

CONFIDENTIAL
For Bird & Son, inc.

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PLAINTIFF'S EXHIBIT

BIR-1011

INVESTIGATION OF CRACKING
OF
ASPHALT SHINGLES IN THE WEATHER

Consideration of Data Collected
in
Four Divisional Areas of Bird & Son, Inc.

June 1973.

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DEFINITION

Horizontal Cracking is a form of cracking developed in the weathered coating of asphalt shingles, irregularly parallel to their butt edges and usually 1/2 to 2 inch down-roof from the butts of the overlying shingles. It often gives the appearance of continuing uninterruptedly from one shingle into adjacent ones. Observed widths have varied from about 0.001 to 0.2 inch.

THE PROBLEM

Serious premature failure of asphalt shingles as a result of severe cracking was first recognized in the Tampa-Orlando area of Florida. Preliminary investigation indicated the possibility of it being more widespread and a few complaint samples from other areas demonstrated the same possibility.

ATTACK

The writer was asked to examine roofs in many regions and attempt to determine to what extent the condition prevailed in each region, also the manner in which local conditions influenced design factors. He was also asked to make recommendations for possible prevention of the trouble.

June 1973
D.J. Smith

ACTION TAKEN

Intermittently over the past year roofs have been examined by the writer and a succession of Bird salesman and Quality Control Superintendents from Tampa, Florida Lat. 28 degrees north, to Burlington, Vermont, Lat. $44\frac{1}{2}$ degrees north, in a band about 3 degrees of longitude wide and roughly parallel to the Atlantic coast. The other area examined was in the South West Division from Baton Rouge to Houston close to the gulf, to Dallas and St. Louis in the more central plains - roughly from 30 to 38 deg. N. Lat. and 90 to 97 deg. W. Long.

Two hundred and twenty-seven (227) roofs were examined and observations recorded; 110 photographs were taken.

Four progress reports have been made. Each included details, summaries and discussion, by areas.

In the remainder of this report, an attempt will be made to present some useful generalizations, without direct reference to the detailed data. It is anticipated that the progress reports will be made available to those interested, or that a comprehensive report will be compiled, if required.

GENERALIZATIONS

1. Development of horizontal cracking was restricted to shingles well sealed down near their butts. The sealant may be either machine or hand applied. When the sealant held down the whole exposed area, no horizontal cracks were observed. Seal-downs, not sealed (as along eaves), did not develop horizontal cracks.

June 1973
D.J. Smith

GENERALIZATIONS cont'd

2. The cracking can often be observed first by the displacement of granules along the line which apparently develops as a crack. This line appears to open progressively wider with the years. It has the form of a "Vee" with the open end on the surface of the shingle and the point of the wedge at the felt.

3. Shingles expand when heated by the sun and contract when cooled. When the exposed portions are not sealed down, this increase in size results in unrestricted movement and the shingles remain flat. However, when the shingles are held between a line of sealant dots and another of nails about 5 inches apart, the expansion can most easily occur when the shingle bows upward. This is like a long low buckle, with the crest about half way between the lines of fixation. It is along this crest that the upper face of the coating is subjected to tension and ultimately opens.

4. There are many factors which can influence the growth of such a crack.

4.1 The extent of the change of temperature.

The greater the range the greater the expected movement. Darker colors increase the range of temperature. In colder climates, it is conceivable that the sheet could become so stiff in the lower temperature range that little bending would occur, so therefore only the upper part of the range would be effective, thus reducing extent of the flexing.

4.2 Southerly slopes developed the worst cracking; they also receive the most heat.

4.3 Brittle coatings would appear to crack more readily than those which could relieve stresses by flow. Coatings on southern slopes receive more ultraviolet light and thus embrittle faster too.

June 1973
D.J. Smith

GENERALIZATIONS cont'd

4.4 In southern regions, moisture adds to the problem. Absorption of moisture increases the amount of expansion. 7

4.5 In these same southern areas, low slopes permit moisture to enter the cracks, get into the felt and help in the growth of fungi. With strength of felt decreased, the cracks open up as splits, running from end to end of a shingle. 7

4.6 The thoroughness with which the felt is saturated has a bearing on the amount of wetting that takes place with water. It thus influences the range of the expansion-contraction cycles.

4.7 The thickness of the coating has a bearing; it appears to be deleterious in the south and perhaps beneficial in the farther north. 7

4.7.1 In the south, the tension developed at the convex surface is greater than for a thin one.

4.7.2 In the north, it may be that the extra thickness results in so stiff a sheet that it does not bend.

4.8 Movement of the deck probably explains much of the variability of the cracking observed on each exposure. Such movement can explain the variability, but not the otherwise consistency of this type of cracking.

5. Horizontal cracking appears on porches and overhangs as well as on main roofs, with no detectably consistent differences among them.

6. No difference was observed resulting from solid lines of adhesive, closely spaced or widely spaced dots. However, the data bearing on this point are meagre.

June 1973
D.J. Smith

GENERALIZATIONS cont'd

7. There were a very few Mark 25's on low slopes in the north, particularly on Cape Cod, free of horizontal cracking. That is all.
8. Competitive shingles generally produced horizontal cracks in about the same degree as did Bird. Wherever there was a difference it was usually in favour of the competitive material, possibly because they were thinner.
9. There is little evidence that no-cut-out shingles had more horizontal cracking than did those with cut-outs. However, the cracks showed up more.
10. No. 9 granules expose the cracks more than No. 11's do. Unless well embedded, they seem to fall out more too.
11. Overall, half-lives from 2 years in the south on 25 yr warranties and as little as 4 to 5 years in some more northerly areas requires action by Bird and probably by the whole industry.