Appendix G – PCN Report

PAVEMENT CLASSIFICATION NUMBER
THE OHIO STATE UNIVERSITY AIRPORT MASTER PLAN
PROJECT NO. 16081

BY: Kendra Dahl, Brandstetter Carroll Inc.

January 15, 2019

The 2018 Airport Master Plan Update at the Ohio State University Airport included the calculation of a Pavement Classification Number (PCN) for the primary runway, Runway 9R-27L. This task involved the input of existing pavement sections, subgrade conditions, and aircraft operation information, into COMFAA software to determine the PCN in accordance with FAA Advisory Circular (AC) 150/5335-5C.

Existing Conditions

Record drawings from the 2008 Runway 9R-27L Pavement Rehabilitation indicated that the existing runway consists of two primary pavement sections. These sections are divided at approximately 600 ft beyond the threshold of Runway 9R. The first 600 ft of Runway 9R is hereby referred to as "Runway 9R" and the remaining portion from about the 600 ft mark to the threshold of Runway 27L is hereby referred to as "Runway 27L".

Both pavement sections, Runway 9R and Runway 27L, contain a 1.5" bituminous surface course and a 3.0" bituminous intermediate course. There is a reclaimed pavement base layer below the intermediate course that is 10" thick for Runway 9R and 14" thick for Runway 27L. The pavement reclamation in both runway sections left a remaining 4.0" of existing aggregate base course below the reclaimed pavement layer. The *Mix Design OSU Airport Phase III* report by EDP Consultants, Inc. recommended the use of cement treatment and emulsion for the reclaimed pavement base course. An independent review of the mix design report was conducted by Resource International, Inc. which supported the recommendation made for the pavement reclamation process. Therefore, for the purposes of PCN calculation, the reclaimed pavement layer was modeled using P-304 Cement Treated Base Course and the 4.0" of aggregate base course was modeled using P-209 Crushed Aggregate Base Course.

The existing pavement layers were used to develop an evaluation thickness that was input into COMFAA for the PCN calculation. An evaluation thickness of 26.4" was computed for Runway 9R and 33.1" was computed for Runway 27L. In addition to the evaluation thickness, the CBR value of the soil was also input into COMFAA. The 2018 *Subsurface Exploration and Geotechnical Engineering Report* by Geotechnical Consultants, Inc. provided an existing CBR of 5.0 at a location approximately 1,000' from the runway. Additional site observations by R.D. Zande and Associates indicated soil characteristics similar to that of a soil with a CBR value around 5.0 near Taxiways A and D, which are closer to the runway. Thus, a CBR of 5.0 was used to calculate the PCN values.

Aircraft Fleet Mix

The aircraft fleet mix listed in Chapter 4, *Facility Requirements*, of the 2018 Master Plan Update was used to assess the aircrafts' impact on pavement strength. If the entire fleet listed in this chapter is analyzed, the most demanding aircraft on the runway pavement is the Lockheed C-130 Hercules. However, the C-130 Hercules has two annual operations at the airport. The use of this aircraft to determine a PCN value is, therefore, not advisable because it could generate a significant over-estimation of pavement strength. To avoid inaccurately reporting pavement strength, the FAA recommends using "regular use" aircraft which are defined as aircraft operating at 1,000 coverages or higher in a 20-year timespan. A single coverage is equivalent to either a single takeoff or landing on the runway. In terms of annual operations, 1,000 coverages in 20 years was approximated as 50 coverages in one year. Therefore, any aircraft with 50 or more operations per year was considered regular use and included in the PCN analysis.

Results

The evaluation thickness, existing CBR value, and regular use fleet mix were input to COMFAA software which calculated a PCN for each of the aircraft in the mix, as well as a Cumulative Damage Factor (CDF). The CDF is a ratio of the number of applied coverages to the number of coverages at pavement failure.

A CDF value is representative of pavement damage in relation to an average 20-year pavement lifespan. For example, a CDF = 1 indicates that the pavement will fail at exactly 20 years if the aircraft continue using the pavement at the frequency and weight specified upon input of the fleet mix. A CDF < 1 indicates less deterioration on the pavement and an expected pavement life greater than the average 20 years. Conversely, a CDF > 1 suggests an expected pavement life less than 20 years. The CDF is also used to help determine accurate PCN values.

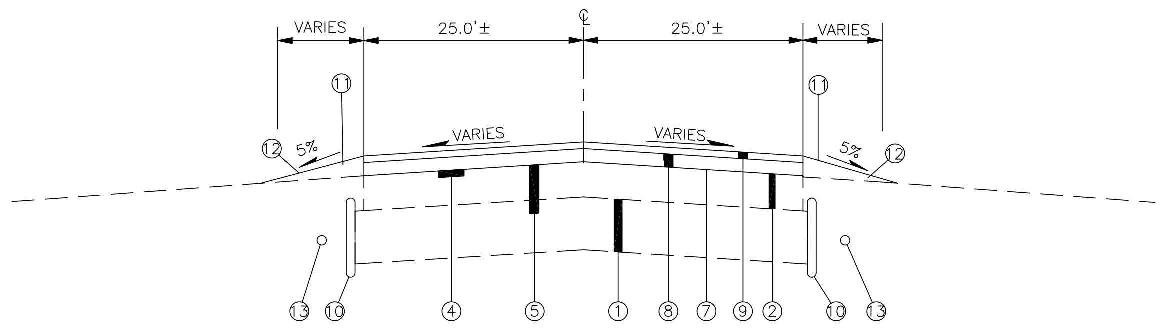
For Runway 9R, the CDF = 0.0223 using the regular use fleet mix. When the CDF is less than 0.15, the FAA recommends adjusting the traffic data to reach a minimum CDF of 0.15. To obtain the minimum CDF, AC 150/5335/-5C suggests either increasing the annual departures by a factor of 10, increasing the pass to coverage (P/TC) ratio, or both. In this case, the P/TC ratio was increased from 1.0 to 6.74 in order to reach a CDF of 0.1571. Since the CDF is less than 1.0, the PCN may be reported as the highest PCN of the aircraft in the fleet mix. The highest PCN for a CDF of 0.1571 is generated by the Gulfstream IV/G400 and resulted in a PCN of 33/F/D/X/T.

For Runway 27L, the regular use fleet mix and a normal P/TC ratio results in a CDF = 0.0000. This means that the fleet mix has little to no effect on the existing pavement section. The PCN in this case is 72/F/D/X/T which is generated by the Gulfstream IV/G400. If the annual departures are increased by a factor of 10 and the maximum P/TC ratio of 10 is used, the resulting CDF is still lower than 0.15. The annual departures would have to be increased by a factor of 1,000 and a P/TC ratio of 5.51 must be used in order to reach a CDF = 0.1497, which would result in a PCN of 28/F/D/X/T. However, a PCN of 28/F/D/X/T is unrealistic for this pavement section. The Runway 27L pavement section is thicker than Runway 9R, and therefore, should have a higher PCN value provided the fleet mix and CBR remain constant. Therefore, a PCN of 72/F/D/X/T is a more accurate representation of the actual conditions for the Runway 27L pavement section.

Enclosed:

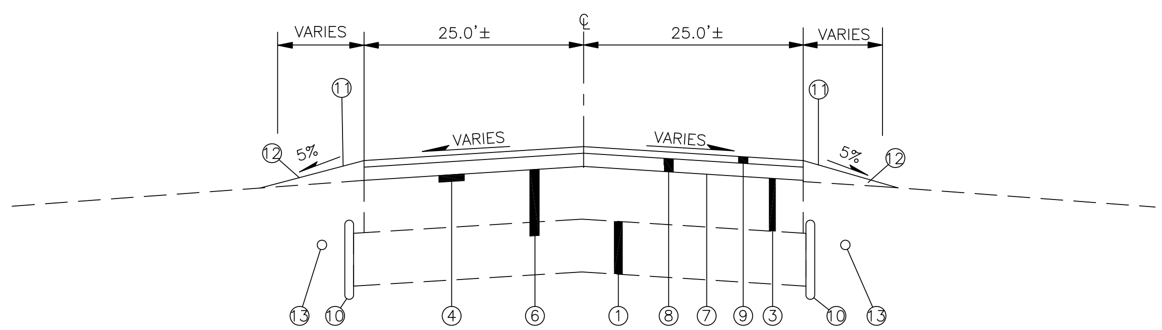
Exhibit 1: Runway Rehabilitation Pavement Section Record Drawing
Exhibit 2: *Mix Design OSU Airport Phase III* by EDP Consultants, Inc.
Exhibit 3: *Review of Document: "Mix Design OSU Airport Phase III"* by Resource International, Inc.
Exhibit 4: *Subsurface Exploration and Geotechnical Report* by Geotechnical Consultants, Inc.
Exhibit 5: *Failing Soil Subgrade Taxiway D and Taxiway A* by R.D. Zande and Associates

EXHIBIT 1



RUNWAY 9R–27L TYPICAL SECTION (STA. 11+95.09 TO STA. 18+00)
N.T.S

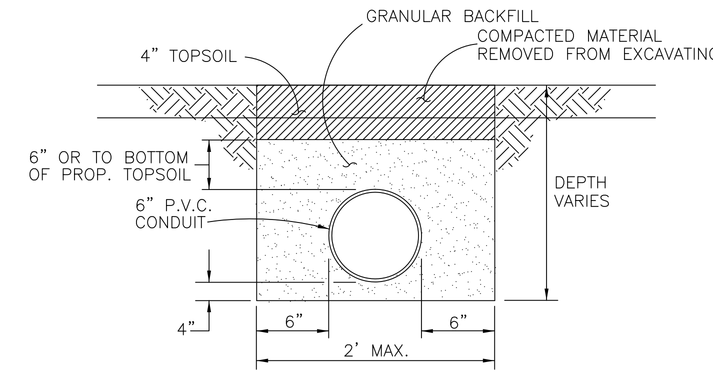
NOTE: TEST RESULTS SHOW THAT EXIST. AGGREGATE BASE IS SIMILAR TO ODOT 304 OR FAA P–209 TYPE.



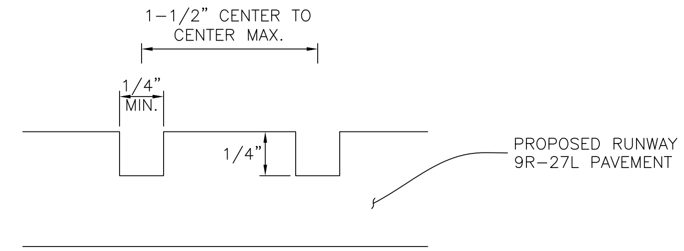
RUNWAY 9R–27L TYPICAL SECTION (STA. 18+00 TO STA. 61+98.73)
N.T.S

NOTE: AFTER INITIAL PULVERIZING, CONTRACTOR MUST GRADE PULVERIZED AREA PRIOR TO STABILIZATION.

① EXISTING AGGREGATE BASE (6"±)
② EXISTING ASPHALT CONCRETE 8"±.
③ EXISTING ASPHALT CONCRETE 12"±
④ P–151 PAVEMENT MILLING (VARIES 0" TO 4")
⑤ ITEM Z–155 PAVEMENT RECLAMATION (APPROX DEPTH=10". EXACT DEPTH PER APPROVED JMF)
⑥ ITEM Z–155 PAVEMENT RECLAMATION(APPROX DEPTH=14". EXACT DEPTH PER APPROVED JMF)
⑦ P–602 BITUMINOUS PRIME COAT
⑧ P–401–1 3" BITUMINOUS INTERMEDIATE COURSE
⑨ P–401–2 1.5" BITUMINOUS SURFACE COURSE
⑩ ITEM D–705 18" PAVEMENT DRAIN
⑪ BERMING
⑫ HYDRO SEEDING
⑬ EXIST. 4" PERFORATED PVC (6" TO 18" FROM E.P.)

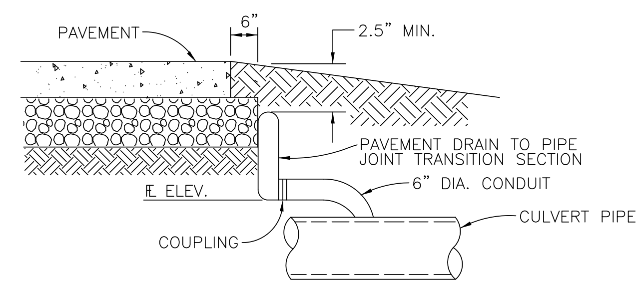


6" P.V.C. OUTLET PIPE DETAIL
NOT TO SCALE

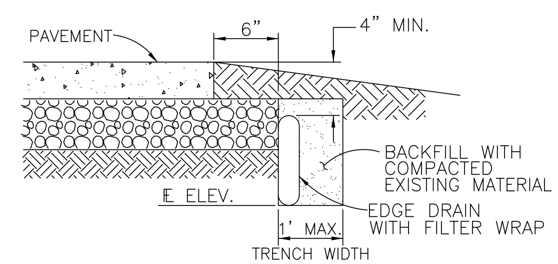


NOTE:
GROOVING OF PROPOSED PAVEMENT SHALL TERMINATE 10' FROM RUNWAY EDGE OF PAVEMENT.

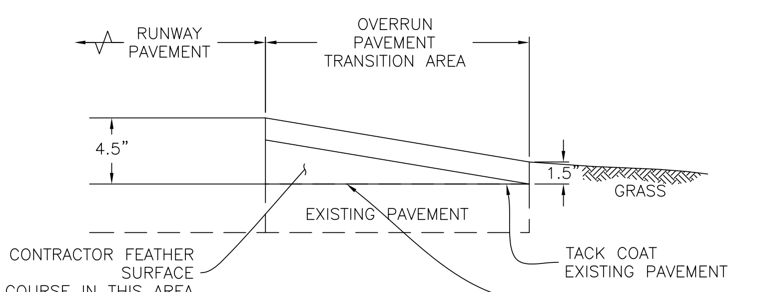
RUNWAY GROOVING DETAIL
N.T.S.



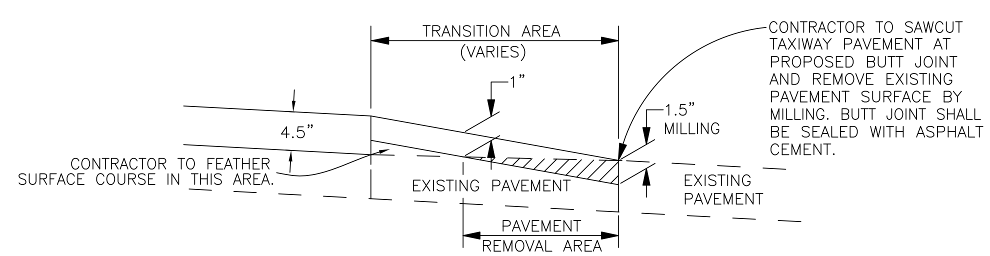
OUTLET DRAIN CULVERT CONNECTION DETAIL
NOT TO SCALE



PAVEMENT DRAIN DETAIL
NOT TO SCALE



OVERRUN TRANSITION DETAIL
NOT TO SCALE



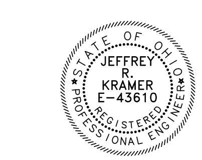
BUTT JOINT DETAIL
NOT TO SCALE

RECORD DRAWINGS

NO.	DATE	DESCRIPTION
		REVISIONS

O.S.U. PROJECT NUMBER 315–2002–931–1
AIRPORT PAVEMENT REHABILITATION
AIRPORT REHABILITATION – SOUTH RUNWAY AND RAMP

PREPARED FOR
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO



PREPARED BY
STANTEC CONSULTING SERVICES, INC.
1500 LAKESHORE DRIVE, SUITE 100 COLUMBUS, OHIO 43204

PAVEMENT DETAILS

SHEET 28

O.S.U. PROJ. NO.	COMM. NO.	DRAWN BY	DATE	OF
315-2002-931-1	7485PDT	BKC	12/19/08	70

EXHIBIT 2

Stantec Consulting Services Inc.
1500 Lake Shore Drive Suite 100
Columbus OH 43204
Tel: (614) 486-4383
Fax: (614) 486-4387

Stantec

June 25, 2009
Shelly & Sands, Inc.
P.O. Box 2469
Columbus, Ohio 43216

Attention: **Mr. Dustin Wilson**
Project Manager

Dear Dustin:

Reference: **315-2002-931-1**

Enclosed for your review and use please find a copy of the following material submittals which were delivered to our office:

NO EXCEPTION TAKEN (AS NOTED):

1. EDP Consultants, Inc. EDP #09060G Full Depth Reclamation Job Mix Formula for the Runway 9R-27L Pavement. This is solely for monitoring quality control, your company is not released from the responsibility to provide a stabilized material that meets or exceeds the design aircraft load on the pavement.

Please forward any additional material submittals for this project (Temporary Closure Markings, Borrow Material, Berm material, etc.).

Call me if you have any questions.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Steven A. Slusher, P. E.
Project Engineer - Airports Division
Tel: (800) 340-2743
Fax: (614) 481-5886
Steve.Slusher@stantec.com

Attachment: Material Submittals

c. Mr. Glenn Gerhart, Mr. Rick Van Deusen
Mr. Dale Gelter

p:\airports\osu\7485\construction\shelly&sandsshop09.doc

MIX DESIGN

OSU AIRPORT PHASE III
COLUMBUS, OHIO
EDP # 09060G
JUNE 16, 2009

Prepared at the request of:

Mr. Dorrian Amling
Base Construction Technologies, Inc.
1595 Frank Road, Suite C
Columbus, Ohio 43223

EDP Consultants, Inc.
9375 Chillicothe Road
Kirtland, Ohio 44094-8501
Phone: 440-256-6500
Fax: 440-256-6507
www.edpconsultants.com

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

Read the full report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
8811 Colesville Road Suite G106 Silver Spring, MD 20910
Telephone: 301-565-2733 Facsimile: 301-589-2017
email: info@asfe.org www.asfe.org

MIX DESIGN FOR THE FULL-DEPTH RECLAMATION OF THE SOUTH RUNWAY AT THE OHIO STATE UNIVERSITY AIRPORT COLUMBUS, OHIO JUNE 16, 2009

INTRODUCTION

This report presents the results of a mix design for the planned Full-Depth Reclamation (FDR) of the south runway at The Ohio State University Airport in Columbus, Ohio. Samples of the pavement materials to be reclaimed were obtained by coring the existing asphalt and sampling the underlying base at 28 locations. Two mixes were prepared and tested in our laboratory to evaluate the use of emulsion combined with Portland cement to complete the FDR work. The results of the field and laboratory testing are presented in this report along with our recommendations for the appropriate amount of admixtures to be used during the reclamation process.

PLANNED REHABILITATION WORK

From our conversations with Mr. Dorrian Amling with Base Technologies Construction and from information gathered during our site visit, we understand that the planned rehabilitation is separated into three sections based on preliminary cores that were obtained by others. For reporting purposes, the portion of the south runway that is to be rehabilitated from stations 12+00 to 18+00 will be referred to as Section 1; the portion of the runway from stations 18+00 to 62+00 will be referred to as Section 2; and the portion of Taxiway D that is to be rehabilitated will be referred to as Section 3.

EXISTING CONDITIONS

Alligator cracking, block cracks, longitudinal cracks, transverse cracks, edge cracks, and joint cracks were present in numerous areas throughout the runway. Some of the cracks were almost 1 inch in width. The width of the runway was measured at each test location and found to vary from 97 to 100 ft. A description of the pavement condition at each test location is presented on the enclosed *Core Locations and Existing Conditions* data sheet. Photographs of the pavement at each test location are enclosed.

FIELD EXPLORATION

Pavement conditions were studied by a field exploration program consisting of 28 pavement cores. The test locations were selected by an EDP representative to provide general coverage to the project limits and also to identify specific distressed areas.

At each test location, the existing pavement was cored using a 10 inch diameter diamond-tipped core barrel, and the underlying aggregate base was sampled, when possible, in its entirety. The thickness of the asphalt and base was measured as the work progressed. The pavement was patched using ready-mix concrete and cold-mix asphalt.

The measured asphalt and base thicknesses are presented in the table titled *Existing Pavement Thickness Measurements* enclosed with this report. The approximate test locations are depicted on the attached *Core Location Plan.*

PAVEMENT PROFILE

The asphalt cores and base samples were examined and classified by a senior pavement technician.

The pavement materials encountered in Section 1 consisted of hot-mix asphalt underlain by crushed limestone base. The thickness of the hot-mix asphalt in Section 1 ranged from 6¾ to 10½ inches. The depth to the bottom of the base course exceeded the anticipated treatment depth throughout the section, and the sampling process was stopped at a depth of 16 inches. Representative locations were selected and sampled down to subgrade to identify the thickness of the base, and in those areas approximately 15¼ inches of stone was encountered. The encountered base resembled ODOT #304 gradation.

The pavement materials encountered in Section 2 also consisted of hot-mix asphalt underlain by granular base, however, the asphalt thicknesses in this section were greater than in Section 1. The thickness of the hot-mix asphalt ranged from 10¼ to 14½ inches. The depth to the bottom of the base course in Section 2 also exceeded the anticipated treatment depth, and in several areas the sampling process was stopped at a depth of 16 inches. At various test locations, the base was sampled in its entirety, with measured thicknesses ranging from 7 to 15 inches.

The pavement materials encountered in Section 3 also consisted of hot-mix asphalt underlain by granular base. The thickness of the hot-mix asphalt ranged from 8¾ to 9 inches, and the base thickness ranged from 10 to 13¼ inches.

MIX DESIGN

Pre-Pulverization Depth

Based on the pavement thicknesses in Sections 1, 2, and 3, and considering the planned initial milling and removal of 2 inches of asphalt, a pre-pulverization depth of 12 inches is appropriate for Sections 1 and 3, and a pre-pulverization depth of 14 inches is appropriate for Section 2.

Sample Preparation

The cores from each section were pulverized to a size judged similar to that produced in the field using a reclaimer/stabilizer. The pulverized asphalt from the three sections was combined into a single composite sample. The base material was also combined to create a single composite sample.

Extraction with Gradation Testing

A representative portion of the composite sample of pulverized asphalt was tested for extracted bitumen content and gradation in general accordance with ASTM D2172. The test results are presented on the enclosed data sheet.

Mix Preparation and Ratio Blending

Based on the pre-pulverization depth of 12 inches in Section 1, the average condition expected to be encountered will consist of approximately 53% asphalt and 47% aggregate base, by volume. Based on a 12 inch pre-pulverization depth in Section 3, the pulverized materials will consist of a similar mix of 57% asphalt and 43% aggregate base, by volume. Because of the similarity of these two mixes, we elected to complete a mix design for Sections 1 and 3, with 53% asphalt and 47% aggregate base. In Section 2 with a 14 inch pre-pulverization depth, the average condition mix will consist of 73% asphalt and 27% aggregate base material, by volume, and a separate mix was prepared to represent this condition.

Modified Proctor and Gradation Testing

Representative samples from both mixes were tested for their Modified Proctor moisture-density relationship in general accordance with ASTM D1557. Samples of the blended mixes were also tested for particle size distribution in general accordance with ASTM C136. The test results are presented on the attached data sheets.

