WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

MISSISSIPPI RIVER COMMISSION

TESTS ON METHODS OF EMPLOYING PIERCED PLANK LANDING MAT WITH PREFABRICATED BITUMINOUS SURFACING

TECHNICAL MEMORANDUM NO. 211-4

U. S. WATERWAYS EXPERIMENT STATION

VICKSBURG, MISSISSIPPI

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TESTS ON METHODS OF EMPLOYING PIERCED PLANK LANDING MAT WITH PREFABRICATED BITUMINOUS SURFACING

Introduction

Authority

1. Authority for conducting these tests is contained in a letter from the Office, Chief of Engineers, Washington, D. C. to the President, The Engineer Board, Fort Belvoir, Virginia, dated 7 May 1945, subject: "Determination of Satisfactory Methods of Employing Pierced Plank Landing Mats Over PBS" (Work Order No. DAC 3083). This authority was transmitted to the Director, U. S. Waterways Experiment Station, Vicksburg, Miss. through the President, Mississippi River Commission, Vicksburg, Miss. by the Engineer Board in a directive dated 19 May 1945, subject: "Plan for Test, Determination of Satisfactory Method of Employing Pierced Plank Landing Mat over PBS."

Purpose

2. The purpose of these tests was to determine the most feasible method of employing standard steel and aluminum pierced plank landing mats in combination with PBS (Prefabricated Bituminous Surfacing) without destroying the waterproof characteristics of the PBS when subjected to 20,000- and 37,000-lb wheel loads.

Scope

3. The tests involved the arrangement of eight combinations of mats in two similar traffic lanes; the rehabilitation of an old traffic test site; the placing of suitable base courses; the laying of pierced plank mats in conjunction with several cushioning materials on PBS, and traffic testing of one lane with a 20,000-lb wheel load and the other with a 37,000-lb wheel load. They also involved laboratory tests on sand-asphalt and soil-asphalt cushion materials and the keeping of complete written and photographic records as the tests progressed.

Preparation of Test Site

Subgrade

4. Layout of test sections. These tests were conducted on a site that had been used in previous tests on aluminum pierced plank mat. The subgrade for the old test lane was 60 feet wide by 500 feet long. Plans for the new tests called for 16 sections 30 feet wide by 35 feet long.

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These sections were organized into two similar parallel lanes, each 30 feet wide by 280 feet long. This required a subgrade 70 feet wide (including a 5-foot shoulder on each side) and 280 feet long (see plate 1). Hence it was decided to widen the west 280 feet of the old subgrade to 70 feet and to utilize the existing turnarounds. Each lane was composed of eight sections and contained eight different combinations of PBS, cushion material and pierced plank mat. The following tabulation shows the combinations. The columns under "Mat Materials" reading from left to right show the materials from base course to wearing surface.

Section Numbers	Mat Materials		
1 and 9	PSP(1)	Asphalt	PBS
2 and 10	PBS	PSP inverted	PSP normal
3 and 11	PBS	Hay mulch	Wire mesh + PSP
4 and 12	PBS	Hay mulch	PSP
5 and 13	PBS	Hay mulch	PAP(2)
6 and 14	PBS	Sand-asphalt	PAP
7 and 15	PBS	Sand-asphalt	PSP
8 and 16	PBS	Soil-asphalt	PSP

(1) Pierced steel plank , (2) Pierced aluminum plank.

Plates 5 and 6 show general views of sections in the two traffic lanes.

5. Preparation of subgrade. California bearing ratio measurements made on the old subgrade showed values averaging about 20% at the surface but these values decreased to 7 or 8% at 12 inches below the surface. This was not considered strong enough for 1000 coverages by either of the traffic testing machines. Hence, an 8-inch lift of heavily compacted soil was added over the entire test area. A 5-inch base course of gravelly sand-clay was placed on the 20,000-lb test lane and an 8-inch base course of the same material was added to the 37,000-lb test lane. These thicknesses were designed to furnish adequate strength to withstand 1000 coverages without failure or serious deflection under the wheel loads used.

Surfacing materials

6. Prefabricated bituminous surfacing. The protective covering of PBS was placed directly on the base course of the whole test area except sections 1 and 9. Its function was to prevent surface water from entering and softening the base and/or subgrade. It was laid with a 50% lap to form a double thickness of fabric. The edges along both sides and at each end of the area were anchored in small V-ditches approximately 8 inches deep. The PBS was placed with the pilot-model laying machine, using diesel oil as a solvent. Rolling was accomplished with a light-weight pneumatic-tired roller. In sections 1 and 9 the protective covering of PBS was placed on top of the pierced steel plank. In these two

sections it was fabricated by hand methods into blankets consisting of six strips of 40-inch PBS 40 feet long. These strips were given a 50% lap, resulting in blankets of double thickness with an effective width of 10 feet. For convenience in handling, the blankets were rolled on pieces of 2 by 4-inch lumber 12 feet long. In this condition they were transported by hand to their positions in the sections where they were unrolled on the pierced plank mat after it had been coated with hot 85-100 penetration AC asphalt, using hand pouring pots. The blanket edges were overlapped 20 inches and sealed together with diesel oil. At the sides of this pair of sections and at the ends adjacent to the turnaround, the mat formed of the PBS blankets was anchored in V-ditches as described above. Along the ends adjacent to sections 2 and 10, a watertight joint was formed by pouring enough hot asphalt through the holes in the PSP to effect a seal between the PBS blanket above the PSP and the PBS mat laid directly on the base course in sections 2 and 10.

7. Inverted pierced steel plank. In sections 2 and 10, a mat of pierced steel plank was placed upside down on the protective covering of PBS. It was believed that the comparatively smooth upper surface of the pierced plank mat would not puncture the PBS and that this inverted mat would eliminate damage by the bayonets of the top course of pierced plank mat laid in the normal manner. This mat was laid by fitting the slots in the planks being placed, over the bayonets on the planks in the last row previously laid. Two spring clips per plank were then inserted from the bottom side (which normally would be the top side) by having two men equipped with wrecking bars raise the last plank placed high enough for two other men equipped with hammers to reach under and drive the clips upward. In this manner the men were able to place approximately one-third as many square feet per man hour as they could place with the usual manner of laying.

8. Hay and wire mesh. In sections 3 and 11 a loose layer of hay 6 to 8 inches thick was placed directly on the PBS mat to protect it from damage by the pierced plank mat. This hay consisted of about 70% Johnson grass, which is a tough, coarse grass with long blades and stems; 10% Bermuda grass, with rather fine but tough stems 6 to 10 inches long, and 20% weeds, vines and other grasses. It was cut locally and trucked to stacks at the test site. Later it was hauled onto the test sections and spread uniformly with pitchforks. After being spread it was held in place by a wire mesh laid parallel to the traffic lanes. The wire mesh used was part of a shipment received for a previous test. It was made of 0.212-inch diameter wire, welded together to form strips 7 feet 3 inches wide and 77 feet 3 inches long, having a 3-inch-square mesh. Plate 2 shows the appearance of the hay mulch and wire mesh just prior to placement of the pierced plank mat.

9. Hay mulch. The hay described in paragraph 8 was used as a protective cushion for the PBS in sections 4, 5, 12 and 13. The directive called for "a layer 2 inches in compacted thickness." Since it was found impractical to compact the hay with any ordinary equipment, a uniform loose

layer was spread 14 to 16 inches thick over the sections. This packed down to about 2 inches thickness under the weight of a smooth-drum roller, but fluffed up again behind the roller. Plate 3 shows the hay mulch at this stage of construction. Traffic tests in the 20,000-lb lane (sections 12 and 13) demonstrated that this thickness was inadequate. Hence, the pierced plank mat was removed and an additional 14 inches of loose hay was placed on sections 4 and 5, making a total loose thickness of approximately 28 inches in the 37,000-lb traffic lane (see plate 1) before traffic testing was started.

10. Sand-asphalt and soil-asphalt cushions. The function of these cushions was to protect the PBS from damage by the bayonets on the pierced plank mats and to serve as a bedding material for those mats. They were not designed to act as pavement nor to increase the load-bearing capacity of the test lane. Aside from protecting the PBS, the only requirements were that they remain dustless in dry weather and that the not be detrimentally affected by water. It was found necessary to do some laboratory work, prior to mixing and placing the cushion material in the field, in order to determine the proper range of mixtures to use.

a. Laboratory testing. Laboratory tests on coarse river-bar sand with various percentages of cut-back asphalt added indicated that no stability could be expected from a straight sand-asphalt cushion. Even after eleven days of aeration the sand appeared oily and could not be compacted to show any stability whatsoever. This led to the inclusion of sand containing a filler of pulverized clay-loess. It was found that the addition of 10 to 25% of this filler to the sand produced a reasonable degree of stability. The soil-asphalt mixed under laboratory conditions developed considerably more stability than the sand-asphalt with filler. MC-3 cut-back asphalt was used with the sand and MC-2 with the soil. In view of the indicated variations in stability of the various mixes, the following subsections were placed:

Sections	Subsections	Design Mix
6 and 14	A	River-bar sand - 8% asphalt
	B	River-bar sand - 6% asphalt - 15% filler
	C	River-bar sand - 7% asphalt - 25% filler
7 and 15	A	River-bar sand - 7% asphalt - 25% filler
	B	River-bar sand - 6% asphalt - 15% filler
8 and 16	A	Clay-loess - 12% asphalt
	B	Clay-loess - 9% asphalt
	C	Clay-loess - 6% asphalt

b. Field mixing and placing. On the test site the sand-asphalt and soil-asphalt cushion materials were mixed in a 6-S concrete mixer. The cut-back asphalt was heated to approximately 180 degrees F. and poured into the mixing drum from the discharge side. The soil, a clay-loess, was thoroughly dried and pulverized before being mixed. This method of mixing was entirely satisfactory for sand-asphalt without filler. When the pulverized clay-loess was added to the sand there was a slight tendency for the filler to form into small pellets over-rich in asphalt and thus reduce the effective percentage of asphalt in the mix. This tendency was more pronounced in the soil-asphalt mixtures. It is believed that better mixing equipment would have eliminated this condition to some extent. After being mixed, the cushion material was dumped directly onto the PBS from rubber-tired wheelbarrows and spread to a uniform thickness slightly greater than 2 inches. It was then allowed to cure from 4 to 6 days, with the surface being raked each day to increase aeration and was then compacted by one pass of a smooth-drum roller.

11. Pierced plank mat. The pierced steel plank was laid directly on the base course in sections 1 and 9. In sections 2 and 10, pierced steel plank was laid in the normal manner over that which previously had been placed upside down. All other pierced plank mat was placed on top of the mulch or cushion material described in paragraphs 8 through 10. Since it was not feasible to truck over and dump bundles of pierced plank on the cushions, the mat was either brought in from the side by hand or trucked in from the rear over the finished test lane. It was found impractical to stretch the mat with trucks or tractors on the hay mulch and asphalt cushions. Hence the slack was pulled out by hand as the mat was placed.

Traffic Testing

Method of testing

12. Testing equipment. The 20,000-lb traffic lane was tested with a 12-cu-yd Tournapull scraper unit, loaded with scrap steel to a gross weight of 20,000-lb on each of the four wheels. This machine was equipped with 21.00-24 tires on the front wheels and 18.00-24 tires on the rear wheels. All of the tires were inflated to 55 psi. This resulted in contact pressures of 60 psi under the front wheels and 70 psi under the rear wheels. Reducing the inflation pressure in the rear tires would have resulted in dangerous deflection of the side walls. The machine for testing the 37,000-lb traffic lane was a 32-cu-yd Tournapull scraper unit loaded with scrap steel to a gross weight of 37,000-lb on each wheel. It was equipped with 30.00-40 tires on all wheels. The tires were inflated to 50 psi and the resultant contact pressure was 64 psi.

13. Testing procedure. The testing machines were driven over the traffic lanes in one direction, turned and shifted laterally the width of one tire print and then driven over the test lanes in the opposite direction. This procedure was repeated until all the traffic lanes had been uniformly covered. When the lanes had been so covered, the direction of traffic was reversed, so that successive passes of the tires over any given point were in opposite directions.

Test results

14. Sections with PBS blankets. Section 1 in the 37,000-lb traffic lane and section 9 in the 20,000-lb traffic lane contained a double thickness of PBS mat cemented to the top of a PSP mat with asphalt. Methods of placing the PBS on the steel mat are described in the last half of paragraph 6. In the 37,000-lb lane the scrubbing action of the large tires (30.00-40), as they deflected under the test load, abraded the PBS so rapidly that holes started appearing at the spring clips at 32 coverages. At 76 coverages the fabric started tearing along the seams where there was only a single thickness to resist lateral tension, and along the edges of the pierced planks where abrasion was accentuated. This abrasion increased so that at 100 coverages the PBS had failed completely as a waterproofing agent, although it continued to serve as a dust preventive throughout the test. No bond failures occurred, either between strips of PBS or between PBS and steel mat. Plate 7 shows how the spring clips punctured the blankets. In plate 8 the blanket has been cut and opened up to show the bond formed by the asphalt cement. Note how thoroughly the pierced plank mat was embedded in the base course material. In the 20,000-lb traffic lane (section 9) the blankets gave much better performance. The tires on the 20,000-lb testing machine were much smaller than those on the 37,000-lb machine (see paragraph 12) and while they had about the same contact pressure the abrasive action was much less. The spring clips did not start coming through the blankets until 300 coverages had been applied. At 700 coverages only 21 clips had come through and a light rain at this stage did little or no damage to the base course. At 1000 coverages (the end of the test) about 60% of the clips had cut through the PBS. No other holes or damage had occurred except a few punctures caused by pieces of gravel that had been picked up by the tires and brought onto the test section from the turnaround. This of course would not occur on a landing field and these punctures were not considered important. Plate 9 shows the condition of section 9 at 1000 coverages.

15. Sections with inverted pierced steel plank. The most noticeable feature of this combination of PSP laid normally over PSP inverted was the noise it produced under traffic. There was no damage to the PBS in either lane visible from the surface at the end of the test (1000 coverages). This is shown by comparison of plate 10 with plate 11 and plate 12 with plate 13. However, removal of the two layers of pierced plank mat after testing the 20,000-lb lane revealed that the base course material had been forced up into the ribs of the inverted layer and had torn the fabric in many places. It is believed that the operation of the 20,000-lb load at somewhat greater speed produced a tamping action which was greater than that produced by the slower 37,000-lb load and hence resulted in loosening the surface of the base course material, and forced it upward into the openings or convex surfaces of the mat. The rounded tops of the spring clips had also cut through the PBS. Careful estimates indicated that this tearing had started just prior to 700 coverages. It was also revealed that even though the base course material had been thoroughly rolled with a smooth-drum roller just before placing the PBS,

practically every piece of heavy gravel left at the surface had cut through the fabric under the tamping action referred to above. After this experience the planks were removed and periodic inspections were made of the PBS in the 37,000-lb traffic lane as the test progressed. The same conditions described for the 20,000-lb lane occurred in this lane, but to a lesser degree. The fabric started tearing between 800 and 900 coverages. Plates 14 and 15 show the condition of the PBS in these sections at the end of traffic testing and plates 16 and 17 are corresponding views of the base courses with the PBS removed.

16. Sections with hay mulch cushions and wire mesh. Hay mulch held in place by wire mesh was tested as a cushion to protect the PBS in both traffic lanes (see paragraph 8 for method of placement). Test results under both wheel loads were practically the same, except that possibly a few more punctures occurred in the 37,000-lb lane. During the early part of the test there was considerable springing of the pierced plank mat as the test load passed. This decreased and finally disappeared at about 200 coverages. The hay compacted so rapidly under traffic that at 300 coverages it was only about one inch thick. At around 800 coverages in each lane it was noted that the wire mesh had been forced down into the hay mulch, forming a mat of hay and wire that actually had more hay above than below the wire mesh. This condition is shown on plate 18. Punctures started to appear in the PBS in both lanes at about 900 coverages. These holes were made by the wire mesh being forced through the fabric by the pierced plank. Plates 19 and 20 show the appearance of section 3 in the 37,000-lb lane before and after testing, respectively. Section 11 in the 20,000-lb lane is similar to section 3. Plates 21 and 22 show the condition of the PBS under the hay and wire mesh after 1000 coverages in the 37,000- and 20,000-lb lanes, respectively.

17. Sections with hay mulch. Hay mulch only, as a means of protecting the PBS from damage by the pierced plank mat, was tested in both traffic lanes and under both steel and aluminum pierced plank (see paragraph 9 for description of mulch). Although the subgrade remained firm, there was a decided springing of the hay mulch and mats in both lanes throughout the tests. The springing was more pronounced in the sections containing aluminum pierced plank than in those containing steel pierced plank. This was attributed to the greater resiliency of the aluminum mat. Apparently more hay worked up through the larger holes in the steel mat than did through the aluminum mat. However, the grinding action and destruction of hay was more rapid under the stiffer aluminum mat. At 700 coverages the hay under the aluminum mat in the 20,000-lb traffic lane had compacted and worn down till the bayonets had come in contact with and punctured the PBS. This did not occur under the steel mat in this lane until after 800 coverages had been applied. In both cases the sections appeared on the surface to be in good condition at 1000 coverages. However, the condition of the PBS would have permitted rain water to enter and soften the base course material. Plates 23 and 24 show section 12 containing the steel mat, with section 13 containing the aluminum mat in the background, at the beginning and end of the test, respectively.

Plates 25 and 26 show the punctured PBS in section 12 at 1000 coverages and that in section 13 at 700 coverages, respectively. The increased thickness of hay mulch in sections 4 and 5 (see paragraph 9), afforded ample protection for the PBS in this portion of the 37,000-lb traffic lane throughout the test. However, the hay was beginning to decay and give off a foul odor at the end of the test. Plate 27 shows the appearance of sections 4 and 5 at 1000 coverages. Plates 28 and 29 show the sound condition of the PBS at the end of the test in these two sections.

18. Sections with sand-asphalt cushions. Sand-asphalt, with and without filler, was tested as a cushion material under aluminum pierced plank in both traffic lanes. Sand-asphalt with filler was tested under steel pierced plank in both lanes. In sections 6 and 14 (37,000- and 20,000-lb lanes) the following mixes of sand-asphalt were found to have been placed, as determined by extraction after the traffic test:

Subsection	Aggregate	% Asphalt
A	Coarse river sand	6
B	Sand with 15% filler	7
C	Sand with 25% filler	7

Note: Percentage asphalt based on dry weight of aggregate.

In sections 7 and 15 the cushion materials in subsections A and B were the same as those in subsections C and B, respectively, of the preceding sections (see plate 1). Despite the fact that the sand-asphalt without filler had no stability and that containing 25% filler had fairly good stability, there was no practical difference in the behavior of the three mixes. In each case the fluxing agent in the cut-back asphalt softened the asphalt on the upper side of the PBS so that the cushion material adhered to the fabric. The steel pierced plank embedded in the cushion material perfectly and after the first few coverages showed no movement under traffic throughout the test. Due to the greater resilience of the aluminum pierced plank, it continued to spring slightly and never became as firmly embedded as did the steel. There was no dusting at the surface of any of the mixes. Light rains and sprinkling had no apparent effect on the cushion material and there was no damage to the fabric in either lane or under either type of pierced plank. Plates 30 and 31 show comparative appearances of section 14 with section 15 in the background (20,000-lb lane) before and after testing, respectively. The appearance of the 37,000-lb lane was similar to this. Plates 32, 33 and 34 show the condition of the PBS under the sand-asphalt cushions in sections 14-A, 14-B and 15-A, respectively, at the end of the test. They are representative pictures for all three types of cushion material in both traffic lanes.

