Effectiveness of clips, staples and cement as fasteners for asphalt-shingle tabs

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EFFECTIVENESS OF CLIPS, STAPLES AND CEMENT AS FASTENERS FOR ASPHALT-SHINGLE TABS

by

LeRoy Wayne Bonnicksen

A Thesis Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of MASTER OF SCIENCE

Major Subject: Agricultural Engineering (Farm Structures)

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1951
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INTRODUCTION

The Problem

Thousands of dollars are wasted annually from wind-damage losses to asphalt shingles and especially from windstorms of high winds that cover wide areas. The problem is to find the causes for this wind-damage to asphalt shingles and to determine satisfactory means of prevention. Because this problem as a whole is too large for a M. S. thesis, this thesis will concern mainly the effectiveness of clips, staples and cement as fasteners on asphalt-shingle tabs.

Justification for Study

In a study on wind damage to farm buildings, Merle L. Esmay and Henry Giese (3) pointed out that there has been a 60 per cent dollar increase of wind damage per 1000 dollars of risk of farm buildings in Iowa from 1930 through 1948 while the rural-farm-fire damage has decreased by 53 per cent even in the face of the last few inflation years. They
state that a reduction in farm-fire damage has been accomplished through research and a comprehensive fire-prevention program. If a research and educational wind-damage program can be made to bring about a similar decrease or even a reduction to the 1930 level, they state that the saving of some four hundred thousand dollars per year could be realized by the members of one mutual.

Esmay and Giese have classified wind damage into major-structural damage and minor-type damage. Roofing damage is included in the minor-type damage. They showed the percentages of this classification for the periods of 1930 to 1933 and 1946 to 1948 and for the October 10, 1949, wind-storm and they stated (3, p. 3):

Percentagewise, major structural damage has dropped some 20% resulting from an increase in minor damage. . . . that minor damage exclusive of damage to roofing has continued almost on a level of approximately 18% throughout the 20 year period and that damage to roofing has been responsible for practically all of the increase of the minor type classification.

Esmay and Giese made a further breakdown of roofing damage into types of roofing materials and they stated (3, p. 4):

The damage to asphalt shingles has increased from 11.1% of the total roofing damage in 1930-33 to 64.5% in 1946-48 or nearly six times within twenty years. The seriousness of this increase of asphalt-shingle damage is emphasized by the findings of a roofing
survey by the Iowa Agricultural Experiment Station in 1948, which found that only one-eighth of the area of all farm building roofing in Iowa was asphalt shingles.

Because the greatest savings in wind-damage losses can be made by increasing the wind resistance of the asphalt-shingle roofs which are now applied, this study of clips, staples and cement tab fasteners, which are the most desirable and commonly used means of increasing the wind resistance to roofs now applied, was conducted.

Review of Literature

The author found only two sources which had any substantial information on tab fasteners. They are by Roger M. Cleveland (1) who made many field observations of asphalt-shingle roofs and James L. Strahan (9) who is the technical director of the Asphalt Roofing Industry Bureau.

Cleveland found a roof where one cement failure had occurred. In this case the tab had not been firmly pressed down on the cement. He (1, p 134) concluded that:

Cementing the tabs down must be done with care if the tabs are expected to be firmly fastened.

He recommended that cement should be applied when the shingles are warm to allow good sealing, because if the
shingles are too cool, the tabs will not settle down and seal but will remain curved and allow the cement to dry. He states that a properly cemented-down asphalt shingle will last until the sun wears out the shingle and that he highly recommends cementing for new construction or repair work.

Cleveland found that clips have given excellent service and he found no evidence that the clip has damaged the tab even on 10 year old clipped shingles. He also recommended the use of clips for new construction or repair work.

Cleveland interviewed 66 lumber dealers in Iowa in 1947-48 and he gives the results in per cent to the following questions (1, p. 66):

- Have you used clips? Yes 34, No 66.
- Do you recommend clips? Yes 53, No 47.
- Have you used cement? Yes 74, No 26.
- Do you recommend cement? Yes 92, No 8.

He stated that the reasons the dealers gave for not recommending clips were (1, p. 73):

- . . . that clips are not necessary, clips add too much to the cost, the dealer did not know anything about them or that clips will spoil the looks of the roof.

James L. Strahan states that the correct nailing of asphalt shingles according to the manufacturer's instructions is really important and vital to the prevention of wind
damage and that four-inch exposure offers greater resistance
to wind damage. He also states (9, p. 117):

Practically certain 100 per cent protection against wind damage can be obtained even in
the most exposed locations, when the 5-in exposure is used, by cementing down the tabs
with quick-setting asphalt cement. This is accomplished by using a caulking gun to place
a spot of cement about as large as a 50-cent piece under the center of each tab and on the
surface of the underlying shingle, thereafter pressing the tab down firmly against the cement.
This same treatment can be applied to two and
three-tab hexagon strip shingles to render them windproof.

Mr. Strahan also brings out the fact that the deck for
asphalt shingles must present a smooth flat surface that
will remain smooth and flat throughout the life of the
structure and that this can only be done if the sheathing
is put on dry and means are incorporated in the building
to prevent the sheathing from becoming wet.

In a pamphlet (6) the Asphalt Roofing Industry Bureau
stated that the buckling of asphalt shingles or bulges on
asphalt shingle roofs is not due to any characteristics
of the shingles or expansion and contraction due to tem-
perature changes but is due to the shrinking of the
sheathing when it dries or to the expansion of the sheathing
when it becomes wet. They recommend that the sheathing
be dry before the shingles are laid and that means are
taken to keep it dry for the life of the roof.
Factors which may resist, cause or influence the wind damage to asphalt shingles

The factors which may resist, cause or influence the wind damage to asphalt shingles are:

A. Factors of the shingle
   1. Stiffness
   2. Temperature of shingle during wind storms
   3. Self sealing characteristics of the back-coating
   4. Weight
   5. Size and shape
   6. Age
   7. Variance of thickness
   8. Composition
   9. Felt thickness

B. Factors of application
   1. Exposure distance
   2. Placement, type and number of nails
3. Quality of workmanship and damage done during application
4. The use, holding ability, and life of tab fasteners
5. The use of starting, ridge, edge and valley strips and how the shingles are fastened at these strips
6. Weather during and for a few months after application

C. Factors of the deck
1. Smoothness of sheathing or old roofing
2. The use of felt under the shingles and the wrinkleless smoothness with which it is applied

D. Factors of exposure to wind and sun
1. Slope, shape, size and height of the roof
2. Direction of the main axis of the roof
3. Windbreak and sunshade protection for the roof
4. Location of the shingle on the roof

E. Factors of wind storms
1. Direction, velocity and gust factor of the wind
2. Amount of sunlight during storm
Factors which may affect the holding power against wind damage and the life of tab fasteners

The factors which may affect the holding power against wind damage and the life of tab fasteners are:

1. The possible increase in self sealing due to the clamping effect of metal fasteners

2. Type of asphalt shingle
   a. Weight of shingle and felt
   b. Smooth or grooved surface
   c. Thick-butt, uniform thickness or tapered
   d. Top and back coating and surfacing
   e. Size and arrangement of the cut outs or slots
   f. Size and shape of shingle

3. The temperature of the shingle during windstorms

4. The type of tab fastener used
   a. Material of fastener
   b. Size and shape

5. The location of the fastener on the tab

6. The workmanship with which the shingles and tab fasteners are applied

7. The exposure distance of the shingle

8. Age and condition of shingle

9. The location of the fastener to the crack between shingles
10. The location and distance between the nails and fastener

Field Observations of Asphalt-Shingle Roofs Using Tab Fasteners

Objectives

The objectives of the observations were:

1. To observe tab-fasteners on Iowa farm roofs and to find and determine, if possible, the limitations, type and causes of failure and other factors that may be present.

2. To observe other pertinent factors that influence the wind resistance of asphalt shingles which may be present on these observations.

Procedure

To obtain the information and data for this section of this report, the author visited Iowa farms to inspect the roofs and interviewed the operator and/or owner and visited and interviewed Iowa lumber dealers, insurance men and representatives from asphalt-shingle manufacturers.

The field observation schedules shown in the appendix were used as data sheets and as a guide to help the
interviewer obtain all pertinent information on inspections of roofs and interviews. There were five schedules, one for the farmstead, which was filled out only once per farm, one for the building, which was filled out once for each building, one for the roof which was filled out once for each flat or curved slope for each building, one for the tab fastener which was filled out once for each roof slope and one for personal opinion which was filled out once for each tab fastener for each interview.

Many pictures were taken to illustrate the observation and if possible a few samples were obtained.

Results and findings

Figure 1 shows samples of clips and staples which were found by the author to have been used or sold.

Table 1 gives the dimension of these fasteners. The 90° horizontal bent point on the lower arm of the round steel clip was 0.36 inches. The flat steel clip was copper coated and the round steel clip had no coating.

Clips. Two clipped roofs were inspected and they are designated roof Nos. 1 and 2. No wind damage had occurred to the clipped tabs of these two roofs. However, on roof No. 1, Figure 2, wind damage had occurred to the top two-thirds of the lower roof, which was not clipped,
while no wind damage occurred to the lower one-third of the roof, which was clipped.

