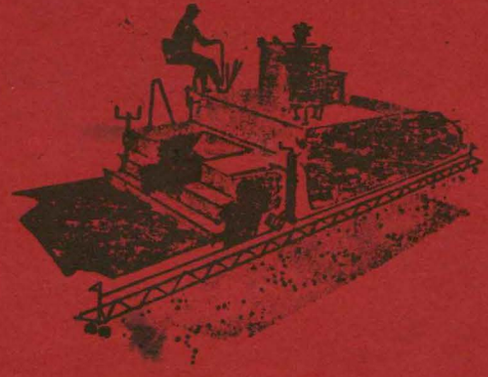
INSPECTOR'S HANDBOOK

RESURFACING
AND
ASPHALT CONCRETE PAVING



IOWA STATE HIGHWAY COMMISSION

AMES, IOWA

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RESURFACING
AND
ASPHALT CONCRETE PAVING

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Revised July 1971
Replaces Handbook for
Asphalt Concrete
Paving dated 1969

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INTRODUCTION

This handbook is an inspector's aid. It was written by an inspector to bring together all of the most-often-needed information involved in his work.

Much care has been taken to detail each phase of construction, with particular attention to the requirements and limitations of specifications. All applicable specification interpretations in Instructions to Resident Engineers have been included.

The beginning inspector should look to the handbook as a reference for standards of good practice. The Standard Specifications and Special Provisions should not, however, be overlooked as the basic sources of information on requirements and restrictions concerning workmanship and materials.

INSPECTION

Plans, Proposals, and Specifications

Inspectors must be furnished a set of plans, proposals, and specifications. Plans indicate length, width, and depth of various components, and provide information about quantities and procedures. The title sheet designates the applicable standard specification book by date.

The inspector should familiarize himself with plans and specifications, checking contract items and quantities to verify their accuracy. The proposal (or contract) designates applicable special provisions and other supplemental specifications by number and date.

The resident or county engineer should issue all of these documents to the chief inspector, the grade inspector, the plant inspector, and other key inspectors.

The individual inspector should have these copies with him in the field for ready reference.

Preconstruction Details

Before any construction work is started, the resident or county engineer and designated inspectors should converse with the contractor to ensure that specifications, limitations, materials, and equipment are fully agreed upon.

The inspector should check and verify that the contractor has enough signs and barricades in place (or available) when needed. The plans and signing specification will indicate the required signing arrangement.

There must be enough checkers and inspectors to examine the various phases of construction without undue delay to the contractor.

REPAIR AND PREPARATION OF OLD BASES FOR RESURFACING

Full Depth Patches

A full depth patch should be used when the broken concrete shows evidence of traffic distortion or mud pumping.

Irregular broken sections of slab should be carefully inspected for any sign of floating or pumping. This can usually be determined by observing the action of these sections under truck traffic. Any evidence of either floating or pumping is sufficient cause for the sections in question to be removed and replaced with full depth patching.

Broken areas at the edge of an old slab should be replaced with full depth patches. A full depth form should be used for the first section of any center patch which extends on both sides of the centerline.

Old reinforcing steel should be removed when asphalt concrete is used for full depth patches.

The 1/8 inch vertical tolerance for the completed patch should be carefully observed. All patches must be filled on the same day of removal.

Traffic should be kept off full depth asphalt concrete patches until the mix has cooled enough to not become distorted--usually overnight.

Cleaning and Removal

All vegetation, dirt, and other foreign material should be removed from the old base. On old concrete bases, all material which can be loosened with pick-axes or air compressor tools should be removed.

All flushed or fat bituminous material should be removed, with the following exception. On projects involving the resurfacing of old bituminous pavement which has had considerable maintenance with cold-mix patches and seal coats, it frequently happens that a considerable portion of the old surface is "flushed" due to fat (excess bitumen).

Experience has found that complete removal of all such flushed material is undesirable and impractical. For this reason, specifications have been revised to read:

> All existing bituminous material that is fat, unstable, or nonadherent to the pavement shall be removed, except on old flexible pavements only those cold-mix patches of sufficient depth to have distorted under normal traffic shall be removed.

For cleaning old flexible pavements, the operation usually involves scraping selected locations with a short blade (3 to 4 foot) on a motor patrol. The locations should be selected using distortion due to thick, fat bituminous patches as a basis--not flushing. The inspector should indicate the locations and check the thoroughness of scraping while it is being done. To facilitate safe traffic movement, the contractor should backfill the resulting hole with hot mixture on the same day scraping takes place. Scraped material should be picked up immediately, for it can become a traffic hazard.

Work should always be confined to one traffic lane. The adjacent lane should be free of obstructions to public vehicles.

If the old pavement is concrete, the guideline string area should be prepared by mowing the grass short along the pavement edge.

Surface Patches

Surface patches consist of hot mix asphalt concrete. They are used to replace undesirable material removed

during cleaning and removal operations. If the depression caused by removal is less than one inch deep, a surface patch is not required.

Considerable inspection effort should be directed toward ensuring conformation of surface patches to the vertical tolerance of adjacent pavement. All patches should be filled on the same day of removal. Patching should be completed before tack-coating is started in any area.

Tacking and Sanding

Refer to the Base Surface Temperature section of this handbook for measuring temperature limitations.

When the slab has been patched and is ready to receive the tack coat, the surface should be inspected carefully to ensure that the road is well-swept and free from all dirt.

All tack coats (except in inaccessible areas) should be applied with the distributor. Inaccessible areas can be tacked with hand spray. Spray bar nozzles must be small enough to permit a reasonably slow distributor speed--less than 20 mph.

Before permitting a Bituminous Distributor to be used, the inspector should check it according to the procedure described in the handbook for Surface Treatments and Bituminous Seal Coats.

A short section should be selected for trial when organizing to place a tack coat. This section should be just long enough to give an accurate check of:

1) the rate of application of bitumen and sand.
2) uniformity of coverage of the surface.
3) efficiency of the equipment.

For roads on which traffic is being maintained, the lineal footage tacked at any one time should be held to a distance which can be covered with sand in an elapsed time of not over 15 minutes. Good results are usually obtained with a sand cover of approximately 5 pounds or less per square yard. Sand in excess of the amount needed for a nonskid surface and to prevent soilage of vehicles is undesirable. Sand used for cover should follow specifications. A good job cannot be obtained with find sand.

LEVELING AND STRENGTHENING

Leveling courses are layers of asphalt concrete (variable in thickness) which are used to eliminate distortions in old pavement. Large areas are leveled with a finishing machine, smaller sections by hand methods.

Ride the highway at a moderate speed. Place stakes at the locations which need leveling.

The different thicknesses of asphalt concrete which might be needed are determined

by stringline. When more than one layer is needed, the lower layer should be constructed the full width of the pavement before a succeeding layer is constructed.

Strengthening courses are layers of asphalt concrete used to strengthen weak areas in old pavement. They are usually uniform in thickness and constructed with a finishing machine.

WEDGE COURSES FOR THE SUPERELEVATION OF CURVES WITH ASPHALT CONCRETE

Wedges of asphalt concrete are laid to put the desired thickness at the outside edge of the curve. Grade stakes showing the elevation of the top of the wedge at the outside edge of the curve are the basis for construction. They are used for alignment as well as elevation of the wedge. To ensure uniform practice throughout the state, the following methods should be used:

1) Drive hubs flush with the ground 5 feet from the outside edge of the base every 25 feet (centerline distance) to the end of each transition.
2) Put hubs at the P.C. and the P.T. The hubs should be aligned well, for they are used as a reference for the guideline string during construction of the wedge.
3) Take elevations of both the hubs and the inside edge of the base opposite each hub.
4) Plot a profile of the elevations of the inside edge of the base.

5) Draw a new profile for the inside edge of the base using the first profile for a guide, eliminating all distortions in the original profile.
6) Give the grade inspector a record of the distortions so he can have them leveled with asphalt concrete.
7) Using a new profile, calculate the fill needed at each hub to give the desired superelevation.
8) For 24-foot pavement, fill = new profile elevation of the inside edge of the base + (.5 ÷ 12) + (24 x superelevation feet-per-foot) - (elevation of the hub).

   (.5 ÷ 12) is the 1/2 inch thickness at the inside edge expressed in terms of feet.

   "superelevation feet-per-foot" is the vertical-over-horizontal of the slope.

9) Mark fill (in feet) on the flat stake adjacent to the hub.

Full superelevation is usually not desired if a curve falls in a speed zone. Sometimes plans show a reduction in the rate of superelevation; other times the reduction is overlooked. Check plans carefully. If the speed zone has been overlooked, reducing the rate of superelevation is usually necessary.

For badly distorted curves--such as some flexible bases being resurfaced--drive

hubs offset from both inside and outside edges of the curve and use the centerline for a basis instead of the inside edge of the curve.

Have the contractor drive 3/4" x 1 1/2" stakes adjacent to the hubs and to the elevation indicated on the hubs. To correct any obvious errors in marking stakes, sight across them after they are driven. Make a table in the field book for each curve, patterning it after this sample:

Sta	Total Fill	Total Centerline Fill	Lay To	1st Lift	Remaining Fill	Lay To	2nd Lift	Remaining Fill	Lay To	3rd Lift

Using a level and a rule, measure (in inches) the total fill needed on the outside edge of the curve opposite the hubs. Record it under "total fill" in the table. To check the thickness necessary at the centerline, hold a string line on the inside edge of the base and at the elevation of the top of the wedge at the outside edge of the base. Measure the necessary fill at the centerline, add 1/2 inch, and record it in the table under "total centerline fill." If the centerline fill is less than 3 inches, it must be brought up with preceding courses. Each course must not exceed 3 inches in depth; the final course should not require more than 3 inches fill at the center.

The additional 1/2 inch thickness at the centerline is placed so the longitudinal joint can be constructed and rolled properly on the curves. This gives a 1/2 inch crown to the superelevated section.

The "lay to" figure in the table is the theoretical remaining thickness between the top of the finished curve and the top of the wedge course being laid. By specification, the thickness of an individual layer of a wedge course for superelevating a curve must not exceed 3 inches. The "lay to" is obtained by subtracting 3 inches from the largest number in the total fill (or remaining fill if it is any but the first course) column. To get the actual thickness to be laid, subtract the "lay to" from each number in the total fill column. Record this under the first lift, second lift, etc.

A guideline string is used for each lift to ensure that all wedges in the curve are constructed in their proper places. The guideline string must be moved for every succeeding lift of asphalt concrete. The edge of the screed of the laydown machine must always be exactly one foot from the guideline string with a bevel side plate giving a 1:1 slope to the edge of the wedge.

The distance of the guideline string from the hubs is calculated by using this formula: guideline distance from hub = 3'12" - "lay to". The formula is derived in the following manner:

1) The top of the final wedge for the curve is directly over the outside edge of the base. Since the edge of the wedge has a 1:1 slope, the "lay to" figure numerically equals the distance from the edge of the lift being constructed.
2) The hub is 5 feet from the edge of the base, and the guideline string is one foot from the edge of the screed.
3) Therefore, guideline distance from hub = 5 feet - "lay to" - 1'
   = 3'12" - "lay to"

Before construction starts on the wedges--but after the contractor has placed the 3/4" x 1 1/2" stakes--the inspector measures the total fill, the total centerline fill, calculates the "lay to" for the first lift, calculates the thickness at each stake for the first lift, and records everything in his book. The following is a sample of field book records at this stage:

Sta	Total Fill	Total Centerline Fill	Lay To	1st Lift	Remaining Fill	Lay To	2nd Lift	Remaining Fill	Lay To	3rd Lift
30	0	0	6¼	0						
+25	1½	0	6¼	0						
+50	3¼	¼	6¼	0						
+75	7	2	6¼	¾						
31	9¼	2½	6¼	3						
+25	8¾	2¾	6¼	2½						
+50	9	2	6¼	2¾						
+75	8½	2	6¼	2¼						
32	8¼	2¼	6¼	2						
+25	9	1¾	6¼	2¾						
+50	8½	2¾	6¼	2¼						
+75	8½	2¼	6¼	2¼						

The contractor sets the guideline string 3'5 3/4" from the hubs and adjusts the paver with the edge of the screed one foot from the guideline string at station 30 + 50. The inspector marks the thickness to be laid on the base ahead of the paver.