19. Sections with soil-asphalt cushions. Soil-asphalt cushions were tested under steel pierced plank in both traffic lanes. The following table shows the mixes employed in the three subsections of sections 8 and 16, as determined by extraction after the traffic tests:

Subsection	Aggregate	% Asphalt
A	Pulverized clay-loess	11
B	Pulverized clay-loess	9
C	Pulverized clay-loess	6

Note: Percentage asphalt based on dry weight of aggregate.

There was no noticeable difference between the behavior of the cushions under the two wheel loads. The material containing 11% of asphalt was satisfactory throughout the test. It adhered to the PBS in the same manner as the sand-asphalt. The soil with 9% of asphalt started dusting at about 300 coverages and continued to do so throughout the test. While no damage was done to the PBS in these tests, it is believed that enough material would be lost in the propeller slipstream to destroy the cushion in an airplane runway. The soil with 6% asphalt protected the PBS from damage by the pierced plank mat during these tests, but it started dusting badly at about 250 coverages and became muddy during a light rain and when sprinkled. Neither of these mixes stuck to the PBS. Plates 35 and 36 show section 16 at the beginning of the test and at 400 coverages, respectively. Note the dust on subsections 16-B and 16-C on the latter plate. Plate 37 shows the dusty appearance of section 8 at 1000 coverages. Plates 38 and 39 show the condition of the PBS under the cushions in subsection 8-A (37,000-lb lane) and 16-C (20,000-lb lane) after the test. It can be seen that while no actual damage had occurred, the PBS under the cushion material in subsection 16-C was beginning to show the results of pressure from the pierced plank mat.

Conclusions

20. From observations made during these tests the following specific conclusions are drawn:

a. The process of cementing PBS blankets to the top of a pierced plank mat with hot asphalt was slow and tedious, but it would be possible to work out a more practical procedure on a large-scale job. The blankets did not possess sufficient toughness to resist the abrasive action of the large, heavy tires of the 37,000-lb wheel load equipment. They did remain watertight under smaller tires loaded to 20,000 lb, under limited operation, with the exception of a few of the spring clips which punctured the PBS blanket.

b. The inverted steel mat did not adequately protect the PBS under either the 37,000- or 20,000-lb wheel loads for limited operation and the combination of two layers of pierced plank was noisy under traffic.

c. Wire mesh adds materially to the effectiveness of a hay mulch in protecting the PBS. However, a 6-inch loose layer is not adequate, even when held in place by the wire mesh. It is believed that a loose layer 12 to 15 inches thick would furnish ample protection for limited operation under both 37,000- and 20,000-lb wheel loads, until the straw decomposes, or is chewed up and blown away.

d. It is impractical to compact straw by rolling. A 14-inch loose thickness of straw not held in place by wire mesh will not protect PBS from damage by either steel or aluminum pierced plank under a 20,000-lb wheel load. However, a 28-inch loose layer furnishes protection under a 37,000-lb wheel load for limited operation. Pierced plank laid on a thick hay mulch forms a very springy surface, and might cause trouble under the braking action of airplanes.

e. A 2-inch loose thickness of sand-asphalt, with or without filler, forms a satisfactory protective cushion for the PBS under either steel or aluminum pierced plank mat. Flexibility rather than stability appears to be the ruling criterion.

f. Pulverized soil and asphalt are difficult to mix uniformly. A soil-asphalt mix containing about 12% of cut-back asphalt forms a satisfactory protective cushion for the PBS. Mixes leaner than this, unless very thoroughly and uniformly mixed, are not satisfactory.

g. Aluminum pierced plank mat, due to its greater stiffness, is more springy and difficult to hold in place on cushions than steel pierced plank mat.

21. General conclusions drawn from the tests described above are as follows:

a. Sand-asphalt, or soil-asphalt of proper consistency, made the most durable protective cushion for PBS under pierced plank mat and the most satisfactory bedding material for the pierced plank. However, the combination of PBS cemented to the top of pierced plank with a hard asphalt was the most practical, in that it required no aggregate for cushion material and the waterproofing qualities of the blankets could be maintained by adding strips of PBS as holes appeared.

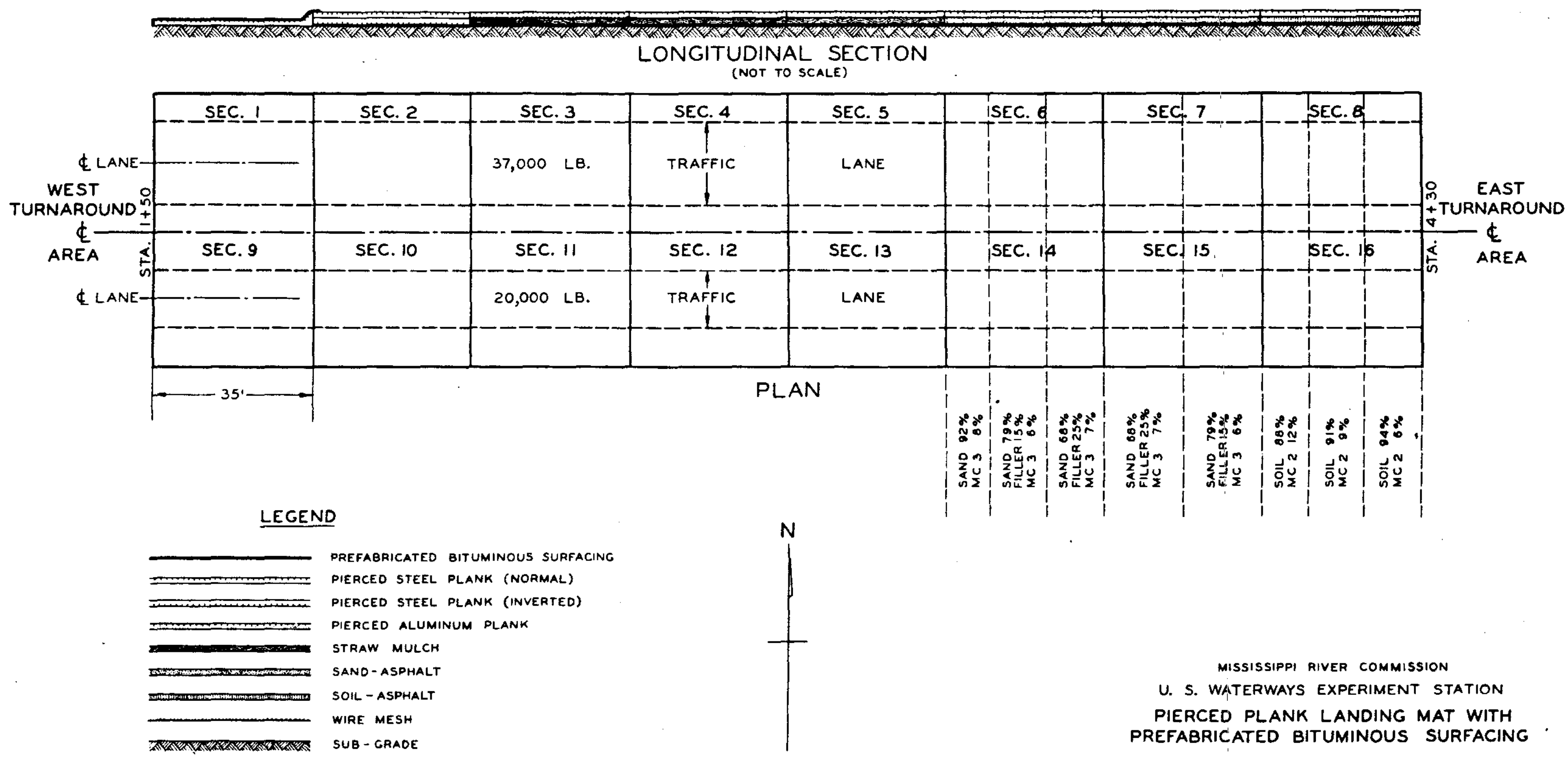
b. The hay mulch was not satisfactory, for the following reasons:

(1) In dry weather it was ground up and destroyed by the springing action of the pierced plank.

(2) In wet weather it tended to decompose rapidly.

(3) Pierced plank laid on a hay cushion was springy to the extent that it might prove dangerous, especially under braking action.

PLATES



MISSISSIPPI RIVER COMMISSION

U. S. WATERWAYS EXPERIMENT STATION

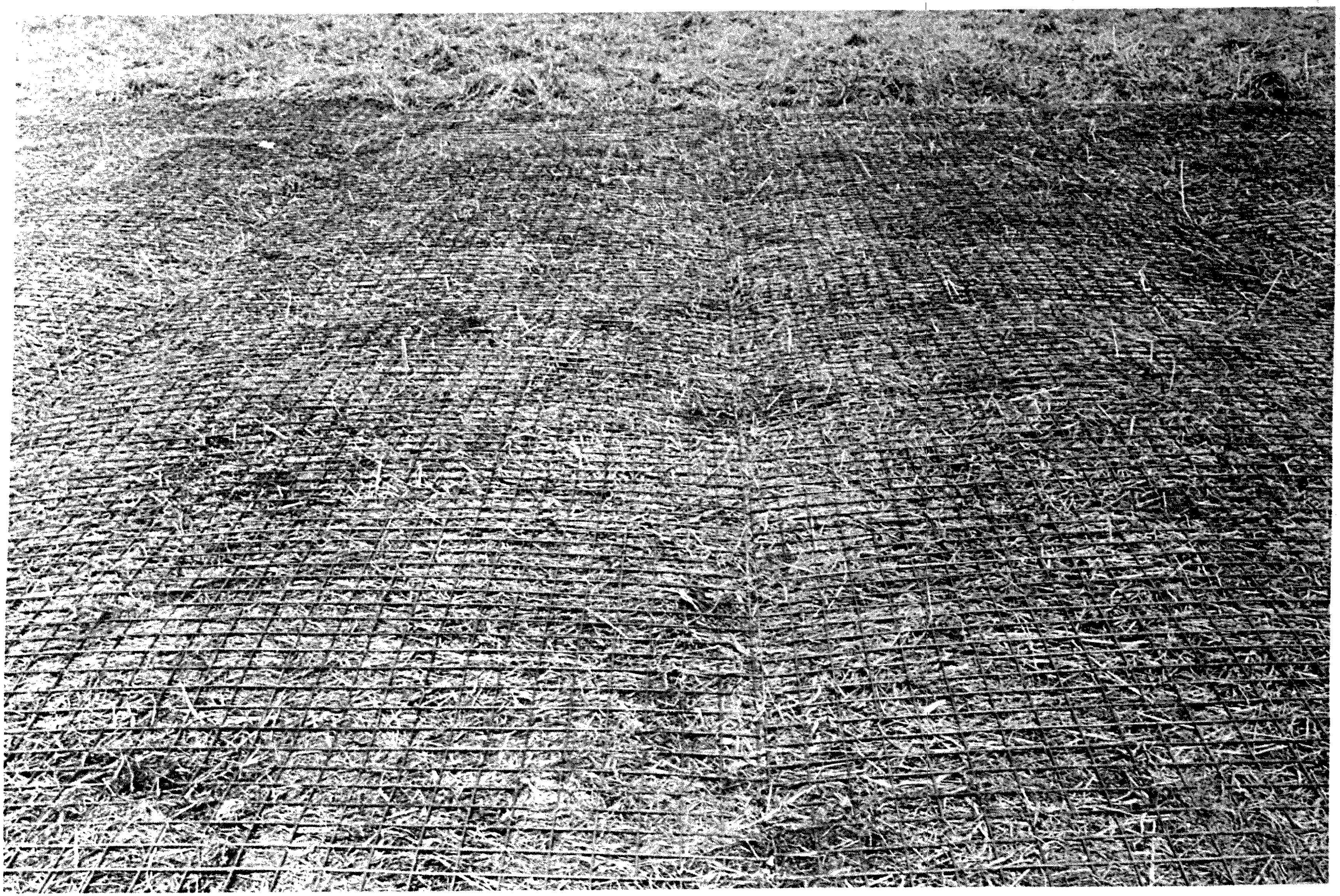
PIERCED PLANK LANDING MAT WITH PREFABRICATED BITUMINOUS SURFACING

LAYOUT OF TEST SECTIONS

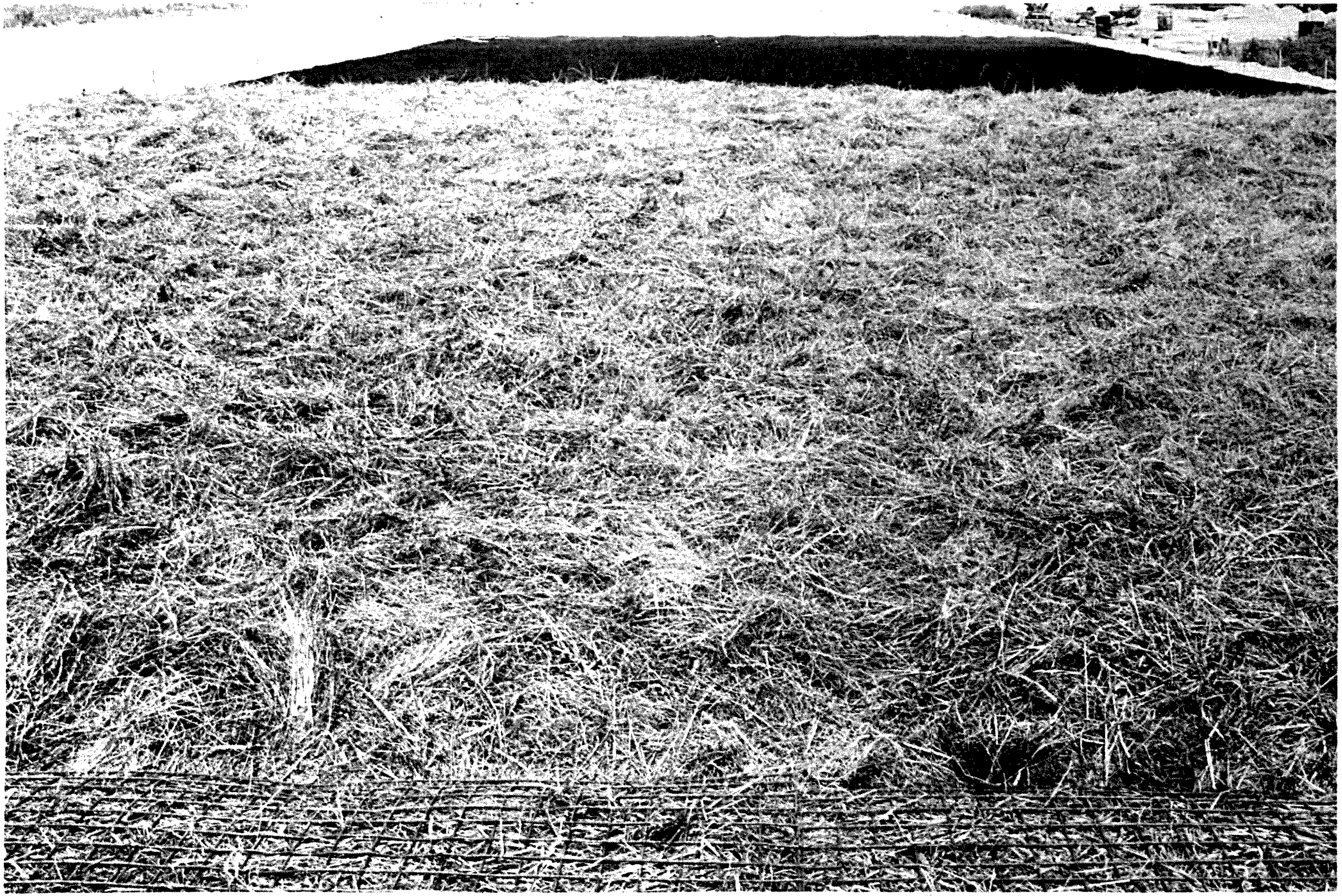
SCALE

20 10 0 20 40 FT.