Roof No. 1, Figures 2 through 8, was three years old, had 5-inch exposure thick-butt shingles and had aluminum clips applied by the farm operator who had never seen or applied any clips. He put the clips on the same year as the new shingles. He decided that the application was too slow and would fasten the rest of the tabs with cement which he had not started at the time of the observation.

The self sealing around the fasteners on roof No. 1 was moderate to none. The self sealing of unclipped shingles was slight to none.

None of the clips on roof No. 1 had lifted, opened or fallen off.

The placement of the clips on the tabs was not too consistent.

Figure 3 shows that the clip could not reach the tab because the exposure distance was too great.

Figure 4 shows how the lower arm of the clip was placed in the crack between two shingles so that the clip was not held down. Figure 5 illustrates better placement of the clip between two shingles so that the tab was held down.
Table 1
Dimension of Tab Fasteners

<table>
<thead>
<tr>
<th>Fastener</th>
<th>Stock material</th>
<th>Width inches</th>
<th>Thickness inches</th>
<th>Lower arm inches</th>
<th>Upper arm inches</th>
<th>Point length inches</th>
<th>Crown width inches</th>
<th>Leg length inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum clip</td>
<td></td>
<td>0.121</td>
<td>0.040</td>
<td>0.84</td>
<td>0.60</td>
<td>0.18</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Copper clip</td>
<td></td>
<td>0.107</td>
<td>0.049</td>
<td>0.80</td>
<td>0.60</td>
<td>0.16</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Flat steel clip</td>
<td></td>
<td>0.134</td>
<td>0.052</td>
<td>0.98</td>
<td>0.64</td>
<td>0.18</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Wide copper clip</td>
<td></td>
<td>0.185</td>
<td>0.050</td>
<td>0.92</td>
<td>0.84</td>
<td>0.24</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Round steel clip</td>
<td></td>
<td>0.071</td>
<td>0.071</td>
<td>0.98</td>
<td>0.98</td>
<td>0.12</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Galv. steel staple</td>
<td></td>
<td>0.103</td>
<td>0.020</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.500</td>
<td>0.500</td>
</tr>
<tr>
<td>Copper staple</td>
<td></td>
<td>0.061</td>
<td>0.061</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.96</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Figure 1. Samples of Clips and Staples. (actual size).
Figure 6 shows a clip which was slipped into place but not tapped down by a hammer. Approximately five to ten per cent of the clips had flattened out as shown in Figure 7.

Figure 8 shows that the top center clip was not fully pushed up to the shingle edges before it was tapped down by a hammer.

Figure 9 is of roof No. 2 which had 5-year-old uniform-thickness 5-inch-exposure shingles. The shingle surface was smooth and all coating on this shingle was pure asphalt with no filler. The tabs were fastened with round steel clips with the horizontal bent lower arm when the shingles were applied.

Figure 9 shows that the clip had opened or the top arm lifted. Approximately five to ten per cent of the clips were in this condition. The holes that had been punched by the points of the lifted clips have in most cases enlarged to double size. However, it appeared as if the pure asphalt coating had flowed in around the edges of the holes and had partly coated the exposed felt.

Because of the heavy backcoating of pure asphalt, the shingles had self sealed from tight to very slight. The self sealing around the fastener was tight to moderate on approximately 95 per cent of the shingles.
Because this was one of the first jobs that the carpenter had applied clips, the placement of the clips was not consistent. A few of the clips were applied in the crack between two shingles but because of the bent lower arm, they still held the tab down.

The opened clips could not be pulled out from under the shingles by the fingers in most cases; however, in all cases tried, the resistance was relatively great.

**Staples.** Four stapled roofs were inspected and are designated Nos. 3, 4, 5, and 6.

Figures 12 and 13 are of roof No. 3. The staple was the ½-inch galvanized steel one. The shingle was a thick-butt with a 5-inch exposure. Figure 13 shows a limitation of the machine in that the throat clearance was only five and one-quarter inches so that when the exposure distance was too large, the staple could not be placed on the tab. However, the tab still could be stapled if the machine was placed at an angle through the slot and two staples were put on the tab as shown. The tabs had fully flattened to the form of the deck and had slightly self sealed. The self sealing around the fastener seemed to be moderate. When it was cold, it was difficult to determine how much of the resistance was due to the stiffness of the tab and
the holding of the fastener and how much was due to self sealing.

Figures 14 through 17 are of roof No. 4. The shingle was a hexagonal three tab and was nine years old. The staples were the 7/8-inch copper staple and were placed when the roof was applied.

Figure 14 shows that some of the staples have lifted as much as one-sixteenth of an inch mostly on the left side. The cause of this lifting could not be determined.

Figures 15 and 17 show that the staple was improperly placed near the bottom edge of the tab so that its effectiveness was reduced.

Figure 16 shows a tab that was not stapled.

The self sealing around the fastener seemed to be moderate.

Figures 18 and 19 are of roof No. 5 which was fifteen years old and had dutch-lap shingles stapled with 7/8-inch copper staples. This roof was on a gambrel roof dairy barn which had its main axis north and south. Wind damage had occurred to the southwest part of the upper roof on May 5, 1950. The shingles started blowing off at the ridge between the upper and lower roof. The shingles came off in bunches as if the wind went in under them and pushed them off. Some of the nails pulled loose with the shingles
Figure 10. Tabs Nailed Down

Figure 11. Large Individual Hexagonal Shingles, 1-inch Copper Staples

Figure 12. 5/8-inch Galvanized Steel Staple

Figure 13. Exposure Distance Too Great
Figure 14. 1-inch Staple Lifted

Figure 15. Staple Improperly Applied

Figure 16. No Staple Applied

Figure 17. Staple Improperly Applied
and the rest stayed on the sheathing. No one remembered or noticed whether the staples failed before the shingles went off, after the shingles went off, or not at all. The shingles on the west roof of the barn had been removed and large individual hexagonal stapled shingles had been put on, shown in Figure 11. Figures 18 and 19 are of the east side which was patched with good shingles from the west side. An inspection was made on the east lower roof. Ninety-nine per cent of the staples that could be seen were still in good condition, were tight and had no enlargement of the holes. One shingle was found that had not been stapled. The corner of the shingles containing the staple was easily lifted $\frac{1}{4}$ to $\frac{1}{2}$ of an inch and very slight to no self sealing was present. This made the side and bottom edge easy to lift. Only the weight of the shingle prevented lifting by the wind. Once the shingle was lifted, the wind would have a channel to push under the shingles. The inspection of a few good shingles taken from the west roof revealed that the distance between the nearest leg of the staple and the nail in the second shingle was $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. This distance permitted the easy lifting of the corner.

Figure 20 is of roof No. 6 which was eight years old and had large individual hexagonal shingles which were
Figure 16. Lifted Staple

Figure 18. Dutch-Lap Shingles Stapled

Figure 19. Staple on Dutch-Lap Shingle

Figure 21. Cement Failure
stapled with 7/8-inch round steel staples. This figure shows how a staple had lifted so that it was no longer attached to the second layer of shingles. The left leg had been placed in the crack between the shingle, had held very little and was still clinched. The right leg had opened when it was pulled loose. A tree had its branches almost on the roof and many of the staples under the tree had lifted while on the rest of the roof they had not lifted. There was a possibility that when the wind blew against the roof, the branches of the tree might have been pushed under the shingles and lifted the staples. The staples were rusty and pitted but had caused no stains on the shingles.

Cement. Three cemented roofs were inspected and are designated Nos. 7, 8 and 9.

Roof No. 7, Figure 21, was three years old, had thick-butt shingles laid five inches to the weather and was laid over old wood shingles. This roof was cemented with plastic cement when it was applied, but has had a few cemented tabs blown off. The shingles were applied by a carpenter and the cementing was done by a small boy who used a caulking gun that was filled from a gallon can of cement. The boy was very inconsistent in
how and where he applied the cement. His various patterns were to apply the cement to:

1. The full length of the tab, Figure 21,

2. A few inches across the slot so that each corner of the tab would be held down and

3. A dab in the center of the tab which varied in size from one inch in diameter to four inches.

In most of the cases the cement was applied half way up on the tab. He did not always press the tab down firmly when it was cemented and in some cases he pressed the point of the gun on the shingle so that not enough cement was applied. He was very messy and spilt cement on the shingle as shown in Figure 21. The inspection of the kind of shingle which was used revealed that the back coating had a layer of sand which probably was applied to prevent sealing of the shingles in the bundles.

Approximately one out of five tabs tested on roof No. 7 could easily be lifted up with the cement staying on the bottom shingle. Figure 21 shows one of these. In most cases it appeared as if the cement had sealed somewhat to the back of the shingle but was gradually becoming loose. The failure of the cement on this roof could be due to one or more of the following reasons:
1. The layer of sand on the back coating prevented the cement from sealing.
2. The cement was applied too thin.
3. The tab was not pressed down on the cement.
4. The cemented area was too small.

