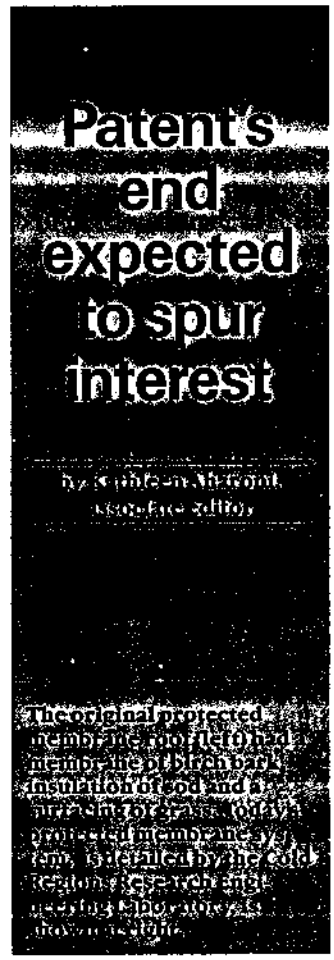
Inverted roof could turn market upside down

Is IRMA about to become extremely popular? No, I'm not talking about the boss's mother-in-law, I mean Dow Corp.'s Inverted Roof Membrane Assembly, in which extruded polystyrene insulation (Styrofoam®) is placed over the roof membrane and ballasted with stone, gravel or pavers; IRMA is Dow's acronym for the system. Some are speculating that the use of IRMAs will increase soon because Dow's patent on the system, which it has held since 1968, expired in November. These experts reason that with the patent's requirements and limitations ended many more owners and roofing professionals will be interested in the IRMA concept.

One reason for this rosy forecast is the fact that the system has already gained a loyal following under Dow's patent. The system's durability attracted many who were willing to pay Dow the royalty that the patent required. During the time IRMA was a proprietary system, it managed to win an 85 percent share of the protected membrane system market. (Protected membrane system is the generic term for an assembly with insulation over the membrane. Protected membranes control 5 percent of the commercial roofing market.)

The non-proprietary IRMA won't be marketed only to old established customers, however. The new versions of the system being developed by Dow and other companies will make installing an IRMA a practical alternative in an expanded number of situations, opening up new markets for the system.