To lay succeeding lifts, the inspector measures the remaining fill each time with a level and a rule, calculates the "lay to" thickness to be laid and the guideline distance from the hubs, and paving procedures are repeated.

INSPECTION OF FINISHING MACHINE

With the exception of the following checks, inspectors should not assume responsibility for the condition of the finishing machine screed. Instead, they should carefully observe the condition of the pavement layer while it is being constructed.

Inspectors should use the following procedures at frequent intervals during construction to check the screed surface for producing the shape of the pavement cross section, and to detect extremely worn screeds:

1) Check the screed surface for places worn through. Do not permit the use of a machine with a hole worn through the screed plate.
2) Check the screed extension installation with the required straight edge.
3) Check with a stringline and rule to see that the crown in

edge of the screed is 1/4 inch. This may vary for unusual sections according to requirements.

4) Check with a stringline and rule to see that the crown in the leading edge of the screed is approximately 3/8 inch. The contractor should be encouraged to change this adjustment during construction to help produce a uniform surface texture. Less crown is put into the leading edge to eliminate tearing near the edges of the lane. More crown is put into the leading edge of the screed to eliminate tearing of the center portion of the lane.

INSPECTION OF ROLLERS

The specifications require rollers to comply with minimum standards. They also permit the contractors to use weights and tire pressures during construction that they think are best, provided that they obtain satisfactory end results.

The following inspection must therefore be made before construction starts to insure that the equipment complies. However, the inspectors should not attempt to control the tire pressure or weights during construction, except to be reasonably sure that the axle weights do not exceed the legal maximum of 18,000 pounds. For base construction, rollers having axle weights exceeding 18,000 pounds may sometimes be permitted. In such cases, the specifications should be read carefully to insure that all the restrictions are enforced.

Self-Propelled, Steel-Tired Rollers

Measure the diameter of the driving roll for compliance with the specified minimum of 60 inches.

On tandem type rollers, have the compaction roll filled with water to insure that it does not leak.

Self-Propelled, Pneumatic-Tired Rollers

Check the roller tire size marked on the tire side walls for compliance with the specified minimum requirement.

The contractor should select the wheel load and tire inflation pressure he wishes to use to produce the required 80 psi ground contact pressure from the tables which follow. If his roller is equipped with tires of a different size than those listed in the tables, wheel load and inflation pressure should be selected from a chart furnished by the contractor.

The inspector should check the contractor's weight and pressure selection to ensure their accuracy and compliance with specifications. For inspection purposes, it is assumed that each wheel on a uniformly-loaded standard roller will carry the same load as all the other roller wheels.

The selected wheel load should be multiplied by the number of wheels on the roller axle supported by the greatest number of wheels. If the product is greater than the maximum legal axle weight of 18,000

pounds, the contractor must select a smaller wheel load and a correspondingly higher inflation pressure to maintain compliance with specifications.

The selected and approved wheel load should be multiplied by the number of roller wheels. The product is the minimum gross weight of the roller.

Check the inflation pressure of each tire.

Differences in tire ply ratings produce different ground contact pressures for the same combination of wheel load and tire inflation pressure. However, the practical difference involved in using the smaller size tires is negligible. It is therefore considered that rollers equipped with 7.15 x 15 tires of different ply ratings are the same as rollers with all tires having the same ply rating.

The following tables can be used to provide 80 psi ground contact pressures. They have been modified somewhat from the standards of the Bituminous Equipment Manufacturers Bureau for purposes of easy inspection. Each combination of wheel load and tire inflation pressure should produce 80 psi ground contact pressure or slightly more:

Tire Size	Wheel Load Lbs.	Inflation Pressure psi	Ply Ratings
7.50 x 15	2000	120	All Ply
	2500	110	

Tire Size	Wheel Load Lbs.	Inflation Pressure psi	Ply Ratings
	3000	100	
	3500	90	
	4000	85	
9.00 x 20	3000	---	Under 12 Ply
	4000	86	
	5000	79	
	6000	73	
	3000	115	Over 12 Ply
	4000	103	
	5000	94	
	6000	88	
10.00 x 20	4000	125	All Ply
	5000	114	
	6000	106	
11.00 x 20	3000	116	All Ply
	4000	99	
	5000	92	
	6000	87	
13.00 x 24	4000	100	18 Ply
	6000	90	
	4000	86	22 Ply
	6000	78	
	4000	78	26 Ply
	6000	72	

INSPECTION OF HAND TOOLS

Specifications indicate few restrictions on the hand tools used in asphalt concrete construction. The most important item is selection of rakes or lutes. These items must be designed for use on asphalt construction. Garden rakes are too light to be useful and must not be used. All hand tools must be kept clean to ensure good workmanship.

SUBBASE AND SUBGRADE STABILITY

There have been occasions when unstable subbases have been overlooked during construction of flexible pavements. Costly overruns have then usually been necessary to correct the undesirable results: subsequent distress of the base due to flexing under construction equipment loads, and the thinning of pavement due to upward distortions of unstable subbases. The remedy for both conditions is additional pavement thickness, which magnifies paving costs.

To avoid these costly overruns, inspectors should exercise special caution. District, county, and/or resident construction engineers should lend supervisory attention and verify that inspectors understand the importance of avoiding paving construction over unstable areas.

Inspectors should stop construction whenever subbases are distorted under the weight of batch trucks or other paving equipment. Both contractors and inspectors should be encouraged to avoid being unprepared when unstable areas are encountered. Subbase problems must be located and corrected before pavement construction begins, thereby avoiding unanticipated and costly work stoppages.

Soft spots are located by testing the finished subbase with a loaded truck. When distortions are observed under the truck, the subbase and subgrade are to be reworked and dried out. Pavement construction should not commence unless testing gives reasonable indication that distortions will not occur.

When unusual problems are encountered with wet subgrades or unstable subbases, the district office should contact the central construction office for assistance.

CONSTRUCTION OF THICK LAYERS

The following shall be used as an inspection policy for thick layers.

When the specifications permit construction of thick layers, the contractors shall be permitted to select the thickness they think should be used.

The inspection forces should then test the thick layer for density and observe its riding quality. If the density and

riding quality are satisfactory, the work should be allowed to continue.

If the density results are not satisfactory, they should be controlled according to this handbook's section on density control.

In determining whether the riding quality of a thick layer is satisfactory or not, consideration should be given to the fact that thick layers are inherently rougher riding than the thinner layers. Also consideration should be given to the location of the layer in the entire pavement. It it is not the top layer of the pavement, it will be reasonable to accept the roughness which is inherent to thick layers. The finishing machines will correct that roughness when subsequent layers are spread.

However, poor rideability which is caused by poor workmanship or incorrect machinery adjustment shall not be tolerated for any layer.

Asphalt treated bases will sometimes be designed with bituminous surface treatments as the wearing course. In those instances the top layer of the base is the top layer of the pavement. To insure satisfactory smoothness of those particular pavements, the inspection forces should not permit the layer thicknesses to be planned and constructed so that the top layer exceeds 2 inches in thickness.

DRIVEWAYS AND INTERSECTING ROADS

Try turning on and off the road with a car to determine the length of fillets for driveways and intersecting roads. Set stakes at the outer limits of the turn, and don't make the fillets too short.

YIELD

Station markers should be placed at least every 500 feet to permit calculation of yield percentages.

Yield percentages are calculated by dividing the actual tonnage used by the tonnage which is estimated using the plan weight for that particular length, depth and width, and multiplying the quotient by 100. Yield percentages are used to indicate the comparative rate of application and are most usually calculated for each 1000 lineal feet constructed.

For the lower layer on resurfacing projects, the automatic controls should not be adjusted repeatedly based on tonnage yields taken at short intervals. The automatic controls should be allowed to correct for the irregularities in the underlying base without frequent adjustments. Accordingly, the spread rate for individual truck loads will sometimes vary substantially from the plan rate because of the irregularities in the old base. However, over longer distances (one half mile or more), taking both

sides of the pavement into account, the inspectors should select a general spread rate that compares as closely as possible with the plan quantities.

BASE SURFACE TEMPERATURE

Hot-mix asphalt concrete cannot be placed when a shaded portion on the road surface is cooler than the specified temperature. For uniformity, the following method of checking temperatures of shaded areas must be used on all projects:

1) Select a representative portion of the road surface to be covered. If all the surface is subjected to direct sunlight, the test location should be in the sunlight. If portions of the road are shaded, the test location should be in the shade.
2) Lay the thermometer directly on the road surface in the test location. Shade the area temporarily while taking the temperature by letting your shadow cover the thermometer. It should remain in the test location for five minutes. Temperature tests should be made as often as necessary for the work to follow specifications.

LAYING WIDTHS

Plans for an asphalt concrete project show the overall dimensions of the finished pavement. The drawings on the next pages illustrate recommended lane dimensions of typical pavements. When other pavement thicknesses or widths are not adaptable to the drawings, similar sketches should be made by the inspector. Drawings made by inspectors should utilize the same principles. A reasonable attempt should be made to secure the contractor's ideas and approval when making the drawings.

For Type B base and other binder and surface layers, pavement can sometimes extend 2 or 3 inches in width under the roller. Under these conditions, the tendency to extend width should be disregarded; the widths shown on the drawings should be the dimensions laid before compaction. An intended lap of one inch at the longitudinal joint is also recommended. This procedure produces pavement up to 3 inches wider than the designed dimension, but avoids undesirable practices such as excessive lap at the longitudinal joint and matching of the joint when using a cutoff shoe.

For asphalt treated bases, requirements for surface roughness and appearance do not demand the above refinements. For this mixture, the contractor is permitted to use a cutoff shoe when matching the longitudinal joints, and to increase the lap at the longitudinal joints beyond one inch. These practices should permit construction of the asphalt treated base

portion of the pavement to the exact dimention shown on the plans.

Complexities encountered in the construction of city streets and other multilane projects involve unusually complex principles. A few procedures connected with multilane construction inspection are discussed more fully in a later section of this handbook.

Width checks should be made and recorded in a field book at least three times each day--usually at the same location and time as field density tests.

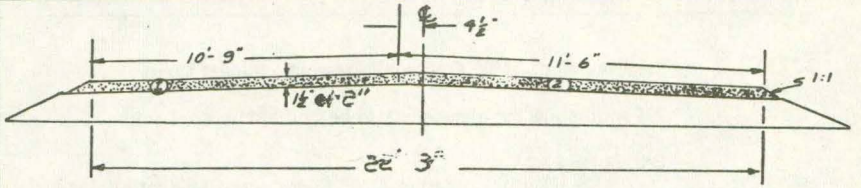

Figure 1 – First Course of a 3" mat with a 22'0" top and beveled edges.

