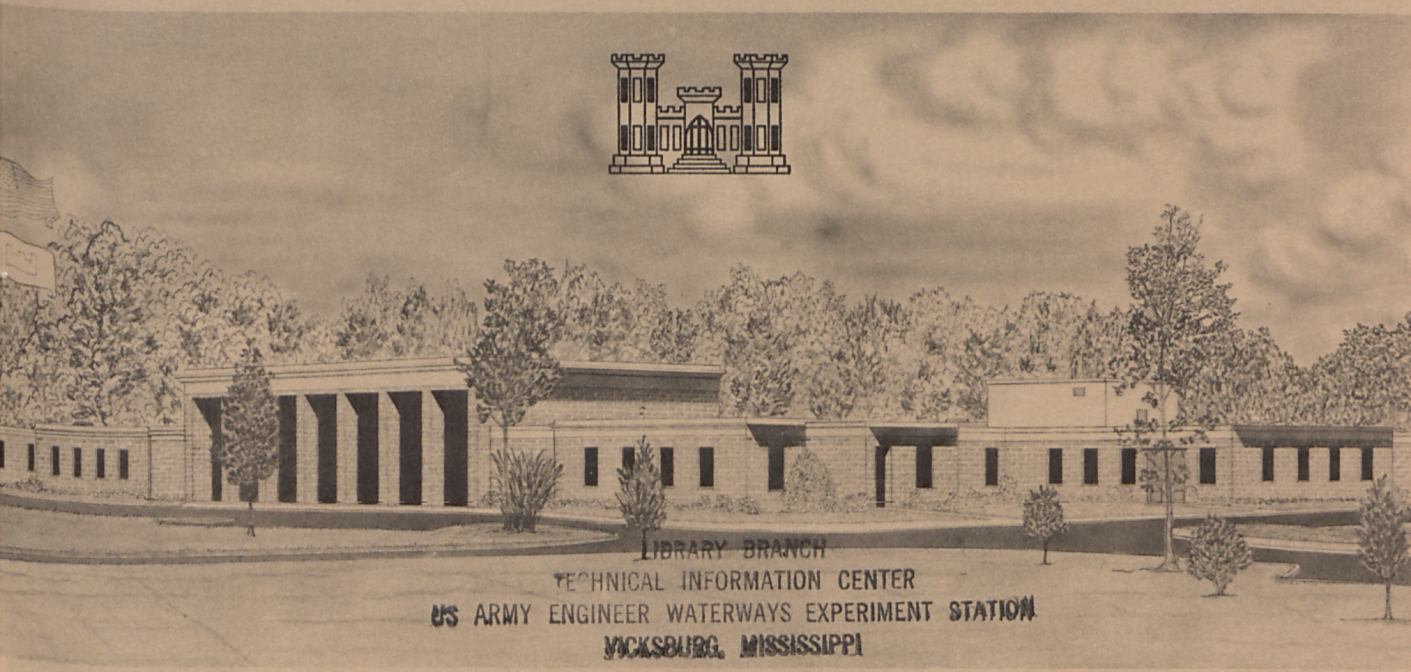
MISCELLANEOUS PAPER S-72-23

# CONDITION SURVEY, REDSTONE ARMY AIRFIELD, HUNTSVILLE, ALABAMA

by

P. J. Vedros, S. J. Alford





June 1972

Sponsored by Office, Chief of Engineers, U. S. Army

Conducted by U. S. Army Engineer Waterways Experiment Station
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ARMY-MRC VICKSBURG, MISS.

## Foreword

Authority for performance of condition surveys at selected airfields is contained in Long-Range Program, O&M,Á, FY 1971, Project Q6-1: "Engineering Criteria for Design and Construction - WES," dated May 1970.

The facilities at Restone Army Airfield were inspected in April 1971 by Messrs. P. J. Vedros and S. J. Alford of the Engineering Design Criteria Branch, Soils and Pavements Laboratory, U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. This report was prepared by Messrs. Vedros and Alford under the general supervision of Messrs. J. P. Sale, R. G. Ahlvin, and R. L. Hutchinson of the Soils and Pavements Laboratory, WES.

