PARTIAL-DEPTH PRECAST CONCRETE PATCHING

by

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SUMMARY

Experiments were performed with partial-depth precast concrete patching to determine the feasibility of the method. In the experiments, prefabricated slabs of various sizes, stockpiled near the pavement repair site, were installed in machine cut holes in the pavement and cemented into place to make 68 patches. To determine the feasibility of using the cutting machines to prepare deteriorated areas for cast-in-place patches, 22 such patches were installed. Two Klarcrete machines were used to prepare the holes for patching. In the precast patching operations 292.5 square feet (27.17 m^2) were installed in 88 working hours and in the cast-in-place operations 101.5 square feet (9.43 m^2) were installed in 26.4 hours.

Major conclusions from the experiments were (1) precast patching is feasible and the machines used to cut the holes did a creditable job, (2) additional projects in the 300-500 square feet (27.87 - 46.5 m^2) range are needed to develop a sophisticated methodology for increasing production, and (3) it is desirable to have available a commercial domestic epoxy resin that will cure as rapidly as the imported product (30 minutes).

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INTRODUCTION

The experiments reported here were conducted in an effort to find new, economical methods of repairing deteriorated portland cement concrete pavements. In conventional repair, where the spalled concrete is sawed and removed with jackhammers and a wet mix is poured in the hole, several undesirable things may occur. Some of these are:

- An excess of good concrete is often removed, especially in depth.
- Not enough concrete contiguous to the spalled area is removed, and therefore the patch material is bonded to unsound concrete.
- Poor compaction occurs due to improper vibration or no vibration.
- The patch material adheres poorly to the surrounding concrete.
- Long curing times are usually necessary.

Poor compaction, attempts to bond good concrete to bad, and improper bonding of the new material to the old are probably the major reasons for patch failure. Of major importance to the function of the highway is the blocking of lanes for long periods of time to allow the patch material to cure. This removal of lanes from service lowers the capacity of the highway, interrupts the traffic flow, increases motorists' frustrations, and increases the accident potential, especially under night conditions, because of the weaving action necessitated by the barricades. In addition, prolonged lane closures may reduce the general high regard that the traveling public has for highway workers. (1)

In view of the many problems associated with cast-in-place patching, new methods of repair are being sought.

PURPOSE

This project was initiated to determine the feasibility of using precast concrete patches in the repair of portland cement concrete pavements. Some of the specific objectives were to:

- Determine the average length of time required to (a) remove the deteriorated concrete, (b) insert a precast patch, and (c) allow the cementing material to cure sufficiently to open the repaired section to traffic.
- Determine, if possible, the cost of precast patching.
- Determine if the wire mesh reinforcing steel in the concrete pavement presents a problem to the machine cutting the holes.
- Determine if the machines used to cut the holes are adaptable to cutting different dimensions and the ease with which they may be adjusted for different configurations.
- Determine if precast patching operations can be set up in a production line in which crews cut holes with the machines and a following crew places and cements the patches.
- Determine the durability of precast patches.

TEST SITE

The site selected for the project was the westbound lanes of Route 44, the Virginia Beach - Norfolk Expressway, in Virginia Beach. Route 44 is a 4-lane divided highway built to interstate standards and opened to traffic in June 1968. It was constructed of jointed reinforced concrete pavement 9 inches (228.60 mm) thick and incorporated tabular metal joint inserts. The joint spacing is 61.5 feet (18.745 m). On most roads in which the inserts have been used joint spalling has occurred and Route 44 is no exception. Exactly why the spalling occurs is not well understood, but certain events have been observed. First the metal insert rusts out and this allows the sealer to fall or sink down into the joint. The joint then is susceptible to entry of foreign materials, which in many cases are noncompressible. Such materials block any subsequent expansion of the slabs and spalling occurs. Another explanation traces the spalling to the small intrusions made in the concrete by the metal inserts as revealed by cores taken at the joints. When rusting occurs a weakened plane evidently is formed and results in spalling. Figure 1 is a view of the tabular metal joint showing its dimensions and cross section.

Foremost among the reasons for selecting this site for study was the fact that the eastbound lanes had just been repaired in the conventional manner, with the joints being sawed and resealed, and the westbound lanes were scheduled for repair in the winter of 1974-75. The site thus presented an excellent opportunity to observe the two types of patching side by side.

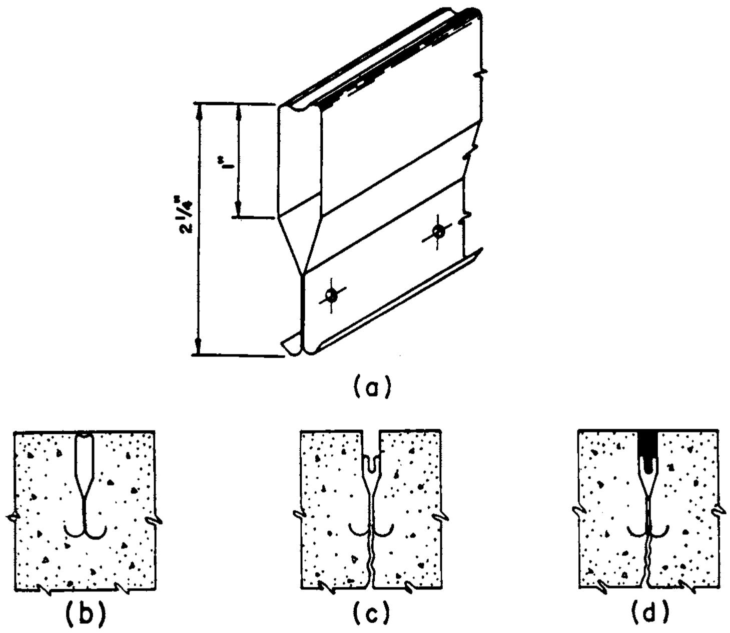

Figure 1. Tabular metal joint insert: (a) cross section of 2 1/4" insert, (b) as installed, (c) after crimping, and (d) after sealing. Basic conversion unit: 1" = 25.4 mm.

PRECAST CONCRETE PATCHING

In modern industry many items are prepackaged, prefabricated, or precast. Nowhere is this more prevalent than in the construction field. There are numerous examples of coliseums built with prefabricated concrete sections hauled to the site and attached to each other to form the finished structure. Many bridge components are prefabricated. The list of prefabricated products is quite large and growing; therefore, it is not surprising that precast or prefabricated road repair products are now being introduced. The experiment performed in this study had to do with partial-depth precast concrete patches for portland cement concrete.

Precast patching consists of prefabricating a supply of various size concrete slabs, stockpiling them near the pavement repair site, using a machine to cut holes to desired dimensions in the pavement, installing the slabs, and cementing them into place with an appropriate material such as a two-component epoxy grout system.

Slabs

Prefabricated slabs may be cast in various ways; however, for this experiment two methods were used. The majority of the slabs were cast using a hydraulic press designed for the purpose. The slabs were very dense and possessed high compressive strengths. All were cast 2" (50.8 mm) in thickness and in sizes ranging from 2' x 3' x 2" (.61m x .91m x 50.8mm) down to 1' x 2' x 2" (.305m x .61m x 50.8mm). Figure 2 shows the stockpile of hydraulically pressed slabs used on this project in the equipment yard adjacent to the job site.

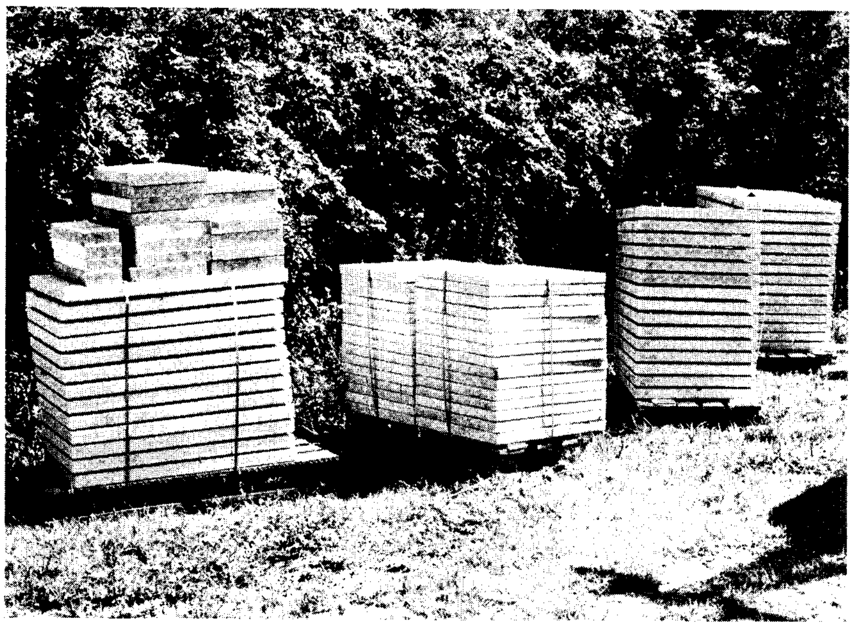

Figure 2. Stockpile of hydraulically pressed precast concrete slabs.

Another type of precast slab used in the experiment — Wirand — was cast at the Virginia Highway and Transportation Research Council. It contained metal fibers for strength and was cast in the conventional manner. The Wirand slabs were 2" (50.8 mm) in thickness and ranged in dimensions from 2' x 2' x 2" (.61m x .61m x 50.8mm) down to 1' x 1' x 2" (.305m x .305m x 50.8mm).

Three of the pressed slabs were treated to produce a polymer impregnated concrete (PIC) for the purpose of determining whether the impregnating process increases resistance to salt action. The treatment was a 9 to 1 mixture of methyl methacrylate (MMH) and trimethylolpropane trimethacrylate (TMP TMA) and 1% by weight of vazo 52 solution.

Embeco 411 A was used for the cast-in-place patches.

Machines

The holes for the experiment were cut with two Klarcrete machines. These machines remove the pavement by striking it with percussive hammers, each of which delivers approximately 1,500 blows per minute. The power source for the machines is compressed air. The general purpose concrete repair machine, as its name implies, was designed as a multiple purpose machine. It contains 11 cutting heads that operate independently. The heads are 2 1/4" (57.15 mm) in diameter and are spaced 2 1/4" apart. They are mounted on a carriage that allows vertical movement and that in turn is attached to a transverse carriage that allows lateral movement. The lateral movement is necessary for the uniform removal of the concrete over the width of operation. The width of cut can be varied from 4 1/2" (114.3 mm) (diameter of cutting head plus space between cutting heads) to 49 1/2" (1.3 m) in 4 1/2" (114.3 mm) increments by adding or deleting cutting heads. Figure 3 shows the configuration of the cutting heads.

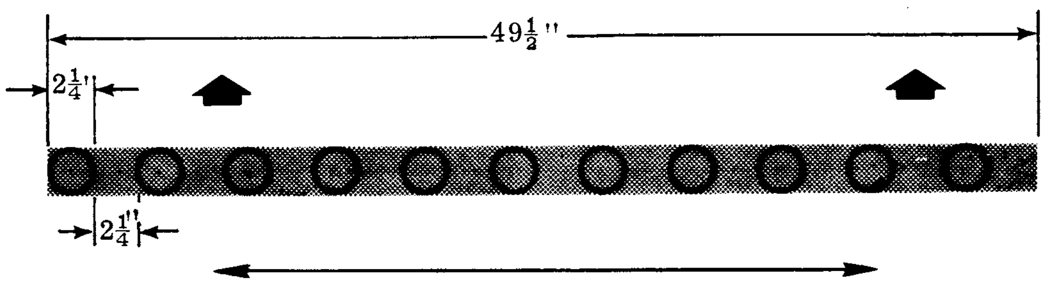

Figure 3. Configuration of cutting heads of the general purpose concrete repair machine. (Two-headed arrow indicates that the heads move to right and left on a transverse carriage to cut area in between.)

The cutting heads, which require no lubrication and are free to rotate, break the concrete into small particles of a gradation not much larger than sand and cause no damage to the surrounding concrete. The machine works on the principle that concrete is stronger under compression than it is under tension. The concrete is compressed by the hammers and when the pressure is released small amounts of concrete are expelled from the surface. The machine removes the surface by the number of impacts rather than the force of individual impacts. The general purpose concrete repair machine is capable of cutting a hole with square sides and flat bottom as large as 4' (1.219 m) by 4' (1.219 m) by 4" (101.6 mm) in depth. Such large holes, in most cases, are not practicable, therefore, the machine is designed so that hole sizes may be reduced by 4 1/2" (114.3 mm) increments each time a cutting head is shut off. The other dimension is adjustable in 6" (152.4 mm) increments by stops on the frame of the machine. The depth of the hole was determined by measurement and when the proper depth was reached the machine was cut off. As may be supposed, a large number of hole sizes are possible. Figure 4 shows the general purpose machine cutting a hole. The technical and physical characteristics of the machine are given in Table 1.

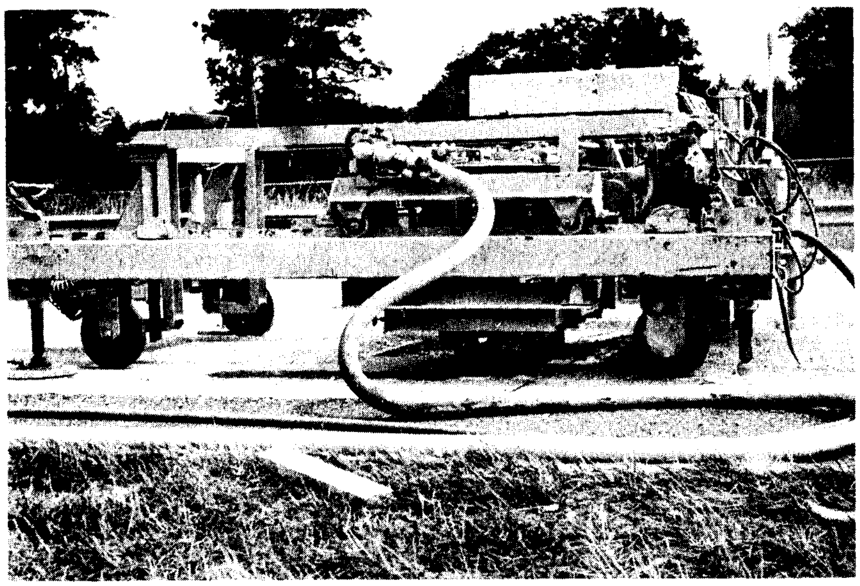

Figure 4. General purpose concrete repair machine in a hole cutting operation.

In addition to the general purpose machine, a smaller machine designed exclusively for hole cutting was used. It required a 250 cubic feet (7.078 m^3) per minute at 100 psi (689.48 kPa) compressor. Its operation is similar to that of the larger machine although it has only four cutting heads and can cut a maximum size hole of only 1.5' (.46 m) by 2' (.61 m). Like the larger machine, its hole cutting dimensions can be adjusted by taking cutting heads out of action. Where the larger machine is self-propelled the smaller one is not, which is a disadvantage because its weight is too great to allow ease of movement and setup by hand by the operator. In Table 1 all of the data under cutting heads, except the width of cut and the footnotes are applicable to the smaller machine. Figure 5 is a rear view of the smaller machine with the four cutting heads visible. Figure 6 shows the machine in operation. Figure 7 shows a hole prepared for patching.

Table 1. Technical details of Klarcrete general purpose concrete repair machine. (From reference 2.)

Item	Value
Overall length	14 ft. (4.27 m)
Length without tiller	10 ft. 4.5 in. (3.16 m)
Width	7 ft. 6 in. (2.29 m)
Overall height	4 ft. 6 in. (1.37 m)
Weight	4,000 lb. (1800 kg)
Power required, compressed air[a]	600 cfm at 100 psi (0.28 m^3/s at 689 kPa)
Cutting heads[b]	
Diameter	2 1/4 in. (57.15 mm)
Distance between heads	2 1/4 in. (57.15 mm)
Air consumption per head	30-35 cfm at 100 psi (0.014-0.017 m^3/s at 689 kPa)
Life	100 hours ± 25
Strokes per minute	1,500
Maximum cutting depth	4 in. (102 mm)
Accuracy	± 1/8 in. (±3.18 mm)
Width of cut	4.5 to 49.5 in. (0.114 to 1.26 m)

[a] The Klarcrete machine is pneumatically and hydraulically operated and pneumatically controlled on a sequential system.

