R-199

PAPER SNOW FENCE INSTALLATIONS 1952-1953

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MICHIGAN
STATE HIGHWAY DEPARTMENT

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STATE HIGHWAY COMMISSIONER

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PAPER SNOW FENCE INSTALLATIONS
1952 - 1953

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Joint Investigation between Maintenance Division
and Testing and Research Division

Snow Fence Material Investigation
Research Project 36 G-3 (10)

Research Laboratory
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During the winters of 1949 - 1950 and 1950 - 1951, the Maintenance Division, in cooperation with the Research Laboratory of the Testing and Research Division, experimented in a small way with snow fences made of paper strips as a substitute for the common wood slat fence. This experimental work was done on M-100, about four miles south of Grand Ledge. Then, during the winter of 1951 - 1952, the Maintenance Division, at the direction of Mr. B. R. Downey, Maintenance Engineer, authorized the erection of approximately five miles of paper snow fence located in various parts of the Lower Peninsula for field study. This work was reported in Research Laboratory Report No. 178 issued July 1, 1952.

The performance of paper snow fence during the winter of 1951 - 1952 was so satisfactory that the installation of a greater mileage of paper snow fence was authorized for the winter of 1952 - 1953 in seven of the eight highway districts of the state, including a total of 28 counties as listed below. The locations of the snow fence installations are shown in Figures 1 and 2.

District 1: Baraga, Dickinson, Gogebic, (Houghton by Keweenaw Co.) Iron, and Ontonagon counties.

District 2: Chippewa and Delta Counties.

District 3: Antrim, Kalkaska, Leelenau, Manistee, Osceola, and Wexford counties.

District 5: Clinton, Mecosta, and Montcalm counties.

District 6: Saginaw and Sanilac counties.

District 7: Berrian, Eaton*, Kalamazoo, and Van Buren counties.

District 8: Hillsdale, Ingham, Jackson, Lenawee, and Macomb counties.

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* Eaton County had special Experimental Fence.

MAP SHOWING LOCATION
OF PAPER SNOW FENCE INSTALLATIONS

WINTER 1952-1953

FIGURE 1

MAP SHOWING LOCATION
OF PAPER SNOW FENCE INSTALLATIONS

FIGURE 2

WINTER 1952 - 1953

Description of Paper Snow Fence Installation

The paper snow fence consisted of two parallel 12-inch wide strips of paper material, fastened to either steel posts or, in special cases, to cut saplings spaced eight to twelve feet apart. In general, the distance between paper strips was 12 inches and the bottom strip was 12 inches above the ground.

All of the paper material used in this work conformed to American Society of Testing Materials Designation C 171-49T, Specifications for Waterproof Paper for Curing Concrete.

On one section of fence in Saginaw County (in 1951 - 1952), a different method of fastening was used which seemed to be an improvement over the stapling method used before, so the Research Laboratory tested this method and, as a consequence, it was recommended for the erection of fence in the last winter. This method was not followed in all cases although it was used in the majority of the installations and in general proved to be as satisfactory as anticipated.

The recommended method of erecting the fence was as follows: The metal snow fence posts were driven to a firm bearing of at least two feet into the ground with the U openings all faced away from the road centerline. Then the paper, together with a cushion strip, was fastened to the post by forcing a 1 by 2-inch piece of wood slightly longer than the width of the paper strip into the U opening of the post, thus wedging the paper into the post, and then tying these wood pieces to the U posts with wire ties. This was a simpler and quicker method than the staple method formerly used.

Various trips were made by the author during the winter to inspect the paper snow fence installations in all parts of Michigan. In general, the fence came through the winter in excellent condition both in the counties where it had been used previously and in those where it was being tried for the first time. In a few cases, the fence had

been put up in a very careless fashion. Where performance was poor, irregular spacing of the posts was generally at fault, although sometimes the wire ties had failed, probably because they were too long and needed so many twists to tighten them that the wire was weakened and additional pull later under working conditions caused it to fail.

Most of the damaged fence observed was in locations where either stock or school age children had broken through the fence. It was apparent that if this type of fence was installed with the proper care, it could resist any type of normal weather hazard.

Pictorial Review

Pictures were taken of nearly every fence installation in the state and the following ones have been selected to illustrate various features found during inspection trips.

Figures 3 to 8 in Plate I illustrate typical examples of snow fence installations found throughout the state near end of winter season. Most of the fence installations were found to be in similar physical condition where properly erected.

Figures 9 to 14 in Plate II illustrate typical conditions of fence slackness which develops under certain installation conditions and also methods employed by maintenance personnel to overcome this undesirable condition.

Figures 15 to 20 in Plate III illustrate typical paper failures and their causes. Most of the damage could be traced to school children and stock; however, certain failures could be attributed directly to installation methods which allowed the paper strips to become loose. Examples of such methods include failure to stretch paper tight enough when installing or failure in methods used to secure paper to the posts.

Figures 21 to 28 in Plate IV show various methods of attaching paper strips to metal fence posts. From field experience, the method recommended early in the

text proved to be the most satisfactory. This method is illustrated in Figure 25.