All widths are the dimensions to be laid before compaction.

ORDER OF LAY

(1) Guideline 1'4½" from Centerline (Cut off 9")
(2) Guideline 1'4½" from Centerline
Use 11'6" paver

Note: For this course have edge of screed 1'0" from Guideline

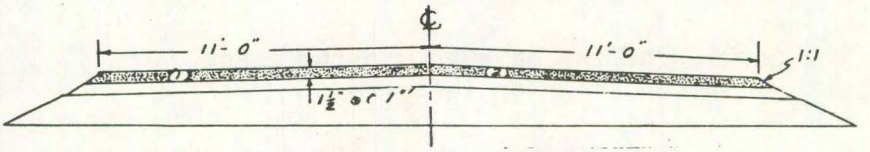

Figure 2 — Second Course of a 3" mat with a 22'0" top and beveled edges.

All widths are the dimensions to be laid before compaction.

ORDER OF LAY (lay either side first)
(1) Guideline 1'0" from Centerline
(2) Guideline 1'0" from Centerline
Use 11'0" paver
Note: For this course have edge of screed 1'0" from Guideline

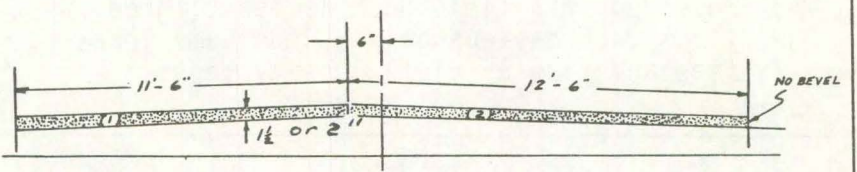

Figure 3 — Resurfacing of 24'0" Concrete Pavement. (Binder Course)

All widths are the dimensions to be laid before compaction.

ORDER OF LAY
(1) Guideline 13'0" from Centerline (cut off 12")
(2) Guideline 13'0" from Centerline
Use 12'8" paver

Note: For this course have edge of screed 1'0" from Guideline

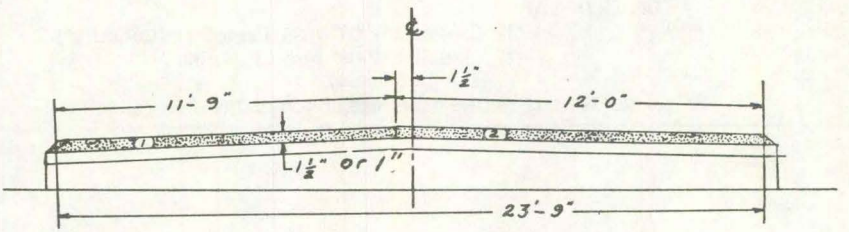

Figure 4 — Resurfacing of 24'0" Concrete Pavement. (Surface Course)

All widths are the dimensions to be laid before compaction

ORDER OF LAY
(1) Guideline 13'0" from Centerline (cut off 3")
(2) Guideline 13'0" from Centerline
Use 12'0" paver
Note: For this course have edge of screed 1'1½" from Guideline
Note: (1) May be laid on either side and can be switched to either side during the job, but it must be laid first.

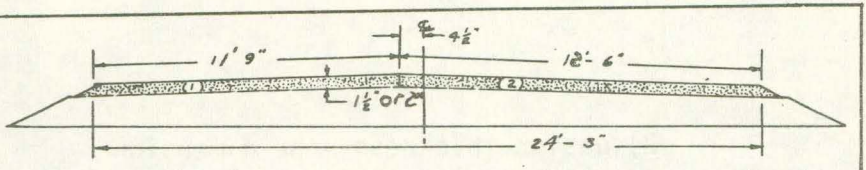

Figure 5 – First Course of a 3" mat with a 22'0" top and beveled edges.

All widths are the dimensions to be laid before compaction.

ORDER OF LAY
(1) Guideline 1'4½" from Centerline (cut off 9")
(2) Guideline 1'4½" from Centerline
Use 12'6" paver

Note: For this course have edge of screed 1'0" from Guideline

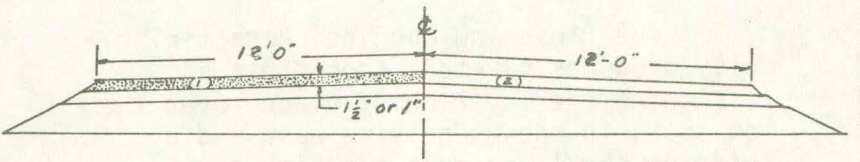

Figure 6 – Second Course of a 3" mat with a 22'0" top and beveled edges.

All widths are the dimensions to be laid before compaction.

ORDER OF LAY (lay either side first)
(1) Guideline 1'0" from Centerline
(2) Guideline 1'0" from Centerline
Use 12'0" paver

Note: For this course have edge of screed 1'0" from Guideline

SPREAD RATES

The three basic factors involved in determining spread rates of asphalt concrete pavement are:

1) plan quantities--the tonnage indicated on the plans and calculated as the amount required to construct the pavement layer to design dimensions.

2) design thickness--the dimension shown on the plans as the nominal depth of the pavement.
3) pavement smoothness--a quality of the surface of the pavement involving a minimum of roughness as determined by specifications and general acceptability.

The inspector should check the plan quantity of each contract item for accuracy.

The finishing machine characteristically produces pavement smoothness by thickening the layer being placed over the low spots in the underlying base and by thinning the layer over the high spots.

Construction should produce a minimum of locations with less than the design thickness and avoid excessive overruns in plan quantities. Careful inspection controls make it relatively easy to accomplish these goals when constructing new pavement and resurfacing old, not-greatly-distorted pavement.

When resurfacing old pavements with uneven profiles or cross sections, judgment must be exercised to avoid excessive overruns of plan quantities and to maintain design thickness within as much of the pavement as is practical.

Leveling courses should be designed for resurfacing unusually rough sections of old pavement. Specifications stipulate that any depressions or low areas more than one inch below the bottom of the intended elevation of the binder course must be

brought to the elevation of the bottom of the binder course by placing preliminary leveling courses.

It may therefore be assumed that most overruns of binder course quantities involving low areas (not exceeding one inch) have been taken into account by the designers with an additional tonnage allowance in binder plan quantities.

It follows that deficiencies in binder course thickness should usually involve only short high spots or occasional protrusions in the underlying base. All asphalt concrete layers should be placed on the basis of design thickness except when the term "average thickness" is used in plans. This requires frequent depth probes during construction and daily yield determinations. Measurement of daily density samples gives an indication of the constructed thickness.

When the term "average thickness" is designated on the plans for a particular layer, it means that the layer should be placed using the plan quantities as a basis. The term is normally used for the lower layer on resurfacing projects which require automatic finishing machine controls. Unusually thin and thick spots can be expected to occur since the automatic controls tend to construct smooth pavements regardless of the distortions in the underlying base.

For the lower layer on resurfacing projects, the automatic controls should not be adjusted repeatedly based on tonnage yields taken at short intervals. The

automatic controls should be allowed to correct for the irregularities in the underlying base without frequent adjustments. Accordingly, the spread rate for individual truck loads will sometimes vary substantially from the plan rate because of the irregularities in the old base. However, over longer distances (one half mile or more), taking both sides of the pavement into account, the inspectors should select a general spread rate that compares as closely as possible with the plan quantities.

Layer depth should be checked and recorded in a field book at least three times each day. Depth checks are usually done at the same location and time as field density tests.

CITY STREETS

When a city street or other base involving more than two lanes for the finisher is surfaced with asphalt concrete, certain procedures and principles produce a finished product with a pleasing appearance and smooth riding qualities. Although the details involved in individual projects may vary, the proper approach is one that works toward the standard procedures described in this section.

In addition to the basic work (proper base repair, cleaning, and tacking), leveling must correct lack of drainage and poor riding qualities, and ensure that none of

the longitudinal joints occur in an inverted crown (except in rare cases when drainage is not adjacent to the curb).

The proper construction of longitudinal joints is associated with straight lines and a uniform minimum lap of each lane over the adjacent lanes.

Preliminary Layout

1) Establish a working centerline by dividing the street at the end of each block.
2) Measure and record the distance from the working centerline to the face of the curb (if laying asphalt to the face of the curb is intended) right and left at 100 foot intervals.
3) Offset the working centerline to stakes in the parking area or to painted X's on the sidewalk and cross-tie all fixtures to be covered with asphalt.
4) Plan the laying procedure using measurements from the working centerline to the face of the curb (right and left). The planned procedure should be drawn up showing the width of each lane, the cutoff necessary from the basic machine width, and the guideline string offset from the established centerline.
5) The guideline string should be 1'0" from the edge of the screed. At least 3 inches should be

allowed between each curb and edge of the screed for irregularities.

If possible, plan laying procedures so all street widths can be both binder and surface-coated with the same basic machine width. This eliminates installing and removing screed extensions during the job. Use the cutoff shoe for varying the widths, but make the last lane the basic machine width with no cutoff used. Plan the width of lanes for different width streets so the inside lanes may be laid continuously. This eliminates many transverse joints and gives the job a better appearance.

The following measurements are typical of two blocks of a city street to be resurfaced; they are the distances from the working centerline to the face of the curb, taken at 100 foot intervals:

Sta. 27 + 00	19'10"	19'10"
Sta. 26 + 00	19'11"	20' 4"
Sta. 25 + 00	20' 0"	20' 1"
Sta. 24 + 00	20' 0"	20' 0"
Sta. 23 + 00	20' 0"	20' 0"
Sta. 22 + 00	20' 1"	20' 1"
Sta. 21 + 00	20' 2"	19'11"
Sta. 20 + 00	20' 0"	20' 0"

It is reasonable to assume that the street was intended to be 40 feet wide, so a typical resurfacing design cross-section would be sketched as follows:

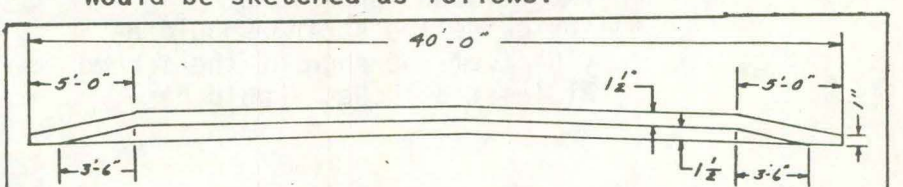

Figure 9 — Sta. 20 + 00 to Sta. 27 + 00.

The inspector should adapt the designed cross section to the existing street measurements using practical methods. He should plan lane widths which ensure the edge of the screed not dragging on the face of the curb. He must provide straight longitudinal joints with a uniform minimum lap of one lane over the adjacent lanes.

Because the narrowest dimension from the working centerline to the face of the curb controls the above factors, that dimension must be used as the basis for construction. All wider dimensions are filled with asphalt along the curb by bleeding out the mix.

The typical street shown has a narrowest dimension of 19'10". Because screed width can usually be varied only in 3 inch increments, the dimension must be reduced to 19'9". For planning purposes, the street width becomes 39'6". The contractor may decide to use a screed width of 11'0". The following is a typical drawing of the laying procedure for an 11'0" screed.