Roof No. 8, Figure 25, which is one year old and was also on the same farm as No. 7 was applied by the same carpenter and cemented by the same boy. This roof is on the north side of a half-monitor hog house. The old wood shingles were removed and the sheathing was respaced to form a solid deck. The sheathing was open to the building and during the cold weather when the sows were farrowing and the building was kept closed to keep it warm, the sheathing had become wet and had expanded causing the bulges. Where the cement was applied to the bottom part of the tab, the tab would be bent and held down. Where the cement was applied up on the tab, the tab would stick out, see Figure 25. Where the tab stuck out, the cement would partly fail by pulling loose the top coating of the second shingle. The sheathing on the south roof of this hoghouse was dryer and had not formed any bulges.

Roof No. 9, Figures 22, 23 and 24, was nine years old and had the ½-tab ¾-inch exposure shingles which were cemented by plastic cement during application of the
shingles by a carpenter. No wind damage had occurred and no tabs were loose except the ones which had been missed and the ones loosened by the bulges. The cement was applied by a paddle. A thick dab was placed on the second shingle under the lower center of the tab and the tab was firmly pressed down. As seen in Figure 23, too much cement was applied and it oozed out when the tab was pressed down.

This roof was on a dairy barn and the sheathing was opened to the inside. During the winter the dairy inspector told the farmer to close the building to keep it warm. Because the sheathing became wet and, shown in Figure 24, warped, it caused a bulge, shown in Figures 22 and 23. When the dairy inspector observed this bulge, he told the farmer to ventilate the building.

On the bottom row of tabs on the bulge, the cement failed by tearing the top coating from the second shingle and, shown in Figure 23, the cement was starting to fail in the same manner.

This inspection revealed that there are many tabs which are not cemented. A carpenter who has cemented roofs for many years gave these reasons why tabs are not cemented:

1. The applicator forgot to place cement under the tab when the scaffold holder was removed.
2. The applicator was working on several rows at a time and missed one when moving from row to row.

3. When two or more men were working and talking, more tabs would be missed.

4. When an applicator stopped work and returned later, he might have missed some between the previous work and later work.

5. When the application was done fast, more tabs were missed.

6. Missed tabs could not be seen.

These missed tabs are susceptible to wind damage which has occurred on some roofs.

Other tab fasteners. Other tab fasteners which have been seen or heard of by the author are:

1. Nailing of the tab. One of these roofs is shown in Figure 10. Nails are very effective in preventing wind damage but when they are exposed to the weather, they may leak which they did on this roof.

2. Wood boards or strips nailed to the roof.

3. Laying bricks on the tabs.

Nos. 2 and 3 are temporary remedies which were used during windstorms and in some cases they were never removed.
Discussion

Because the clip is fully dependent on the relative position of the top of the slot and the lower edge of the tab, the exposure distance is very critical and in some cases when it is too large the clip will not reach the tab and is ineffective. The clip cannot be applied in any other manner in these cases except if put in at an angle from the crack between shingles.

The high percentage of aluminum clips which had their tips flattened could be due to the low strength of aluminum and/or a slanting blow from the hammer.

The lifting of the upper arm of the round steel clip may be due to the lifting of the tab by the wind or bulges, to the thawing and freezing action of water and snow on the roof or to the force of snow sliding down the roof.

On shingles that have a pure coating of asphalt with no filler, the asphalt may flow and seal around the metal fasteners. However this tendency may lessen with age and if the metal fastener is disturbed or moved too much the seal may break and not reseal. When a filler is added to the asphalt coating, the flowing and sealing ability of the asphalt coating around the fastener may lessen.

The author has observed that if the fastener was not disturbed, moved or lifted after application, the fastener
would be sealed in the punched hole and if the fastener had been disturbed, moved or lifted the seal would be broken and the hole enlarged.

Most of the ineffectiveness of the tab fasteners that were seen in these observations was due to the poor quality of workmanship such as improper exposure distance, improper placement of fastener on the tab and not applying a fastener to the tab. The latter was found mainly on cemented roofs because the uncemented tabs could not be seen.

Because of the fastener, it is difficult to determine the amount of self sealing and the nail placing. If the shingles are removed, this can easily be determined.

The best time to inspect a roof for factors which can only be determined by removing the shingles is before and during the repair of wind damage and when the roof is torn off to be replaced.

Many other asphalt-shingle roofs were seen or inspected by the author but they were not included in this thesis because not enough information was known about them or they did not have tab fasteners.

**Indications**

Because not enough observations were taken, no substantiated conclusions can be made, but from these
observations the following indications are evident:

1. The exposure distance limits the use of the clip.
2. The clamp type fastener, clip or staple, promotes the self sealing of the shingle.
3. The horizontal bent part of the lower arm of the round steel clip aids in preventing the clip from being pulled out and in increasing the holding power when placed in the crack between the shingles.
4. The rusting of steel fasteners does not stain the shingles.
5. When tab fasteners are properly applied, they will increase the wind resistance of the shingles.
6. The failure of cement other than poor workmanship may be due to the original surfacing of the back coating of the shingle.
7. Poor workmanship may be the largest factor which decreases the effectiveness of tab fasteners.
8. The distance from the tab fastener to the nail may be a factor in the holding power of the fasteners.
9. If the wind is allowed to channel under the shingles and push or puff them off, the shingles will blow off in groups.
Laboratory Tests of the Holding Power of Tab Fasteners

Objectives

The objectives of these tests are:

1. To find the indication of comparative holding power of four selected metal fasteners under specific conditions.
2. To find the effect of any factors which may affect the holding power of tab fasteners.
3. To observe the type of failures which occur.
4. To observe the value of the apparatus used.

Procedure

The four fasteners which were tested were the flat steel clip, the round steel clip, the copper clip and the steel staple. They are shown in Figure 1 and their dimensions are given in Table 1. Each fastener was tested four times.

Figure 26 shows the apparatus which was used to lift the tabs. The upper arm was free to rotate about its center which was on top of the vertical wood member. The sash chain lifting the tabs was located two feet to the left of the center of the arm and the hanger for the pail was two feet to the right. The movable weight on the arm
was used to balance the arm, chain and tab holders and pail hook with the shingle panel and pail removed.

Figures 27 and 28 show the shingle panel and how the sash chain and tab holders were attached. The panel was located so that it was at $60^\circ$ from the horizontal and that the sash chain was vertical at no load. Lead weights were used to hold the panel down and in place. The clear distance through which the tab was placed in the tab holders was 2.81 inches and the main axis of the holders was placed at a $45^\circ$ angle to the edges of the shingle. The thickness of the steel in the tab holders was 0.12 inches. The sash chain was tied with wire on top of the holder and was free to rotate. The distance of the sash chains from the tab holders to where they were tied together was 5.5 inches. The length of the sash chains from the point where they were tied together to the upper arm was adjusted so that the arm was vertical when the tabs were lifted half way.

The panel was made of two perpendicular layers of 1 x 6 boards so that it measured approximately sixteen inches by sixteen inches. Two 12 x 12 inch tabs, one with a complete tab and one with a half a tab on each side, were cut from a shingle. The top five inches was cut from the whole tab and placed on the panel so the top was nine
Inches from the bottom of the panel. The half and half tab was then placed on the panel so that the bottom edges of the tabs were two inches from the bottom edge of the panel. Two nails were then placed 1 1/2 inches to the side of the center of the slot and 5/8 of an inch above the top of the slot. See Figure 29. The remainder of the whole tab was then placed on top and laid so that its bottom edge was five inches from the bottom edge of the half tabs. This tab was nailed with the nails at the same relative distance from the slots.

The fastener was then applied. The flat steel clip was placed so that its point was 9/16 of an inch from the bottom edge of the top tab, round steel clip 11/16 of an inch and the copper clip 7/16 of an inch. The staple was placed so that its center line was 5/16 of an inch from the bottom edge of the top tab. The clips were placed by hand and tapped down with a hammer. The staple was placed by a stapling machine.

The pail was used to hold the water which was used for the load. The weight of the pail was included in the load. Each load was individually weighed on a balance scale. The first load was two pounds. It was applied for five seconds and released for five seconds. After
ten cycles, the load was increased one pound. The lifting and releasing of the arm were done by hand.

The tests were made in an insulated room which was maintained at an even temperature by a thermostat connected to an electric heater. A fan, which was directed toward the heaters and running continuously, was used to keep the air in the room in motion. Additional heat was gained by the light bulb which furnished the light. A weekly recording hygro-thermograph was used to measure and record the temperature and humidity. The temperature was maintained at 90°F and no control was made on the humidity.

The tabs were cut from a thick-butt shingle which had a dry felt base of 50.9 pounds per 480 square feet. The surface had no embossing or texture. The thickness of the butt was 0.175 inches. The thickness was uniform in the lower 6.5 inches of the shingle. The slot was 5.0 inches in length.

All material was kept in the room so that it would be at room temperature.