Figures 29 to 34 in Plate V exemplify several types of special installations. Figures 29 and 30 show two methods of providing gaps in paper snow fence installations to cut down damage by stock and people. This procedure is recommended for all long snow fence installations. Figures 31 and 32 are self-explanatory. Figures 33 and 34 show two typical paper snow fence installations employed to protect roads running adjacent to lakes. In such cases, saplings driven firmly into the lake bed are used to support the paper strips in order to avoid the loss of expensive steel posts and wooden slat fence when the lakes thaw in the spring.

SPECIAL TEST SECTION ON M-100

Special experimentation was continued this winter on M-100 south of Grand Ledge to determine the possibility of increasing spacing between posts beyond 8 feet, a value fixed by earlier field tests, and in addition to determine if the snow fence paper, if carefully salvaged, could be used the second season.

Stretches of fence were set up with controlled spacing of 8 feet, 9 feet, and 10 feet between posts, using new paper, and carefully inspected at intervals all during the winter. Figures 35 to 39 in Plate VI show installations. These tests indicate that when proper methods are used in erecting paper snow fence, a 10-foot post spacing can be employed with confidence. This has been verified by field installations erected throughout the state in 1952 - 1953.

Also sections of fence using paper salvaged from last year's fence were erected with 8, 9, 10, and 12-foot spacings. The salvaged paper performed satisfactorily all winter for post spacings of 8, 9, and 10 feet. The 12-foot spacing finally failed about ten days before time to remove the fence from the farmer's field. Figures 40 to 45 in Plate VII show installations using salvaged paper. There also was a section

of salvaged paper erected in Jackson County that went through the winter in excellent shape, the only breaks being where children had played. These tests indicate that with proper installation and handling it should be possible to re-use the paper the second year.

It should be kept in mind in interpreting these results that the 1952 - 1953 tests were performed under rather unusually mild winter conditions. Table I, based upon data furnished by the United States Weather Bureau at East Lansing, gives a comparison of the average snowfall, temperature, and wind velocity in Michigan for the 1951 - 1952 and the 1952 - 1953 winter seasons. (A winter season in this case is considered as lasting from November 1st to April 30th).

TABLE I

Average Climatic Conditions for Michigan

Climatic Conditions	Winter Season 1951-1952	1952-1953
Average Snowfall, inches	90.1	55.5
Average Temperature, deg. F.	29.6	32.1
Average Wind Velocity, m.p.h.	12.4	12.7

These data show that the 1951 - 1952 winter season was much more severe than the 1952 - 1953 winter season from the standpoint of snowfall. Since paper snow fence tested during both of these seasons survived in excellent condition, it is apparent that normal winter conditions have no adverse affect on this type of installation.

SPECIAL LABORATORY STUDY OF TIE WIRES FOR PAPER SNOW FENCE

A special laboratory study was conducted to determine the magnitude of the force exerted by various sizes and lengths of tie wires on the wooden stick which binds the paper to the snow fence post. This was accomplished by means of a metal device which was, in effect, a simple beam to which electrical strain gages were attached. This device simulated the wooden stick and it measured the force exerted by the wires as they were twisted around the electronic device and the post.

The results of this study showed, for a given sized wire, that the shorter tie wires with fewer turns developed more force on the wooden stick than the longer tie wires with a greater number of turns. A length of tie wire sufficient to wrap around the post and wooden stick and, in addition, provide 2 to 3 twists was found to be the most satisfactory.

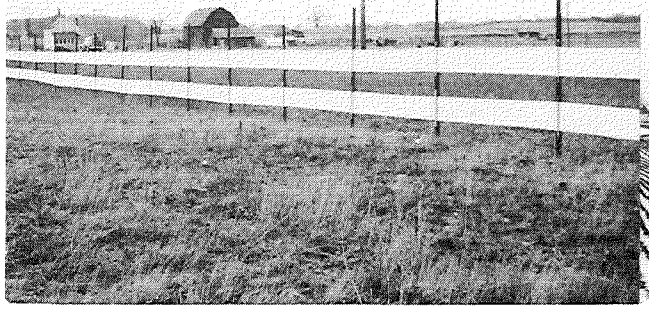

Figure 3. Lenawee Co., US-223 southeast of Devil's Lake. 3-24-53.

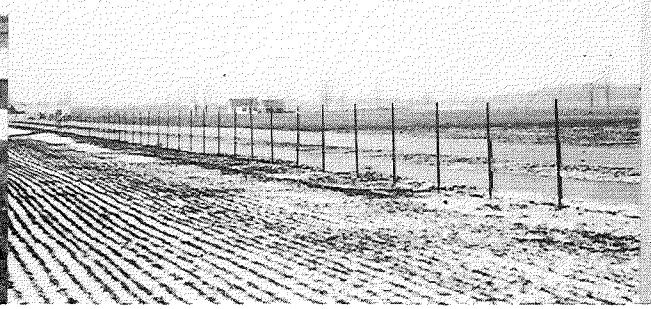

Figure 4. Saginaw Co., US-10 west of Saginaw. 2-12-53.

Figure 5. Leelenau Co., M-22. 2-27-53.