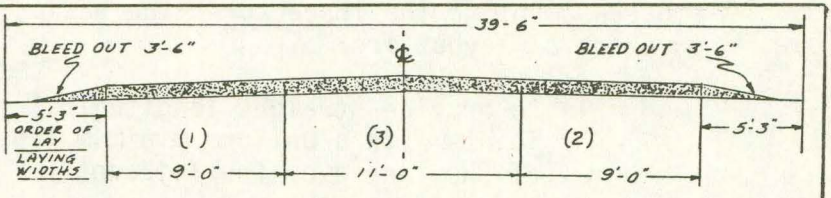

Figure 10 – Binder Course. Use 11'0" screed.

ORDER OF LAY (Guideline string 1'0" from screed edge)

(1) Guideline string 2'6" from centerline cutoff 2'0".

(2) Guideline string 2'6" from centerline cutoff 2'0".

(3) Guideline string 6'6" from centerline no cutoff.

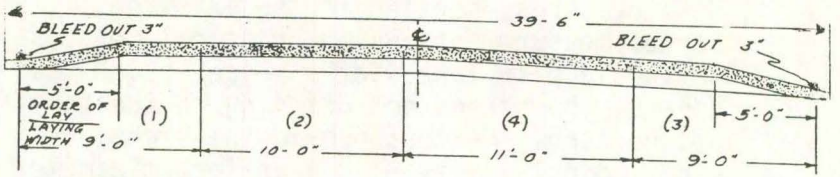

Figure 11 – Surface Course. Use 11'0" screed

ORDER OF LAY (Guideline string 1'0" from screed edge)

(1) Guideline string 7'6" from centerline cutoff 2'0".

(2) Guideline string 1'6" from centerline cutoff 1'0".

(3) Guideline string 7'6" from centerline cutoff 2'0".

(4) Guideline string 1'6" from centerline no cutoff.

Layout

The inspector should carefully lay out and thoroughly check lane widths and guideline string offsets before construction commences. This eliminates errors which cause time loss to the contractor and embarrassment to the inspector. The basic purposes of layout are:

1) to provide straight longitudinal joints with a uniform minimum lap of one lane over the adjacent lanes.
2) to keep the edge of the screed from dragging on the face of the curb.

Although all construction should work toward those ends, it is often necessary to vary procedures as work progresses. Lane widths shown on plans are widths before

rolling. Lanes widen under rolling, and this fact must be taken into account. It is necessary to reduce the width of at least one of the lanes after the first lane is placed and before the last one is placed. The lane with the adjusted width is normally the next-to-last lane placed; this is important if the closing lane (which must be the basic machine width without a cutoff shoe) is to be placed without excessive, unsightly lap at longitudinal joints. Because of widening under rolling, it is also necessary to vary the width between the guideline string and the edge of the screed to provide the desired joint lap.

A lap of one inch at the longitudinal joint is recommended. To eliminate confusion, the guideline string should be placed as shown on the planned procedure. On all but the first lane placed, the measurement between the edge of the screed and the guideline should be adjusted until the desired one-inch lap is obtained. On the first lane placed, the edge of the screed should be exactly one foot from the guideline string.

The guideline string is the basis of construction and its proper use determines the amount of success attained. It must be accurately set and maintained. The contractor must appoint a capable full-time man each day to mark the working centerline from the offset line with crayon. He then sets the guideline string by measuring from the working centerline. Hard steel nails are the only thing which can usually be driven between bricks or cracks in old

pavement to hold the guideline string. The guideline string is required by specifications, and it must be used. The concrete curb or the edge of the exposed gutter line are not acceptable substitutes, and they should not be used in lieu of the guideline string.

Edge alignment of each lane determines the trueness of longitudinal joints. For satisfactory joint construction and pleasing, straight lines, the inspector should require hand work wherever it is needed to straighten unevenly placed edges.

When resurfacing an old street, the shape of the finished pavement should be kept in mind. It is nearly impossible to make a longitudinal joint inversely crowned without leaving objectionable roller marks. It may be necessary to raise the inside edge of certain lanes more than the intended thickness to provide a slight crown at the joint.

When the street under construction makes a right angle turn, paving must proceed through the intersection. The finishing machine should make a joint along the edge (which should be sawed if allowed to cool) instead of turning the corner.

Thickness tapers are sometimes designed at the outer edges of asphalt concrete resurfacing adjacent to existing curbs in order to maintain gutter depth and still permit full resurfacing thickness as wide as possible. Thickness tapers constructed with finishing machines leave

surfaces adjacent to curbs smooth and free of distortions, thereby providing satisfactory drainage.

In comparison, tapered surfaces constructed by hand or by using a wing plate attached to the finishing machine oftentimes yield gutter surfaces with many minor distortions; the free flow of water is then obstructed. These distortions also collect silt, causing streets to be dusty during dry weather.

Thickness tapered sections of surface layers should therefore be constructed with a finishing machine whenever possible. Thickness tapers at the outer edges of binder layers can be constructed by hand or with a wing plate, however, for they are later covered by surface layers done with a finishing machine.

Because of the peculiar dimensions and adjustments of the screed, it is impossible to use the finishing machine for constructing thickness tapers less than five feet wide; it is impractical to construct thickness tapers less than six feet wide with the finishing machine on streets 24 or 26 feet wide. Whenever possible, the Design Department specifies thickness tapers wide enough for construction with a finishing machine; it should be used whenever plans provide adequate width.

EDGE ALIGNMENT AND GUIDELINE STRINGS

Edge alignment is one of the most readily noticed features of new pavements. A job is marred if there are irregular and unsightly distortions along the outer edges. It is also easily recognized when objectionable straight sections on horizontal curves are left uncorrected. Care and good workmanship produce true edge alignment and lend a pleasing, well-built appearance.

True edge alignment also affects construction of longitudinal joints. The lap at the junction of adjacent lanes should be constructed with uniform width and as little variation as possible. If joints do not lap, there is no seam to bond the two lanes together and handwork corrections become necessary. Excessive lap, however, produces an objectionable wide scab of mixture (on the surface next to the joint) which must be removed with hand tools.

A lap of one inch with a variance of 1/2 inch (in either direction) produces the best appearance with the least effort. If these close variances are to be followed, each adjacent lane must be built with true edge alignment.

The inspector should make frequent measurements to ensure that the guideline string is carefully set and maintained. Pegs used to secure the guideline string should be at intervals close enough to eliminate chords on curves and other irregularities caused by high winds, etc.

Guideline strings for asphalt concrete paving should be located by measuring from "redhead nails" placed on the centerline of all surfaces except portland cement concrete. After construction of lower layers--which cover the centerline "redheads"--the guideline string for succeeding layers can be located by measuring from the pegs used to secure the string for the lower layers. When setting the guideline string on curves, an adequate number of pegs should be used to permit the finishing machine to follow the line exactly, without producing unsightly chords on the curved edge alignment.

When resurfacing old concrete pavement, the contractor is permitted to locate guideline strings by measuring out from one of the pavement edges at intervals of approximately 500 feet. He then tightens the string and uses intermediate pegs to secure it. The pegs should be located to produce a smooth line and still construct the resurfacing edges on the old pavement as much as possible.

To ensure parallel alignment in the adjacent lane, the guideline string for that lane should be located by measuring across the pavement from the pegs used to secure the first line.

Specifications require that grass must be mowed closely for an 18-inch width along old concrete pavements to prepare a smooth location for setting the guideline string near the pavement edge.

The finishing machine operator should follow the guideline string exactly. When the machine goes off the line for any

reason, it should be immediately adjusted back onto the line. Irregular edge alignment occurring due to quickly adjusting the finishing machine's deviation from the line should be corrected at once with hand tools.

The finishing machine operator should not attempt to smooth out edge alignment irregularities by coming back onto the line gradually. This results in long stretches with improper lapping of the longitudinal joint. When finishing machines are pushed off the line on curves, the movement is usually down the slope of the curve. Bringing the machine back on the line gradually results in a long, objectionable straight chord in the curved edge alignment.

Sometimes workmen are unable to make hand work corrections as rapidly as they occur. In such cases, the inspector should require the finishing machine to stop until edge alignment corrections have caught up.

When constructing hand-worked areas, such as driveway run-outs and bridge approach tapers, edge alignment usually becomes irregular during steel-tired rolling; the small high and low spots in the hand-worked surface tend to extend unevenly in width. The edge alignment of these hand-worked areas can be trued by trimming the edge with hand tools while the asphalt mixture is still hot and workable--immediately after rolling.

AUTOMATIC SCREED CONTROLS

Specifications require automatic screed controls for many types of county, primary, and interstate highway construction projects. Machines with automatic controls used in Iowa are made by three firms: the Iowa Manufacturing Company, the Barber-Greene Company, and the Blaw-Knox Company. The electric self-contained grade referencing systems for the three types of machines are explained fully in literature available from the manufacturers.

The Iowa Manufacturing Company Control

The Iowa Manufacturing Company device consists of two sections of steel pipe laid end to end and connected by two splice plates. By using four bolts in the splice plates, the entire device can be made rigid. By using three bolts in the splice plates, the device becomes hinged at the midpoint. Specifications permit either rigid or hinged operation. Smoother pavement results from hinged operation, for the hinge permits thinning the pavement over high points in the underlying base. A spring-loaded taut wire attached lenghwise to the device indicates the desired grade to the control sensor. The wire must be attached to the extreme ends of the control in hinged operation, and may be attached to the midpoints of each section in rigid operation.

The Barber-Greene Company Control

The Barber-Greene Company Control device consists of a steel truss operated by either sliding along the base or attaching wheels near each end. Specifications permit the device to be operated with or without the wheels attached. Smoother pavement results from using the wheels. They support only the ends of the truss, permitting thinning of the pavement over high spots in the underlying base. When the wheels are used, a taut string must be attached to each end of the truss to indicate the desired grade to the control sensor. This is necessary because the truss flexes up and down when operated on wheels. When no wheels are used, the control sensor may rest directly on the truss.

The Blaw-Knox Company Control

The Blaw-Knox Company device consists of a beam supported on numerous ski-shaped feet attached in a line along the beam. The feet can be spring-supported to permit free individual vertical movement, or they can be locked to permit no individual vertical movement. Specifications permit operation with the feet either locked or free-moving. Smoother pavement results from using the feet free-moving, for this permits thinning over high spots in underlying base layers. The control sensor can rest directly on the beam in either case.

binder course, it is sometimes discovered that a leveling course should have been placed but was overlooked. In such an instance, leveling courses should be constructed on top of the binder layer.

The distance between the ski device and the finishing machine can be adjusted. The contractor should be advised to select the most correct offset for the ski device to avoid distortions such as channeled wheel paths.

Techniques should be worked out for adjusting the automatic grade and crown slope controls when paving through transitions between superelevated curves and normal tangent sections. Dialing a change in the crown slope and concurrently adjusting the height of the sensor to compensate for the change in elevation of the ski device (relative to the elevation of the paving machine) must be done. The change in relative elevation can be predicted by calculation, for the offset distance of the ski device from the centerline, the crown slope, and the curve superelevation slope are all known. The calculated elevation difference can only be an approximation, however; slight variations from the specified slopes are usually encountered under field conditions. When dialing slope changes, numbers on the automatic control panels do not usually correspond exactly to the slopes being laid. Field calibration for correction is therefore recommended. To check the slope, a slope board can be made with a 10-foot board, a level, and an adjustable rod.

Using Automatic Screed Controls

The specified 30-foot-long device must be used for all layers requiring automatic controls (except surface courses) when matching mongitudinal joints. A short shoe may be used for joint matching on all surface courses.