Strength Testing for Sections 1 and 3

The water content of a representative portion of the mix was adjusted to approximately 90% of optimum, as determined by Modified Proctor testing. The percentage of optimum was selected based on our experience from previous reclamation projects.

A portion of the moisture-conditioned material was divided into five sets of nine, 1,200 gram samples. The sets were used to prepare Marshall briquettes for strength testing. The briquettes were prepared by treating the material with an HFRE emulsion at application rates varying from 1.2 to 2.0 gal/yd^2, in 0.2 gal/yd^2 increments. Portland cement was added at an application rate of 2% by weight to each sample at each emulsion application rate. Nine briquettes per emulsion application rate were prepared using heavy-duty Marshall methods utilizing 4 inch diameter molds.

After the briquettes were cured for seven days at ambient temperature, they were measured for height, weight, and diameter. Each set of briquettes was then tested in the following manner:

- Three of the nine briquettes from each set were tested for dry indirect tensile strength (ITS).
- Three briquettes were soaked in a vacuum bath for 1 hour and then tested for soaked ITS.
- The last three briquettes from each set were soaked in a circulating water bath at 140 degrees Fahrenheit for 30 minutes before being tested for stability and flow.

Strength Testing for Section 2

Testing for Section 2 was completed in the same manner as for Sections 1 and 3.

Additional Engineering Properties

Maximum theoretical density (MTD) was determined for a sample representing each emulsion application rate in general accordance with ASTM D2041. A sample representing each emulsion content was also tested for percent air voids in general accordance with ASTM D3203.

The test results for both mixes were tabulated and graphed, copies of which are enclosed.

ENGINEERING INTERPRETATION & RECOMMENDATIONS

Discussion

All of the mixes tested using a combination of 2% Portland cement and emulsion produced results meeting typically specified minimum strengths for FDR projects: 1,200 lbs stability, 250 kPa dry ITS, and 70% retained strength when soaked. For Sections 1 and 3, we recommend using an emulsion application rate of 1.2 gal/yd^2 in conjunction with 2% Portland cement. The average stability value using 1.2 gal/yd^2 was 5,454 lbs with a flow of 16.3 and an air void content of 12.4%. The average dry ITS was 692 kPa and the average soaked, 651 kPa. The mix retained approximately 94% of its dry strength when soaked.

For Section 2, we also recommend using an emulsion application rate of 1.2 gal/yd^2 in conjunction with 2% Portland cement. The average stability value using 1.2 gal/yd^2 was 2,610 lbs with a flow of 17.0 and an air void content of 12.5%. The average dry ITS was 533 kPa and the average soaked, 440 kPa. The mix retained approximately 83% of its dry strength when soaked. A summary of the test results is presented on the enclosed graphs. A brief summary of the test results is presented in the following tables. These values are the average of three briquettes for each test.

Table 1. Sections 1 and 3 - 53% Asphalt and 47% Base

Emulsion Rate (gal/yd^2)	Portland Cement (%)	Stability (lbs)	Flow (in/100 in)	Dry ITS (kPa)	Soaked ITS (kPa)	Retained Strength (%)
1.2	2	5,454	16.3	692	651	94
1.4	2	3,951	14.5	696	679	98
1.6	2	3,970	15.5	685	577	84
1.8	2	3,878	12.7	647	551	85
2.0	2	3,336	15.5	647	533	82

Table 2. Section 2 - 73% Asphalt and 27% Base

Emulsion Rate (gal/yd^2)	Portland Cement (%)	Stability (lbs)	Flow (in/100 in)	Dry ITS (kPa)	Soaked ITS (kPa)	Retained Strength (%)
1.2	2	2,610	17.0	533	440	83
1.4	2	2,555	16.5	571	506	89
1.6	2	2,105	12.0	548	512	93
1.8	2	2,047	13.7	599	485	81
2.0	2	2,320	13.7	560	409	73

Verification Testing

Verification testing was completed on mixes from Section 1 and from Section 2. The two mixes represent what we would consider the least favorable conditions of Sections 1 and 2. The first verification mix represented test location C-8, where the asphalt thickness will be 4¾ inches after 2 inches are milled and removed. This would result in a mix consisting of approximately 40% asphalt and 60% base. The second verification mix represented test location C-12, where the asphalt thickness will be 12½ inches after 2 inches are milled and removed. This would result in a mix consisting of approximately 89% asphalt and 11% base.

The emulsion application rate for each verification mix was referenced to the maximum dry density determined during the testing of Sections 1 and 2. Both verification mixes used an application rate of 1.2 gal/yd^2 to match the application rate selected for each.

The first verification mix indicated an average stability value of 1,726 lbs with a flow of 13.5 and an air void content of 8.4%. The average dry ITS was 483 kPa and the average soaked, 455 kPa. The mix retained approximately 94% of its dry strength when soaked.

The second verification mix indicated an average stability value of 6,768 lbs with a flow of 16.5 and an air void content of 8.8%. The average dry ITS was 700 kPa and the average soaked, 667 kPa. The mix retained approximately 95% of its dry strength when soaked.

Both verification mixes indicated that the intended emulsion application rates would provide acceptable strengths for the least favorable conditions in both Sections 1 and 2.

Summary Tables

Reclamation Summary Mix 1 & Verification Mix 1	
Pre-Pulverization Depth	12 inches
Treatment Depth (specified by others)	12 inches
HFRE Emulsion Application Rate	1.2 gal/yd^2
Portland Cement Application Rate	2%
Material Density for Calculation of Portland Cement Application Rate	136.2 pcf

Reclamation Summary Mix 2 & Verification Mix 2	
Pre-Pulverization Depth	14 inches
Treatment Depth (specified by others)	12 inches
HFRE Emulsion Application Rate	1.2 gal/yd^2
Portland Cement Application Rate	2%
Material Density for Calculation of Portland Cement Application Rate	124.3 pcf

NOTE

The reclaimed pavement will need to be swept of all loose material and treated with a tack coat prior to surfacing with hot-mix asphalt. We recommend that the stabilized mat be allowed to cure for at least five days. Construction or other heavy traffic should not be allowed to travel the stabilized mat during the cure period. The project's construction schedule should assure that the recommended cure period can be achieved.

The stabilized base course (SBC) should be graded to drain toward the edges of the runway, and edge and finger drains should be provided.

Field Changes & Quality Control

Adjustments to the recommended stabilization details will likely need to be made due to varying field conditions. We recommend that a senior engineering technician or engineer from our firm be on-site during the stabilization process to help determine required adjustments, test the compaction of the treated materials, and prepare representative field specimens to be tested in the laboratory for verification purposes.

SIGNATURES

Steven S. Taylor (MB)
Steven S. Taylor, C.E.T.
Senior Pavement Technician

STATE OF OHIO
JOSEPH W. PETRAUS
E-39038
REGISTERED
PROFESSIONAL ENGINEER

Joseph W. Petraus, P.E.
Senior Principal Engineer

CORE LOCATIONS & EXISTING CONDITIONS

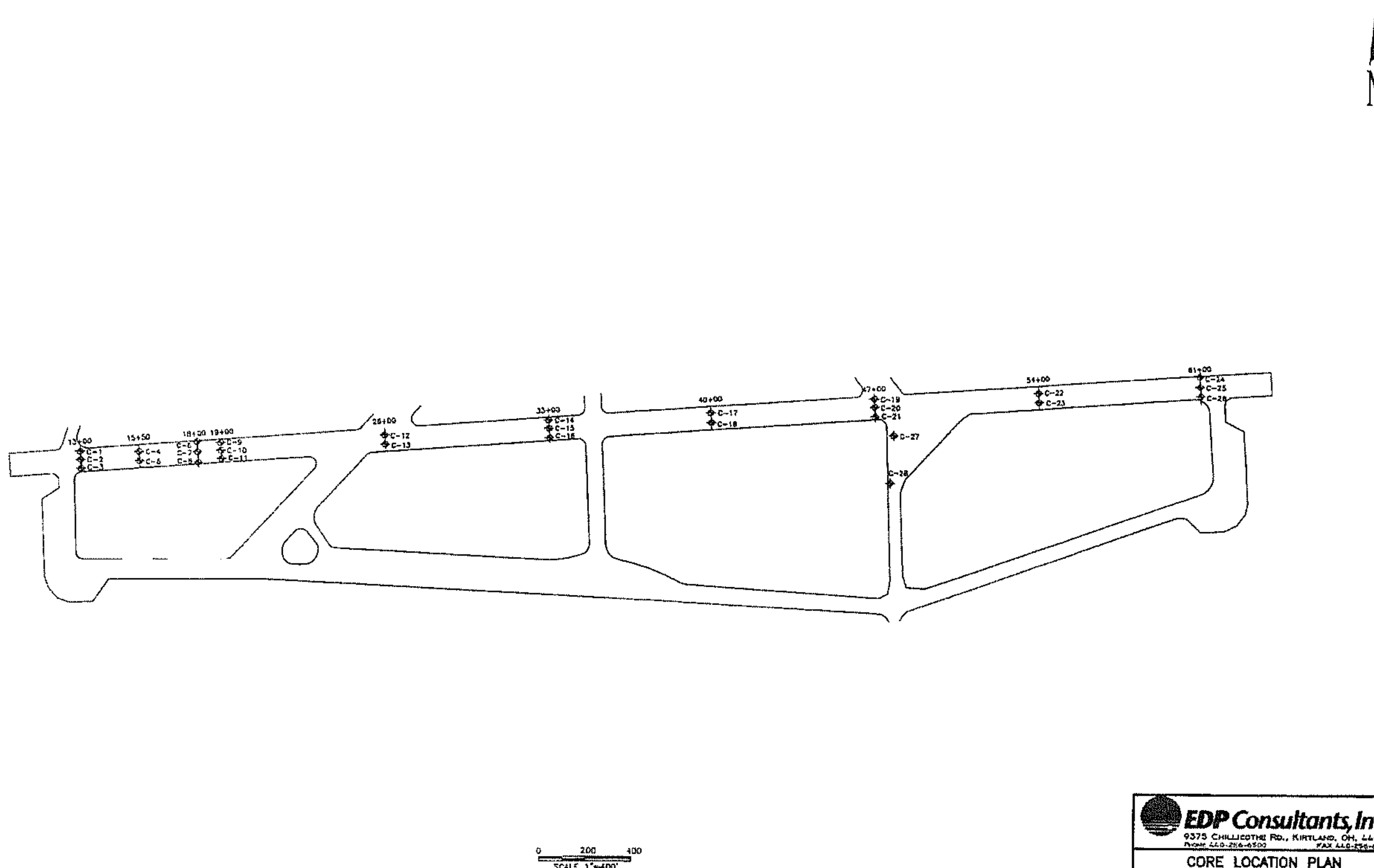
Ohio State University Airport Phase III
Columbus, Ohio
EDP #09060G

Core #	Station	Lane	Distance from Edge of Pavement (feet)	Width of Existing Pavement (feet)	Existing Pavement Conditions
C-1	13+00	N/A	11' south of north edge	97	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-2	13+00	N/A	45' south of north edge	97	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-3	13+00	N/A	82' south of north edge	97	Block cracks, longitudinal cracks, transverse cracks, joint cracks with some sealing, and 1 inch cracks
C-4	15+50	N/A	30' south of north edge	100	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-5	15+50	N/A	70' south of north edge	100	Block cracks, longitudinal cracks, transverse cracks, joint cracks with some sealing, and 1 inch cracks
C-6	18+00	N/A	4' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-7	18+00	N/A	50' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks with some sealing, and 1 inch cracks
C-8	18+00	N/A	92' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-9	19+00	N/A	15' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-10	19+00	N/A	46' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-11	19+00	N/A	83' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-12	26+00	N/A	30' south of north edge	100	Block cracks, alligator cracking, longitudinal cracks, transverse cracks, joint cracks, and cracks ¼" to 1"
C-13	26+00	N/A	70' south of north edge	100	Block cracks, alligator cracking, longitudinal cracks, transverse cracks, joint cracks, and cracks ¼" to 1"
C-14	33+00	N/A	12' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing

CORE LOCATIONS & EXISTING CONDITIONS

Ohio State University Airport Phase III
Columbus, Ohio
EDP #09060G

Core #	Station	Lane	Distance from Edge of Pavement (feet)	Width of Existing Pavement (feet)	Existing Pavement Conditions
C-15	33+00	N/A	50' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-16	33+00	N/A	87' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-17	40+00	N/A	28' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-18	40+00	N/A	68' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks and some crack sealing
C-19	47+00	N/A	12' south of north edge	98	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-20	47+00	N/A	on center	98	Block cracks, transverse cracks, longitudinal cracks, and joint cracks
C-21	47+00	N/A	87' south of north edge	98	Block cracks, transverse cracks, longitudinal cracks, joint cracks, and cracks ¼" to 1"
C-22	54+00	N/A	30' south of north edge	100	Block cracks, longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-23	54+00	N/A	70' south of north edge	100	Block cracks, alligator cracks, transverse cracks, longitudinal cracks, joint cracks, and cracks ¼" to 1"
C-24	61+00	N/A	4' south of north edge	100	Block cracks, alligator cracks, transverse cracks, longitudinal cracks, joint cracks, and crack sealing
C-25	61+00	N/A	52' south of north edge	100	Block cracks, alligator cracking longitudinal cracks, transverse cracks, joint cracks, and some crack sealing
C-26	61+00	N/A	89' south of north edge	100	Block cracks, alligator cracks, transverse cracks, longitudinal cracks, joint cracks, and sealing
C-27	75' South of Runway	N/A	30' east of west edge	47	Block cracks, transverse cracks, and longitudinal cracks
C-28	205' South of Runway	N/A	10' east of west edge	50	Block cracks, transverse cracks, and longitudinal cracks



EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 FAX 440-256-6507

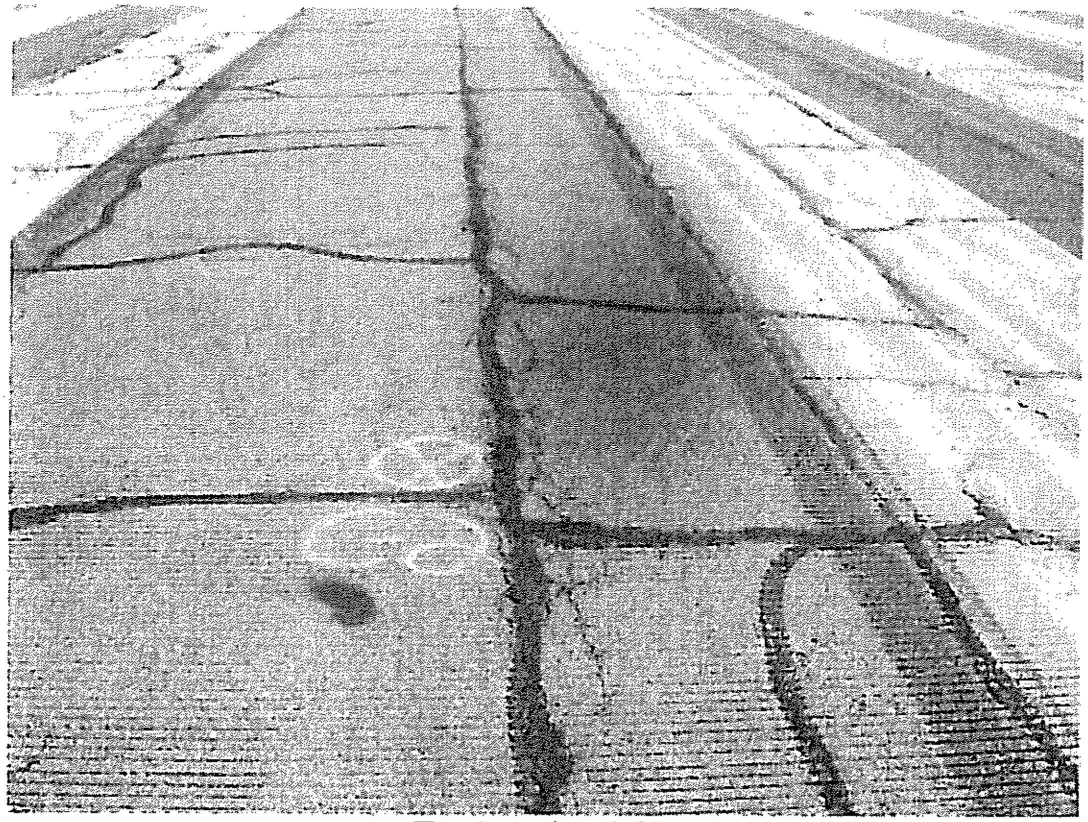
CORE LOCATION PLAN
O.S.U. AIRPORT PHASE III
COLUMBUS, OHIO
PROJECT NO. 09060G

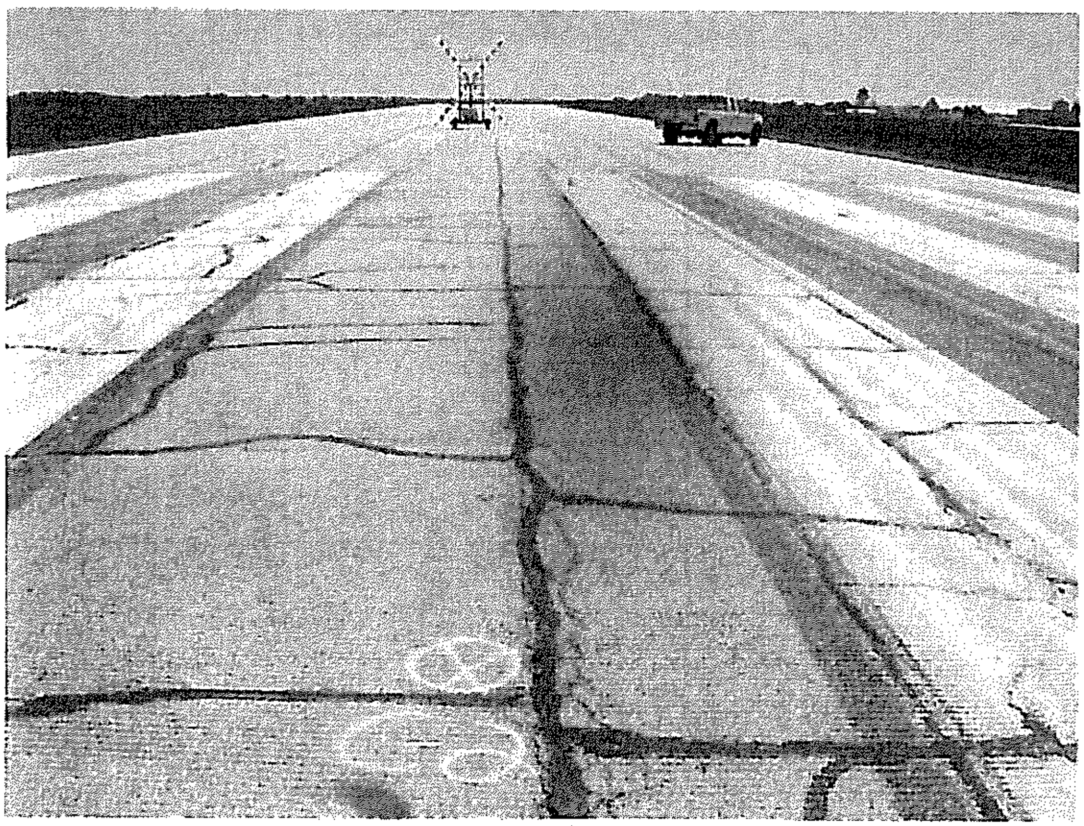
DWG DATE	DWG BY	APPROVED BY
6-5-09	HRP	JAJ

