Engineering Brief # 4

Date: April 7, 1975

Subject: Engineering Brief No. 4, Preparing Existing Bituminous Concrete Pavements for Overlays by Use of Heater Scarifying (Remixing) Technique

From: Acting Chief, Airports Engineering Division, AAS-500
To: All Regions

Attn: Chiefs, Airports Divisions

Engineering Brief No. 4, Preparing Existing Bituminous Concrete Pavements for Overlays by Use of Heater Scarifying (Remixing) Technique, is enclosed. The content and purpose of Engineering Briefs are as stated in our transmittal letter of September 18, 1974.

Approval of the heater-scarifying procedure by Airports Service is not required since experience in various regions indicates it has merit under some circumstances. The Engineering Brief suggests items to be considered by responsible offices in deciding on sponsor requests to use heater scarification.

It should be noted that Order 5300.1A, Approval level for Adaptations of Agency Airport Standards is being revised regarding approval of widely used nonstandard construction items.

ORIGINAL SIGNED BY:
E. DONALD BAUER

Enclosure

AAS/580 AIKMAN/cam 4/7/75
cc: AAS/500/580/11B/All Regions

ENGINEERING BRIEF NO. 4
PREPARING EXISTING BITUMINOUS CONCRETE PAVEMENTS FOR OVERLAYS BY USE OF HEATER SCARIFYING (REMIXING) TECHNIQUES

During the week of February 10, 1975, I inspected pavement at several airports where heater scarifying had been used to prepare existing bituminous concrete pavements for bituminous overlays. The locations were as follows.

San Francisco International Airport, California
Bishop Airport, Bishop, California
Long Beach-Daugherty Field, Long Beach, California
Ramona Airport, Ramona, California
El Paso International Airport, Texas
Deming Municipal Airport, Deming, New Mexico

Alamogordo Municipal Airport, New Mexico
Roswell Industrial Air Center, Roswell, New Mexico

The reason for the inspections was that there seemed to be substantial variances between and within FAA Regions on how and where the heater scarifying technique is used. It has been popular with the Western, Northwest, and Rocky Mountain Regions, and in the Albuquerque District of the Southwest Region, but is little known and almost unused in the Eastern, Northeastern, Southern, Great Lakes and Central Regions.

Opinions on heater scarifying range from "an essential method for improving bond and reducing reflective cracking", to "I don't know," to "an unwarranted, expensive procedure which provides little or unneeded improvement over the conventional less costly tack coat ."

In addition, the purposes and methods of applying the heater scarifying technique vary as is indicated in the following paragraphs which describe how it was used at the inspected locations.

1. San Francisco International Airport. (SFO). On February 7, 1975, I met with Mike Mavarakis and John Pfeifer of the San Francisco ADO and Mitch Baugh, construction engineer for the City and County of San Francisco Airports Commission, to inspect and discuss pavement overlays at SFO. Heater scarifying is used where overlays are less than 5 inches thick. The purpose is to "insure adequate bond between the old pavement and the overlay." Heating and scarifying has also been used to correct differential settlement, particularly at runway intersections.

An example of where heater-scarifying was used for bonding purposes was the extension of Runway 28R and its parallel taxiway. The existing runway and taxiway had to be overlayed for a distance of about 600 feet to match grade with the extension. The first step before the overlay was placed was to cut the existing pavement about 1 inch in depth with a surface heater and blade to provide a butt-joint at the match point rather than a feathered edge. This procedure was referred to as contouring and was paid for by the cubic foot of removed pavement (1800 c.f. @ $2.00 = $3600.00).

Once this matching had been done, heater scarifying of the old pavement surface was started in the longitudinal direction. The specified minimum depth for scarifying was 1/2 inch. An additional requirement was that a minimum of 60 percent of the loosened material be turned and tumbled and spread evenly across the surface. The heater scarified material was then given a "rejuvenating tack coat" at a rate of 0.10 to 0.20 gallons per square yard. Immediately following this application the new surfacing material was spread and compacted in order to firmly bond the new material to the scarified material and old pavement. Cores of the overlayed pavement show this was accomplished and that there was no sharp line of demarcation between the old

and the new materials. At SFO heater-scarifying was paid for by the hour (100 hours @ $100 = $10,000) and the rejuvenating tack coat was paid for by the gallon.