PLATE 2



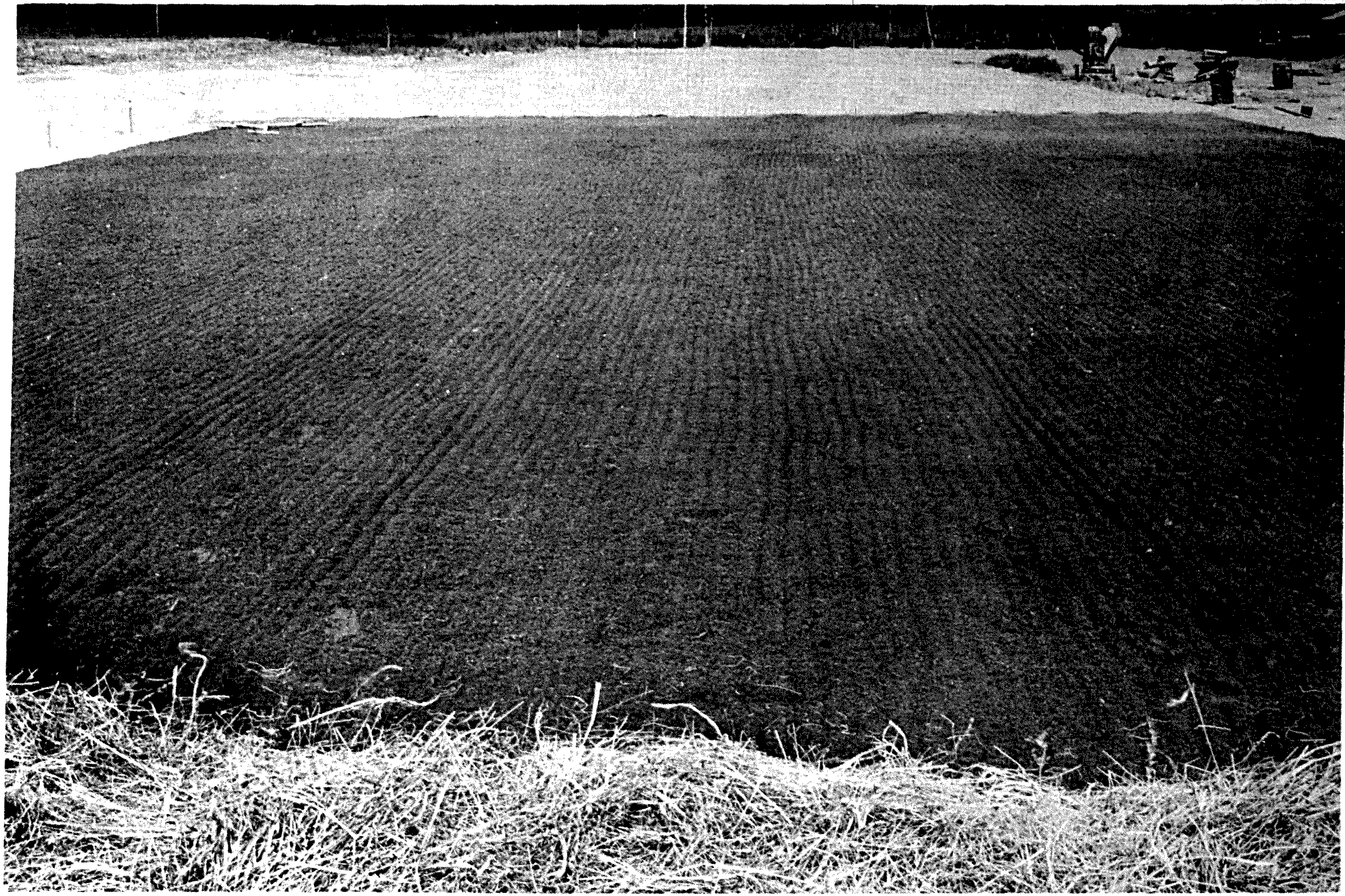
STRAW MULCH WITH WIRE MESH, READY FOR COVERING WITH PIERCED PLANK MAT



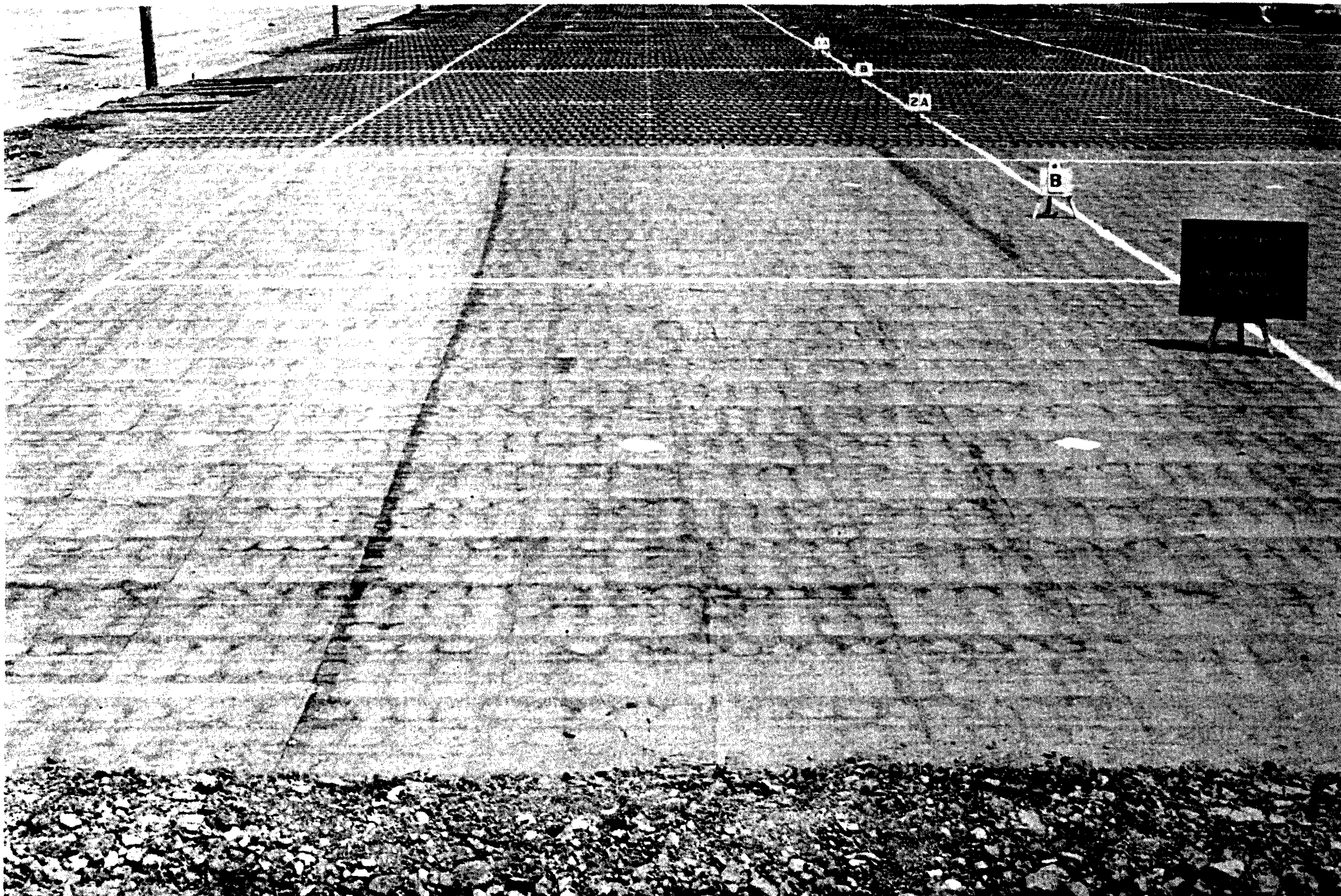
STRAW MULCH, JUST PRIOR TO PLACEMENT OF PIERCED PLANK MAT

PLATE 3

PLATE 4

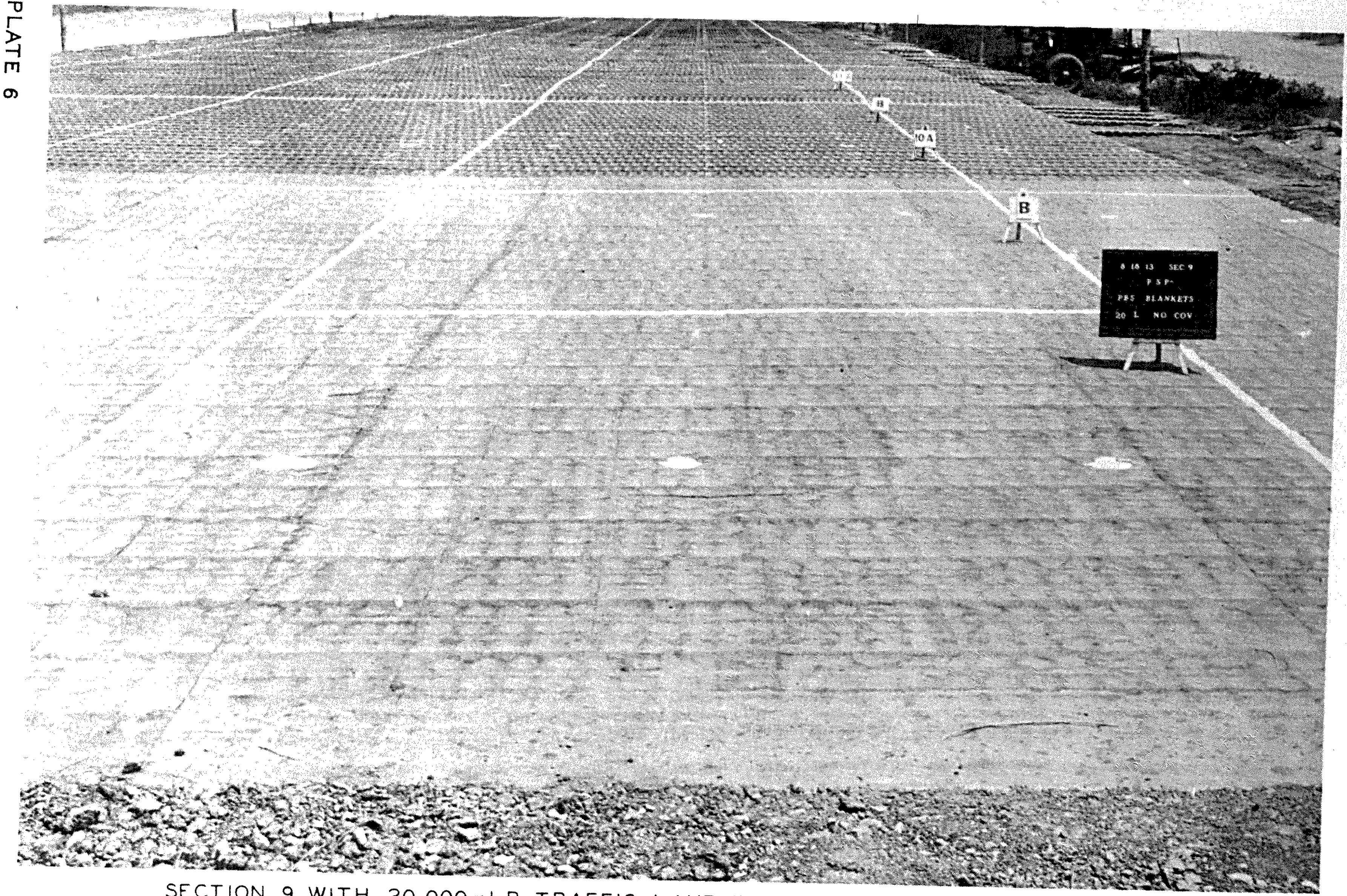


SAND - AND SOIL - ASPHALT CUSHIONS READY FOR COMPACTION



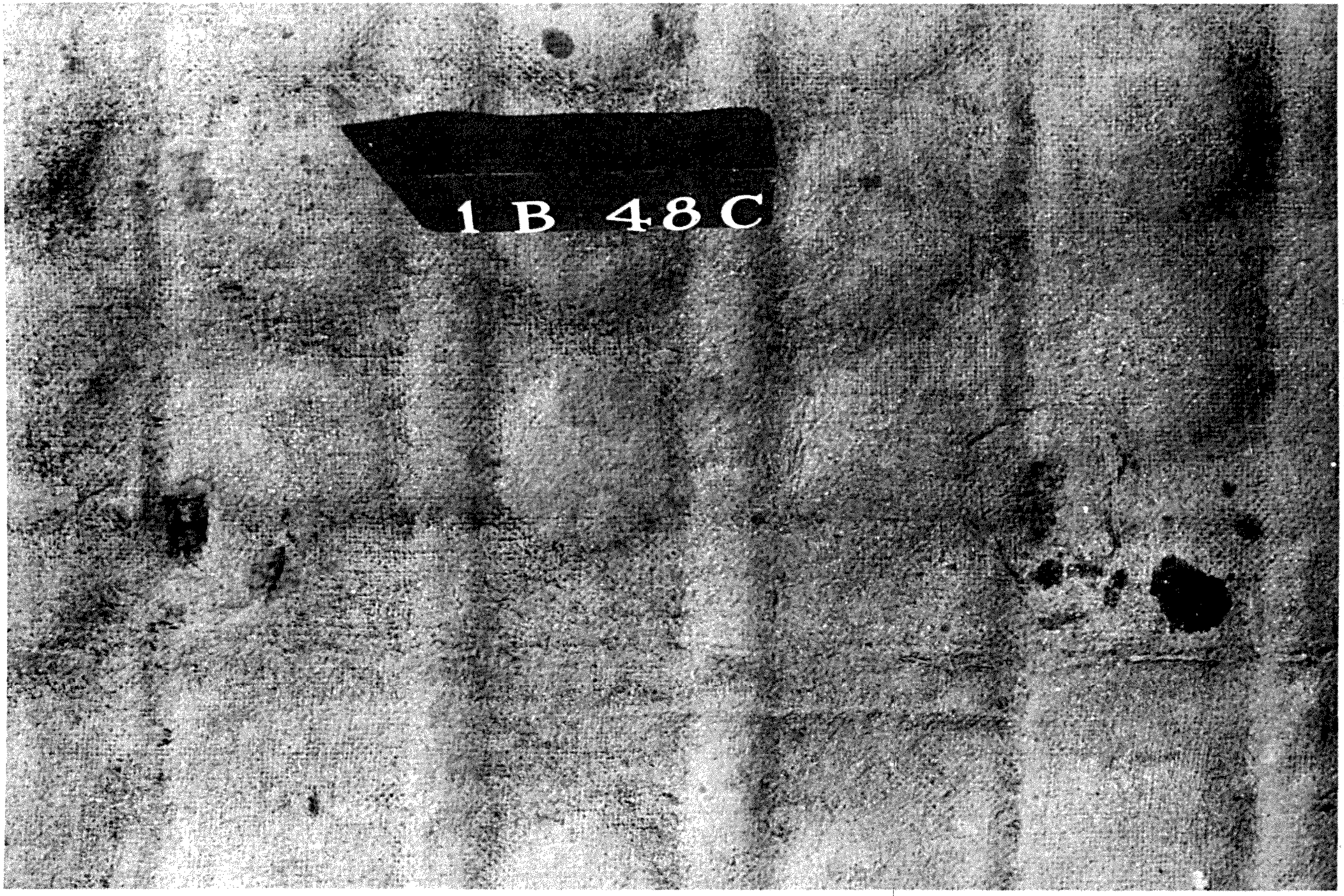
SECTION 1, WITH 37,000-LB TRAFFIC LANE IN BACKGROUND, PRIOR TO TESTING

PLATE 5

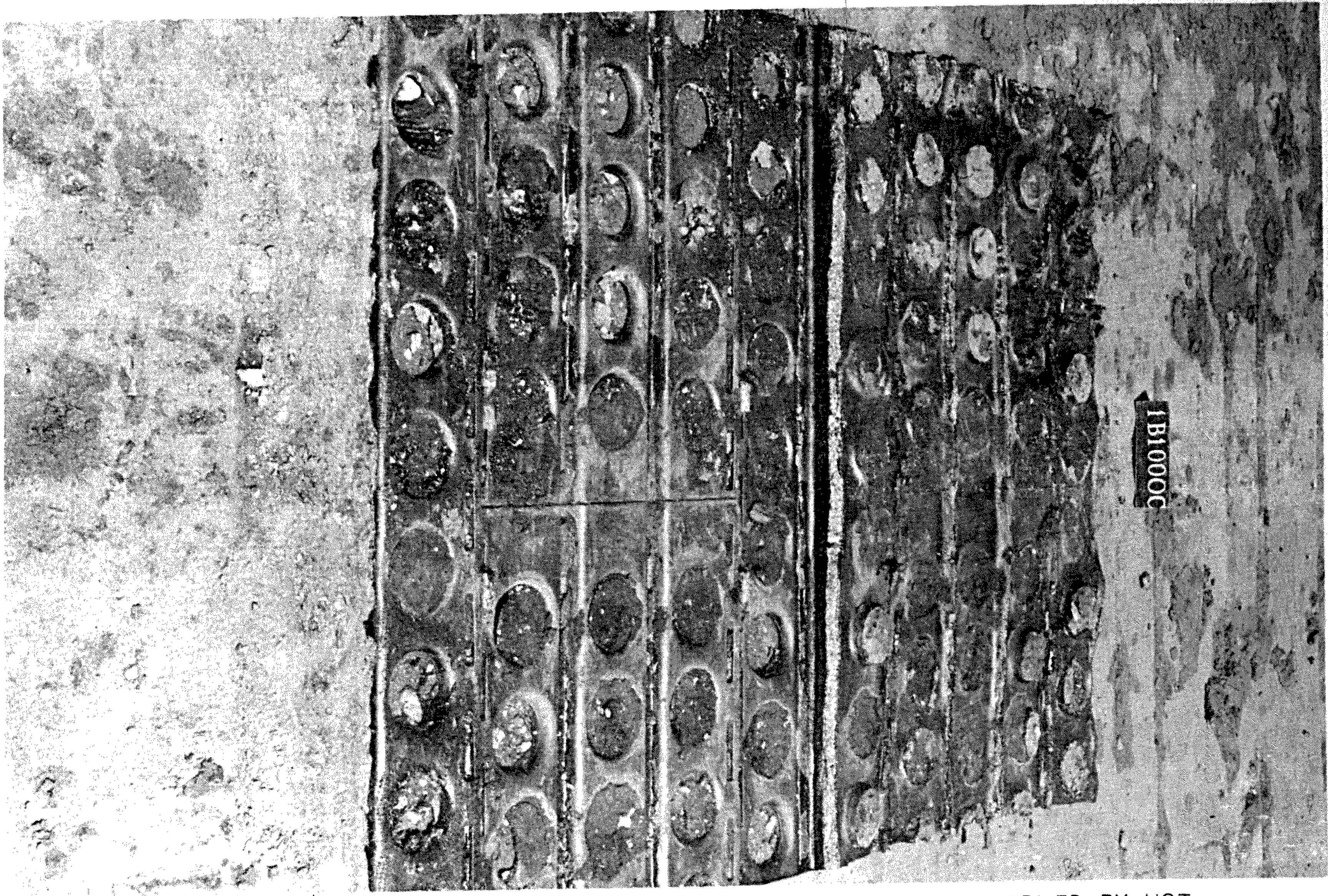


SECTION 9, WITH 20,000-LB TRAFFIC LANE IN BACKGROUND, PRIOR TO TESTING

PLATE 7



SECTION I, 37,000-LB LANE. BLANKET PUNCTURED BY SPRING CLIPS (48 COVERAGES)

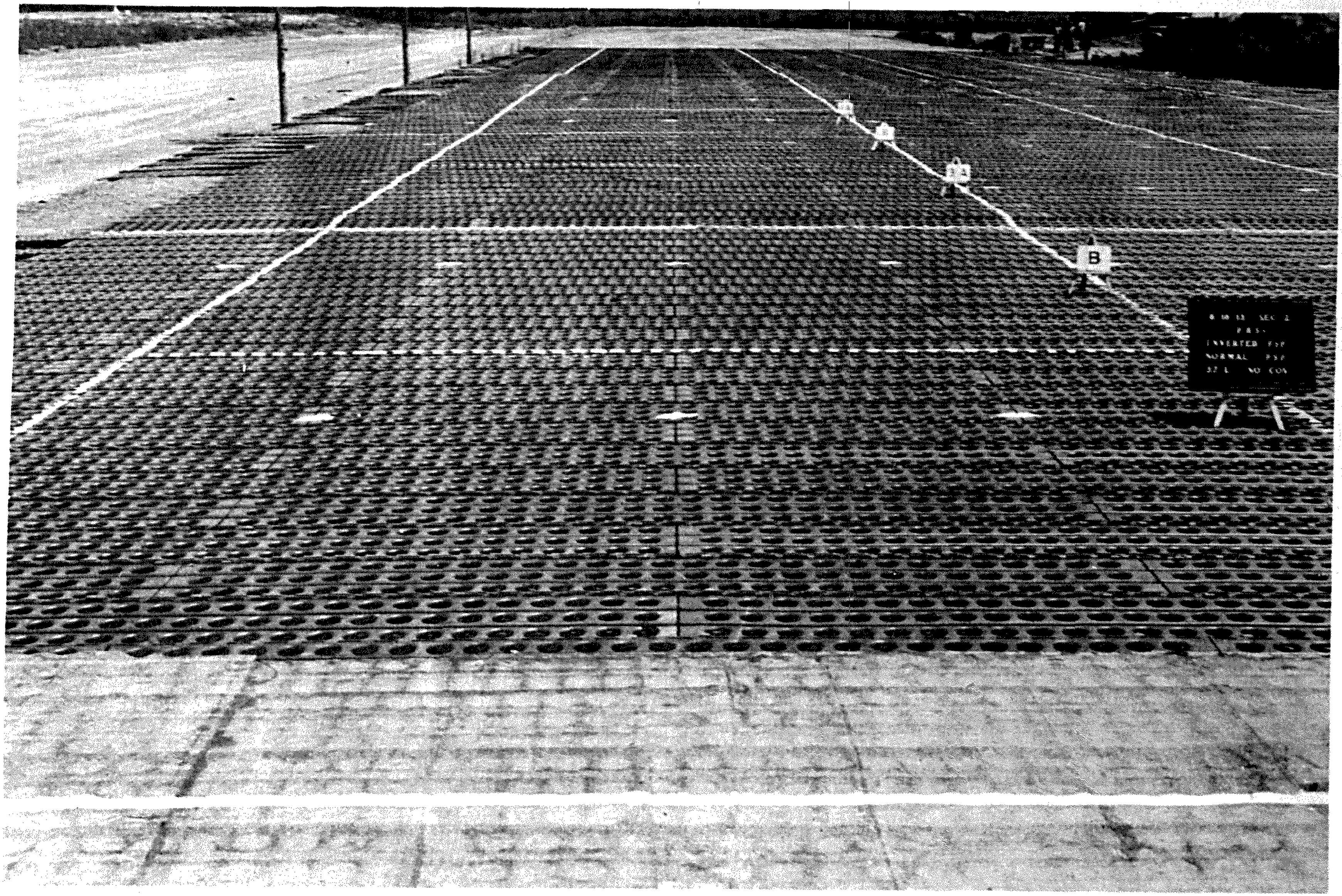


SECTION 1, 37,000-LB LANE, SHOWING EFFECTIVENESS OF BOND FORMED BY HOT ASPHALT CEMENT (1000 COVERAGES)