Test Location C-1

Overview of Test Location C-1

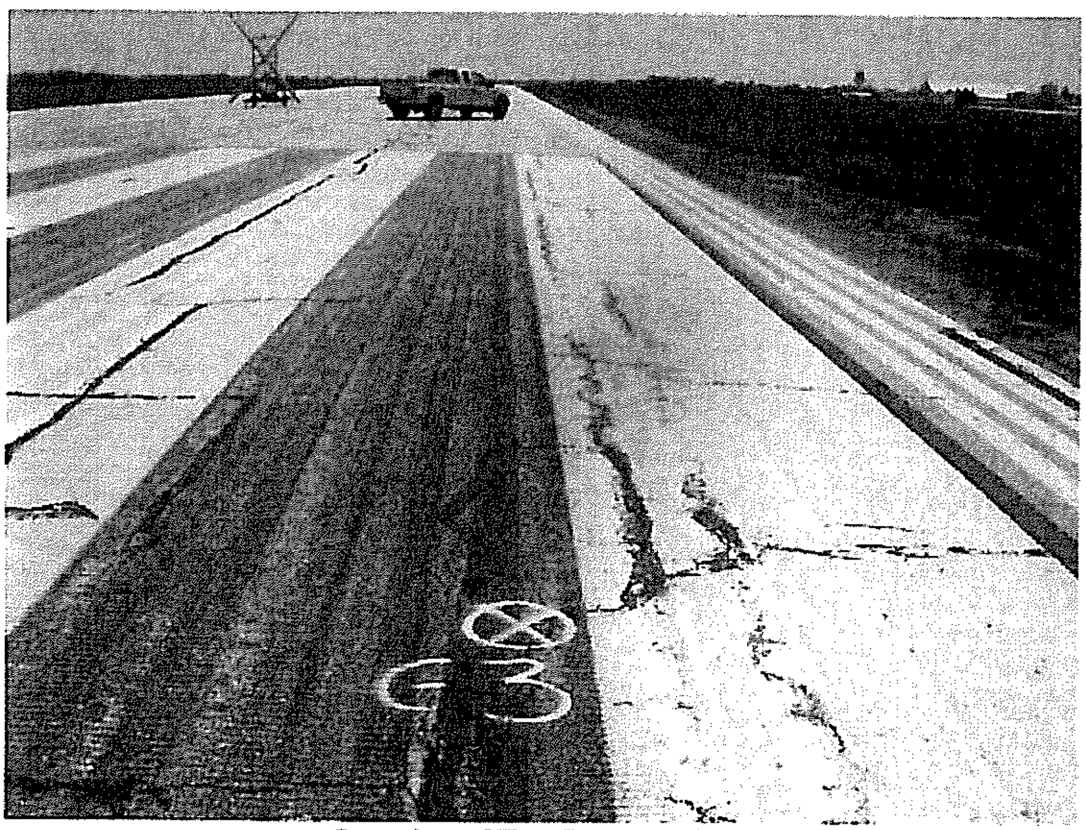
EDP Consultants, Inc.
June 15, 2009


Test Location C-2


Overview of Test Location C-2

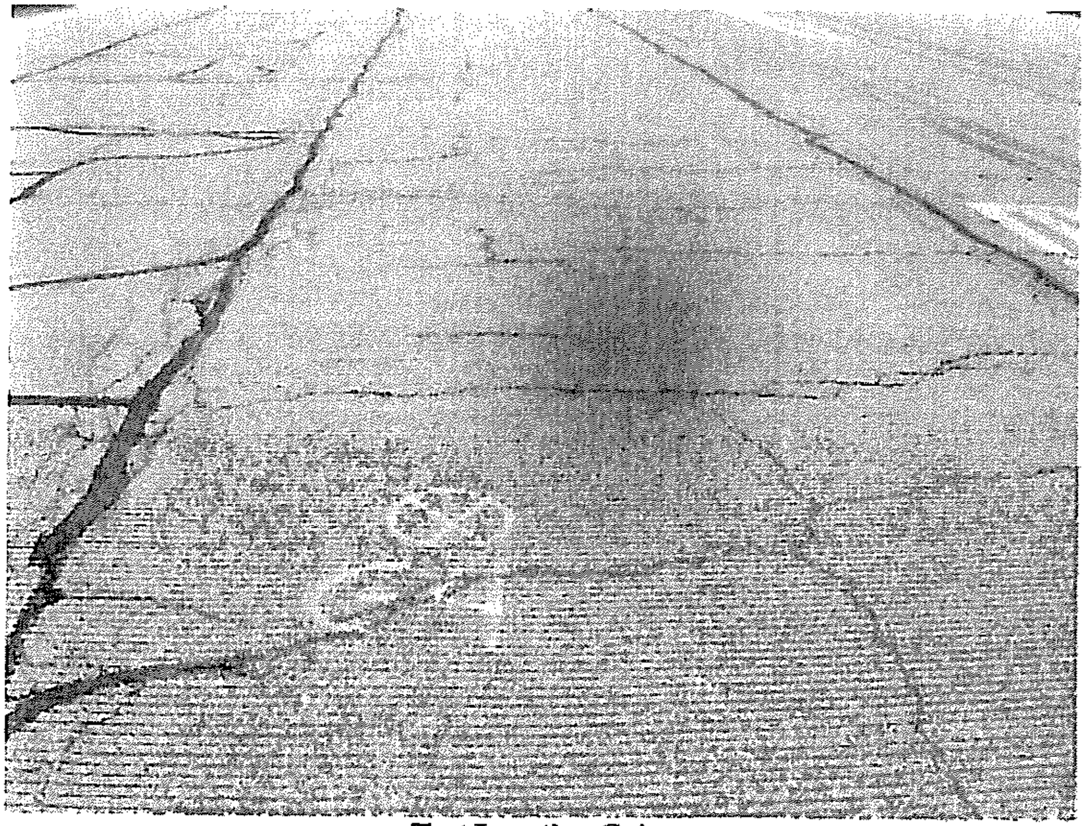
EDP Consultants, Inc.
June 15, 2009

Test Location C-3

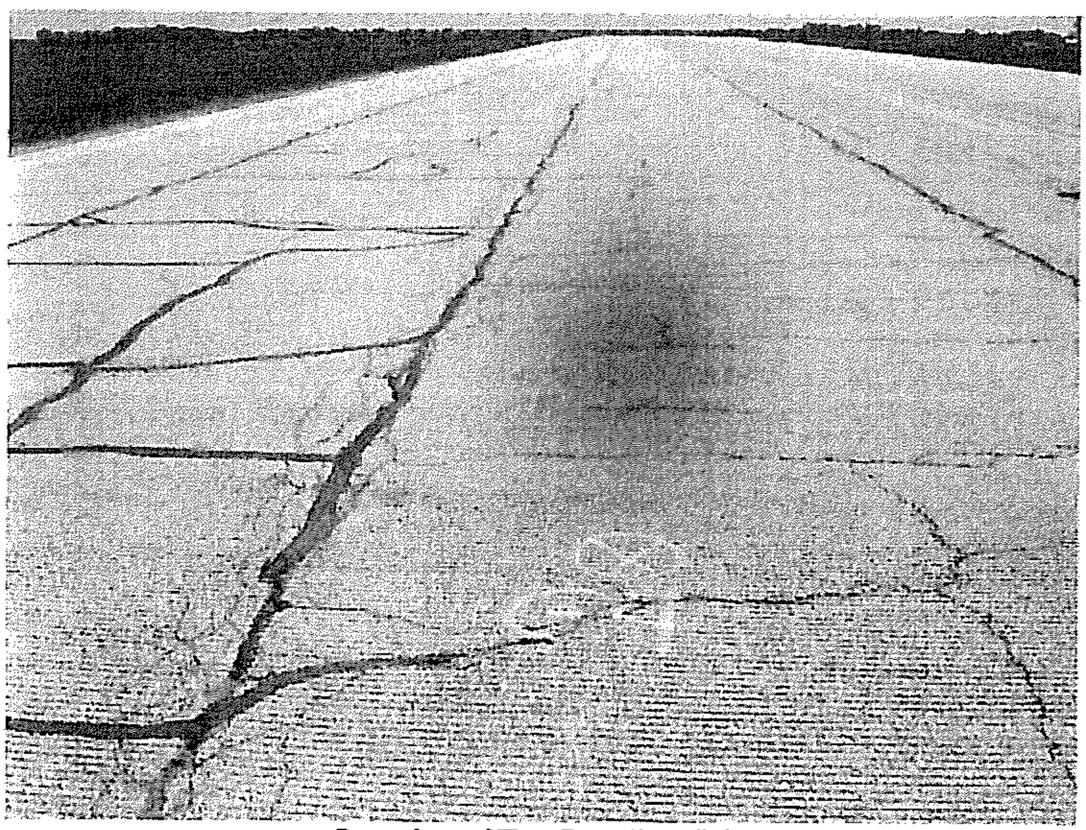


Overview of Test Location C-3

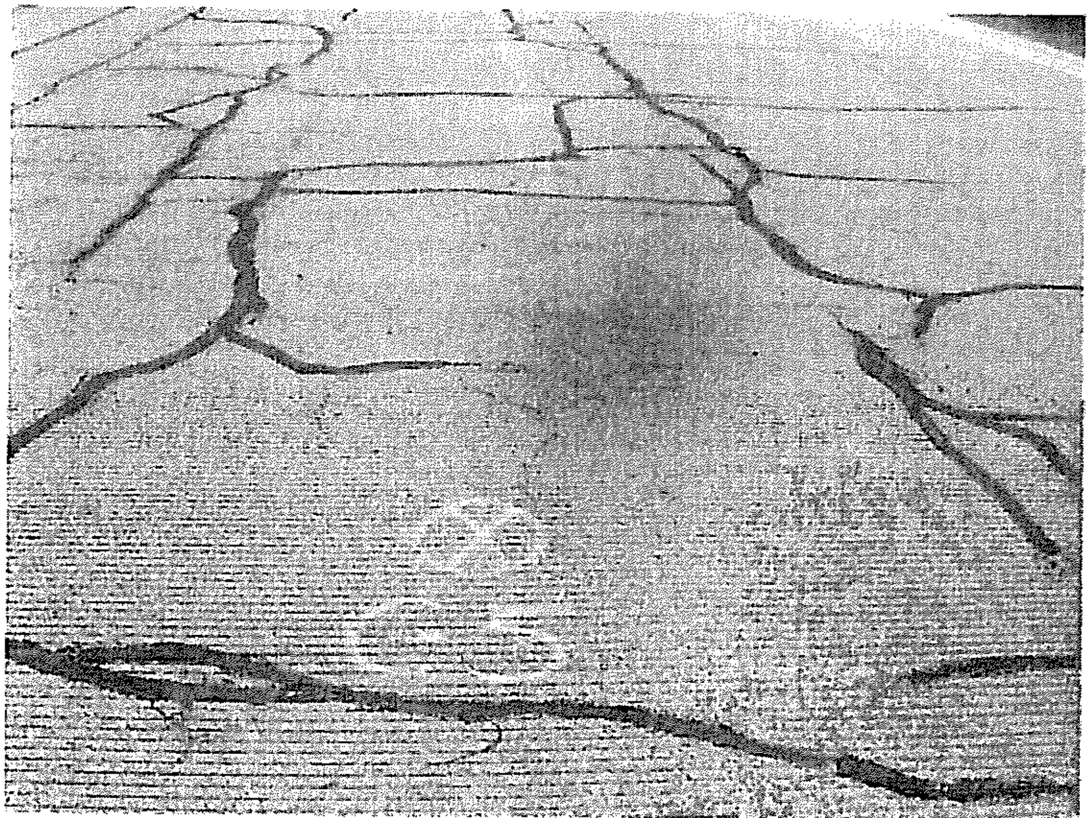
EDP Consultants, Inc.
June 15, 2009



Test Location C-4

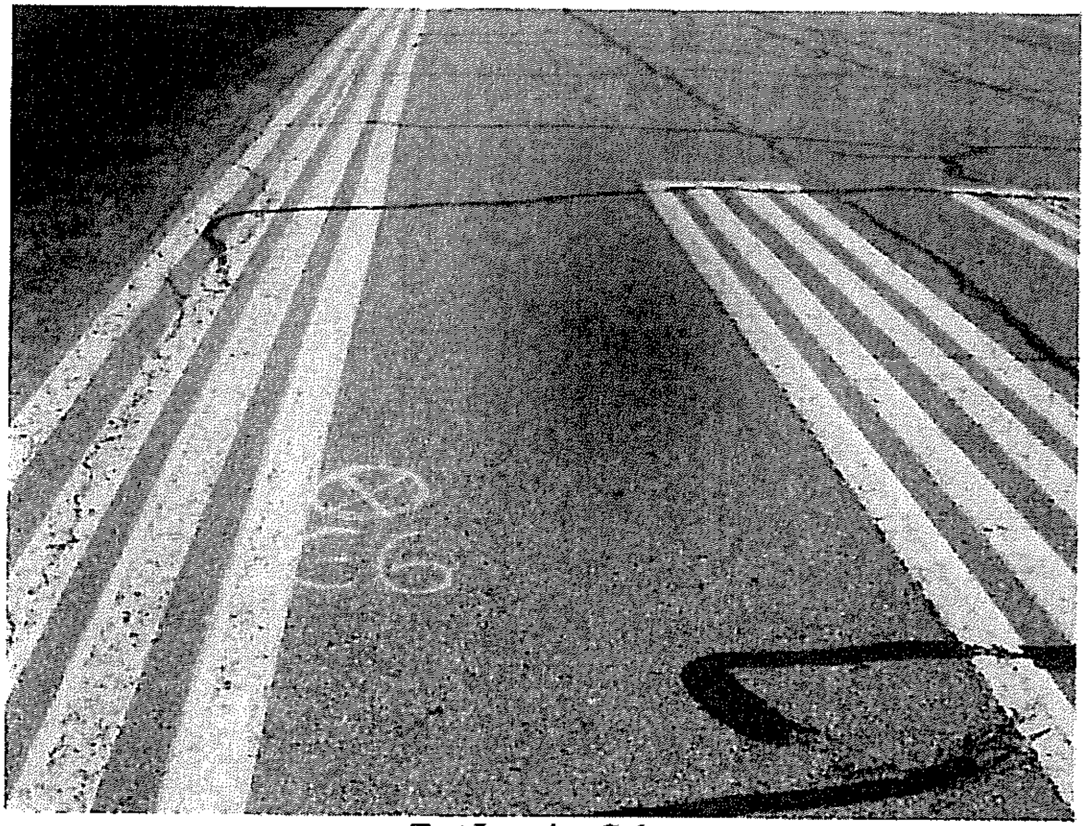


Overview of Test Location C-4



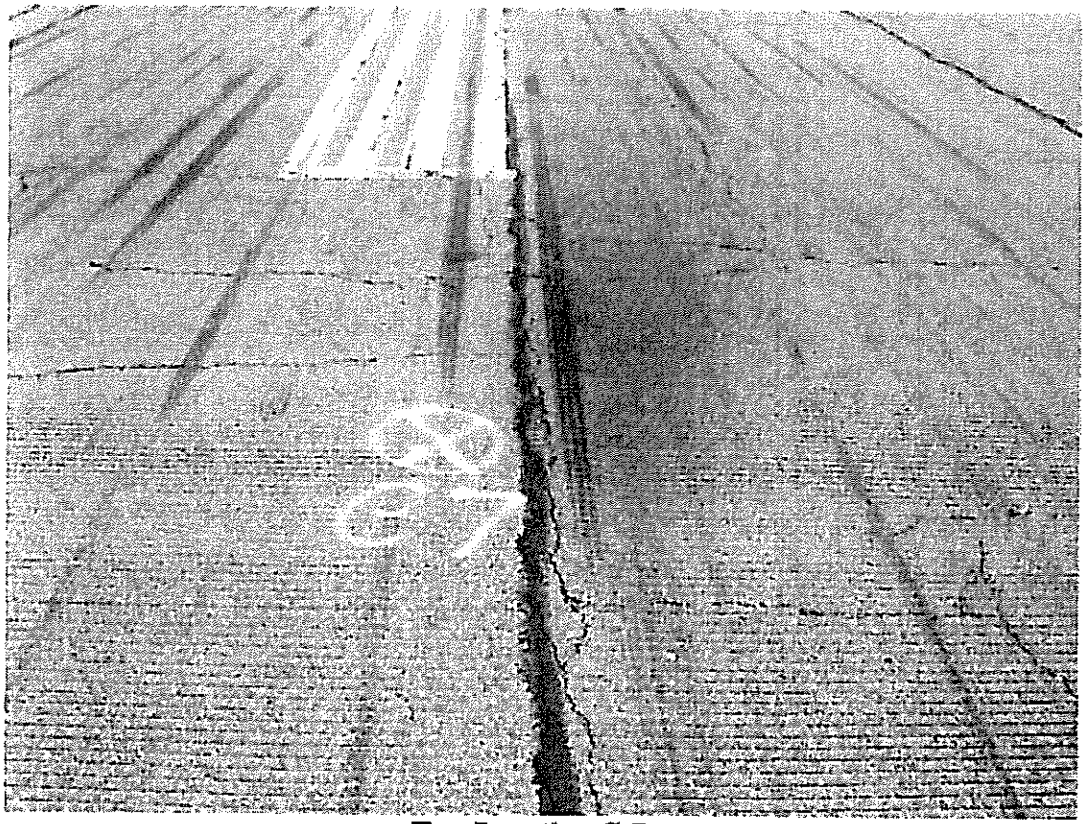
Test Location C-5

Overview of Test Location C-5

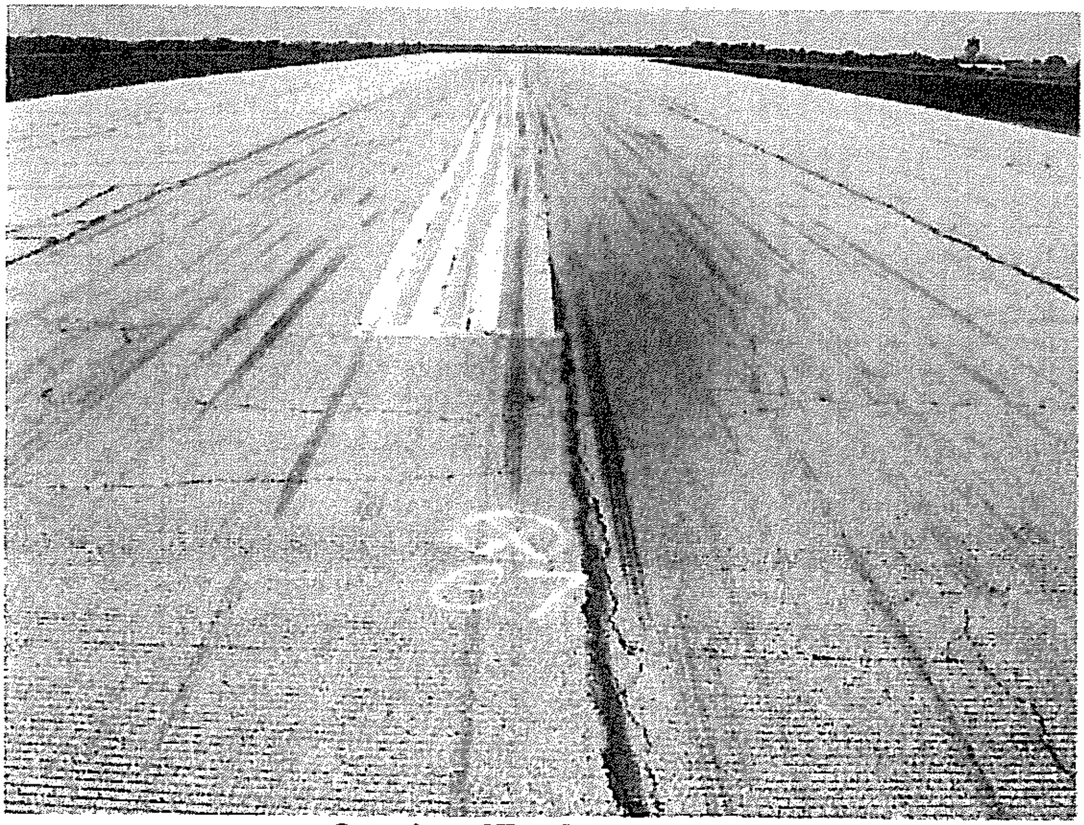

Test Location C-6


Overview of Test Location C-6

EDP Consultants, Inc.
June 15, 2009

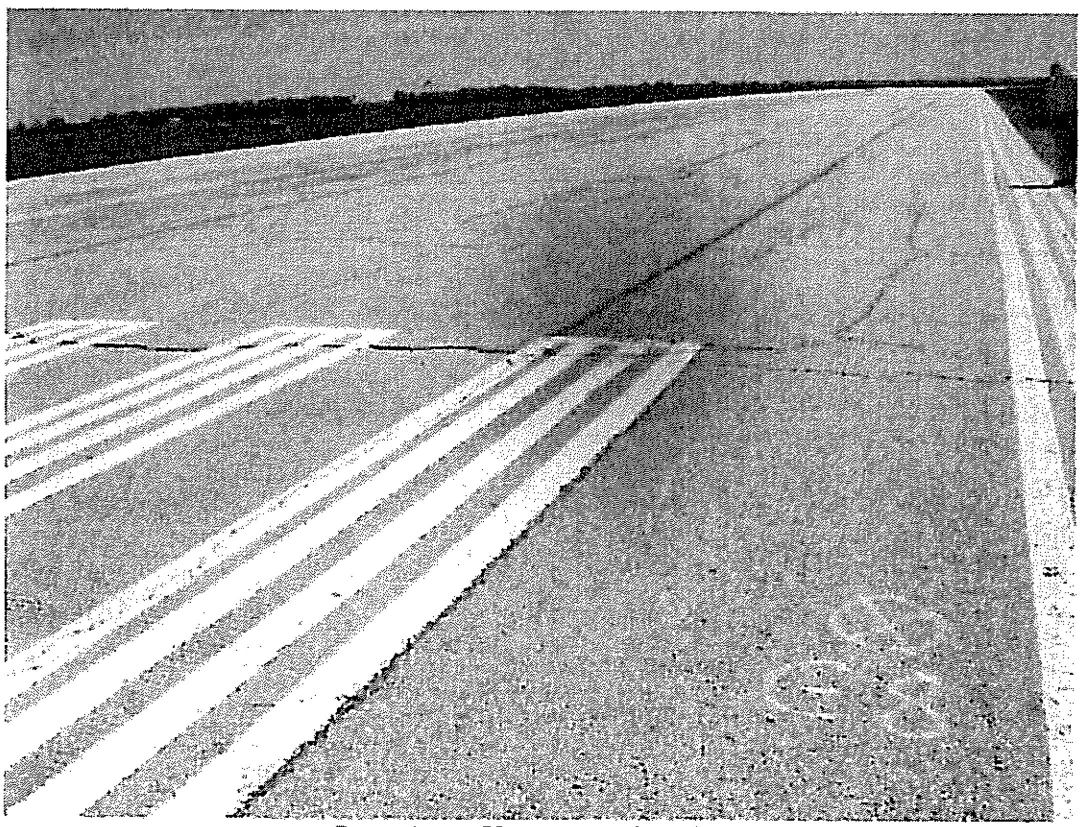


Test Location C-7

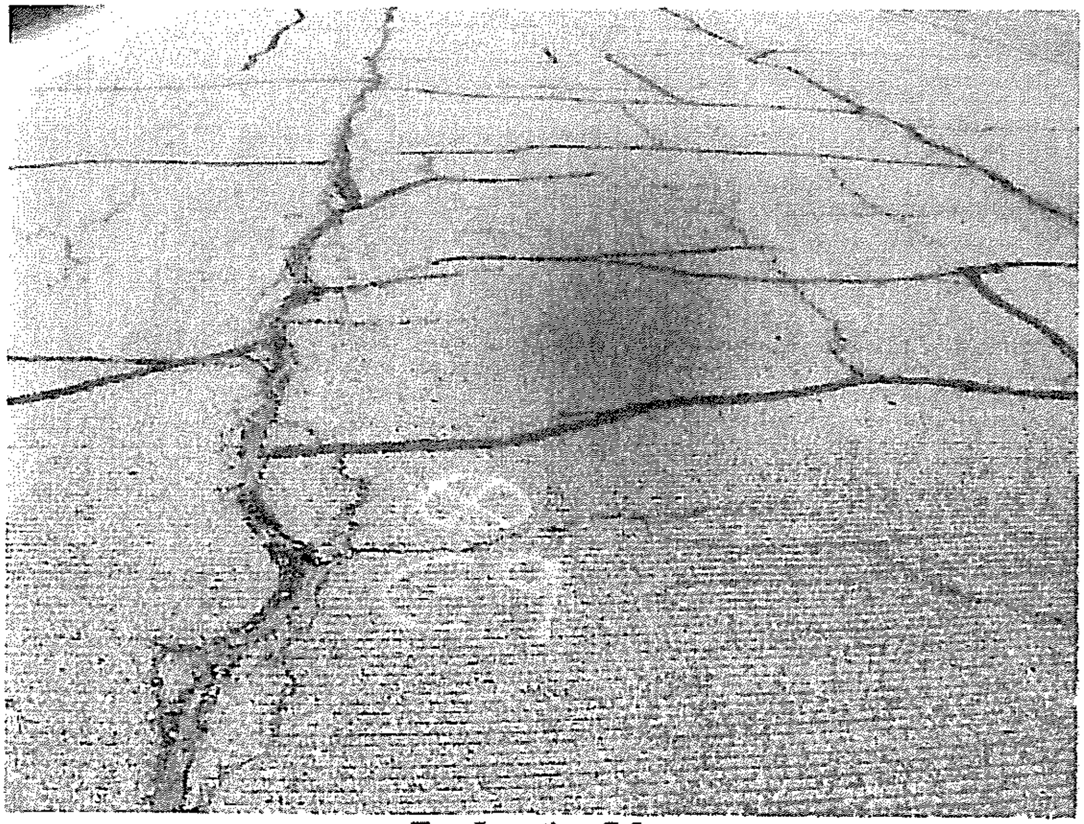


Overview of Test Location C-7

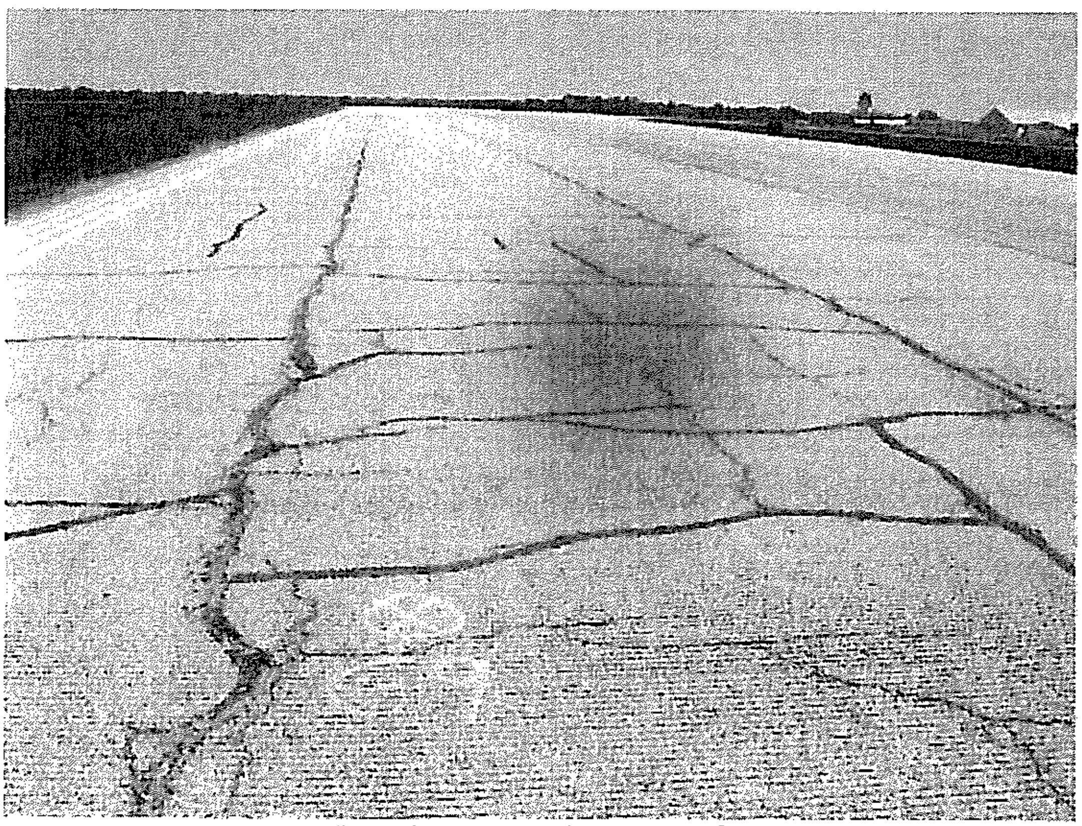
Test Location C-8



Overview of Test Location C-8

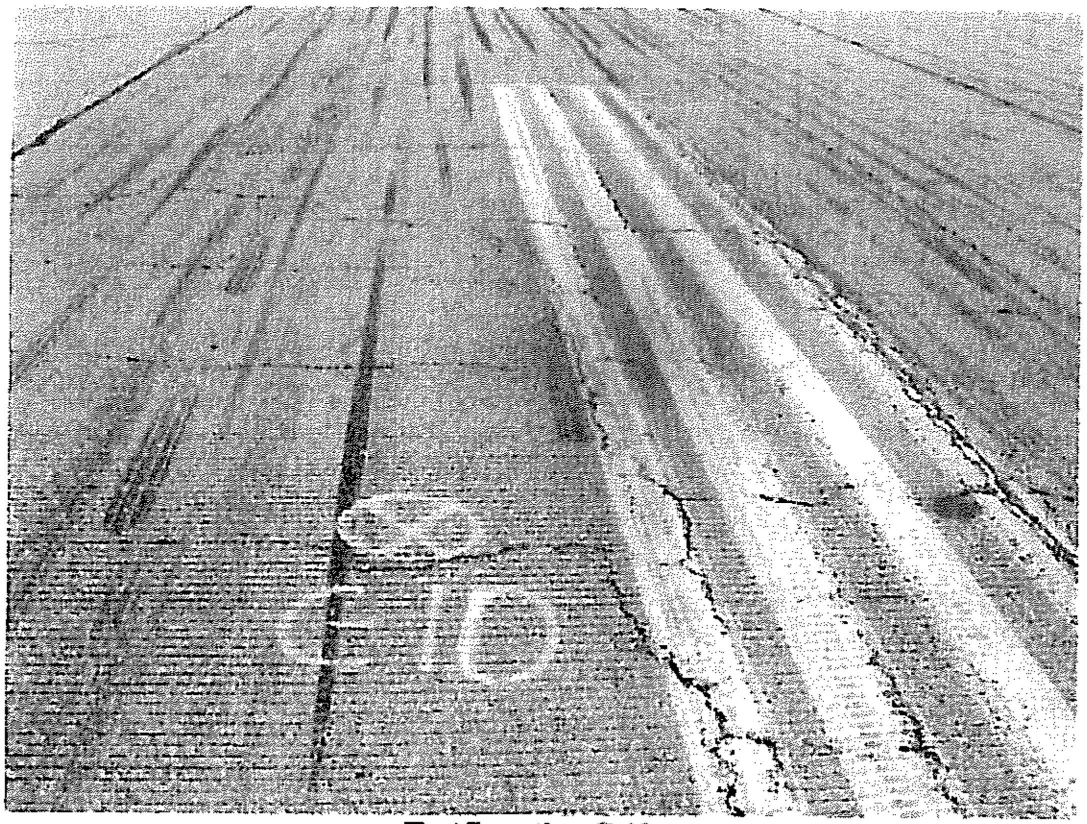


Test Location C-9



Overview of Test Location C-9

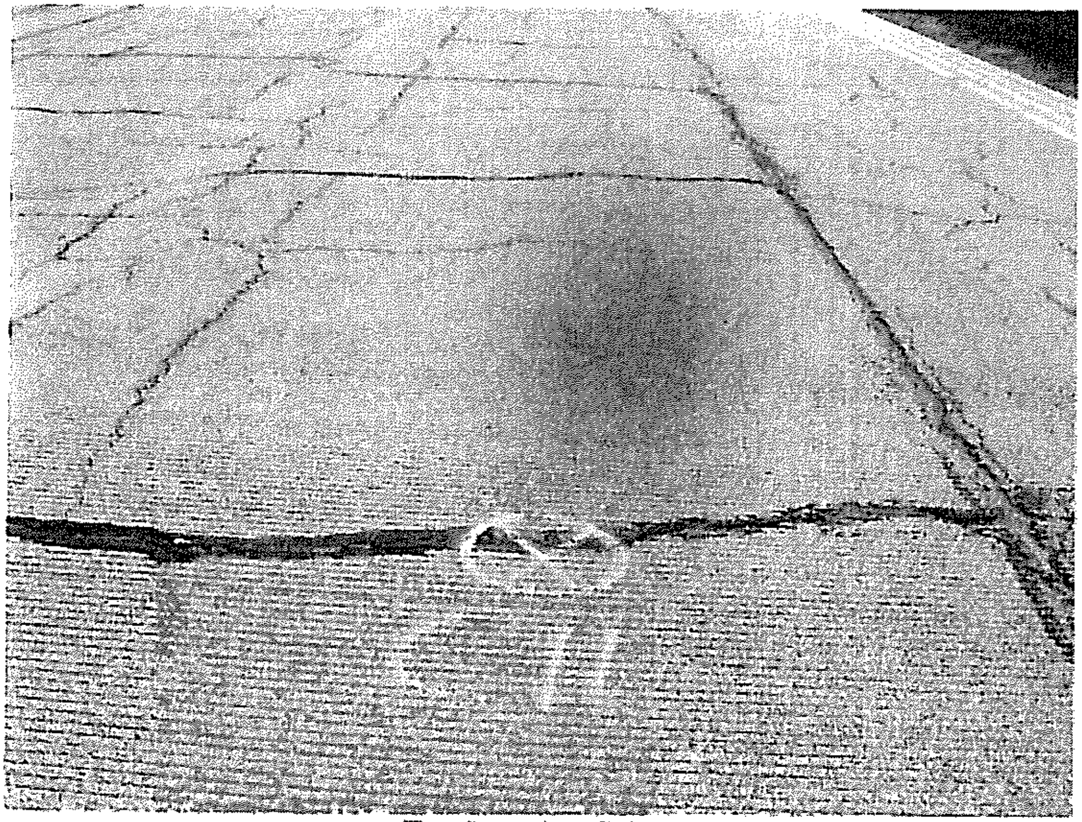
EDP Consultants, Inc.
June 15, 2009



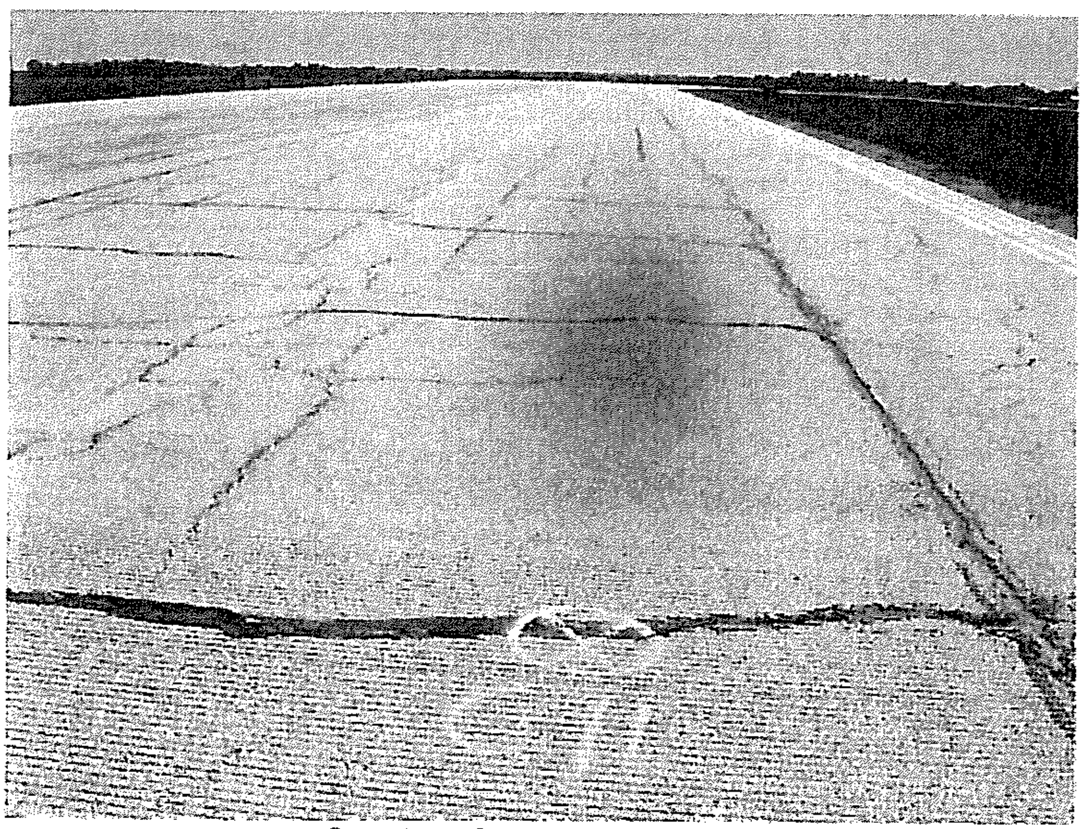
Test Location C-10

Overview of Test Location C-10

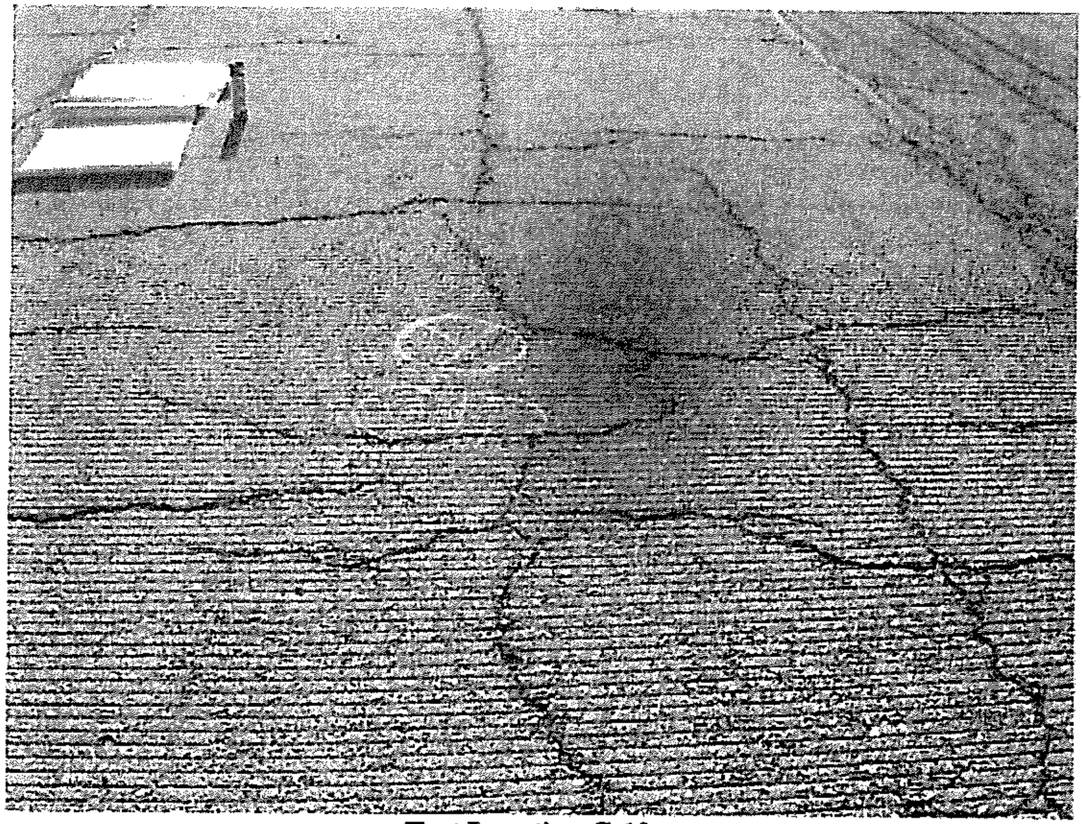
EDP Consultants, Inc.
June 15, 2009



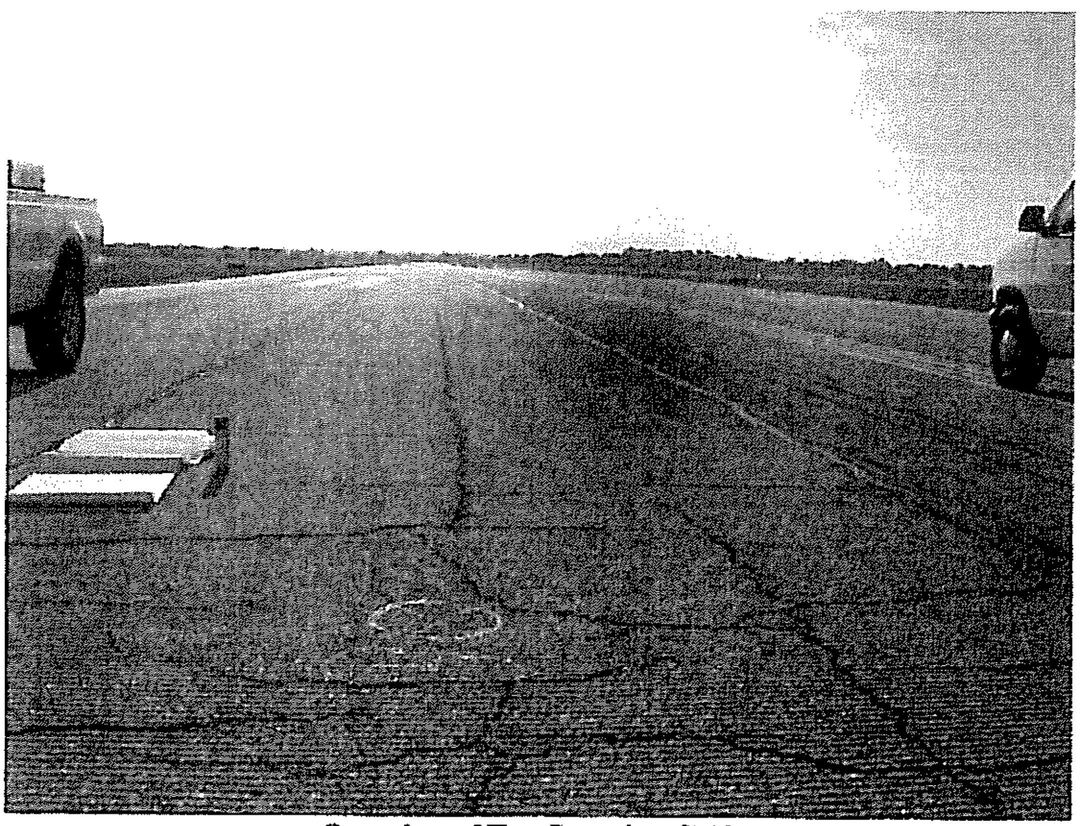
Test Location C-11



Overview of Test Location C-11

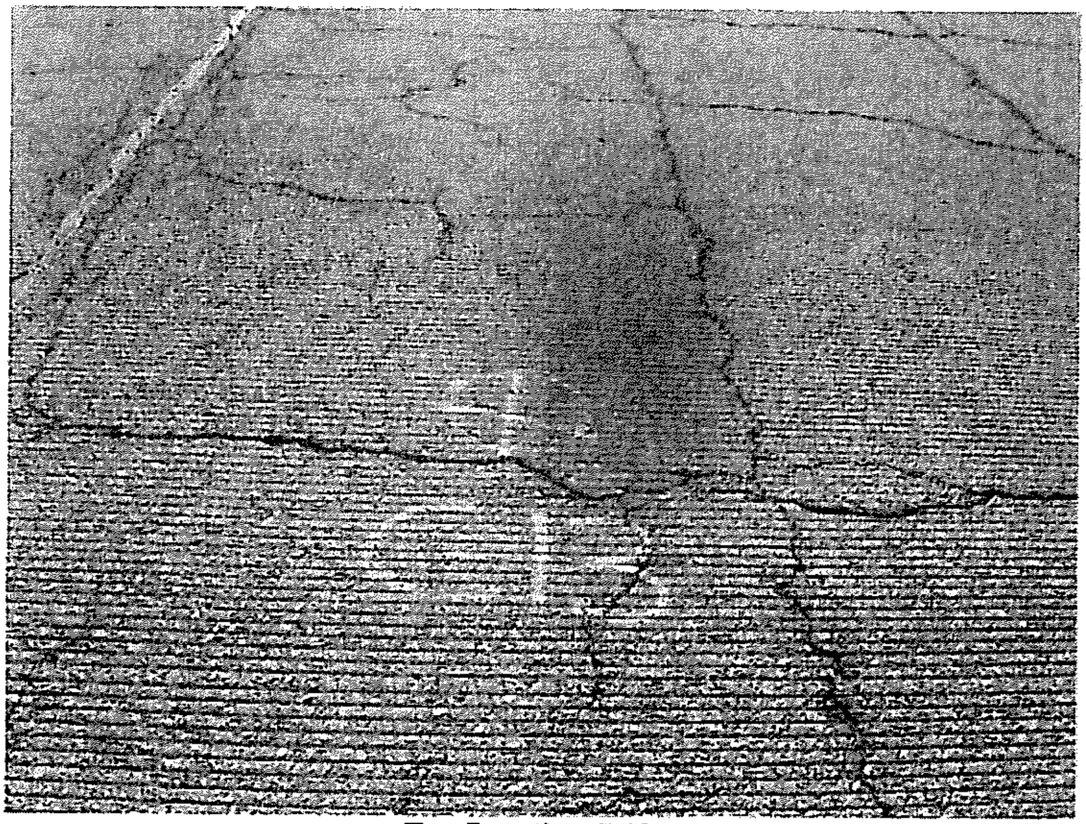


Test Location C-12



Overview of Test Location C-12

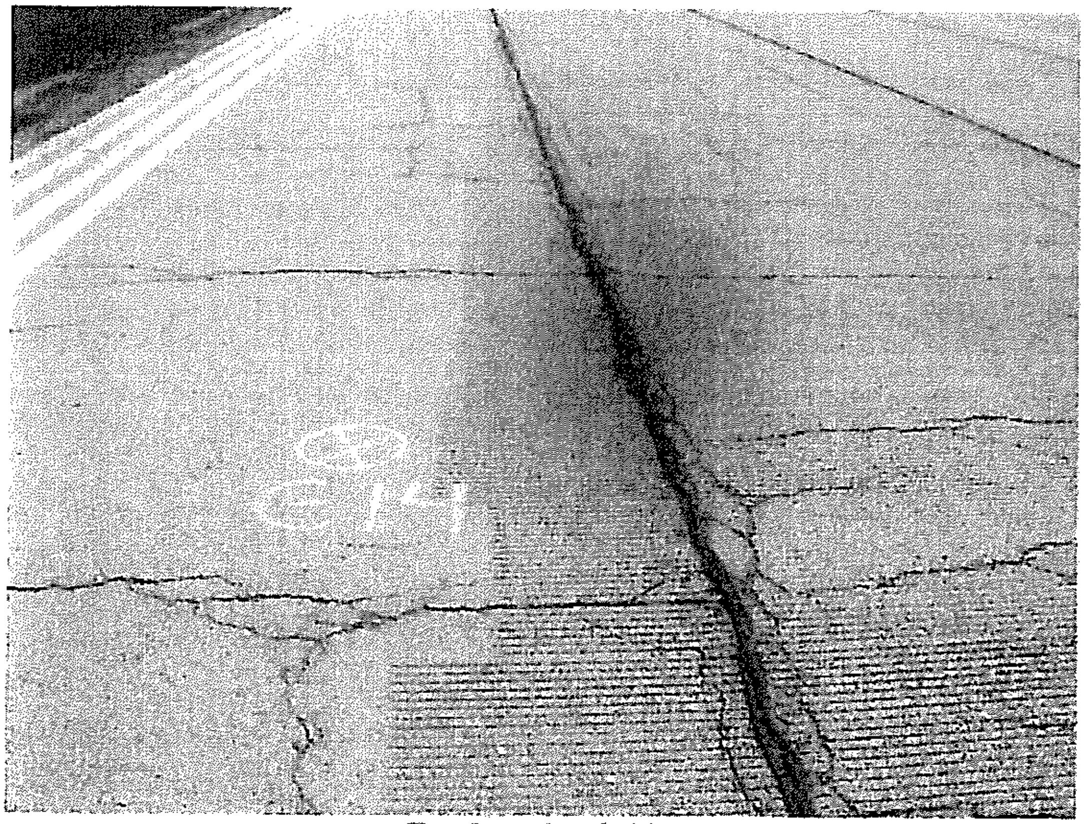
EDP Consultants, Inc.
June 15, 2009



Test Location C-13

Overview of Test Location C-13