COL Ernest D. Peixotto, CE, was Director of the WES during the conduct of the study and preparation of the report. Mr. F. R. Brown was Technical Director.

## Contents

## Conversion Factors, British to Metric Units of Measurement

British units of measurement used in this report can be converted to metric units as follows:

| Multiply | By | To Obtain |
|---|---|---|
| inches | 2.54 | centimeters |
| feet | 0.3048 | meters |
| square inches | 6.4516 | square centimeters |
| miles (U. S. statute) | 1.609344 | kilometers |
| pounds | 0.45359237 | kilograms |

# CONDITION SURVEY, REDSTONE ARMY AIRFIELD
# HUNTSVILLE, ALABAMA

## Purpose

1. The purpose of this report is to present the results of an investigation performed at Redstone Army Airfield (RAAF) in April 1971. The inspection was limited to visual observations, and no tests were conducted on the existing runway and taxiways. A layout of the airfield is shown in plate 1.

## Pertinent Background Data

### General description of airfield

2. RAAF is located in the southwest corner of Redstone Arsenal, approximately 6 miles* southwest of the city of Huntsville, Alabama. The mean sea level elevations for the airfield vary from 655 ft msl at the south end of the runway to 685 ft msl at the north end. The surface and near-surface soils at the site are fat clays, lean clays, and clayey sands with lean and fat clays predominating. These soils are underlain by thin to thick bedded, highly fossiliferous limestone of the Tuscumbia formation at a depth of approximately 40 ft below ground surface. Natural drainage in the airfield is generally to the east. Groundwater is encountered at approximately 38 ft.

3. In April 1971, the airfield facilities consisted of a north-south runway 7300 ft long and 150 ft wide with 300-ft-diam turnarounds at each end, three connecting taxiways, and two parking aprons (see plate 1).

### Previous reports

4. Previous reports relative to RAAF are as follows:

   a. Condition survey. No previous condition surveys have been made at RAAF.

   b. Evaluation. Two evaluation reports have been prepared for the pavements at RAAF: "Army Airfield Pavement Evaluation, Redstone Army Airfield, Huntsville, Alabama," Technical Report No. 3-466, Report 5, dated January 1958, prepared by U. S.

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* A table of factors for converting British units of measurements to metric units is presented on page vii.

Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.; and "Pavement Evaluation Report, Redstone Arsenal, Redstone Army Airfield, Huntsville, Alabama," dated February 1962, prepared by U. S. Army Engineer District, CE, Mobile, Ala.

Pertinent data have been extracted from these reports and used herein.

## History of Airfield Pavements

### Construction history

5. 1942-43 construction. The airfield was constructed during this period under the supervision of the District Engineer, Corps of Engineers, Atlanta, Georgia. No design criteria were available for these pavements. Design drawings, dated 13 May 1942, indicated that the north-south runway, the turnaround at the north end of the runway, and the connecting taxiways were paved with 2 in. of asphaltic concrete over an 8-in. base course that was a mixture of crushed limestone and soil. The apron was constructed of 6 in. of plain concrete placed on a compacted natural soil.

6. 1958 construction. The northwest-southeast taxiway was strengthened in 1958 by the Post Engineer. No records were available on this work.

7. 1961 construction. In 1961 the north-south runway was extended 1460 ft on the north end. The existing runway and taxiways were overlaid with asphaltic concrete. Portland cement concrete turnarounds were added at each end of the runway. This work was under the supervision of the District Engineer, Corps of Engineers, Mobile, Alabama. The pavements were designed as type B traffic areas for tricycle-type landing gear, twin-assembly, 630-sq-in. contact area, and with each wheel spaced 44 in. c-c for minimum operational category.

8. 1965 construction. In 1965 an extension was added to the south end of the parking apron. It was reported that this construction consisted of a 4-in. asphaltic concrete surface over a 16-in. stabilized aggregate base course. This work was done under the supervision of the Post Engineer.

