

The roof survey: getting back to basics

by Michael Dhunjishah, P.E.

The last decade has seen the introduction of sophisticated equipment to evaluate and analyze roof conditions. Most of the roofing being analyzed, however, is still conventional BUR. And when it comes to evaluating conventional roofing, the newer approaches cannot replace the basics—a systematic and visual survey based on knowledge and experience.

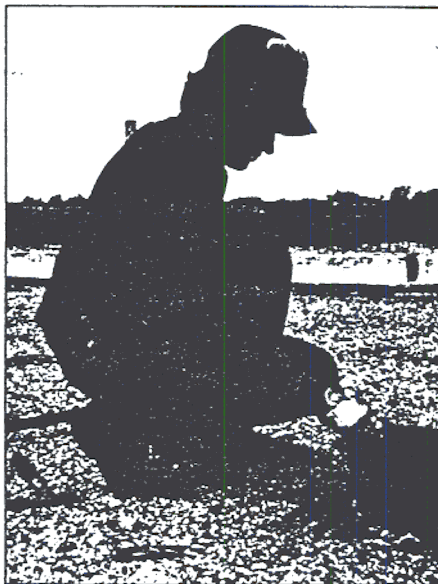
The systematic approach to roof surveys involves preparation, field work, evaluation, reporting and possibly follow-up work. For a visual condition survey to be useful, the documentation, results and evaluation must be reported in a form that will permit the building owner to take the appropriate actions based on his financial and other constraints. Advanced, non-destructive techniques that measure infrared radiation, nuclear movement or capacitance can be used if necessary, but in my opinion, they should be used only to augment the visual survey.

Basic, systematic visual surveys aren't only for built-up systems, however. More and more single-ply systems are requiring inspection and repair as the number of installations increases and existing systems age. Although this article describes procedures for evaluating built-up roofs, the same general approach can be applied to single-ply systems. The growing variety of single-ply systems makes one additional evaluation necessary, however. When surveying a single-ply roof, it should be determined if the system

applied fits the installation's structural and environmental constraints.

Establish purpose first

Prior to starting a roof condition survey, it is necessary to establish its purpose. There are four main reasons why surveys are undertaken:



An investigator cuts a small sample out of the roof to analyze its condition.

Maintenance. This type of survey determines what maintenance procedures are needed to maximize the service life of the existing roof. These surveys are generally carried out for the owner or property manager.

Existing condition determination. This survey evaluates a roof's present condition and probable service life. Roof problems are examined, and the costs and procedures of the options available to maximize service life are determined. These surveys are generally carried out for the present owner or property manager or for prospective owners.

Leak investigation. This survey is conducted to determine the cause of a roof's leaks and the best way to fix the damage.

Lawsuit investigation. This type of survey provides an independent expert's opinion about the condition of a roof and the possible cause of its problems. The information is usually requested by two or more parties who cannot agree on a remedy for the roof's ailments.

Regardless of the type of survey, the approach is generally the same, even though the degree of documentation and reporting may vary.

Gathering the information

Once the purpose of the survey is established, the next step is to obtain as much information about the roof as possible. The best way to start is with a review of the roof plans, details and specifications. In most instances, however, these are not available. Nevertheless, some information such as the roof's age, and the number and dimensions of the roof's different levels should be available. Other useful information includes the locations of the roof's current leaks and its leak history as well as other past or present roof problems.

Often, the surveyor will be able to obtain a chronological history of the roof by reviewing repair invoices. Much information can also be gleaned from the maintenance workers that are responsible for getting roof problems fixed. The building's occupants can be valuable sources of background information as well.

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The roof investigator uses several tools and pieces of equipment to evaluate the roof's condition. Generally, he will bring with him:

- a ladder;
- a camera and film;
- measuring devices;
- a lumber crayon and marking paint to designate problem areas;
- a clipboard and paper, including a checklist of items to be observed;
- some roof cut tools, including a knife, heavy-duty plastic bags, tape, a test cut template, a whisk broom, a hatchet, a brick mason's hammer and a rag; and
- a flashlight to look at the roof from below.