The depth of new surfacing varies considerably when using machines equipped with automatic controls. Thick and thin spots occur, particularly when resurfacing old, distorted pavement. This happens because the automatic machine constantly strives to lay a uniform profile and crown slope, regardless of distortions in the old base.

When resurfacing old pavement, measurements should be taken at representative locations to determine the average crown slope. If the average crown slope is satisfactory, automatic controls should be set to produce that slope. All deviations from that slope in the old pavement then result in thick or thin spots in new surfacing. A similar method can be used on superelevated curves unless plans indicate the use of wedge courses to produce a specified slope.

Dips are occasionally encountered in old pavement which are too long for the 30-foot ski to eliminate. Some distortions in old pavement are too deep for the automatic control's capacity to correct them completely. Leveling courses should be constructed before placing the binder layer in such cases. After constructing the

When malfunctioning occurs in the automatic controls, corrections should immediately be made on all affected pavement. The normal procedure is to stop the finishing machine, repair the automatic controls, shovel paths for the finishing machine tracks in the affected pavement, back up the machine to the properly paved portion, and commence paving operations from that point.

When malfunctions repeatedly occur, construction should be stopped until the necessary steps have been taken to ensure permanent repairs to the controls. Specifications allow the engineer to permit completion of a day's work on manual controls when malfunctions occur. Use of manual controls should not be permitted unless the overall final construction is not seriously affected by not using the automatic controls.

When using machines equipped with automatic controls, the depth of the new surfacing has been observed to vary considerably. Unusually thick and thin spots will occur, especially when resurfacing old pavements which are distorted. This is because the automatic machine is constantly striving to lay to a uniform profile and crown slope regardless of the distortions in the old base.

For the lower layer on resurfacing projects, the automatic controls should not be adjusted repeatedly based on tonnage yields taken at short intervals. The automatic controls should be allowed to correct for the irregularities in the underlying

base without frequent adjustments. Accordingly the spread rate for individual truck loads will sometimes vary substantially from the plan rate because of the irregularities in the old base. However, over longer distances (one half mile or more), taking both sides of the pavement into account, the inspectors should select a general spread rate that compares as closely as possible with the plan quantities.

OPERATION OF FINISHING MACHINES

The inspector should require that the forward speed of a finishing machine be slowed until reasonably continuous operation is established. There should be no waiting between trucks unless breakdowns or other unavoidable stoppages occur.

Operation of the spreading screws which distribute the mixture in front of the screed affects the depth of the layer. Depth is slightly greater when they are operating. Consequently, a regular on/off operation of the spreading screws produces a slight rhythmic ripple in the pavement surface. The ripples can usually be noticed under lights at night or during a rainy day. They are directly associated with high roughometer readings.

To minimize rippling, the inspector should require adjusting hopper gates downward until the screws are operating at least 80 percent of the time or more. This procedure is required only on binder and surface courses.

CONTROL OF SURFACE TEARING

Although experience is necessary to detect the more subtle results of poor screed functioning, it is fairly easy to perceive non-uniform surface texture when it occurs. Different mixtures produce comparatively different surface textures. Surface texture should be uniform for any given asphalt mixtures. If it is not, the screed can be assumed malfunctioning, and work should be stopped for corrections.

When undesirable screeding results continue for more than two or three hundred feet, a work stoppage should be ordered. The screed must be adjusted or repaired. Work should not continue unless the contractor has demonstrated a serious effort to remedy the trouble. If undesirable screeding results persist, construction should be stopped until permanent corrections have been made. Permanent corrections might involve installation of new screed plates or the visit of an authorized service repairman.

Under no circumstances should work be permitted to continue beyond reasonable trial limits with poor screeding results. The contractor must have the screed checked for trueness and proper adjustment. He should also make any necessary hand-method corrections on poor pavement surfaces. The contractor is responsible for equipment and procedural adjustments needed to eliminate tearing, and the inspector's assignment is to stop work if tearing persists.

Less crown in the leading edge of the screed eliminates tearing near lane edges. More crown in the leading edge eliminates tearing in the lane center.

Sometimes the use of DC-200 in asphalt cement improves control of surface tearing. If it persists, the following can be tried. Dilute 2 ounces of DC-200 in 2 gallons of kerosene or No. 1 diesel fuel. Add this mixture to a 10,000 gallon tank of asphalt. The resulting proportion is about 2 parts per million. Add this to the transport truck before it is pumped into storage to promote adequate mixing. Do not use proportionately more DC-200 than is recommended; excessive amounts might be harmful.

If no remedial procedure solves the tearing, construction must be stopped. The District Office should be contacted, and they may in turn call the Central Construction Office. In any case, work must not be permitted to continue until the problem has been solved.

CONTROL OF SEGREGATION

In order to insure uniform control of segregation when it occurs, it is recommended that the following procedures be enforced.

1) Insure that lack of mixing is not the cause.
   a) Check the mixing time according to specifi-

cations. Do not permit construction to continue unless the mixing time conforms to the minimum specified.

b) The proper paddle arrangement is also essential to thorough mixing. If segregation persists, do not permit the construction to continue until the pugmill has been checked and properly adjusted by an authorized service repairman.

2) When segregation persists, use DC-200 in the asphalt cement according to the following proportion.

Dilute 2 ounces of DC-200 in 2 gallons of kerosene or No. 1 diesel fuel. Then add this mixture to a 10,000-gallon tank of asphalt. This is equivalent to about two parts per million content. Some contractors add this to the transport truck before it is pumped into storage tanks at the plant. This helps toward adequate mixing.

Do not use more DC-200 proportionately than is recommended, as an excessive amount is reported to be harmful.

3) Prevent coning in the truck during loading.

a) Do not permit the work to continue unless the pugmill hopper gate is properly repaired and has a quick opening and closing operation.

b) Require the trucks to be moved between dumps from the pugmill.

4) Prevent segregation when unloading the trucks by requiring the truck boxes to be raised high enough to cause the mixture to slide out instead of flowing out of the truck.
5) Observe the effect of not cleaning the finishing machine hopper frequently. If an improvement is noticed, allow the corners to become filled with cooling mixture and then waste that material at the day's end.

RAKING AND HANDWORK

The contractor must provide necessary hand tools and maintain them in good condition.

Specifications stipulate that kerosene, distillate, and fuel oil must not be used around the finishing machine to clean tools. A pressure tank and burner have proven satisfactory for that purpose, and the contractor will provide such apparatus if requested to do so.

Another acceptable method is to equip each worker with a putty knife. Then he can keep his rake or shovel clean by scraping off the asphalt while it is still warm.

The inspector should verify that all high and low spots are corrected whenever handwork is done. He should insist that all

coarse rock be removed from the handworked surface, and that all rake marks be smoothed with a lute or the back of a rake. Handwork should be done with hot materials, clean tools, and techniques which prevent foot prints and other objectionable scars in the finished work.

TRANSVERSE JOINTS

Specifications require the use of a 10-foot straightedge for checking binder, surface, and Type B base transverse joints for smoothness. The inspector should use the straightedge according to the following procedures:

1) The layer should be checked with the straightedge before the saw cut is made for the transverse joint. Use the straightedge to determine where the full thickness of the layer ends and the tapered portion begins. The saw cut must be located in the full thickness of the layer. All of the layer extending beyond the saw cut--including the tapered portion--should then be removed.
2) Stop the finishing machine 30 feet from the joint while construction is being checked and hold it there during checking. A joint indicating a poor riding surface should be repaved immediately with the finishing machine.

3) The second check with the straighedge should be made after the finishing machine has constructed the new layer but before the layer has been compacted. Use it to locate irregularities in the newly-constructed layer. Corrections should be done by hand. When the straightedge indicates no high or low spots, initial roller compaction can be permitted.
4) After initial roller compaction, make a third straightedge check across the joint between the cold pavement and the hot mixture. This check indicates whether or not the proper amount of material has been placed. If the freshly-rolled layer is too high, too much material has been placed; if the freshly-rolled layer is too low, not enough material has been placed.
   a) High and low pavement near transverse joints should not be corrected with additional rolling. Allow only cutting and filling corrections, while the mix is warm and workable.
   b) If unusually high or low areas remain after rolling, have paths shoveled through the pavement for the finishing machine tracks. The machine can then be backed up to the joint and paving can be resumed.
5) The above procedures should be repeated as necessary to secure a good riding joint. If repeated repaving causes the mixture to

cool beyond practical re-use, it should be shoveled aside and wasted. When the straightedge indicates a smooth riding joint, the finishing machine can proceed with paving construction.

6) Checking for true edge alignment is the final procedure. The edge of a freshly-rolled layer should be carefully trimmed with hand tools until it matches alignment with adjoining cold pavement.

DENSITY SAMPLING AND CONTROL

Specifications require that hot-mix asphalt concrete and hot-mix asphalt-treated bases be compacted to a density not less than a specified percentage of the density obtained in the lab for the corresponding mix. The actual density is determined from small samples cut from the surface on the working day following construction.

At least three density samples per day are required for all types of work except thin surface layers. The recommended minimum number for thin surfaces is designated by special instruction. The specifications will sometimes designate the number of samples to be taken for thin surfaces as well as other types of construction.

Density samples should not be taken within one foot of either edge of a lane being tested.

The comparative laboratory density shall be determined for each day's construction from a mixture sample taken as prescribed by the following section. The inspection forces shall deliver each day's mixture samples to the district materials forces, who will perform the laboratory density tests. The materials forces will then communicate the test results back to the inspection forces by telephone or by other prompt and suitable means, so that they may be used to calculate the comparative percentages.

In the event that a laboratory density is not available from the district materials office for a particular day's sample, the daily control shall be based on the laboradensity for the previous day's construction, using the same mixture.

It is the contractors' responsibility to produce the minimum density by varying their procedures, etc., within the specification limitations. The inspection forces should, therefore, not attempt to solve the density problems for the contractors. The contractors should use their own initiative to control failing density results.

To eliminate the possibility of overlooking density failures, each test failure should be reported by the inspector to his engineer, and to the contractor, on the day that the test is performed.

Although it is not the inspectors' duty to solve the contractors' density failure problems, the following is included to inform both the contractors and the inspection forces.

The first general procedure for increasing low densities is to insure that all the rollers are being used effectively.

Sometimes the pneumatic-tired roller has been held back because of pickup on the tires. Although pickup is undesirable, it is not a specification violation and should not have priority over the minimum density requirement. Every known method should be used to prevent pickup, but sometimes it must be endured in order to compact the pavement while it is still hot and therefore to avoid failing densities.

Many times, increasing the weights of the rollers will be effective.

In addition to the above, the most common procedure for increasing low densities is more coverages with the pneumatic-tired rollers. This sometimes will necessitate using additional pneumatic-tired rollers.

Another item for consideration includes checking to insure that the sampling and testing procedures are not in error.

To control pickup on the pneumatic roller tires, canvas or plywood covers around the wheels to prevent their cooling has been effective. Also using soap or detergent in the water that wets the tires (if water is used instead of rolling dry) will sometimes be helpful.

It is the responsibility of the district construction engineers on primary

and interstate highway projects, and the district secondary engineers on secondary highway projects, to supervise, at the district level, the administration of the asphalt concrete density specifications. These engineers should take the necessary steps to insure that they are informed of density failures and should give personal attention to the more persistent or serious density problems.

If the normal remedial measures should fail to obtain the minimum density requirement, the district office should notify the central construction office immediately so that assistance can be given.

