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INSPECTION OF PAVEMENT GROOVING

Robert C. Gunkel

Army Construction Engineering Research Laboratory
Champaign, Illinois

February 1973

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DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORY

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AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

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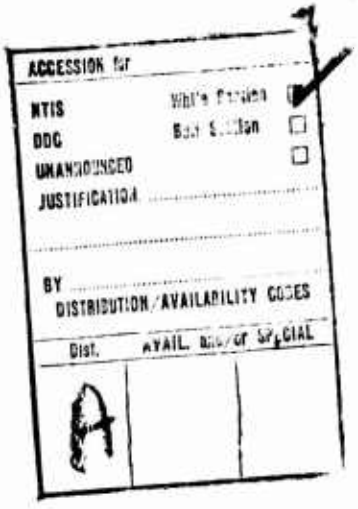

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I

FOREWORD

This report was prepared by the Department of the Army, Construction Engineering Research Laboratory, Champaign, Illinois, under MIPR 69-21. The research was performed under Project 6111A, Task 5.3

Inclusive dates of research were December 1971 through January 1972. The report was submitted 22 November 1972 by the Air Force Weapons Laboratory Project Engineer, Mr. Loren M. Womack (DEZ-P).

This technical report has been reviewed and is approved.

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13 ABSTRACT

(Distribution Limitation Statement A)

A reinspection of grooved pavements at four commercial and one military airfield was conducted by the Construction Engineering Research Laboratory (CERL) in December 1971 and January 1972. The inspection included grooving in both portland cement concrete (PCC) asphaltic concrete (AC) pavements which had been grooved approximately 4 1/2 years prior to this inspection. Grooves in all PCC pavements were considered to be in excellent condition with no evidence of deterioration on the pavement surface. At one airfield, Kansas City Municipal, numerous surface voids were noted which were due mainly to weathering out of poor quality materials. Many of these surface defects apparently were present at the time of grooving; however, it was apparent that some of the surface defects had developed recently. Because of this, it could be possible that deliberate grooving has contributed to an increase in these defects. The grooved AC pavements were in very good to good condition at the time of this inspection. Some groove deterioration was noted, and in one touchdown area a shifting of the pavement surface was observed. This shifting condition was noticeable because of the distortion of the grooves. Rubber deposits have accumulated in the grooves in both PCC and AC pavement and removal operations are performed several times a year with no difficulty and no adverse effects on the grooves. Based on this inspection, the general indication is that deliberate grooving does not cause surface deterioration. Periodic inspection should be continued to determine the long-term effects of grooving.

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Civil Engineering						

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SECTION I

INTRODUCTION

1. Purpose and Scope

The purpose of this study was to reinspect the condition of grooved pavement at several airfields in the United States to ascertain if any deterioration of the pavements had developed since the original inspection performed in 1969. Comparison of pertinent data will provide additional information on the long-term effect of grooving on pavement deterioration.

In view of the interest in pavement grooving a secondary purpose was undertaken to determine, through discussions with airfield personnel: performance of pavement grooving from an operational viewpoint; effects of de-icing agents, snow and rubber removal operations; surface drainage; maintenance problems; and a consensus of opinion on grooved pavements.

The scope of this study was limited to a reinspection of the grooved runway pavements at the same four commercial airfields and one military airfield that had been inspected by the Ohio River Division Laboratories in 1969 (see AFWL-TR-69-166). All of the pavement at these airfields had been grooved some 1 1/2 years ago. One additional airfield, LaGuardia, was inspected during this study. The runway pavement at this airfield was grooved in the spring of 1971. The data collected during this study will furnish useful information for future evaluation. This report represents the results of the inspections made, and pertinent comments on performance of the grooved pavements based on field observations and discussions with airfield personnel.

2. Background

A study was made on the deterioration effects of deliberate grooving on airfield pavements. Grooving is done to reduce hydroplanning and skidding. Grooved pavements were inspected at four commercial and one military airfield in 1969 (see AFWL-TR-69-166). The inspection included both portland cement concrete (PCC) runways and asphaltic concrete (AC) runways, all of which had been grooved within 2 years before the inspection. Grooves in all PCC runways were in excellent condition with no evidence of deterioration except in one case where numerous small pop-outs and weather-outs had occurred. Grooving had apparently contributed to an increase in the defects. The AC runways showed minor groove deterioration in some areas, and some obliterations of the grooves in one touchdown area. Some closing of grooves in touchdown areas of AC surfaces can be expected, but this is not considered to be pavement deterioration. In both PCC and AC pavements rubber deposits were observed in the grooves, but no removal had been required at the time of the 1969 inspection. The pavement inspection (1969) indicated that the grooving had not caused any appreciable deterioration of either PCC or AC pavements.

SECTION II

KANSAS CITY MUNICIPAL AIRPORT

1. Runway Grooving

Runway 18/36 is 7000 feet long by 150 feet wide with PCC pavement and an AC overlay beginning near the center of the runway and extending southward approximately 2000 feet toward the south end. The original grooved portion of this runway was 4500 feet long and 130 feet wide with 10 feet of ungrooved pavement on each side. Six hundred feet of PCC pavement at the south end and 1900 feet of PCC pavement at the north end of the runway were not grooved. All grooves were sawed transverse to the runway centerline, and are 1/8 inch wide by 1/4 inch deep at a spacing of 1 inch center to center. This grooving was completed in May 1967.

During November and December 1969, the 1900 feet of PCC pavement at the north end and the 600 feet of PCC pavement at the south end of Runway 18/36 were grooved. The grooves in these two sections are 1/4 inch wide by 1/4 inch deep at a spacing of 1 inch center to center.

2. Discussion with Airport Personnel

In discussion of the grooving operations with airport personnel, it was indicated that the grooving has been very effective from an operational standpoint, and the effect of pavement deterioration has been negligible. It was also noted that during the period of snow removal and the use of de-icing agents no adverse effects have occurred.

on the grooved pavement. Rubber deposits have produced no problems to date. A minor problem with dust from dried cutting waste was experienced after the initial grooving in 1967 but during grooving operations performed in 1969, a continuous slurry pick up was performed which greatly reduced this problem.

Aircraft traffic consisted of about 20,000 operations per month at this airfield. An operation is defined as being either one landing or one takeoff.

3. Pavement Inspection

The grooved pavement inspection was made on 2 December 1971. Because of the heavy flying schedule, it was not possible to make a continuous inspection of the grooved runway pavement. However, a cursory inspection was permitted for examination of the grooving and for taking photographs in several different areas.

a. AC Grooving

The general condition of the grooved AC overlay pavement was considered to be "very good" to "good" at the time of this inspection (Figure 1). Only a minor amount of deterioration has developed after 4 1/2 years of service under heavy traffic conditions. In one area, near the south end, some minor surface raveling of the grooves was observed (Figure 2). However, this condition was said to have occurred during sawing of the grooves. No maintenance of the grooved AC pavement has been required.

b. PCC Grooving

The sawed grooves in the PCC pavement are in excellent to very good condition. There was no evidence of raveling or any other deterioration of groove edges. Numerous surface voids due to weathering out of unsound aggregate particles were noted (Figure 3). Many of these surface defects apparently were present at the time of grooving; however, it was noted that some of these defects appeared to have developed recently. Some minor spalling and random transverse cracking was observed. Figure 4 shows a random transverse crack located about 1500 feet from the north end of the runway. The excellent condition of the new PCC grooving located in the runway ends is shown in Figure 5. Figure 6 depicts grooving operations ending in AC shoulder pavement. No maintenance of the grooved PCC pavement has been required.

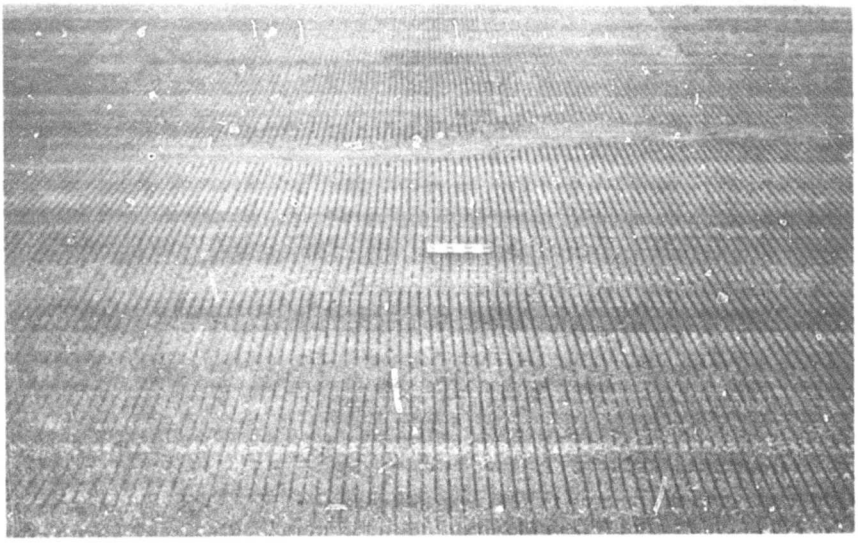

Figure 1. Kansas City Municipal Airport -- Typical view of AC grooving

Figure 2. Kansas City Municipal Airport -- Deterioration of AC grooving located near runway end (36)

Figure 3. Kansas City Municipal Airport -- PCC grooving (small holes in surface are weatherouts).