An example of where heater scarifying was used to correct differential settlement of reclaimed land at SFO was at the intersection of RW lR-l9L with lOR-28L. In this case there were high points and hollows in the pavement surface that resulted in troublesome bumps. The first step in the corrective procedure was to lay a wedge of asphalt in the deeper hollows. The heater planer was then used to cut off high points and heater scarify the entire surface to a level 1-1/4 inches below finish grade. The scarified surface was sprayed with the rejuvenating agent at 0.2 gallons per square yard. This was followed by the placement and rolling of a thin asphalt overlay so that the desired grades were restored and the pavement unevenness due to differential settlement was eliminated. This resurfacing of the intersection closed the two runways for 72 hours.

At SFO the primary uses of heater scarifying have been in matching grades for extensions and restoring finish pavement grades which have been distorted by differential settlement. Heater scarifying provides a means of doing this and at the same time establishes a good bond between old pavements and thin overlays. Reflective cracking in overlays has not been a problem and it is not one of the primary reasons for heater-scarifying at SFO.

2. Bishop Airport, Bishop, California. On February 10, I inspected Bishop Airport in the company of Byron Osterloh, AWE-620, Carl Davidson of the Los Angeles ADO, and Chuck Luther, airport manager. Runway 16-34 had been heater scarified and overlayed in the fall of 1974 and the sponsor is planning to overlay Runway 12-30 in the near future.

The reasons for using heater scarification at this general aviation airport were quite different than at San Francisco International Airport. The runways at Bishop had not been improved since their original construction in 1942 and were badly oxidized and cracked and in need of leveling and strengthening. The existing Runway 16-34 pavement consisted of 6 inch gravel base and 4 inch asphalt surface on E-3 soil. The asphalt course had been placed in two layers.

The sequence of work in the overlay of RW 16-34 at Bishop was as follows. First of all, special care was taken in sealing cracks in the existing asphalt surface course. Cracks greater than 3/8 inch wide were blown clean through the first layer of old asphalt, a soil sterilant was applied, and they were refilled with an aggregate slurry and rejuvenator. After crack sealing, the existing pavement was heater scarified to a depth of from 1/2 inch to 1 inch and shot with rejuvenator at a rate of about 0.15 gallons/square yard. The placement and rolling of the overlay followed immediately after the heater-scarifier-rejuvenator operations and varied in thickness from 2 to 6 inches to reestablish longitudinal and transverse grades. The cost of heater scarifying at Bishop was $O.40/square yard. This did not include the cost of crack sealing or rejuvenator application.

3. Ramona Airport, Ramona California. On February 11, I inspected Ramona Airport with Byron Osterloh, AWE-620, Maurice Sasson of Los Angeles ADO and engineers Charles Stuck and Larry Clark of the County of San Diego Department of Public Works. Runway 9-27 had been heater scarified and overlayed in the summer of 1974.

The conditions at Ramona prior to the construction of the overlay were very similar to those at Bishop. Ramona is a general aviation airport and the runway had not been improved since its construction in the early l94O's. The asphalt surface was badly cracked and oxidized and in need of minor leveling and strengthening. The overlay, which was 1-1/2 inches plus additional amounts needed for leveling, was constructed in one lift. The reasons for heater scarifying were to provide a good bond between the thin overlay and existing pavement and to minimize the chances of reflective cracking.

The procedure and sequence of paving at Ramona were similar to Bishop except that the work done in sealing cracks was not quite as extensive. Instead of cleaning out cracks to the bottom of the first layer of the old asphalt pavement and applying a soil sterilant, the cracks were swept and blown out and then treated with rejuvenator and sand. There was extensive cracking in the old runway. After crack sealing, the old runway surface was heater scarified to a depth of 5/8 inches and shot with rejuvenator at 0.15 gallons/square yard. The placement and rolling of the 1-1/2 inch overlay followed immediately thereafter. At Ramona the cost of preparing the existing surface was $O.40/square

yard for crack sealing, $0.24/square yard for heater scarifying, and $1.10/gallon for the rejuvenator.

The only difference in the appearance of the overlays was that very minor reflective cracking appeared in the new Ramona surface while none was observed in the Bishop pavement. Since both runways were overlayed in the summer and fall of 1974, their long range performance remains to be seen.