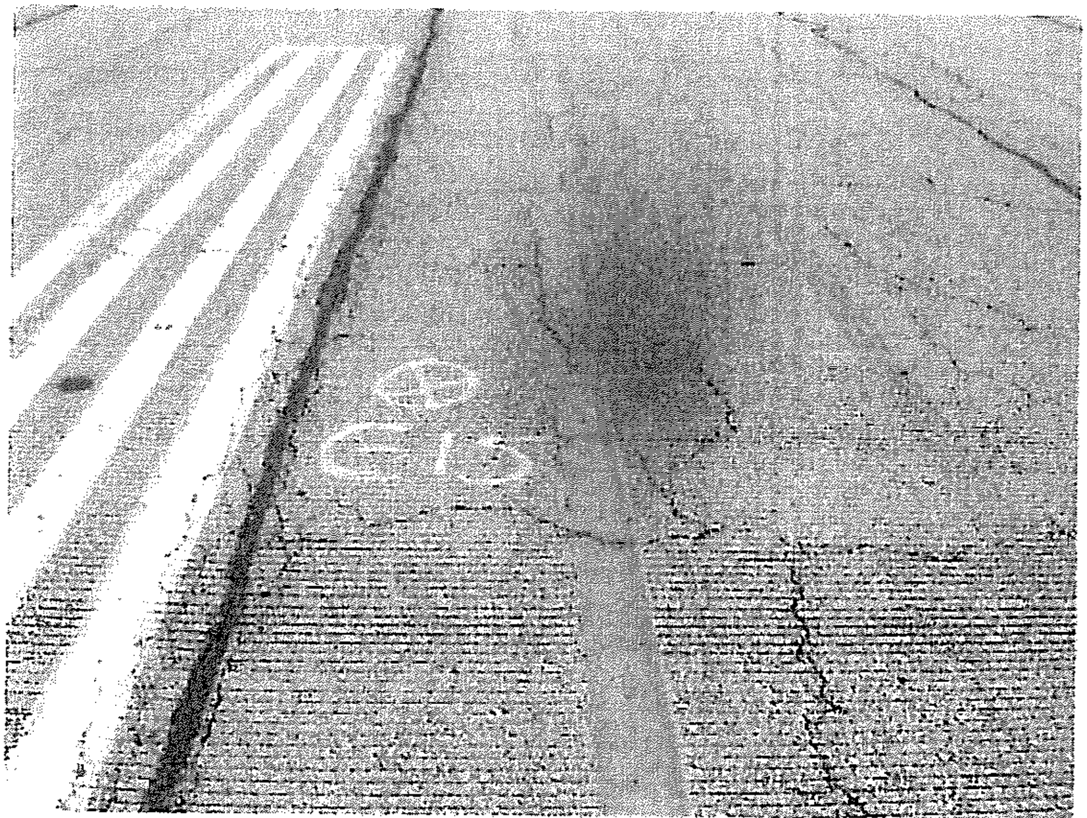
EDP Consultants, Inc.
June 15, 2009



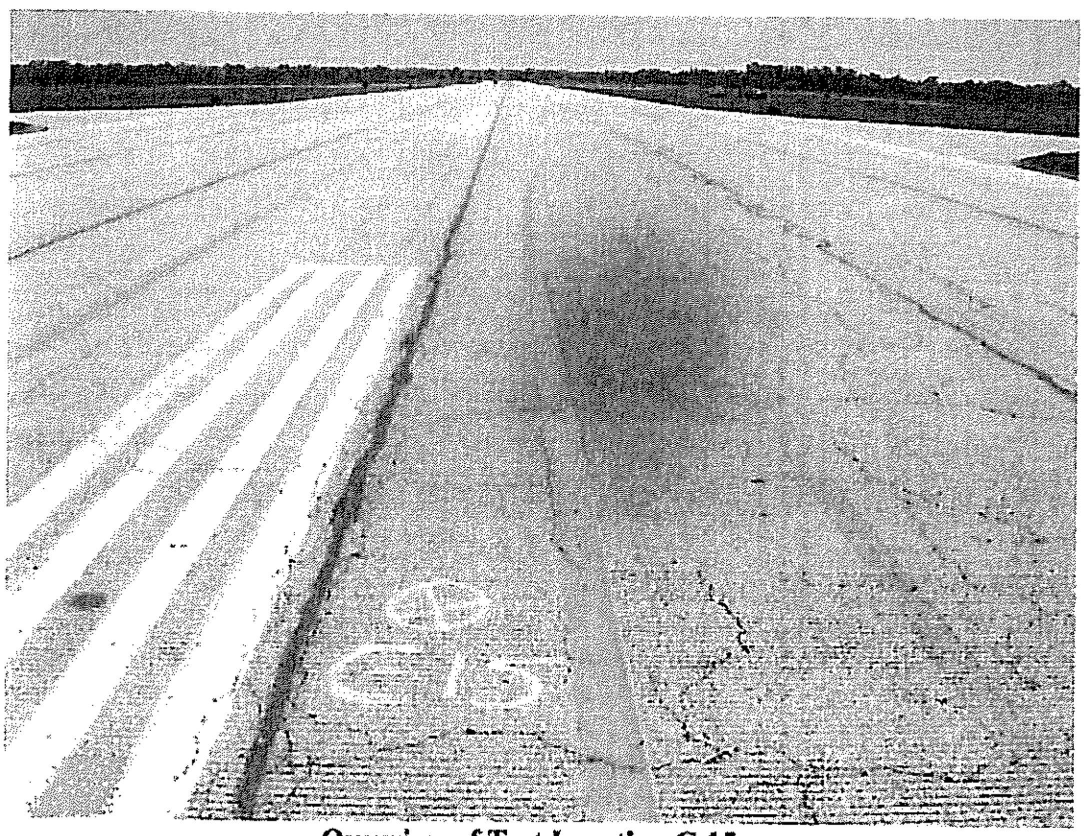
Test Location C-14

Overview of Test Location C-14

EDP Consultants, Inc.
June 15, 2009

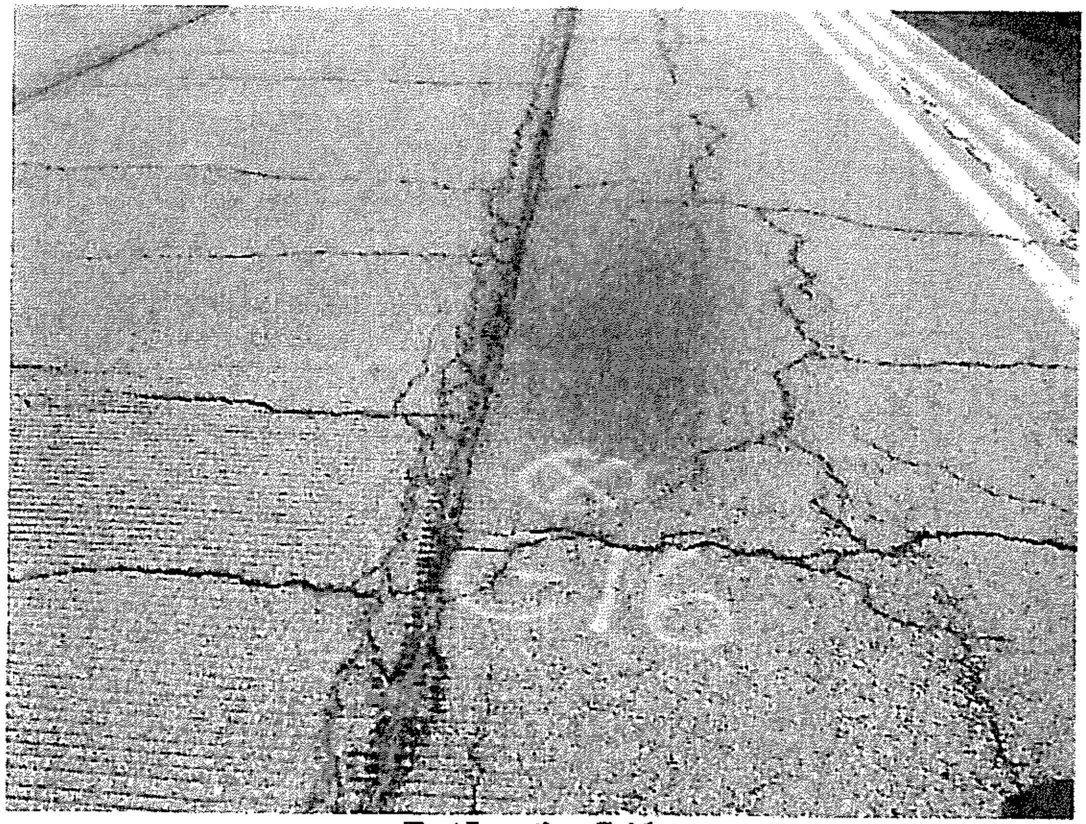


Test Location C-15



Overview of Test Location C-15

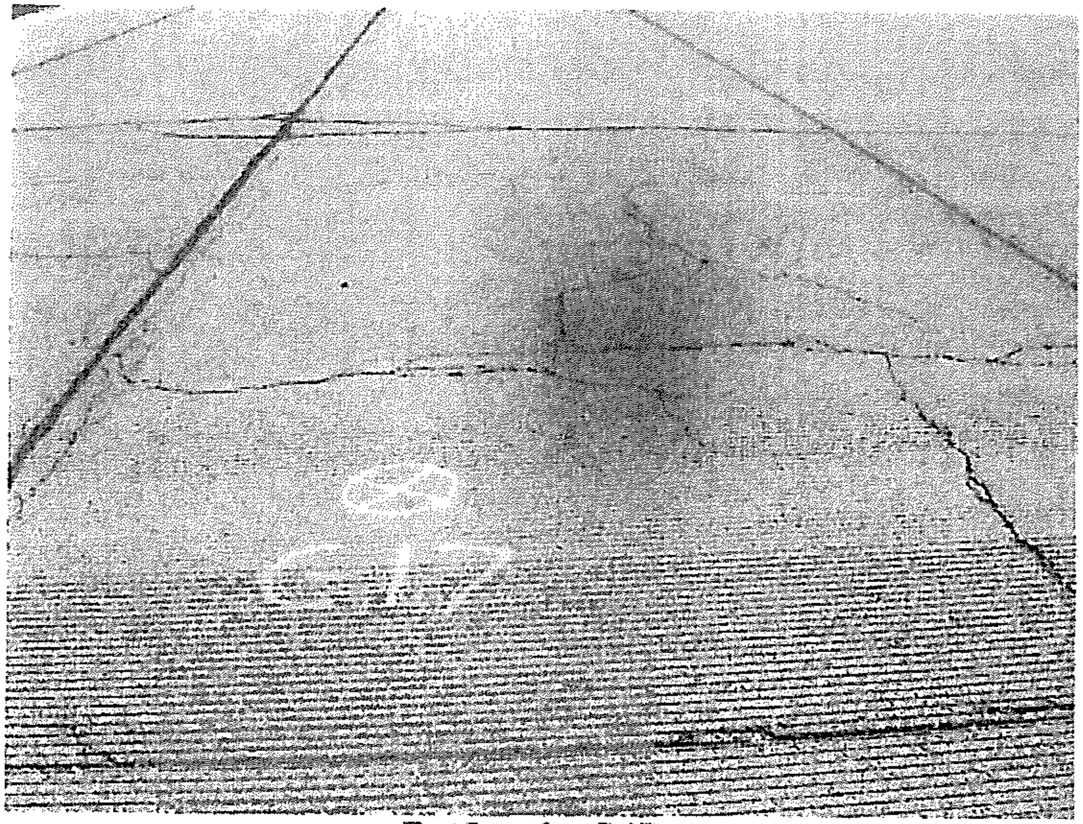
EDP Consultants, Inc.
June 15, 2009



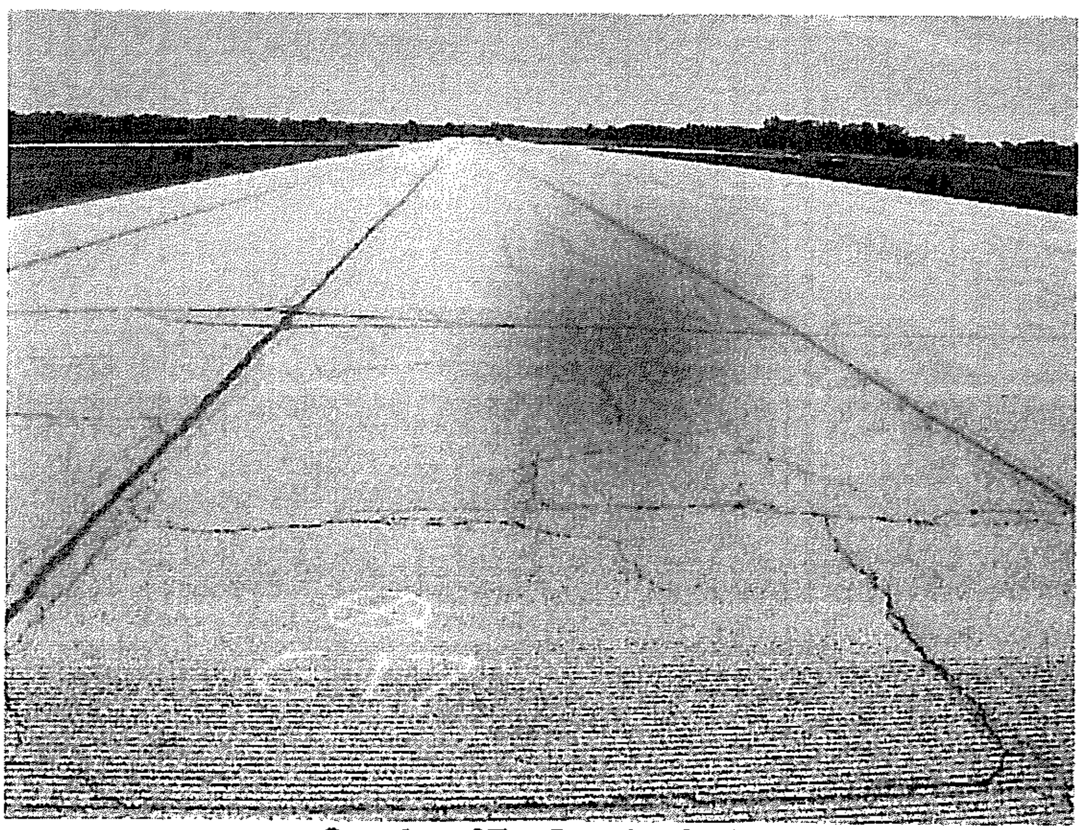
Test Location C-16

Overview of Test Location C-16

EDP Consultants, Inc.
June 15, 2009

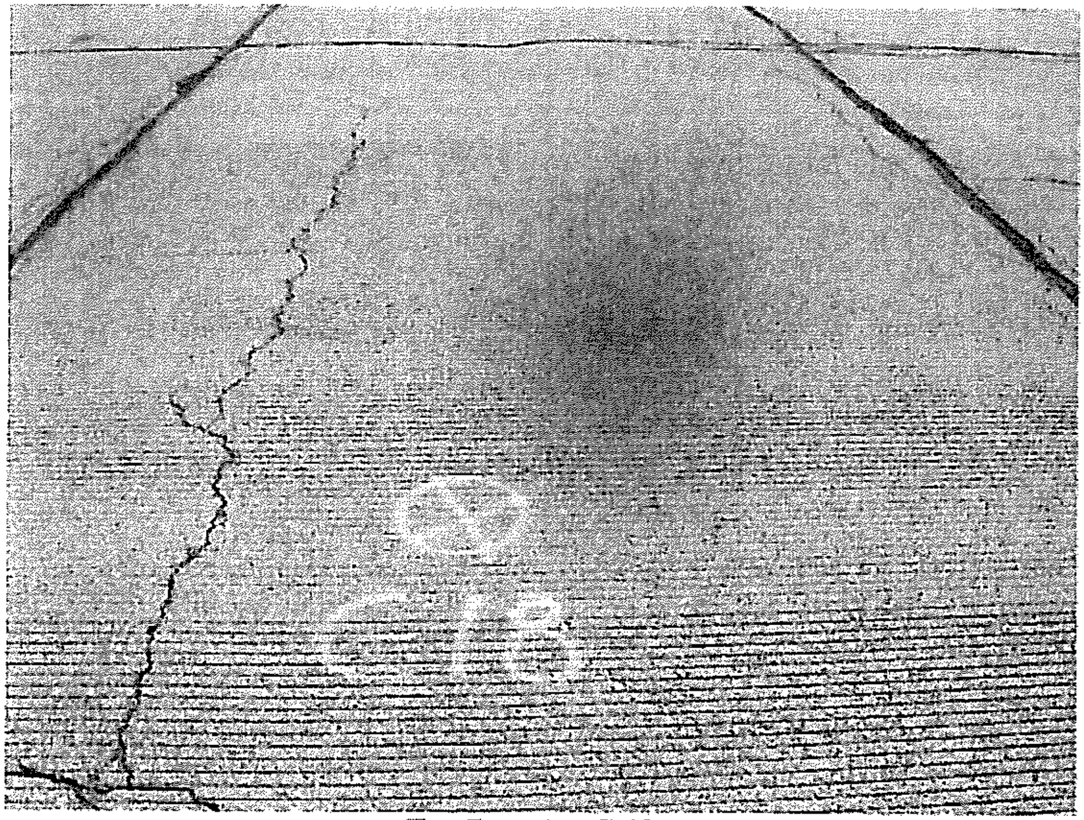


Test Location C-17

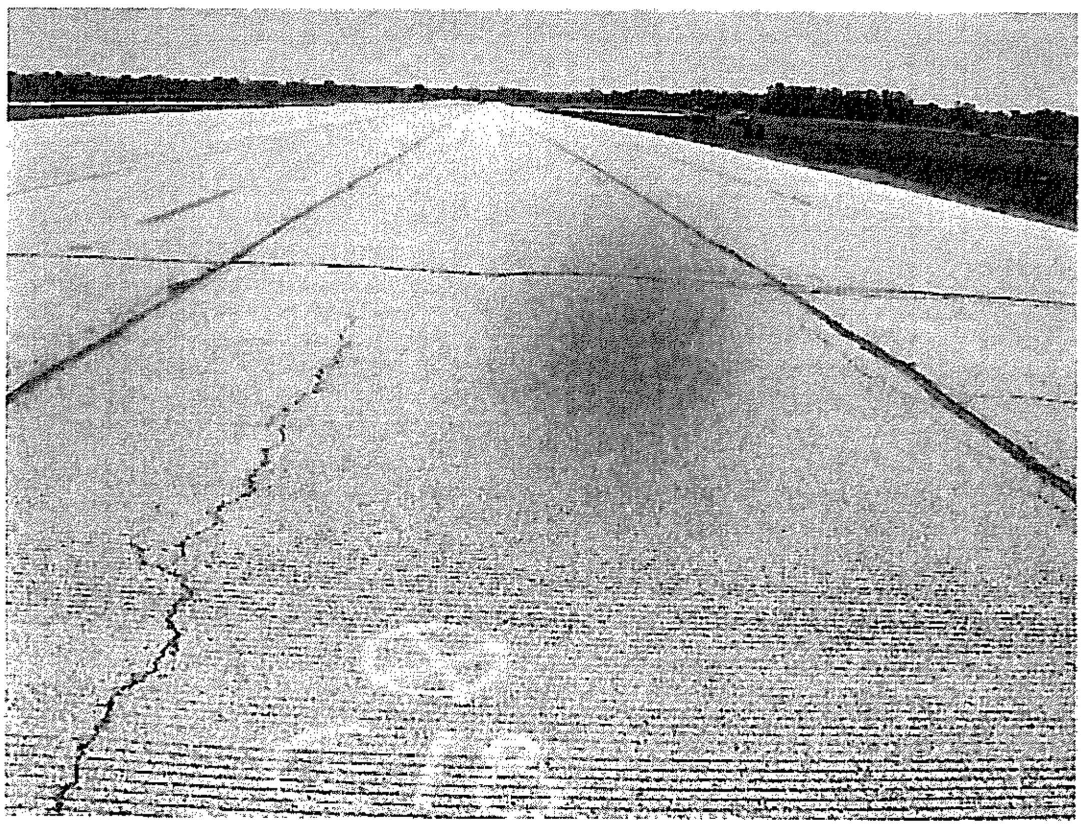


Overview of Test Location C-17

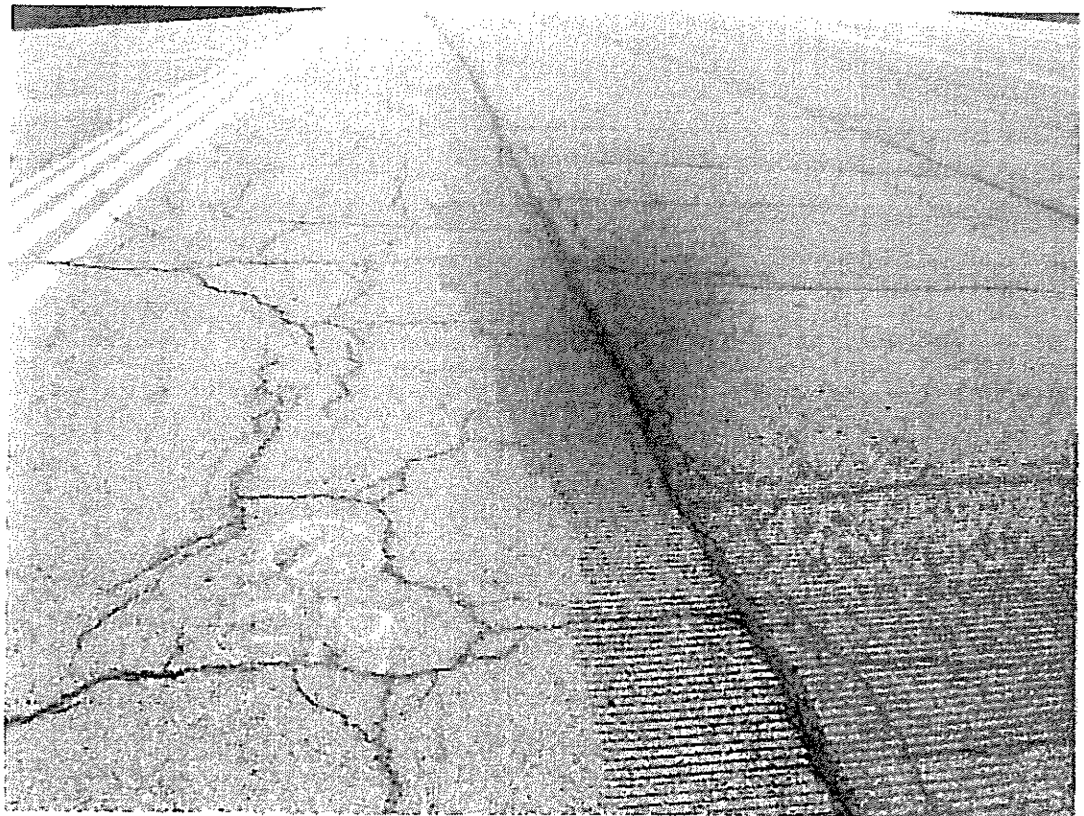
EDP Consultants, Inc.
June 15, 2009



Test Location C-18



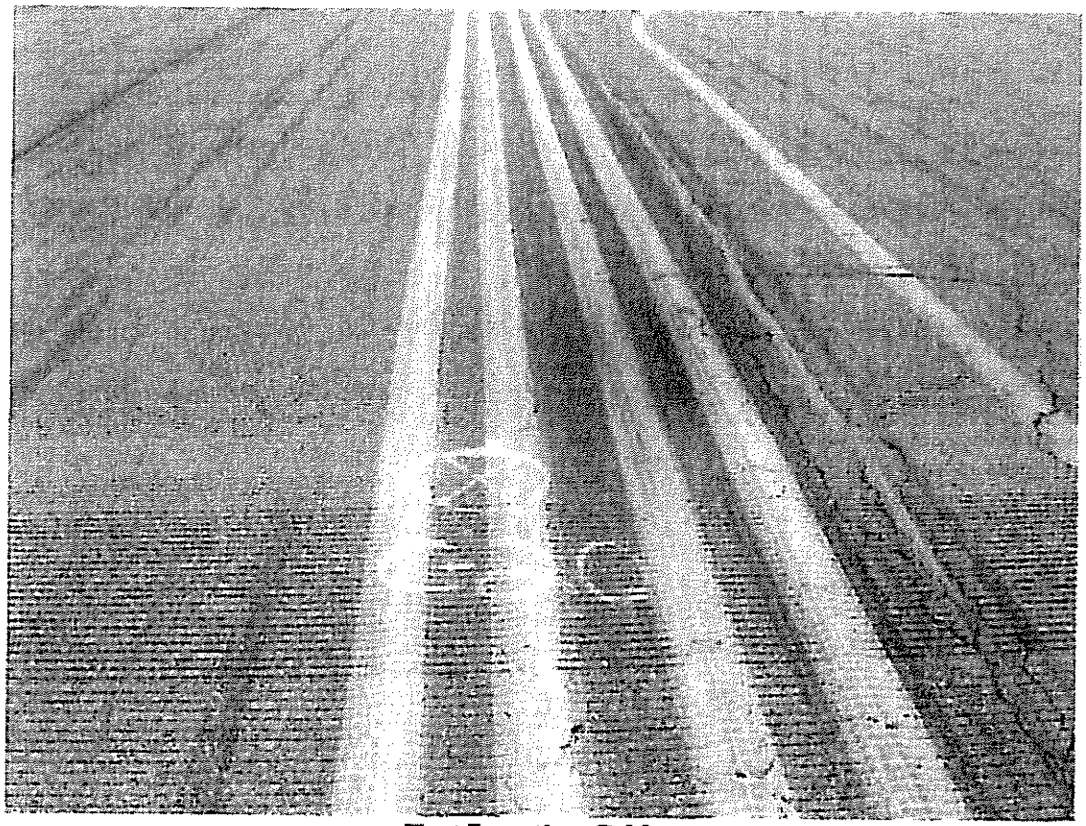
Overview of Test Location C-18



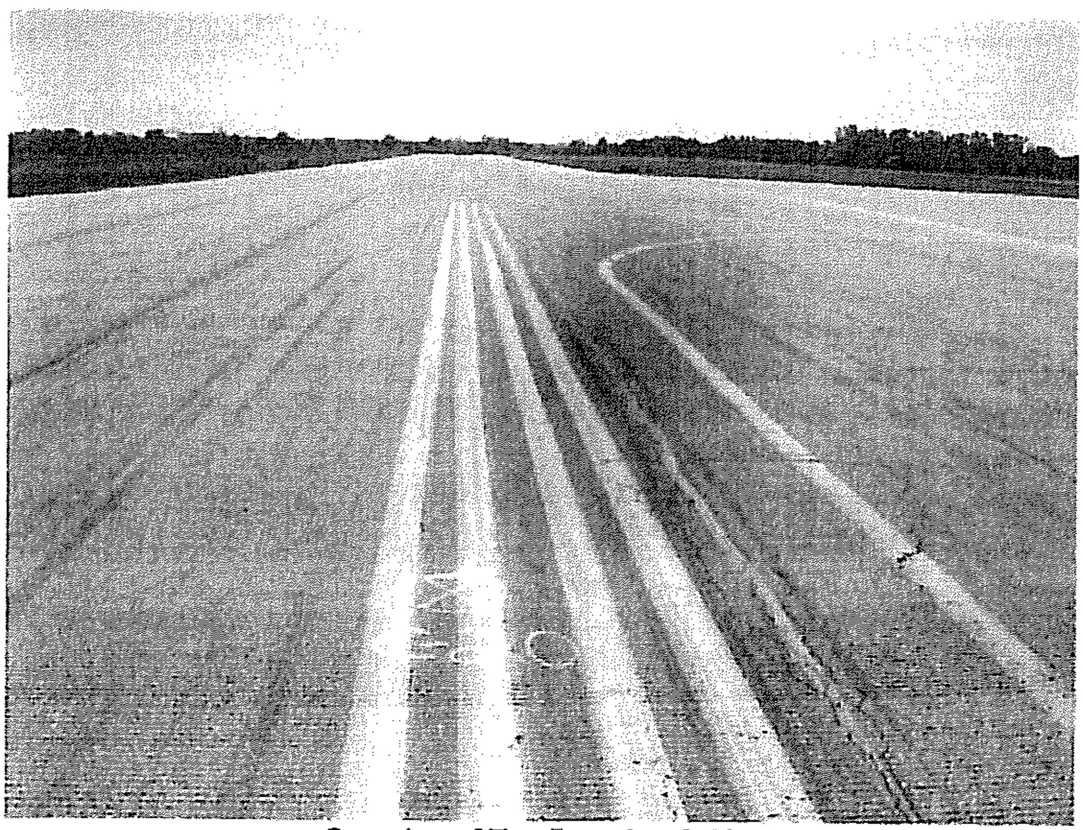
Test Location C-19

Overview of Test Location C-19

EDP Consultants, Inc.
June 15, 2009



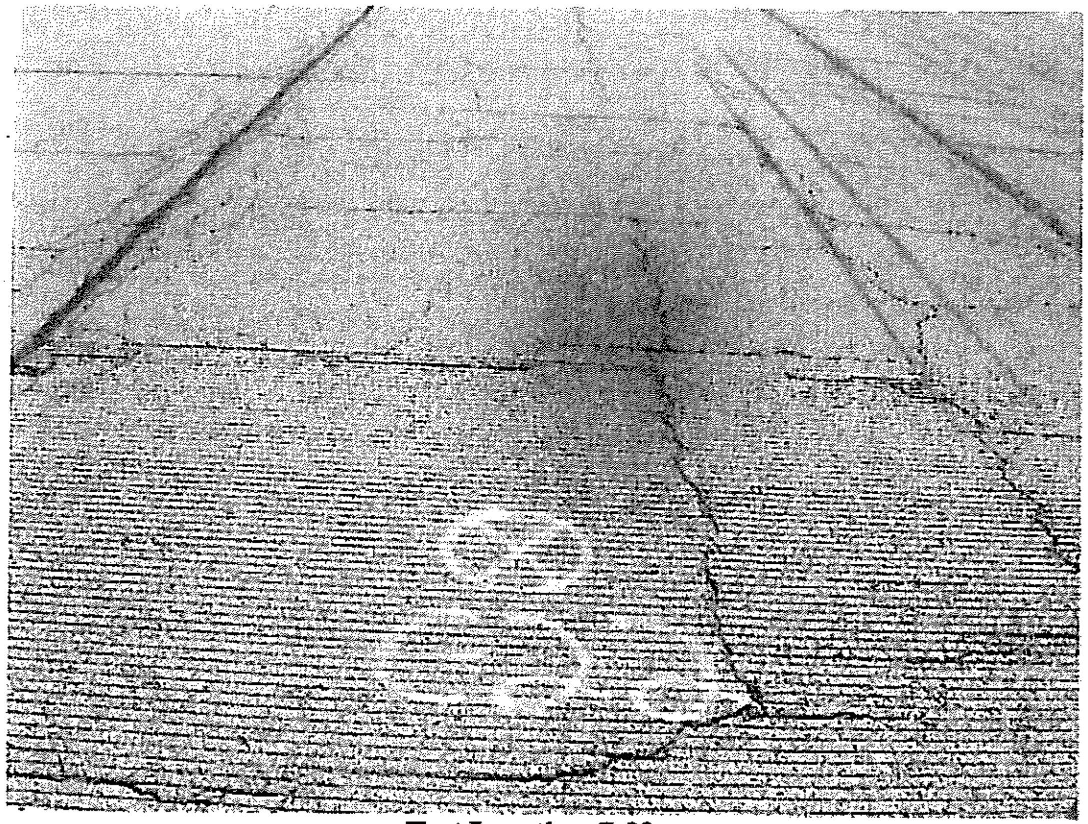
Test Location C-20



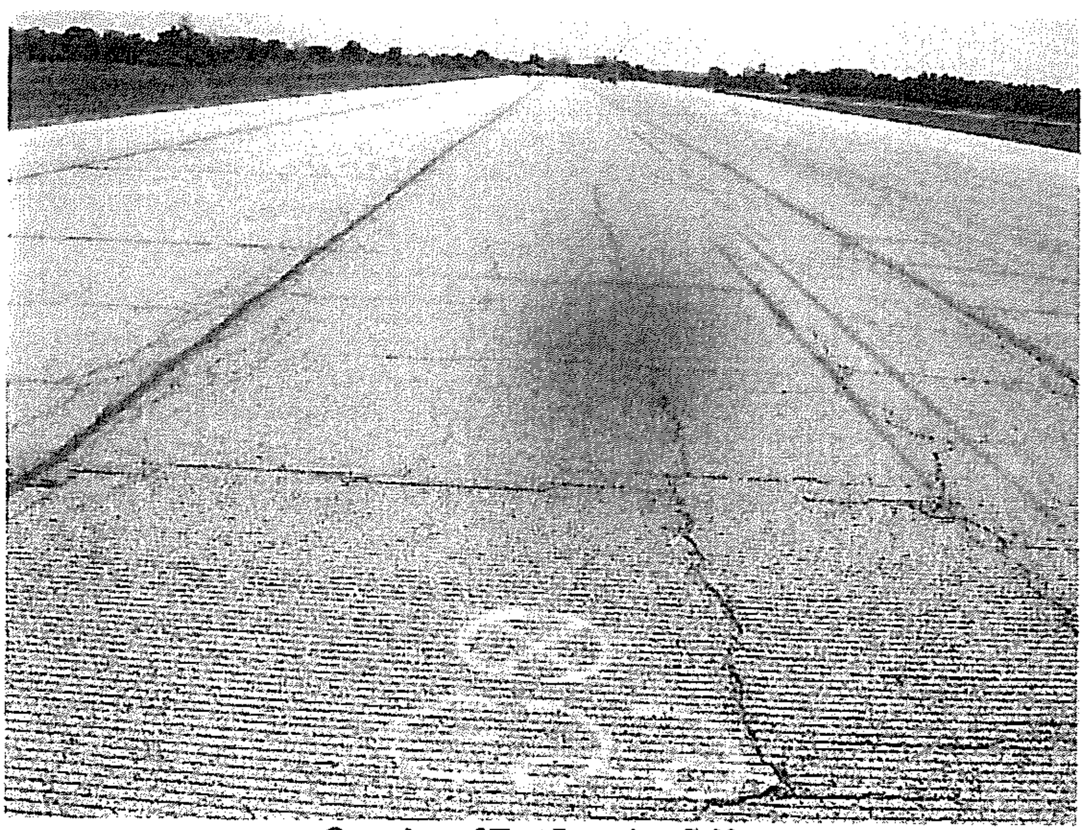
Overview of Test Location C-20

Test Location C-21

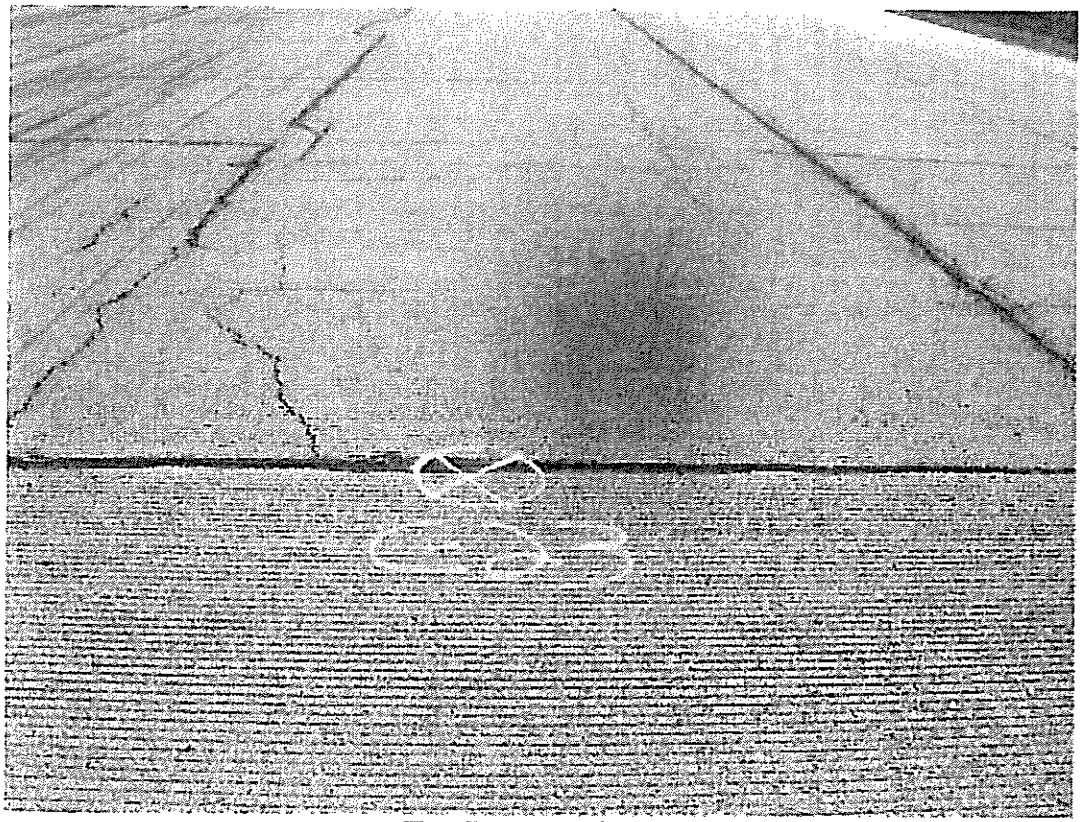
Overview of Test Location C-21



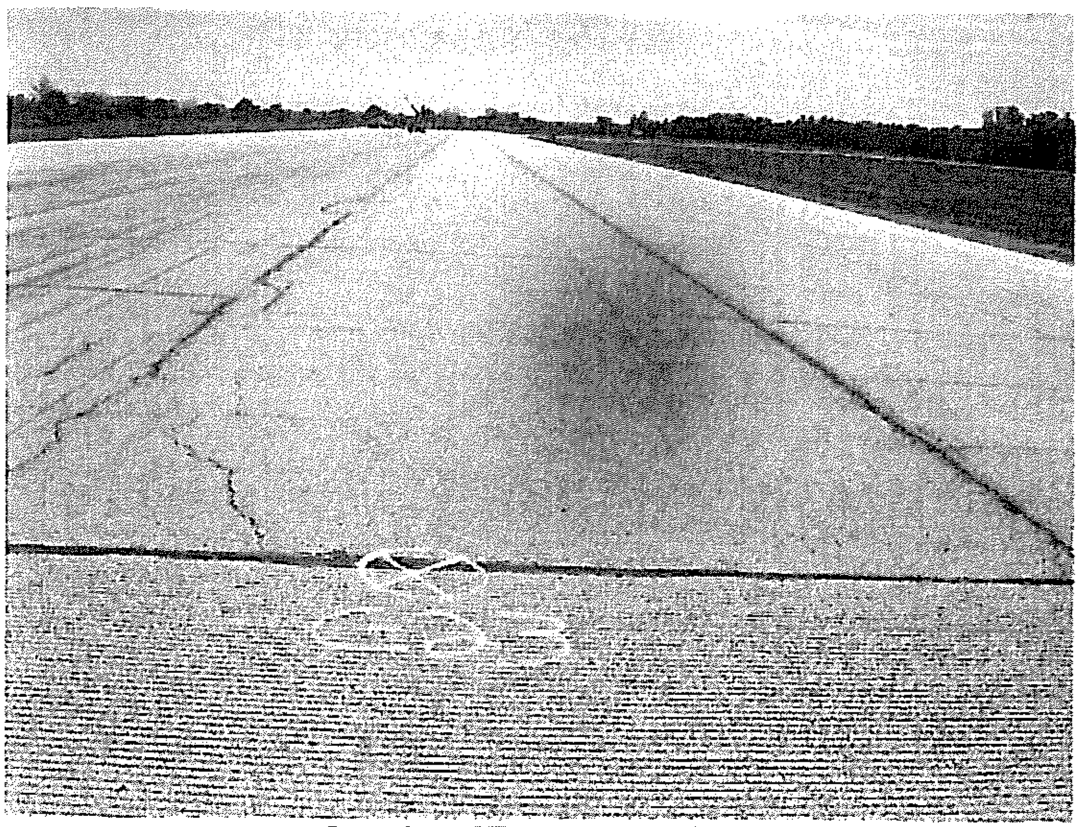
Test Location C-22



Overview of Test Location C-22

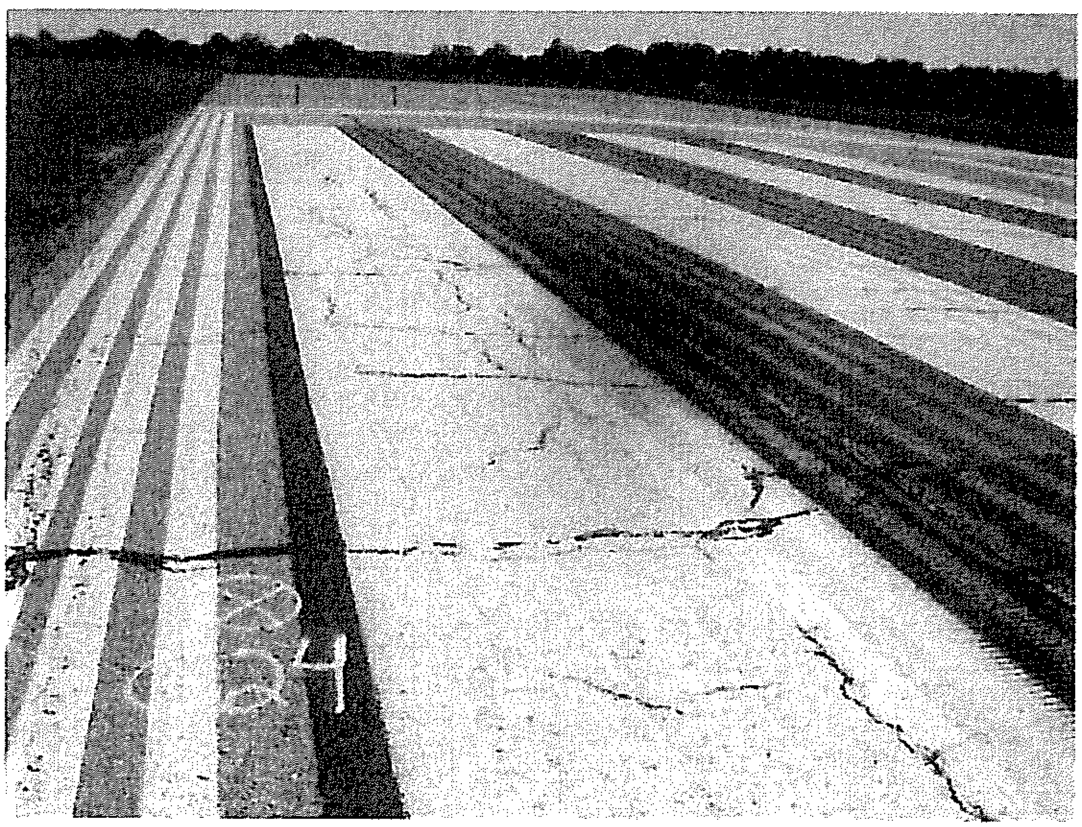


Test Location C-23



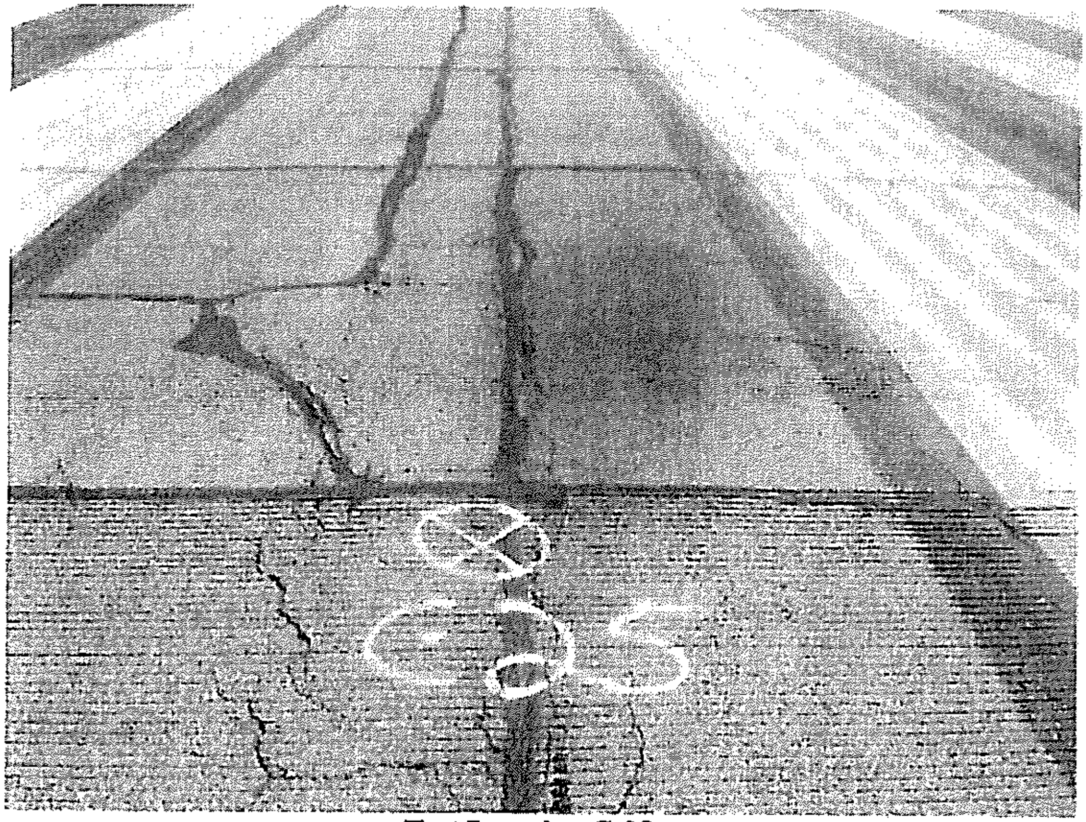
Overview of Test Location C-23

Test Location C-24

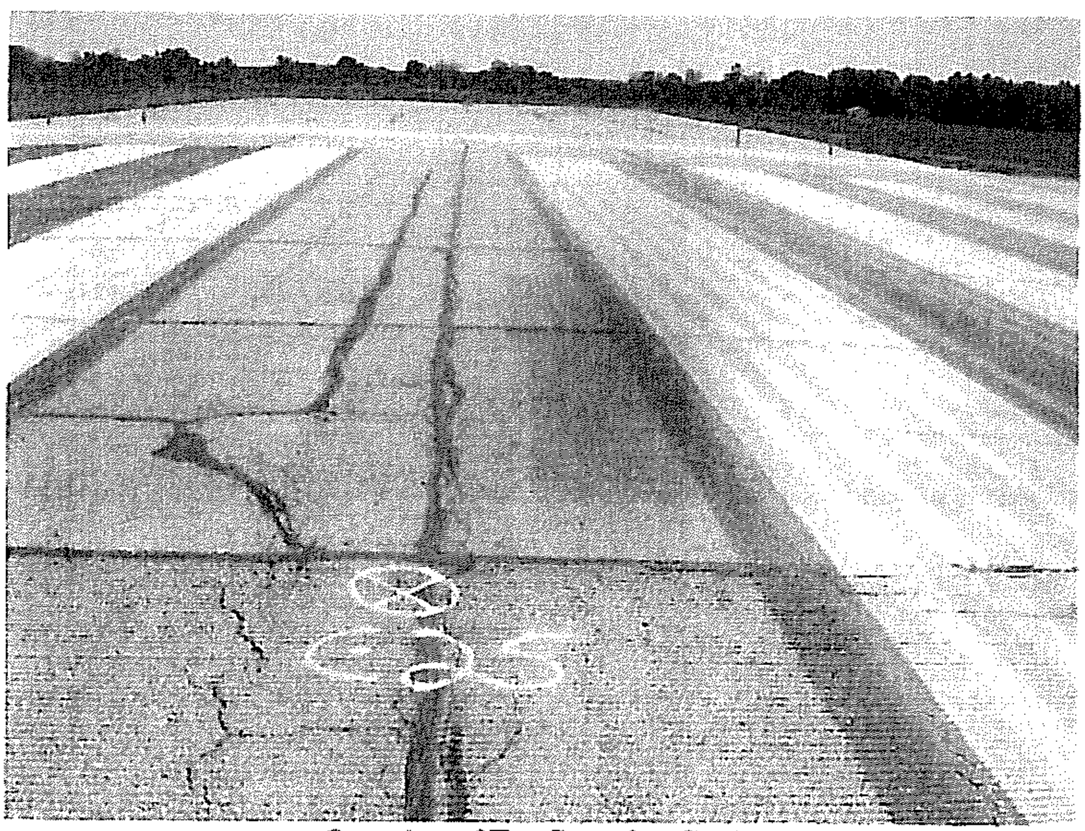


Overview of Test Location C-24

EDP Consultants, Inc.
June 15, 2009



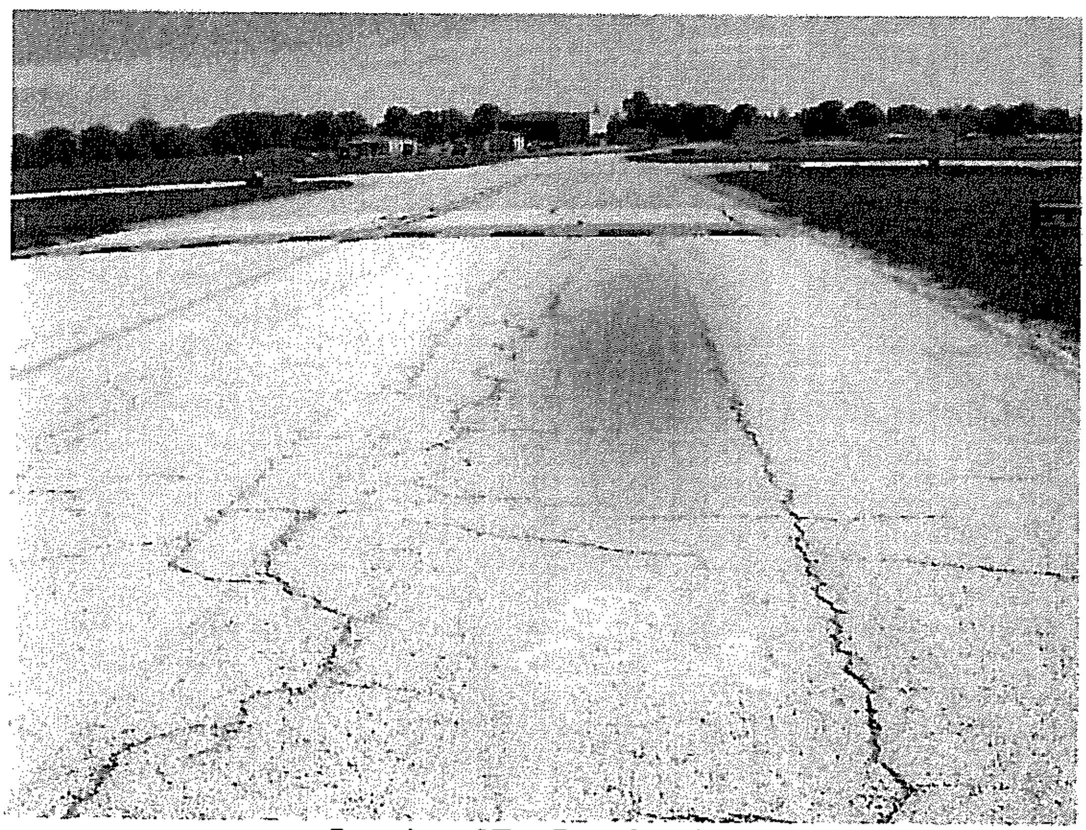
Test Location C-25