[b] There are 11 tungsten carbide cutting heads, composed of a motor and a head; each head (except the first one) can be controlled individually. The cutting face is made up of 6 tips intersecting in the center of the head at 60 degrees. Depth of the cut depends on forward speed of the machine.

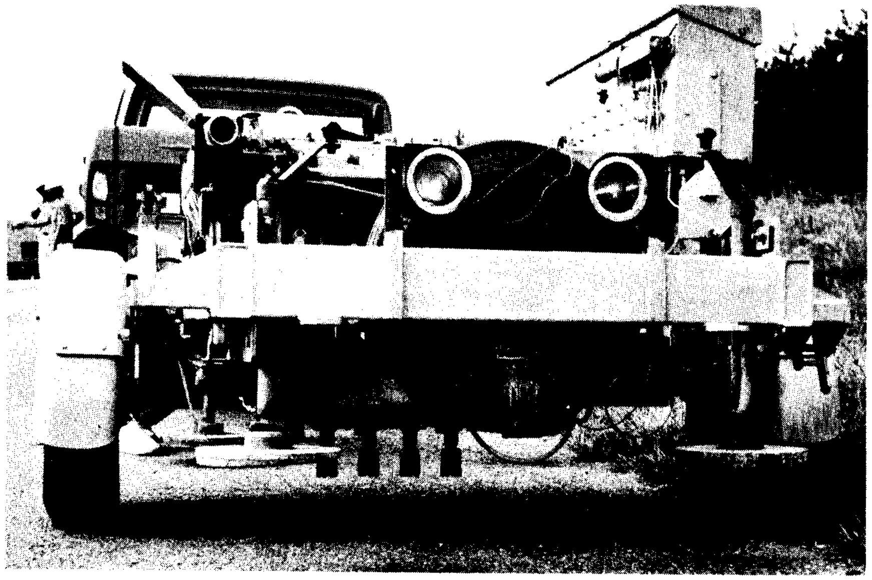

Figure 5. Rear view of small hole cutting machine with cutting heads visible.

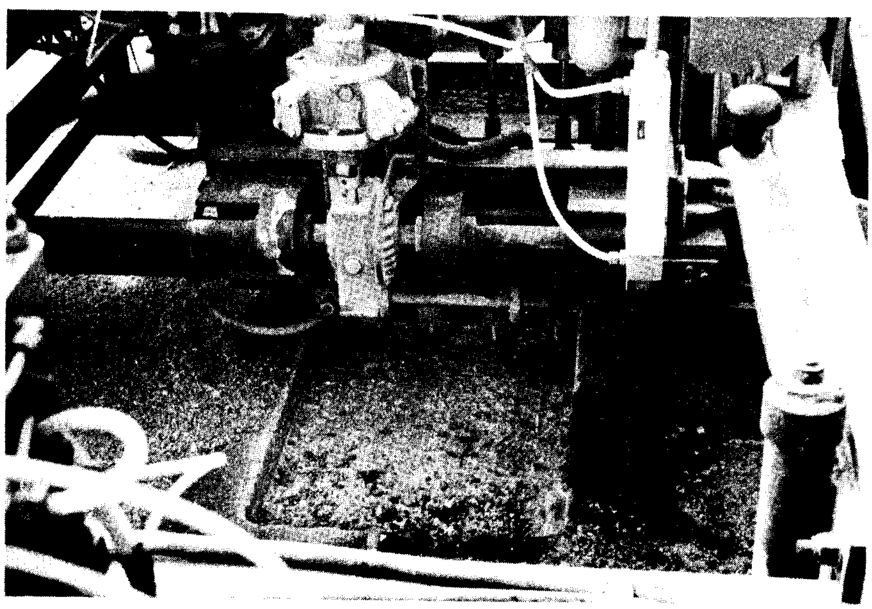

Figure 6. Small machine in hole cutting operation.

Figure 7. Hole prepared for precast patching.

Epoxy

The epoxy used meets AASHTO standard M200-65. The formulation consisted of adding 1/2 gallon (1.89ℓ) of catalyst to 1 gallon (3.7854ℓ) of resin and mixing thoroughly for 3 minutes or more. Sand was then mixed with the epoxy until it reached the desired consistency. The ratio was approximately 5 to 10 parts sand to 1 part epoxy. A total of 56 gallons (211.98ℓ) were used, 52 from the United States and 4 from England. The epoxy from the U. S. appeared to do a good job but a disadvantage was that it needed 3 hours at road temperatures (100^{o}F $\pm$ 14^{o}F) (37.8^{o}C $\pm$ 10^{o}C) to cure sufficiently to allow traffic on patches. The epoxy shipped from England cured sufficiently in 30 minutes.

EXPERIMENTS ON ROUTE 44

On patch number one, because of the configuration of the deteriorated concrete, 1' x 10' (0.3048m x 3.048m), it became obvious that it would not be possible to adhere to the patch sizes designated in Table 2. The decision was made to remove only the deteriorated concrete and saw the slabs if necessary. This procedure had an added advantage in that the smaller machine could be kept operating, since it is limited in the size

Table 2. Quantities specified in contract for experiment.
Basic conversion units: 1" = 25.4 mm; 1 ft^2 = 0.09 m^2

Route 44 Pavement Repairs — WBL
From: Parks Avenue
To: 3.0 Miles West of Parks Avenue

ITEMS	QUANTITY
Removal Pavement 2" Depth	408 ft^2
Removal Pavement 4" Depth	20 ft^2
Removal Pavement 2" & 4" Depth	150 ft^2
Partial-depth Patch 4' x 6' x 2"	2
Partial-depth Patch 3' x 4' x 4"	1
Partial-depth Patch 2' x 2' x 4"	1
Partial-depth Patch 1' x 4' x 2"	1
Partial-depth Patch 4" x 3" x 2"	10
Partial-depth Patch 2' x 2' x 2"	25
Partial-depth Patch 1' x 2' x 2"	10
Wirand Patch — Installation (2' x 2' x 2")	10
Wirand Patch — Installation (1' x 2' x 2")	10
Cast-In-Place Joint Spall and Pavement Spall Repair	150 ft^2

hole it can cut and otherwise could have been used in the preparation of only 21 holes.

The experiment was performed in 15 working days during June 1974, during which a total of 90 patches were placed. For the holes for some patches, such as patch number one (see Figure 8), the cutting machines had to be repositioned several times. For others only one setup was necessary (see Figure 7). It was found repositioning the machine greatly increased the time necessary for cutting a hole; in fact, almost as much time was required to set up and adjust for the cutting operation as was required to cut the hole. In many cases, however, more than one setup was necessary and more than one slab was needed to fill the hole (see Figure 9). When a slab of a not available size was needed it was sawed from a larger slab as shown in Figure 10.

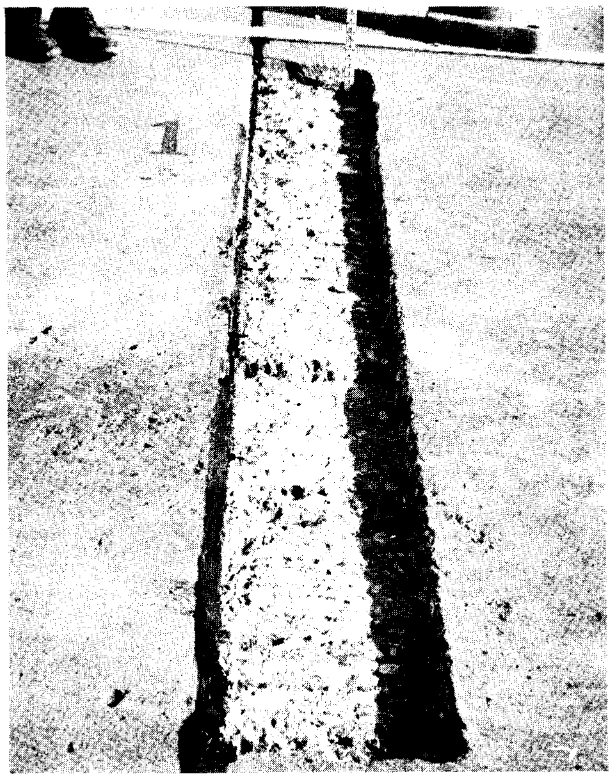

Figure 8. Hole Number 1 after cutting and cleaning. The cutting machine had to be repositioned three times to cut this hole.

The handwork necessary in preparing the holes consisted of removing the steel mesh with a small hand tool as shown in Figure 11, which resulted in the grid-like pattern in Figure 12, and removing small amounts of concrete at the few joints that had bad concrete below the level cut by the machine. Figure 13 shows a hole from which concrete along the joint had to be removed by hand. In cases such as this the crack was filled with epoxy grout up to the level of the remainder of the hole and the patch was installed in the normal manner. After a hole was prepared for patching it was sounded to make certain all deteriorated concrete had been removed.

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Figure 9. Patched area requiring more than one slab.

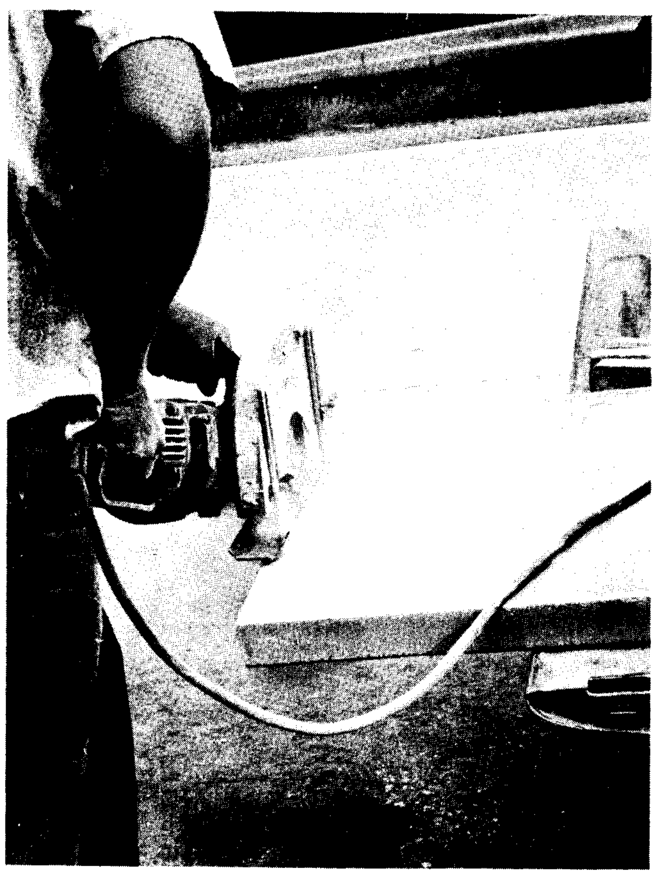

Figure 10. Precast slab being sawed to proper dimension.

Figure 11. Steel mesh being removed from hole with hand tool.

Figure 12. Grid pattern left after removal of steel mesh.

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Figure 13. Hole from which deteriorated concrete along joint had to be removed with hand tool.

Since all hole depths were approximately 2.5" (63.5 mm) and the slabs were 2" (50.8 mm) thick, a 0.50" (12.7 mm) layer of epoxy grout was necessary to bring the patch up to the level of the surrounding pavement. The width of epoxy around the slab depended upon the accuracy of the cut of the hole and the slab. However, the variance was from a high of 2.75" (69.85 mm) to a low of 0.50" (12.7 mm). Figure 14 shows crack widths for a typical patch. There is no doubt that with more exact control of hole configuration and slab size less epoxy would have been necessary; however, other than the slight wastage of material no harm seems to have been done. Figure 15 shows two patches, one in which two slabs have been installed and a second in which the epoxy grout has been placed in the hole. Note that the bottom of the slab to be installed has been painted with epoxy. Experience seems to show that the painting improves the bond. Figure 16 gives a better perspective of the epoxy grout in the bottom of the slab. In installing the slabs a slight excess of epoxy was forced up along the cracks. The excess was trowelled off and the patch finished. To determine that a good bond had been obtained between the patch and old concrete each precast patch was sounded after the epoxy had cured.

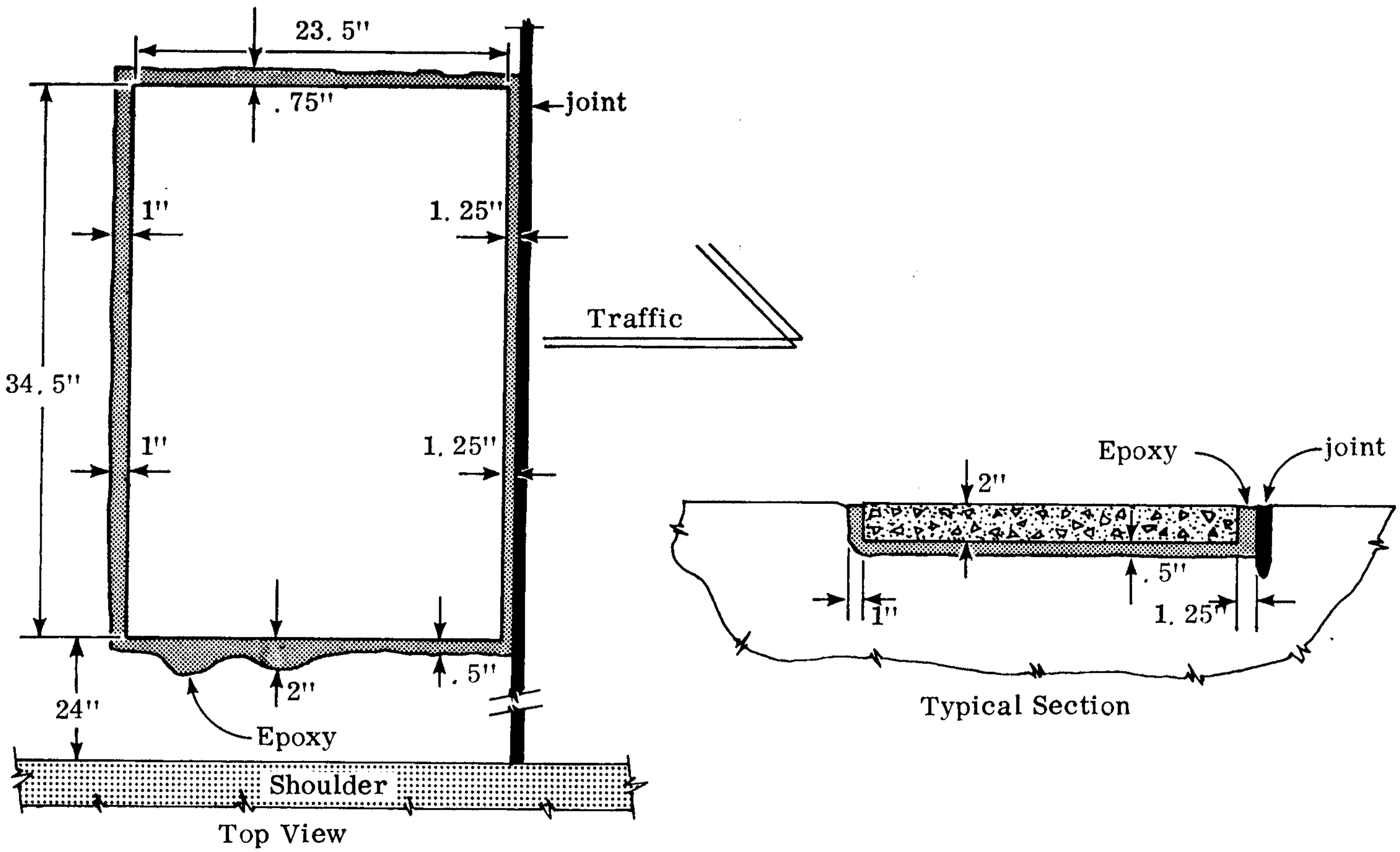


Figure 14. Sketch of patch showing dimensions of crack around patch. Basic conversion unit: 1" = 25.4 mm.