Results and findings

Table 2 gives the results of the test with the unit of comparison being the pound cycle which is the summation of the pounds of load times the number of cycles of loading.
<table>
<thead>
<tr>
<th>Type of fastener</th>
<th>No. of cycles for Test failure: failure: load: cycles:</th>
<th>Total lb.</th>
<th>Type of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat steel clip</td>
<td>20: 10: 1: 160</td>
<td>296: 296</td>
<td>Clip tore patch from top tab.</td>
</tr>
<tr>
<td></td>
<td>12: 8: 2: 259</td>
<td>192: 192</td>
<td>Clip tore thru top tab.</td>
</tr>
<tr>
<td></td>
<td>8: 7: 7: 13</td>
<td>5: 5</td>
<td>Clip tore thru bottom tab; top tab was weakened.</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>302: 302</td>
<td></td>
</tr>
<tr>
<td>Stand. dev.</td>
<td></td>
<td>99: 99</td>
<td></td>
</tr>
<tr>
<td>Round steel clip</td>
<td>5: 9: 7: 423</td>
<td>354: 354</td>
<td>Clip tore thru bottom tab; top tab was weakened.</td>
</tr>
<tr>
<td></td>
<td>9: 8: 8: 252</td>
<td>252: 252</td>
<td>Clip tore thru top tab; bottom tab was weakened.</td>
</tr>
<tr>
<td></td>
<td>18: 5: 9: 15</td>
<td>104: 104</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>291: 291</td>
<td></td>
</tr>
<tr>
<td>Stand. dev.</td>
<td></td>
<td>104: 104</td>
<td></td>
</tr>
<tr>
<td>5/8&quot; steel staple</td>
<td>21: 8: 2: 236</td>
<td>288: 288</td>
<td>Staple tore thru bottom tab; top tab was weakened.</td>
</tr>
<tr>
<td></td>
<td>15: 8: 1: 288</td>
<td>252: 252</td>
<td>Staple tore patch from top tab.</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>267: 267</td>
<td></td>
</tr>
<tr>
<td>Stand. dev.</td>
<td></td>
<td>26: 26</td>
<td></td>
</tr>
<tr>
<td>Copper clip</td>
<td>11: 8: 1: 288</td>
<td>125: 125</td>
<td>Clip tore thru bottom tab; top tab was weakened.</td>
</tr>
<tr>
<td></td>
<td>14: 5: 5: 125</td>
<td>125: 125</td>
<td>Clip tore thru top tab.</td>
</tr>
<tr>
<td></td>
<td>4: 5: 1: 105</td>
<td>74: 74</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>101: 101</td>
<td></td>
</tr>
<tr>
<td>Stand. dev.</td>
<td></td>
<td>74: 74</td>
<td></td>
</tr>
</tbody>
</table>

*Standard deviation.

At the start of the test the load was two pounds and it was increased one pound after each ten cycles.

For each cycle the load was applied for five seconds and released for five seconds.

The temperature was held constant at 90°F.
Figures 29 through 37 show each clip before the test and after failure.

In none of these tests did the fastener open or fail. All failure was to the shingle material.

The shingle material would tend to fail on both sides of the flat steel clip and on the round steel and copper clip the material would fail in one line under the clip. On test No. 18 the round steel clip had been hammered into the top shingle surface so that it indented and weakened the top tab. The failure occurred on the top tab on the weakened line. Around the staple, the tab material would form two failure lines, one on each side. When a patch is torn from the top shingle, it indicates a line of failure on each side of the fastener.

The flat and round steel clips had the greatest holding power in these tests. This may be due to their greater length. The round steel clip was longer than the flat steel clip, but the round edge may have caused earlier failure. This was indicated by test No. 18 where the clip was hammered into the surface more than the other clips and where the early failure occurred. The flat steel clip may have gained its holding power from the fact that there were two lines of weakness, one on each side of the clip. The copper clip had the least
Figure 34. 3/8-inch Galvanized Steel Staple (Test No. 10)

Figure 35. Copper Clip

Figure 36. Staple Tore Patch from Top Tab

Figure 37. Clip Tore Through Bottom Tab
holding power and this may be due to its shorter length and the fact that only one line of weakness occurred under the clip. The staple had the shortest length but was perpendicular to the clips.

Because the room was closed and water was present, the relative humidity remained at between 98 to 100 per cent.

Discussion

The exact forces that the wind puts on a tab are not fully known. For these tests it was assumed, (1) that the wind forces could be duplicated by one force which, on the intersection line of the planes which are perpendicular to the bending axis of each corner, could be broken into its component forces in each of the planes to the tab corners and (2) that each of the component forces should stay within its plane and decrease its angle with the plane of the roof as the tab lifted.

For these tests it was also assumed that the wind does not put a continuous, steadily-increasing force on the tab but a repeated varied load. To duplicate this, an increasing repeated load, which was applied for five seconds and removed for five seconds, was used. It was two pounds at the start of the tests and was increased one pound after each 10 cycles.
No tests were made on cemented tabs because there was insufficient time for the cement to set.

No attempt was made to find the equivalent velocity of the wind which will produce a certain force and the maximum wind force that will occur on the tab during the life of the tab. A fastener needs only to be strong enough to hold against this maximum wind force.

Pound-cycles can be used as means of comparison only if the sequence of the increasing repeated load was the same in all tests and then they should be used with reservation because each pound-cycle unit does not have the same effect.

The standard deviation for clips is three to four times higher than for staples. This could mean that under the preset conditions, one or more factors of clips had a very critical influence on the holding power of clips while no factor was as critical for staples.

This apparatus did not maintain the force within the plane which is perpendicular to the bending axis of the tab corner, because the distance normal to the surface from the tab holder to the intersection line of the perpendicular planes or to the vertical sash chain becomes shorter as the tab corners are lifted while the short sash chain distances remain the same. This difficulty could be overcome by using pulleys which are located in the planes
and lead the path of the pulling chains to the pulling device. However, the direction of pull changes within the plane as the tab is lifted so the pulley would have to be relocated in the plane as the tab lifts. Another method would be to locate an eccentric pulley or cam in each plane and as it turns it would change the line of pull to the proper direction.

The manual operation of the loading and unloading was unsatisfactory in that the rate of the releasing of the load and the time for which the load is applied, which are critical factors, could not be held constant throughout each and all tests. A mechanical means which could hold the loading constant would be much better and could decrease the standard deviation.

These tests should be treated only as preliminary tests and no definite conclusion should be made from them.

**Indications**

Under the present conditions of the test and after the tab corners have once been lifted the following indications are evident:

1. The holding power of a clip may be increased by the increase in length of the clip within limits.

2. The holding power of a clip may be greater when two lines of failure occur, one on each side of the clip, than when one line occurs under the clip.
3. The roundness of the bottom part of the upper arm of a clip may cause a decrease in the holding power, especially if the clip is hammered into the surface of the tab.

4. That at 90°F and with a 51-lb. felt, the shingle material will fail before the fastener.

5. The flat and round steel clips may have the greatest holding power of the four fasteners, the 5/8-inch steel staple third and the copper clip fourth.

6. The testing apparatus did not satisfactorily duplicate wind action for these tests.

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Farm Roofing Material Survey to Iowa
Lumber Dealers

Objectives and purpose

The objectives of this survey are:

1. To find what application methods for asphalt shingles lumber dealers are recommending to farmers and which of these methods the dealers prefer.

2. To find what roofing material Iowa farmers prefer and what factors influence their preference.
The purpose of the first objective is to determine how conscious the lumber dealers are of the problem of asphalt-shingle wind damage and what methods they are recommending to correct the problem and to promote a greater interest in the problem.

The purpose of the second objective in relation to the problem of this report is to determine the change, if any, in the farmers preference for asphalt shingles due to the windstorms of October 10, 1949, and May 5, 1950, or other factors and to show that this problem of wind damage to asphalt shingles will be increasing if more asphalt shingles are put into use.

Procedure

To get the information desired in the first objective without any interviews, which require expensive traveling, a questionnaire survey directed to lumber dealers was conducted. The information on the second objective could also be obtained from the dealers because the dealers would know approximately the farmer's preference by what he sells and by conversation with the farmers. Also from conversation, he may know what factors influenced the farmer's preference. However, this is an indirect method of gathering this information and would not be fully unbiased and accurate but it would give indications that may be of
value and that may aid in further surveys. Directing the survey to farmers would be more nearly accurate but because the dealers were to be contacted for the first objective, this second objective was also included in the dealer's survey.

To prevent any sampling errors, to promote more interest and to obtain more samples, a questionnaire was sent to each of the 1200 Iowa lumber dealers listed in the Iowa Retail Lumbermens Association's Directory of Iowa Lumber Dealers (5). A return of 30 per cent was anticipated.

The questionnaire is shown in Figure 38. Questions C and D were made to find the information on the second objective and questions E and F were made to find the information on the first objective.

The desired method of answering this questionnaire is as follows: For question C in the column under each type of building, the number 1 is to be placed to the right of the roofing material which is the farmer's first preference or choice for that building, the number 2 to the right of the second preference and 3 to the right of the third preference. This is to be repeated for each type of building. Question D is to be answered in the same manner as question C. For question E, a check mark is to be placed under either yes, no or no recommendation for each application method. Question F is to be answered in the
Farm Roofing Material Questionnaire to Iowa Lumber Dealers

A. Name_________________________________________ Date___________________

B. Firm____________________________________________ Address________________

C. What roofing materials do farmers prefer? (Check with numbers 1, 2, 3)

<table>
<thead>
<tr>
<th>Material</th>
<th>Dwelling</th>
<th>Shelter</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wood shingles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Asphalt shingles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Asphalt roll</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Galvanized steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Asbestos-cement shingles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Aluminum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. (Other)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. What factors influence the farmer's choice of roofing materials? (1, 2, 3)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Dwelling</th>
<th>Shelter</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Price</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Length of life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Wind resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hail resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Fire resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Deck requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Ease of application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. (Other)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E. What application methods do you recommend for asphalt shingles for use on farms?