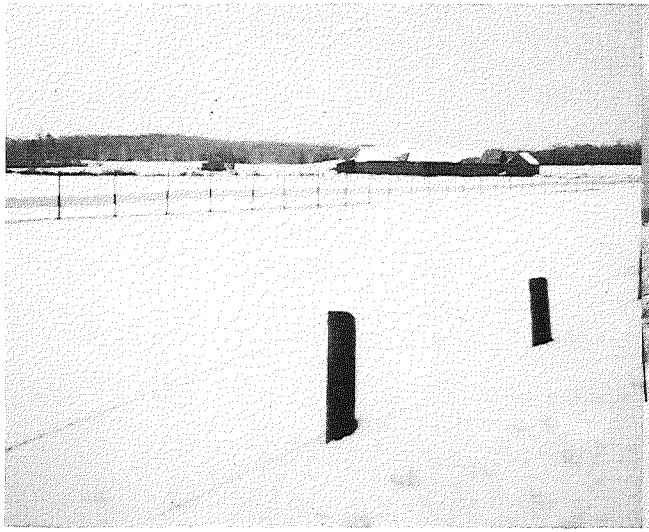

Figure 6. Iron Co. on M-73. 2-25-53.

Figure 7. Baraga Co., US-41. 2-24-53

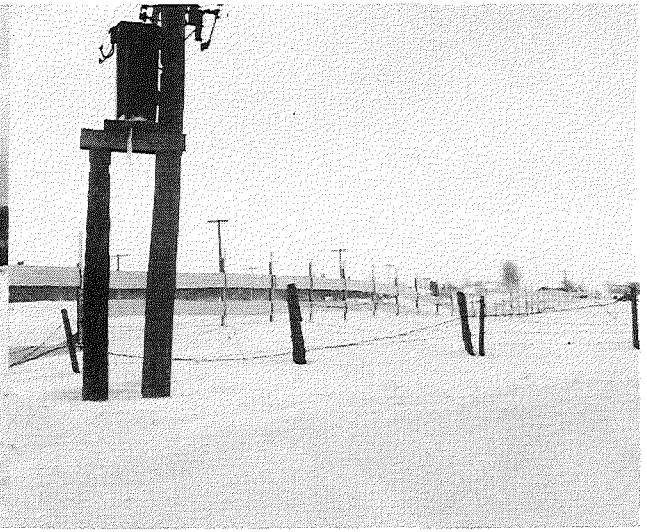

Figure 8. Keweenaw Co., US-41. 2-25-53.

TYPICAL EXAMPLES OF SNOW FENCE INSTALLATIONS THROUGHOUT THE STATE

PLATE I

Figure 9. Macomb Co., M-53 south of Romeo. Note slackness in end panel. 1-9-53.

Figure 10. Hillsdale Co. on M-99 detour south of Homer. Note general slackness of paper. 2-11-53.

Figure 11. Hillsdale Co., M-99 north of Litchfield. Use of wire bracing. 2-11-53

Figure 12. Hillsdale Co., M-49 south of Litchfield. End post braced by tie wire attached to stakes. 2-11-53.

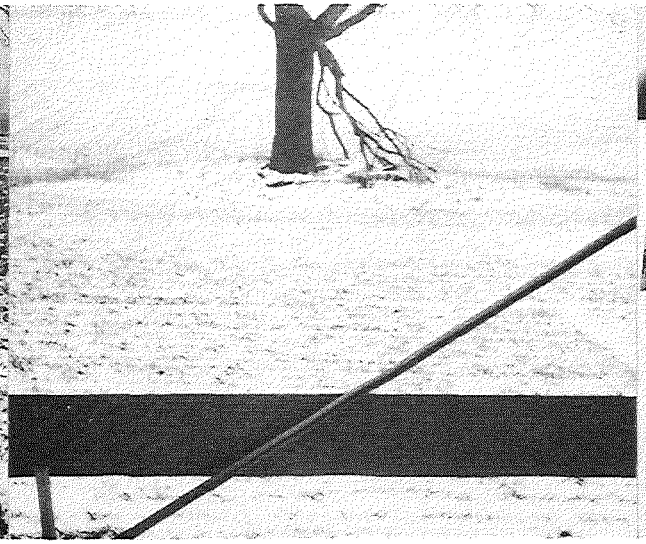

Figure 13. Hillsdale Co., M-99 south of Hillsdale. Steel post used to brace end post. 2-11-53.

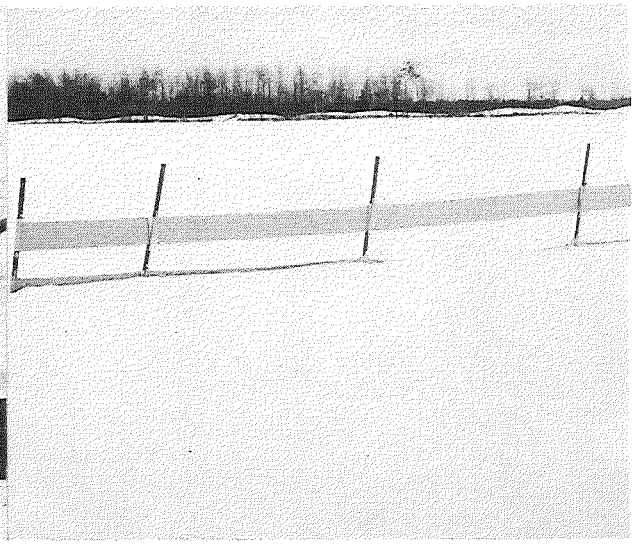

Figure 14. Ontonagon Co., M-45. Use of short end panel. 2-25-53.