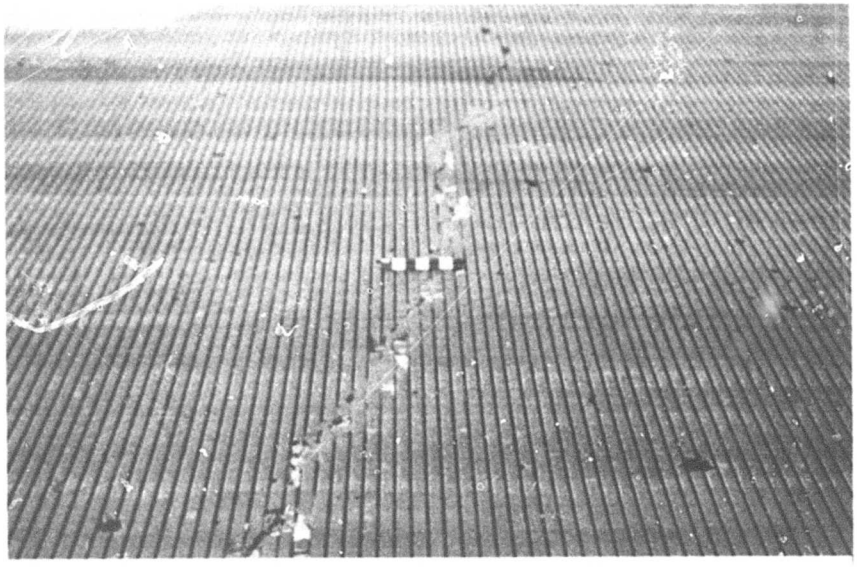

Figure 4. Kansas City Municipal Airport -- Transverse crack and surface voids located in PCC, 1500 feet from north end of runway.

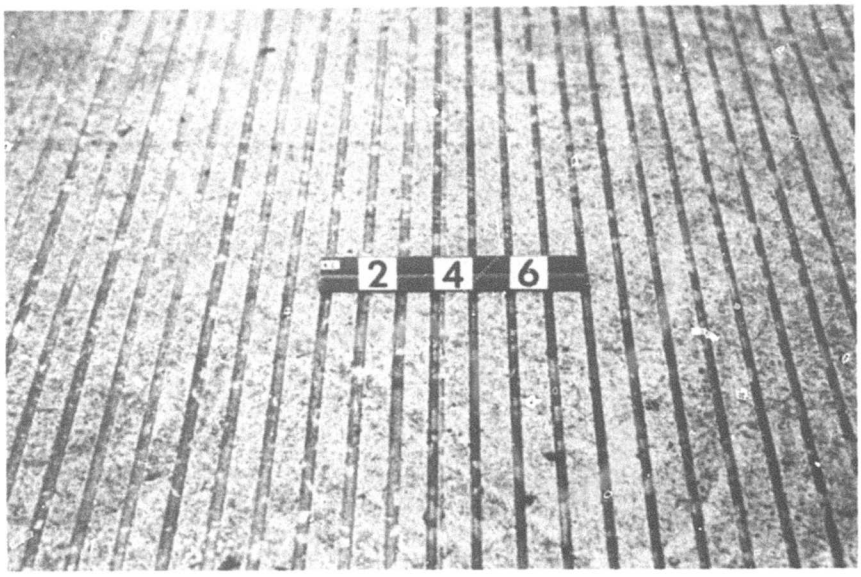

Figure 5. Kansas City Municipal Airport -- Typical view showing excellent condition of new PCC grooving.

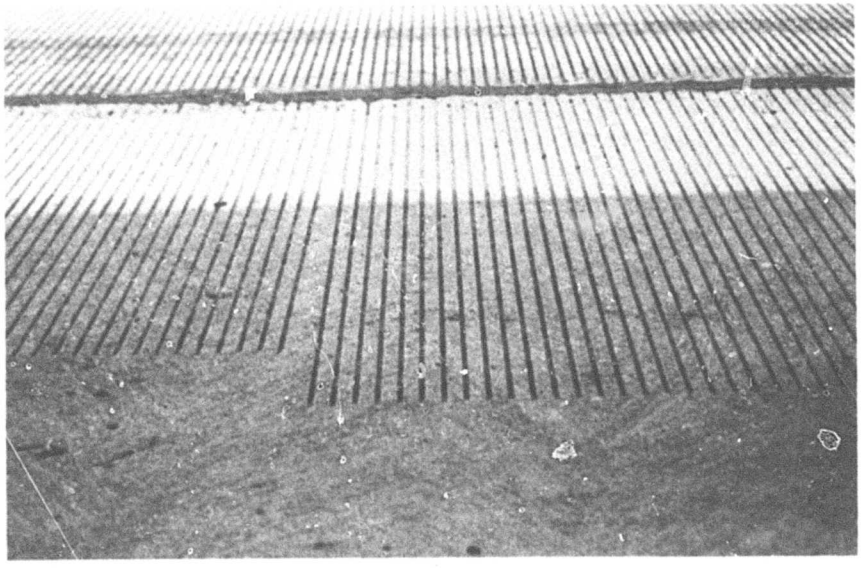

Figure 6. Kansas City Municipal Airport -- View showing how grooving operations end in AC shoulder pavement.

SECTION III

CHICAGO MIDWAY AIRPORT

1. Runway Grooving

Runways 13R/31L (6520 feet) and 4R/22L (6104 feet) were resurfaced with continuously reinforced PCC pavement in November 1967. Each runway consists of a 100-foot wide (four 25-foot lanes), 8-inch thick, continuously reinforced PCC overlay with a 37 1/2-foot AC shoulder on each side. Both runways were grooved transversely across the 100-foot PCC pavement and 2 feet into the AC shoulder on each side for a total width of 104 feet. The grooves are 1/4 inch wide by 1/4 inch deep with a spacing of 1 1/4 inches center to center.

2. Discussion with Airport Personnel

No problem with dust from sawing operations was experienced because the grooved areas were thoroughly flushed with water under high pressure immediately after grooving until all cutting waste was removed. It was stated that the grooving has been very effective from an operational point of view. There has been very little accumulation of rubber in the grooves, and therefore, no rubber removal has been required. During the winter, when sand used with de-icing agents is applied to the runway, it was noted that no accumulation of these materials is found in the grooves. There appears to be a self-cleaning action from aircraft operations which keeps the grooves clean. Airport and Operations personnel concur that grooving of the runway pavements has improved the stopping

distance for aircraft landing operations. Periodic inspections of the runways are performed to remove foreign objects, but no maintenance of the grooved pavement has been required.

Aircraft traffic at Chicago Midway Airport consists of about 16,000 operations per month. An operation is defined as being either one landing or one takeoff.

3. Pavement Inspection

The inspection of Runway 13R/31L was made on 7 December 1971. (Runway 4R/22L was not inspected due to flying operations, but it was assumed to be essentially in the same general condition based on reports by airport personnel.) The inspection started at the southeast end of the runway and the general condition was observed while driving slowly over the pavement. Several stops were made for close examination of the pavement and for taking photographs.

All of the pavement grooving observed at this airfield was in excellent condition (see Figures 7, 8, and 9). Tire marks were apparent in the touchdown areas, but there was little evidence of rubber deposits in the grooves. Several small areas of ungrooved pavement were observed where the grooving equipment had skipped over low places in the pavement surface (Figure 10). The continuously reinforced pavement had typical transverse cracks at closely spaced intervals, but there was little evidence of deterioration at intersections of the grooves with the cracks (Figure 11). A minor amount of surface voids were also noted (Figure 12). An extensive amount of spalling had occurred along the center longitudinal joint of the PCC pavement (Figure 13). This is

a structural problem which is not related to pavement grooving. Figure 14 shows a longitudinal joint spall repair made with a bituminous mixture.

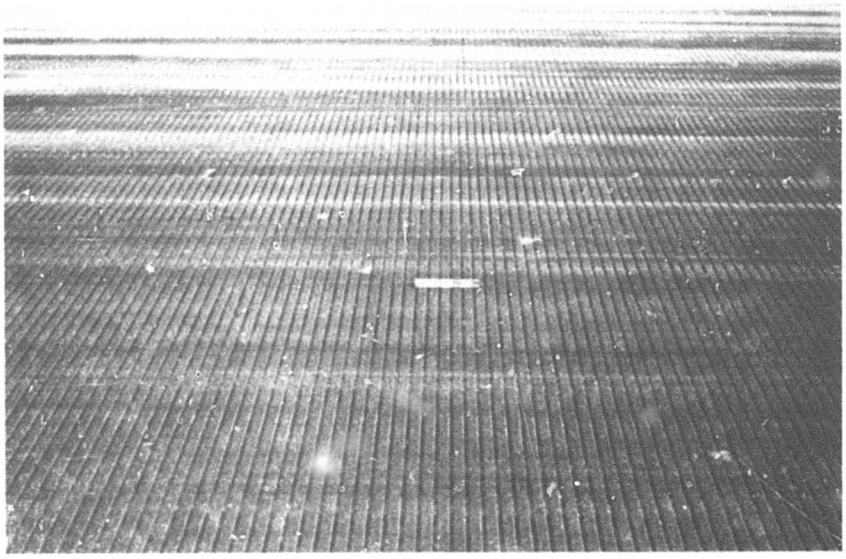

Figure 7. Chicago Midway Airport -- Grooved pavement in touchdown area, 1500 feet from southeast end of runway.