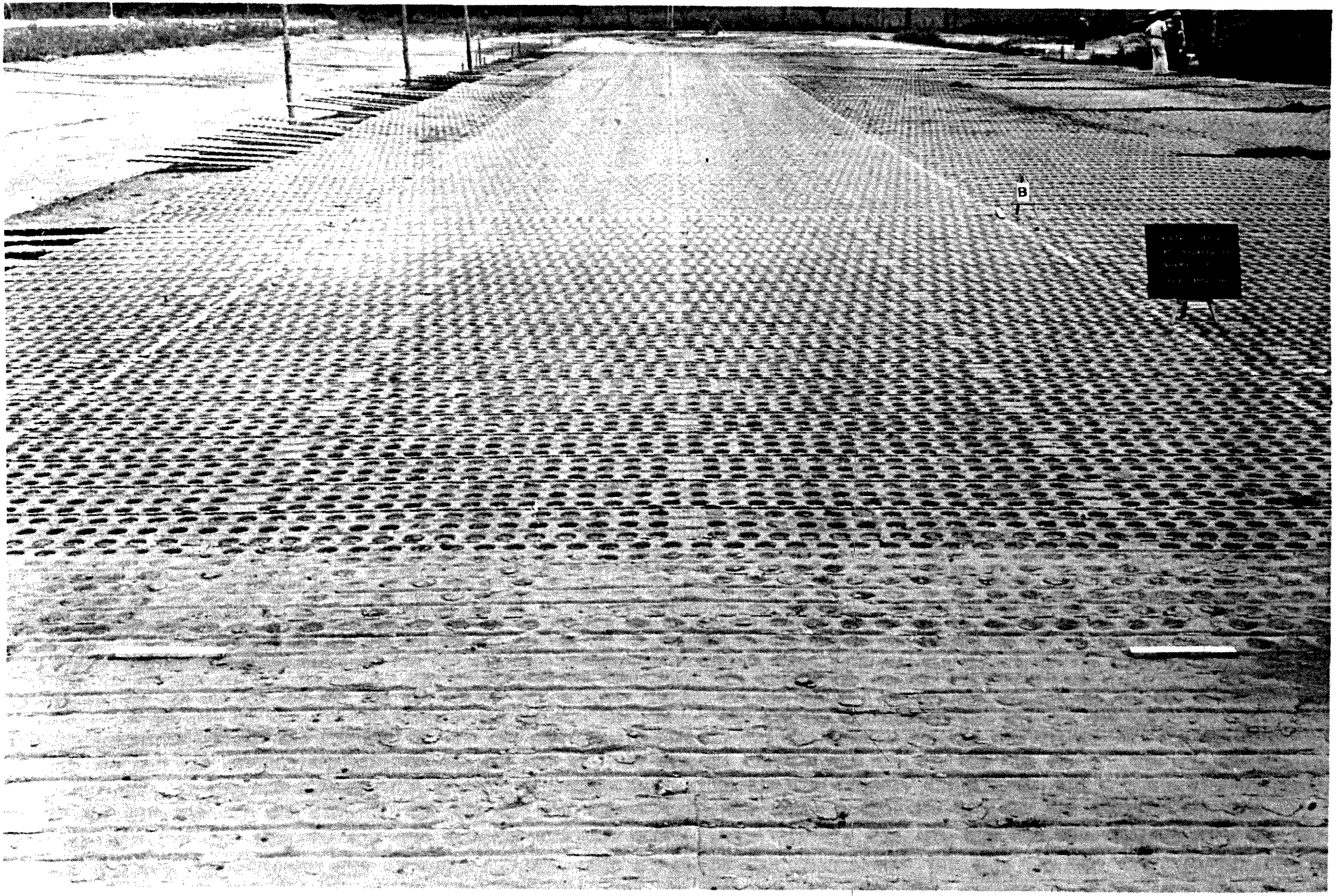
CONDITION OF PBS BLANKETS IN 20,000-LB TRAFFIC LANE AT 1000 COVERAGES

PLATE 9

PLATE 10



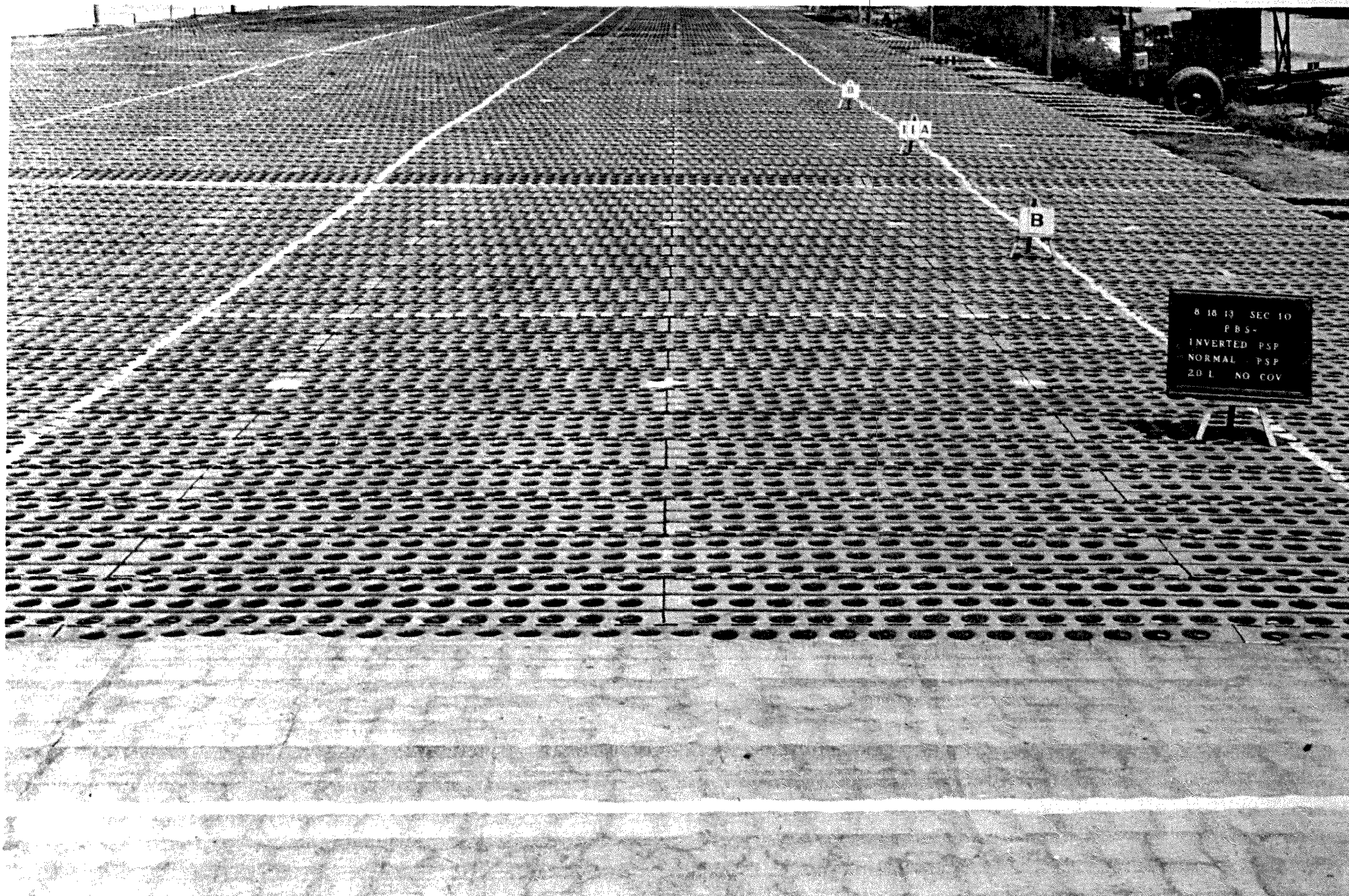
SECTION 2, WITH INVERTED PSP CUSHION, BEFORE TESTING



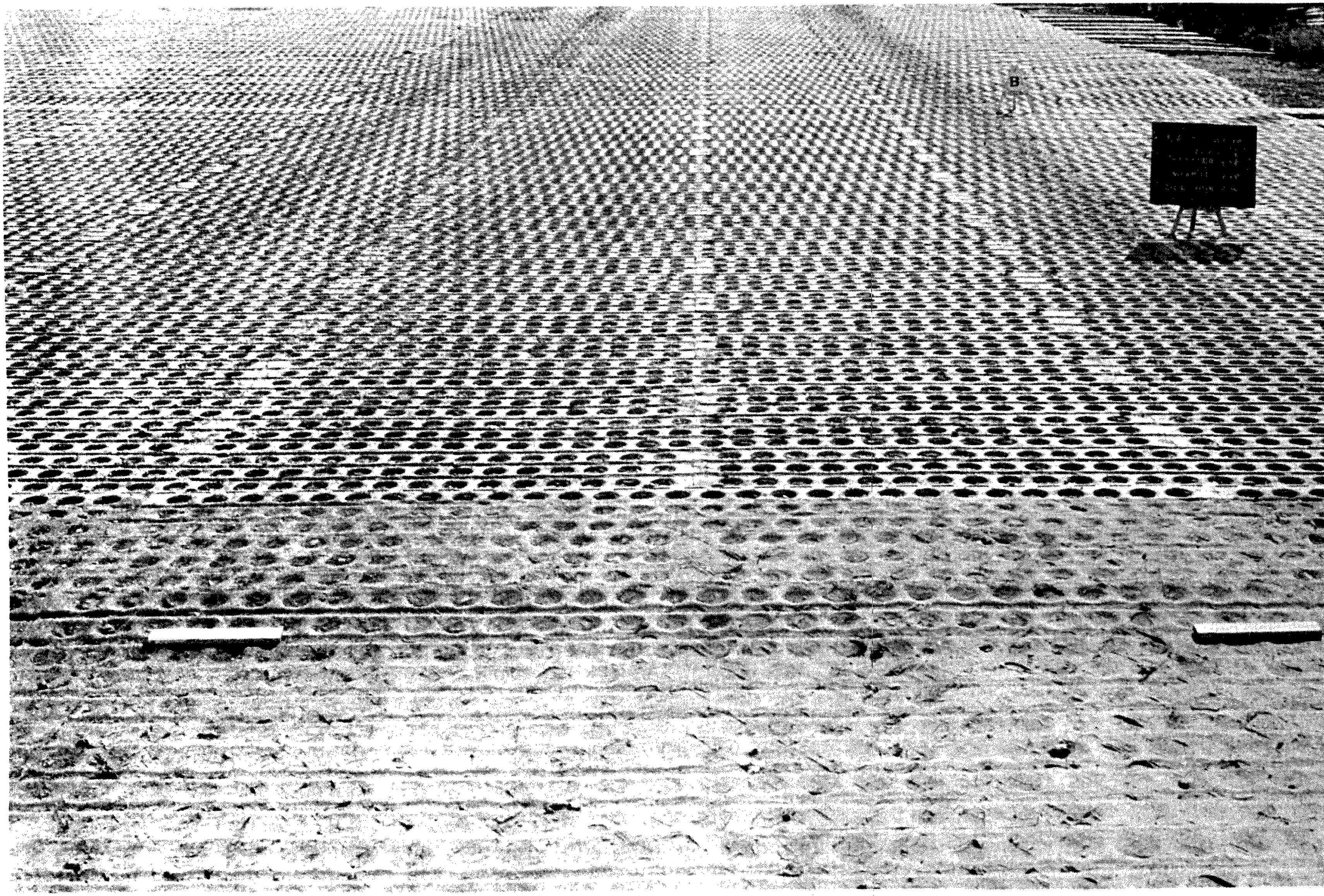
SECTION 2, WITH INVERTED PSP CUSHION, AFTER TESTING

PLATE 11

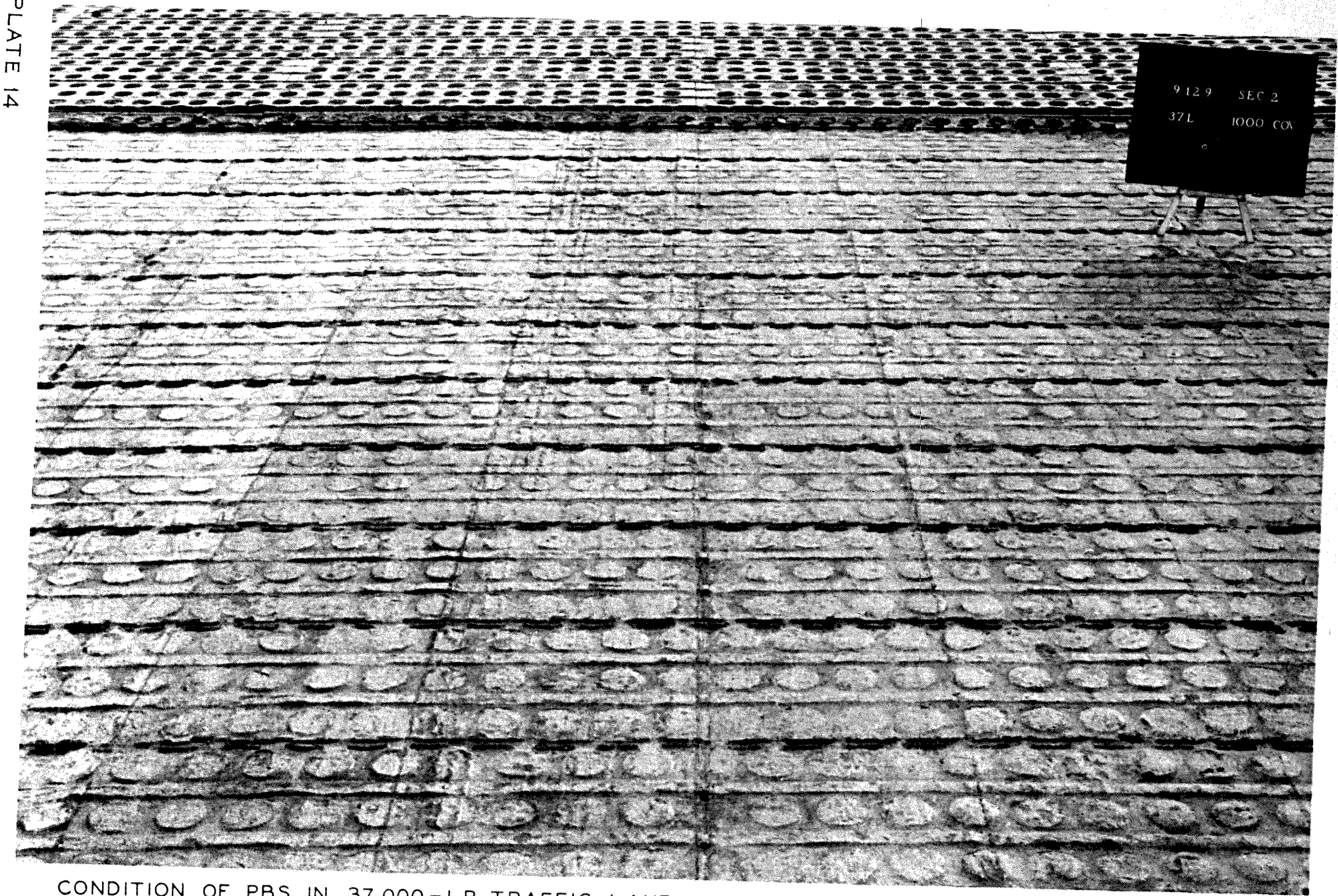
PLATE 12