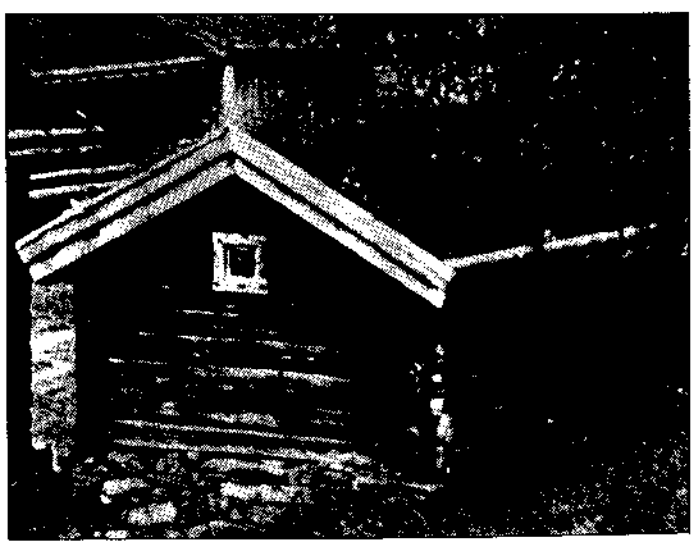

Patent's end expected to spur interest

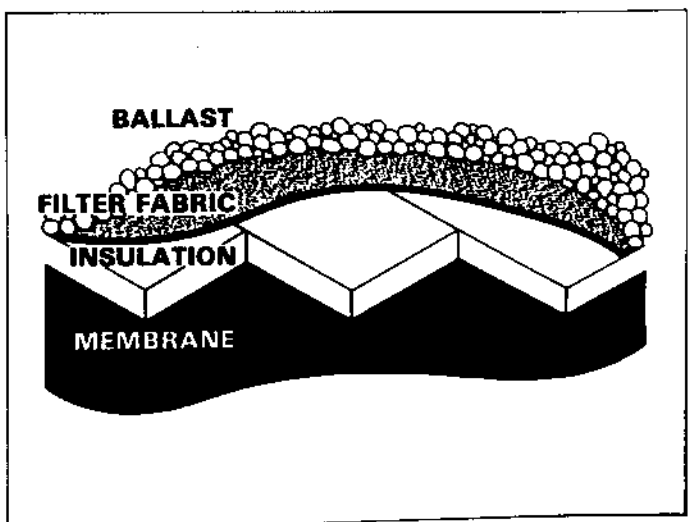
Back to the future

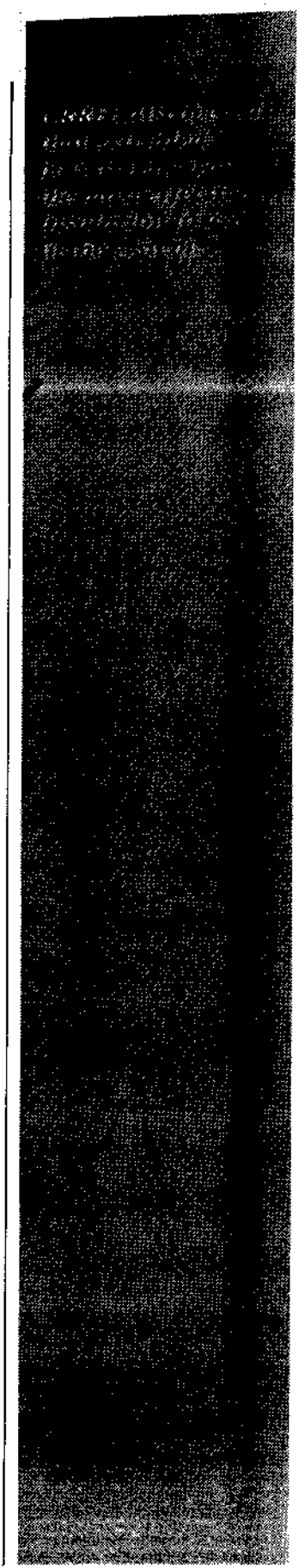
To understand the future of the protected membrane system and Dow's relationship to its growth, it is important to understand how the system evolved in the United States and how Dow's IRMA became almost synonymous with protected membranes.

Protected membrane roofs originated in Norway hundreds of years ago. The Norwegian version was quite different from today's system, however. The roof's bottom layer, the membrane, was made of birch bark. Sod was placed on top of the membrane and served as insulation, and grass was used as the surfacing.

Over the years, new components for the system evolved. By the time Dow began marketing its protected membrane system in 1968, built-up roofing was used most often as the waterproofing membrane. Dow's system used Styrofoam insulation, of course. In Dow's original specification the insulation was to be mechanically attached. Later specifications required loosely laid insulation. As surfacing, Dow specified stone ballast to protect the system and hold the insulation in place.







The real experimenting with protected membrane components came in the 1970s when the U.S. Army Cold Regions Research Engineering Laboratory (CRREL) in Hanover, N.H., began using the system. According to Wayne Tobiasson, CRREL's civil engineer, the Army first heard about the protected membrane idea from Max Baker of the Division of Building Research at the National Building Council of Canada. Baker strongly recommended using the system in cold regions because it could serve as a vapor retarder, a needed component of cold region roofs. Baker also praised the system's ability to insulate the membrane from the cold region's severe temperature shifts. With the insulation protecting the membrane from the environment, he said, the membrane's temperature fluctuates only 5 or 10 degrees from room temperature. An added advantage that attracted CRREL was that the system protects the membrane from mechanical damage such as the cuts that frequently occur when snow is shoveled off a roof.