9. 1966 construction. A parking apron and taxiway (designated NASA apron in plate 1) were constructed at this time. This apron adjoins the

small extension placed in 1965. It was reported that the construction consisted of a 3-in. asphaltic concrete surface over a 12-in. stabilized aggregate base course. This facility was designed by NASA and constructed under the supervision of the Post Engineer.

10. A complete construction history for all facilities is given in table 1. Typical pavement sections are shown in plate 2.

Traffic history

11. Detailed traffic records were not available. It was reported by the operations officer that the field is used periodically by various types and sizes of aircraft. Small jet aircraft flown by the astronauts occasionally use the facility. The Arsenal presently has one C-54, two C-47's, and some light Army-type aircraft based at the field. NASA utilizes two Lockheed Electra aircraft, which apply about 3-5 cycles per week on the pavements. There is about one operation per week by C-9 aircraft (medical air evacuation) and about one to three operations per month by C-130, C-133, C-124, and C-141 aircraft. The Guppy (a modified C-97 aircraft used for hauling large missiles) has periodically used the facility and has caused distress in the NASA apron taxiway.

## Airfield Maintenance

12. Maintenance has consisted of sealing cracks and repairing spalled areas in the portland cement concrete on the parking apron. The spalled areas, caused by D-line cracking in the slab and occurring mostly along the joints, have been repaired using an epoxy grout. About 132 slabs on the northwest corner of the apron were replaced due to structural failures. An extensive maintenance program is needed at the present time to repair the many spalled areas in the parking apron.

## Condition of Pavement Surfaces

13. A visual inspection of the pavements in April 1971 indicated the pavement condition to range from poor to very good. The surface on the runway and two connecting taxiways was in very good condition with some evidence of crack opening at longitudinal joints (photographs 1-3). The taxiway to the NASA apron showed distress in the form of rutting (photograph 4) from the wheel load of the Guppy aircraft. A localized weak area probably exists in the taxiway as there is no evidence of any distress from operation of this aircraft on the NASA apron. The portland cement concrete apron is in poor condition as a result of numerous spall areas that are occurring on the surface (photographs 5-8). These spalls appear to be the result of D-line cracking that occurs in the slab surface. This type cracking may extend for the full depth of the slab, but it appears only the top 1-2 in. at the surface are affected. Some spalled areas along the joints have been repaired in the past with an epoxy grout, and in some cases, the cracking continues next to the patched area (photograph 8). A crack survey of the parking apron indicates that approximately 6 percent of the slabs contain major structural defects, such as longitudinal, transverse, or diagonal breaks.

## Evaluation

14. The last evaluation of the load-carrying capacity of the airfield pavements at RAAF was made in 1962, as indicated in paragraph 4b. For that evaluation, field evaluation tests were performed to determine the physical properties of the pavement materials. These properties, such as CBR, subgrade modulus k , and flexural strength values, were assumed to be still valid, and the evaluation presented herein upgrades the 1962 evaluation to include the C-5A, C-133, C-9, C-97, and C-141 type aircraft. No evaluation is presented for the apron extension constructed in 1965 or the NASA apron constructed in 1966, as no information could be obtained on the quality of

the base course materials used in construction. In-place testing would be required before a CBR value could be assigned to the base course material. It is felt that the failures that have occurred on the NASA taxiway may be the result of a localized weakness that is not representative of the NASA apron area. The pavements were performing satisfactorily for the type aircraft now using the facility.

15. The load-carrying capacity of the pavements at RAAF is shown in table 2. As noted, the basic field evaluation is controlled by the carrying capacity of the rigid pavement on the parking apron. Occasional use of the pavement facilities by aircraft having gross weights greater than the basic evaluation may be necessary. Table 3 shows the allowable loading of such aircraft operating at frequencies of one cycle per day, one cycle per week, and one cycle per month. These allowable overloadings are based on the basic field evaluation.

16. Recent tests at the Waterways Experiment Station on controlled test sections for the C-5A aircraft indicated that this aircraft will cause failures on rigid pavements in which slabs are joined together with keyed joints. It should be pointed out that the keyed joints exist in the pavements at RAAF on the turnarounds, on the runway, and on the parking apron, and possible distress could occur in these pavements even though the pavements are rated to carry the weight of the aircraft.