(Please check one for each method): Yes: No: No recommendation: 

<table>
<thead>
<tr>
<th>Method</th>
<th>Yes</th>
<th>No</th>
<th>No Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clipping tabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cementing tabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stapling tabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Lock tab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. 4-inch tab exposure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Self sealing tabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Smooth, solid deck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Felt underneath</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Over old wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. (Other)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F. Which methods do you prefer? (1, 2, 3)

G. Any remarks on roofing materials will be appreciated. (Use the back of this sheet if needed.)

Please return to: L. W. Bonnicksen
Agricultural Engineering Department
Iowa State College
Ames, Iowa

Figure 38. Questionnaire
same manner as questions C and D. Question F refers to the application methods listed in question E.

To encourage the return of more questionnaires, a letter dated January 16, 1951, shown in the appendix, and a stamped self-addressed return envelope were enclosed with the questionnaire.

Results and findings

From the time of mailing until the time of tabulating the results, which was approximately two months, 651 questionnaires were returned. Eight of that number did not answer the questionnaire for the following reasons:

(1) three dealers did not sell roofing materials, (2) three dealers located in large cities did not feel qualified to answer, (3) one dealer sold out and (4) one sent the questionnaire and letter back unanswered with no remarks. These eight returns were not included in any of the results. The results are the tabulation of the 643 (53.5%) questionnaires returned with answers.

One hundred eighty-four (28.6%) of the dealers who answered gave remarks which clarified their answers and/or gave additional information.

Figure 39 shows the number of lumber dealers and the number and the percentage of questionnaires returned per county. This does not include the eight unanswered
Fig. 39 The Number of Lumber Dealers and the Number and the Percentage of Questionnaires Returned per County, MARCH, 1951
questionnaires either in the subtraction from the total or addition to the returned.

Figure 40 shows the frequency distribution, which approaches the normal distribution curve, of the county percentages of returned questionnaires.

<table>
<thead>
<tr>
<th>Number of Counties</th>
<th>0% to 9%: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10% to 19%: 1</td>
</tr>
<tr>
<td></td>
<td>20% to 29%: XXXXX6</td>
</tr>
<tr>
<td></td>
<td>30% to 39%: XXXXXXX8</td>
</tr>
<tr>
<td></td>
<td>40% to 49%: XXXXXXXXXXXXXXXXXX19</td>
</tr>
<tr>
<td></td>
<td>50% to 59%: XXXXXXXXXXXXXXXXXXXXXXXXX29</td>
</tr>
<tr>
<td></td>
<td>60% to 69%: XXXXXXXXXXXXXXXXXXXXXXXX17</td>
</tr>
<tr>
<td></td>
<td>70% to 79%: XXXXXXXXXXXXXX12</td>
</tr>
<tr>
<td></td>
<td>80% to 89%: XXX14</td>
</tr>
<tr>
<td></td>
<td>90% to 100%: XX3</td>
</tr>
</tbody>
</table>

Fig. 40. Frequency Distribution of the County Percentages of Returned Questionnaires

Because of the briefness of instructions on the questionnaire, various methods of answering the choice or preference questions, C, D and F, were used. The methods are illustrated in Figure 41 and are as follows:

a. Correctly answered. The desired method as explained in the procedure was used.

b. Duplication of choice. The desired method was used but the number 1, 2 or 3 was used two or more times giving a duplication of that choice.
Figure 4.1. Methods of Answering Choice Questions C, D and F
c. Only one choice checked. Only one check mark was given.

d. Two or more choices checked. Two or more check marks were given.

e. Percentages given. For question C only, a percentage for each material was given. The percentages usually meant the sales volume of the dealer.

f. Choice not given. A choice, which was usually the third, was not indicated.

g. No choices given. No numbers, checks or marks that indicated a choice were given.

Because 33\frac{1}{4}\% of the returned questionnaires answered questions C, D or both C and D by other methods than a, b and e mentioned above, the questionnaire was remailed to these 33\frac{1}{4}\% dealers to obtain more answers given by the desired method. A letter giving instructions for answering the questionnaire, dated February 15, 1951, and shown in the appendix and a stamped self-addressed envelope were also enclosed. One hundred eighty-five of these questionnaires were returned and 161 of these were answered by the desired or correct method.

In the tabulation of the answers, a coding system was used to separate the above methods of answering except where percentages were given. In this case the higher
percentage was given first choice, the second highest the second choice and third highest the third choice. In the case where two percentages were equal, it was coded as a duplication of choice.

Table 3 shows the tabulation of the choices for questions C and D. For each dealer only one material or factor for each of the first, second and third choices was credited.

However, to tabulate the duplication-of-choices and two-or-more-choices-checked, the materials or factors which were noted the same by the dealer were given partial credit so that each dealer had a total of one credit for each of the first, second and third choices. In illustration, for Figure 41b, materials 1 and 2 would each be given one-half credit for both first and second choice and material 5 would be given full credit for third choice. For Figure 41d, each of the materials 1, 3 and 4 would be given one-third credit for each of the first, second and third choices. If two checks were given, one-half credit would be given to each of the two materials for the first and second choices and the third choice would be tabulated as choice not given. If four checks were given, one-fourth credit would be given to each of the four materials for the first, second and third choices.
Table 3. Results from the Farm Roofing Material Questionnaire to Iowa Farm Dealers

<table>
<thead>
<tr>
<th>Incentives returned</th>
<th>A. What roofing materials do farmers prefer?</th>
<th>B. What factors influence the farmer's choice of roofing material?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Good quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwellings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correctly answered</td>
<td>121</td>
<td>97%</td>
</tr>
<tr>
<td>Only one choice checked</td>
<td>32</td>
<td>90%</td>
</tr>
<tr>
<td>Two or more choices checked</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100%</td>
</tr>
<tr>
<td>Second Choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correctly answered</td>
<td>50</td>
<td>50%</td>
</tr>
<tr>
<td>Only one choice checked</td>
<td>32</td>
<td>62%</td>
</tr>
<tr>
<td>Two or more choices checked</td>
<td>18</td>
<td>94%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
<tr>
<td>Livestock Sheds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correctly answered</td>
<td>50</td>
<td>50%</td>
</tr>
<tr>
<td>Only one choice checked</td>
<td>32</td>
<td>62%</td>
</tr>
<tr>
<td>Two or more choices checked</td>
<td>18</td>
<td>94%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
<tr>
<td>Second Choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correctly answered</td>
<td>65</td>
<td>57%</td>
</tr>
<tr>
<td>Only one choice checked</td>
<td>32</td>
<td>62%</td>
</tr>
<tr>
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<td>18</td>
<td>94%</td>
</tr>
<tr>
<td>Total</td>
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<td>100%</td>
</tr>
<tr>
<td>Feed Storage</td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
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<td>300</td>
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</tr>
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<td>Total</td>
<td>480</td>
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</tr>
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<td>Second Choice</td>
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<tr>
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<td>50</td>
<td>50%</td>
</tr>
<tr>
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<td>94%</td>
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<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
<tr>
<td>Implements Sheds</td>
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<td></td>
</tr>
<tr>
<td>First Choice</td>
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<td>90%</td>
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<td>58</td>
<td>96%</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100%</td>
</tr>
<tr>
<td>Second Choice</td>
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<td></td>
</tr>
<tr>
<td>Correctly answered</td>
<td>121</td>
<td>71%</td>
</tr>
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<td>90%</td>
</tr>
<tr>
<td>Two or more choices checked</td>
<td>58</td>
<td>96%</td>
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<td>Total</td>
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<td>100%</td>
</tr>
<tr>
<td>$ of total checks</td>
<td>$158</td>
<td>$158</td>
</tr>
</tbody>
</table>

**Part I**

- **Total:**
  - Good quality: 100%
  - Price: 100%
  - Incentives: 100%

**Part II**

- **Total:**
  - Good quality: 100%
  - Price: 100%
  - Incentives: 100%
Table 4 shows the percentages of total choices given and the ranking of the materials and factors.

To determine why each type of roofing material received first preference, a breakdown was made, shown in Table 5, of the first, second and third choice factors which influence farmers in their choice of roofing material according to the material which had first preference.

Table 6 shows the results from questions E and F. The first, second and third choices were tabulated in the same way as in Table 3.

Discussion

It should be noted that in the tabulation of duplication-of-choice and two-or-more-choices-checked, that proportionally more weight was given to the material or factors which were in the minority than in the tabulation of correctly-answered and only-one-choice-checked. This was due to the fact that all materials or factors which were duplicated or checked were given the same weights.

In this thesis all methods of answering were added together. For further study only the correctly-answered and the only-one-choice-checked could be treated separately which may give more reliable results.