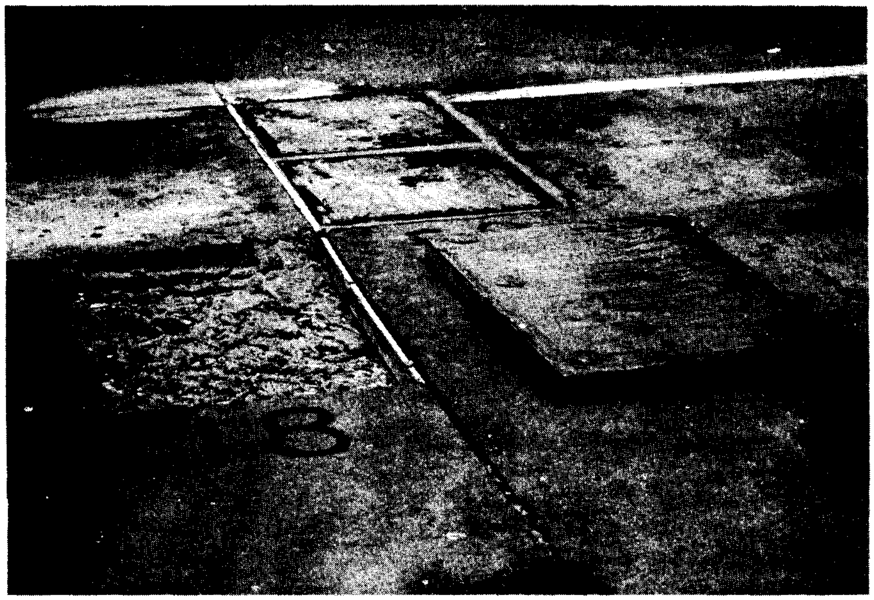


Figure 15. View of two patches, one with two slabs in place, and a second with the epoxy grout in the hole. Note the back of the slab to be installed has been painted with epoxy.

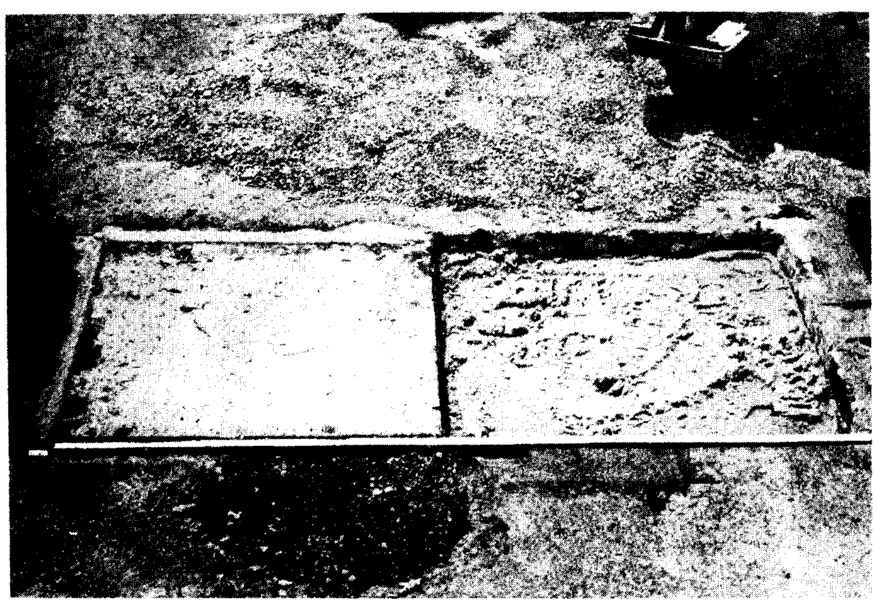


Figure 16. Half finished patch showing epoxy grout in right-hand portion of hole.

Table 3 is a summary of the precast patches installed. Included in the installation time is the time required for moving and positioning the machine, cutting the hole, and mixing the epoxy and setting the slabs.. From the table it may be observed that the smaller patches required approximately one hour to install. With larger, more complicated patches for which the machine had to be repositioned the times increased dramatically. The average times for the operations involved are shown in Table 4.

Table 3. Summary of precast patches installed.

Number of Patches	Size*	Average Installation Time	Total Area	Total Time
1	1' x 1'	56 min.	1 ft^2	56 min.
15	1' x 2'	61 min.	30 ft^2	915 min.
1	1' x 7'	146 min.	7 ft^2	146 min.
1	1' x 10'	220 min.	10 ft^2	220 min.
14	1.5' x 2'	61 min.	42 ft^2	854 min.
1	1.5' x 3'	112 min.	4.5 ft^2	112 min.
1	1.5' x 4'	102 min.	6 ft^2	102 min.
14	2' x 2'	72 min.	56 ft^2	1,008 min.
14	2' x 3'	87 min.	84 ft^2	1,218 min.
5	2' x 4'	92 min.	40 ft^2	460 min.
1	3' x 4'	133 min.	12 ft^2	133 min.
68			292.5 ft^2	5,224 min. = 88 hours

*Each at 2" thickness
1 ft. - .3m
1 ft^2 - .093m^2

Table 4. Average times for patching operations

Operation	Minutes	Percentage
Machine set up time	17.4	23
Hole cutting time	41.6	54
Mixing epoxy and installing patch	17.8	23
Total	76.5	100

As shown in Table 3 a total of 292.5 square feet (27.5 m^2) of precast patches were installed in 88 hours.

Table 5 is a summary of the cast-in-place patching. Twenty-two patches totaling 101.5 square feet (9.43 m^2) were installed. All patches were 2" (50.8 mm) in depth and in all except two the wet concrete was vibrated. For cast- in-place concrete this type of hole preparation is too elaborate and time-consuming.

Table 5. Summary of cast-in-place patching.

Number of Patches	Patch Size	Average Time Per Patch (Min.)	Total Area	Total Time
2	1' x 2'	87	4 ft^2	174 min.
6	1' x 1.5'	44.17	9 ft^2	265 min.
1	1' x 2.5'	38	2.5 ft^2	38 min.
6	1.5' x 2'	61.5	18 ft^2	369 min.
1	2' x 2'	63	4 ft^2	63 min.
1	2' x 3'	126	6 ft^2	126 min.
2	2' x 4'	68.5	16 ft^2	137 min.
1	2' x 6'	201	12 ft^2	201 min.
1	3' x 4'	74	12 ft^2	74 min.
1	3' x 6'	137	18 ft^2	137 min.
			101.5 ft^2	1584 min. = 26.4 hours

*Each at 2.5" thickness
8 hours curing time
All patches vibrated, except patches 54 (2' x 6') & 55 (2' x 2')
1 ft. = .3 m
1 ft^2 = .093 m^2

Table A-1 of the Appendix is a comprehensive summary of data for the experiment.

PROBLEMS ENCOUNTERED

Equipment

In the first two weeks of the project extensive machine failures occurred that extended the job. The small machine, which had been stored in the contractor's equipment yard for the winter, malfunctioned after cutting only 1 hole and was down for four working days until the problem was diagnosed.

The general purpose machine came to the job in a very worn state and was found not to be cutting the holes to the proper dimensions. After operating on a reduced basis for five working days it was taken out of service for two working days for overhaul. The overhaul entailed putting all new cutting heads (11) and guide rollers on the hammer carriage. After this maintenance was performed no more equipment problems were experienced during the project.

Materials

Not enough epoxy was stockpiled at the site to complete the precast patching, and when it was used the operation had to be suspended for several days while awaiting a new supply.

RESULTS

The two Klarcrete machines used to cut the holes functioned well after the previously noted maintenance was performed. All holes were cut to a 2.5" (63.5 mm) depth and the steel mesh in the pavement occurred most often at approximately that depth. The machines would not remove the steel mesh but it presented no problems in removal with a hand tool. The capability of the machines to cut a 4" (101.6 mm) depth was not determined. Of the 90 holes cut (68 for precast, 22 for cast-in-place) none required a depth greater than 2.5" (63.5 mm), although on a few, less than ten, a small amount of deteriorated concrete below that level was taken out with a hand tool.

The best combination of men and machines for production with what was available during the experiment consisted of one operator for each machine and three men to mix the epoxy and install the patches, with one of these assisting the machine operators when needed. When operating at an optimum, the two machines were barely able to keep ahead of the crew installing the patches.

On this first partial-depth precast concrete patching project in the United States, many pitfalls common to new methods were encountered. Two such pitfalls were casting three or four sizes of precast slabs with the belief that they would take care of all situations and casting the slabs in even increments of feet and inches, for which the machines were not always capable of cutting proper size holes. For example, the four heads on the small machine each cut 4.5" (114.3 mm) for a total of 18" (457.2 mm). Since the slabs were cast exactly 18" they didn't fit because at least a .25" (6.25 mm) crack must be left on each side for epoxy. The same thing happened when patching with slabs cast 2' (0.6096 m) in one dimension. The general purpose machine with five cutting heads operating cuts a width 22.5" (.57 m) and with six heads operating 27" (.686 m), neither of which matches the 2' (0.6096 m) dimension. This necessitated the cutting of slabs to fit the holes in certain cases.

The 22 cast-in-place patches were all vibrated with the exception of two. The bottoms and sides of the holes were painted with a slurry of the patching material to enhance bonding between the old and new concrete. A curing membrane was sprayed on the patches and the finished product was a very professional job. However, hole preparation with the Klarcrete machines is too time-consuming and sophisticated to make it practical for this type of patching.

In summation, it can be said that the precast patching was successful but more developmental work in the form of field projects such as this one is necessary to increase production. Figures 17, 18, 19, and 20 are examples of the holes cut and the precast patches placed during this project.

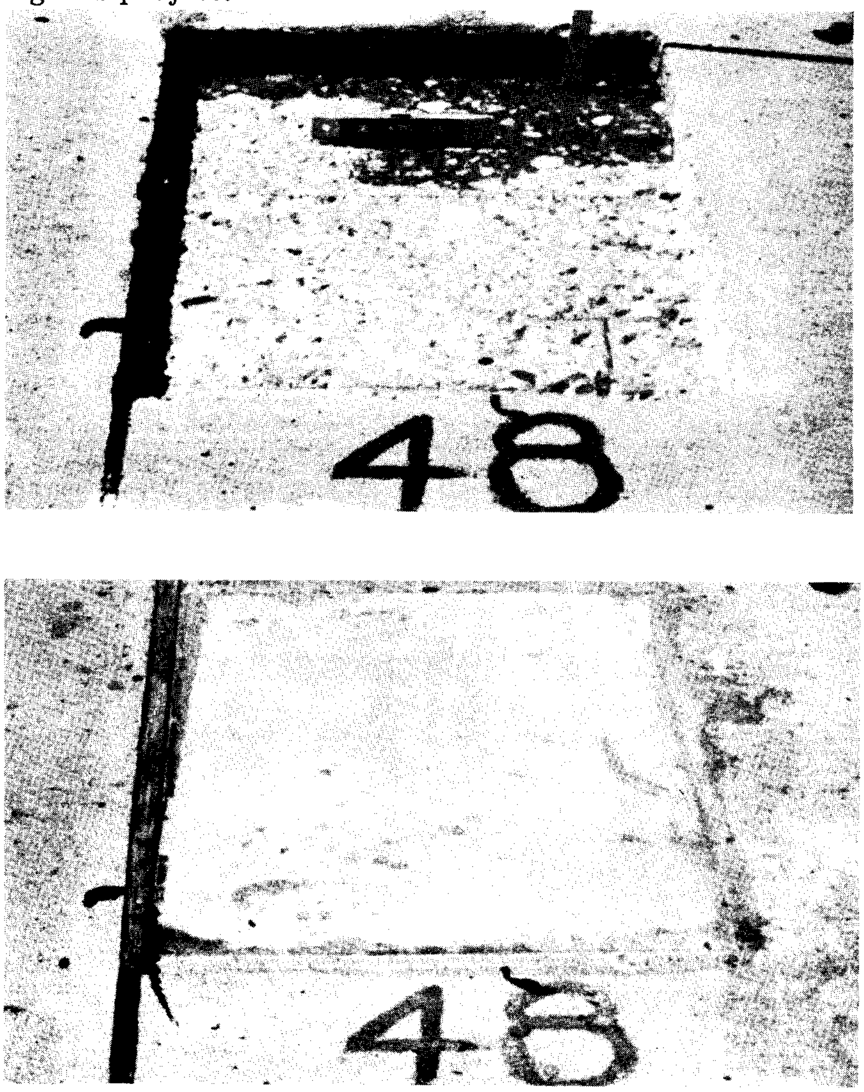


Figure 17. Patch Number 48 showing the finished hole and the completed patch. The dimensions of the slab are 24" x 34" and the hole 25" x 35". Basic conversion unit: 1" = 25.4 mm.

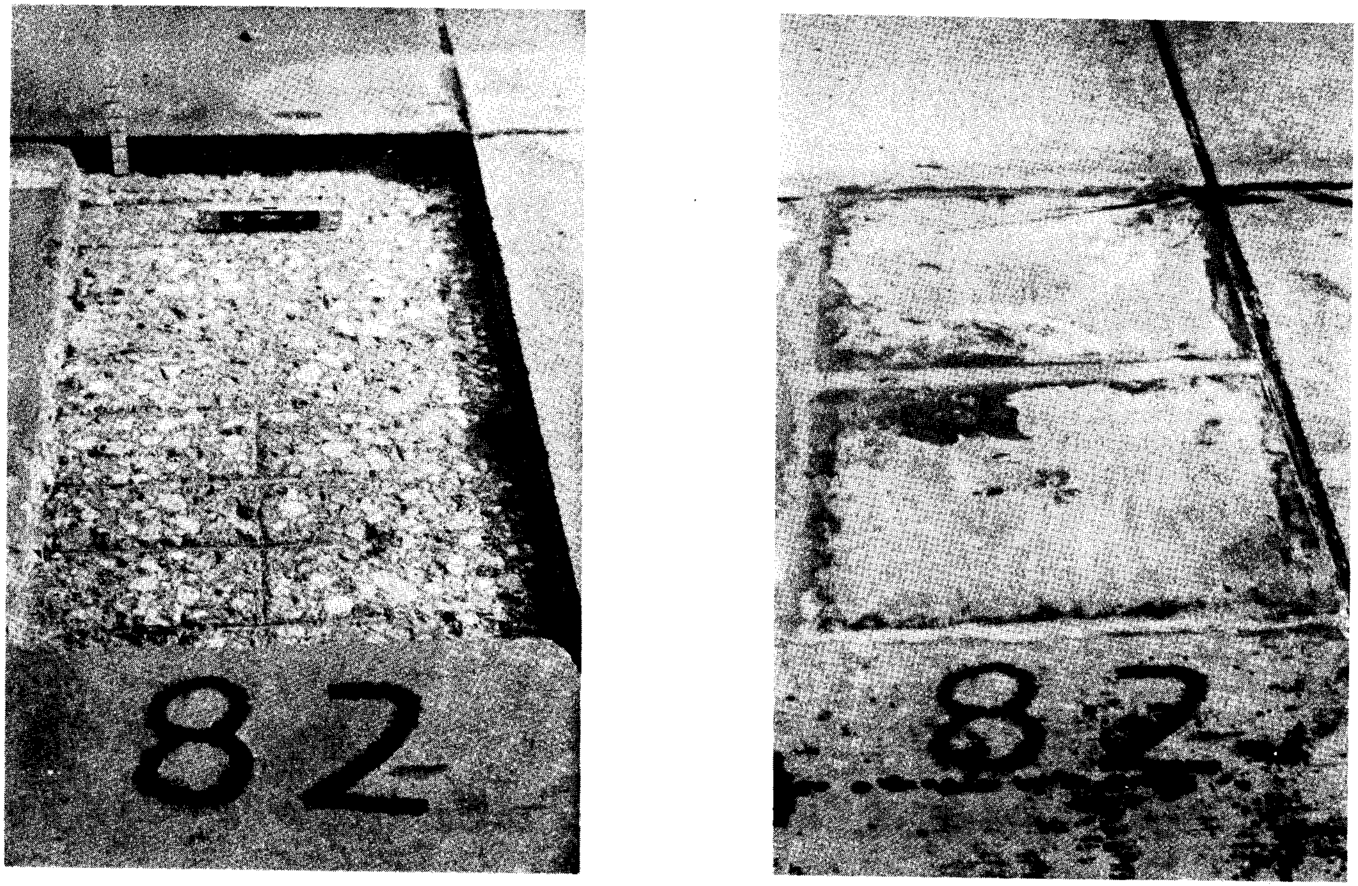


Figure 18. Patch Number 82 showing the finished hole and the completed patch. The hole is 51" in length and 26" wide. The slabs are each 2' x 2'. Basic conversion unit: 1" = 25.4 mm.