4. Long Beach-Daugherty Field, California. Long Beach is a location where the performance of overlays with heater scarification have been observed since 1968. Three of the five runways received this treatment in 1968 and have been subjected to heavy air carrier type traffic such as DC-9s and DC-lOs which are manufactured and flight tested at the Long Beach McDonnel Douglas plant.

On February 11, I inspected Long Beach pavements and cores in the company of Byron Osterloh, AWE-620, Maurice Sasson of Los Angeles ADO, and Ben Warren and Doyle Bowers who are airport engineers for the city of Long Beach. The purpose of the 1968 overlays was to provide pavement strength for increased aircraft weights and eliminate dips in pavement surfaces. Increased traffic and loads had caused deterioration and differential settlement. The existing pavements also contained fatigue cracks and their surfaces were contaminated with deposits of rubber and fuel.

The sponsor decided on heater scarification because he felt it would oxidize surface contaminants, seal fatigue cracks and provide a good bond between the old pavement and the overlay. The old pavement surface was scarified to a depth of about 3/4 inch and sprayed with rejuvenator about 0.15 gallons per square yard. This was followed immediately by the placement and rolling of the overlay. The thickness of the overlay varied from as little as 1 inch at runway edges to as much as 6 inches near centerlines. Where the overlay was placed in two lifts only the surface between old and new material was heater-scarified.

During the February 11 inspection, examination of cores taken shortly after construction and as recently as February 1975 revealed that an excellent, long lasting bond had been achieved between the old pavement and the overlay. This was also apparent in observing current surface conditions. There was no evidence the surface had been shoved by the operation of heavy aircraft and reflective cracking seemed minimal.

Whether these same good conditions would have been present if the conventional tack coat had been used is anyone's guess. However the sponsor's engineer indicates Long Beach hopes to use heater scarification on future overlays because of the good performance of the 1968 overlays and the added confidence the city has in pavements constructed with this technique. Based on extensive tests and analysis, he feels the extra cost is justified.

5. El Paso International Airport, Texas. The situation at El Paso was somewhat similar to that at Long Beach from the standpoint of longevity and use. RW 8-26 had been heater scarified and overlayed in 1966 and has been subjected to heavy air carrier traffic. However, the condition of RW 8-26 before overlay was quite different from that at Long Beach because of the arid desert conditions at El Paso. The existing pavement was badly oxidized and contained large shrinkage cracks.

I inspected the El Paso pavements on February 12 in the company of John Dufficy, I.D. Miller, and Blair Harvey of ASW-600; Roy Biscamp and Gene Falkner of Albuquerque ADO; and Carter Porter and Don Creman representing El Paso International Airport and Industrial Park. Don Cremen's engineering firm prepared the plans and supervised construction for the overlay project.

The construction procedure at El Paso was similar to that at the other locations with heater scarification about 3/4 inch, rejuvenator application of about 0.15 gal/sy, followed by overlay laydown and compaction. The overlay thickness was 1-1/2 inches plus. After almost 10 years of service the surface is in fair to good condition. The reflective cracking which has taken place is not serious and there is little evidence of overlay displacement due to shoving.

The sponsor is pleased with the performance of the RW 8-26 overlay and plans a 2 to 2-1/2 inch overlay of RW 4-22 using the heater-scarified technique in the near future. RW 4-22 has lots of cracks and its surface is oxidized due to the desert climate. The sponsor has done a good job in keeping RW 4-22 cracks sealed so they should require minimal work in preparation for the pending overlay.

6. Deming Municipal Airport, Alamogordo Municipal Airport, and Roswell Industrial Air Center, New Mexico. On February 13 I inspected heater scarified overlays at Deming, Alamogordo, and Roswell with John Dufficy, I.D. Miller, and Blair Harvey of ASW-600 and Roy Biscamp and Gene Falkner of the Albuquerque ADO.