CRREL took up Baker's recommendation and conducted a number of protected membrane studies using various building material combinations. CRREL tested systems using expanded polystyrene insulation and extruded polystyrene insulation. Through these studies the laboratory discovered that extruded polystyrene was the most effective insulation to use in the system. At about this time, others using protected membrane systems in civilian applications were discovering the same thing. Because Dow held the patent on extruded polystyrene and was the only U.S. manufacturer marketing a protected membrane system using extruded polystyrene roof insulation, the company was able to move quickly into a prominent position in the protected membrane system market.

No membranes eliminated

Further tests on other system components showed that almost any type of membrane could be used, according to Dow's Dave Roodvoets, development leader for Styrofoam Board Products Technical Service and Development. "Fiber glass-reinforced BUR is great," he said, and then added that "EPDM, PVC and Hypalon also work exceptionally well."

CRREL's Tobiasson, however, believes some membranes may be better suited for use with IRMA than others. "Reliability-wise," he said, "a bituminous built-up roof membrane or EPDM membrane should be used. The membrane must be highly moisture-resistant because it doesn't have exposure to the sun to dry it." Tobiasson further suggests that glass felts should be used if a BUR membrane is chosen.

Both Roodvoets and Tobiasson mentioned that a low-cost modified bitumen membrane would be an ideal component for future IRMA installations. CRREL is testing a modified membrane in an IRMA system in Alaska this year. "It should be a super application," Tobiasson said.

South remains cool

To date the market for IRMA roofs has continued to be in the Northern states, such as Minnesota, Alaska, New Hampshire and Wyoming, and Canada. In Canada the system has become so popular that 40 to 50 percent of the country's total commercial roofing is protected membrane systems.

The reasons Baker gave CRREL help explain why IRMA is so popular in cold regions, but they don't explain why markets further south haven't jumped on the IRMA bandwagon. Some believe that part of the South's coolness toward IRMA may be attributed to the system's weight. Because IRMA is a loose-laid-and-ballasted system, it weighs more than a conventional system. This has never been a deterrent in the North because buildings there are built to accommodate heavy snow falls. In the South, however, the ballast's extra weight makes the system impractical.

Some are finding, however, that an IRMA roof does offer advantages even to Southern builders. "In the South they've learned that insulation can reduce the cost of air conditioning," Tobiasson said. Protected membrane systems are being installed frequently in Washington, D.C.; and in Atlanta, almost all the high-rise buildings have protected membrane roofs, Roodvoets said.

For those Southern designers and contractors who may still be worried about IRMA's weight, Dow has developed and patented a product that just might win them over. The product, called Light-Guard®, combines concrete mortar ballast with the insulation. The ballast/insulation boards use a tongue-and-groove system to hold the product in place, reducing the amount of added ballast needed. The lower weight will help open up new markets by making IRMA more appropriate for buildings that weren't designed to handle heavy roof systems.

Paying the price of success

IRMA's weight isn't the only drawback that has prevented the system from gaining converts in some markets. Owners also find its initial price prohibitive. IRMA marketers answer this criticism by pointing out that IRMA applications don't need the major additional expenditures for replacement or repair that conventional systems need. This means that over the long haul the cost of installing and maintaining an IRMA roof may nearly equal the cost of installing and maintaining a conventional roof.

Now that Dow's patent has ended, other factors may also lower the cost of owning an IRMA roof. Under the patent, manufacturers and distributors had to pay Dow royalties for the privilege of passing Styrofoam on to Dow-licensed contractors. Because these royalties no longer need to be paid, the companies should, in theory, be able to pass the cost savings on to their customers.

The patent's end also means that roofs may be installed without a warranty or with a lower grade of insulation, practices which should further lower the initial price of the system. However, these cost-cutting measures may not save money in the long run if they lead to repair problems later on, Roodvoets warned.

