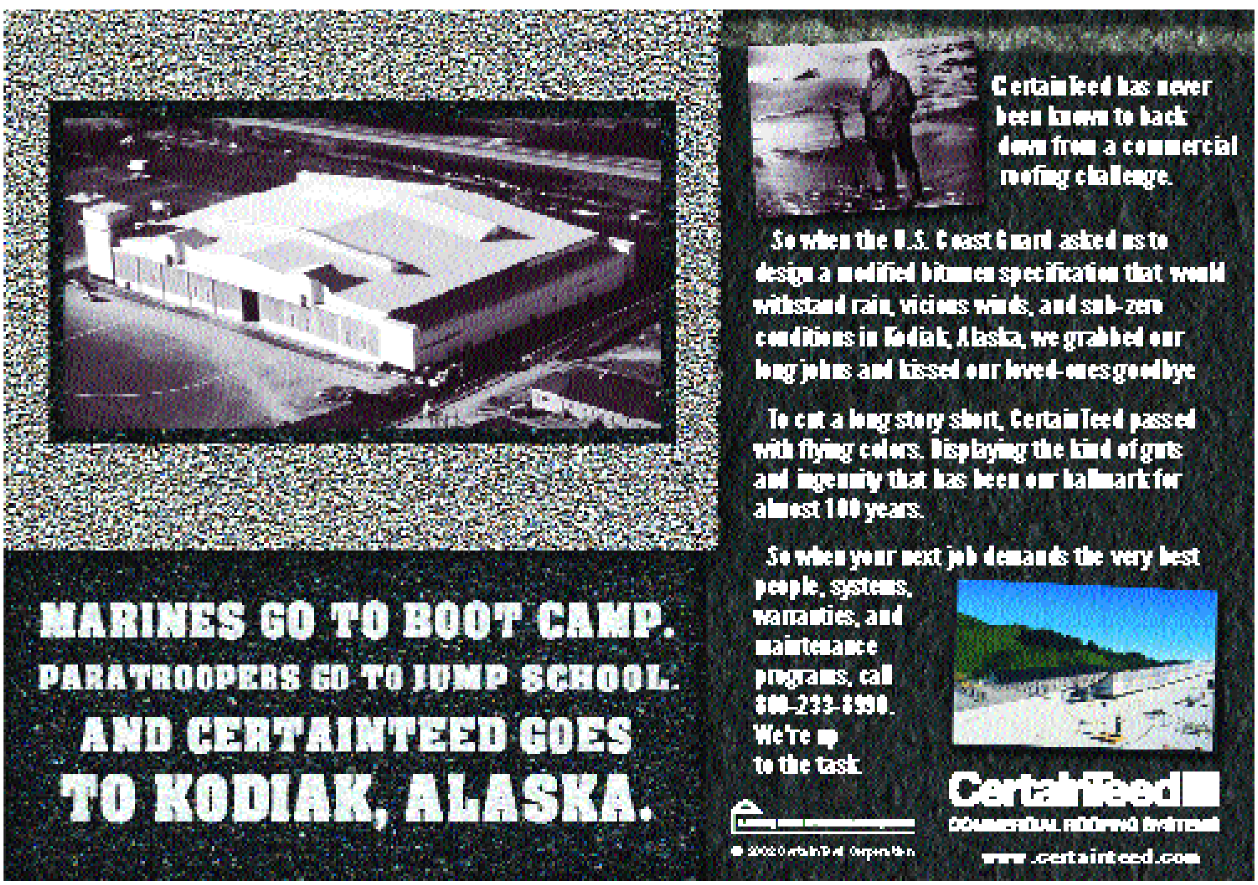
electric field and places the probes on the surface. If there is a breach in the membrane, the dial on the potentiometer will move either to the left or to the right. The survey technician can then follow the direction of the electric field to the membrane breach. Because of the high electrical resistance through the roof, the magnitude of the electrical current is relatively small. However, the magnitude of the current is not important, but the direction of the current flow is what leads the survey technician to the breach.

