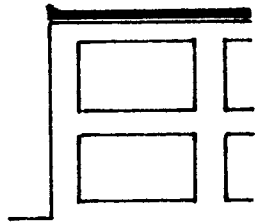


ROOFS

SUMMARY

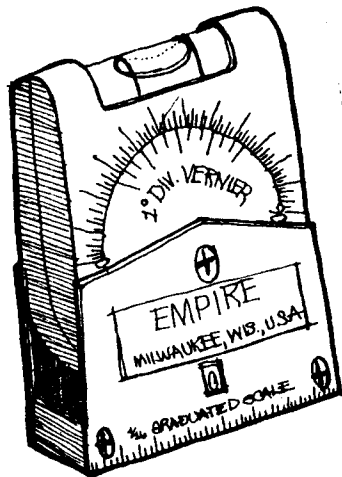


The primary objective of the roofing membrane is to absolutely keep out weather - principally moisture. In the process of achieving this goal, the roofing membrane is directly exposed to the brunt of the elements. The field tests in this area emphasize the primary objectives and are directed at conditions which impair this performance.

Small openings in the impervious roof surface cause leaks. Field tests in this area examine potential and actual openings and attempt to attribute their cause. The flat roofs are typical for the building type studied and are the only type examined by the B.I.U. Project.

PERFORMANCE OBJECTIVE: KEEP MOISTURE FROM ENTERING BUILDING

TEST # 1: Minimize Standing Water on Roof Surface



Test Method: Determine past performance, if possible. It is necessary that the field test should occur within four days of a moderate to heavy rain. Test by visually examining the entire roof to determine overall drainage patterns, standing water and obstacles to proper drainage. A long level (four feet or longer) used with a vernier inclinometer reading 1° accuracy should be used to determine slopes. Approximately five measures in each direction at equal intervals should be made for every 1000 sq. ft. of roof surface. A metal ruler can be used to measure the depth of standing water. Data is recorded and unusual conditions are photographed. Wear waterproof boots.

Measures: Ponding (standing water)

- Slopes of roof to 1° accuracy
- Extent (to two feet) and depth (to 1/4 inch) of standing water

- measure with the ruler on membrane surface below aggregate level (on top of membrane).
- Obstacles in gutters and drains
 - Comparison between the level of roof drain (lip) and roof three feet from drain (to 1/4 inch).

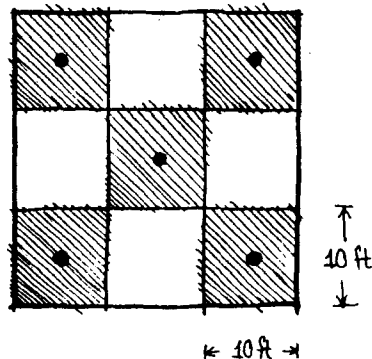
TEST # 2: Proper Detailing of Roof Penetrations

Test Method: Determine past performance if possible. Test by close examination of the working drawings and specifications to determine conditions which are not consistent with good practice and may cause potential leaks. These conditions bear careful examination in the field.

All penetrations through the roof membrane, including level changes, the roof edge, ducts, piping, skylights, etc., should be examined from a distance of one foot with a concentration on the interior of the building around these joints. Data is recorded and photographs are taken of unusual conditions.

Measures: Proper roof detailing

- Adequate flashing above roof level (to 1/2 inch)
- Membrane carried up around penetration (to 1/2 inch)
- Exposed flashing
- Evidence of leakage around penetrations



TEST # 3: Resistance to Movement

Test Method: Determine past performance if possible. Test by making a detailed visual examination of the roof from a few inches. Approximately five observations are made per 1000 sq. ft. on alternate ten foot squares. Data is recorded and unusual conditions are photographed.

Measures: Deterioration due to movement

- Tears and splits caused by moisture or temperature expansion and contraction (length to 1 inch; width and depth to 1/32 inch)
- Alligatoring around standing water due to temperature differentials or by embrittlement (extent to 6 inches; width and depth to 1/32 inch)
- Blisters and buckles due to trapped air within membrane (to 1 inch)
- Holes (to 1/32 inch)
- Extent and quality of aggregate coverage

TEST # 4: Proper Installation of Roofing Membrane

Test Method: Same as Test #3

Measures: Roof construction

- Exposed laps of roofing membrane (to 1 inch)
- Fishmouthing (to 1 inch)

REFERENCES

Material on roofing performance which helped develop our field tests was plentiful. Manufacturers literature (Johns-Manville; Pittsburgh-Corning) and reports by institutions (National Research Council, Canada; Small Homes Council, University of Illinois; U.S. National Bureau of Standards) are all useful. The book, Manual of Built-Up Roof Systems, C.W. Griffin, McGraw Hill, 1970, was especially comprehensive. Though there is no lack of material in this area it remains, in general, an area of poor performance in practice. Reasons for this are discussed in detail in the Technical Factors Report.

In Addition:

ASTM D-1709 Impact Resistance for Film and Sheet-Type Materials

ASTM D-781 Sudden Application of Puncture

ASTM D-471 Absorption by hydroscopic Roof Covering Materials

"Flat Roof Failures" in Architects' Journal, 30 June 1971

A roofing contractor can be used to take a core sample of a roof which reveals problems in cross section. This is easily patched.

SUMMARY OF ROOFS PERFORMANCE TESTS

PERFORMANCE OBJECTIVE: KEEP MOISTURE FROM ENTERING BUILDING

TEST # 1: Minimize Standing Water on Roof Surface

TEST # 2: Proper Detailing of Roof Penetrations

TEST # 3: Resistance to Movement

TEST # 4: Proper Installation of Roofing Membrane