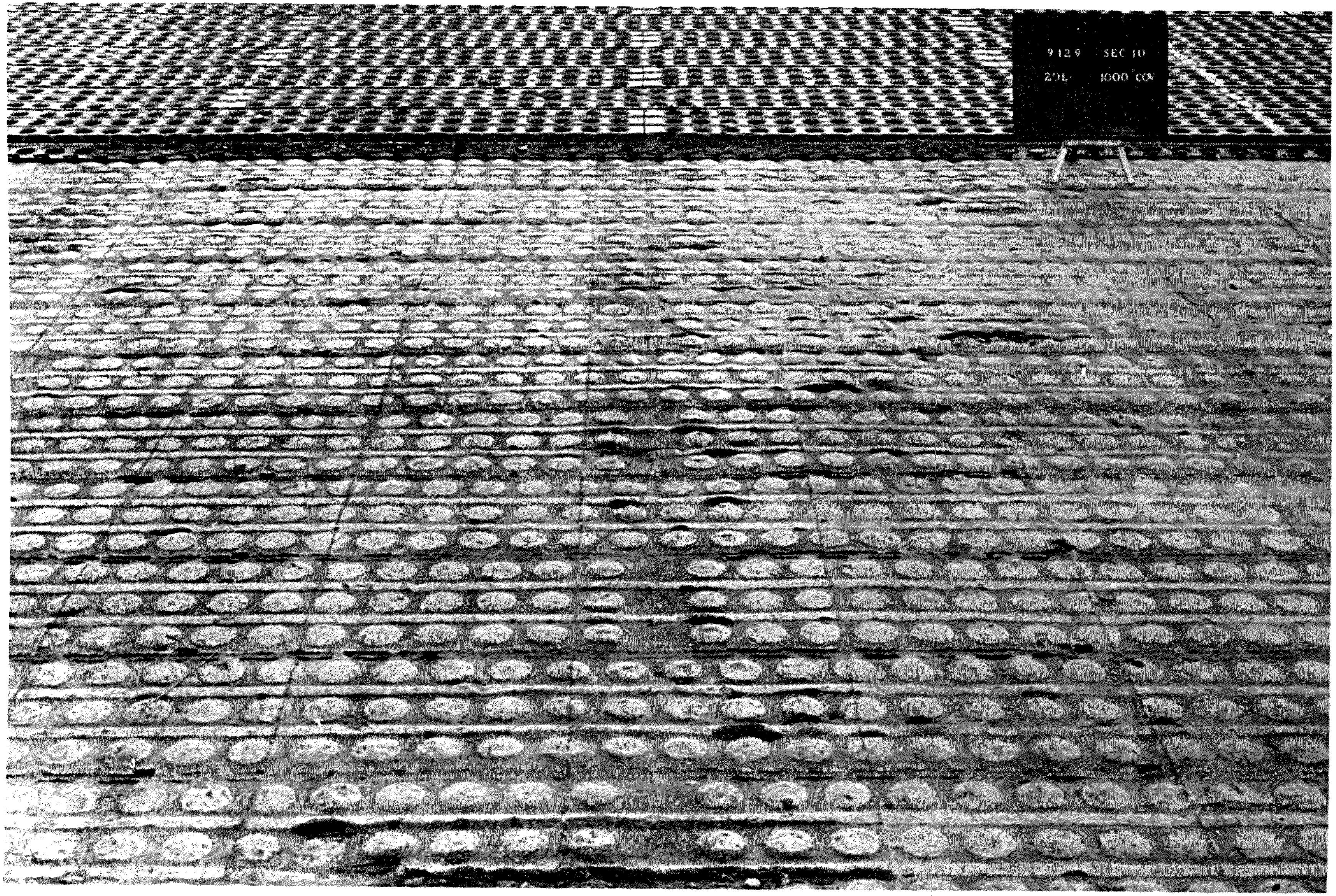
SECTION 10, WITH INVERTED PSP CUSHION, BEFORE TESTING



SECTION 10, WITH INVERTED PSP CUSHION, AFTER TESTING



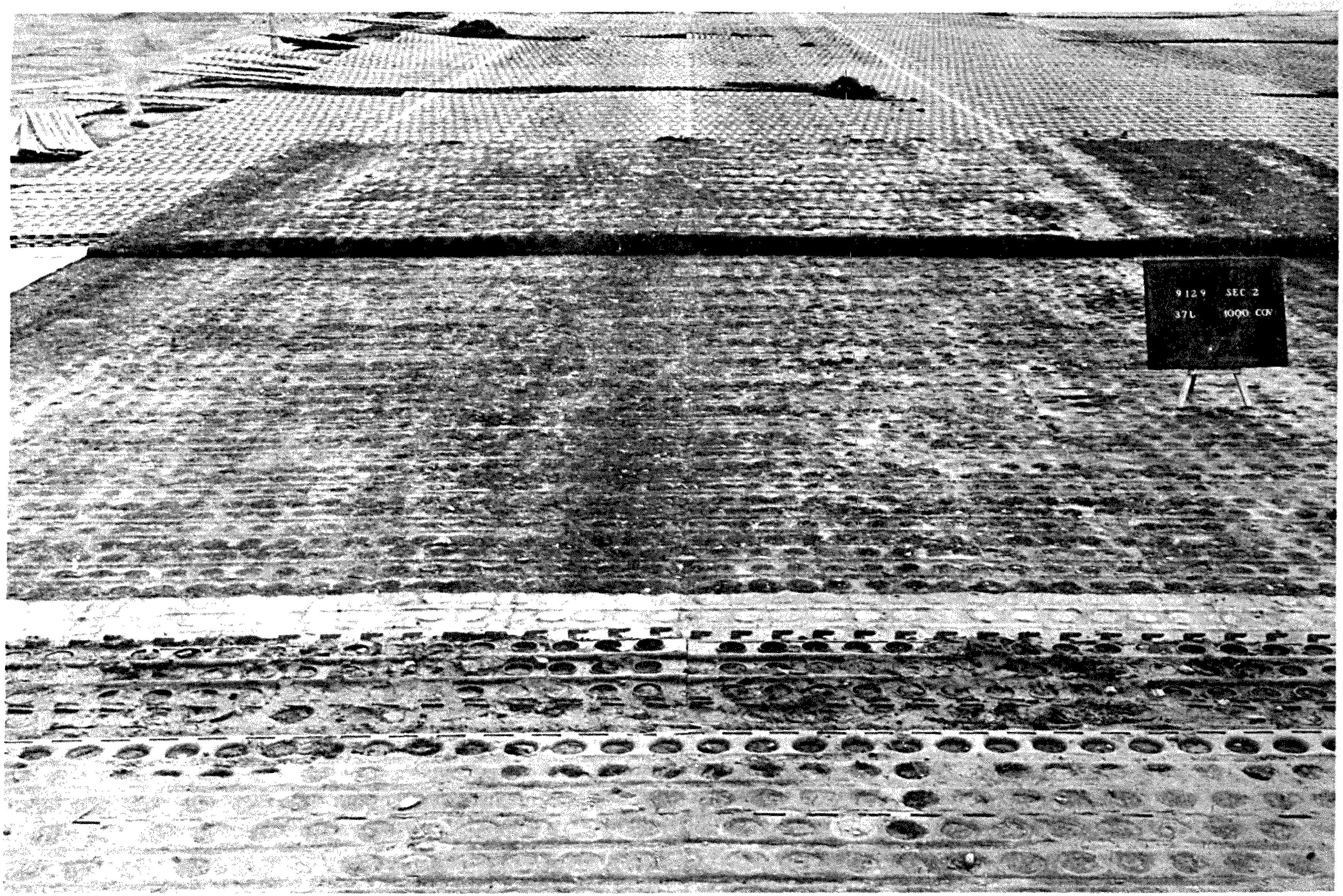
CONDITION OF PBS IN 37,000-LB TRAFFIC LANE, INVERTED PSP MAT REMOVED AT END OF TEST



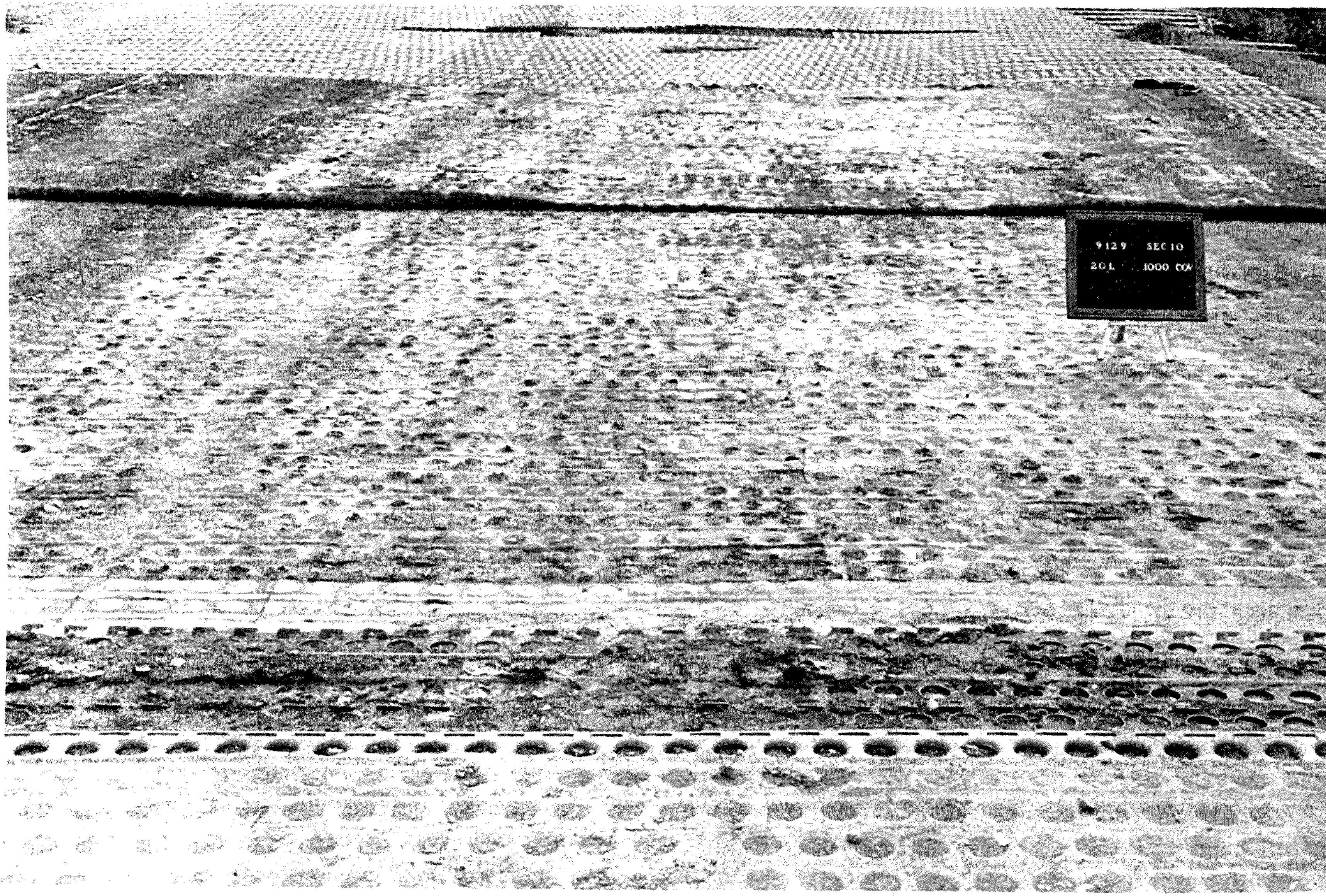
CONDITION OF PBS IN 20,000-LB TRAFFIC LANE, INVERTED PSP MAT REMOVED AT END OF TEST