*Figure 2: Leak investigation on a green roof in Frankfurt, Germany.*

## Benefits of EFVM

The benefits for EFVM can be summarized as follows:

- Ability to locate defects precisely and non-destructively.
- Ability to re-test repairs immediately.
- Can be used *after* cover systems are installed, especially with "green roof" landscapes.
- Eliminates the hazard of overloading structural decks during testing, since ponding water is *not* part of the testing procedure.
- Can be used on sloped roof surfaces where flood testing is impossible.

## Applications

EFVM has been used successfully with a wide range of waterproofing materials. AB Flachdach, a leak detection company in Germany, has electronically surveyed in excess of 35 million square feet of roof membrane within the past five years. The suitability of EFVM depends on the electrical resistance of the waterproofing materials. As an example, EPDM membranes, which contain carbon black, are generally not suitable due to their normally all-too-high electric conductivity. Aluminized protective coatings, commonly used in North America in conjunction with modified bituminous membranes, may also defeat the technique. However, International Leak Detection Ltd., a North American affiliate of AB Flachdach, can conduct bench-scale tests in order to establish that EFVM is suitable for a particular waterproofing material. EFVM can be used on all types of structural roof decks, including metal, concrete, and wood. (A special "grounding grid" must be introduced on top of the wood deck in this case.)

*Figure 3: Leak detection at Chek Lap Kok airport, Hong Kong. Applying continuous flow of water on the sloped PVC membrane to facilitate the test.*

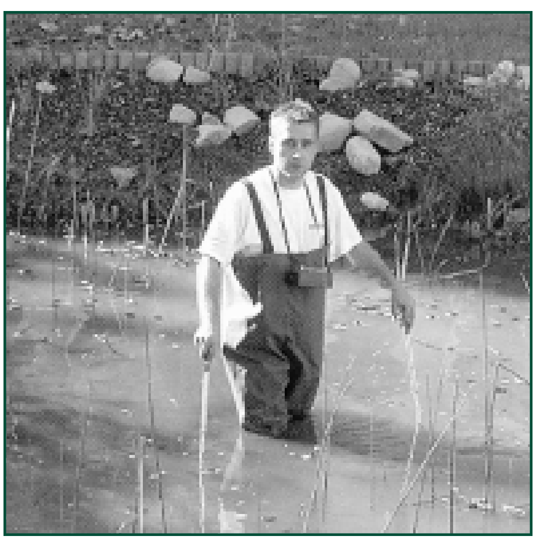


*Figure 4: Locating leaks in a geo-membrane liner with the EFVM technique.*

The EFVM method has proven highly advantageous in situations where the waterproofing is concealed or buried. These include IRMA (Inverted Roof Membrane Assembly) configurations, plaza installations, ballasted roofs, and "green roofs." Green roofs are veneer landscapes installed on top of conventional roofs. They may be anywhere from 2.5 inches to 3 feet deep.

Without an effective method of locating defects, leak location and repair can become very expensive on these systems. Currently, EVFM is being used by Roofscapes Inc., a green roof provider, on numerous green roof projects in North America, including South River Colony office building in Maryland, Point Defiance Zoo in Washington State, and a large chiropractic center in Pennsylvania.

EVFM was used as a quality control measure at the Chek Lap Kok Airport in Hong Kong. A total of 165,000 square feet was electronically surveyed, and over 100 breaches were located in the membrane. The contractor was still on site at the time of the testing and repaired the breaches on a daily basis. The repaired areas were tested upon completion by the survey technicians to ensure the membrane was 100% watertight. A new addition, presently at the developmental stage, will include the EFVM test as part of the specifications.

A recent project in Frankfurt, Germany, further illustrates the value of EFVM as an asset management technique. This project involved an 110,000 square foot roof that was installed in 2000. The technicians found 17 defects in the membrane. Some of these flaws were located in defective seams (workmanship) while others were found to be tiny punctures. There was no visible water damage in the interior of the building. The building owners did not know that there were any problems and probably would not have found the flaws until the insulation had become saturated.