Field work begins indoors

The actual survey begins inside the building. First, the investigator tries to update and fill the gaps in the previously gathered information by interviewing the owner, maintenance personnel or occupants. Then, the problem areas are examined. During the inspection, evidence of roof leaks, water stains, structural damage, and leaking drain lines or other mechanical units will be documented on the checklist and the problem areas marked on the roof plan. Sometimes this documentation is augmented with photographs.

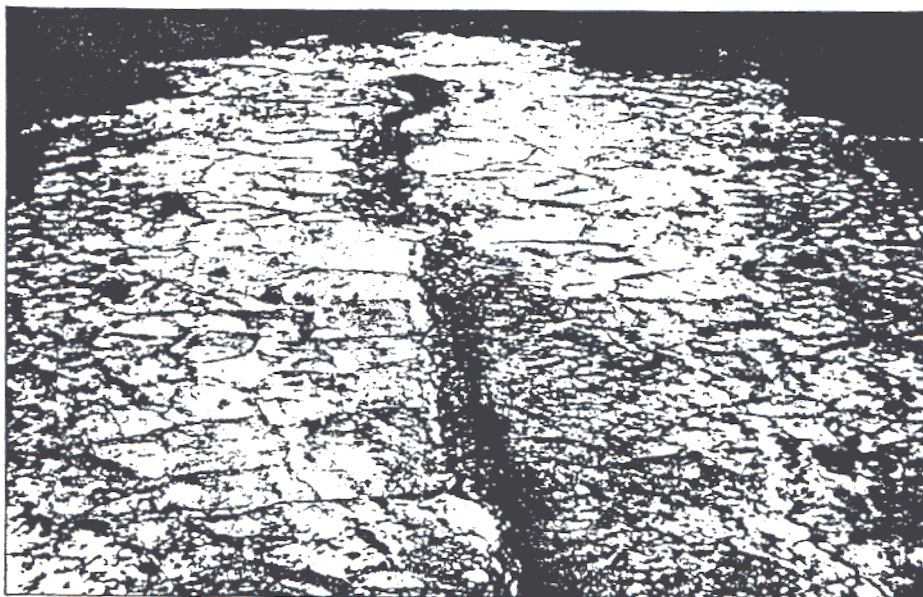
This interior survey should proceed systematically and should include as much of the interior area below the roof as possible. The deck will also be inspected during this survey. A close examination of the deck may reveal the actual construction of the roof. This information can be used to verify that the roof was constructed according to the plan.

C.W. Griffin in his *Manual of Built-Up Roof Systems* (McGraw-Hill Book Co., New York, 1982) presents a fairly comprehensive list of items that need to be evaluated. For the following types of decks Griffin suggests:

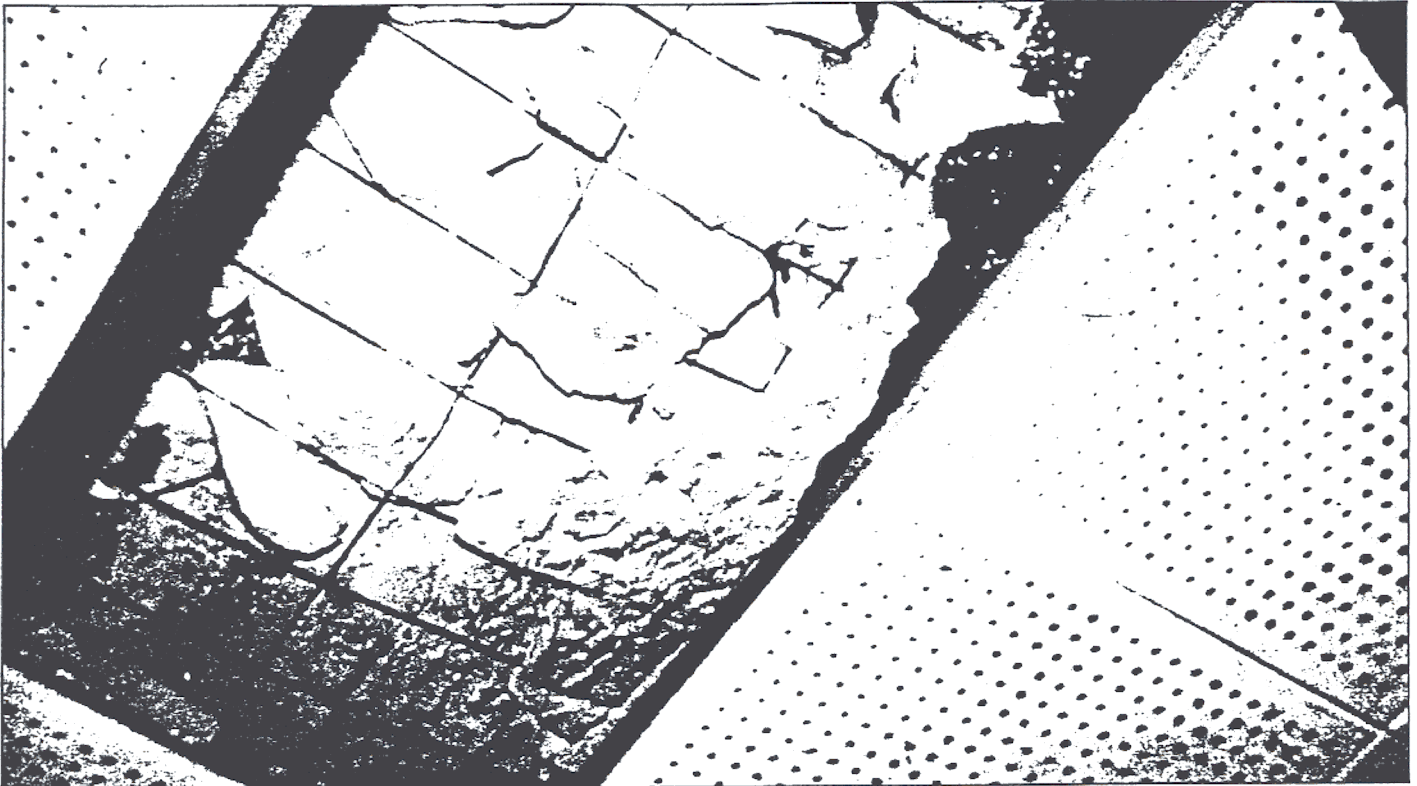
Steel should be examined for rusting, differential deflection at side or end laps and excessive deformation. Welds should be sound and rooftop components should have their own structural angle supports.

Wood should be checked for rotting, warping, shrinkage, excessive joint gaps and proper attachment.

Structural concrete should not have cracks over 1/8-inch wide, and deflection should not be excessive.



Roof problems such as ridging, alligatoring, cracking and blistering will be documented in the investigator's report.



Examining the underside of the roof may be the only way to discover this type of deteriorated condition.

Precast concrete should not have excessive joint gaps or differential deflection at adjacent units.

Poured gypsum should be examined for excessive deflection of subpurlin bulb tees, cracking and evidence of excess moisture.

Corrugated steel supporting lightweight insulating concrete should have venting slots in the deck's underside or side laps. There should be no effluence on the metal. The deck surface should be checked carefully during the topside inspection.

Structural wood fiber should be checked for excessive deflection, differential deflection between adjacent units and excessive joint gaps.

Up on the roof

Once topside, the investigator will walk over the roof to form a general impression of its condition, making mental notes of any visible problems and problem areas. A systematic examination may proceed after an overview of the roof has been gained. During the systematic examination, such things as roof dimensions; the location, type and size of each rooftop unit and penetration; the type of perimeter; and any other pertinent information will be documented and verified.

A systematic examination will yield information about each roof area and component, and include a record of any signs of damage, misuse or improper installation. The investigator's observations should include:

The roof surface's general appearance. The investigator will note if the roof is well-maintained or if material is being stored there and debris allowed to collect. The quantity and adequacy of repairs and the amount

of traffic and mechanical damage to which the roof has been subjected will also be observed.

The membrane and surfacing. Bare areas, ridges, splits, blisters, curled felt edges, alligating and other damage will all be documented as well as inadequate amounts of aggregate and excessive dirt in the aggregate. The quality of the roof's construction will also be evaluated. This can be gauged from evidence of correct design; good or poor workmanship; the use of proper materials; adequate attachment of the membrane to the insulation and the insulation to the deck; adequate decking; deterioration of the roof assembly or decking; and the presence of moisture within the system.