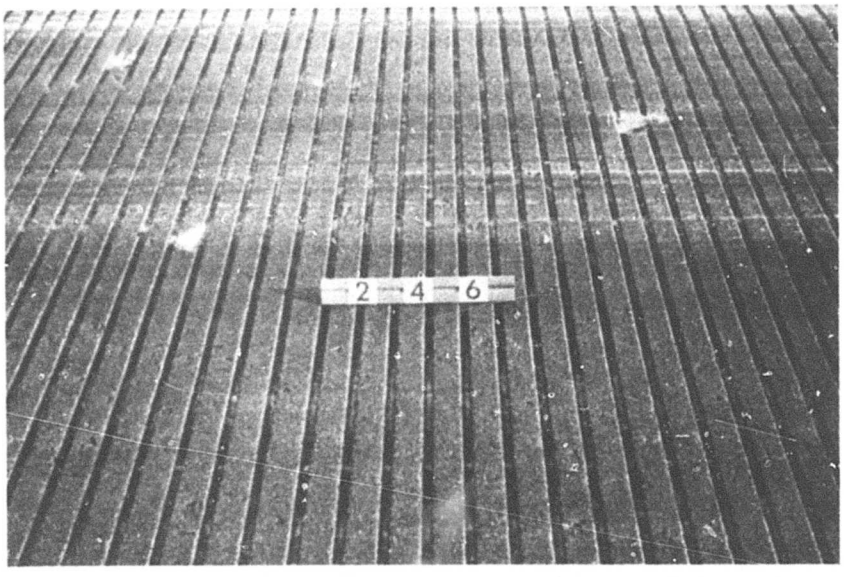

Figure 8. Chicago Midway Airport -- Close view in same area as Figure 7.

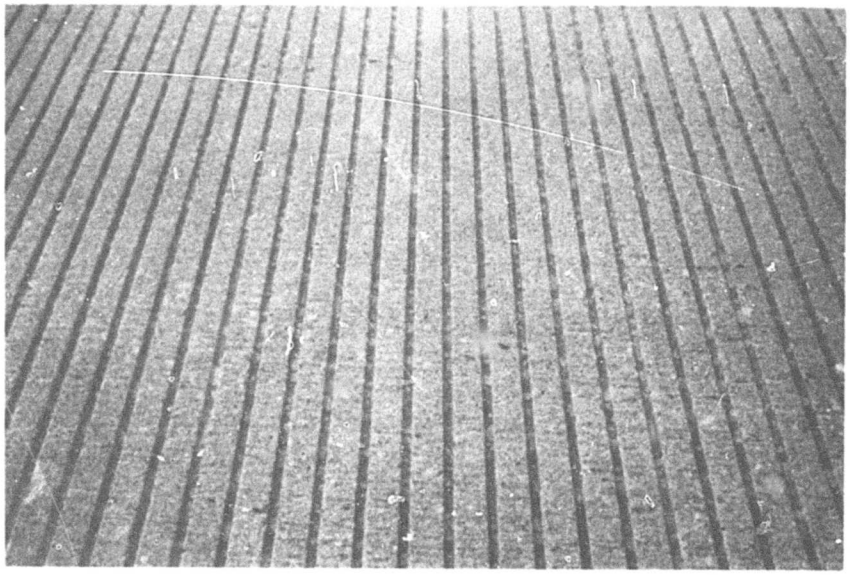

Figure 9. Chicago Midway Airport -- Excellent condition of grooving in southeast runway end.

Figure 10. Chicago Midway Airport -- Deficiency in grooving due to low area in pavement surface.

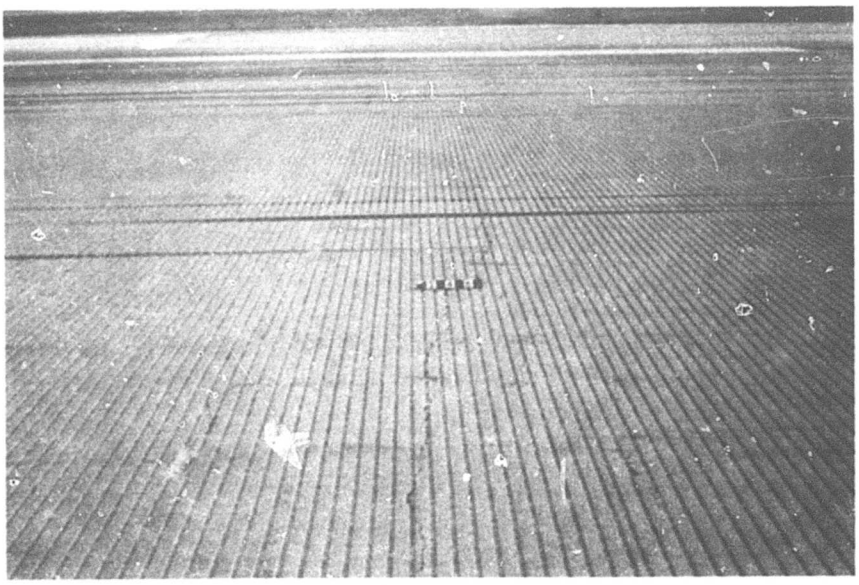

Figure 11. Chicago Midway Airport -- Typical transverse cracking found in continuously reinforced pavement.

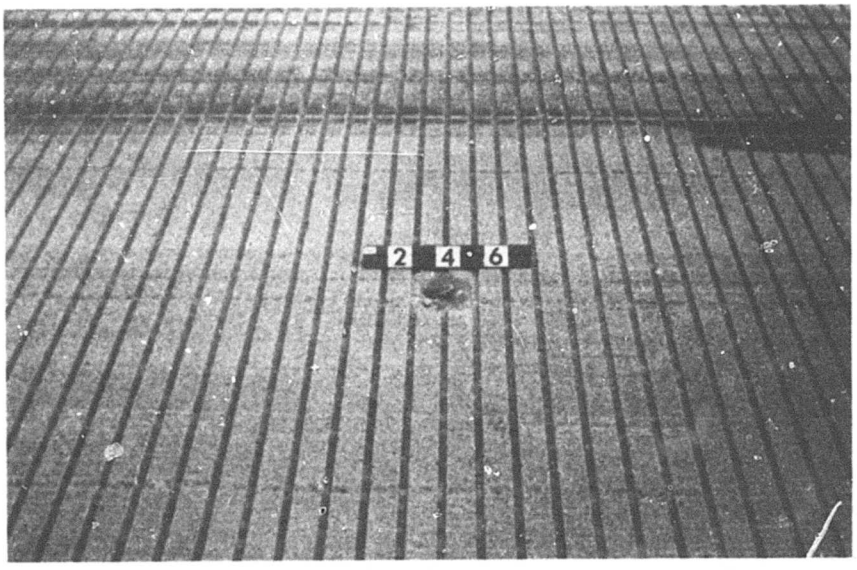

Figure 12. Chicago Midway Airport -- Close view of a weatherout, 1500 feet from northwest end of runway.

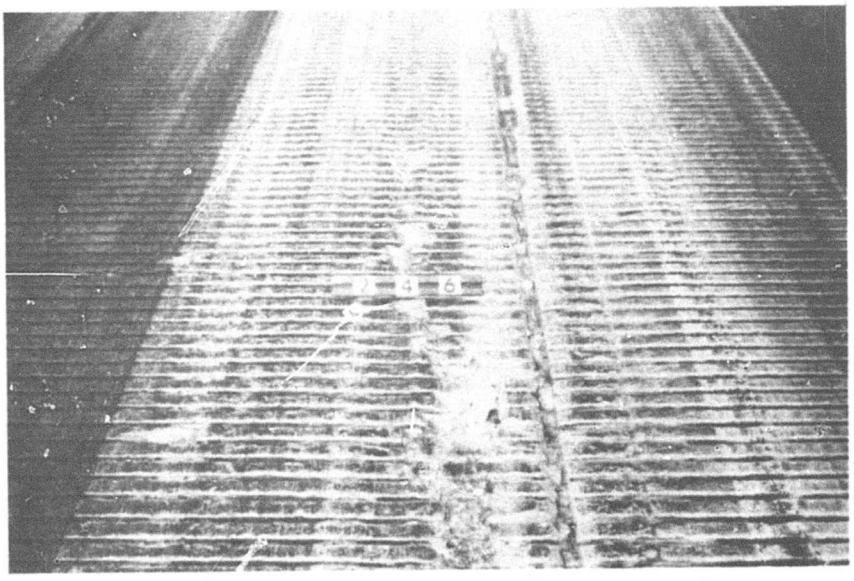

Figure 13. Chicago Midway Airport -- Spalling along center longitudinal joint of runway.