Overview of Test Location C-25

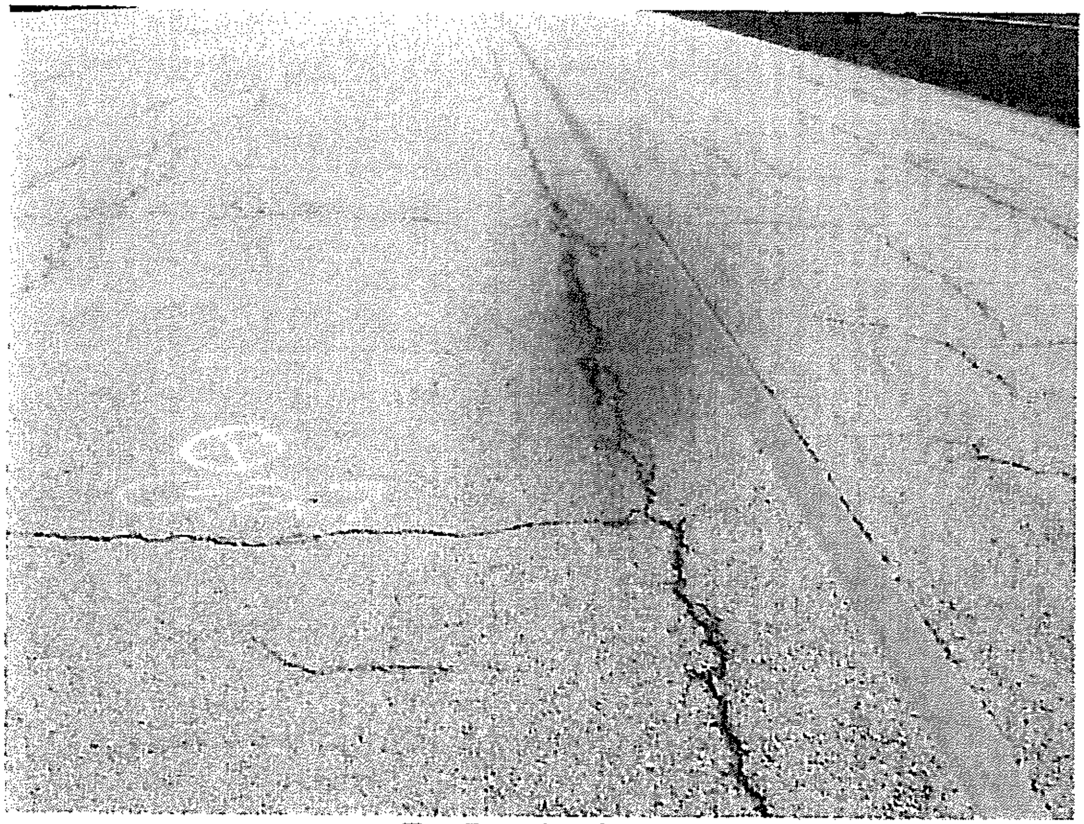
EDP Consultants, Inc.
June 15, 2009

Test Location C-28

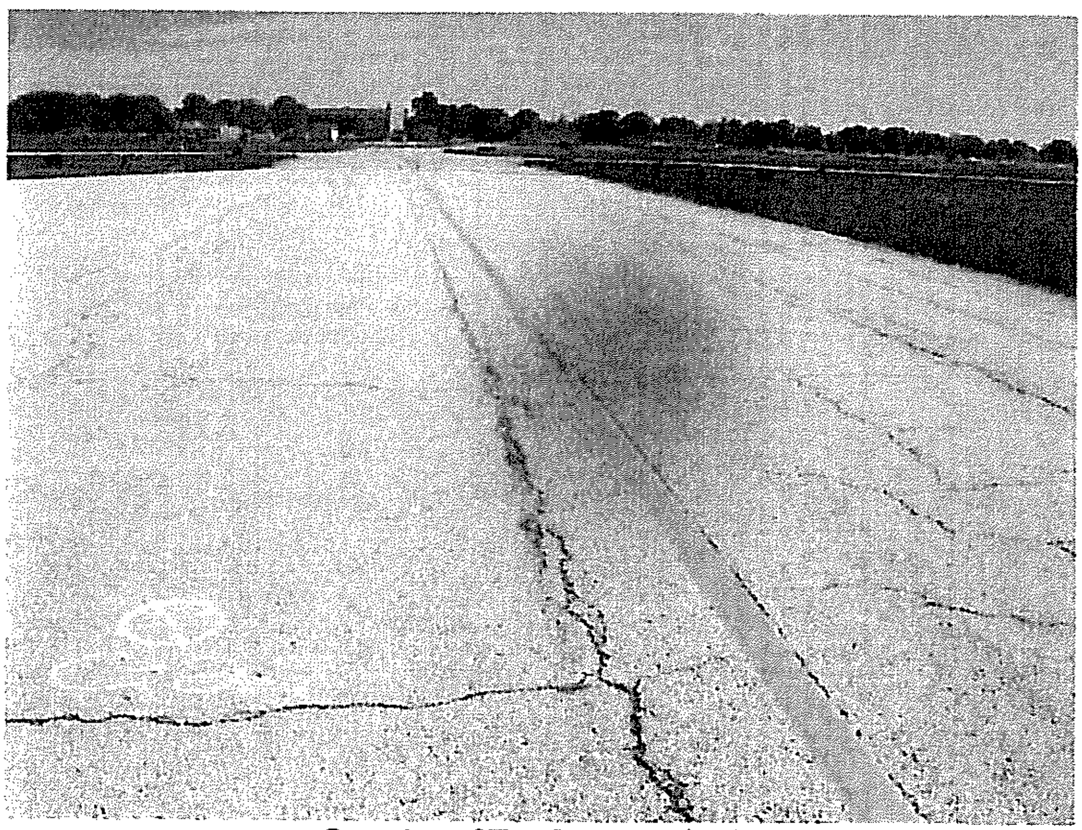


Overview of Test Location C-28

EDP Consultants, Inc.
June 15, 2009



Test Location C-27



Overview of Test Location C-27

EXISTING PAVEMENT THICKNESS MEASUREMENTS

Ohio State Airport Phase III
Columbus, Ohio
EDP #09060G

Runway				
Core #	Asphalt Thickness (inches)	Base Thickness (inches)	Pavement Thickness (inches)	Water Encountered in Base
C-1	8 1/4	7 3/4	16	no
C-2	10 1/2	9 1/2	20	no
C-3	9	7	16	no
C-4	8	13 1/4	21 1/4	no
C-5	8 1/2	7 1/2	16	no
C-6	8 3/4	8 1/4	17	no
C-7	8	13	21	no
C-8	6 3/4	15 1/4	22	no
C-9	12	7	19	no
C-10	10 1/2	9 1/2	20	no
C-11	12	7 3/4	19 3/4	no
C-12	14 1/2	15	29 1/2	no
C-13	12 1/4	11 1/2	23 3/4	no
C-14	10 1/4	5 1/4	15 1/2	no
C-15	10 3/4	5 1/4	16	no
C-16	11 1/4	5	16 1/4	no
C-17	12	9	21	no
C-18	10 1/2	5 1/2	16	no
C-19	13	12	25	no
C-20	11 3/4	13 1/4	25	no
C-21	12 1/4	8 1/2	20 3/4	no
C-22	12 1/2	6	18 1/2	no
C-23	14	8	22	no
C-24	13 3/4	7	20 3/4	no
C-25	12	5	17	no
C-26	12 1/2	4	16 1/2	no
Average	10	9 1/2	19 1/2	-

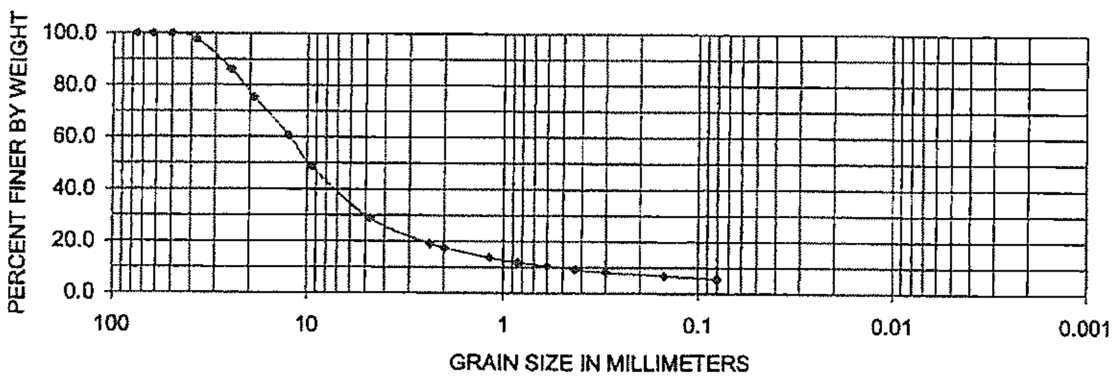
Taxiway D				
Core #	Asphalt Thickness (inches)	Base Thickness (inches)	Pavement Thickness (inches)	Water Encountered in Base
C-27	9	10	19	no
C-28	8 3/4	13 1/4	22	no
Average	11 1/4	9 1/2	20 3/4	-

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

SIEVE ANALYSIS ASTM C136

PROJECT: OSU Airport Phase III
LOCATION: Columbus, Ohio
DATE: June 8, 2009
EDP #: 09060G

Sample Description: 53% puverized asphalt, 47% base
Sample Location: C-1 to C-8
Sample #: 7446