Evidence of ponded water. The depth of any ponded water will be measured and the length of time it has been present on the roof will be recorded. If there is

no water on the roof, other evidence of ponding such as a buildup of dirt, algae and dark areas or growing vegetation will be noted.

Flashings. If their positions correlate with interior leak locations, this will be noted. Base flashings around the perimeter and rooftop will be checked to see if they were properly constructed and mechanically fastened to prevent slippage. Evidence of deterioration, damage, disbonding or wrinkling, partially filled pitch pans or otherwise improperly flashed penetrations will also be recorded. The investigator must also determine if the counterflashing was sealed and secured in a way that allows for contraction and expansion.

Other roof accessories and drains should also be examined to determine if they were properly installed and are performing adequately.

Test cuts check quality

While you will learn much about a roof through a surface inspection, it has been my experience that roof test cuts should be made, if at all possible. To glean the most information from the samples, they should be taken from locations that represent both typical and atypical conditions.

The location of each sample should be documented as it is taken as well as the type of substrate it is attached to and the method of attachment. The amount, type and condition of insulation and the sample's pli-

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ability should also be recorded along with any other pertinent data noted during the cut.

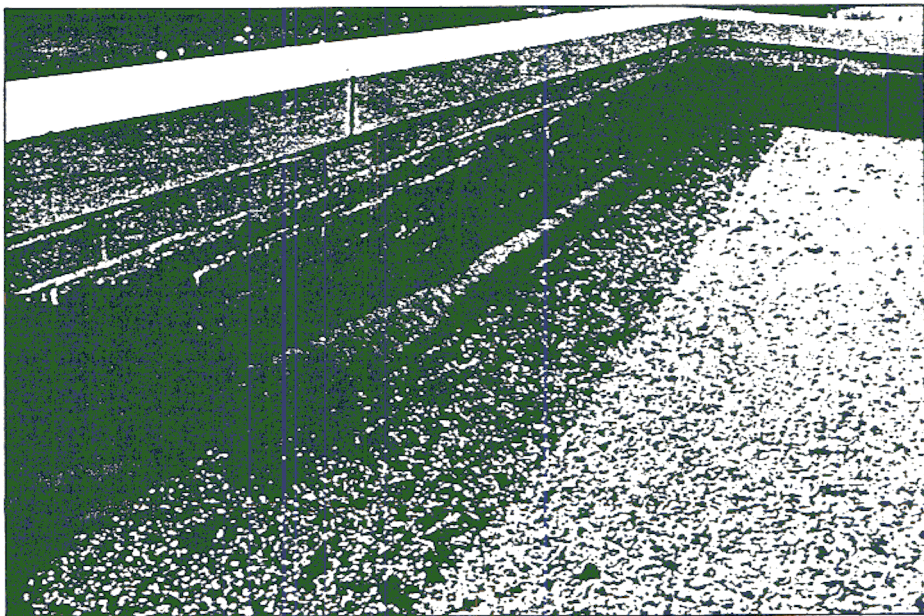
Once all the cuts have been removed, they will be sent to a laboratory where they can be frozen, dissected and examined. Information such as the membrane's adhesion, the general amounts of interply bitumen that were applied, how the inter-

plies cooled and the type of felt used can be gleaned from this technique.

An analysis of the test cuts can also yield quantitative information, if needed. A laboratory can deduce a roof's interply bitumen content, amount of flood coat or number of plies from a test cut evaluation. While this quantitative information may be necessary for documentation in case of a lawsuit, I find that the qualitative analysis yields the invaluable data that is needed to evaluate a roof's condition and history.

Report presents evaluation

For the investigator to evaluate the information he has gathered, he must keep in mind the reason the survey was undertaken and what the client wants or needs. As he reviews the field-work documentation, he will look at the

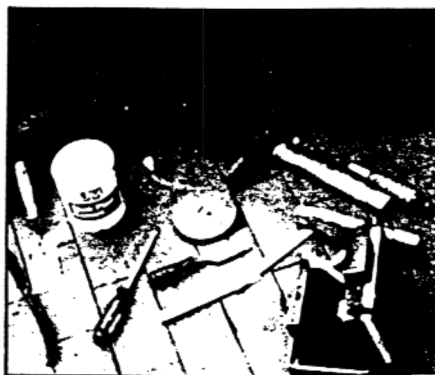


Poorly flashed parapet walls are a prime source of leaks in a roof system.

roof's general condition, the quality of its construction, the condition of the flashings and penetrations and the adequacy of its drainage.