21871

PLATE 15

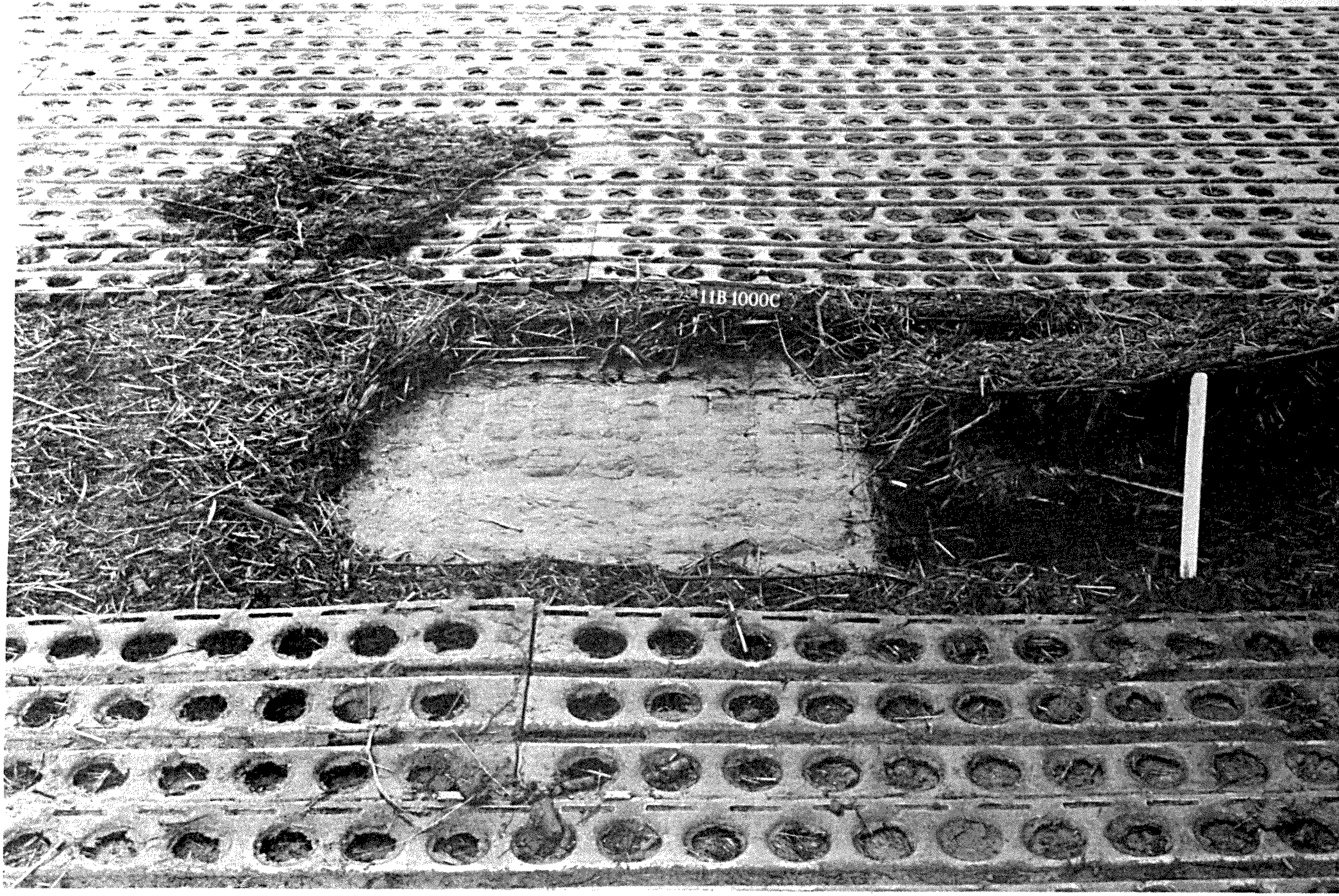


BASE COURSE UNDER INVERTED PSP IN 37,000-LB LANE, AT END OF TEST



BASE COURSE UNDER INVERTED PSP IN 20,000-LB LANE, AT END OF TEST

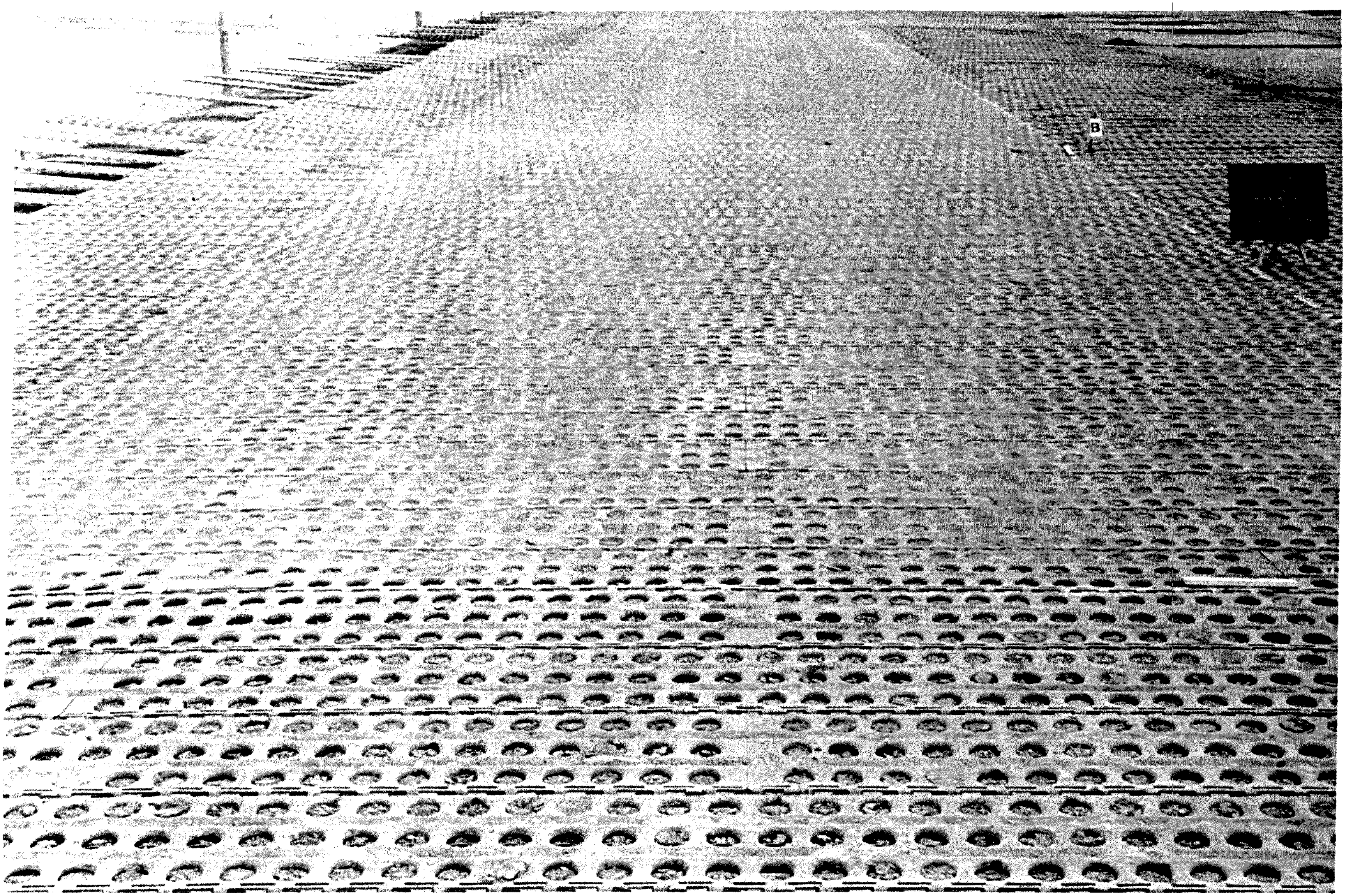
PLATE 17



SECTION 11, WIRE MESH EMBEDDED IN STRAW AT 1000 COVERAGES

SECTION 3, BEFORE TESTING

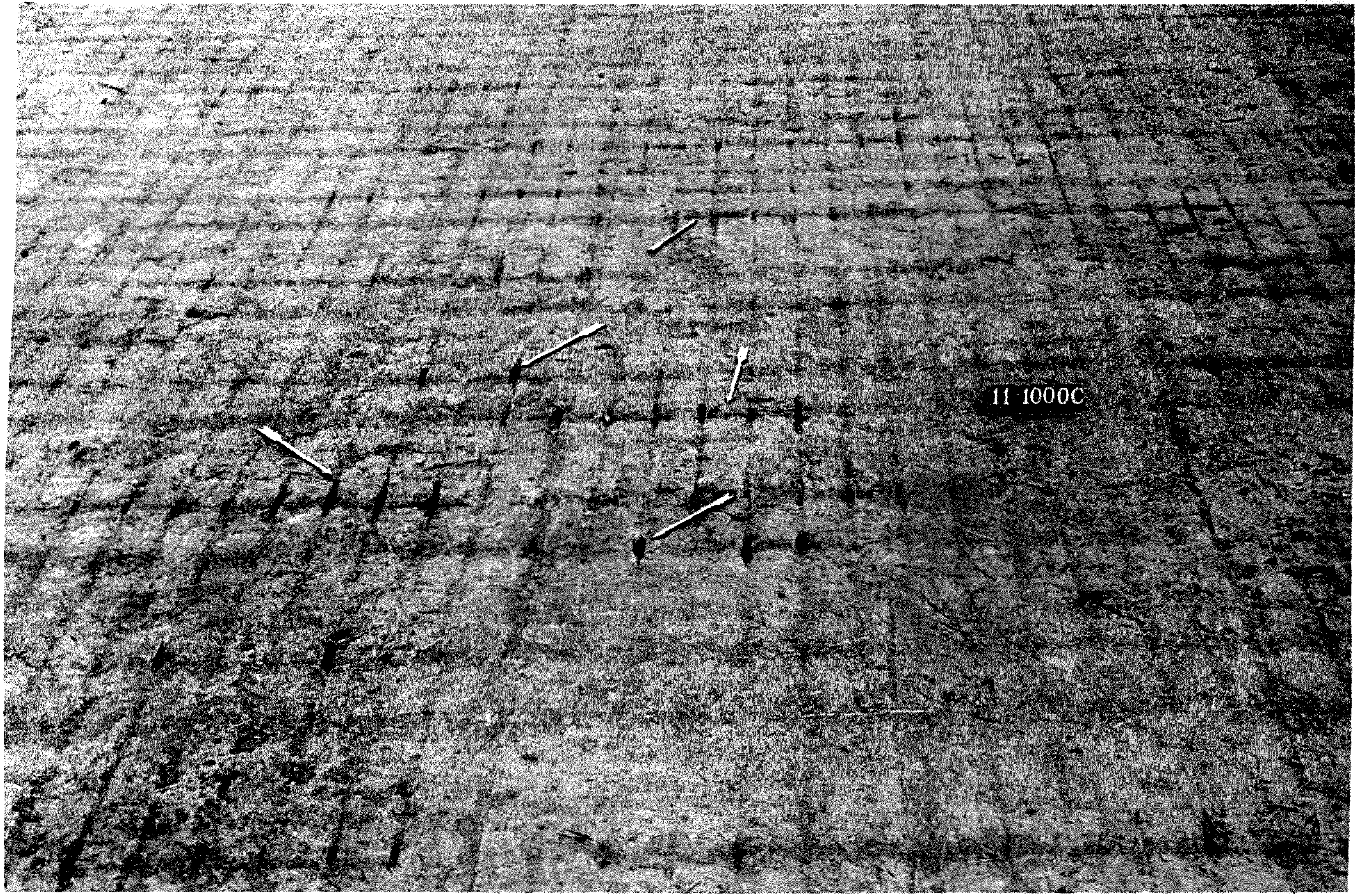
PLATE 19



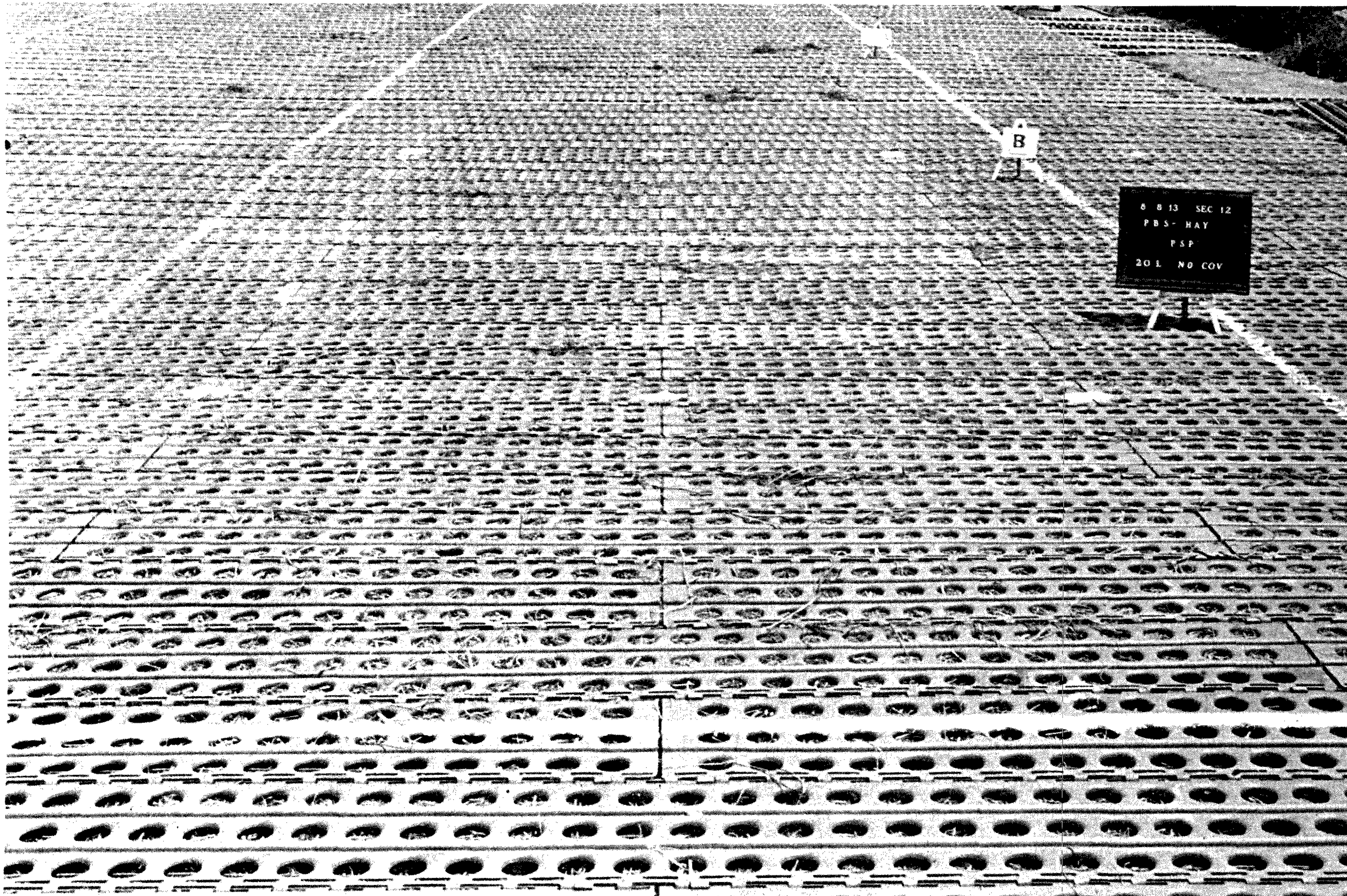
SECTION 3, AT END OF TEST

SECTION 3, APPEARANCE OF PBS UNDER STRAW AND WIRE MESH AFTER 1000 COVERAGES (ARROWS INDICATE HOLES)

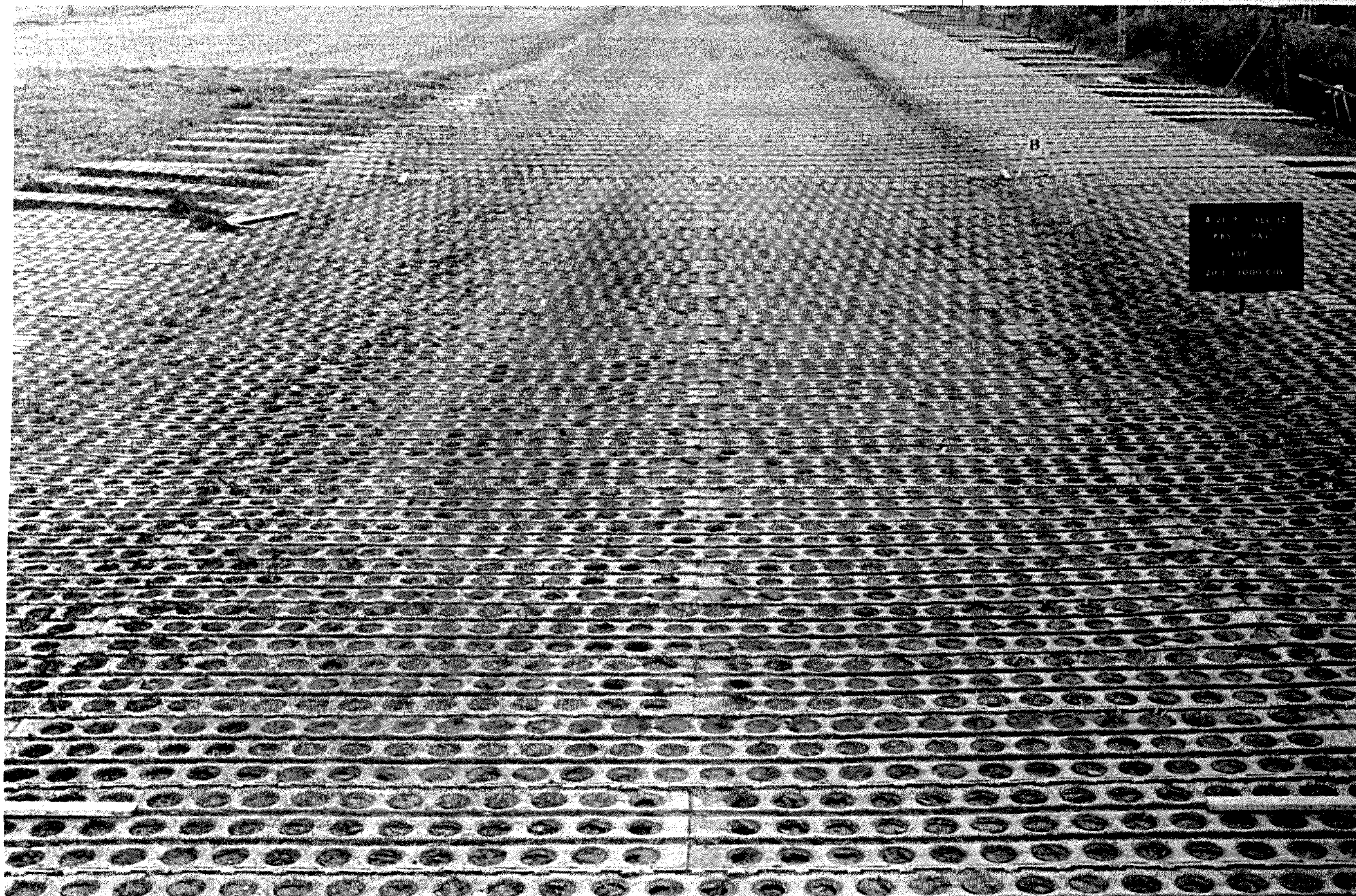
PLATE 22



SECTION II, APPEARANCE OF PBS UNDER STRAW AND WIRE MESH AFTER 1000 COVERAGES (ARROWS INDICATE HOLES)



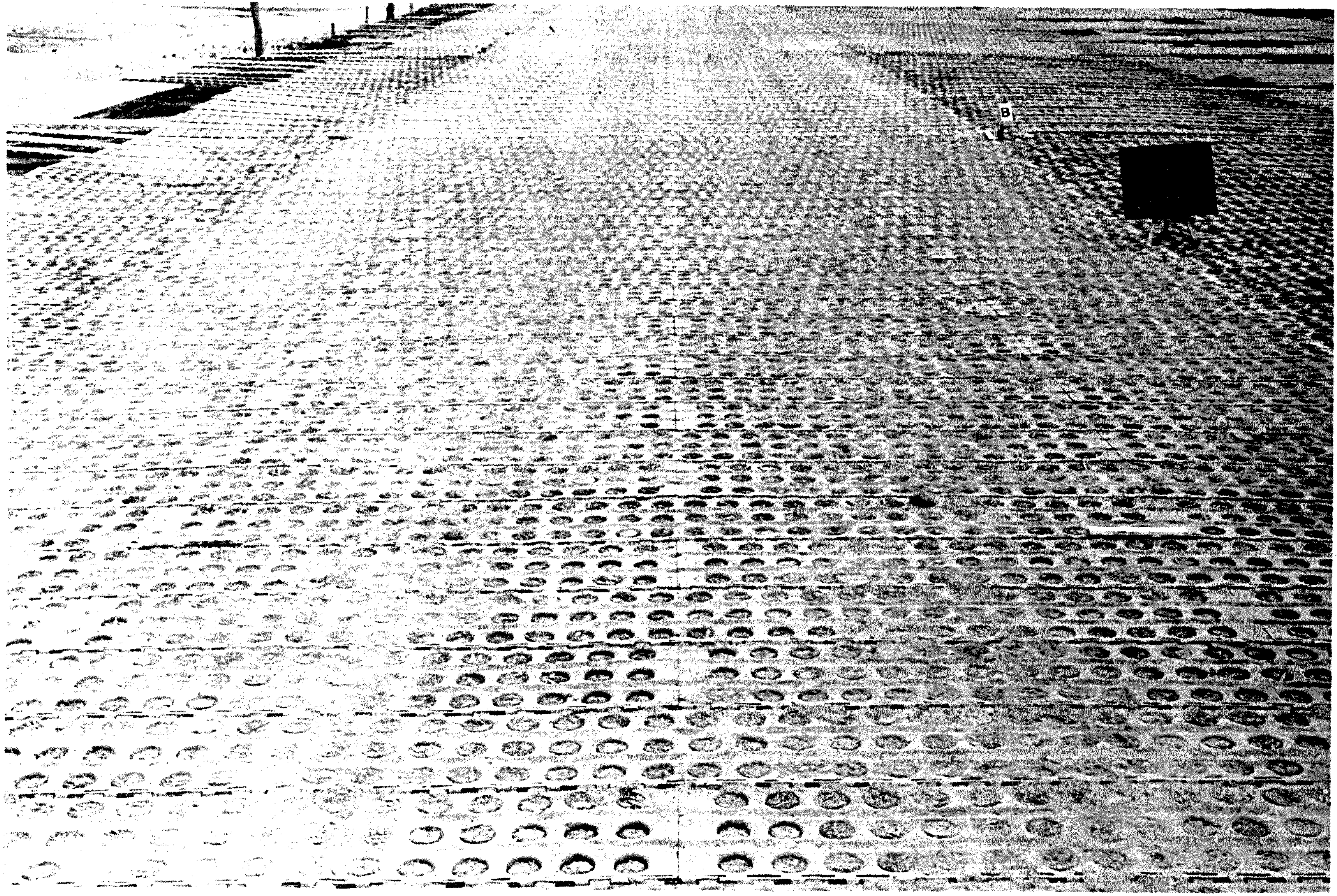
SECTION 12 (SECTION 13 IN BACKGROUND) AT BEGINNING OF TEST



SECTION 12 (SECTION 13 IN BACKGROUND) AT END OF TEST (1000 COVERAGES)