Table 1

Construction History

| Facility | Dimensions Length ft | Dimensions Width ft | Surface Thickness in. | Surface Type | Construction Year | Construction Agency | Remarks |
|---|---|---|---|---|---|---|---|
| N-S runway | 5000 | 150 | 3 | Asphalt conc | 1942-43 | USCE (Atlanta Dist) | |
| NE-SW taxiway | 670 | 50 | 3 | Asphalt conc | 1942-43 | " | |
| NW-SE taxiway | 670 | 50 | 3 | Asphalt conc | 1942-43 | " | |
| Parking apron | 1130 | 180 | 6 | Portland cement conc | 1942-43 | " | |
| NW-SE taxiway | 670 | 50 | varies | Asphalt conc | 1958 | Post Engineer | Construction was for strengthening taxiway |
| N-S runway extension | 1460 | 150 | 3 | Asphalt conc | 1961 | USCE (Mobile Dist) | |
| N-S runway extension N turnaround | 300 | 300 | 8 | Portland cement conc | 1961 | " | |
| N-S runway extension S turnaround | 300 | 300 | 8 | Portland cement conc | 1961 | " | Old asphalt turn-around removed |
| N-S runway | 5240 | 150 | varies | Asphalt conc | 1961 | " | Leveling course |
| N-S runway | 5240 | 150 | 3 | Asphalt conc | 1961 | " | |
| NE-SW taxiway | 520 | 50 | varies | Asphalt conc | 1961 | " | Leveling course |
| NW-SE taxiway | 520 | 50 | varies | Asphalt conc | 1961 | " | Leveling course |

Table 1 (Concluded)

| Facility | Dimensions | | Surface | | Construction | | Remarks |
|---|---|---|---|---|---|---|---|
| | Length ft | Width ft | Thickness in. | Type | Year | Agency | |
| NE-SW taxiway | 520 | 50 | 3 | Asphalt conc | 1961 | USCE (Mobile Dist) | |
| NW-SE taxiway | 520 | 50 | 3 | Asphalt conc | 1961 | " | |
| Apron extension | 211 | 50-96 | 4 | Asphalt conc | 1965 | Post Engineer | |
| NASA apron | 220 | 180 | 3 | Asphalt conc | 1966 | " | |
| NASA taxiway | 375 | 75 | 3 | Asphalt conc | 1966 | " | |

Table 2

Summary of Basic Evaluation

| Facility | Allowable Gross Aircraft Loadings in Pounds | | | | Remarks |
|---|---|---|---|---|---|
| | Normal Period Operation | | Frost-Melting Period Operation | | |
| | Single-Wheel Gear | Twin-Wheel Gear | Single-Wheel Gear | Twin-Wheel Gear | |
| North-South Runway North & South Turnarounds | 60,000+ | 50,000+ | NA | NA | |
| North-South Runway Sta 3+00 to 55+40 | 42,000 | 50,000+ | NA | NA | |
| North-South Runway Sta 55+40 to 70+00 | 70,000+ | 50,000+ | NA | NA | |
| Northeast-Southwest & Northwest-Southeast Taxiways | 42,000 | 50,000+ | NA | NA | |
| Parking Apron | 25,000 | 37,000 | NA | NA | Basic field evaluation |

Table 3

Summary of Pavement Evaluation for Overload Aircraft

(Basic field evaluation: 25,000-lb gross wt for single wheel and 37,000-lb gross wt for twin wheel)