Expired patent opens new markets

The non-proprietary IRMA is also attracting attention from customers that aren't necessarily interested in the potential cost savings. These designers, owners and contractors may have been interested in the system in the past, but didn't want to bother with proprietary agreements.

One group that was hesitant to use the system while it was patented was the U.S. Department of Defense. "Government agencies don't like to get locked into proprietary contracts," explained Richard Fricklas, director of the Roofing Industry Educational Institute (RIEI). But even though the department had reservations about IRMA's use, the system wasn't forgotten entirely. IRMAs were installed in Alaska and were used almost exclusively at a couple of Air Force bases in the Arctic. The Army even made a film about building the system that is still shown at RIEI.

The systems proved to be so successful in these limited applications that Defense officials are wholeheartedly endorsing IRMA now that the patent has expired. "They've screamed and yelled, 'we must take advantage of the system,'" Tobiasson said. "So now, the U.S. Army Corps of Engineers is in the process of putting together guide specifications so that the system can be used freely on new Army and Air Force construction." The Corps of Engineers is also stepping up research on the system's use in warmer climates.

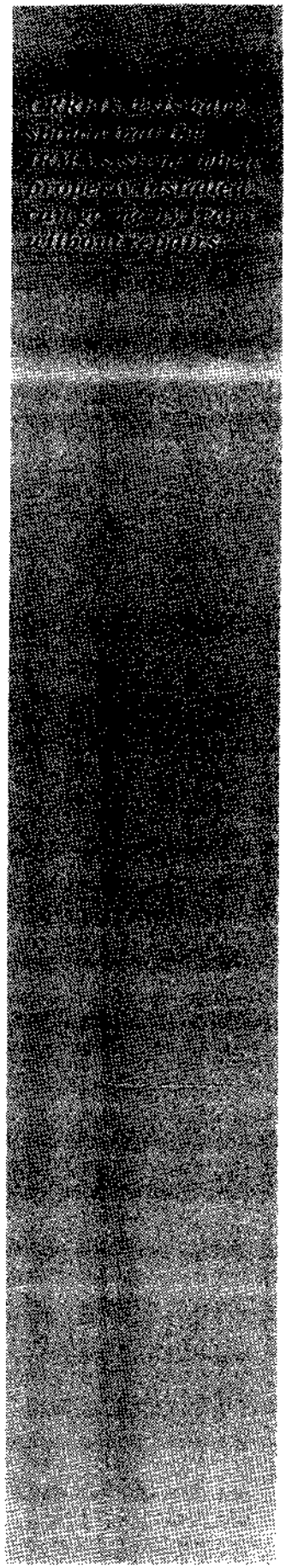
The patent's end has also caught the interest of the American Institute of Architects (AIA). The Institute is planning to publish specifications for generic protected membrane systems. Because of IRMA's position in the market, AIA asked Dow to write these specs. Dow should be finished with the work by the end of 1985, Roodvoets said.

System developing a track record

Perhaps the one characteristic of the protected membrane roof that will insure the system's growing popularity among users and manufacturers is its durability. CRREL's tests have shown that the IRMA system, when properly installed, can go many years without repairs. "There are even some protected membrane systems that have been down 12 to 15 years and are still performing beautifully," Roodvoets said. Roodvoets also claims that 98 percent of all installed protected membrane systems are still performing and haven't needed major repairs. These roofs have been down an average of eight years, he said.

The oldest protected rubber membrane roof in the United States is on the CRREL building in New Hampshire. The system contains an EPDM membrane and Dow's Styrofoam insulation. While this roof has had problems, the installation has given CRREL engineers the chance to study the system's strong points and determine what mistakes must be avoided in future protected membrane installations.