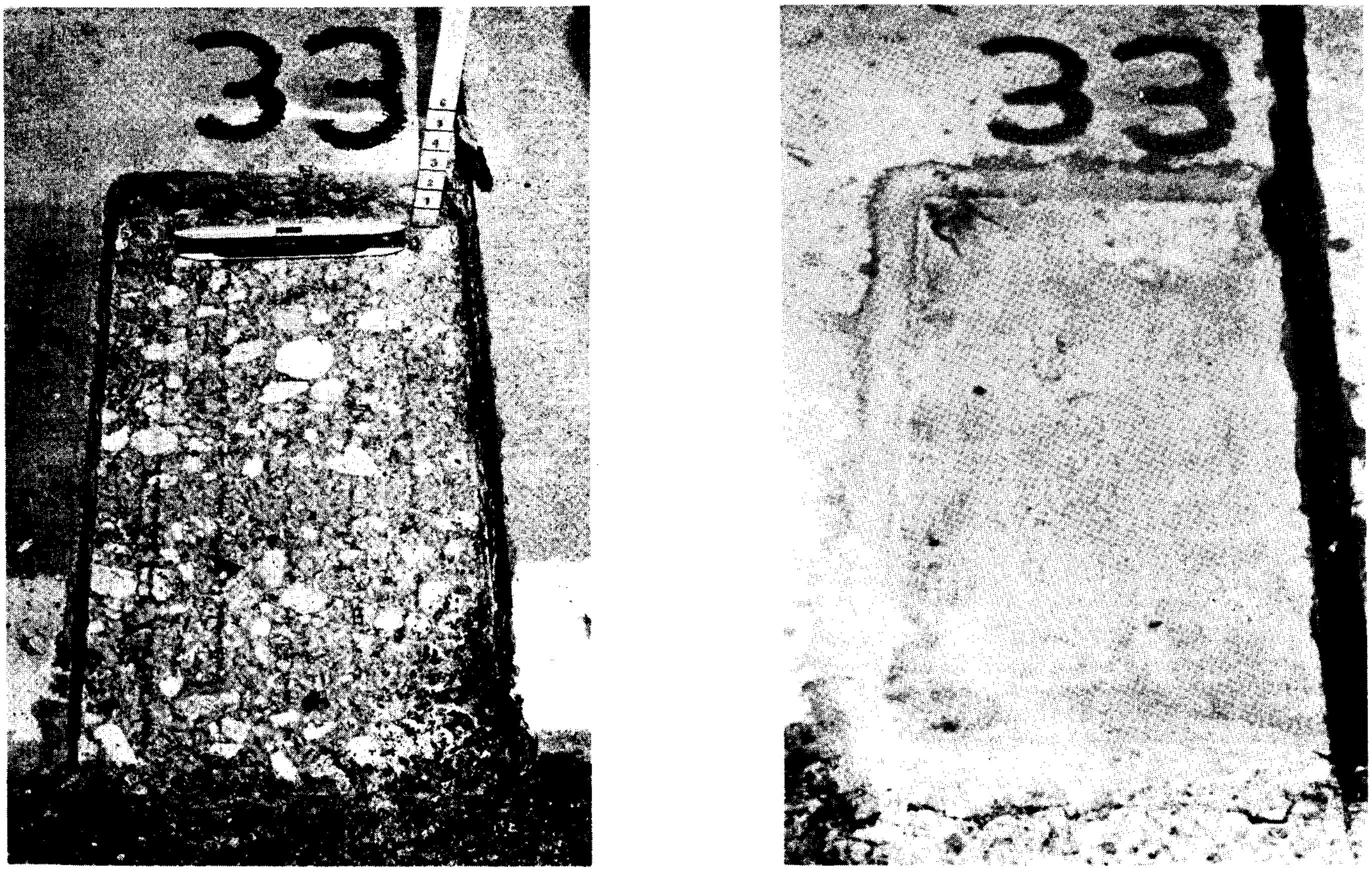


Figure 19. Patch Number 33 showing the finished hole and the patch installed. Patch size is 1' x 2' and the hole size is 13.5" x 25". Basic conversion unit: 1" = 25.4 mm.

Figure 20. Patches Number 87 and 88 showing the holes after cleaning and the completed patches. The patches are 25" x 17" and the holes are 24.5" x 18". Basic conversion unit: 1" = 25.4 mm.

PLANNED EVALUATION

At this writing not enough time has elapsed to gain any meaningful data on the durability of the patches placed during the experiment. However, two precast patches were placed on I-95 in Emporia, Virginia, in the summer of 1973 in a demonstration and they have proven durable so far.

When the patching operations were under way, a sketch was made of each hole showing all of the dimensions, irregularities and any other information thought to be important. Also a sketch was made of each patch showing the dimensions of the cracks between the slab and surrounding concrete (refer to Figure 14). In addition, a photograph was taken of each hole to show areas next to the joint where additional bad concrete had been removed and which would require backfilling with epoxy grout to bring them up to patching level. A photograph was also taken of the finished patch.

Figures A-1 through A-3 of the Appendix are examples of the completed data forms. Such forms were prepared for all patches. With these data and the information on the epoxy it should be possible to diagnose the causes of any failures that occur. Figure A-4 of the Appendix is a road log showing the location of each patch so that surveys may be made at two-month intervals.

Any recipients of this report who travel in the area where the precast patches were placed are invited to go by and inspect them. Should a failure be noted, it would be appreciated if you would notify the author.

A report setting forth the findings will be written within a three-year period.

COST COMPARISON

The following figures reflect only the cost where the contractor removed the deteriorated concrete and supplied the precast slabs. No cost data are given for the Wirand or cast-in-place patching. The total cost for 236 square feet (21.926 m^2) of precast patching was $5900, for a cost of $25 per square foot (.0929 m^2). On a cast-in-place project in the eastbound lanes, not included in the experiment, the cost per square foot was $29.80. This is probably not a true cost comparison and it is anticipated that the contractor will have to adjust his cost figures in the future.

CONCLUSIONS

The following conclusions were derived from the experiment:

1. Precast concrete patching is feasible.
2. The Klarcrete machines used to cut the holes did a creditable job.

3. Although the installation of partial-depth precast patches was deemed successful, more projects are needed in the 300-500 square feet (27.87 - 46.5 m^2) range to develop a methodology for increasing output.

4. Although the epoxy obtained from the United States sources met AASHTO standards and apparently worked well, the three-hour curing time was excessive and defeated one of the purposes of the experiment. However, the four gallons (15.142 ℓ) shipped from England cured quickly enough to allow traffic on the patches in 30 minutes, which proves that rapid opening to traffic is possible.

5. The most efficient makeup of men and machines was one operator for each machine and a patching crew of three men, one of whom assisted the machine operators when necessary. The two machines kept one patching crew busy.

6. Precast concrete patching projects should have a bench type masonry saw on the job site capable of sawing precast slabs to exact dimensions. It is not practical to try to cast all of the different size slabs that may be needed.

7. The steel mesh in the pavement did not cause a problem in precast patching.

8. Adequate supplies of materials should be stockpiled prior to beginning the project.

9. To assure a neat job a canvas covering should be spread on the road surface where epoxy is being mixed to catch the drippings.

10. Preparation of holes by the Klarcrete machines to exact dimensions for cast-in-place concrete patching is an unnecessary sophistication.

RECOMMENDATIONS

1. On future partial-depth concrete repair jobs the contractor should be given the option of repairs by precast methods or conventional cast-in-place methods. If the precast patches prove far superior in durability to cast-in-place patches and are economically justifiable they should be recommended; however, it will take some time to complete the durability phase of the study.

Other factors that should be considered in recommending precast patching over conventional patching are:

A. The time element — patching and reopening to traffic almost immediately.

B. Safety factor of having barricaded lanes for shorter periods of time.

C. Motorist comfort and convenience.

2. Deterioration of concrete happens over a period of years and repairs are not usually performed until the pavement is ready for a major repair job as the Department does very little permanent repairs of concrete pavement by state forces. The precast method lends itself well to repairing spalled areas as they occur and the casting of precast slabs is relatively simple. The Department may wish to consider buying a machine after further development of the method. Advantages that would accrue to the Department would be pavements with few or no spalled areas, ability to patch areas in off-traffic hours and immediately release to traffic, and the possibility of avoiding some large repair contracts that tie up roads for months.

ACKNOWLEDGEMENTS

The author expresses thanks to C. M. Clarke, P. D. Hughes, John Hyman, Mike Pugh, Frank Philpott, and Jamie Freeman, without whose help the project would not have been possible.

REFERENCES

1. Creech, Marion F., "Working Plan, Partial-Depth Precast Concrete Patching," VHRC 73-WP13, Virginia Highway Research Council, February 1974.

2. Creech, Marion F., "Mechanical Alteration of the Texture of Old Concrete Pavement with the Klarcrete Machine," Transportation Research Record 484, 1974, pp. 9-23.

APPENDIX

Little machine

Figure A-1
Data Form for Precast Patching Experiment
Route 44 — Virginia Beach, Virginia

(1 Form for Each Patch)

Data Recorder F. Philpott

Date June 13, 1974 Temperature Air 84°F
Surface 108°F

Locational Information

Patch Number 31

Route Number 44

Location: Lane Passing Direction Westbound

Description of Location 50' west of "No Turns" sign near entrance from Birdneck Rd.

Condition of the Pavement: (check one) Wet ___ Dry ✓ MP 11.54
SN 50

Hole Cutting Information

Dimension of Hole: Length (inches) 36 Width (inches) 25 Depth (inches) 2.5

Length of Time to Cut Hole (minutes) 82 setup 9:15-9:30, 10:09-10:14
cut 9:31-9:44, 9:49-10:09, 10:25-10:50, 10:55-10:59, 11:08-11:13

Check Following: 15+10+13+20+5+4+5+10 = 82

Hole Cleaned HAND 10 min ✓
Level of Bottom of Hole Checked ✓
If Bottom of Hole not Level - Degrees Off Level ___

First Photograph Taken: (check) ✓ Photographer F. Philpott

Was Klarcrete machine able to remove wire mesh: Yes ___, No ✓ Did not penetrate deep enough to come in contact with ___. If answer is no, how long did it take to roll the machine off the hole, cut the wire out and reposition (minutes) 10.

Patch Installation Information

Type of Cementing Material Used Industrial coating, resin & catalyst, AASHO M 200 65

Size of Patch: Length (inches) 34.5 Width (inches) 24 Depth (inches) 2

Length of Time to Install Patch (minutes) 30

Patch Leveled with Surrounding Pavement: Yes ✓, No ___

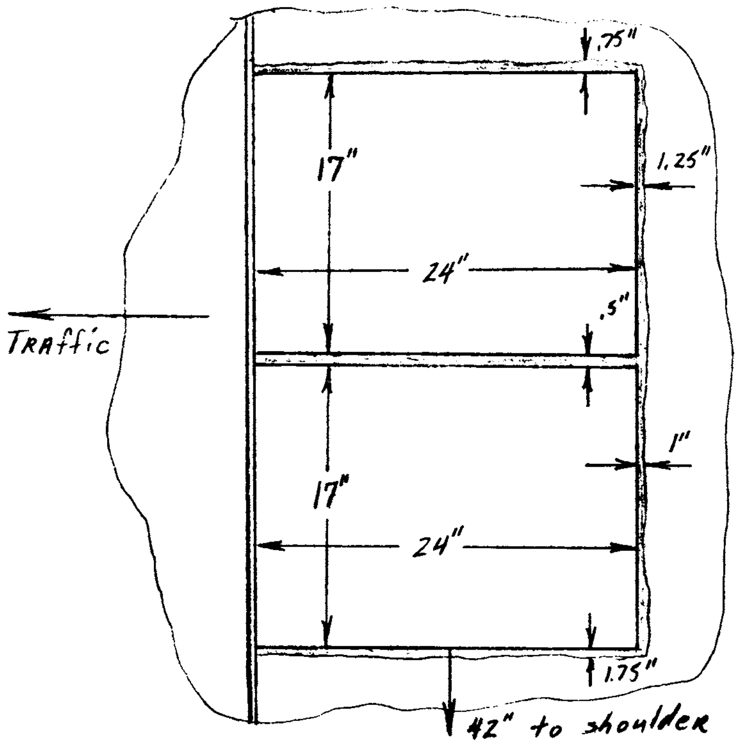
Second Photograph taken with Patch Number Showing: (check) ✓

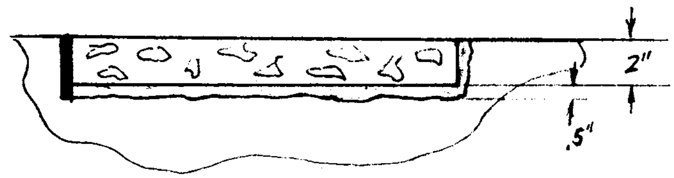
Photographer M. Pugh

Total length of time to install patch (length of time for cutting hole + length of time for placing patch 112

Over

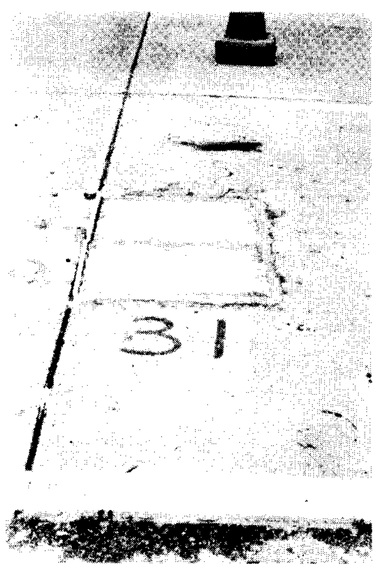
Draw sketch of patch including all dimensions — especially interested in crack width between patch and surrounding pavement.



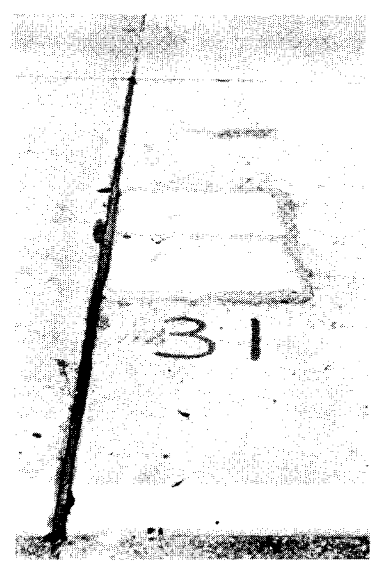


scale : 1" ≅ 1'

HOLE CUT AND CLEANED



PATCH INSTALLED



JOINT SAWED AND SEALER INSTALLED

LARGE MACHINE
BOTTOM PAINTED

Figure A-2
Data Form for Precast Patching Experiment
Route 44 — Virginia Beach, Virginia

(1 Form for Each Patch)

Data Recorder M. PUGH

AIR - 84°

Date JUNE 5, 1974 Temperature CONCRETE 110°

Locational Information

Patch Number 3

Route Number 44

Location: Lane TRAFFIC Direction WEST BOUND

Description of Location 25' east of "Speed checked by RADAR" sign west of PARK St.