| Overload Aircraft | | | Allowable Gross Aircraft Load, lb | | |
|---|---|---|---|---|---|
| | Weight, lb | | | | |
| Type Aircraft | Empty | Gross | One Cycle Per Day | One Cycle Per Week | One Cycle Per Month |
| C-123 | 30,000 | 60,000 | | | 30,500 |
| C-47 | 17,900 | 33,000 | 27,000 | 29,000 | 30,500 |
| C-131 | 30,700 | 60,000 | 40,000 | 42,500 | 45,000 |
| C-119 | 41,000 | 77,000 | | 42,500 | 45,000 |
| C-54 | 39,000 | 82,500 | 40,000 | 42,500 | 45,000 |
| C-130 | 69,837 | 155,000 | 85,000 | 90,000 | 95,000 |
| C-124 | 100,700 | 216,000 | | | |
| C-141 | 134,000 | 316,600 | 140,000 | 175,000 | 210,000 |
| C-5A | 318,200 | 770,000 | 400,000 | 490,000 | 600,000 |
| C-9 | 62,000 | 108,000 | 70,000 | 85,000 | |
| C-97 | 98,000 | 175,000 | | | 120,000 |
| C-133 | 123,000 | 300,000 | 140,000 | 175,000 | 210,000 |

30,500 — Aircraft can operate at indicated gross load.

Evaluation is less than empty weight of aircraft.

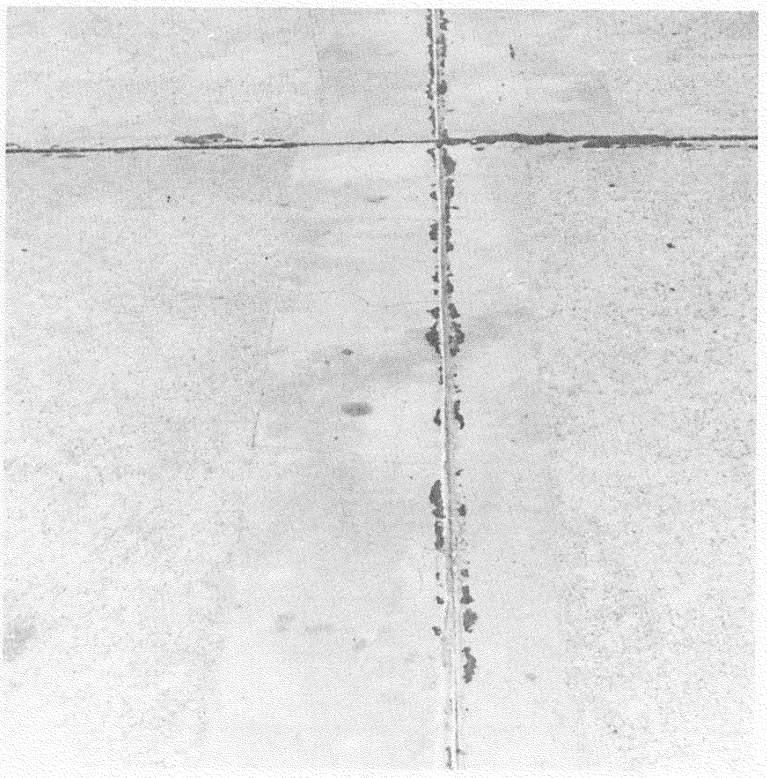
Aircraft can operate at maximum gross load.

Photograph 1. View along N-S runway (south to north)

Photograph 2. Cracking in longitudinal construction joint in runway

Photograph 3. Condition of connecting taxiway

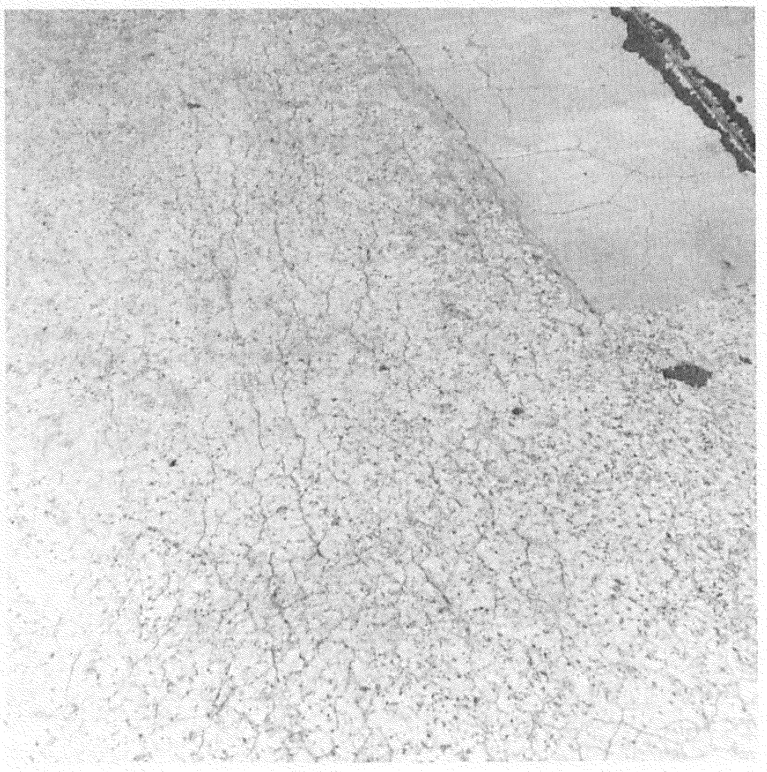
Photograph 4. Rutting in NASA taxiway from operation of Guppy aircraft