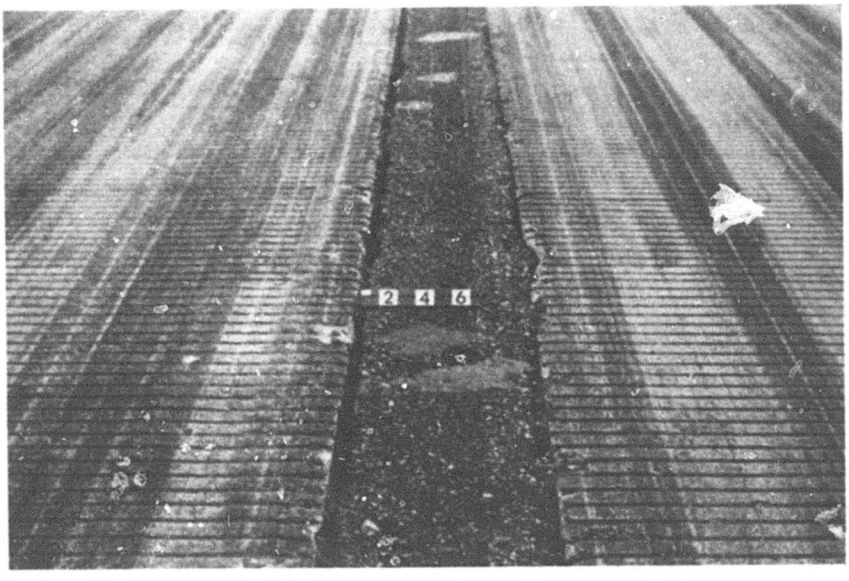

Figure 14. Chicago Midway Airport -- Joint spall repair made with bituminous mixture.

SECTION IV

J. F. KENNEDY INTERNATIONAL AIRPORT

1. Runway Grooving

Grooving of Runway 4R/22L was accomplished from May to August 1967. This is a PCC runway which is 8400 feet long by 150 feet wide and is grooved transversely over the full length to a width of 140 feet. The grooves are 1/8 inch deep and 1/8 inch wide at the bottom and beveled shaped with a top width of 3/8 inch. The grooves were sawed at a spacing of 1 3/8 inches center to center.

2. Discussion with Airport Personnel

Airport personnel stated that the grooving has been very effective from an operational point of view. It was also stated that pilot comments have been very favorable. An appreciable amount of rubber deposits were observed in the touchdown areas. Operations to remove rubber deposits are performed several (2-3) times a year. Airport personnel stated that rubber deposits also had to be removed two or three times a year before the runway was grooved. No problem has been encountered from snow removal or the use of de-icing agents. It was also mentioned that skid resistance, after more than 4 years, is still very good. Port personnel have observed no pavement deterioration and no repairs have been necessary.

J. F. Kennedy International Airport averages about 35,000 aircraft operations per month. An aircraft operation is defined as being either

one landing or one takeoff.

3. Pavement Inspection

The inspection of grooved runway 4R/22L was made on 16 December 1971. The inspection was started at the southwest end of the runway. The condition of the grooved pavement was observed while the inspectors drove slowly over the pavement. Several stops were made for close examination of the pavement and for taking photographs. Several small areas of ungrooved pavement were observed where the grooving equipment had skipped over low places in the pavement surface (Figure 15). There was appreciable rubber deposited in grooves in the touchdown areas (Figure 16). In one portion of the touchdown area, approximately 1800 feet from the southwest, rubber accumulation had completely filled the grooves (Figure 17). Based on observations during this inspection, the runway grooving was in excellent condition, and there was no evidence of groove deterioration or surface defects due to grooving. Figures 18, 19, and 20 are typical views showing the excellent condition of the pavement surface and grooves.

An examination was also made of the Federal Aviation Administration experimental test installation. This is part of an environmental test program and includes a variety of groove patterns. There has been essentially no traffic on this taxiway and all groove sections were in excellent condition.

Figure 15. J. F. Kennedy International Airport -- Ungrooved area due to low place in pavement surface.

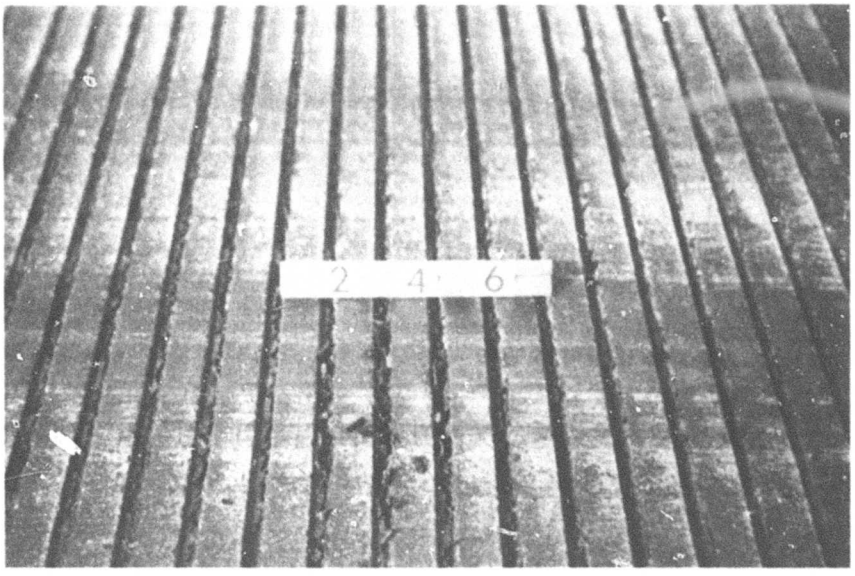

Figure 16. J. F. Kennedy International Airport -- View of rubber deposits in grooves in touchdown area.

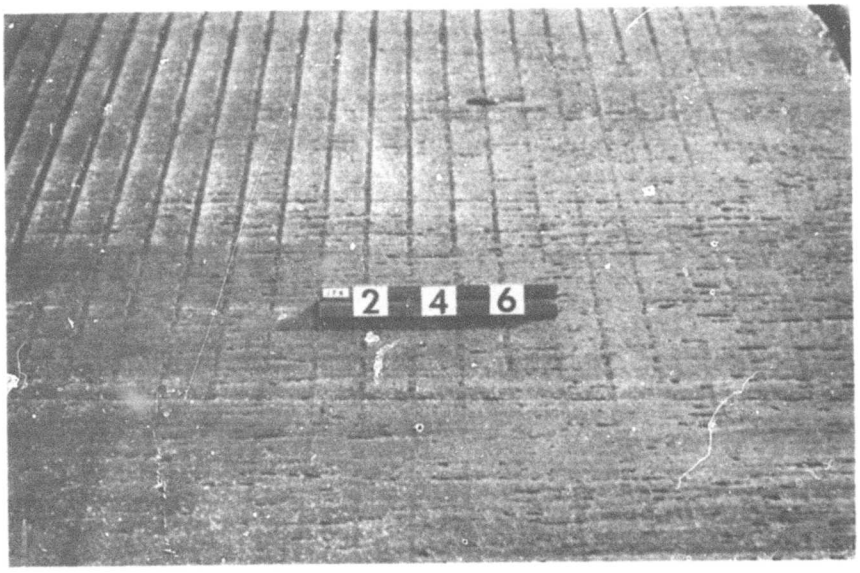

Figure 17. J. F. Kennedy International Airport -- Rubber accumulation completely filling grooves in touchdown area.

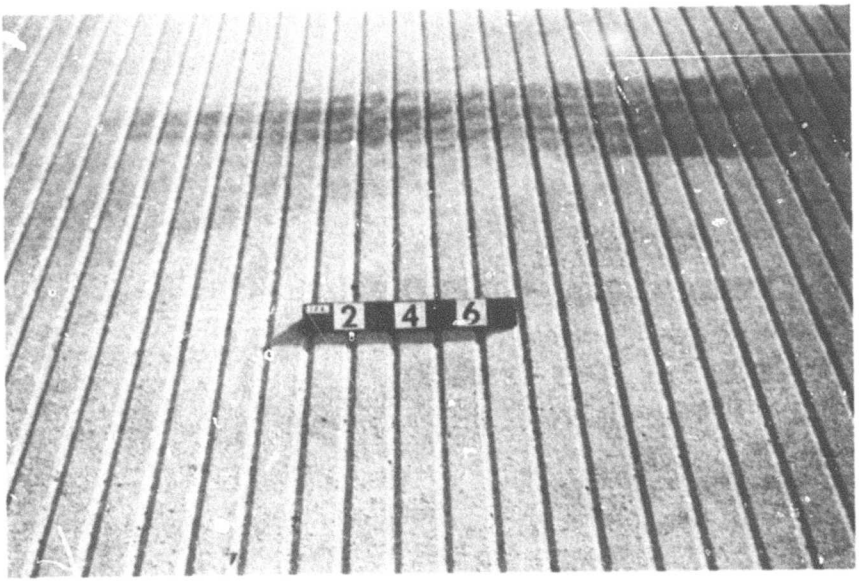

Figure 18. J. F. Kennedy International Airport -- Typical grooving in southwest runway end showing excellent condition.