The results for asphalt shingles and wood shingles may be misleading in that many of the dealers said the
### Table 4. Results from the Farm Roofing Material Questionnaire to Iowa Lumber Dealers

#### Part II

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>C. What roofing materials do farmers prefer?</td>
</tr>
<tr>
<td></td>
<td>D. What factors influence the farmer's choice of roofing materials?</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood shingles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Asphalt shingles</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt roll</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galvanized steel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% of total first choices given:
- Dwelling: 125, 3, 68, 0, 2, 5, 4
- LIVESTOCK SHELTER: 61, 7, 13, 9, 2, 0, 20, 5, 0.5, 3.6
- FEED STORAGE: 62, 5, 10, 3, 3, 9, 12, 6, 0.2, 0.9
- IMPLEMENT STORAGE: 20, 3, 3, 6, 6, 8, 8, 3, 1, 2

% of total second choices given:
- Dwelling: 75, 4, 6, 4, 1, 2, 15, 0
- LIVESTOCK SHELTER: 40, 4, 13, 3, 1, 2, 4
- FEED STORAGE: 12, 1, 2, 3, 9, 2, 2, 5
- IMPLEMENT STORAGE: 25, 6, 10, 3, 8, 1, 2, 6

% of total third choices given:
- Dwelling: 17, 2, 4, 7, 0.2, 0.3
- LIVESTOCK SHELTER: 10, 1, 5, 5, 12, 6
- FEED STORAGE: 7, 3, 1, 9, 0.9, 1.7
- IMPLEMENT STORAGE: 13, 2, 1, 2, 4, 1, 2, 5

Rank of all choices:
- Dwelling: 2nd, 4th, 5th, 3rd, 6th
- LIVESTOCK SHELTER: 2nd, 4th, 5th, 6th, 5th
- FEED STORAGE: 2nd, 4th, 5th, 6th, 5th
- IMPLEMENT STORAGE: 2nd, 3rd, 5th, 6th, 4th
Table 6. Results from Lumber Dealer's Questionnaire

Part IV
E. What application methods do you recommend for asphalt shingles for use on farms?

<table>
<thead>
<tr>
<th>Questionnaires returned</th>
<th>Clipping tabs</th>
<th>Stapling tabs</th>
<th>Lock tab</th>
<th>N-inch-tab exposure</th>
<th>Self-sealing tab</th>
<th>3-inch solid deck</th>
<th>Flat iron work</th>
<th>Shingle hood</th>
<th>Other</th>
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<tbody>
<tr>
<td>Jan., Feb., and March, 1951.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>33%</td>
<td>17%</td>
<td>14%</td>
<td>14%</td>
<td>8%</td>
<td>4%</td>
<td>4%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>% of total questionnaires</td>
<td>34.4%</td>
<td>17.7%</td>
<td>12.3%</td>
<td>11.1%</td>
<td>6.5%</td>
<td>4.3%</td>
<td>4.3%</td>
<td>2.7%</td>
<td>1.4%</td>
</tr>
<tr>
<td>No</td>
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<td>50%</td>
<td>71%</td>
<td>67.3%</td>
<td>72.2%</td>
<td>72.1%</td>
<td>72.1%</td>
<td>67.2%</td>
<td>56.7%</td>
</tr>
<tr>
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<td>7.8%</td>
<td>12.4%</td>
<td>11.1%</td>
<td>7.0%</td>
<td>7.0%</td>
<td>7.0%</td>
<td>6.2%</td>
<td>4.7%</td>
</tr>
<tr>
<td>No recommendation</td>
<td>45%</td>
<td>21%</td>
<td>52%</td>
<td>68%</td>
<td>60%</td>
<td>41%</td>
<td>20%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>% of total questionnaires</td>
<td>7.0%</td>
<td>3.3%</td>
<td>6.4%</td>
<td>12.4%</td>
<td>12.4%</td>
<td>8.4%</td>
<td>3.3%</td>
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<tr>
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<td>17%</td>
<td>98%</td>
<td>11%</td>
<td>12.4%</td>
<td>12.4%</td>
<td>12.4%</td>
<td>12.4%</td>
<td>12.4%</td>
<td>12.4%</td>
</tr>
<tr>
<td>% of total questionnaires</td>
<td>27.5%</td>
<td>15.2%</td>
<td>13.1%</td>
<td>13.1%</td>
<td>13.1%</td>
<td>13.1%</td>
<td>13.1%</td>
<td>13.1%</td>
<td>13.1%</td>
</tr>
<tr>
<td>Total questionnaires</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
<td>66%</td>
</tr>
</tbody>
</table>

F. Which methods do you prefer?

<table>
<thead>
<tr>
<th>Choice</th>
<th>11%</th>
<th>20%</th>
<th>9%</th>
<th>7%</th>
<th>6%</th>
<th>1%</th>
<th>4%</th>
<th>42%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only one choice checked</td>
<td>21%</td>
<td>6%</td>
<td>15%</td>
<td>7%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>53%</td>
</tr>
<tr>
<td>Two or more choices checked</td>
<td>2%</td>
<td>2%</td>
<td>17%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
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<td>66%</td>
</tr>
<tr>
<td>Total</td>
<td>41%</td>
<td>28%</td>
<td>15%</td>
<td>10%</td>
<td>5%</td>
<td>1%</td>
<td>4%</td>
<td>56%</td>
</tr>
</tbody>
</table>
farmers preferred wood shingles but would buy asphalt shingles instead because of the high price of wood shingles. This would give higher results for wood shingles and less for asphalt shingles if all factors of question D were to be considered in the preference of material. Many dealers' connotation of the word "prefer" does not include the price factor. The word purchase instead of prefer might have made more consistent answers.

In Table 4 the ranking of the first choices was simple and when there was no significant difference between certain materials or factors, they were ranked the same. If there was any question in the ranking of the materials or factors where all three choices were considered, they were also ranked the same.

To complete this study, the three choices and the types of buildings should be combined to indicate the farmer's preference by total roof area in order to compare with previous surveys. The weight that each of the three choices should receive when combining is difficult to determine and needs further investigation.

From Table 4 it can be seen that for dwellings asphalt shingles were the farmer's first preference, wood shingles second and asbestos-cement shingles third. For livestock shelter wood shingles were the first preference,
steel second and asphalt shingles third. For feed storage wood shingles were the first preference, asphalt shingles second and steel third. For implement storage steel was the first preference, wood shingles second and asphalt shingles third.

It should be noted that steel was preferred considerably more than aluminum.

Price, length of life and fire resistance were the main factors which influence the farmer's choice of roofing material for dwellings. Appearance and wind resistance ranks next. Price and length of life rank first or second for the other three types of buildings while wind resistance ranks next. Price and length of life rank first or second for the other three types of buildings while wind resistance ranks third. Appearance ranks high for dwellings but low for the other buildings. Deck requirements seem to have little to do with influencing the farmer in his choice of roofing material.

The data from Table 5 indicate:

1. Length of life was the main factor in the farmer's choice of wood shingles for dwellings, livestock shelter and feed storage. For implement storage, price was the main factor.

2. Price, length of life and wind resistance were the main factors in the farmer's preference for wood shingles.
3. For dwellings, fire resistance was the main factor influencing the farmer's preference for asphalt shingles and price was second.

4. For buildings other than dwellings, price was the main factor in the farmer's preference for asphalt shingles.

5. The main factor in the farmer's preference for steel was price.

6. For dwellings, length of life was the main factor in the farmer's preference for asbestos-cement shingles.

Because of time the second objective and purpose could not be completed. Its completion should be made in future study because many valuable indications can be made.

Questions E and F were direct questions and direct answers were received. Assuming that the results of the dealers who answered represents the results of the dealers who did not answer, the results of these two questions will hold true for all the lumber dealers of Iowa.

The data from Table 6 show that the lumber dealer's first preference of application methods was cementing-of-tabs and lock-tab and 4-inch exposure run close second or third. Between clips, staples and cement, cement ranks first far above clips which are second and staples which are third. Fifty-five point seven per cent of the dealers recommended applying over old wood shingles.
From the interviews and remarks on the questionnaire, the lumber dealers are very conscious of wind damage to asphalt shingles and are trying to promote proper application.

Conclusions and indications

Conclusions

1. That 73.7 per cent of the 53.5 per cent of the Iowa lumber dealers who returned the questionnaire recommended cementing tabs, 34.4 per cent clipping tabs, 27.5 per cent stapling tabs, 67.3 per cent lock tab, 72.2 per cent 4-inch exposure, 22.1 per cent self sealing tabs, 38.0 per cent smooth, solid deck, 67.2 per cent felt underneath and 55.7 per cent over old wood shingles.

2. The dealers first preference of application method was cementing-of-tab with lock-tab and four-inch tab exposure a close second and third preference.

Indications. Because of uncertainties in the answering of questions C and D, no conclusions can be made from them. However, the following indications are evident:

1. For dwellings asphalt shingles were the farmer's first preference, wood shingles second and asbestos-cement shingles third. For livestock shelter wood shingles were the first preference, steel second and asphalt shingles
third. For feed storage wood shingles were the first preference, asphalt shingles second and steel third. For implement storage steel was the first preference, wood shingles second and asphalt shingles third.

2. Steel was preferred by farmers considerably more than aluminum.

3. Price, length of life and fire resistance were the main factors which influence the farmer's choice of roofing material for dwellings. Appearance and wind resistance ranks next. Price and length of life rank first or second for the buildings other than dwellings while wind resistance ranked third. Appearance ranked high for dwellings but low for the other buildings.