MIXTURE SAMPLING

Frequency

Not less than one sample of all mixtures per each days' work should be forwarded to the District Materials Office. Densities will be determined on all samples submitted. One additional sample should also be delivered at two day intervals for forwarding to Ames Lab for extraction, gradation, and stability testing.

Sampling Hot-Mix Asphalt Concrete for Lab Tests

APPARATUS: template 8" wide, 8" long, 4" deep
scoop
putty knife
two-gallon cardboard box

SIZE OF SAMPLE: 45 to 50 pounds

PROCEDURE: Take the sample behind the laydown machine before any material receives compaction.

Template shall be placed on the mat and forced straight down through the entire depth of the mat being laid. All material inside the template shall be scooped out and placed uniformly in the sample box. All the material which has stuck to both the inside and outside of the scoop shall be scraped off and added to the sample.

Take all samples as follows to get a representative cross-section of the mat:

Take a minimum of 4 template samples: one 4 inches in from the outside edge of the mat,

one 12 inches right of the center of the screed, one 12 inches left of the center of the screed, and one 4 inches in from the inside edge of the mat.

If 6 template samples are needed to yield a 45-50 pound sample, take an additional template sample at each quarter point. If 8 or more template samples are needed to yield a 45-50 pound sample, two or more repetitions of 4 or 6 template samples might be necessary.

PRECAUTIONS: Extreme care must be taken to minimize segregation of coarse and fine particles while the sample is being taken.

Extreme care must be taken to avoid contamination of the sample with foreign matter such as fuel oil or dust.

SURFACE CHECKING

Standard Specifications provides techniques for straightedging of both binder and surface courses. Required methods of correcting depressions and bumps are also described. Corrections for surface irregularities should be made, if possible, before the material has cooled to air temperature. A large percentage of irregularities can be corrected by manipulating the roller if such action is not delayed too long.

The proper procedure is to have a full-time inspector running the surface checker immediately behind the finish roller. Mixture buildup on the wheels of the surface checker should be regularly removed with a knife. The surface checker should be placed where it will not be damaged when not in use.

RECEIVING TICKETS

The paving inspector must pick up and sign or initial each weight ticket representing a truck-load of hot mixture. The best procedure is to do each ticket as the truck unloads, if other duties permit. If checking work elsewhere is necessary, a few tickets can accumulate.

Any waste occurring on the grade should be noted on the ticket and initialed by the grade foreman if possible. This

information should also be given to the plant inspector to keep a record of waste for payment deduction; the contractor is not paid for wasted materials.

Tickets should have the contractor's name, county, project number, date, truck number, net weight, ticket number, and weighing inspectors initials. They should identify the type of material weighed.

ADJUSTING FIXTURES

The specifications require that manholes, water boxes and other similar fixtures must be adjusted to the finished surface. The adjustment must be made before the final lift of asphalt concrete is placed but after all preceding lifts have been constructed adjacent to the fixture.

The fixtures are adjusted before the top layer is constructed to avoid the permanent bumps and blemishes which are associated with raising them afterwards.

REPORTS AND RECORDS

Required Reports

The paving inspector is not required to send any form reports to the central office. However, he is expected to advise the resident or county engineer of:

1) any test results (alignment, compaction, etc.) falling outside specifications.
2) corrective measures taken.
3) the reason for acceptance of materials and construction.

Weekly Postcards

Cards should be sent only on primary or interstate projects which fit the following classifications. They should be mailed on Friday night or Saturday to be in the central office the following Monday.

AC and PCC Pavement
Asphalt Concrete Resurfacing
Grading

When a project is suspended, it should be so noted on the card, giving the date of suspension. Cards need not be sent until work on a suspended project is resumed. When a project is completed, the final card should note the date of completion.

The cards are available from the Central Construction Office in Ames.

Forms Optional for Local Use

Form 52, Construction Quantities Asphalt Concrete Widening and Resurfacing, is prepared by the inspector on each project to provide information to the resident construction engineer for the preparation of estimates. It is intended for resurfacing pavements both with or without widening. It is for field use only, and copies should

not be sent to Ames. Copies should only be sent to the resident construction engineer and the District Office upon request.

Form 53, Construction Quantities Flexible Pavements, is intended for use on all flexible base and asphalt base or surface projects, both primary and secondary. It is prepared by the inspector on each project to provide information to the resident construction engineer (county engineer) for the preparation of estimates. It is for field use only, and copies should not be sent to Ames.