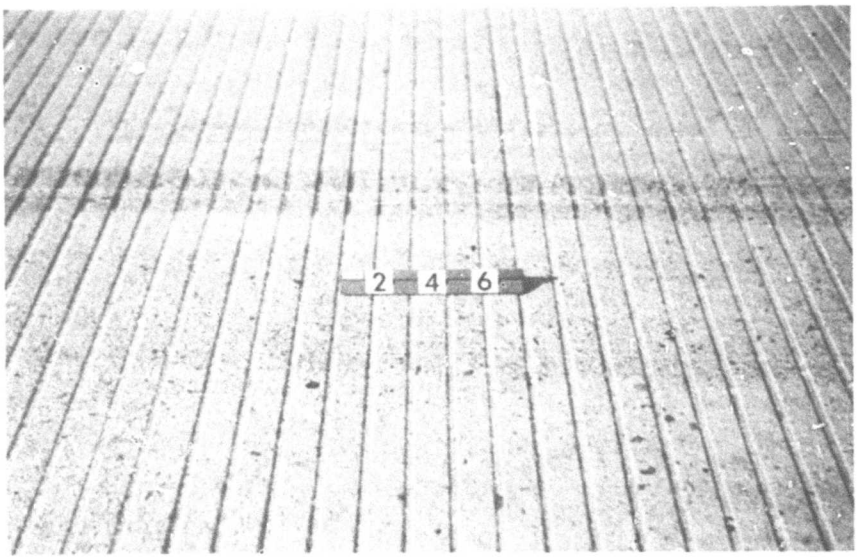

Figure 19. J. F. Kennedy International Airport -- Excellent condition of grooving in northeast end of runway.

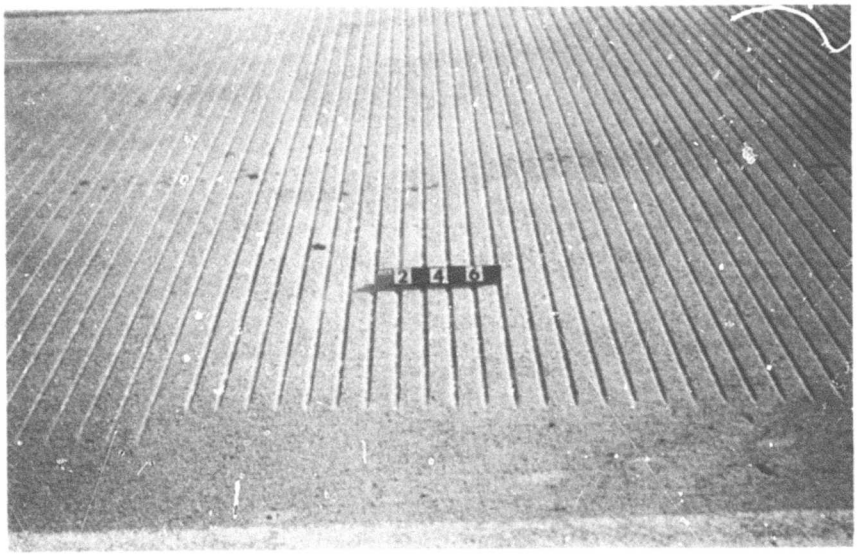

Figure 20. J. F. Kennedy International Airport -- View of outside traffic lane - grooving operations stopped within 5 feet of runway edge.

SECTION V

LAGUARDIA AIRPORT

1. Runway Grooving

Runway 13/31 is 7000 feet long and 150 feet wide. The first 950 feet, northwest end, is a PCC deck that is grooved transversely to a width of 140 feet with 5 feet of pavement on each side left ungrooved. The remainder of this runway is AC pavement. Beginning at the southeast end there is 4800 feet of AC grooving to a width of 140 feet.

Runway 4/22 is 7000 feet long and 150 feet wide. The first 1750 feet, southwest end, is a PCC deck that is grooved transversely to a width of 140 feet. The remaining 5250 feet of this runway is AC pavement. Approximately 4000 feet, beginning at the northeast end, was also grooved to a width of 140 feet. The grooving of both runways was completed in the spring of 1971.

The grooves in the PCC pavements on both runways are 3/8 inch wide at the top, beveled to a width of 1/8 inch at the bottom, and are 1/8 inch deep. All grooves were sawed at a spacing of 1 1/2 inches center to center. The grooves in the AC pavement have the same beveled shape and dimensions but are 3/16 inch deep.

2. Discussion with Airport Personnel

New York Port Authorities and airport personnel concur that pilot comments have been very favorable and that the grooving is considered to be highly successful from an operational viewpoint. It was also

stated that during rain the grooves were effective in draining the water from the runway surface. Because of the limited period that the grooving has been in use, no evaluation could be made pertaining to de-icing agents, snow removal or rubber removal operations. It was stated that rubber deposits were removed from the runways several times a year before grooving and that no foreseeable problem due to the grooving was anticipated.

About 28,500 aircraft operations are experienced monthly at LaGuardia Airport. An operation is defined as either one landing or one takeoff.

3. Pavement Inspection

The inspection of the pavement grooving at LaGuardia Airport was performed on 15 December 1971. The inspection was limited to Runway 13/31 as Runway 4/22 was being used for flying operations. However, it was reported to be essentially in the same general condition. The inspection began at the southeast end of the runway and the pavement grooving was observed during a drive over the pavement. Several stops were made for close examination and photographs of the pavement grooving. The inspection indicated that there was very little deterioration of the groove edges in either the PCC or AC pavements. The most common condition observed on this runway was ungrooved areas that were skipped over during grooving operations because of the undulating condition of the pavement surface.

It was reported that approximately 1200 feet of AC pavement on both runways was left ungrooved because of a settlement problem. This area is located at the intersection of the two runways and is resurfaced periodically.

Typical views of the grooved runway pavement are shown in Figures 21 through 24 and a description of the condition observed follows:

Figure 21 shows the grooving in the PCC deck at the northwest end of the runway. The grooves are sharply outlined and the beveled shape of the grooves may be detected. The grooved pavement was in excellent condition.

Figure 22 shows another view in the same general area as Figure 21. However, this portion was skipped over during grooving operations because of a low area in the pavement surface.

Figure 23 shows a small ungrooved area which was skipped during grooving due to a low place in the pavement surface. This is a deficiency in grooving and not a pavement deterioration.

Figure 24 is a typical view of the grooving in Runway 13/31 AC pavement.

The pavements in these figures may appear darker and glossier as they were wet due to rain at the time of this inspection.

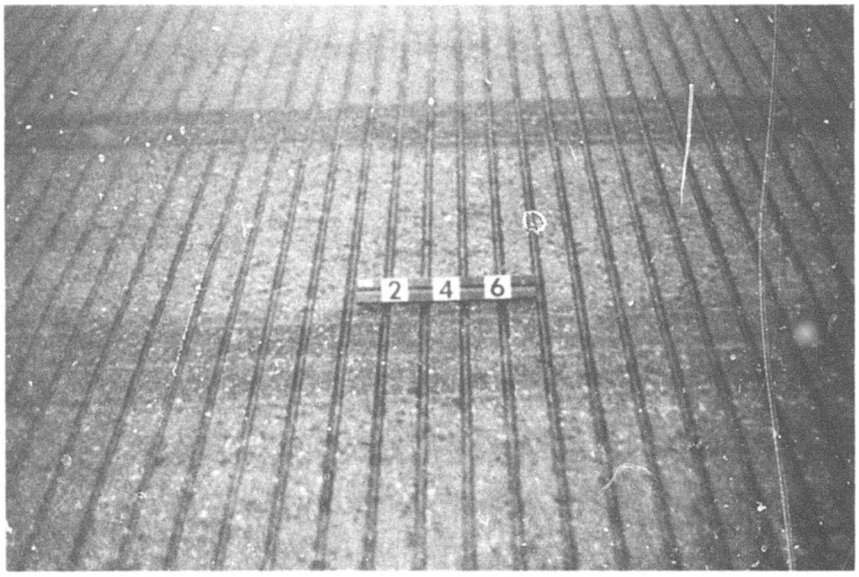

Figure 21. LaGuardia Airport -- General view showing excellent condition of grooving in PCC pavement - northwest end.

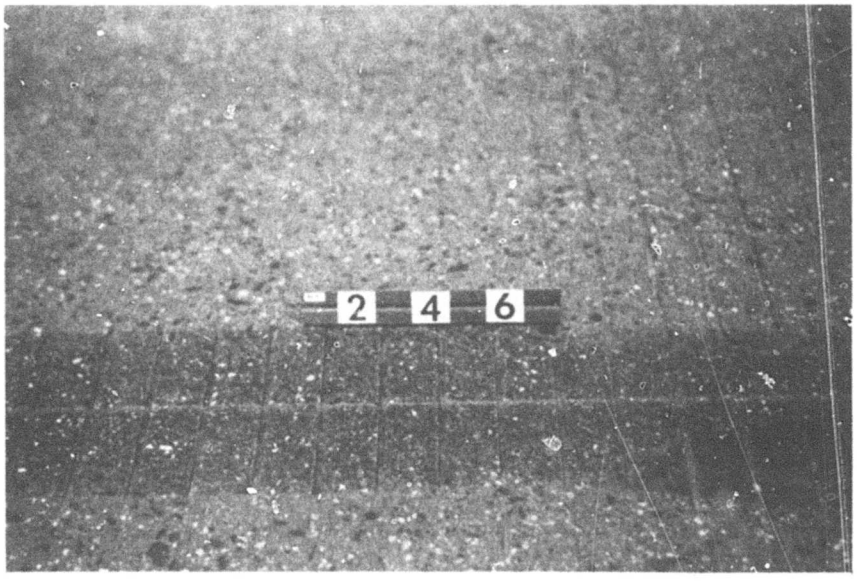

Figure 22. LaGuardia Airport -- Skipped area due to surface depression in northwest end of runway.