4. Deck requirements seemed to have little to do with influencing the farmer in his choice of roofing material.

5. Length of life was the main factor in the farmer's choice of wood shingles for dwellings, livestock shelter and feed storage. For implement storage, price was the main factor.

6. Price, length of life and wind resistance were the main factors in the farmer's preference for wood shingles.

7. For dwellings, fire resistance was the main factor influencing the farmer's preference for asphalt shingles and price was second.
8. For buildings other than dwellings, price was the main factor in the farmer's preference for asphalt shingles.

9. The main factor in the farmer's preference for steel was price.

10. For dwellings, length of life was the main factor in the farmer's preference for asbestos-cement shingles.
DISCUSSION

Advantages and Disadvantages of Asphalt-Shingle Tab Fasteners

The advantages and disadvantages of asphalt-shingle tab fasteners are:

**Clips**

**Advantages**

1. Because of the clamping effect, they promote the self sealing of the tabs and prevent dust from getting between the shingles to stop self sealing.

2. They have immediate effective holding power when applied.

3. Regardless of the age or how wet or dusty the shingles are, clips will still hold.

4. On old roofs clips can be applied without lifting the tab which may crack or weaken the tab.

5. On rough decks or over ridges where the tab is bent and has a constant lifting force, the clip will hold without creep.

6. You can see every clip and know that all tabs have fasteners.
7. No expensive tools are necessary to apply them. Only a hammer and maybe a pair of pliers is needed.

8. They can be applied at any time of the year except when the shingles are too hot to walk on.

9. If they are still in good condition, they can be reclaimed from an old roof for reuse on a new roof.

10. They can easily be removed and reapplied for the easy repair of shingles.

Disadvantages

1. The holding power of the clip is very dependent on the exposure distance or the distance from the top of the slot to the bottom edge of the tab and if this distance is too great the clip will not reach the tab.

2. If the top arm is lifted and the lower arm is straight, the clip may fall off the tab.

3. Clips open the felt and expose it to moisture which may deteriorate the shingle. However, the clip does not open the felt as much as a staple.

4. Metal clips are subject to corrosion. However, this seems to be negligible.

5. The holding power of the clip over the crack between two shingles is very dependent on how the nails and the clip are placed.
Staples

Advantages

1. Because of the clamping effect, they promote the self sealing of the tabs and prevent dust from getting between the shingles to stop self sealing.

2. They have immediate effective holding power when applied.

3. Regardless of the age or how wet or dusty the shingles are, staples will still hold.

4. On old roofs staples can be applied without lifting the tab which may crack or weaken the tab. However, the tongue of the staple machine may damage an old or cold, stiff shingle.

5. On rough decks or over ridges where the tab is bent and has a constant lifting force, the staple will hold without creep.

6. You can see every staple and know that all tabs have fasteners.

7. They can be applied at any time of the year except when the shingles are too hot to walk on or when the shingles are cold and stiff so that the staple-machine tongue may damage the shingle.

8. They can be applied to any point of the shingle where the tongue of the stapling machine can reach. They are
not limited to a small area on top of the slot such as clips are.

9. They can easily be removed and a new staple replaced for repairs with little or no damage to the shingles.

10. A wide staple can staple over the crack between two shingles and a narrow staple can be placed to one side of the crack.

Disadvantages

1. Staples open the felt and expose it to moisture which may deteriorate the shingle.

2. Staples require an expensive machine to apply.

3. The location of the staple on the tab is dependent on where the tongue can be placed. If the tongue is of a length near the exposure distance of the shingle and the top shingle is placed too high, the stapling machine may not be able to place a staple above the slot. However, it can place two staples on each side of the slot if the tongue is slanted through the slot.

4. Metal staples are subject to corrosion. However, this seems to be negligible.

5. The staple can not be reused again like a clip.

Cement

Advantages

1. The variance from the desired exposure distance
has little or no effect on the holding power or application of cement.

2. The application of cement is not limited to any certain part of the tab or type of shingle.

3. No expensive tools are necessary for applying cement. A chaulking gun, paddle or putty knife can be used.

4. Cementing does not open the felt and expose it to moisture which causes deterioration.

5. Cement can easily be applied over the crack between two shingles.

**Disadvantages**

1. Cement may not hold to shingles which are wet, dusty or have a mineral surfaced backcoating.

2. For repair work the shingles cannot be removed without damage.

3. Cement takes weeks to months to fully set so it does not have effective immediate holding power against wind.

4. On rough decks or over small ridges where the tab is bent and has a constant lift, the cement will creep loose or pull apart.

5. The applicator cannot see if any of the tabs are uncemented so a few misses may occur which are subject to wind damage.
6. On old roofs when the tab is lifted, there is a chance of the tab cracking, breaking or weakening.

7. If the cement is thick and not pressed down, the shingles are separated which causes less self-sealing and a chance for dust to get between the shingles which also causes less self-sealing.

Additional Indications

The author has found some additional indications from his observations and wishes to state them here.

1. The dutch lap and large individual hexagonal shingles edges may be too long so that the wind can lift the edges and channel under the shingles and push or puff them off the roof.

2. The grooving or embossing of the surfacing of the tab may decrease the holding power of the fasteners. The groove presents a line of weakness. This also holds for self-lock-tab shingles.

3. The temperature of asphalt shingles may be only a few degrees above air temperature during windstorms due to the air cooling effect of the wind.
4. On dutch lap and self-lock tab shingles the wind may blow water into the side lap which will cause the water to run over the nail and perhaps leak onto the sheathing.

5. The velocity of the wind over the top part of a large roof is greater than the open air velocity due to the lower pressure head and increase in velocity head.

6. Clips may be the best of the three types of fasteners because clips have all of the most desired advantages and their disadvantages can be overcome by the proper application of the shingles and the proper placement of the clip. Clips may prove to be the best for old roofs except where the exposure distance is too great. In this case another fastener will have to be used. Better designs may be made to improve the clip.

Possible Future Studies

Possible future studies which may be of value are:

1. To determine the increase of self sealing due to the use of clamp fasteners.

2. To determine the relationship between the holding power of a tab fastener and the distance between the fastener and the shingle nail.
3. To determine the value of a horizontal bend or a point on the lower arm of a clip in holding power when placed in or near the crack between shingles and in resistance to being pulled out from under the tab.

4. To determine if thawing and freezing of snow and water and the sliding action of snow down the roof can lift the top arm of clips.

5. To determine the placement of a clip that will give the greatest holding power.

6. To determine the value of clips on old roofs.

7. To determine the extent of deterioration to the felt caused by the holes punched by clips and staples.

8. To determine the effect of backcoating and surfacing on the holding power of cement.

9. To determine the effect of each of the factors which affect the holding power and life of tab fasteners.

10. To determine the value of the various types of asphalt cement as tab fasteners.

11. To complete all possible information which can be obtained from the lumber dealer's questionnaires.
Recommendations

The author wishes to make the following recommendations:

1. In the nailing of shingles to which clips are to be applied, either the right or left edge nail should be placed near the edge so the clip can be placed at an inward angle on that side of the slot.

2. The throat clearance of a stapler should be at least one inch longer than the exposure distance or at least six inches.

3. A pair of pliers should be used to insert the clips. A special grip could be made to make it easier to hold and insert.

4. The sheathing of an asphalt-shingle roof should be dry before the shingles are placed and should remain dry the life of the roof.

5. A program should be conducted to educate applicators in the proper methods of application and the limitations of roofing materials.
SUMMARY

Three types of studies were conducted. They were: (1) field observations, (2) laboratory tests and (3) a questionnaire survey to Iowa lumber dealers.

Field observations were made of asphalt shingle roofs that had clips, staples or cement applied as tab fasteners. These observations indicated: (1) that poor workmanship, which consists mainly of, (a) not laying the shingles to the proper exposure distance so the fastener can be properly applied, (b) improper placement of the fastener on the tab and (c) not placing a fastener on the tab, may be the greatest factor in the decrease of effectiveness of tab fasteners, (2) that the clamp type fasteners promote the self sealing of the shingle, (3) that cement may fail due to the original surfacing of the back coating, (4) that the rusting of steel fasteners does not stain the shingles and (5) that if the bottom edge of the top tab is too far above the top of the slot, a clip cannot be used.

The laboratory tests consisted of lifting the corners of tabs that had been clipped or stapled. The shingle used was a smooth-surfaced thick-butt that had a 51 pound felt base. These tests were run at a temperature of 90°F.
An increasing repeated load was applied to the tab corners until failure. Under the specific conditions these tests indicated: (1) that at 90°F and with a 51 pound felt, the shingle material will fail before the fastener, (2) that the holding power of clips may be decreased by, (a) a decrease in length, (b) only one line of failure occurring under the clip instead of two lines, one on each side of the clip, (c) the roundness of the cross section of the clip and (d) the hammering of the top arm of the clip into the surface of the tab.