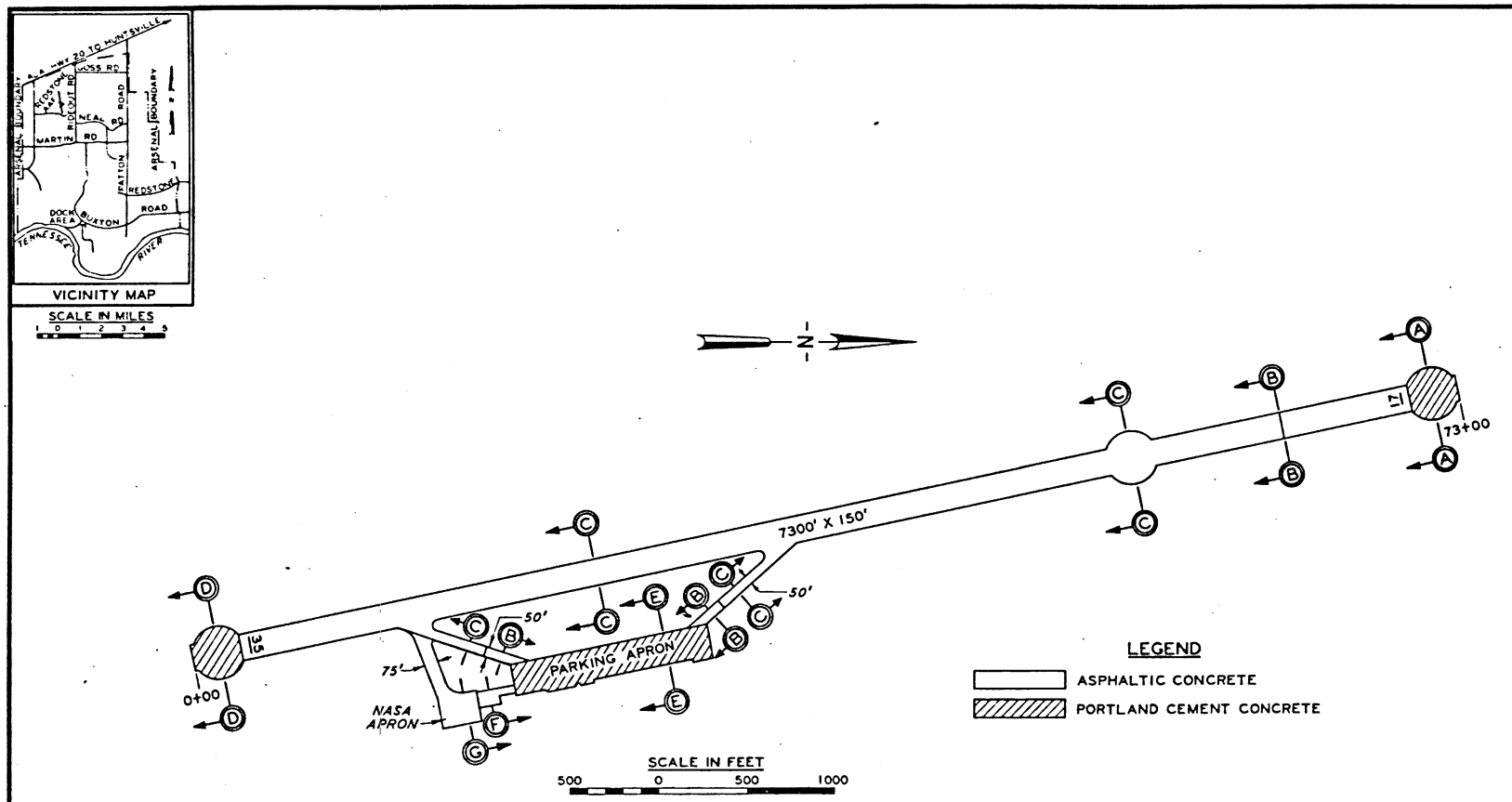
Photograph 5. Spall on longitudinal joint in apron area that has been repaired with epoxy grout