SECTION 12, PUNCTURED PBS UNDER PSP IN 20,000-LB LANE AT 1000 COVERAGES

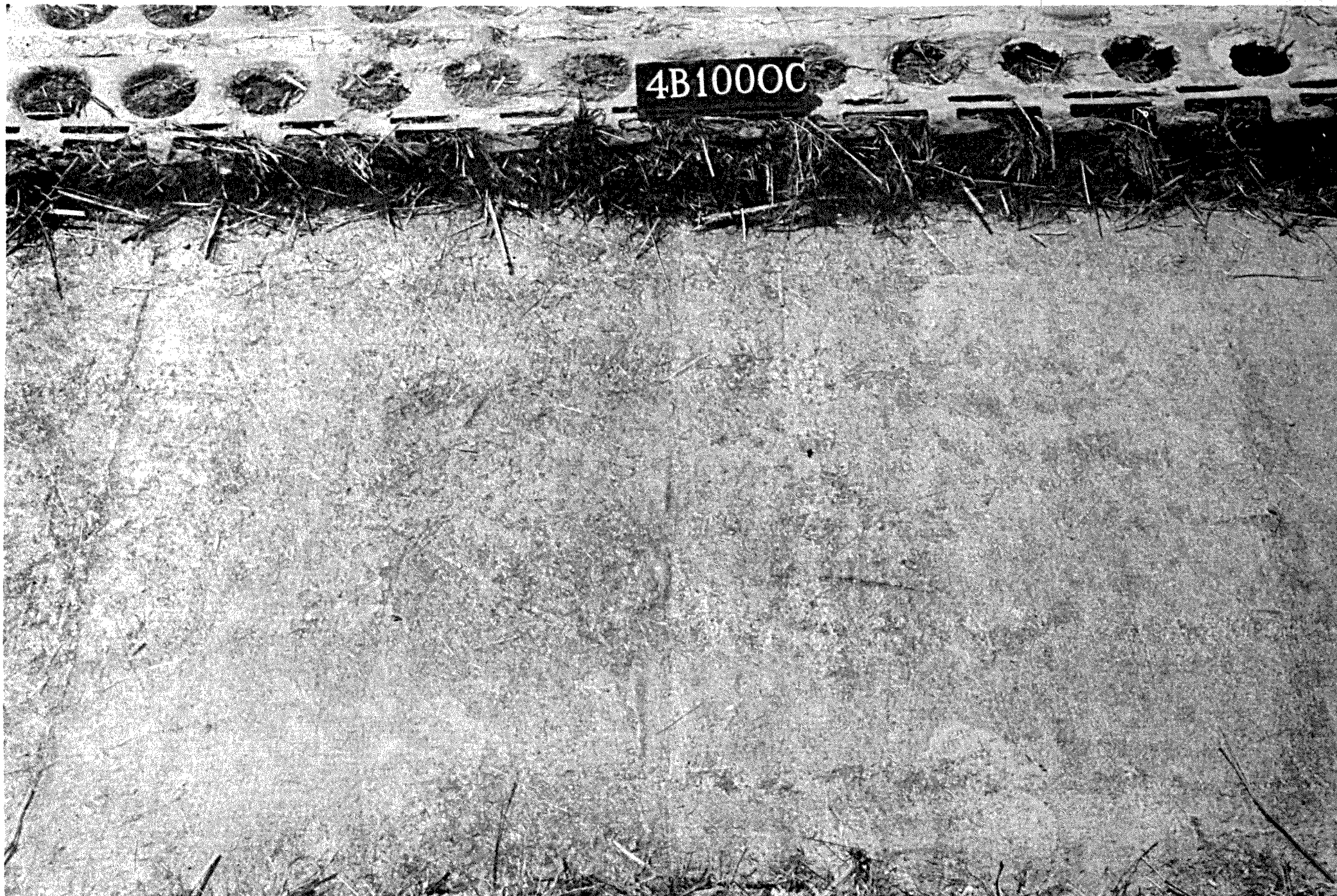
SECTION 13, PUNCTURED PBS UNDER PAP AT 700 COVERAGES



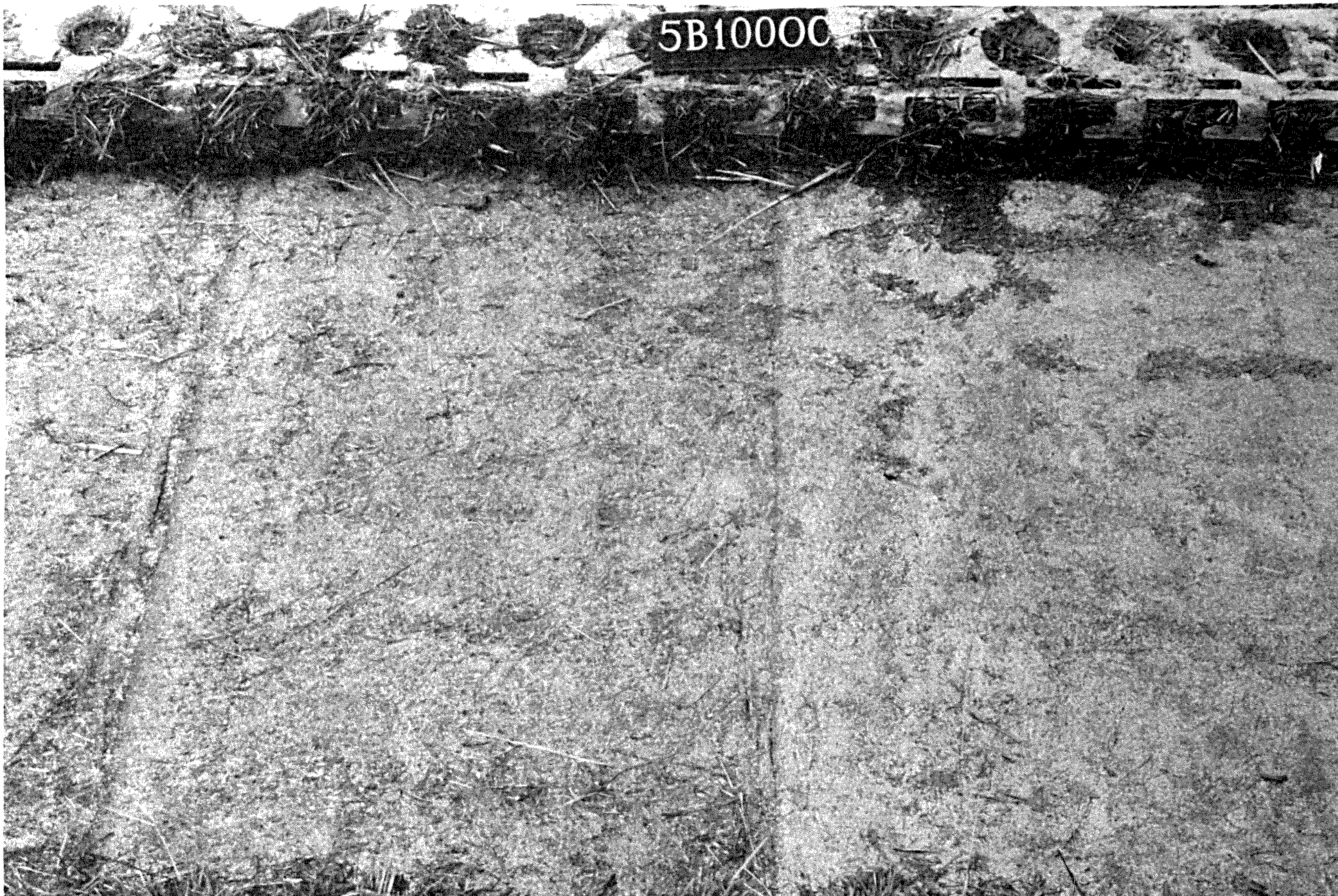
SECTION 4 (SECTION 5 IN BACKGROUND) AT END OF TRAFFIC TEST

PLATE 27

PLATE 28

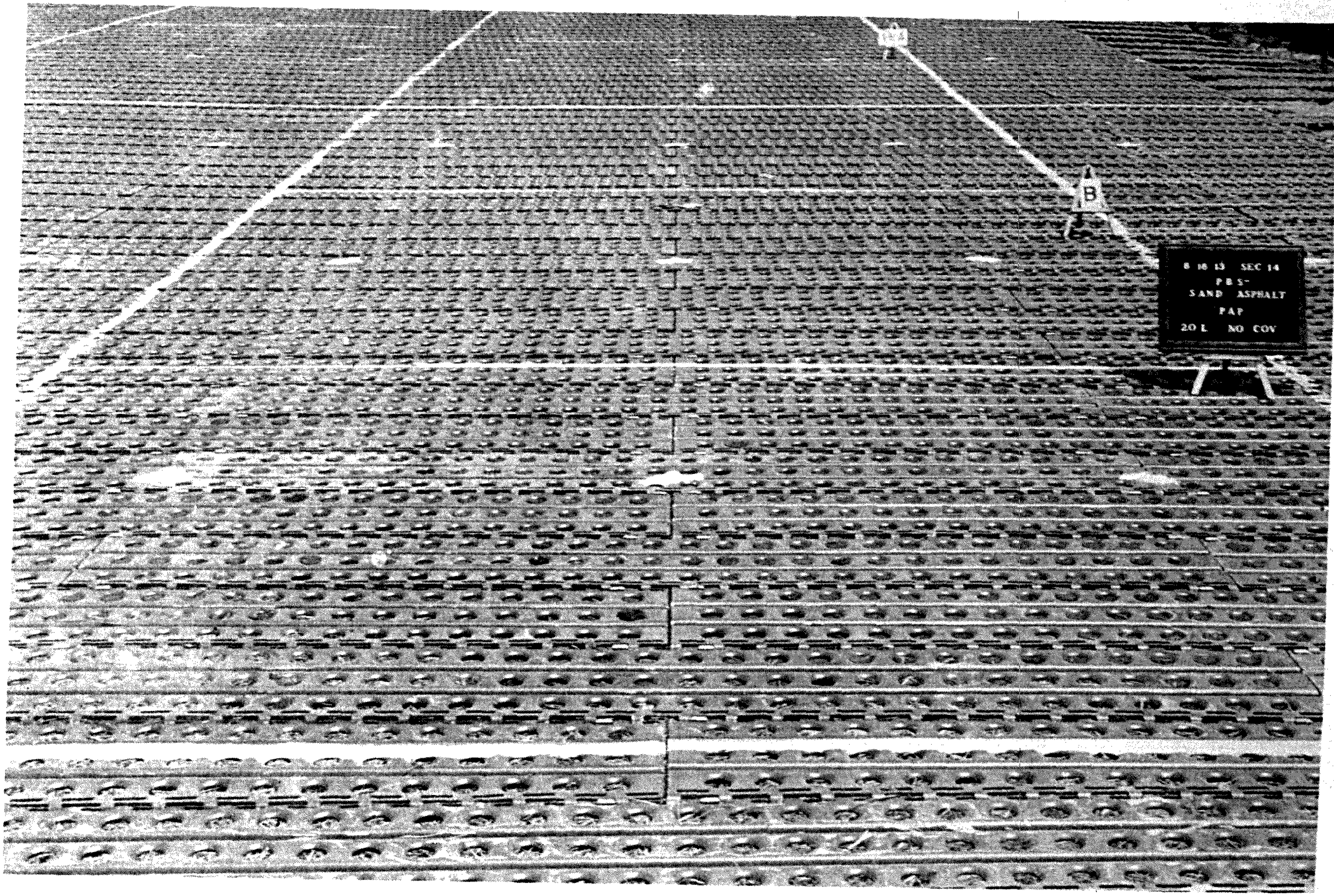


CONDITION OF PBS UNDER STEEL MAT IN SECTION 4 AT 1000 COVERAGES

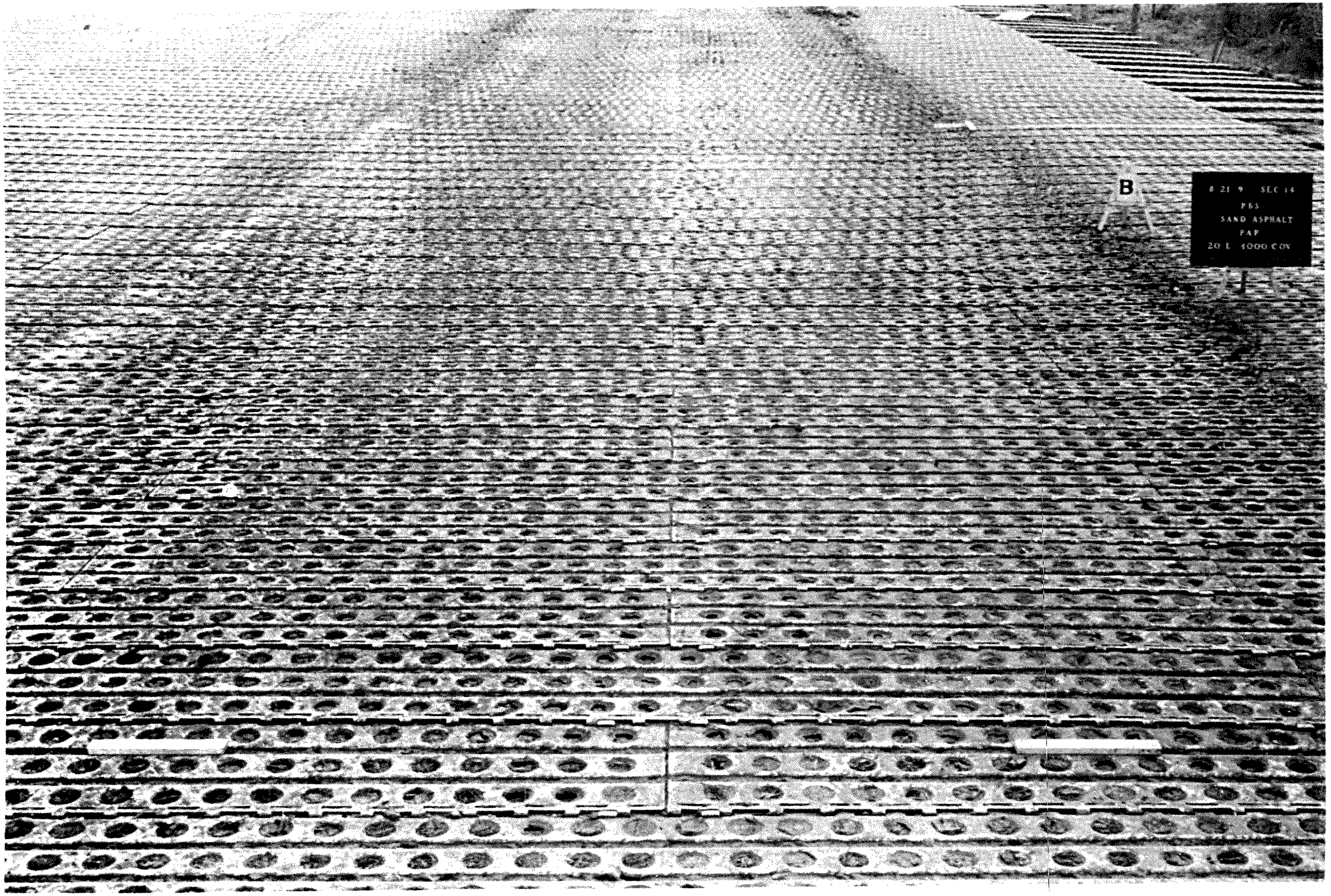


CONDITION OF PBS UNDER ALUMINUM MAT IN SECTION 5 AT 1000 COVERAGES

PLATE 29

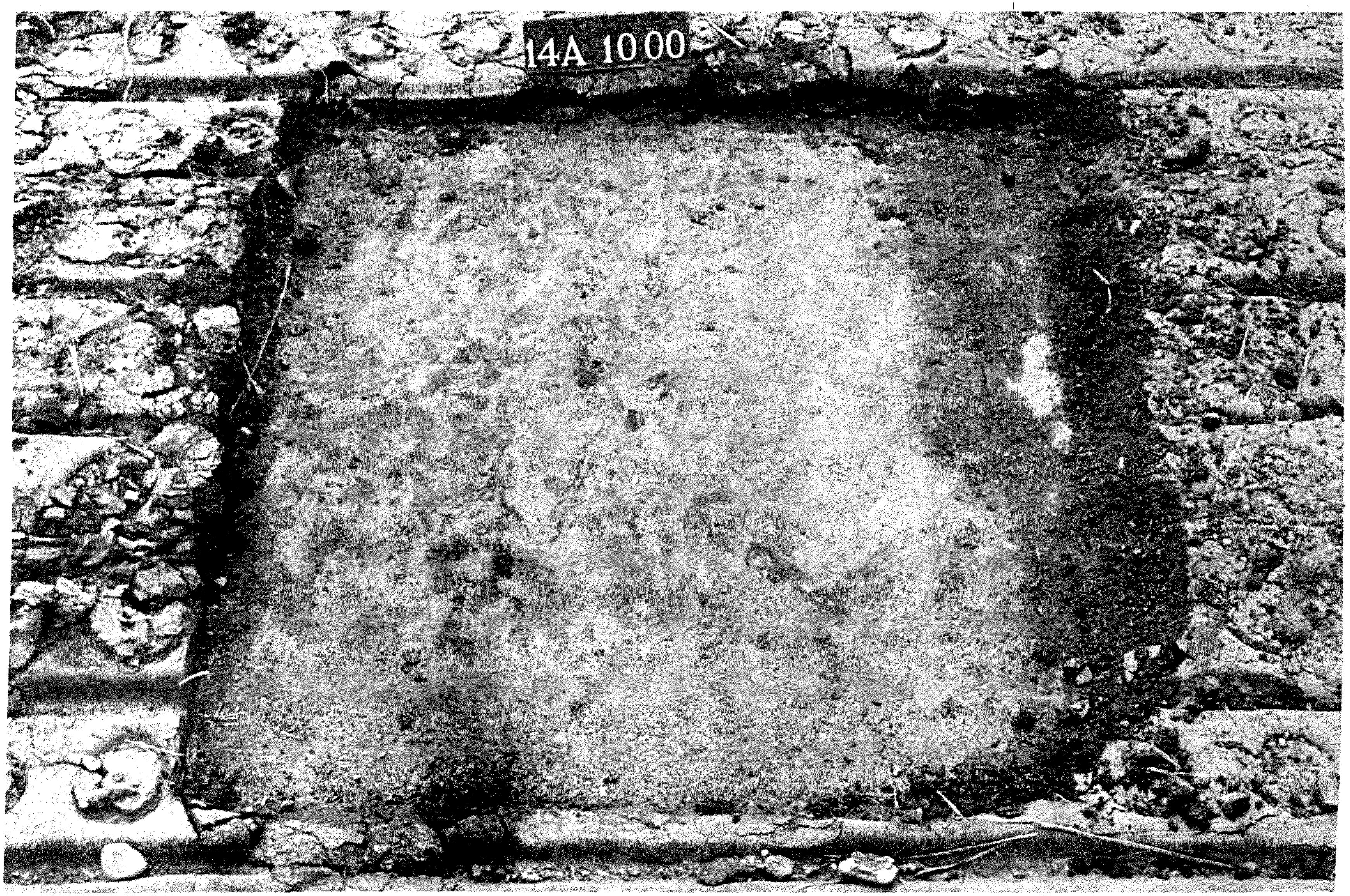


SECTION 14, BEFORE TESTING



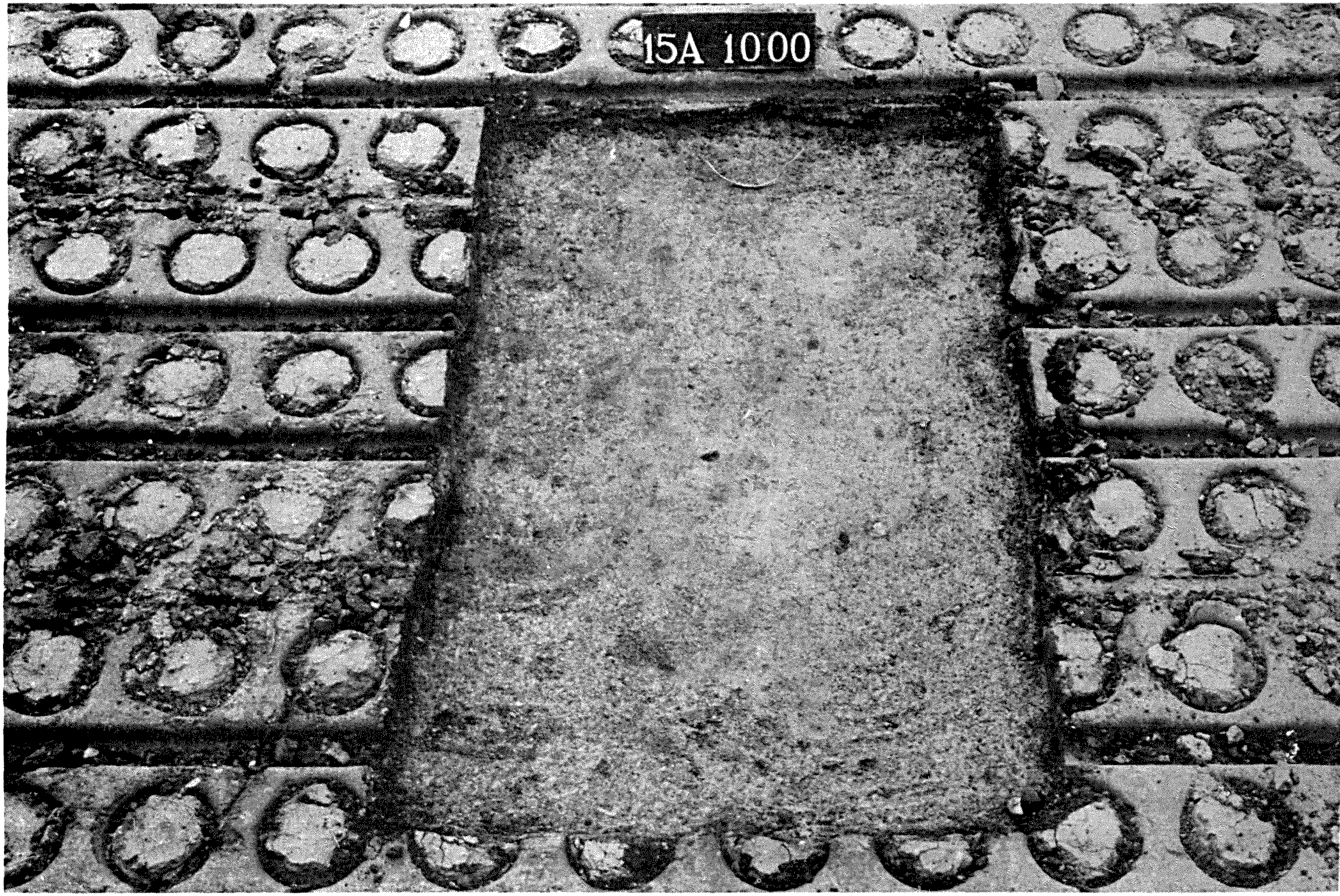
SECTION 14, AFTER TESTING

PLATE 32