Condition of the Pavement: (check one) Wet ____ Dry ✓

MP 12.11
SN 8

Hole Cutting Information

Dimension of Hole: Length (inches) 36 Width (inches) 25 Depth (inches) 3

Length of Time to Cut Hole (minutes) 82 CUT 1:13 - 2:06
ADJUSTMENT 1:16 - 1:20; 1:29 - 1:33
HAND 19 min

Check Following: 53 + 19 + 10

Hole Cleaned ✓
Level of Bottom of Hole Checked ✓
If Bottom of Hole not Level - Degrees Off Level ____

First Photograph Taken: (check) ✓ Photographer F. PHILPOTT

Was Klarcrete machine able to remove wire mesh: Yes ____, No ✓ Did not penetrate deep enough to come in contact with ________. If answer is no, how long did it take to roll the machine off the hole, cut the wire out ~~and reposition~~ (minutes) 10 MIN

Patch Installation Information

Type of Cementing Material Used INDUSTRIAL COATING, MEETS AASHO M 200 65

Size of Patch: Length (inches) 36 Width (inches) 24 Depth (inches) 2

Length of Time to Install Patch (minutes) 31 (4:16 - 4:47)

Patch Leveled with Surrounding Pavement: Yes ✓, No ____

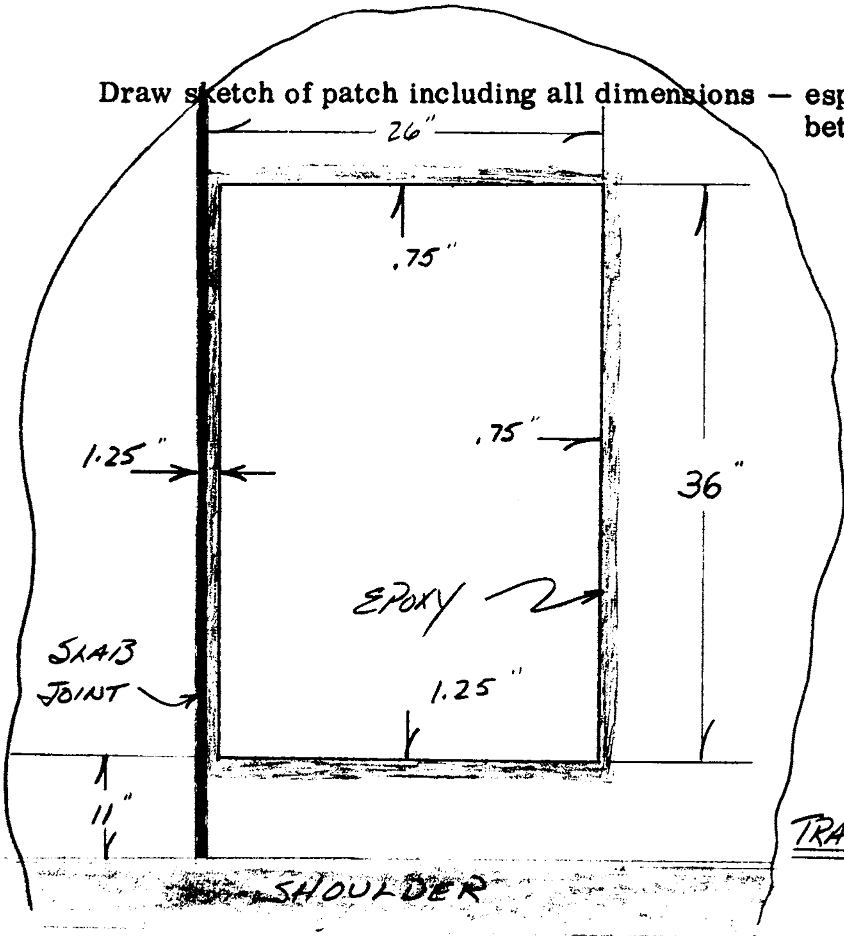
Second Photograph taken with Patch Number Showing: (check) ✓

Photographer F. PHILPOTT

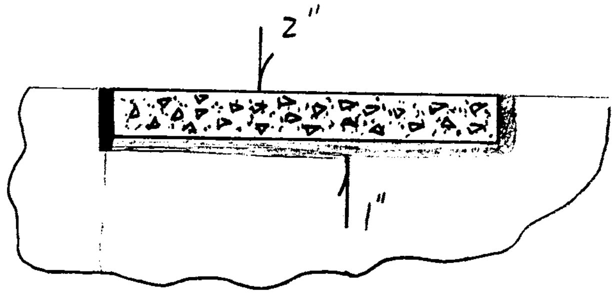
Total length of time to install patch (length of time for cutting hole + length of time for placing patch 113

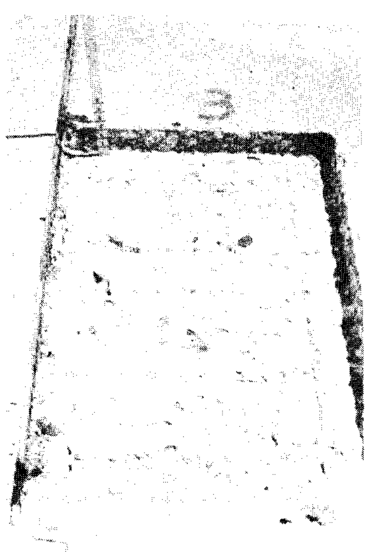
Over

Draw sketch of patch including all dimensions — especially interested in crack width between patch and surrounding pavement.

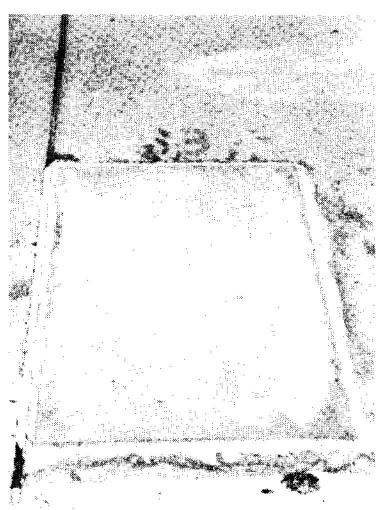


SCALE: 1" = 1'





HOLE CUT AND CLEANED



PATCH INSTALLED

JOINT SAWED AND SEALER INSTALLED.

LARGE MACHINE
BOTTOM PAINTED

953

Figure A-3
Data Form for Precast Patching Experiment
Route 44 — Virginia Beach, Virginia

(1 Form for Each Patch)

Data Recorder M. PUGH

AIR — 77° F

Date JUNE 18, 1974 Temperature CONCRETE 112°F

Locational Information

Patch Number 46
Route Number 44
Location: Lane TRAFFIC Direction WEST BOUND
Description of Location 200' east of end of acceleration lane from Birdneck Rd.
Condition of the Pavement: (check one) Wet____ Dry ✓ MP 11.38 SN 64

Hole Cutting Information

Dimension of Hole: Length (inches) 36 Width (inches) 25.5 Depth (inches) 2.5
Length of Time to Cut Hole (minutes) 57 SET-UP: 6:40 - 7:02 CUTTING: 7:02 - 7:35 HAND: 2 min
Check Following: 22 + 33 + 2
Hole Cleaned ____
Level of Bottom of Hole Checked ____
If Bottom of Hole not Level - Degrees Off Level ____
First Photograph Taken: (check) ✓ Photographer M. PUGH
Was Klarcrete machine able to remove wire mesh: Yes____, No ✓ Did not penetrate deep enough to come in contact with______. If answer is no, how long did it take to roll the machine off the hole, cut the wire out and reposition (minutes) 2 MIN.

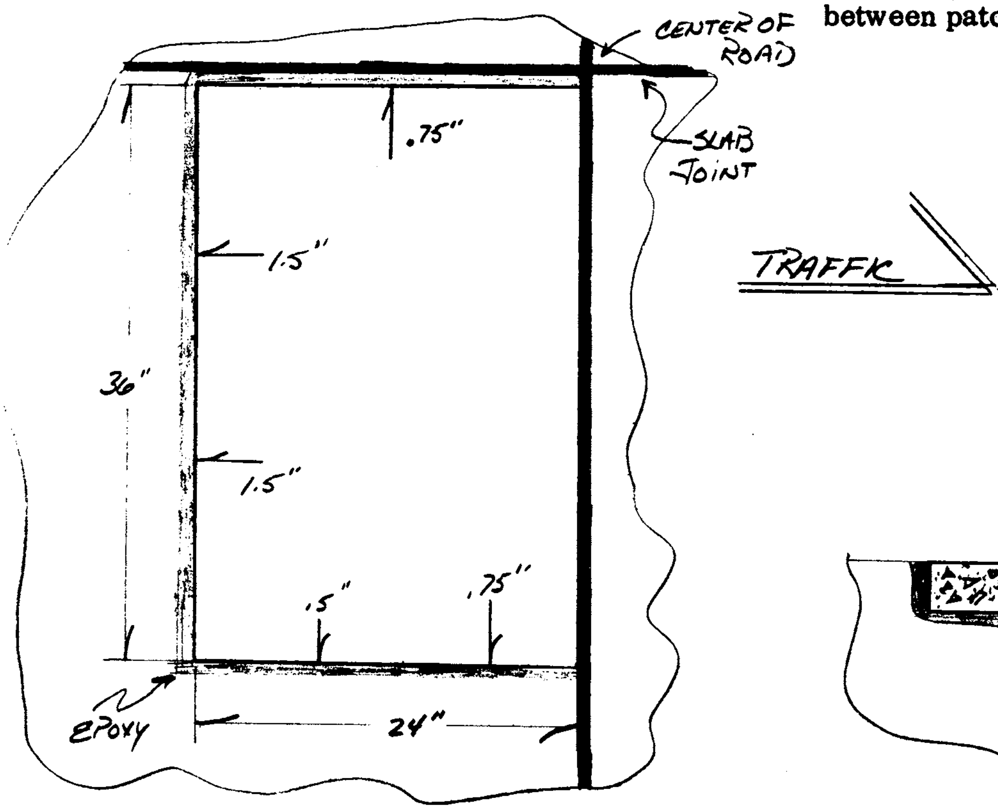
Patch Installation Information

Type of Cementing Material Used Industrial Coating, Resin & Catalyst; Meets AASHO M 200 65
Size of Patch: Length (inches) 36 Width (inches) 24 Depth (inches) 2
Length of Time to Install Patch (minutes) 18 12:55 - 1:13
Patch Leveled with Surrounding Pavement: Yes ✓, No____
Second Photograph taken with Patch Number Showing: (check) ✓
Photographer F. PHILPOTT
Total length of time to install patch (length of time for cutting hole + length of time for placing patch 75

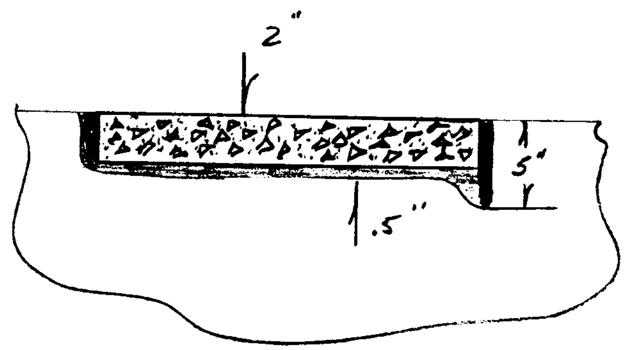
Over

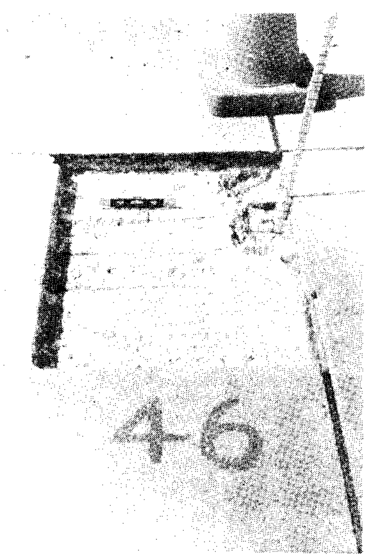
954

Draw sketch of patch including all dimensions — especially interested in crack width between patch and surrounding pavement.

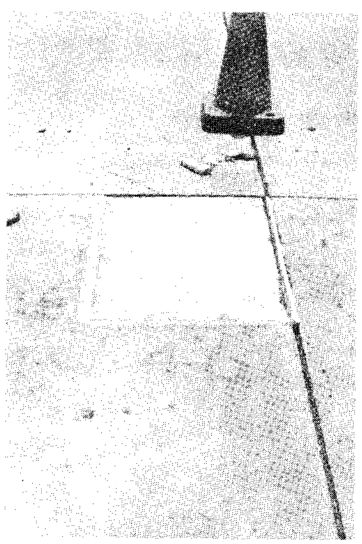


SCALE: 1" = 1'

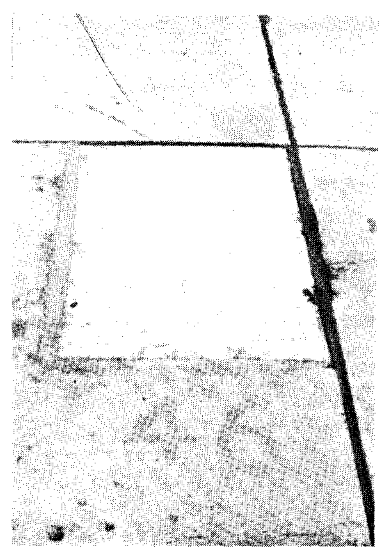




HOLE CUT AND CLEANED



PATCH INSTALLED

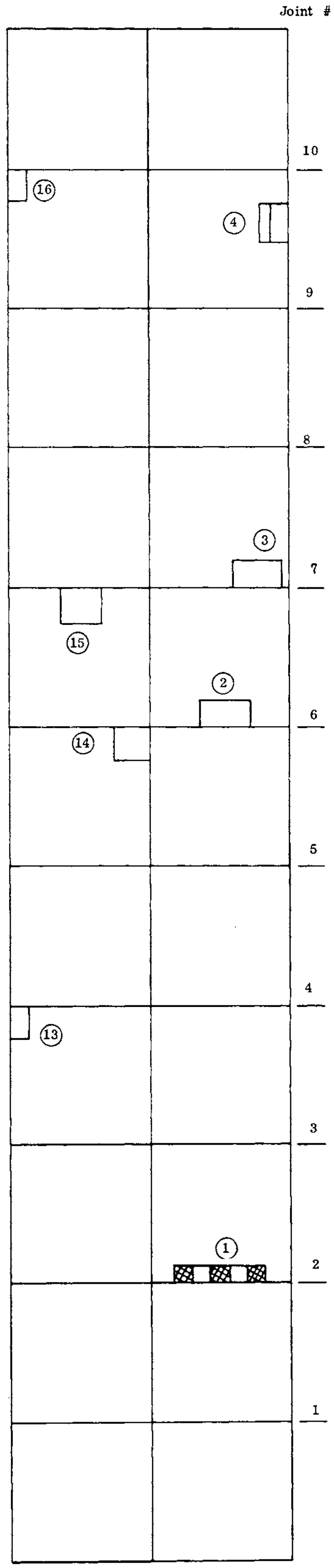


JOINT SAWED AND SEALER INSTALLED.