APPENDIX

SAMPLE DIARY PAGES

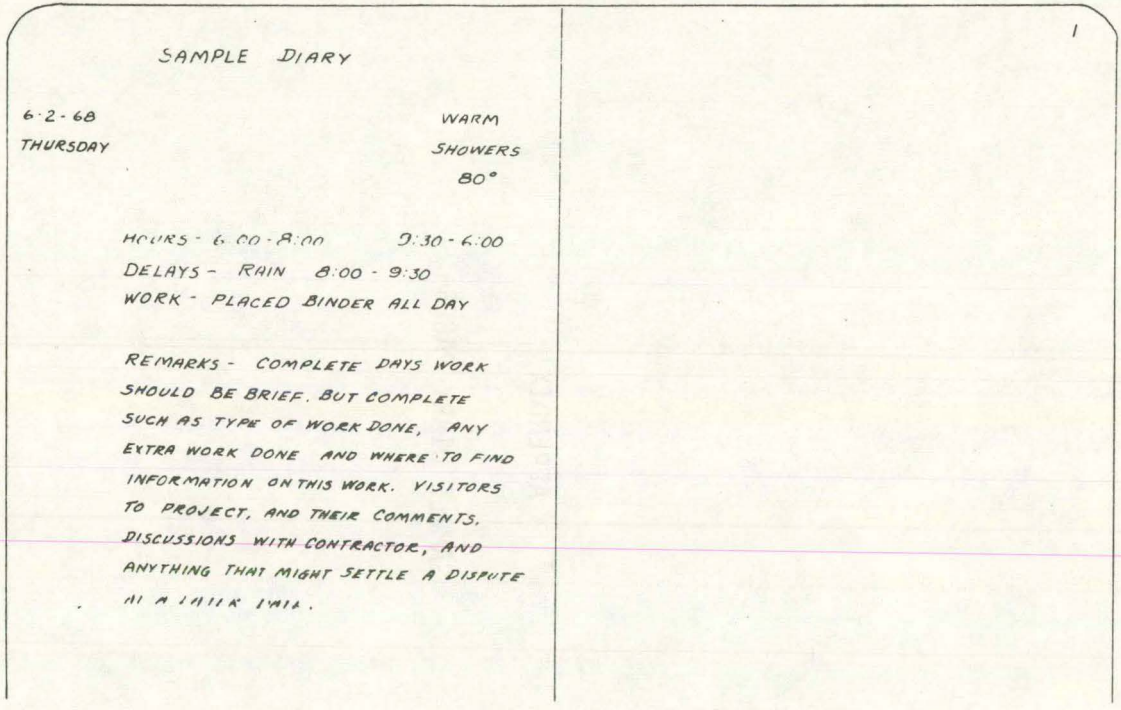

Figure 12 – Diary

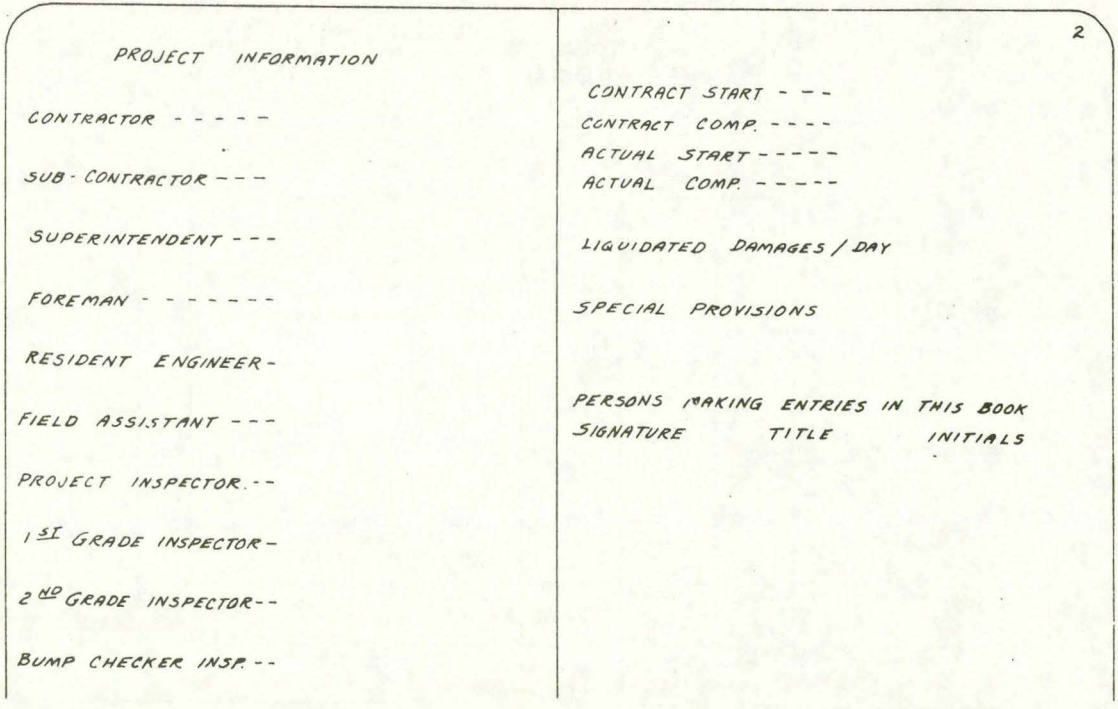

Figure 13 – Diary

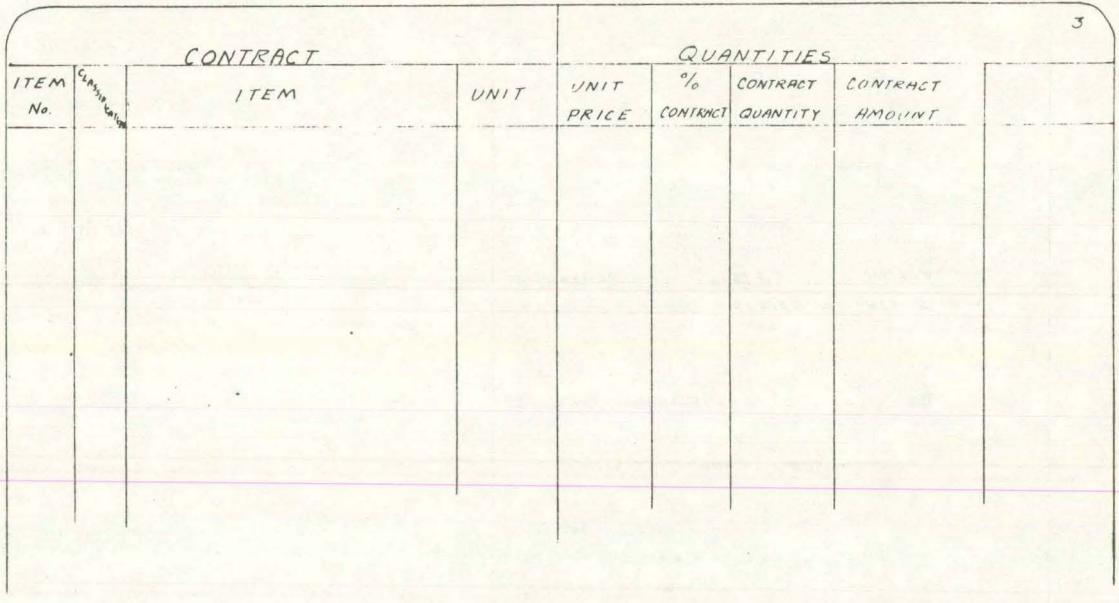

Figure 14 – Diary

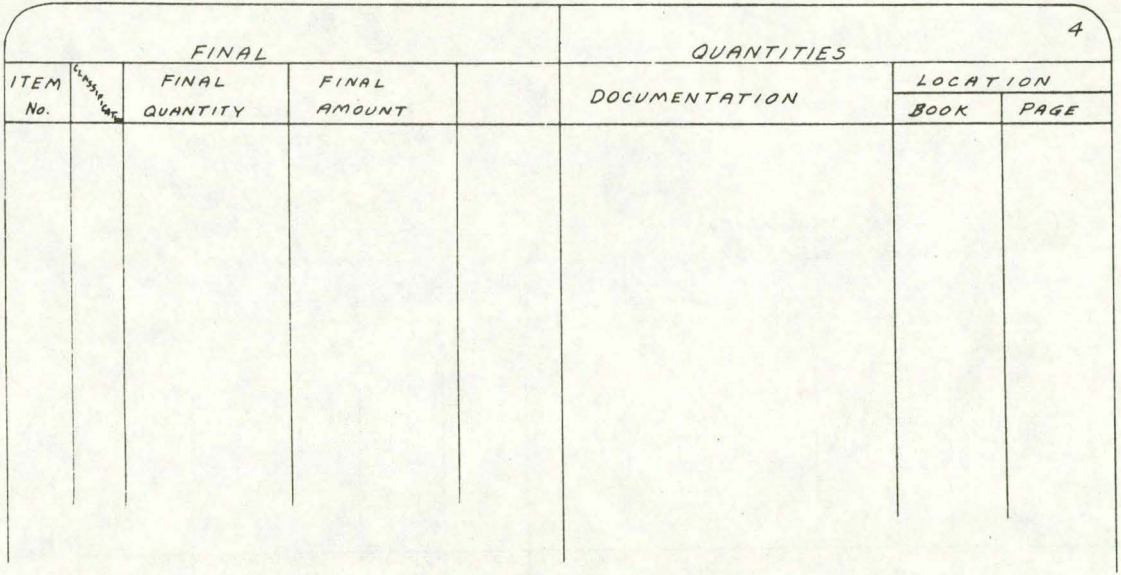

Figure 15 – Diary

CLEANING & PREPARATION OF OLD BASE

5

ART. . PAGE

DATE	STATION		MEASURED		INSP. INITIALS	MEASURED BY	REMARKS	
	FROM	TO	LIN. FT.	MILES				

TOTAL FOR PAGE

TOTAL DIV. I

TOTAL DIV. II

TOTAL MILES ITEM No.

INSPECTOR SIGNATURE

CHECKED WITH CONTRACTOR

CONTRACTOR SIGN

CHECKED BY

Figure 16 – Diary

FULL DEPTH PATCHES ITEM 9

6
ART. PAGE

DATE PLACED	STA.	DIV. I & REF.	AVG. LENGTH	AVG. WIDTH	SQ. FT.	SQ. YDS.	INIT.	TOTAL SQ. YDS.	DESCRIPTION OR SKETCH

TOTAL FOR PAGE

INSPECTORS SIGNATURE

TOTAL DIV. I

TOTAL DIV. II

TOTAL ITEM 9 FOR PROJECT

CHECKED WITH CONTRACTOR, _____
DATE

CHECKED BY _____

Figure 17 – Diary

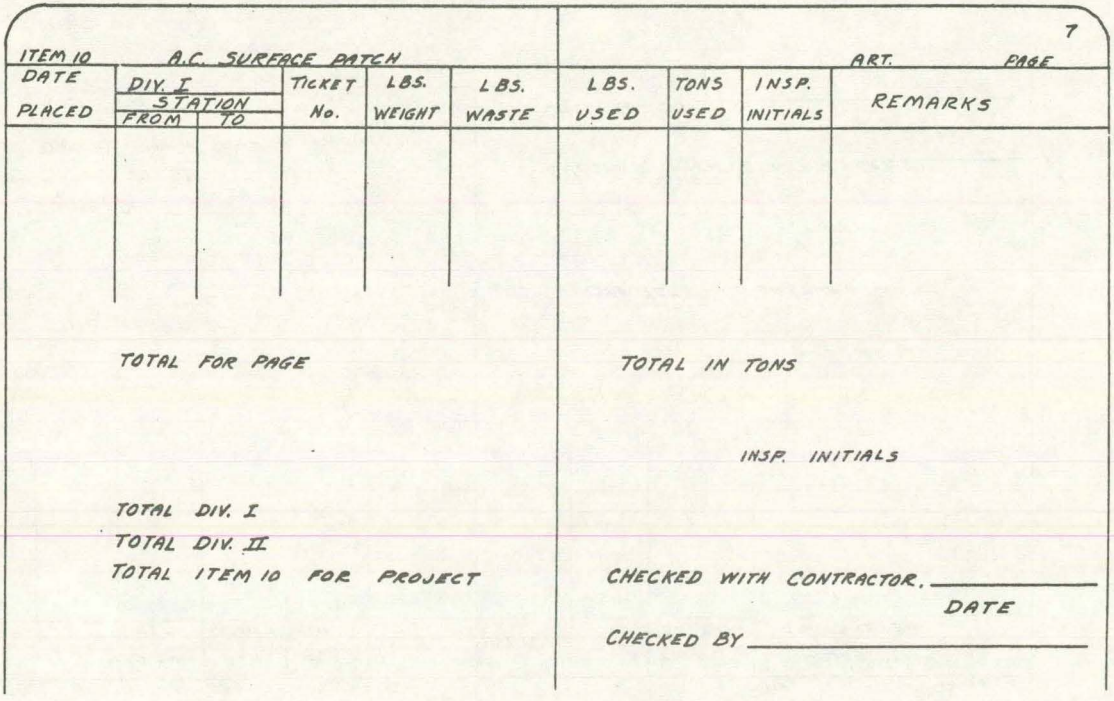

Figure 18 – Diary

DIV. I

B.

ITEM 11 PRIME OR TACK COAT BITUMEN

ART.

PAGE

DATE	TIME	DISTRIBUTOR START	DISTRIBUTOR STOP	GALS.	TEMP.	CORR. FACTOR	GALS @ 60°	STATION START	STATION STOP	LIN. FT.	WIDTH	SQ YDS.	RATE	INSP. INITIALS

TOTAL FOR PAGE

CHECKED WITH CONTRACTOR, _____

DATE

* TOTAL DIV. I
* TOTAL DIV. II
* TOTAL ITEM 11 FOR PROJECT
* NOTE - FINAL PAGE ONLY

INSPECTORS SIGNATURE

CHECKED BY, _____

Figure 19 – Diary

ITEM 6 SAND COVER

DIV. I

9

ART PAGE

DATE	STATION FROM	STATION TO	LIN. FT.	WIDTH	SQ. YDS.	TICKET No.	LBS. WASTE	LBS. USED	RATE	INSP. INITIALS

TOTAL POUNDS FOR PAGE

TOTAL TONS FOR PAGE

NOTE: IF ONE TICKET IS USED IN MORE THAN ONE DIV. EXPLAIN ON BACK OF TICKET

TOTAL DIV. I

TOTAL DIV. II

TOTAL FOR PROJECT

TOTAL CHECKED WITH CONTRACTOR, _____ DATE

CHECKED BY _____

Figure 20 – Diary

ITEM 17 BASE ASPHALTIC TREATED DIV. I

10

ART. PAGE

DATE	& REF.	WIDTH	DEPTH	STATION FROM	STATION TO	LIN. FEET	TONS USED	TONS REQ'D	%	INSP. INITIALS	REMARKS
											ON INTERSTATE SHOW A.C. CONTENT AND LIFT No.

PAGE TOTAL

TOTAL DIV. I
TOTAL DIV. II
TOTAL ITEM 17 FOR PROJECT

INSPECTORS SIGNATURE

CHECKED WITH CONTRACTOR, _____
DATE

CHECKED BY, _____

Figure 21 – Diary

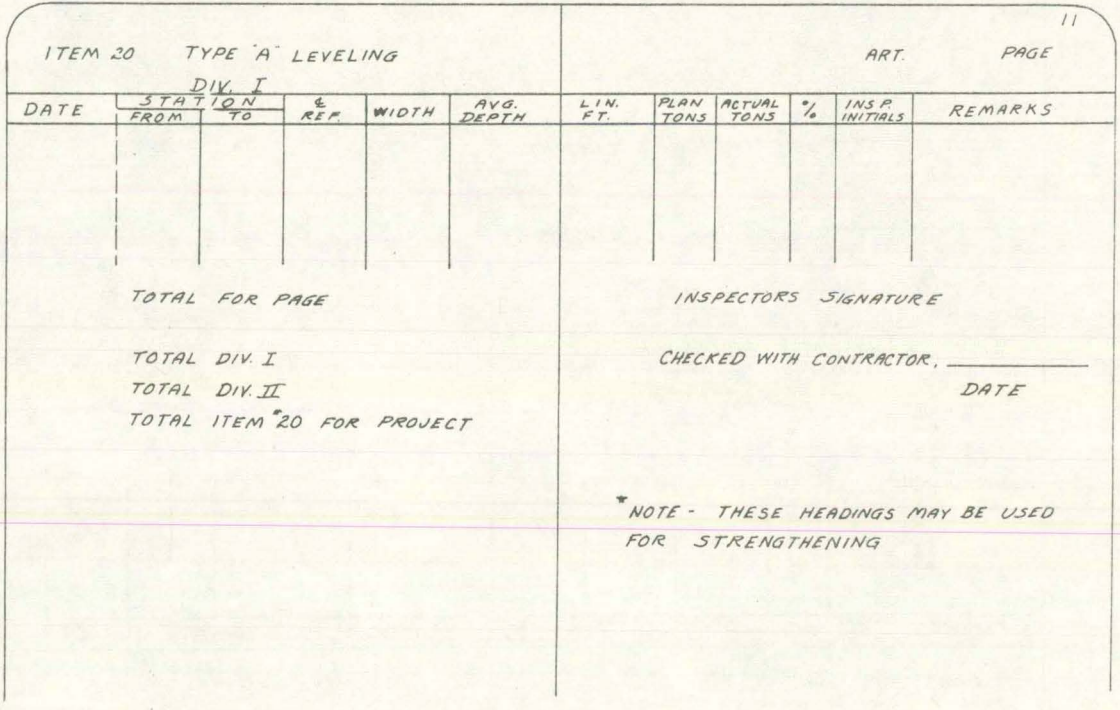

Figure 22 – Diary

12

TYPE "A" SURFACE ITEM 21 ART. PAGE

DATE	& REF.	LIFT	WIDTH	DEPTH	STATION FROM	STATION TO	LIN. FT.	TONS USED	TONS REQ'D	TOTAL TO DATE	%	INSP. INITIALS	REMARKS

PAGE TOTAL

TOTAL DIV. I

TOTAL DIV. II

TOTAL ITEM 21 FOR PROJECT

INSPECTORS SIGNATURE

CHECKED WITH CONTRACTOR, _____

DATE

CHECKED BY, _____

*NOTE - THESE HEADINGS MAY BE USED FOR BINDER & WEDGE.