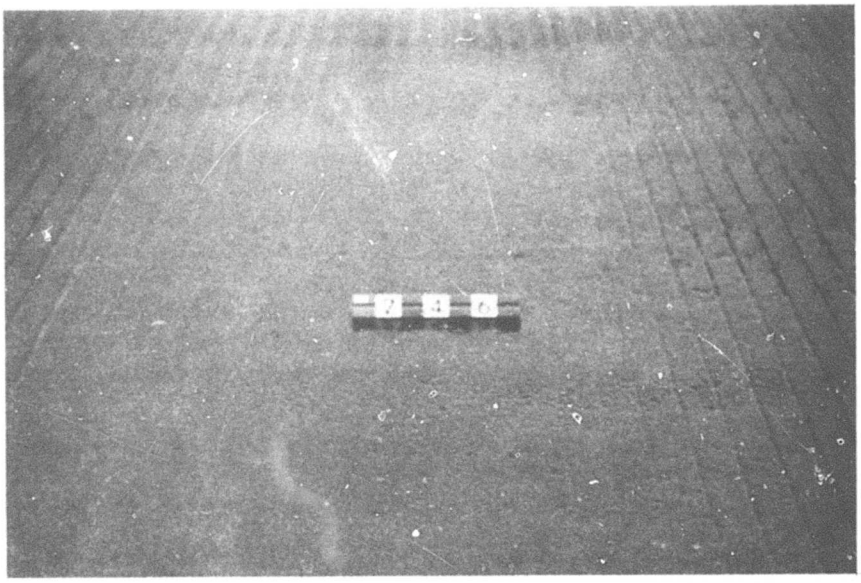

Figure 23. LaGuardia Airport -- Close view of ungrooved portion of AC pavement.

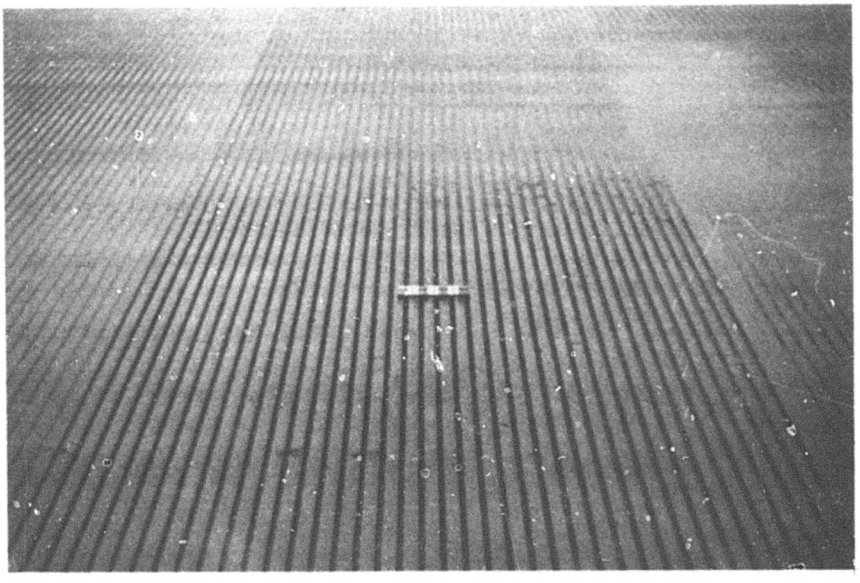

Figure 24. LaGuardia Airport -- Typical view of AC grooving in Runway 13/31.

SECTION VI

WASHINGTON NATIONAL AIRPORT

1. Runway Grooving

Runway 18/36 at Washington National Airport, which was grooved in March - April 1967, was the first operational runway to be grooved in the United States. The original runway, consisting of a flexible pavement up to 6 inches thick, was constructed in the early 1940s. An overlay pavement consisting of 3- to 9-inch thick asphalt concrete was placed in the spring of 1965. The runway is 6870 feet long by 200 feet wide and is grooved transversely over the full length to a width of 150 feet. A 25-foot width of pavement on each side was left ungrooved. The grooves are 1/8 inch wide by 1/8 inch deep at a spacing of 1 inch center to center.

Because of rutting on both sides of the center line, where main gears of the aircraft traffic, two thin wearing surfaces of asphaltic concrete were placed in 10-foot wide strips 5 feet from either side of the center line. Except for the first 500 feet at both ends, these strips extend the full length of the runway. The strips vary in depth, but the final grade is slightly higher than the original runway surface. The construction and grooving of these two strips were completed in October - November 1971. The groove dimensions are 1/8 inch wide by 1/8 inch deep at a spacing of 1 3/4 inches center to center.

2. Discussion with Airport Personnel

Airport personnel stated that the grooving has been very effective from an operational point of view. Pilots' comments pertaining to the runway grooving have been very favorable. During the interim of placing and grooving the two AC strips, several inquiries from pilots were made as to when the strips would be grooved. No problem has occurred from ice and snow removal during the winter season. According to the Operations Officer, a complete asphaltic concrete overlay for Runway 18/36 was being planned for the summer of 1972.

Washington National Airport traffic records indicate about 27,000 operations per month. An operation is defined as either a landing or a takeoff.

3. Pavement Inspection

The inspection of the grooved runway (18/36) was made on 29 December 1971. The runway was being used for flight operations so it was not possible to make a continuous inspection of the grooved pavement. Access to the runway was permitted for brief examinations of the grooving and for taking photographs at several different locations. A shifting of a portion of the surface near the north end of the runway was observed (Figures 25 - 26). The shift is noticeable because of the distortion of the pavement grooves in this area. Some minor raveling or chipping of fine aggregate particles was observed in non-touchdown areas. In some areas it was also noted that the edges of the grooves were slightly rounded. No appreciable rubber accumulation in the grooves

was observed during this inspection as it was during the inspection 2 1/2 years ago. This can be attributed to the two AC strips that were placed on this runway just prior to this inspection (Figure 27). The grooves in the two AC strips were in excellent condition (Figure 28). However, the spacing of the grooves did vary from the planned 1 3/4 inches center to center. Figures 29 and 30 show typical views of grooving in Runway 18/36 AC pavement. A rough textured pavement surface was observed but no deterioration was evident.

Figure 25. Washington National Airport -- Shifting of pavement surface in area of north end of runway.

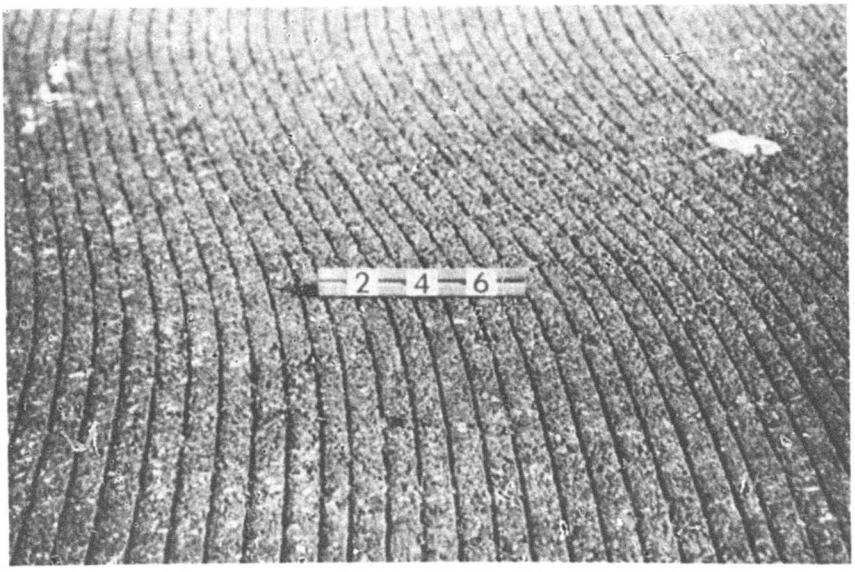

Figure 26. Washington National Airport -- Closeup showing distortion of grooves - same area as Figure 25.

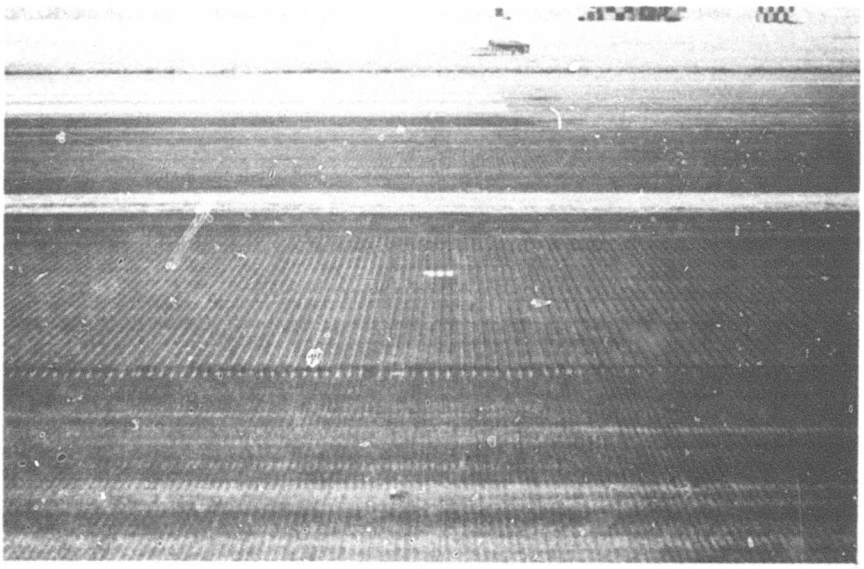

Figure 27. Washington National Airport -- View showing slightly elevated AC strips along center line of runway.