A questionnaire was sent to each of the lumber dealers in Iowa asking them what application methods for asphalt shingles they recommended and preferred, what roofing materials farmers prefer for various types of buildings and what factors influenced the farmer in his choice of roofing material. The lumber dealers were very conscious of wind damage to asphalt shingles and were trying to promote proper application. Nearly three-fourths of the dealers recommended cementing tabs, approximately one-third, clipping and one-fourth, stapling.

Advantages and disadvantages were given for clips, staples and cement.
BIBLIOGRAPHY


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The National Association of Mutual Insurance Companies, for the sponsorship of this project.

Mr. James Eaton, Chief Inspector of the Farmers Mutual Reinsurance Company of Grinnell, Iowa, and to Mr. S. M. Hickman, manager of the Denniston & Partridge Company of Altoona, Iowa, for their help in locating roofs for observations.

Mr. G. L. Oliensis, Director of Research for the Lloyd A. Fry Roofing Company, for giving his knowledge of and experience with tab fasteners.

The Lumber Dealers of Iowa for their cooperation in returning the questionnaires and in giving interviews.

The fellow graduate students of the author who have given their help, suggestions and criticisms.
APPENDIX
A STUDY OF THE PREVENTION OF WIND DAMAGE TO ASPHALT SHINGLES

Field Observations

FARMSTEAD

<table>
<thead>
<tr>
<th>Number</th>
<th>Interviewer</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>A.</th>
<th>Interviewer</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.</td>
<td>State, County, Township, Section, Location</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Size of farm, acres</td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Operator: Owner, Tenant, Period of occupancy, years</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>Owner: Living, Operator, Period of ownership, years</td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>Buildings maintained by: Owner, Operator, Other</td>
<td></td>
</tr>
<tr>
<td>G.</td>
<td>Interviewee: Owner, Operator, Farmhand, Housewife, Other</td>
<td></td>
</tr>
<tr>
<td>H.</td>
<td>Condition of buildings</td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Remarks</td>
<td></td>
</tr>
</tbody>
</table>

BUILDING ORIENTATION

<table>
<thead>
<tr>
<th>Farm No.</th>
<th>Building No.</th>
<th>Photo No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Use of building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Width, ft; Length, ft; Height to eaves, ft; Height to peak, ft; Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Roof type: Shed, Gable, Hip, Half monitor, Monitor, Gambrel, Gothic, Circular, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Main axis: N-S, E-W, Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Ventilation of building, Ventilation under roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Age of building, years; (E estimated, K known; By: B observer, W owner, T tenant, H housewife.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Present condition, Future life, years, if</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Is building insured for wind? Yes, No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance Company</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ASPHALT SHINGLES

Farm No.________; Building No.________; Roof No.________
Photo No.__________________________________________
Description
A. Shingle type: Dutch single, Hex single, Hex 2 tab, Hex 3 tab, Hex 4 tab, Amer. 3 tab, Amer. 4 tab, Lock tab, Other__________________________________________________________
B. Name of manufacturer__________________________________________________________
C. Weight per square ______ lbs.
D. Thickness at bottom ______ inches; Top ______ inches.
Uniform, Tapered, Thickbutt.
E. Surfacing: Slate, Ceramic, Other__________________________________________________
   Top coating______________________________________________________________
   Under coating___________________________________________________________
F. Felt thickness ______ inches; Weight ______ lbs./sq.
G. Grooves: None, Sharp, Rounded, Deep, Shallow.
H. Size and shape of shingle:
Installation
I. Slope ______ in/ft: Lower roof, upper roof, curved
J. Facing: North, South, East, West, Other________________________________________
K. American tab exposure ______ inches.
L. Deck: New, Old.
M. Felt underneath: Yes, No.
N. Over old roofing: No, wood shingles, asphalt shingles, asphalt roll, other______;
   Age ______ years.
   Condition of old roofing____________________________________________________
O. Sheathing: White pine, douglas fir, yellow pine, Other______; Age ______ years;
   Thickness: Planed 1", Rough 1", Other______;
  Spacing: none, Rough inches, Ship Lap, Tongue and groove, end match, Other____;
   Width ______ inches.
   Condition: Checked ______ %, Decayed ______ %, Warped ______ %, Sound ______ %,
   Unable to inspect ______ %, Other ______ %
P. Starting strip: None, Upsidedown shingle, Wood shingles, Metal______ inches,
   Asphalt roll______ inches, Other______;
   Edge strip: None,_______________________________
   Ridge strip: None, Boston, Other_____________________
   Valley: None,_______________________________
Q. Nailing: Number per shingle ______; Length ______ inches;
   Size of head ______ inches; Angle driven: Top______ Bottom;
   Material: Galv. steel, Other______;
   Placing: ______ inches from center to bottom of shingle;
   ______ inches from center to bottom of overlapping shingle.
   Penetrates sheathing: Yes, No, Unable to inspect:
   Shank: Plain, Screw, Barbed, Ring, Other______

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R. Self sealing: None, very slight, slight, moderate,
fairly tight, tight.

S. Tab fasteners: None, Clips, Staples, Cement, Other______.

T. Weather during and after installation___________________________.

U. Who applied: Carpenter, Owner, Tenant, Other______________.

V. Age of shingles______years; _______by______________.

W. Service life remaining: _________years, if______________.

X. Present condition______________________.

Y. Material that would be used for reroofing__________, By______.

Failure

Z. Hail: None, __________________________________________.
   holes punched per square: _________% of granules
   loosened.

AA. Curling: None, Due to______________________________

BB. Bulges: None, Due to______________________________

CC. Leaks: None, Due to______________________________

DD. Other__________________________________________

EE. Insurance claims: None,
   Date_______; Amount_____; For______
   Date_______; Amount_____; For______

FF. Wind: None, Lifted up %, Tabs off______________________
   Shingles off __________________%
   Returned to normal, Patched; Date of wind
   Direction of wind_____________; Velocity of wind____________;
   Description__________________________________________
   Causes____________________________________________
   Location of damage diagram:

---

**TAB FASTENERS**

Farm No. _______; Building No.________; Roof No.______ Fastener
No._____; Photo No.____________________.

Type of Fastener: Clip, Staple, Cement.

Description

A. Material________________________: Coating__________________________

B. Manufacturer__________________________________________________

C. Trade name____________________________________________________

D. Size and shape:

Application

E. Location on shingle:

F. Tools used to apply______________________________________________

G. How applied____________________________________________________

H. Applied by: Owner, Tenant, Carpenter, Other______________________

I. Weather during and after application______________________________

J. Applied same time as shingles: Yes, No; _________after
   shingles.

K. Age of fastener______years; _______by______________.
L. Condition of shingles during installation
M. Self sealing around fastener: None, Very slight, slight, moderate, fairly tight, tight

The effect of the fastener on:
N. Watertightness
O. Water vapor permeability
P. Expansion and contraction
Q. Bulges
R. Other

Failure
S. Enlargement of punched holes. None,
T. % Tight, % Slightly loose, % Loose, % Very loose, % Off;
U. Corrosion: None, Slight, Moderate;
V. Damage during application
W. Has fastener lifted or moved
X. Wind: None, Describe
Y. Other

PERSONAL OPINION ON ASPHALT-SHINGLE TAB FASTENERS

Name_, Address_, Date_
A. Fastener in question: Clip, Staple, Cement, Other_
B. Have you (used, applied) them? Yes, No_
C. Your method of application
D. Are they easy to apply?
E. How do you like their appearance?
F. What is their effect on:
   Water tightness
   Vapor permeability
   Temp. expansion and contraction
   Bulges
   Other
G. Have you seen any failures? No, Describe
H. Do you believe that they will hold the tabs down in strong winds?
I. Do you believe that they will last the life of the shingles?
J. Would you use them again? Yes, No_
K. Which one would you use? Clip_, Staple_, Cement_
Gentlemen:

Excessive wind damage to roofing material on Iowa farms resulting from the windstorms of 10 October, 1949, and 5 May, 1950, has stimulated a study of the characteristics of roofing materials which permit damage by wind and improvements in material and/or application which may be effective in preventing damage. As a part of this study we are anxious to get an appraisal of farmer preferences of roofing materials and application methods recommended by Iowa lumber dealers.

Your cooperation in filling out the enclosed questionnaire and mailing to L. W. Bonnicksen will be greatly appreciated. We believe the results from this study will be of value to you. A self-addressed stamped envelope is enclosed for your convenience.

Sincerely yours,

Henry Giese,
Professor
February 15, 1951

Gentlemen:

The response to our farm roofing questionnaire has been quite gratifying and many worth while remarks have been received. We believe that you will be interested in the summary which we hope to have published in News Flashes.

However, it appears that our instructions were not sufficiently specific with the result that your copy did not indicate fully all first, second and third choices. We are therefore sending another with the request that you favor us by filling it out in accordance with the instructions given below.

For question C in the column under each type of building, place the number 1 to the right of the roofing material which is the farmer's first preference for that building, the number 2 to the right of the second preference and 3 to the right of the third preference. Repeat for each type of building. For question D, fill it out in the same manner as question C. For question E, put a check mark under either Yes, No or No recommendation for each application method. For question F, fill it out in the same manner as question C and D. Question F refers to the application methods listed in question E.

Enclosed is the questionnaire and a self-addressed stamped envelope for your convenience.

Sincerely yours,

L. W. Bonnicksen

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