EXAMPLE OF PAPER SLACKNESS AND METHODS EMPLOYED TO OVERCOME IT

PLATE 11

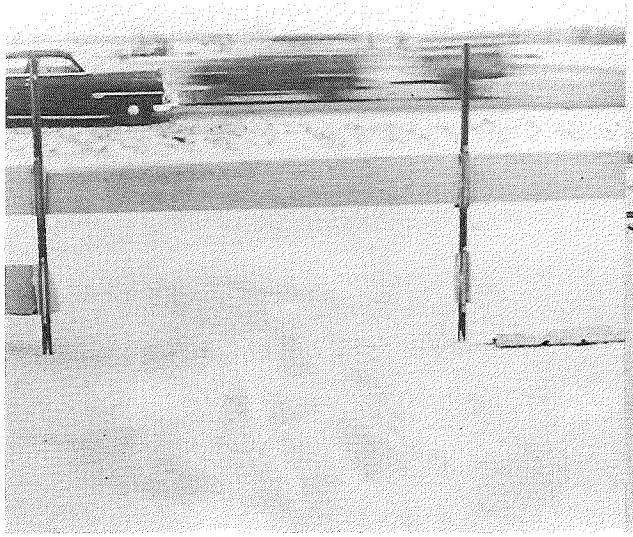

Figure 15. US-127 south of Mason. Close-up of break caused by children with sleds. 1-22-53.

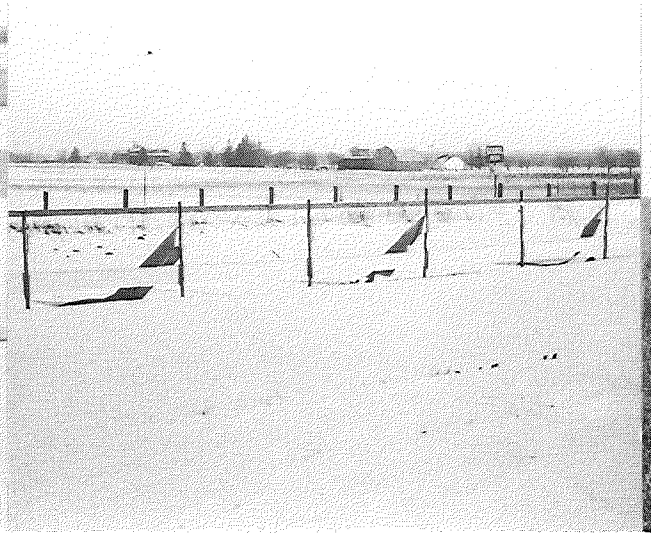

Figure 16. US-131 in Oceana County. Breaks caused by children playing, as evidenced by footprints. 2-18-53.

Figure 17. M-43 south of Richland. Damage caused by cattle. 11-12-53.

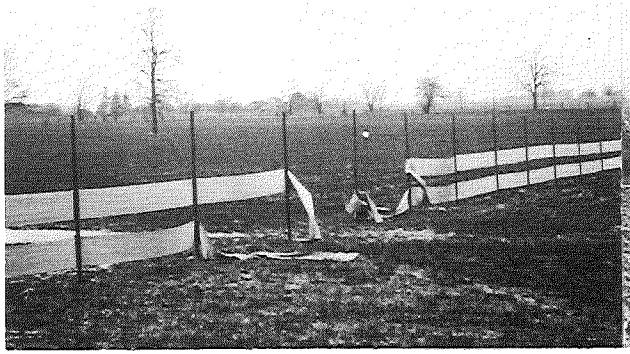

Figure 18. US-27 north of St. Johns. Damage caused by stock passing through long installations. 2-12-53.

Figure 19. M-99 south of Hillsdale. Damage resulting from improper installation. Paper was not stretched tight. 3-25-53.

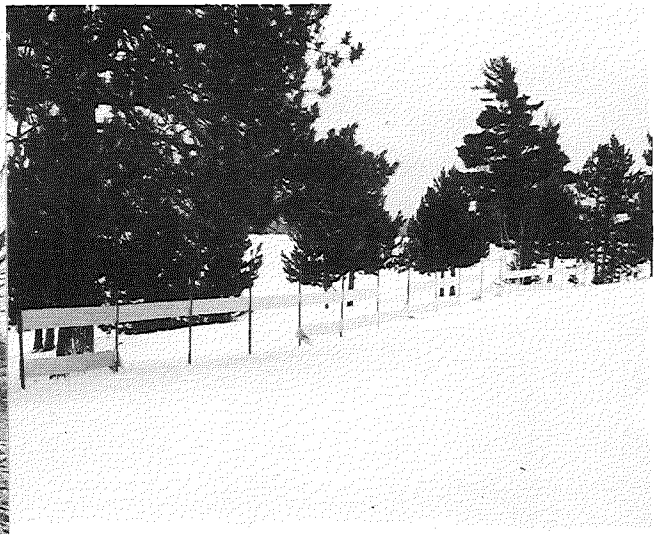

Figure 20. Baraga Co., US-41. Failure resulting from use of long tie sticks. 2-24-53.