Sieve	Sieve size, mm	Total Percent Passing	Total Percent Retained	Individual Percent Retained
3	75	100.0	0.0	0.0
2-1/2"	62.5	100.0	0.0	0.0
2"	50	100.0	0.0	0.0
1-1/2"	37.5	97.8	2.2	2.2
1"	25	86.1	13.9	11.7
3/4"	19	75.4	24.6	10.7
1/2"	12.5	60.5	39.5	14.9
3/8"	9.5	48.5	51.5	12.0
#4	4.75	28.8	71.2	19.6
#8	2.36	19.1	80.9	9.8
#10	2	17.4	82.6	1.6
#16	1.18	13.6	86.4	3.8
#20	0.85	11.9	88.1	1.7
#30	0.6	10.5	89.5	1.5
#40	0.43	9.2	90.8	1.3
#50	0.3	8.2	91.8	1.0
#100	0.15	6.8	93.2	1.4
#200	0.08	5.6	94.4	1.2

D_{60}= 12.50
D_{30}= 5.00
D_{10}= 0.59

$C_u=D_{60}/D_{10}$= 21.2
$C_c=(D_{30})^2/(D_{10}*D_{60})$= 3.4

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

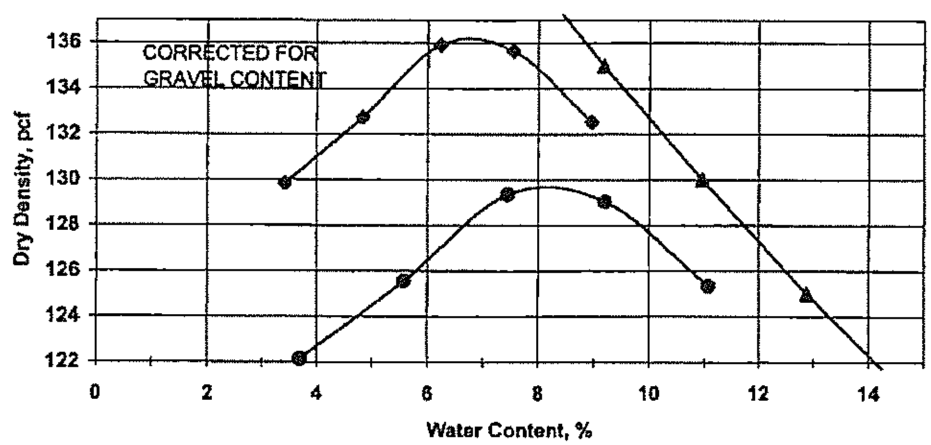
MOISTURE DENSITY RELATIONSHIP
ASTM D1557

Project	OSU Airport Phase III
Project Location	Columbus, Ohio
Date	June 4, 2009
EDP #	09060G
Sample Number	7446
Sample Location	C-1 to C-8
Sample Description	53% pulverized asphalt, 47% base

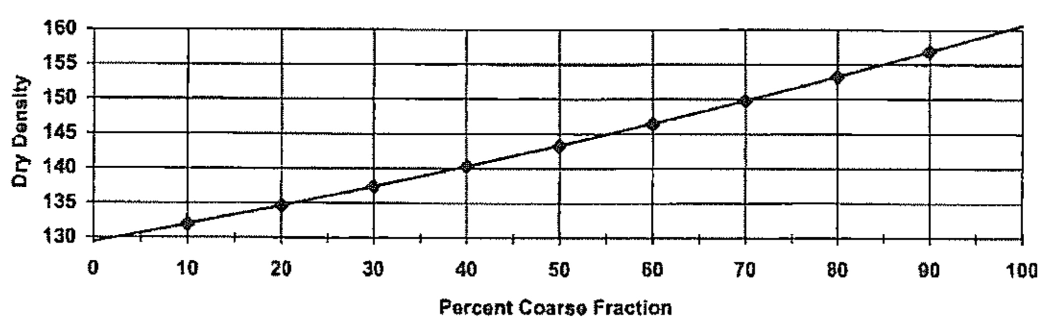
Proctor Method	ASTM 1557C
Maximum Dry Density, pcf	136.2
Optimum Moisture, %	6.7
As Rec'd w%	---
Grain Size	
Percent Ret'd on 3/4"	25
Percent Ret'd on 3/8"	52
Percent Ret'd on #4	71
Liquid Limit	---
Plastic Limit	---
Plasticity Index	---

This test was conducted in accordance with ASTM D1557. The maximum dry density and optimum moisture content have been corrected when appropriate to account for the oversize fraction of material excluded from the test sample.

MOISTURE-DENSITY RELATIONSHIP



GRAVEL CORRECTION WITH MATERIAL RETAINED ON 3/4

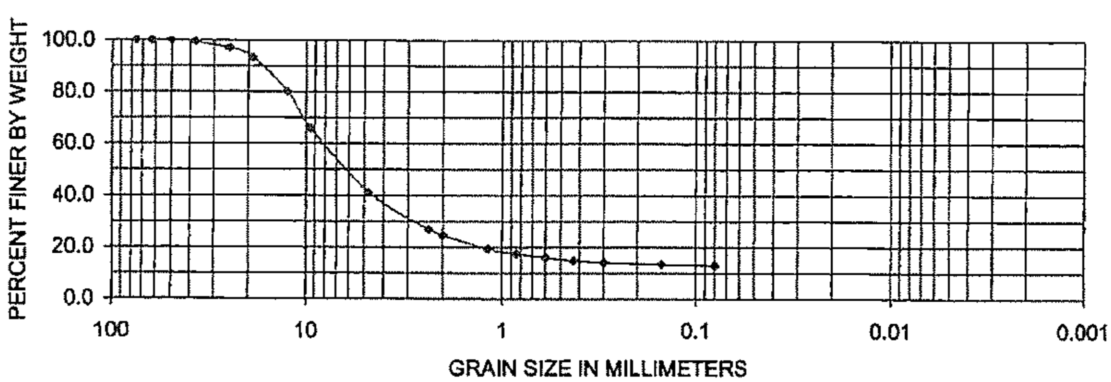


EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

SIEVE ANALYSIS ASTM C136