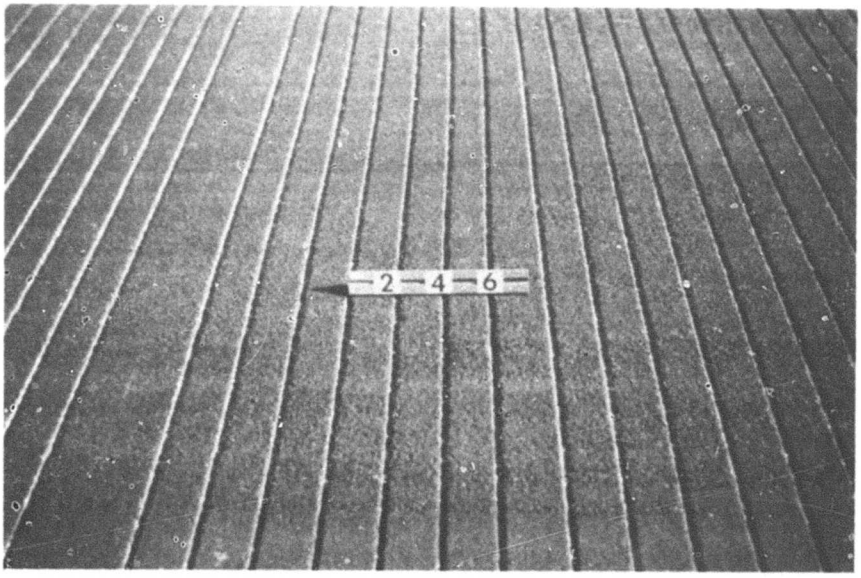

Figure 28. Washington National Airport -- Typical view of grooving on the AC strips.

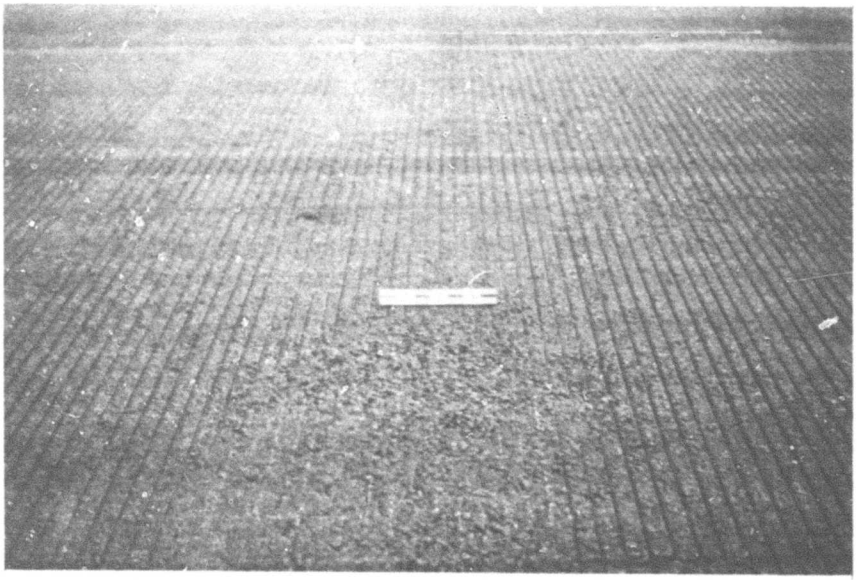

Figure 29. Washington National Airport -- Typical grooving in runway 18/36. Note rough textured AC pavement in foreground.

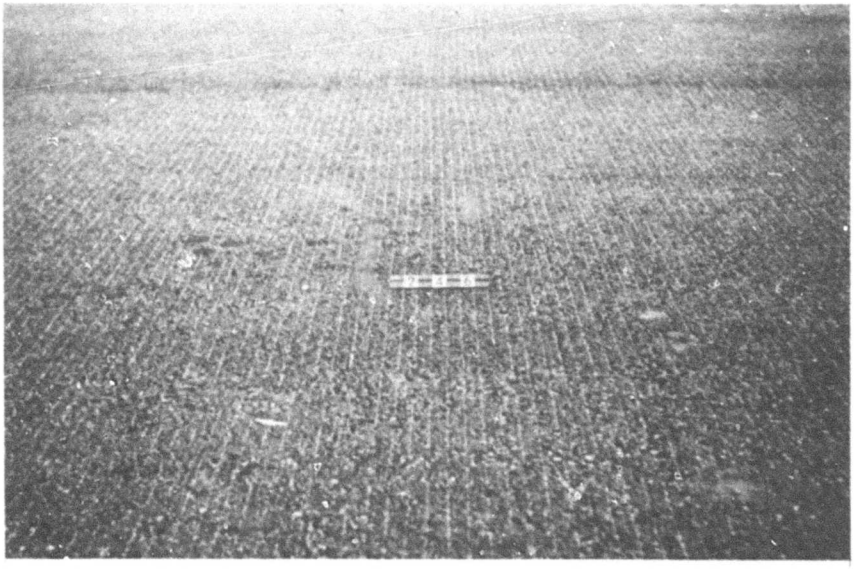

Figure 30. Washington National Airport -- Typical view of AC grooving near south end of runway.

SECTION VII

BEALE AIR FORCE BASE

1. Runway Grooving

Grooving on Runway 14/32 at Beale Air Force Base was accomplished during the period from October 1967 to February 1968. The runway is 300 feet wide by 12,000 feet long, and the PCC pavement ranges from 18 to 24 inches in thickness. The grooved portion is 140 feet wide by 10,800 feet long with an ungrooved portion 600 feet long on each end and 80 feet wide on each side. All grooves were sawed transverse to the runway centerline and are 1/4 inch wide by 1/4 inch deep at a spacing of 1 inch center to center.

2. Discussion with Base Engineer Personnel

Base engineering personnel stated that the grooving has been very effective for operations and there has been no evidence of any surface deterioration. It was also stated that during wet weather, the grooved portion of the runway appears drier than the adjacent ungrooved portion. Rubber deposited in the grooves has not been a problem; however, rubber removal operations are performed once a year. A chemical solvent is used for this rubber removal and is performed by base personnel. This operation has been done in the fall of the year with no difficulty encountered.

Aircraft traffic records indicate that about 7500 - 8000 operations per month are being experienced at this air base. B-52, KC-135, and

SR-71 aircraft are based at Beale Air Force Base. An operation is defined as either one landing or one takeoff.

3. Pavement Inspection

The grooved runway pavement was inspected on 26 January 1972, about 4 years after the grooving had been completed. There were very few surface defects and the grooved pavement appeared to be in the same condition as the ungrooved portion of the runway. Touchdown areas showed tire marks and only a small amount of rubber deposits were found in the grooves (Figure 31). The pavement surface was in excellent condition and there was no evidence of any deterioration of the pavement due to grooving (Figure 32).

About 75 percent of the landings and takeoffs occur from the north end of this runway. During the inspection it was observed that the pavement surface was discolored from landing operations. However, the grooves were sharply outlined and the pavement was in excellent condition. This is evident in Figures 33 and 34.

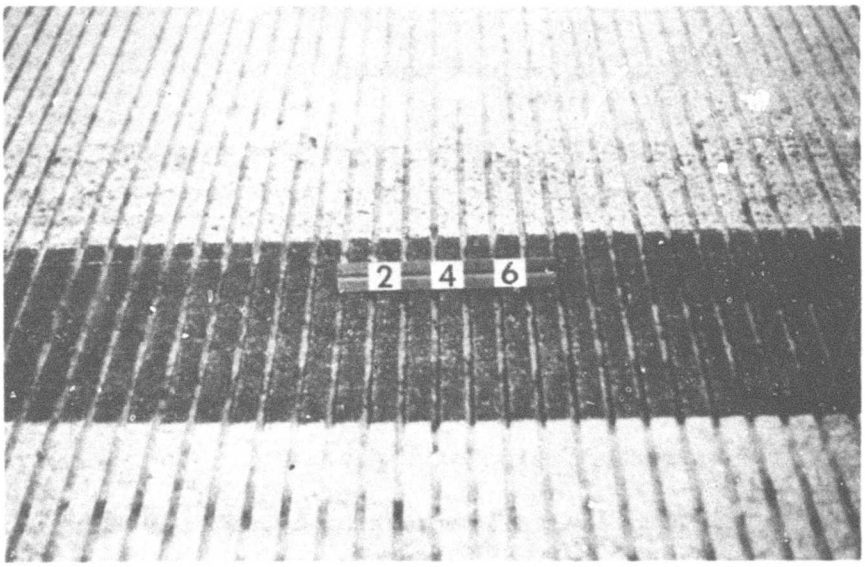

Figure 31. Beale Air Force Base -- Close view of tire mark showing some rubber deposits in grooves near south end of runway.