EXAMPLES OF TYPICAL PAPER FAILURE AND THEIR CAUSES

PLATE III

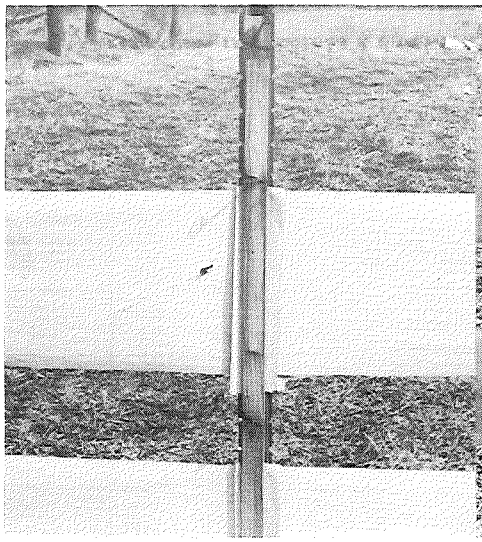

Figure 21. Original method. Paper clamped between two wooden slats which were wired to steel posts.

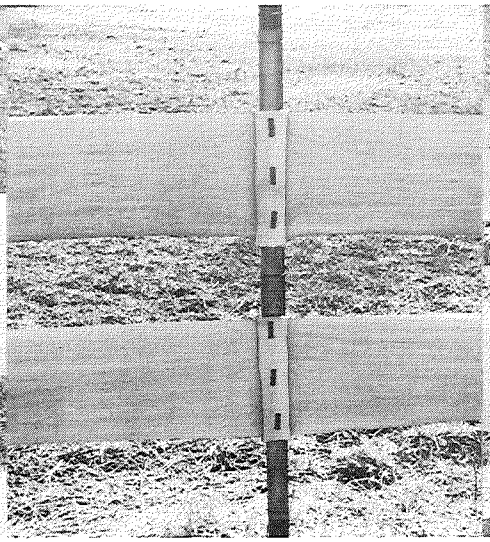

Figure 22. Paper stapled to long slat wired to steel U Post.

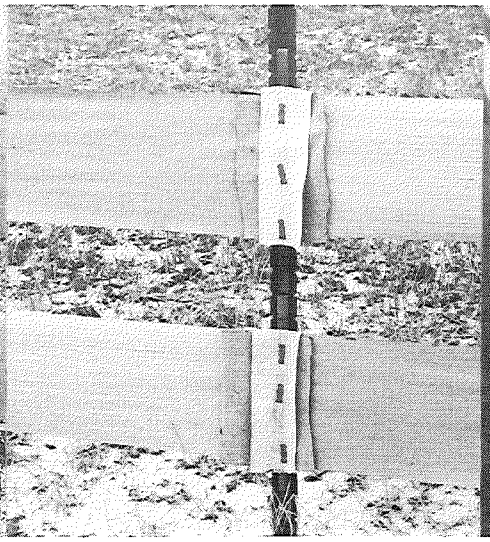

Figure 23. Paper stapled to a long narrow stick wired in groove of steel U post.

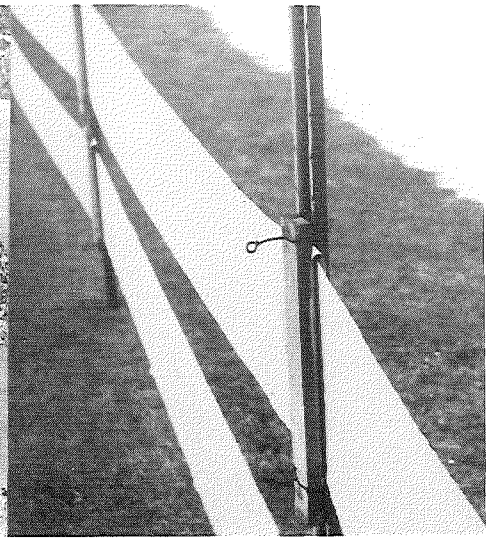

Figure 24. Paper held directly against steel U post by short slats wired flat side to paper.

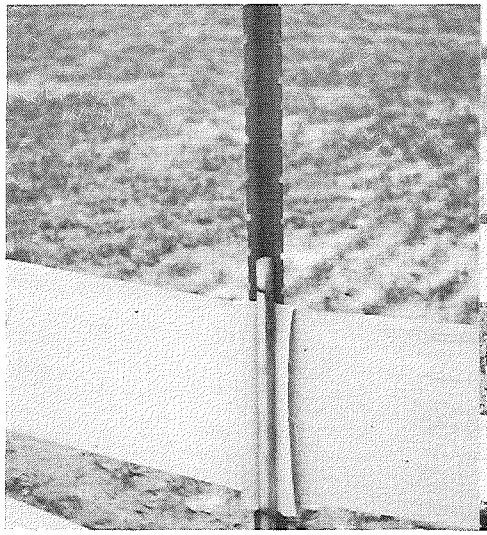

Figure 25. Paper forced into U post groove by short piece of wood wired to post. Note paper cushion strip placed around 12" paper fence material.