Figure 23 – Diary

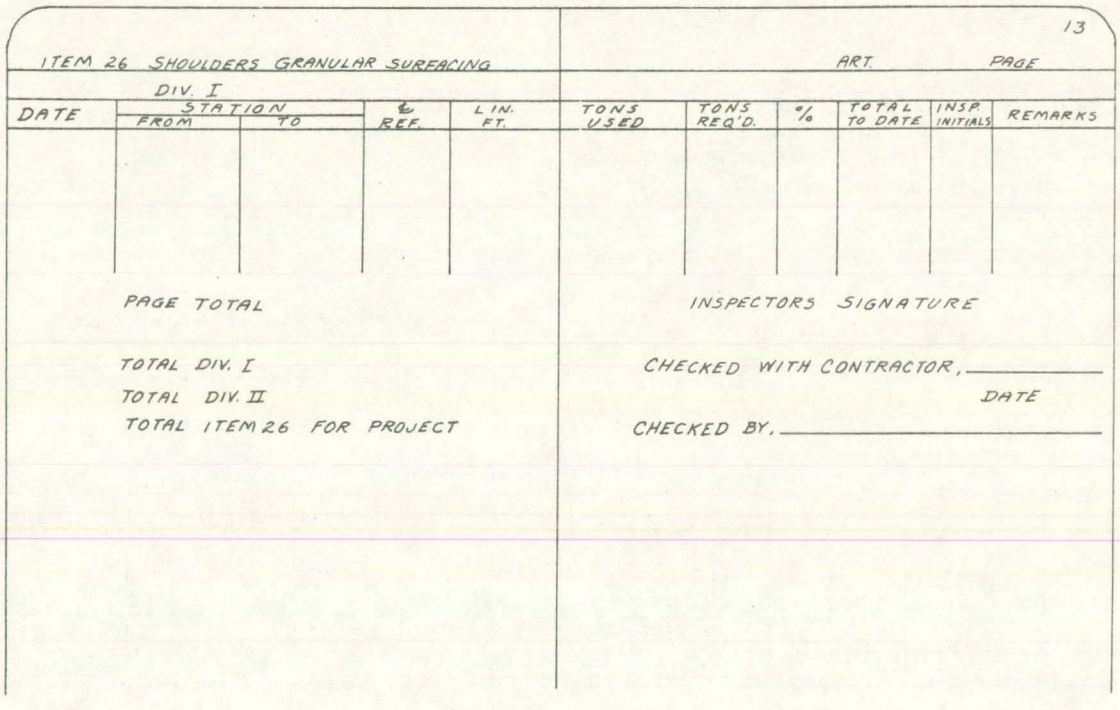

Figure 24 – Diary

REF. FROM PLANT WORKSHEET

14

ITEM 39 INCREASED OR DECREASED ASPHALT

NET TONS A.C. MIX	BASIC % A.C.	BASIC TONS A.C.	BILLED GALS.	BILLED TONS	TONS IN STORAGE BEG. PROJ.	TONS IN STORAGE END OF PROJ.	WASTE	NET A.C. USED	TONS INCR. OR DECR.	REMARKS

INSPECTORS SIGNATURE

CHECKED WITH CONTRACTOR, _____

DATE

* NOTE: THIS HEADING IS USUALLY IN PLANT BOOK

Figure 25 – Diary

% AIR VOIDS								
DATE	STATION	% A.C.	COMB. SP.GR. AGG.	SP. GR. A.C.	SP. GR. SLAB SAMPLE	% AIR VOIDS	CHECKED BY	REMARKS

Figure 26 – Diary

DENSITY RECORD

16

DATE LAID	REF. TO ℄	STATION	ORIGINAL DRY WT.	WT. IN H_2O	COURSE	DIFF.	FIELD DENS.			LAB. DENS.	% LAB. DENS.	THICK-NESS	INSP. INIT.

Figure 27 – Diary

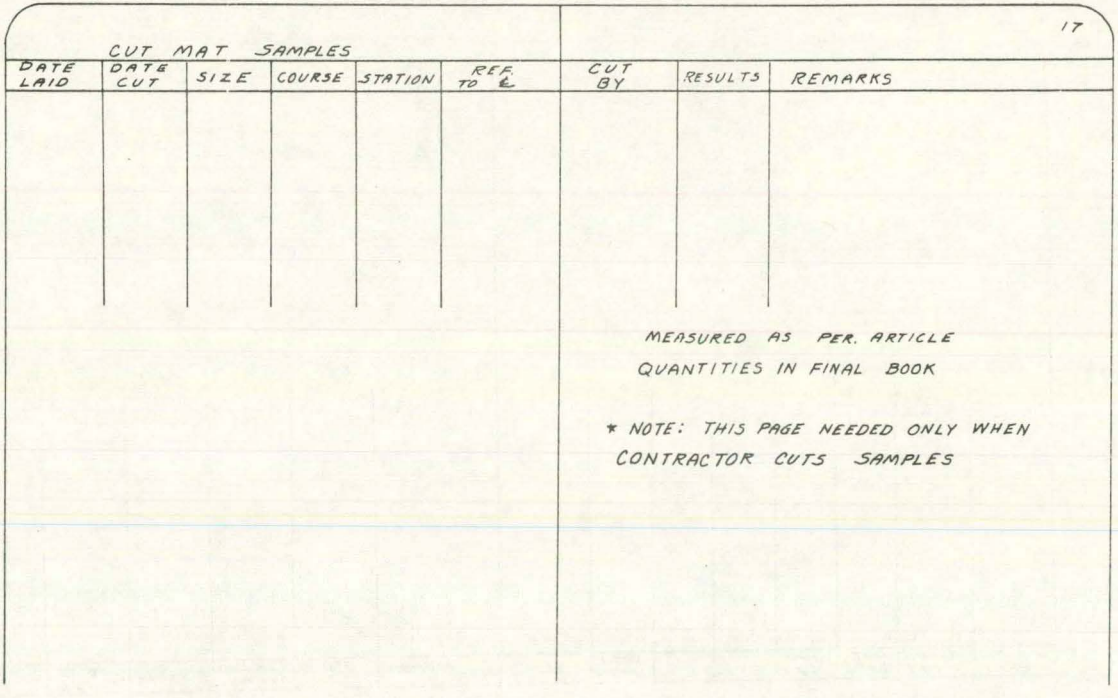

Figure 28 – Diary

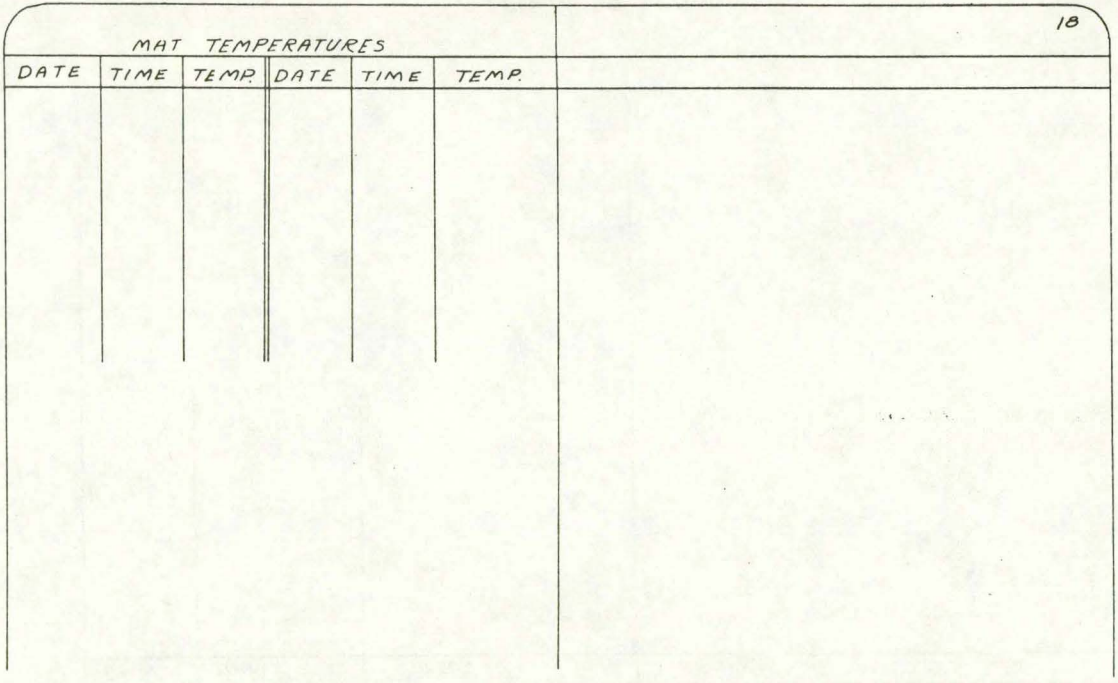

Figure 29 – Diary

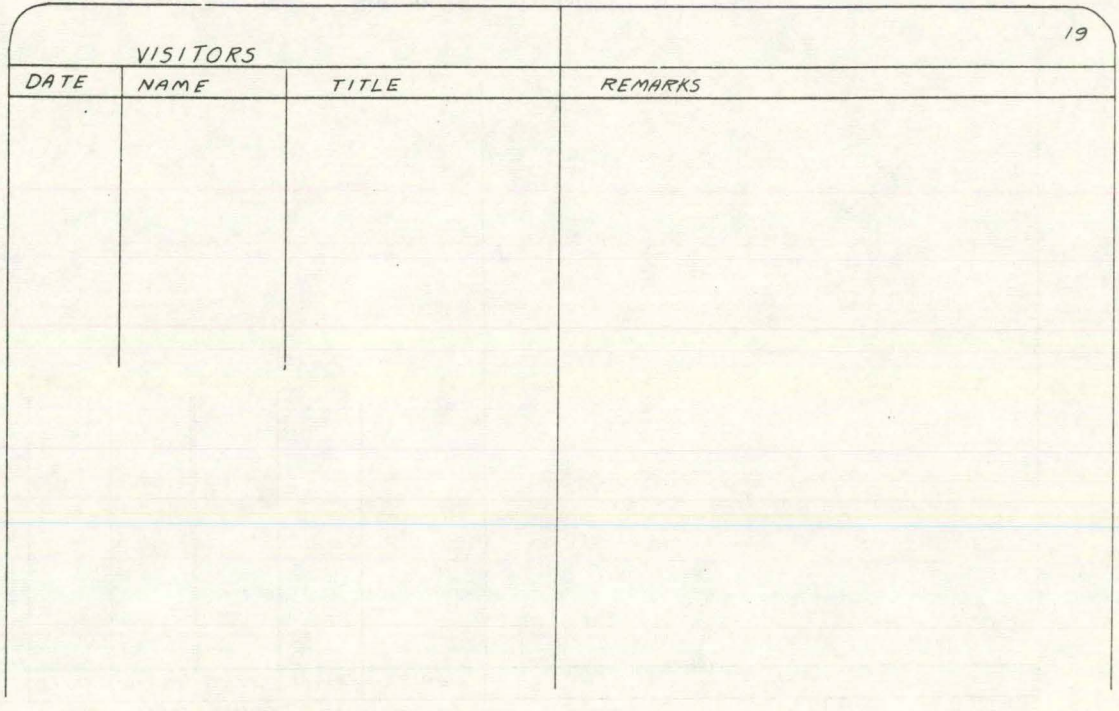

Figure 30 – Diary

NOTES