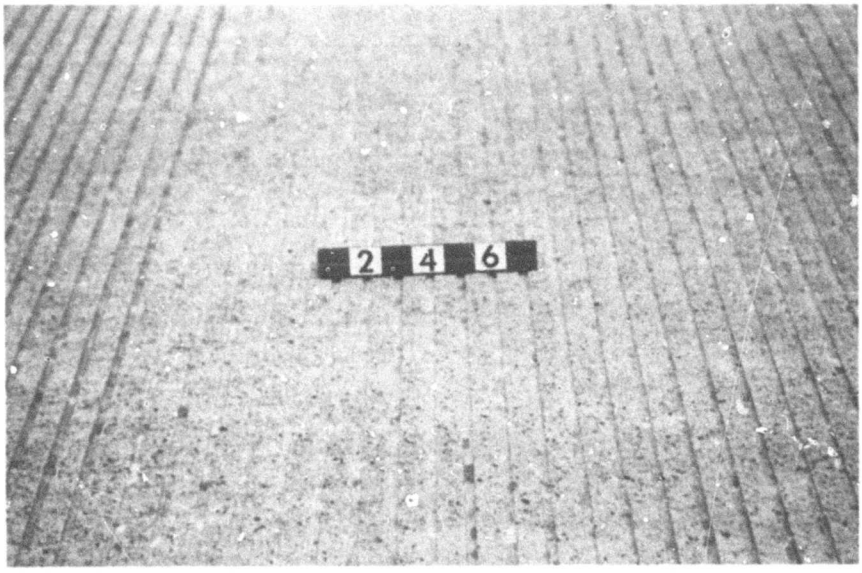

Figure 32. Beale Air Force Base -- Typical grooving in Runway 14/32.

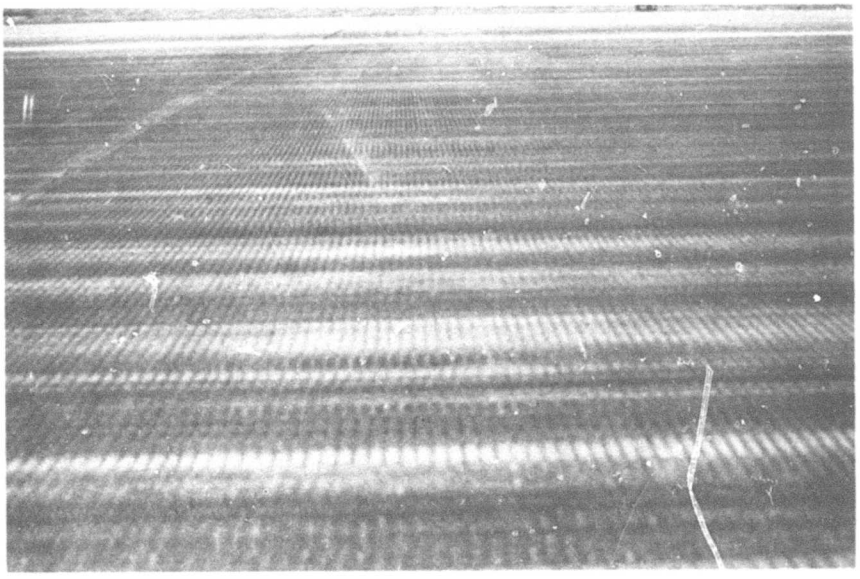

Figure 33. Beale Air Force Base -- General view of grooved runway pavement 3000 feet from north end.

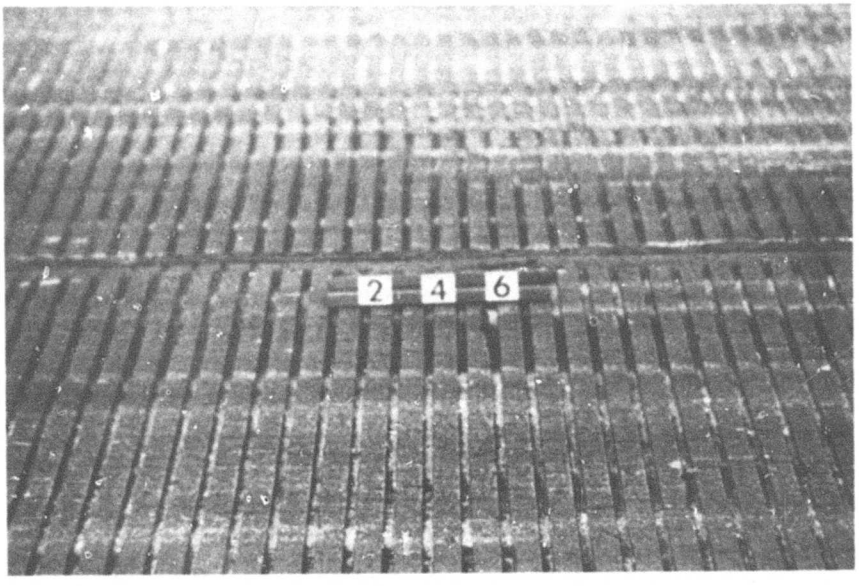

Figure 34. Beale Air Force Base -- Close view of PCC grooving in touchdown area north end of runway.

SECTION VIII

DISCUSSION

Airfield inspections were made to determine if pavement grooving has contributed to pavement deterioration. Because of the special interest in grooved pavements, information was also gathered to determine the performance of these pavements from an operational point of view. Information regarding maintenance operations was also obtained to ascertain what effects, if any, they may have on the grooved pavements.

The grooved PCC pavement surfaces were in excellent condition at all airfields. The grooves in these pavements were sharply outlined and there was no evidence of chipping or raveling at the edges of the grooves due to traffic or weather. The beveled groove shape used at Kennedy International and LaGuardia Airfields has given satisfactory performance, but there has been no indication that this groove pattern is better than the square edge groove. Kansas City Municipal airfield pavement contained numerous small surface voids due to weathering out of unsound aggregate particles. However, most of these surface defects were present when the pavement was grooved. Many new surface voids were detected at the time of this inspection. Therefore, it is probable that the grooving did contribute to an increase in the number of surface voids by exposing unsound aggregate particles which otherwise would have been protected by the surface mortar. Since the grooving at the other airfields did not produce surface defects, it could be assumed

that grooving contributes to surface deterioration only when surface defects exist before grooving.

The grooved AC pavements at the time of this inspection were considered in very good to good condition. Some deterioration of the grooves was observed. This condition was evident because of some raveling or chipping of the groove edges. This condition has required no maintenance and has had no adverse effect on the performance of the grooves. A shifting of a portion of the surface was noted in the touchdown area at Washington National Airfield. The shift was noticeable because of the distortion of the pavement grooves in this area. This movement appears to extend to a much greater depth than the 1/8-inch groove depth and probably is related to the construction of the overlay.

Various groove details and spacings have been used in both PCC and AC pavements. The only common feature has been that all airfield grooving has been transverse to the direction of traffic. A comparison of the groove details used for various pavements is presented in Table I.

Table I

COMPARISON OF GROOVE DETAILS

Airfield	Pavement Type	Grooving Completed	Groove Dimensions (inches) Width	Depth	Spacing	Inspection Date	General Condition Grooves
Kansas City Municipal	AC	May 1967	1/8	1/4	1	Dec 1971	Very Good - Good
	PCC	May 1967	1/8	1/4	1	Dec 1971	Excellent - Very Good
	PCC	Dec 1969	1/4	1/4	1	Dec 1971	Excellent
Chicago Midway	PCC	Sep 1968	1/4	1/4	1 - 1/4	Dec 1971	Excellent
J. F. Kennedy International *	PCC	Aug 1967	3/8	1/8	1 - 3/8	Dec 1971	Excellent
LaGuardia *	AC	Apr 1971	3/8	3/16	1 - 1/2	Dec 1971	Excellent
	PCC	Apr 1971	3/8	1/8	1 - 1/2	Dec 1971	Excellent
Washington National	AC	Apr 1967	1/8	1/8	1	Dec 1971	Very Good - Good
	AC	Nov 1971	1/8	1/8	1 - 3/4	Dec 1971	Excellent
Beale Air Force Base	PCC	Feb 1968	1/4	1/4	1	Jan 1972	Excellent

NOTE: All airfield grooving transverse to runway centerline.

* Tapered groove.

SECTION IX

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

Conslusions, based on the foregoing discussions and observations during the inspection of pavement grooving, are as follows:

a. Grooving does not cause surface deterioration in PCC pavements which have no surface defects prior to grooving. Where there is an existing problem with popouts or other surface defects, an increase in these defects can be expected.

b. Chipping or raveling at edges of grooves due to weather and traffic does not appear to be a problem in either PCC or AC pavements.

c. Rubber deposits do accumulate in the grooves and removal operations are performed several times a year. However, this has not been a problem according to airport personnel.

d. Airport and Operations personnel concur that grooving does reduce hydroplanning and skidding.

e. Pilots' reaction to pavement grooving has been very favorable.

2. Recommendations

It is recommended that periodic inspections be made of grooved pavements to provide additional information on the effect of grooving on pavement deterioration.