FIGURE A-4

LOCATIONAL LOG FOR PRECAST PATCHING

RT. 44 VA. BEACH - NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974



(16) Located in front of closed off road in park; mp. 12.07; SN 10; 1' x 2' (.3m x .61m)

(4) Located in front of closed off road in park; mp. 12.07; SN 10; 1.5' x 2' (.45m x .61m)

(3) 25 feet east "Speed Checked By Radar" sign; mp. 12.11; SN 7; 2' x 2' (.61m x .91m)

(15) 25 feet east "Speed Checked By Radar" sign; mp. 12.11; SN 7; 2' x 2' (.61m x .61m)

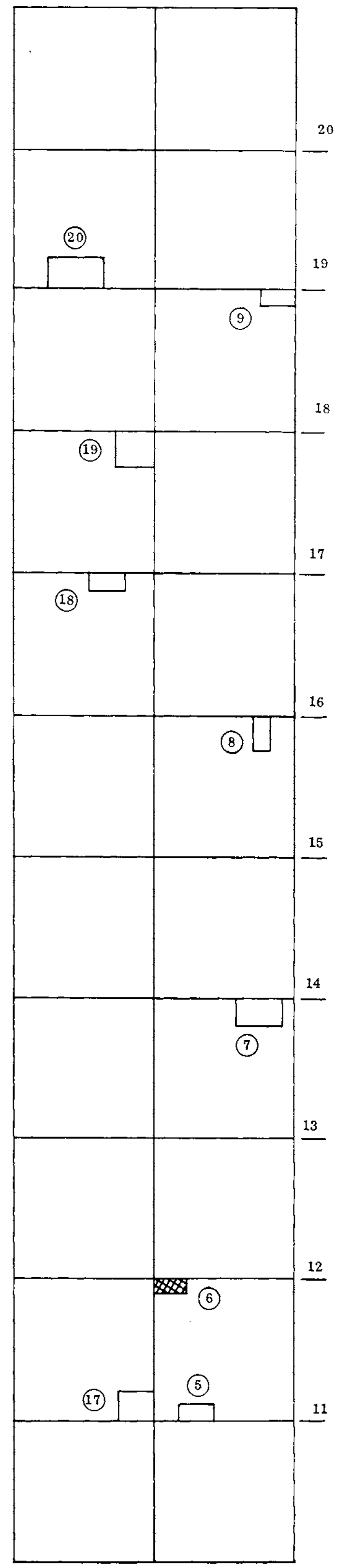
(2) 100 feet east "Speed Checked By Radar" sign; mp. 12.12; SN 7; 2' x 3' (.61m x .91m)

(14) 100 feet east "Speed Checked By Radar" sign; mp. 12.12; SN 6; 2' x 2' (.61m x .61m)

(13) 300 feet west of Park St.; mp. 12.14; SN 4; 1' x 2' (.3m x .61m)

(1) 250 feet west of Park St.; mp. 12.16; SN 3; 1' x 10' (.3m x 3m)

Wirand



(20) Just past Rt. 44 & Expressway signs; mp. 11.96; SN 20; 2' x 3' (.61m x .91m)

(9) Just past Rt. 44 & Expressway signs; mp. 11.96; SN 19; 1 x 2 (.3m x .61m)

(19) Directly opposite Rt. 44 & Va. Beach Expressway signs; mp. 11.97; SN 18; 1' x 2' (.3m x .61m)

(18) 60 feet east Rt. 44 west & Va. Beach Expressway signs; mp. 11.99; SN 17; 1' x 2' (.3m x .61m)

(8) 150 feet east Rt. 44 west & Va. Beach Expressway signs; mp. 12.00; SN 16; 1' x 2' (.3m x .61m)

(7) 150 feet east end of guardrail, Birdneck Road overpass; mp 12.02; SN 14; 2' x 3' (.61m x .91m)

(6) 270 feet east end of guardrail, Birdneck Road overpass; mp. 12.04; SN 12; 1' x 2' (.3m x .61m)

(17) Same as patch 5; 2' x 2' (.61m x .61m)

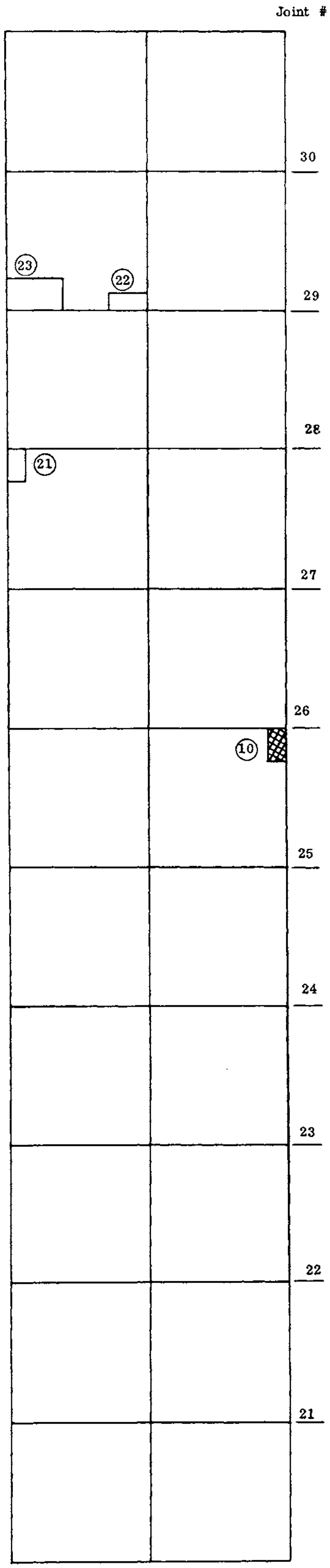
(5) 75 feet west closed of road in park; mp. 12.06 ; Slab 12; 1'x 2' (.3m x .61m)

PARK STREET

mp 12.19

FIGURE A-4 continued

LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH - NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974

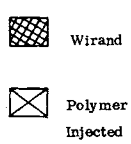


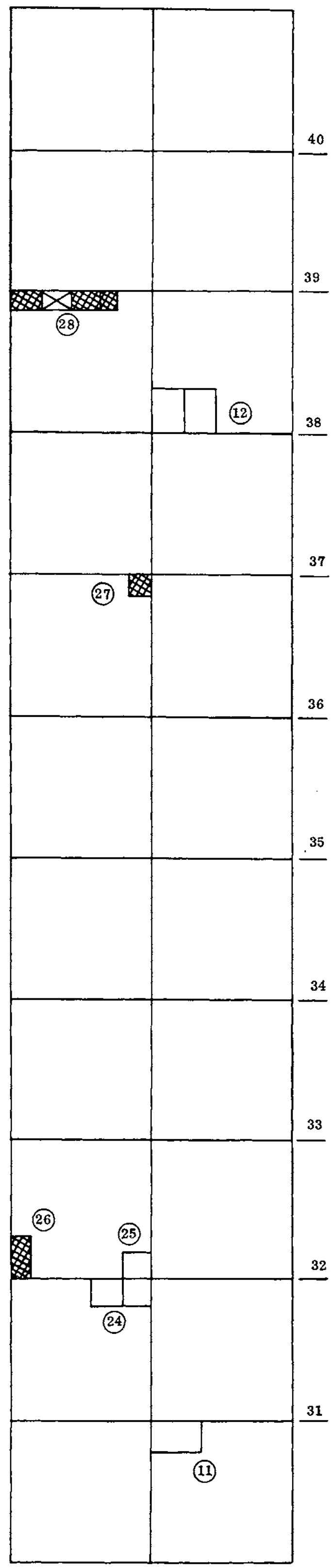
(23) 240 feet east of Rt. 64 & Norfolk mileage sign; mp. 11.84; SN 30; 2' x 3' (.61m x .91m)

(22) Same as patch 23; 1' x 2' (.3m x .61m)

(21) 300 feet east of Rt. 64 & Norfolk mileage sign; mp. 11.85; SN 28; 1' x 2' (.3m x .61m)

(10) 510 feet west of Rt. 44 & Va. Beach-Norfolk Expressway west sign; mp. 11.87; SN 26; 1' x 2' (.3m x .61m)





(28) East end of bridge. Birdneck overpass; mp. 11.71; SN 39; 1' x 7' (.3m x 2.1m)

(12) 60 feet east end of bridge; Bird-neck overpass; mp. 11.71; SN 39; 3' x 4' (.91m x 1.2m)

(27) 150 feet east end of bridge; Birdneck overpass; mp. 11.74; SN 37; 1' x 1' (.3m x .3m)

(26) 60 feet east of Rt. 64 & Norfolk mileage signs; mp. 11.80; SN 33; 1' x 2' (.3m x .61m)

(25) Same as patch 26; 1.5' x 2' (.45m x .61m)

(24) 60 feet east of Rt. 64 & Norfolk mileage signs. mp. 11.80; SN 32; 1.5' x 4' (.45m x 1.2m)

(11) 120 feet east Rt. 64 & Norfolk mileage signs; mp. 11.81; SN 31; 2' x 3' (.61m x .91m)

FIGURE A-4 continued

LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH — NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974

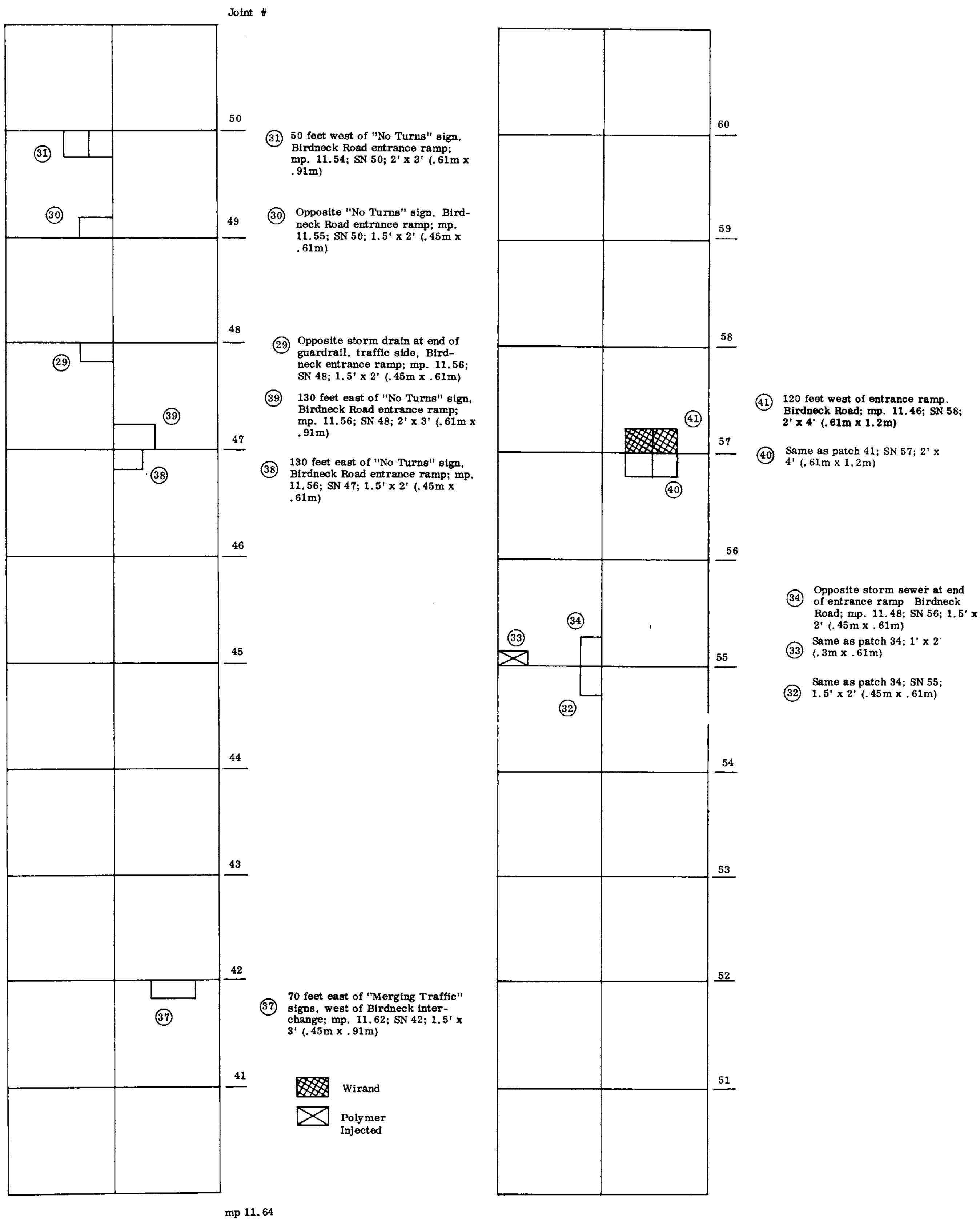


FIGURE A-4 continued

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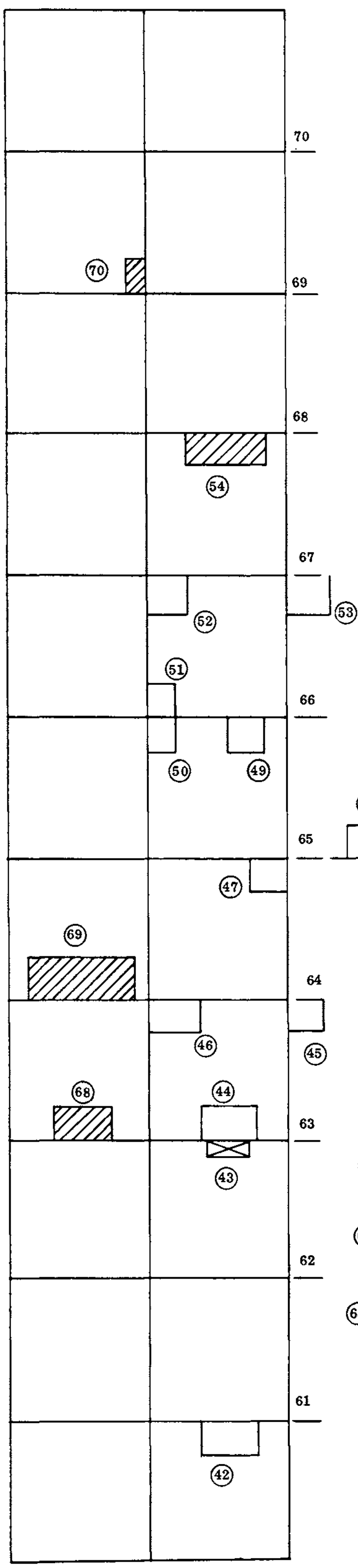
LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH — NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974



(70) 120 feet west end of acceleration lane, 120 feet west drain culvert; mp. 11.33; SN 69; 1' x 2' (.3m x .61m)

(54) 120 feet west of storm sewer opposite Birdneck Rd. exit sign, eastbound lane; mp. 11.33; SN 68; 2' x 6' (.61m x 1.8m)

(53) End of acceleration lane, Birdneck Interchange, acceleration lane; mp. 11.34; SN 67; 2' x 2' (.61m x .61m)

(52) Same as patch 53; in traffic lane

(51) 50 feet east end of acceleration lane, Birdneck Rd. interchange; mp. 11.35; SN 67; 1.5' x 2' (.45m x .61m)

(50) Same location as patch 51; SN 66; 1.5' x 2' (.45m x .61m)

(49) Same as patch 50; 2' x 2' (.61m x .61m)

(48) 150 feet east end of acceleration lane; Birdneck interchange; mp. 11.37; SN 66; 2' x 3' (.61m x .91m)

(47) Same location as patch 48; SN 65; 2' x 2' (.61m x .61m)

(46) 200 feet east end acceleration lane, Birdneck interchange; mp. 11.38; SN 64; 2' x 3' (.61m x .91m)

(45) Same as patch 46, in acceleration lane; 1.5' x 2' (.45m x .61m)