At Deming we were joined by a Mr. Harris who had supervised the overlays for the city of Deming. Deming Municipal is a general aviation airport which was constructed in the 1940s. When RW 4-22 was overlayed in 1972, it was badly cracked and oxidized. Heater scarification with rejuvenator was performed prior to placing and compacting a 2-inch overlay. No special treatment was given to the existing cracks in pavement since the philosophy at Deming was that heater scarification alone would take care of reflective cracking. Because the overlay at Deming was not carried to the full width of the original pavement and because the heater scarification was carried beyond the width of the overlay, it was possible to see the adjacent conditions of the original pavement, heater scarified pavement and the

overlay. The original pavement is badly cracked and oxidized. The scarified strip was less oxidized due to the rejuvenator application and a thin skin of scarified material still existed over wide cracks. The overlay was in good condition except there were some reflective cracks extending from the wide cracks in the old pavement into the overlay.

The question was raised as to what would have happened at Deming if cracks in the old pavement had been blown out and sealed and conventional tack coat had been applied prior to the overlay instead of the heater scarification and rejuvenator treatment. It appeared the heater scarification had not eliminated reflective cracking. Because of the light aircraft using Deming there was little concern about the displacement of the runway surface due to aircraft operations.

The situation at Alamogordo was similar to that at Deming as far as condition of the existing pavement and the overlay procedure were concerned. The joints were broomed and cleaned before scarification but no joint filler or sealer was applied. The thickness of the overlay, which was placed in October 1973, was 1-1/2 inches plus. The rate of rejuvenator application was 0.10 gallons/sy.

Inspection of Alamogordo was made in the company of Dan Gudeczansicas, airport manager, and Quinten Daniel, consulting engineer for the overlay job. The condition of the overlay was good except there were some minor hairline reflection cracks from the old pavement. The heaviest pavement loads at Alamogordo are from aircraft used to fight forest fires and from Frontier Airline's prop-jet flights. There was no evidence of pavement displacement due to aircraft operations. An overlay of the taxiway paralleling runway 3-21 using heater scarification is also scheduled for Alamogordo.

At Roswell, New Mexico RW 17-31 had been rehabilitated in the spring of 1974 by heater scarifying and placing a 1-1/2 inch overlay on the old surface and constructing a 5/8 inch porous friction course on the overlay. According to local airport officials the old surface had been badly cracked and oxidized. The new porous friction course was in excellent condition and there were no signs of reflective cracking or overlay displacement due to aircraft operations. The airport is subject to heavy aircraft loads from wide body jets which use Roswell as a training facility. Roswell airport representatives included Caesar Lohman, airport manager, and Earl Cook, airport engineer.

Conclusions. The use of heater scarification with an asphalt rejuvenating agent has in general been successful in the above and cores taken therefrom. However, the problem with this construction technique, as its detractors point out, is that success in similar overlay constructions has also been achieved by sealing cracks and treating old surfaces with

properly placed tack coats. This is evidenced by the fact that most overlays constructed in the past have been subject to this conventional procedure and have been successful in their performance. The comparative degree of success of the two methods has not been established although experience indicates that a superior bond results from heater scarification. The question is, "When is the superior bond necessary?"

In deciding on sponsor requests to use heater scarification with an asphalt rejuvenating agent it is recommended that each request be judged on its merits and that considerations include the following:

1. Thickness of overlay.
2. Forecast aircraft weights and volume.
3. Condition of existing pavement.
4. Credit in pavement thickness, if any, for heater scarified overlays.
5. Cost of heater scarification.
6. Comparison of costs between heater scarification and conventional tack coat.

If it is decided that heater scarification is desirable, it is suggested that bid documents contain alternates for tack coat and heater scarification, that all work preparatory to either process be fully described in the specification and bid items, and that the various operations involved in heater scarification be separated in the bid items. In addition, for jobs which result in heater scarification after this analysis and bidding, it is recommended that the construction of an overlay test section be required using conventional tack coat so that more definitive information can be obtained regarding comparative performance of the two overlay types under the same conditions.

As is indicated in this Engineering Brief, the choice of either overlay type is often a matter of personal preference which is not based on detailed comparative experience or technical data. therefore, special care should be taken when constructing heater scarified overlays, to provide a means of collecting meaningful information. Any comments on your experience with this process will be appreciated.

ORIGINAL SIGNED BY:
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April 2, 1975

Note: Picture of Ramona Airport, California, showing sealed cracks in runway before heater scarification and overlay, is enclosed.