Geo-membrane liners and/or containment liners are also beneficiaries of the EFVM test. These membranes can be tested for any defects prior to commissioning their use and, depending on the depth of the containment basins, also during their use.

## Conclusion

EVFM testing is a practical alternative to flood testing low slope roofs, waterproofing membranes, and geo-membrane liners and is an invaluable tool for our industry. Application of the non-destructive test method includes checking the integrity of newly installed roof membrane systems as part of a quality control procedure and assessing the waterproofing integrity of aged roofs. The greater and more widespread use of the EFVM test as an objective method for positively identifying breaches in membranes is likely to contribute to confidence in the performance of waterproofing membranes for the future. n

## REFERENCES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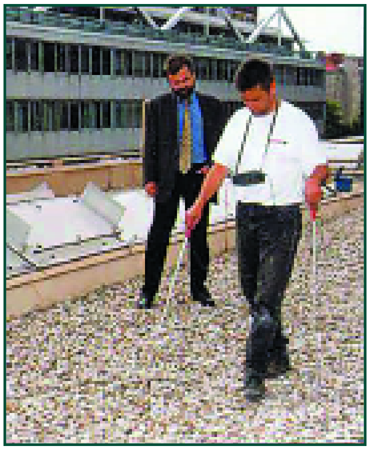

*Figure 5: Leak detection procedure on an inverted BUR roof system. Locating breach through the ballast and insulation.*


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## About the Author

**Chris Eichhorn, RRO,** is president and founder of International Leak Detection, Ltd., a company specializing in membrane leak detection services across North America. Mr. Eichhorn has been involved in the roofing industry since 1977. Chris has served on the Board of Directors and is past Chairman of the Membership Committee of the Ontario Industrial Roofing Contractor Association and currently serves on the Board of Directors of RCI, Ontario Chapter, as its Technical Director.

**Chris Eichhorn, RRO**


## TERRORISM INSURANCE

Another effect of the September terrorist attacks has been the refusal, by most major insurance firms, to provide insurance coverage for future losses due to terrorism. As a result, there is a movement to establish a federal safety net to encourage the property and casualty insurance industry to continue offering such coverage.

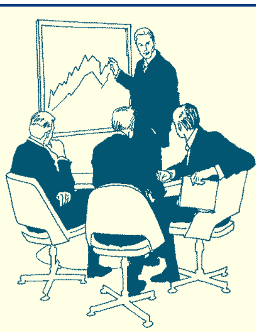
The proposals currently before both the Senate and the House of Representatives would provide a federal reinsurance partnership and co-payment of damage claims over a set amount for a period of short duration, such as 3-5 years. Disagreements remain in both parties, especially over whether to protect corporations and insurance companies from lawsuits over inadequate safeguards against terrorism.

**—SMACNA News**


President Bush placed tariffs of 8 to 30% on steel imported from Asia, Europe, and South America on March 5. The tariffs exclude NAFTA nations and 80 other "developing" countries and will be in effect for three years.

The European Union has announced it will fight the tariffs in the World Trade Organization, which has international authority in trade disputes. The tariffs are meant to protect the bruised American steel industry.

## DOL Forecasts Job Growth



The U.S. Department of Labor has projected a rapid growth in demand for environmental engineers and architects over the next ten years. The field for architects could grow from 102,000 in 2000 to 121,000 in 2010. The following table shows projected growth in related professions from 2000 to 2010.

(In Thousands)

| | 2000 | 2010 | % change |
|---|---|---|---|
| Architects | 102 | 121 | 18.5% |
| Environmental eng. | 52 | 66 | 26.0% |
| Construction trades | 6,466 | 7,328 | 13.3% |
| Civil engineers | 232 | 256 | 10.2% |



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