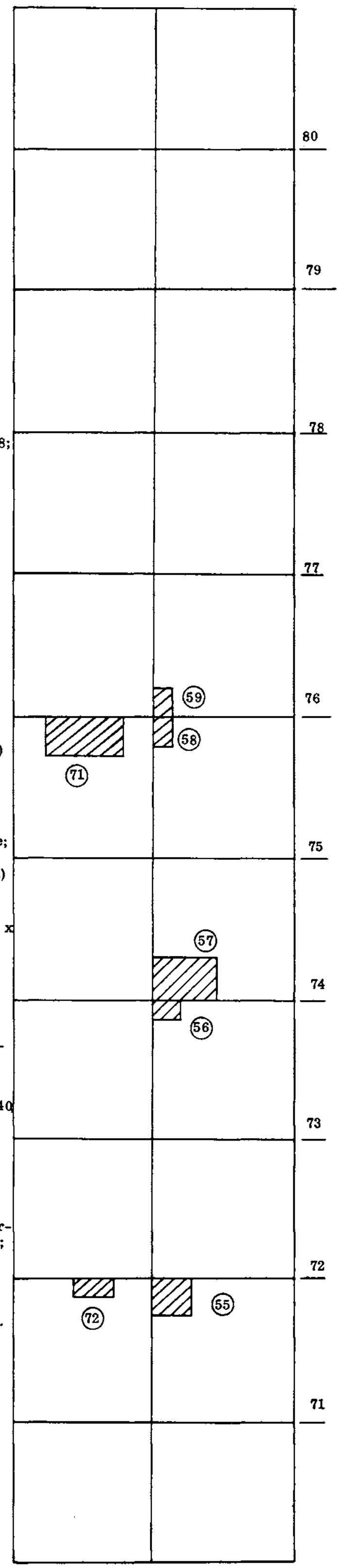
(44) 360 feet west of Gore acceleration ramp from Birdneck Rd.; mp. 11.40 SN 64; 2' x 3' (.61m x .91m)

(43) Same location as patch 44; SN 63; 1' x 2' (.3m x .61m)

(69) 420 feet west of beginning of acceleration lane Birdneck Rd.; mp. 11.39; SN 64; 3' x 6' (.91m x 1.8m)

(68) 360 feet west beginning of acceleration lane, Birdneck interchange; mp. 11.40; SN 63; 2' x 3' (.61m x .91m)

(42) 300 feet west of Gore acceleration lane, Birdneck Rd.; mp. 11.42; SN 61; 2' x 3' (.61m x .91m)



(59) Same location as patch 71; SN 77; 1.5' x 1' (.45m x .3m)

(58) Same as patch 71; 1.5' x 1' (.45m x .3m)

(71) **20 feet east of "Rt. 44 West" sign just before Great Neck Creek** Bridge; mp. 11.26; SN 76; 2' x 4' (.61m x 1.2m)

(57) 150 feet east "Rt. 44 West" sign; mp. 11.28; SN 75; 3' x 4' (.91m x 1.2m)

(56) Same location as patch 57; SN 74; 1.5' x 2' (.45m x .61m)

(55) Same as patch 72; 2' x 2' (.61m x .61m)

(72) 540 feet east of Great Neck Creek Bridge; mp. 11.28; SN 72; 1' x 2' (.3m x .61m)

Embeco

Polymer Injected

FIGURE A-4 continued

LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH — NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974

959

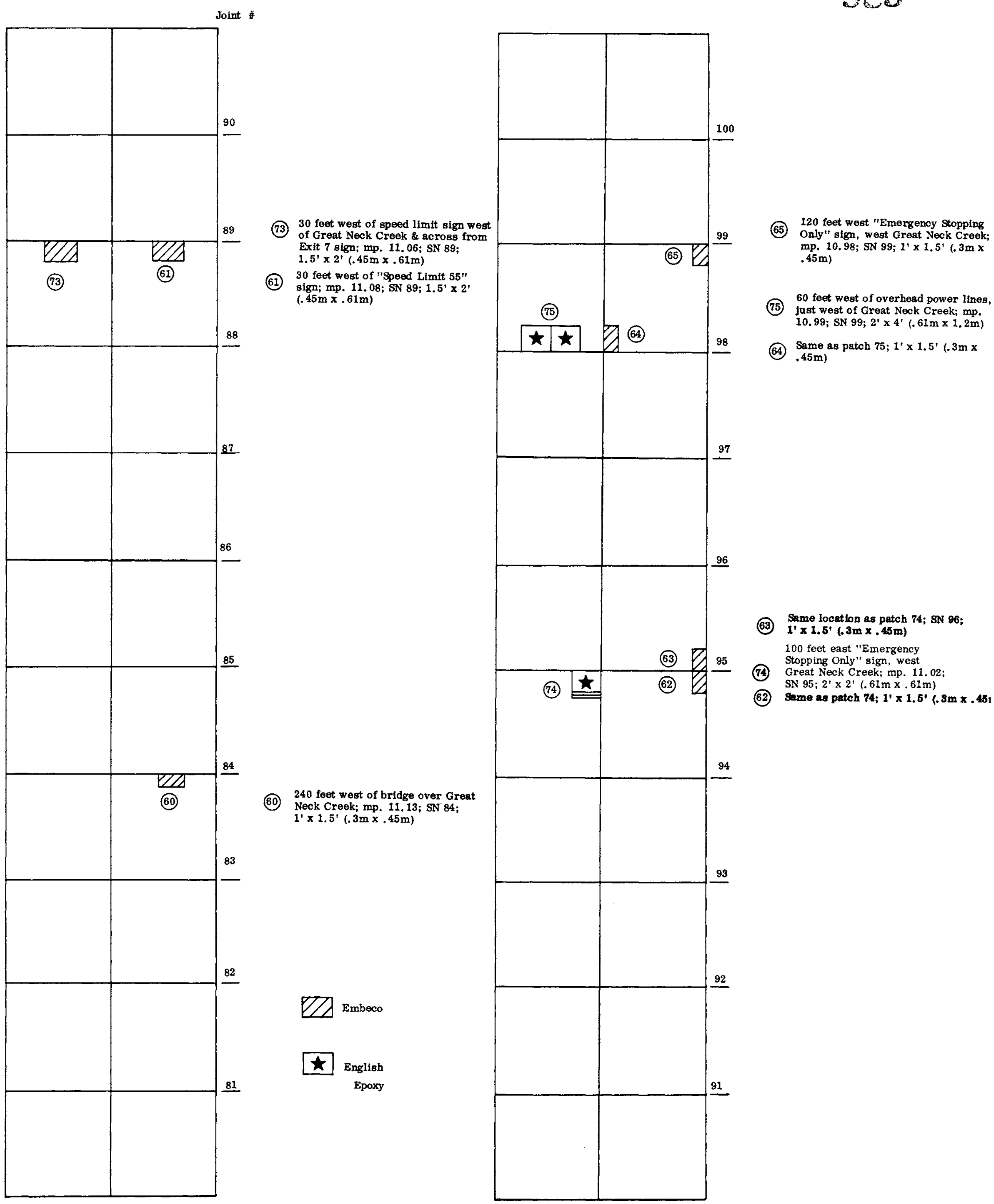


FIGURE A-4 continued

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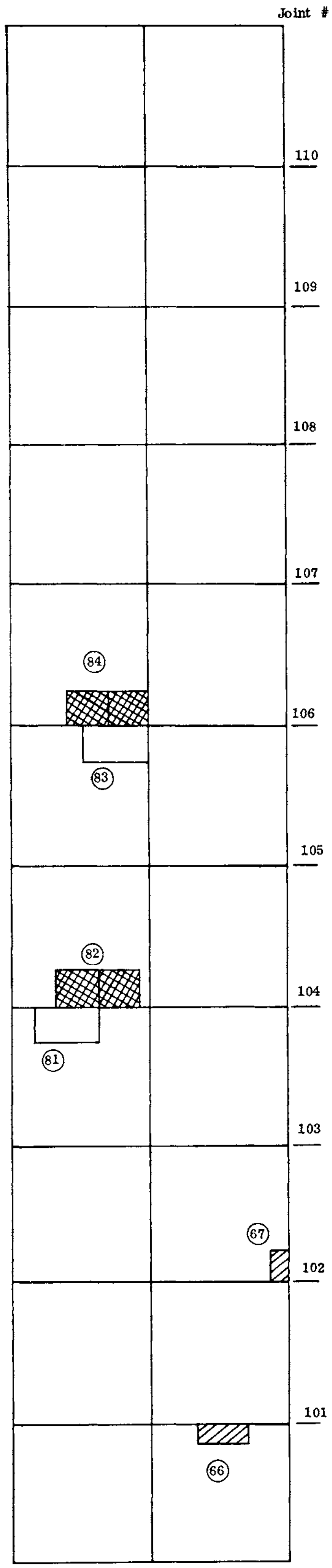
LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH — NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974



(84) 540 feet west "Emergency Stopping Only" sign; mp. 10.91; SN 107; 2' x 4' (.61m x 1.2m)

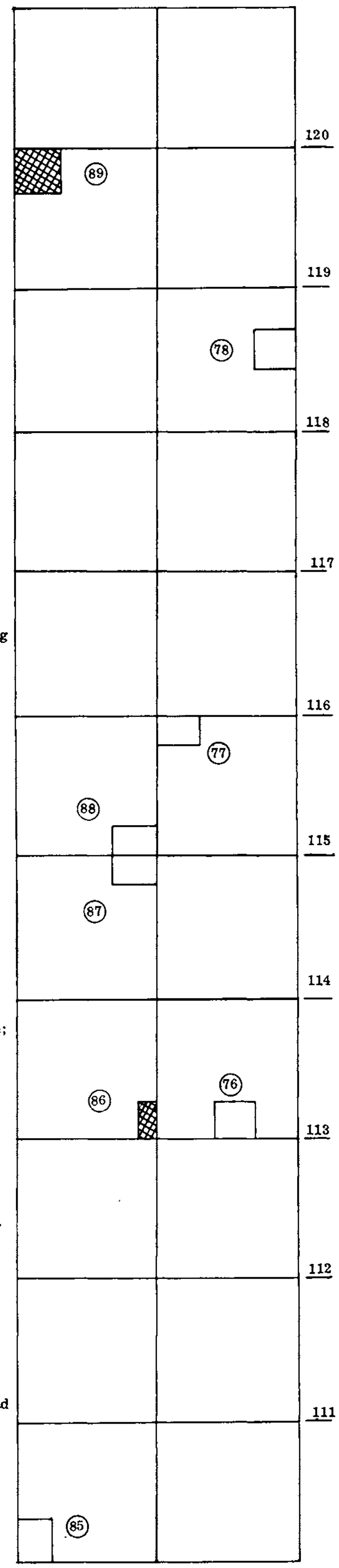
(83) Same location as 84; SN 106; 2' x 3' (.61m x .91m)

(82) 420 feet west "Emergency Stopping Only" sign; mp. 10.93; SN 105; 2" x 4' (.61m x 1.2m)

(81) Same location as patch 82; SN 104; 2' x 3' (.61m x .91m)

(67) 300 feet west of overhead power lines over Birdneck Rd., next exit sign; mp. 10.95; SN 103; 1' x 1.5' (.3m x .45m)

(66) 240 feet west of "Emergency Stopping Only" sign and overhead power line; mp. 10.96; SN 101; 1' x 2.5' (.3m x .61m)



(89) 1320 feet west of "Emergency Stopping Only" sign, west of Great Neck Creek; mp. 10.72 SN 120; 2' x 2' (.61m x .61m)

(78) 1250 feet west of "Emergency Stopping Only" sign; mp. 10.73; SN 119; 2' x 2' (.61m x .61m)

(77) 1180 feet west "Emergency Stopping Only" sign; mp. 10.75; SN 116; 1.5' x 2' (.45m x .61m)

(88) 1100 feet west "Emergency Stopping Only" sign; mp. 10.74; SN 116; 1.5' x 2' (.45m x .61m)

(87) Same location as patch 88; SN 115; 1.5' x 2' (.45m x .61m)

(86) 1000 feet west "Emergency Stopping Only" sign; mp. 10.76; SN 114; 1' x 2' (.3m x .61m)

(76) Same as patch 86; 2' x 2' (.61m x .61m)

(85) 850 feet west "Emergency Stopping Only" sign; mp. 10.79; SN 111; 1.5' x 2' (.45m x .61m)

Wirand

Embeco

FIGURE A-4 continued

LOCATIONAL LOG FOR PRECAST PATCHING
RT. 44 VA. BEACH — NORFOLK EXPRESSWAY (WESTBOUND)
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 — JUNE 26, 1974

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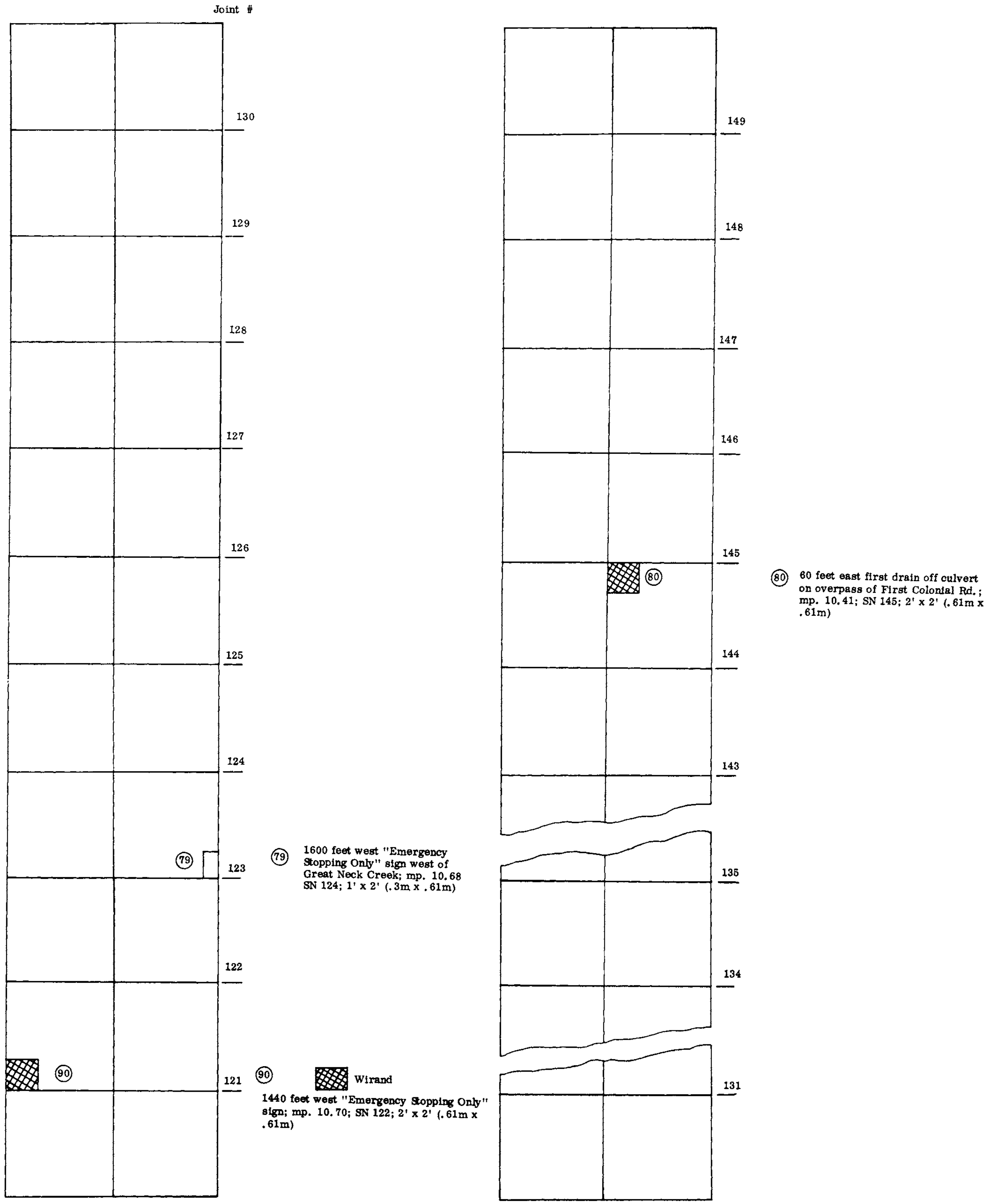