The CRREL roof was disassembled in 1982, Tobiasson explained, because a portion of the roof had chronic leaks after heavy rains. "When the roof was laid in



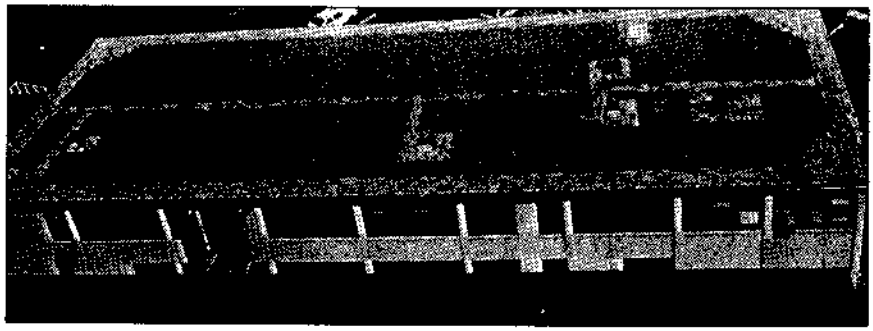
During the last three years, IRMAs have been finding their niche in reroofing/retrofit as well.

1972 they didn't know a whole lot about EPDM membranes. A lot of dumb things were done," Tobiasson said.

As the researchers began studying the system, they discovered that some of its problems were caused by the dirt that the design allowed to enter the assembly. This dirt trapped water, which, in turn, caused hydrostatic pressure to build up. The process inevitably led to the development of leaks within two or three years. To solve this problem, a filter fabric was placed between the insulation and ballast. The screen allowed water and vapors to escape while preventing dirt from seeping through, Tobiasson explained.

As they studied the roof further, the researchers also discovered that all of the problems were occurring on the half of the roof that was built on a dead flat deck, although there were flaws in both halves of the roof. They found that the half of the roof that had been built on a ¼-inch slope remained watertight.

By examining the CRREL roof's insulation, the reasearchers determined that extruded polystyrene installed in this type of roof system is able to retain its moisture and thermal resistance. Tobiasson said a few heavy extruded polystyrene insulation boards were found, indicating that the insulation had absorbed a large amount of moisture, "but most didn't contain much moisture and did retain over 80 percent of their insulation ability," he added. "Even without slope and with dirt, most of the insulation worked fine. The heavy boards were the exception not the rule."



This roof at the Devens, Mass., demonstrates how a protected membrane roof should look when finished. Gravel or stone ballast covers most of the roof. Pavers are placed at the roof's perimeters where extra wind uplift protection is needed most. Note the extra pavers at the roof's corners.

Proper application yields durability

CRREL's experience with its test roof led the lab to develop some guidelines for proper protected membrane system installation, according to Tobiasson. These guidelines include:

- using a filter fabric between the insulation and ballast;
- building slope into the deck to encourage drainage; and
- leaving an open surface that is capable of being vented.

"The top surface should not be sealed," Tobiasson stresses. "Water will get trapped." To create an open surface Tobiasson suggests using fluted pavers, pavers on pedestals or fluted insulation. Pavers should not be laid tight against the insulation, Tobiasson says. He also warns against using low-strength concrete pavers because experiments have shown they deteriorate during freeze/thaw action.

For low-cost ballast the best choice is still stone, according to Tobiasson. "The system is generally least expensive and easiest to apply using stone ballast—10 to 12 pounds per square foot will hold down almost any reasonable amount of insulation for most places in the United States. Even for heavily insulated protected roofs there's no need to keep piling on stone," he said.

If the use of stone ballast causes concern because of wind uplift, Tobiasson suggests using pavers at the points of the roof where wind uplift would be greatest. These locations would be around the perimeter of the roof and especially at the roof's corners.

Ready to take on new markets

To date, most protected membrane systems have been used in new construction, especially for institutional structures such as schools, universities and government buildings. But during the last three years, IRMAs have been finding their niche in reroofing/retrofit as well. Roodvoets predicts that this trend will continue and the largest growth in the use of IRMAs will be in this market.

Over the next five years, Dow also expects to see more interest in protected membrane systems from owners who occupy their own buildings. These would include owners of shopping malls and industrial plants. Dow believes these owners will be looking for a long-term investment and will be attracted to IRMA's durability.