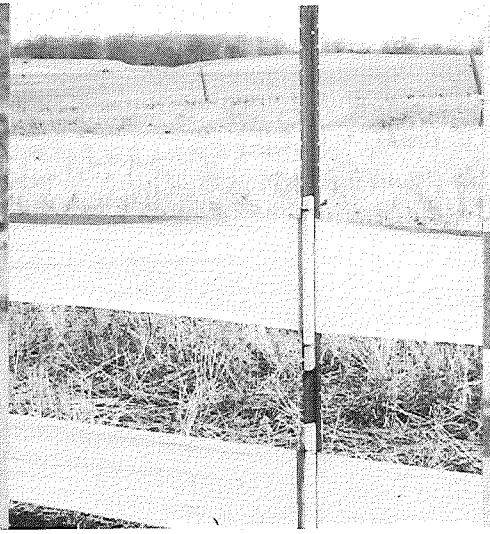

Figure 26. Same method as shown in Figure 25. Without paper cushion strip.

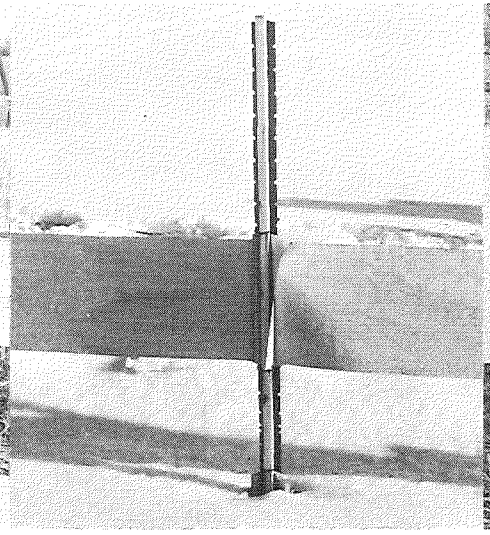

Figure 27. Both 12" strips of fence paper forced into groove of steel U post by one continuous long slat. Bottom fence strip buried in snow.

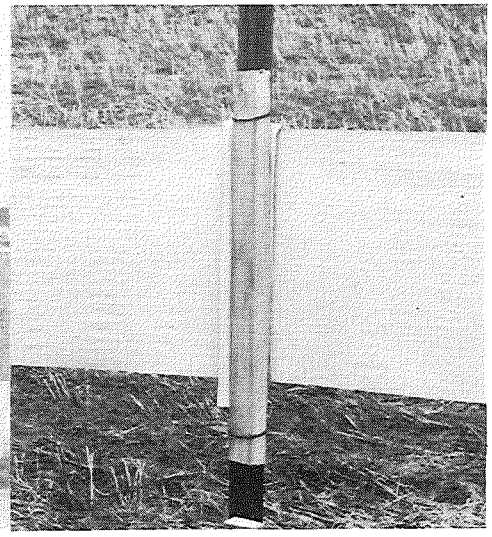

Figure 28 Method employed to attach paper to metal T posts. Paper forced into corner of T post by short piece of wood wired to post.

TYPICAL METHODS OF FASTENING PAPER STRIPS TO FENCE POSTS

PLATE IV

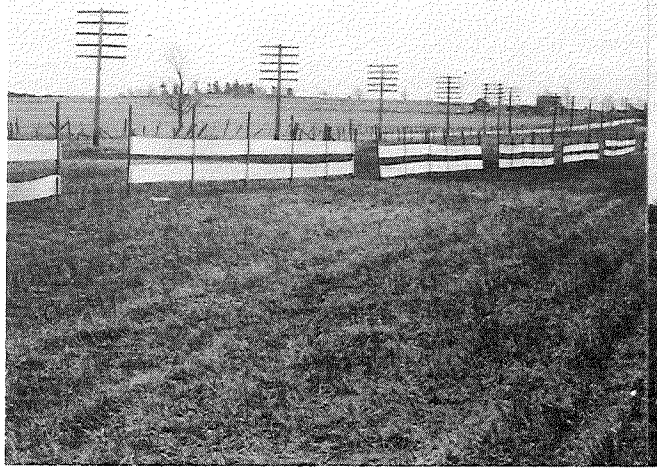

Figure 29. Gaps provided at short intervals in a long fence installation to permit passage of stock and people, thus avoiding unnecessary damage.

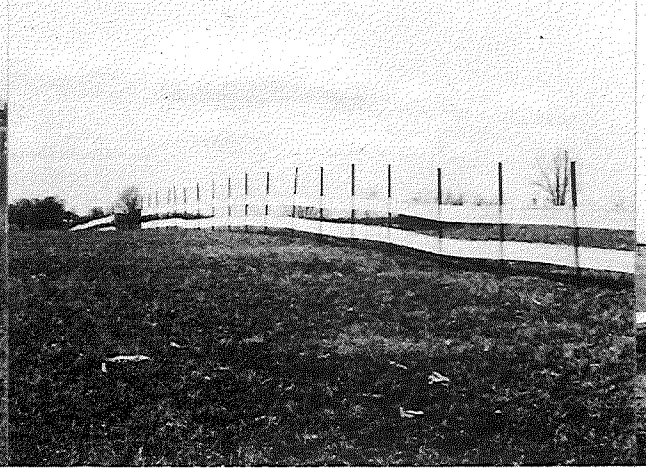

Figure 30. Gaps provided at larger intervals for same purpose as explained in Figure 29.