PROJECT: OSU Airport Phase III
LOCATION: Columbus, Ohio
DATE: June 8, 2009
EDP #: 09060G

Sample Description: 73% Asphalt and 27% Base
Sample Location: C-9 to C-26
Sample #: 7447



Sieve	Sieve size, mm	Total Percent Passing	Total Percent Retained	Individual Percent Retained
3	75	100.0	0.0	0.0
2-1/2"	62.5	100.0	0.0	0.0
2"	50	100.0	0.0	0.0
1-1/2"	37.5	99.4	0.6	0.6
1"	25	97.0	3.0	2.4
3/4"	19	93.3	6.7	3.7
1/2"	12.5	80.3	19.7	13.1
3/8"	9.5	66.0	34.0	14.3
#4	4.75	41.2	58.8	24.8
#8	2.36	26.9	73.1	14.3
#10	2	24.6	75.4	2.3
#16	1.18	19.4	80.6	5.2
#20	0.85	17.3	82.7	2.0
#30	0.6	15.9	84.1	1.4
#40	0.43	14.9	85.1	1.0
#50	0.3	14.2	85.8	0.7
#100	0.15	13.4	86.6	0.8
#200	0.08	12.9	87.1	0.4

D_{60}= 8.10
D_{30}= 3.00
D_{10}= —

$C_u=D_{60}/D_{10}$= —
$C_c=(D_{30})^2/(D_{10}*D_{60})$= —

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH. 44094
Phone 440-256-6500 Fax 440-256-6507

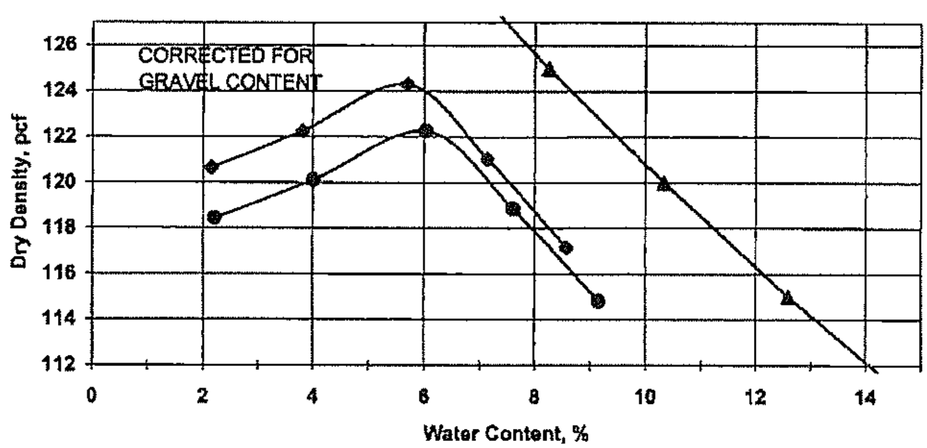
MOISTURE DENSITY RELATIONSHIP
ASTM D1557

Project	OSU Airport Phase III
Project Location	Columbus, Ohio
Date	June 5, 2009
EDP #	09060G
Sample Number	7447
Sample Location	C-9 to C-26
Sample Description	73% Asphalt and 27% Base

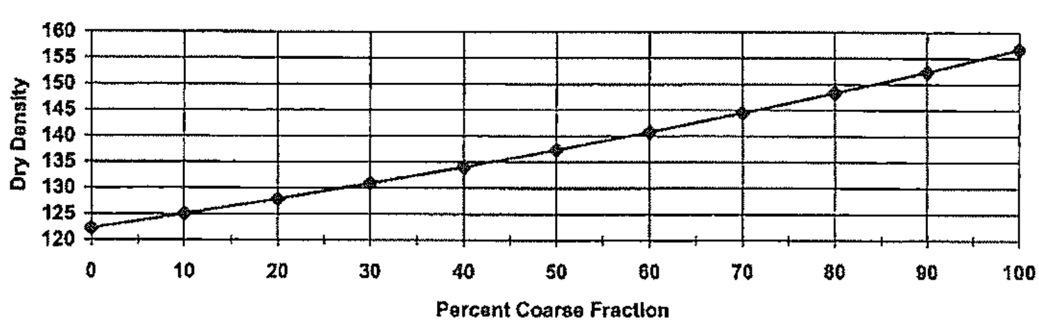
Proctor Method	ASTM 1557C
Maximum Dry Density, pcf	124.3
Optimum Moisture, %	5.6
As Rec'd w%	---
Grain Size	
Percent Ret'd on 3/4"	7
Percent Ret'd on 3/8"	34
Percent Ret'd on #4	58
Liquid Limit	---
Plastic Limit	---
Plasticity Index	---

This test was conducted in accordance with ASTM D1557. The maximum dry density and optimum moisture content have been corrected when appropriate to account for the oversize fraction of material excluded from the test sample.