Once the investigator has evaluated the roof's design, materials, installation methods and maintenance, he is ready to make a set of recommendations tailored to the client's needs. Generally, it is possible to give the client a set of options. However, each of the options should be presented in enough detail to allow a decision suited to the client's constraints to be made. The client should also be able to determine the amount of risk involved with each option.

Three courses of action are usually possible with most existing roofs. The client can choose to reroof, undertake major repairs or repair the specific



These are some of the common tools an investigator will use to examine and document a roof's condition.

problems. In most instances, finances will be the most important consideration.

Information in a properly presented report is arranged to allow the client to weigh the available alternatives and reach the decision that best suits his needs.

Regardless of its format, a report should contain the following items:

- the purpose of the evaluation;
- background information, listing the sources of roof data; the building's location, construction, age and size; and the roof's composition, area, levels and problems;
- the scope of services, including the review of plans and specifications, interviews with building personnel, visual examinations, roof cuts and analyses that were needed to conduct the evaluation;
- the evaluation, describing the roof's condition and giving an estimate of remaining service life along with the criteria that was used to arrive at conclusions (summary of major findings);

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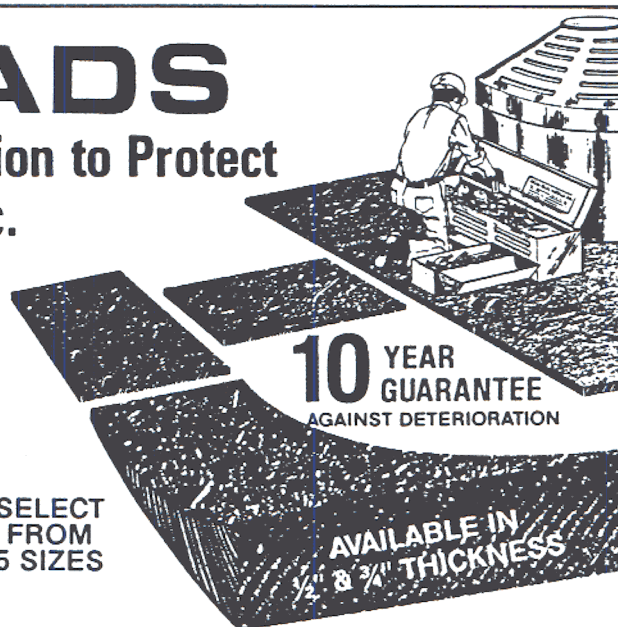
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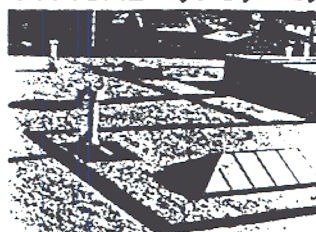


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- the investigator's recommendations, including a summary of the client input that affected the recommendations; the options available, stating the advantages and disadvantages of each; the recommended option, if applicable; and cost estimates;
- any recommended additional work such as additional evaluations; non-destructive surveys; preparation of plans, details and specifications for corrective work; prerooting conferences; and inspections during repairs or reroofing that will be needed; and
- an appendix that includes the detailed findings, an analysis of any roof cuts made; a roof plan; and numbered photos with captions.

Once topside, the investigator will walk over the roof to form a general impression of its condition.

Systematic survey remains the key

After the condition of the roof is assessed, additional tests using non-destructive detection devices may be desirable. These tests can pinpoint moisture that is not readily detectable by visual examination. However, the usefulness of non-destructive tests is


limited by the operator's expertise, the type of roof system being tested and the interpretation of the results. The advent of sophisticated non-destructive moisture detection equipment may seem like a roofing problem panacea, but a systematic survey in conjunction with the use of all available data and roofing knowledge still remains the key to determining the causes of roof problems.

Simply repairing the symptom without knowing the cause leads to a temporary solution at best!

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