Photograph 6. Spalling along longitudinal joints in apron area

Photograph 7. Spalled area covering most of slab



Photograph 8. D-line cracking that is causing spalling

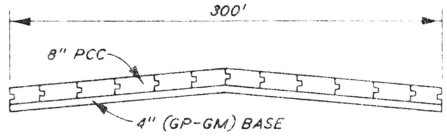



# LAYOUT OF AIRFIELD PAVEMENTS

REDSTONE ARMY AIRFIELD

HUNTSVILLE, ALABAMA

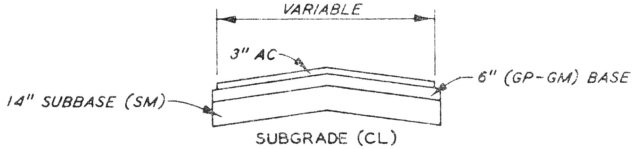
PLATE 2




SUBGRADE (CL) AND (SM-SC)

SECTION A-A

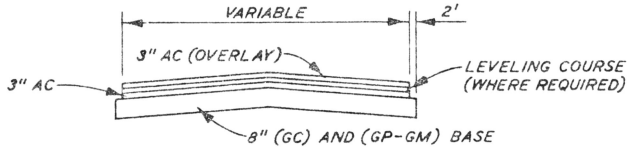
TURNARONDAUND (NORTH END)




SUBGRADE (CL)

SECTION B-B

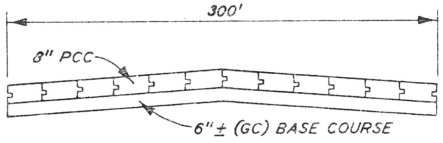
TAXIWAY AND RUNWAY




SUBGRADE (CL)

SECTION C-C

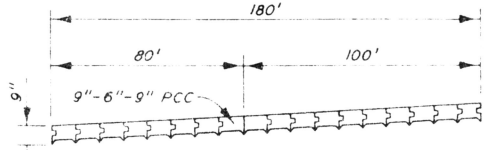
TAXIWAY, RUNWAY, AND TURNAROUND




SUBGRADE (CL)

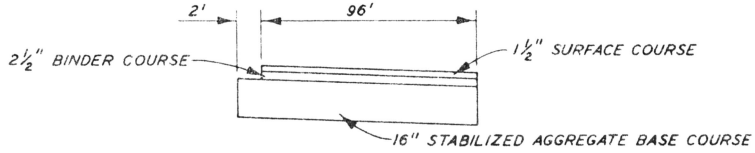
SECTION D-D

TURNAROUND (SOUTH END)

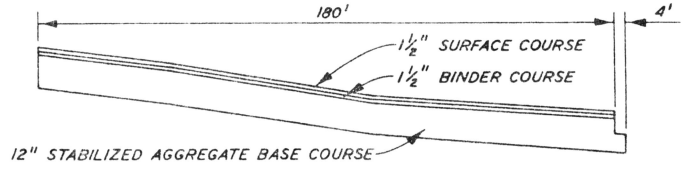



SUBGRADE (CH)

SECTION E-E




SECTION F-F




SECTION G-G

REDSTONE AAF

# TYPICAL PAVEMENT SECTIONS