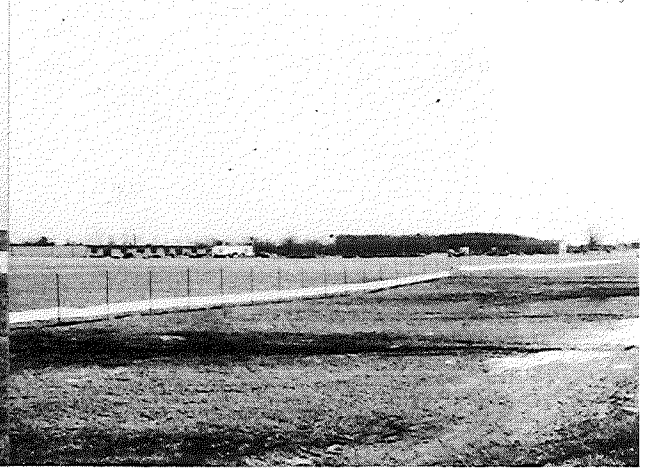

Figure 31. Installation of single paper strip in areas of limited snowfall. Second strip may be added if necessary.

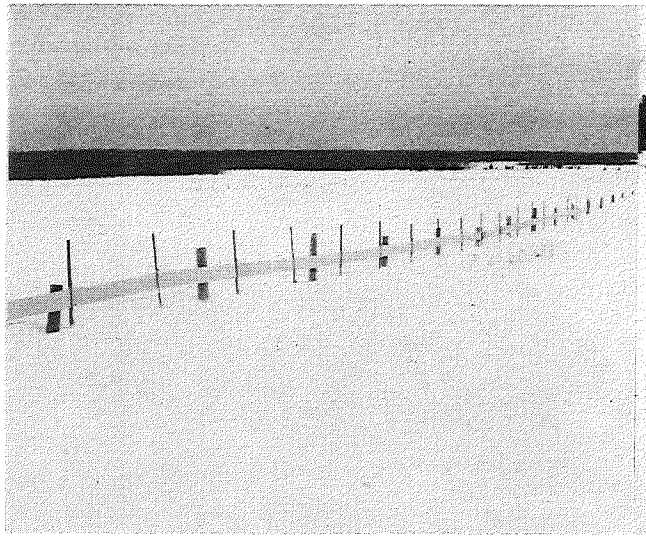

Figure 32. Illustrating erection of paper snow fence parallel and adjacent to existing right-of-way fence.

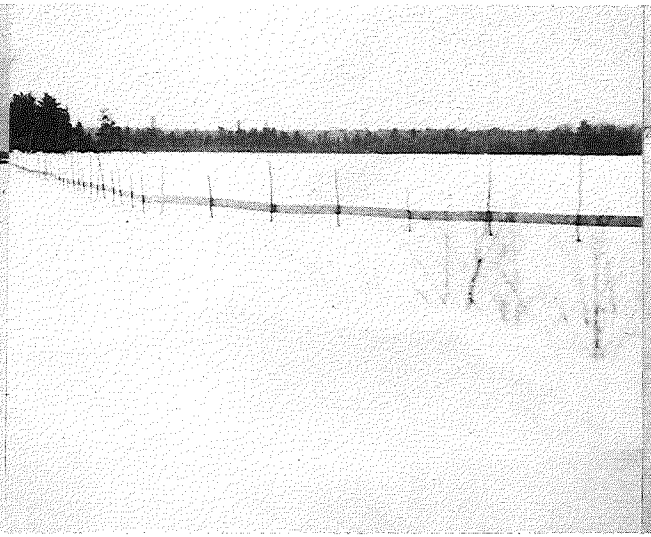

Figure 33. Paper fastened to wood saplings driven in bed of lake. Lower strip buried in snow. Bass Lake, Gogebic Co.

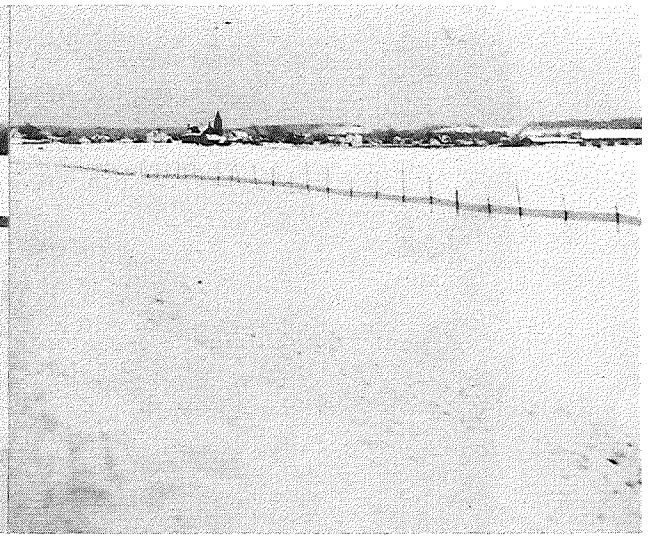

Figure 34. Another view of a lake installation to protect adjacent roadway. Sandy Lake, Gogebic Co.