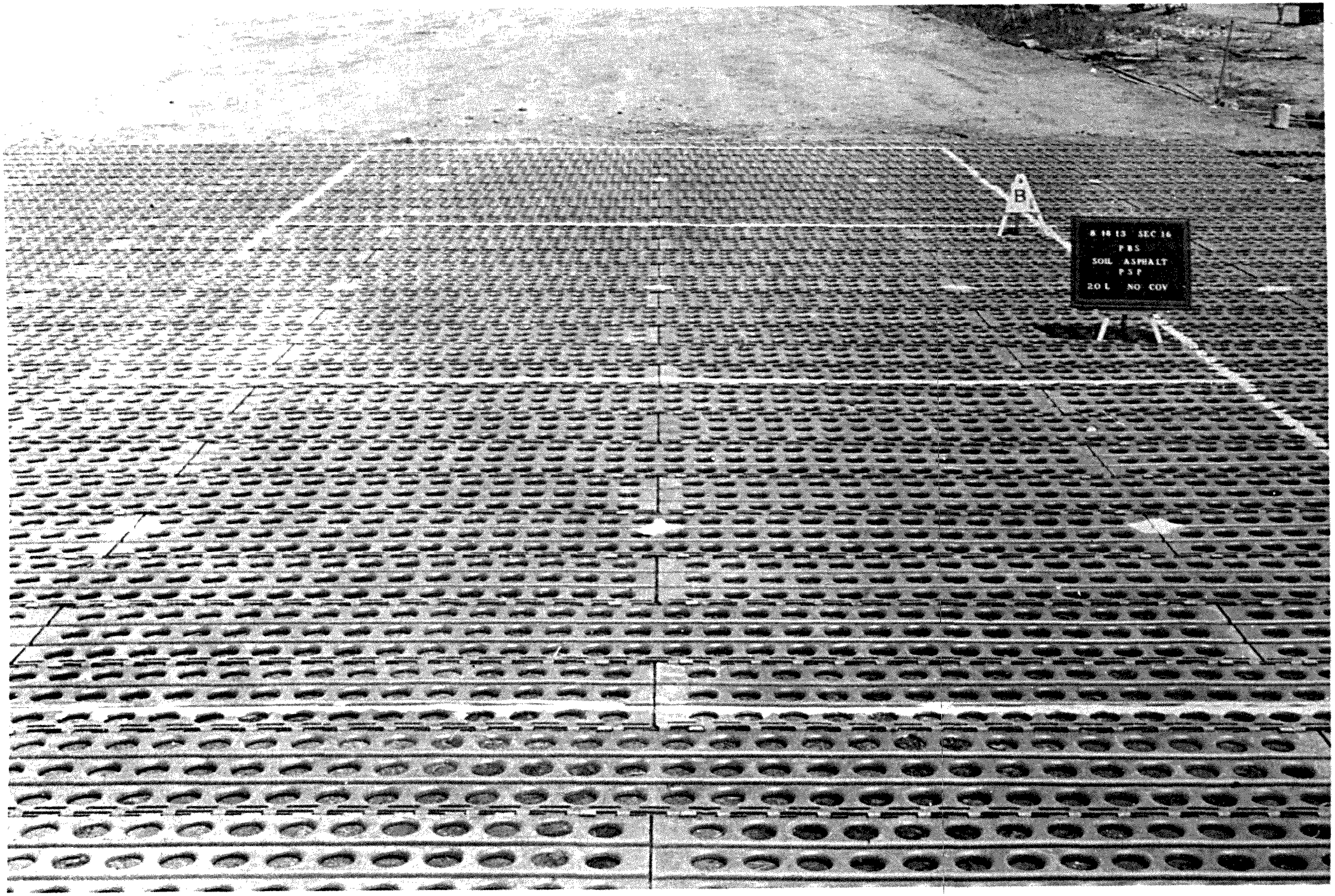


CONDITION OF PBS UNDER SAND-ASPHALT CUSHION IN SECTION 14-A AFTER TEST

CONDITION OF PBS UNDER SAND-ASPHALT CUSHION IN SECTION 14-B AFTER TEST

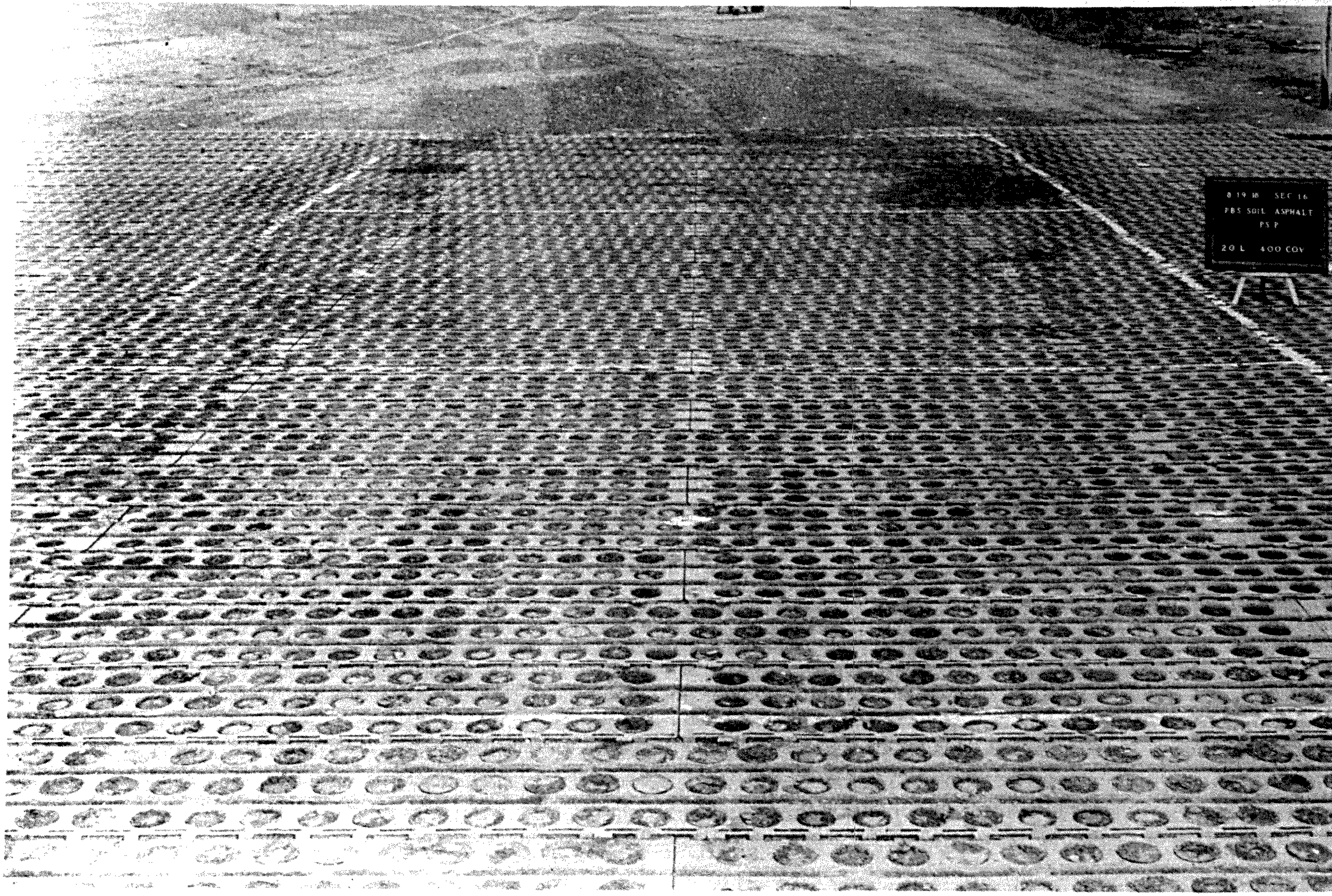


CONDITION OF PBS UNDER SAND-ASPHALT CUSHION IN SECTION 15-A AFTER TEST

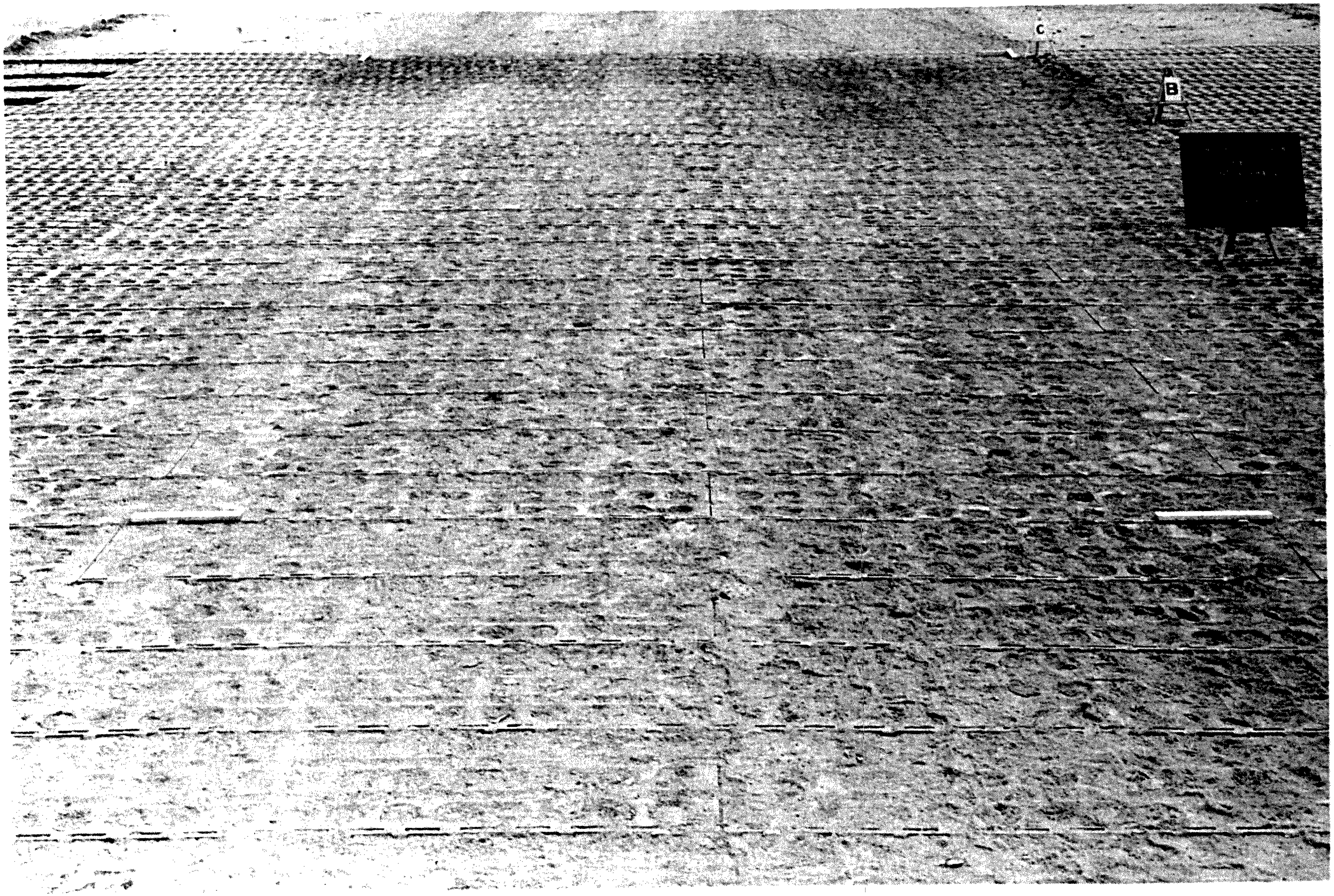


SECTION 16, BEFORE TESTING

PLATE 35



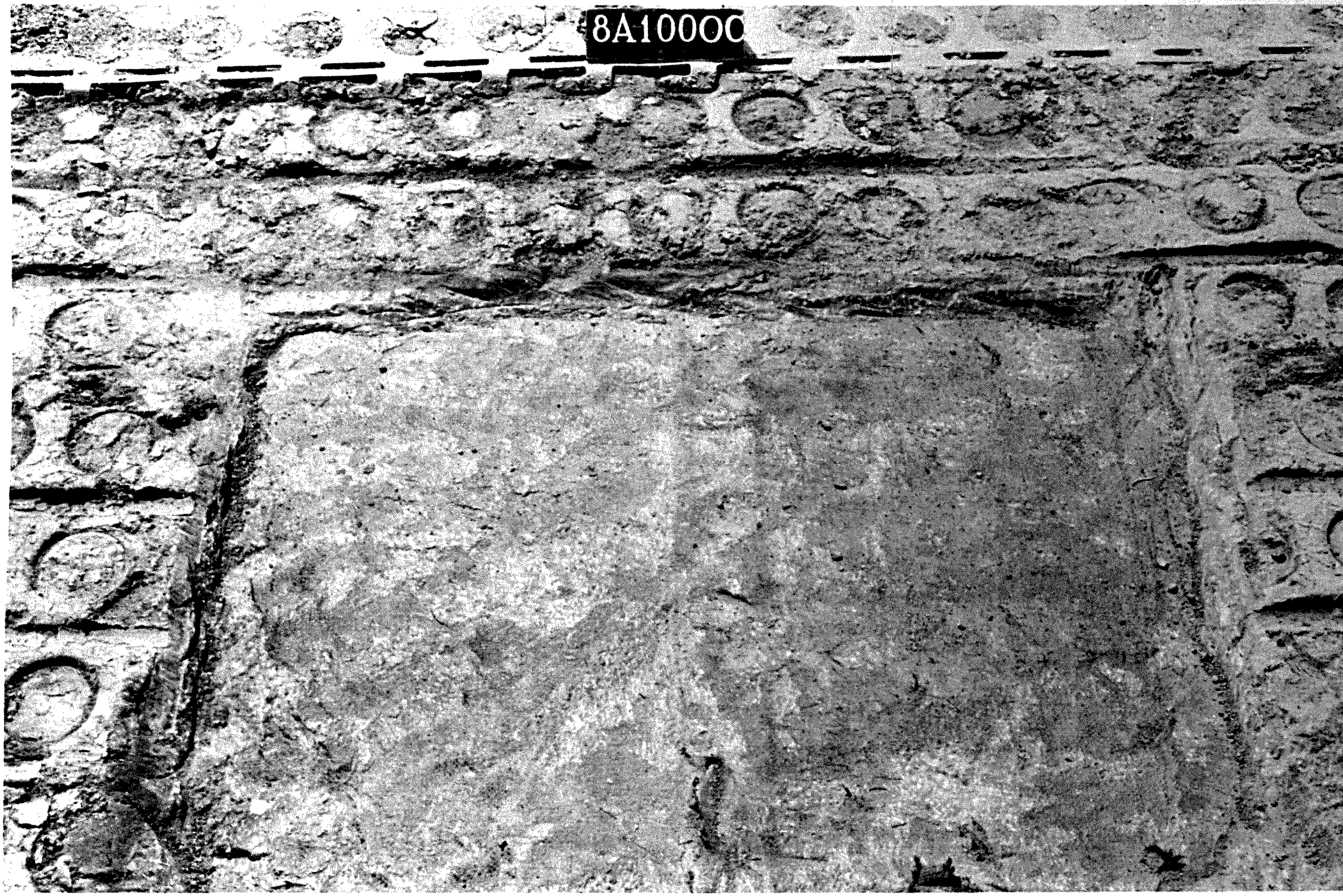
SECTION 16, AT 400 COVERAGES



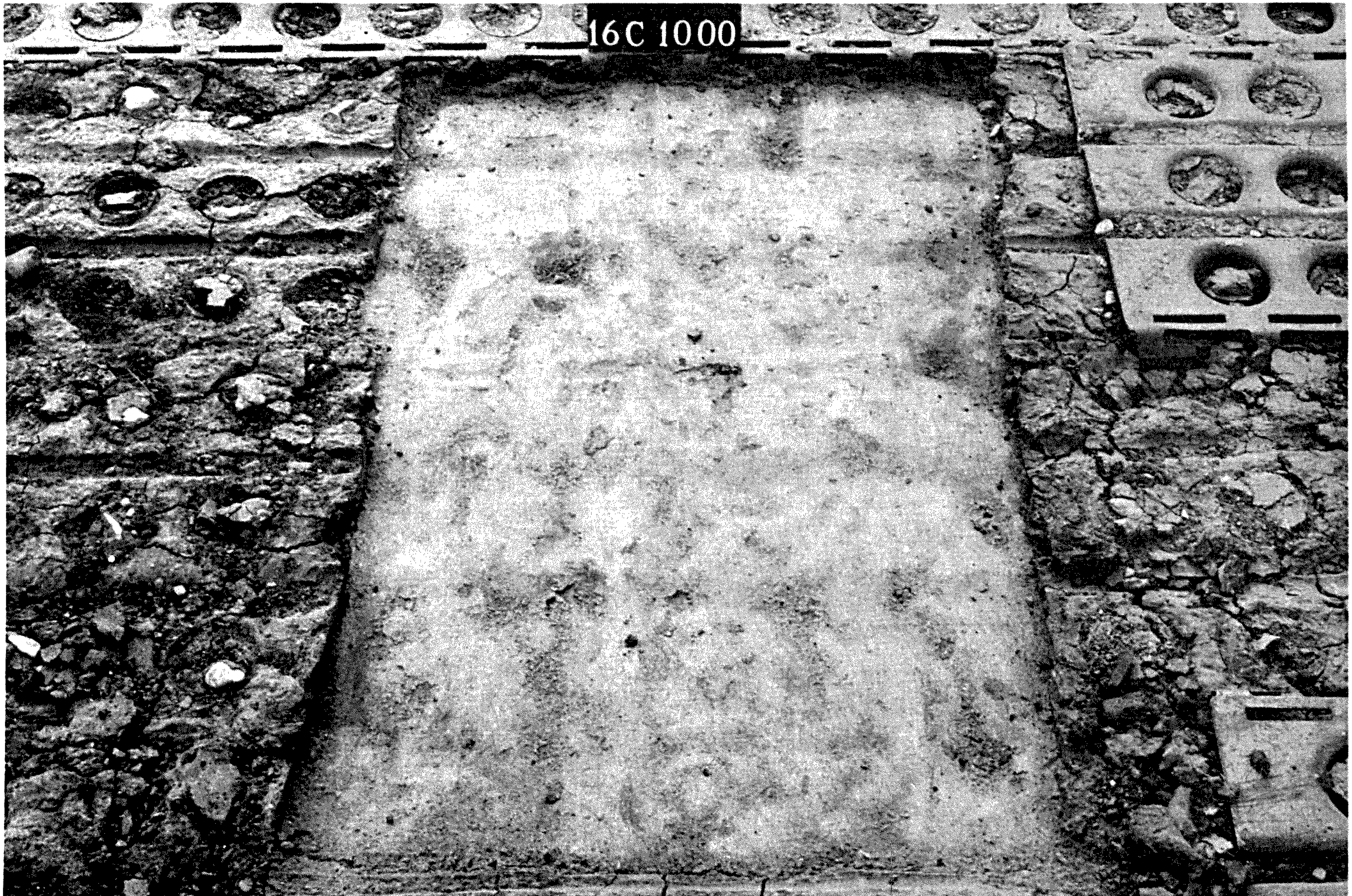
SECTION 8, AT 1000 COVERAGES

PLATE 37

PLATE 38



CONDITION OF PBS UNDER SOIL-ASPHALT CUSHION IN SECTION 8-A AFTER TEST



CONDITION OF PBS UNDER SOIL-ASPHALT CUSHION IN SECTION 16-C AFTER TEST

PLATE 39