TABLE A-1

SUMMARY OF DATA

PRECAST PATCHING EXPERIMENT

RT. 44 VA. BEACH - NORFOLK EXPRESSWAY

BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD

JUNE 4 - JUNE 26, 1974

Patch #	Size Width In.	Size Width m	Size Length In.	Size Length m	Depth* In.	Depth* m	# Slab	Size of Slabs Width In.	Size of Slabs Width m	Size of Slabs Length In.	Size of Slabs Length m	Machine Set Up Time	+ Hole Cutting Time	+ Mixing Epoxy and Installing Patch	= Total	Type Cementing Material	Type Patch	Surface Temp.	Date Installed	Lane
1	12	.30	121.5	3.1	2.5	.06	3	12	.30	24	.61	30	150	40	220 min.	**Industrial Coating	Wirand	104°F 40°C	6/4	Traffic
							2	12	.30	23.5	.60									
							5													
2	24.5	.62	36	.91	2.5	.06	1	24	.61	35.5	.90	15	25	20	60 min.	"	***Hyd. Pres.	104°F(40°C)	6/4	"
3	25	.63	36	.90	3	.08	1	24	.61	36	.90	15	82	31	128 min.	"	"	110°F(43°C)	6/5	"
4	18.5	.47	25	.63	2.5	.06	1	5.5	.21	23.5	.60	30	19	10	59 min.	"	"	108°F(42°C)	6/4	"
							1	12	.30	23.5	.60									
							2													
5	14	.36	24.5	.62	2.5	.06	1	12	.30	23.5	.60	30	18	12	60 min.	"	"	106°F(41°C)	6/4	"
6	13	.33	24	.61	3	.08	1	12	.30	23	.58	17	18	16	51 min.	"	Wirand	108°F(42°C)	6/6	"
7	25	.63	36	.90	2.5	.06	1	23.5	.60	34.5	.88	30	105	15	150 min.	"	Hyd. Pres.	99°F(37°C)	6/5	"
8	12.5	.32	22	.56	2.5	.06	1	12	.30	22	.56	30	17	12	59 min.	"	"	112°F(44°C)	6/6	"
9	13	.33	22.5	.58	2.5	.06	1	12	.30	22	.56	9	27	15	51 min.	"	"	112°F(44°C)	6/6	"
10	12.5	.32	22.5	.57	2.5	.06	1	12	.30	23	.58	10	23	12	45 min.	"	Wirand	110°F(43°C)	6/6	"
11	23.5	.60	35.5	.90	2.5	.06	1	22.5	.58	34	.86	30	42	20	92 min.	"	Hyd. Pres.	110°F(43°C)	6/6	"
12	36	.91	47	1.2	2.25	.05	2	23	.58	35	.89	30	58	45	133 min.	"	"	110°F(43°C)	6/6	"
13	13.5	.35	24	.61	2.5	.06	1	12	.30	22	.56	30	23	20	73 min.	"	"	125°F(52°C)	6/10	Passing
14	23	.58	25	.63	3	.08	1	22.5	.58	24	.61	8	34	22	64 min.	"	"	105°F(41°C)	6/10	"
15	22	.56	23.5	.60	2.5	.06	1	21.5	.55	24	.61	30	33	15	78 min.	"	"	111°F(44°C)	6/10	"
16	13.5	.35	25	.63	2.5	.06	1	12	.30	23.5	.60	10	23	20	53 min.	"	"	120°F(49°C)	6/10	"
17	23.5	.60	25	.63	2.5	.06	1	23	.58	24	.61	6	35	25	66 min.	"	"	120°F(49°C)	6/10	"
18	13	.33	22	.56	2.5	.06	1	12	.30	22	.56	9	17	11	37 min.	"	"	120°F(49°C)	6/10	"
19	23	.58	25	.64	2.5	.06	1	22.5	.57	24	.61	30	45	14	89 min.	"	"	120°F(49°C)	6/10	"
20	25	.64	35	.89	2.25	.05	1	24	.61	34	.86	30	45	34	109 min.	"	"	87°F(30°C)	6/11	"
21	13.5	.35	23	.58	2.25	.05	1	12	.30	22	.56	10	41	12	63 min.	"	"	90°F(32°C)	6/11	"
22	13	.33	22.5	.58	2.5	.06	1	12	.30	22	.56	30	45	17	92 min.	"	"	102°F(39°C)	6/11	"
23	25	.64	36	.91	2.75	.07	1	24	.61	34.5	.88	30	41	15	86 min.	"	"	102°F(39°C)	6/11	"
24	18	.46	48.5	1.2	2.5	.06	2	17	.43	23.5	.60	23	59	20	102 min.	"	"	100°F(38°C)	6/12	"
25	18	.46	24	.61	2.5	.06	1	17	.43	23.5	.60	3	32	20	55 min.	"	"	116°F(47°C)	6/12	"
26	14.5	.37	25.5	.65	2.5	.06	1	12	.30	24	.60	26	39	6	71 min.	"	Wirand	87°F(30°C)	6/12	"
27	12.5	.31	13	.33	2.5	.06	1	12	.30	12	.30	20	21	15	56 min.	"	"	104°F(40°C)	6/12	"
28	13	.33	87	2.2	2.5	.06	2	12	.30	24	.60	39	87	23	146 min.	"	"			
							1	12	.30	12	.30					"	Polymer			
							1	12	.30	24	.60					"	Injected			
							4													
29	18.5	.47	24	.61	2.5	.06	1	17	.43	24	.61	30	38	15	83 min.	"	Hyd. Pres.	83°F(28°C)	6/13	"
30	18	.46	25	.64	2.5	.06	1	17	.43	24	.61	6	49	15	70 min.	"	"	82°F(28°C)	6/13	"
31	25	.64	36	.91	2.5	.06	1	24	.61	34.5	.88	25	57	30	112 min.	"	"	108°F(42°C)	6/13	"
32	18	.46	24.5	.62	2.5	.06	1	17	.43	24	.61	7	32	10	49 min.	"	"	107°F(42°C)	6/13	"
33	13.5	.35	24.5	.62	2.5	.06	1	12	.30	24	.61	38	33	5	76 min.	"	Polymer Injected	102°F(39°C)	6/13	"
																"				
34	18	.46	24.5	.62	2.5	.06	1	17	.43	24	.61	9	43	10	62 min.	"	Hyd. Pres.	102°F(39°C)	6/13	"
35	19	.48	25	.64	3	.08	-	-	-	-	-	16	45	10	71 min.	-	Embeco	104°F(40°C)	6/20	"
36	25.5	.66	50	1.3	2	.04	-	-	-	-	-	21	37	11	69 min.	-	"	104°F(40°C)	6/20	"
37	19	.48	37.5	.94	2.5	.06	1	18	.46	36	.91	41	51	20	112 min.	Industrial Coating	Hyd. Pres.	88°F(31°C)	6/14	Traffic
38	18.5	.47	24.5	.62	2.5	.06	1	17	.43	24	.61	20	39	12	71 min.	"	"	102°F(39°C)	6/14	"
39	24	.61	36.5	.92	2.5	.06	1	24	.61	36	.91	10	69	25	104 min.	"	"	103°F(39°C)	6/14	"
40	25	.64	50	1.3	2.5	.06	2	24	.61	24	.61	20	67	30	117 min.	"	"	87°F(31°C)	6/17	"
41	25.5	.65	49.5	1.3	2.5	.06	2	24	.61	24	.61	23	47	36	106 min.	"	Wirand	124°F(51°C)	6/14	"
42	25	.64	36	.91	2.5	.06	1	24	.61	34	.86	15	27	23	65 min.	"	Hyd. Pres.	82°F(28°C)	6/17	"
43	14	.36	25	.64	2.5	.06	1	12	.30	23	.58	6	38	12	56 min.	"	Polymer Injected	112°F(44°C)	6/17	"
44	25	.64	36	.91	2.5	.06	1	24	.61	34	.86	8	26	25	59 min.	"	Hyd. Pres.	112°F(44°C)	6/17	"
45	18	.46	24.5	.62	2.25	.05	1	16.5	.42	24	.61	12	29	15	56 min.	"	"	112°F(44°C)	6/18	Accel. Traffic
46	25.5	.65	36	.91	2.5	.06	1	24	.61	36	.91	22	35	18	75 min.	"	"	"	6/18	
47	23.5	.60	25.5	.65	2.5	.06	1	22	.56	25	.63	25	38	12	75 min.	"	"	"	6/18	"
48	25	.64	36	.91	2.5	.06	1	24	.61	34	.86	7	30	13	50 min.	"	"	"	6/18	"
49	22.5	.57	25.5	.65	2.5	.06	1	22	.56	24	.61	15	33	13	61 min.	"	"	"	6/18	"
50	18	.46	24	.61	2.25	.05	1	17	.43	24	.61	5	26	6	37 min.	"	"	"	6/18	"
51	19	.48	25	.64	2.75	.07	1	17	.43	24	.61	15	31	10	56 min.	"	"	"	6/18	"
52	24	.61	26	.66	2.5	.06	1	23	.58	23.5	.60	7	38	8	53 min.	"	"	"	6/18	"
53	24	.61	26	.66	2.5	.06	1	23	.58	23.5	.60	15	38	57	110 min.	"	"	"	6/18	"
54	25.5	.65	72	1.8	2.5	.06	-	-	-	-	-	26	141	34	201 min.	-	Embeco	"	6/18&19	Accel. Traffic
55	24	.61	26	.66	2.5	.06	-	-	-	-	-	10	38	15	63 min.	-	"	"	6/19	
56	19.5	.49	23.5	.60	2	.05	-	-	-	-	-	7	31	8	46 min.	-	"	110°F(43°C)	6/19	"
57	37	.94	50	1.3	2	.05	-	-	-	-	-	14	45	15	74 min.	-	"	"	6/19	"
58	18	.46	25	.64	2.5	.06	-	-	-	-	-	3	37	11	51 min.	-	"	"	6/19	"
59	18	.46	25	.64	2.5	.06	-	-	-	-	-	13	32	11	56 min.	-	"	"	6/19	"
60	13.5	.35	18	.46	2.75	.07	-	-	-	-	-	9	22	7	38 min.	-	"	"	6/19	"
61	19	.48	24.5	.62	2.5	.06	-	-	-	-	-	25	49	9	83 min.	-	"	"	6/19	"
62	13.5	.35	21	.53	2	.05	-	-	-	-	-	25	15	8	48 min.	-	"	"	6/19	"
63	13.5	.35	18.5	.47	2	.05	-	-	-	-	-	25	15	8	48 min.	-	"	"	6/19	"
64	13	.33	18	.46	2	.05	-	-	-	-	-	17	28	7	53 min.	-	"	"	6/19	"
65	13	.33	19	.48	2.5	.06	-	-	-	-	-	17	12	4	33 min.	-	"	"	6/19	"

*All precast patches cast at 2" thickness

**Resin & Catalyst; Meets AASHO M 200 65

***Hydraulically Pressed

TABLE A-1 continued

SUMMARY OF DATA
PRECAST PATCHING EXPERIMENT
RT. 44 VA. BEACH - NORFOLK EXPRESSWAY
BETWEEN PARK STREET & VICINITY OF FIRST COLONIAL ROAD
JUNE 4 - JUNE 26, 1974

Patch #	Size				Depth*		# Slabs	Size of Slabs				Length of Time to Install Patch				Type	Type Patch	Surface Temp.	Date Installed	Lane
	Width		Length					Width		Length		Machine Set Up Time +	Hole Cutting Time +	Mixing Epoxy and Installing Patch =	Total	Cementing Material				
	In.	m	In.	m	In.	m		In.	m	In.	m									
66	13.5	.34	31.5	.79	2.5	.06	-	-	-	-	-	12	17	9	38 min.	-	"	"	6/19	"
67	13.5	.34	19	.48	2.5	.06	-	-	-	-	-	14	20	11	45 min.	-	"	"	6/19	"
68	25	.64	36.5	.92	2.5	.06	-	-	-	-	-	15	96	15	126 min.	-	"	$90^{\circ}F(32^{\circ}C)$	6/20	Passing
69	37	.94	76.5	1.9	2.5	.06	-	-	-	-	-	25	95	17	137 min.	-	"	$110^{\circ}F(43^{\circ}C)$	6/20	"
70	14.5	.37	27	.69	2.25	.05	-	-	-	-	-	23	67	5	95 min.	-	"	$104^{\circ}F(40^{\circ}C)$	6/20	"
71	26	.66	49.5	1.3	2.5	.06	-	-	-	-	-	19	33	16	68 min.	-	"	"	6/20	"
72	11.5	.29	24.5	.62	2	.05	-	-	-	-	-	8	65	6	79 min.	-	"	"	6/20	"
73	19	.48	27	.69	2	.05	-	-	-	-	-	24	33	5	62 min.	-	"	$135^{\circ}F(58^{\circ}C)$	6/20	"
74	25	.64	28	.71	2.5	.06	1	23	.58	24	.61	22	43	20	85 min.	Dupoxy	Hyd. Pres.	$106^{\circ}F(42^{\circ}C)$	6/21	"
							1	1.5	.04	24	.61									
							1	2	.05	24	.61									
							3													
75	25	.64	48.5	1.2	2.5	.06	2	24	.61	24	.61	14	45	34	93 min.	"	"	"	6/21	"
76	22.5	.57	25	.64	2.5	.06	1	22	.56	24	.61	14	38	14	66 min.	"	"	$95^{\circ}F(35^{\circ}C)$	6/25	Traffic
77	19	.48	25.5	.65	2.5	.06	1	17	.43	24	.61	10	52	10	72 min.	Industrial Coating	"	"	6/25	"
78	24.5	.63	27	.69	2.5	.06	1	24	.61	24	.61	20	34	10	64 min.	"	"	"	6/25	"
79	14.5	.37	25	.64	2.5	.06	1	12	.30	24	.61	19	44	5	68 min.	"	Wirand	"	6/25	"
80	24	.61	25	.64	2.5	.06	1	24	.61	24	.61	15	40	10	65 min.	"	"	"	6/25	"
81	26	.66	36	.91	2.25	.05	1	24	.61	34	.86	17	35	12	64 min.	"	Hyd. Pres.	$100^{\circ}F(39^{\circ}C)$	6/26	Passing
82	25	.64	50	1.3	2.5	.06	2	24	.61	24	.61	15	42	19	76 min.	"	Wirand	"	6/26	"
83	25	.64	36.5	.93	2.5	.06	1	24	.61	34	.86	8	47	8	63 min.	"	Hyd. Pres.	"	6/26	"
84	25	.64	50.5	1.3	2.5	.06	2	24	.61	24	.61	6	45	19	70 min.	"	Wirand	"	6/26	"
85	19.5	.50	24	.61	2	.05	1	16.5	.42	23	.58	8	43	6	57 min.	"	Hyd. Pres.	"	6/26	"
86	13	.33	25	.64	2	.05	1	12	.30	24	.61	10	37	16	63 min.	"	Wirand	$98^{\circ}F(38^{\circ}C)$	6/26	"
87	18	.46	24.5	.63	2.5	.06	1	17.5	.45	24	.61	15	41	19	75 min.	"	Hyd. Pres.	"	6/26	"
88	18	.46	24.5	.63	2.5	.06	1	16.5	.42	24	.61	11	49	19	79 min.	"	"	"	6/26	"
89	24	.61	25	.64	2.5	.06	1	23	.58	24	.61	11	41	20	72 min.	"	Wirand	"	6/26	"
90	24	.61	25	.64	2.5	.06	1	23	.58	24	.61	18	35	10	63 min.	"	"	"	6/26	"

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