EXAMPLES OF SPECIAL SNOW FENCE INSTALLATION

PLATE V

Figure 35. Fence posts spaced 8 feet apart. 1-12-53.

Figure 36. Fence posts spaced 9 feet apart. 1-12-53.

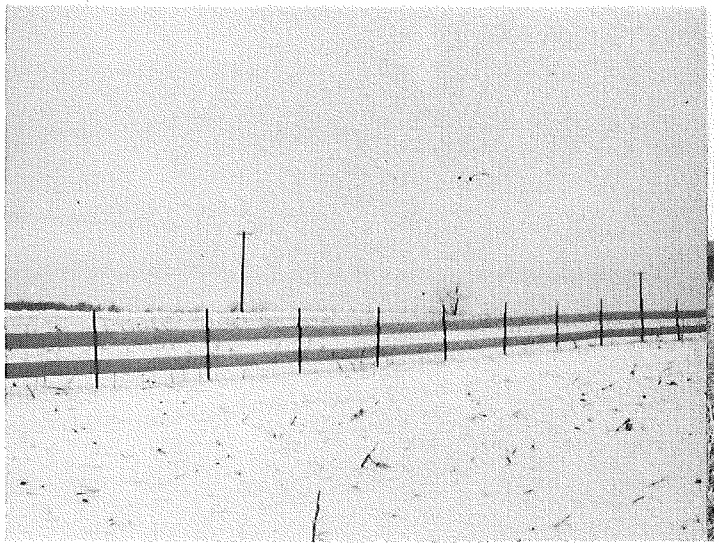

Figure 37. Fence posts spaced 10 feet apart 1-12-53.

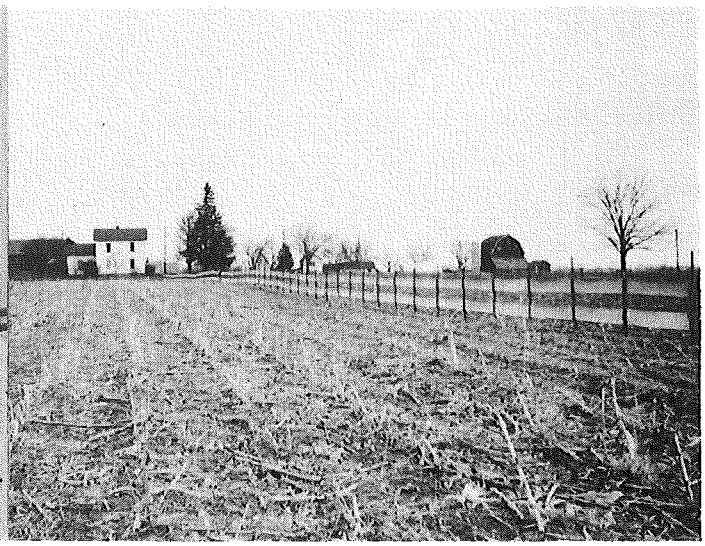

Figure 38. Special installation M-100. General view of snow fence installation. 1-16-53.

Figure 39. General view of test section. 3-27-52.

SPECIAL SNOW FENCE INSTALLATION,
M-100 - NEW PAPER -
SPACING OF SNOW FENCE POSTS

PLATE VI

Figure 40. General view of installation. 10-9-52.

Figure 41. Eight-foot spacing of posts. 1-12-53.

Figure 42. Nine-foot spacing of posts. 1-12-53.

Figure 43. Ten-foot spacing of posts. 1-12-53.

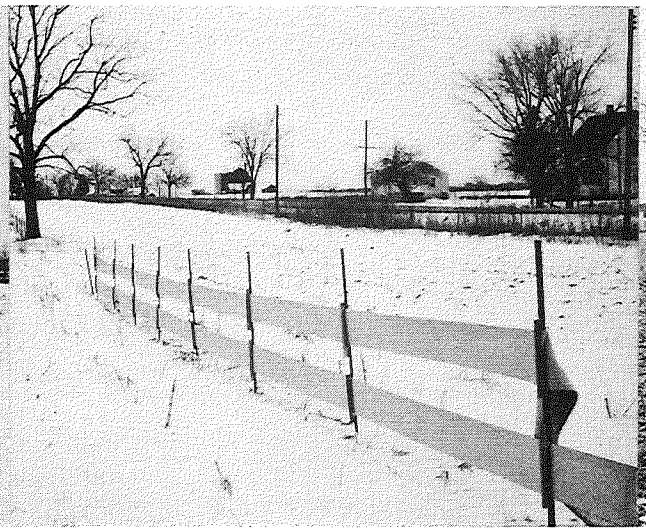

Figure 44. Twelve-foot spacing of posts. 1-12-53.

Figure 45. Another view of twelve-foot spacing. 2-4-53.

SPECIAL SNOW FENCE INSTALLATION, M-100 - SALVAGED PAPER

PLATE VII