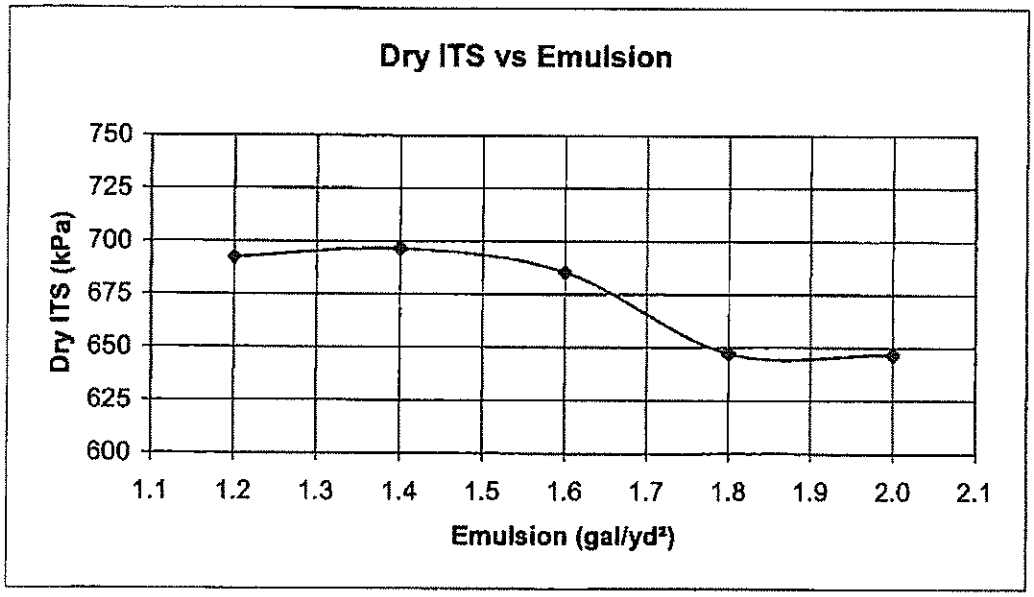
MOISTURE-DENSITY RELATIONSHIP



GRAVEL CORRECTION WITH MATERIAL RETAINED ON 3/4



OSU Airport Phase III
EDP #09060G
Dry ITS and Density
Section 1- 53% Asphalt and 47% Base



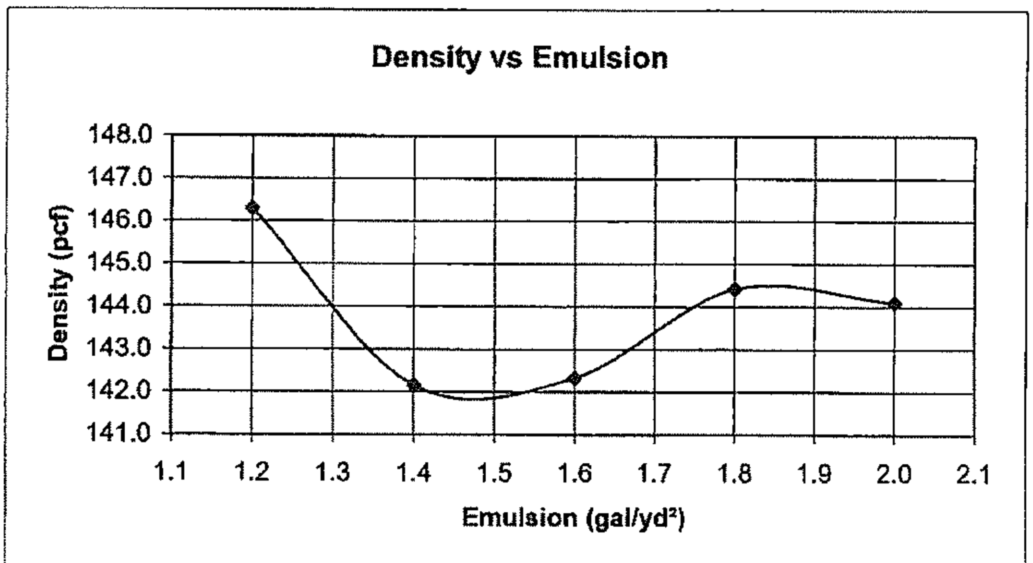
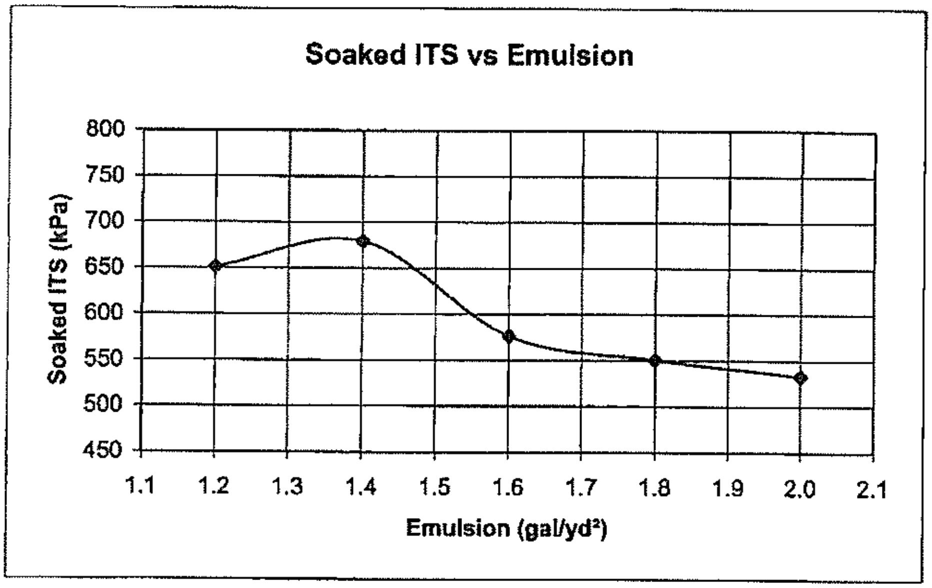
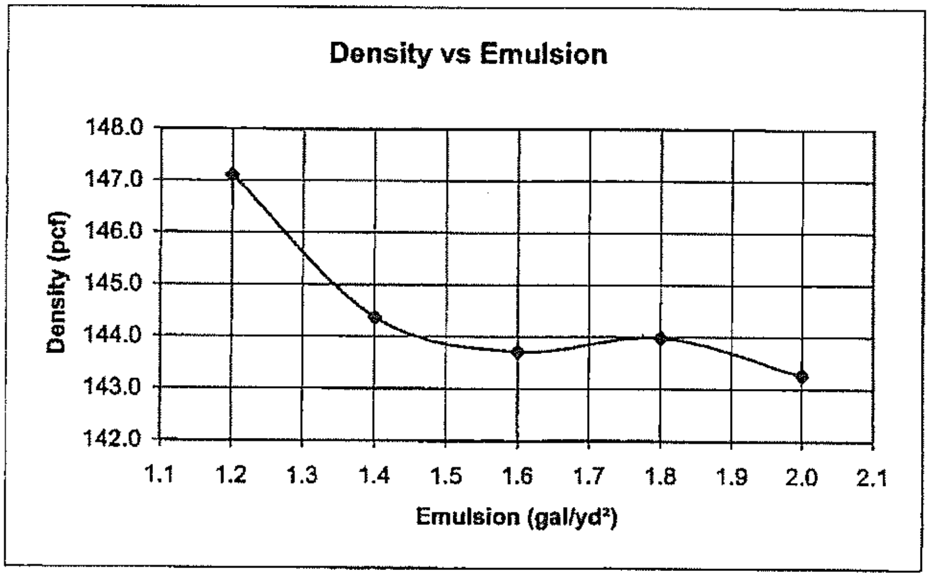


Table of Average Test Results

Emulsion Rate (gal/yd²)	Wet Density (pcf)	Dry ITS (kPa)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	146.3	692	2,344	158.4	92
1.4	142.2	696	2,277	158.3	90
1.6	142.3	685	2,280	158.0	90
1.8	144.4	647	2,314	158.8	91
2.0	144.1	647	2,308	158.5	91

OSU Airport Phase III
EDP #09060G
Soaked ITS and Density
Section 1- 53% Asphalt and 47% Base

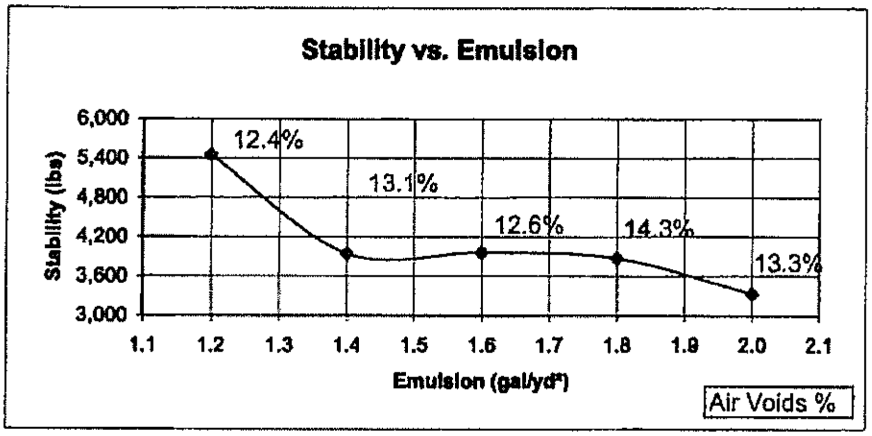


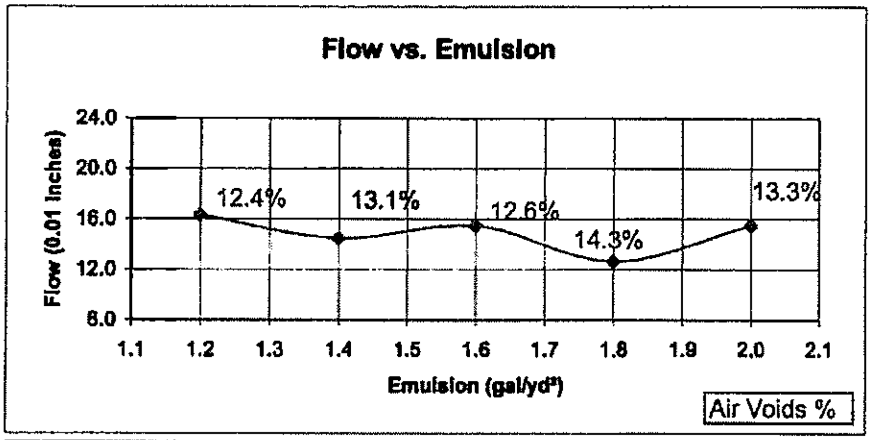


<u>Table of Average Test Results</u>

Emulsion Rate (gal/yd^2)	Wet Density (pcf)	Soaked ITS (kPa)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	147.1	651	2,357	158.4	93
1.4	144.4	679	2,313	158.3	91
1.6	143.7	577	2,302	158.0	91
1.8	144.0	551	2,307	158.8	91
2.0	143.3	533	2,295	158.5	90

OSU Airport Phase III
EDP #09060G
Heated and Soaked Stability, Flow, and Density
Section 1- 53% Asphalt and 47% Base





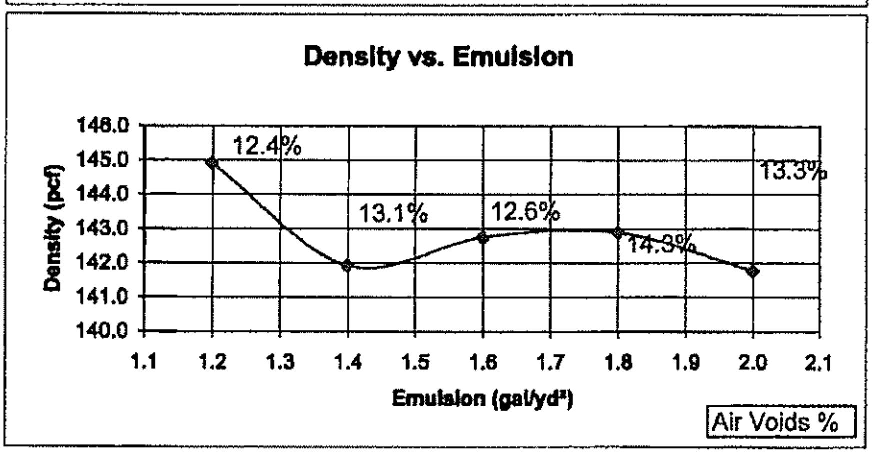
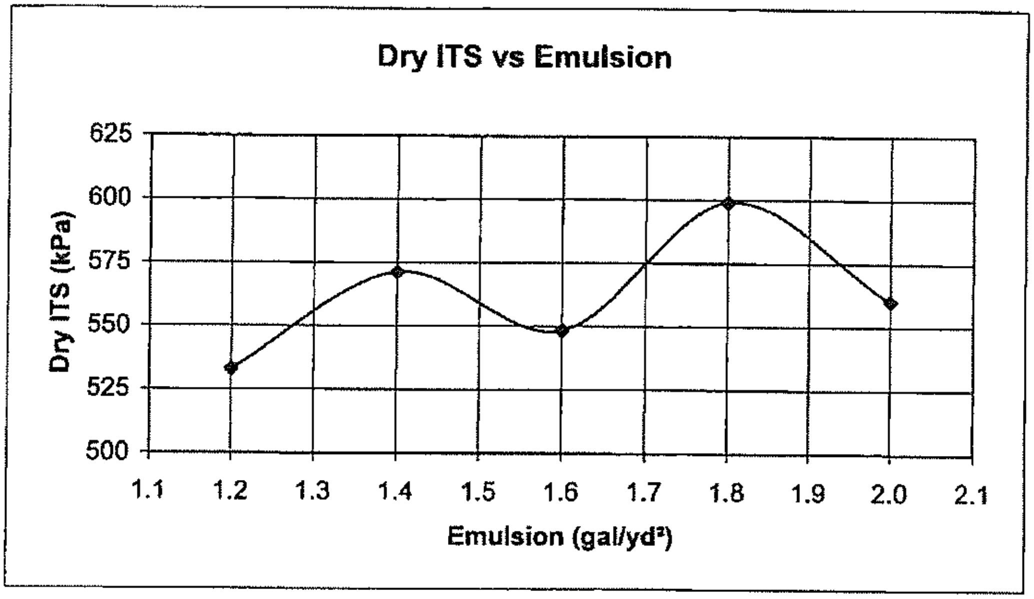


Table of Average Test Results

Emulsion Rate (gal/yd²)	Wet Density (pcf)	Stability (lbs)	Flow (0.01 in)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	144.9	5,454	16.3	2,322	158.4	92
1.4	141.9	3,951	14.5	2,274	158.3	90
1.6	142.7	3,970	15.5	2,287	158.0	90
1.8	142.9	3,878	12.7	2,289	158.8	90
2.0	141.8	3,336	15.5	2,271	158.5	89

OSU Airport Phase III
EDP #09060G
Dry ITS and Density
Section 2- 73% Asphalt and 27% Base



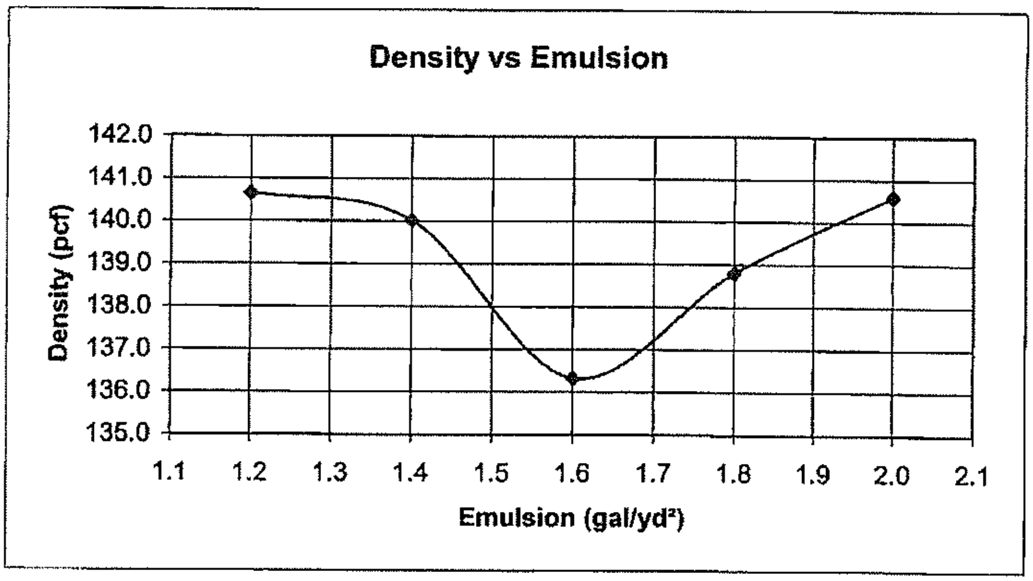
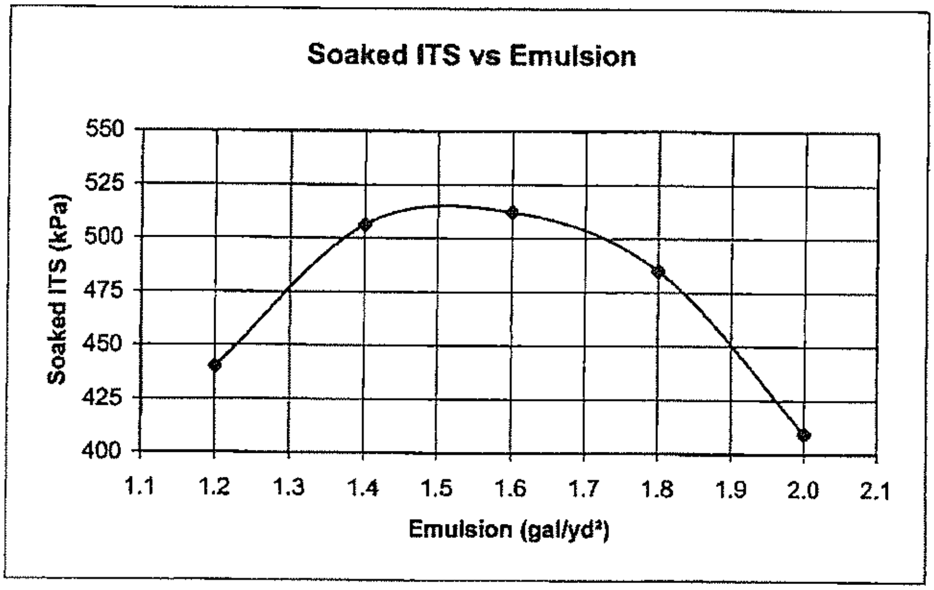


Table of Average Test Results

Emulsion Rate (gal/yd²)	Wet Density (pcf)	Dry ITS (kPa)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	140.7	533	2,253	154.8	91
1.4	140.0	571	2,243	156.8	89
1.6	136.3	548	2,184	155.3	88
1.8	138.8	599	2,224	156.0	89
2.0	140.6	560	2,252	155.5	90

OSU Airport Phase III
EDP #09060G
Soaked ITS and Density
Section 2- 73% Aspahlt and 27% Base



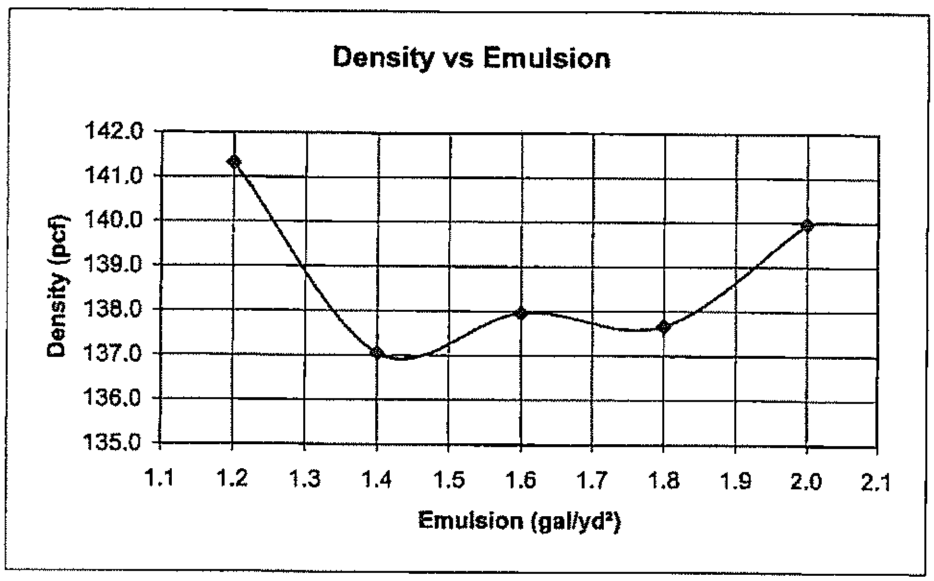
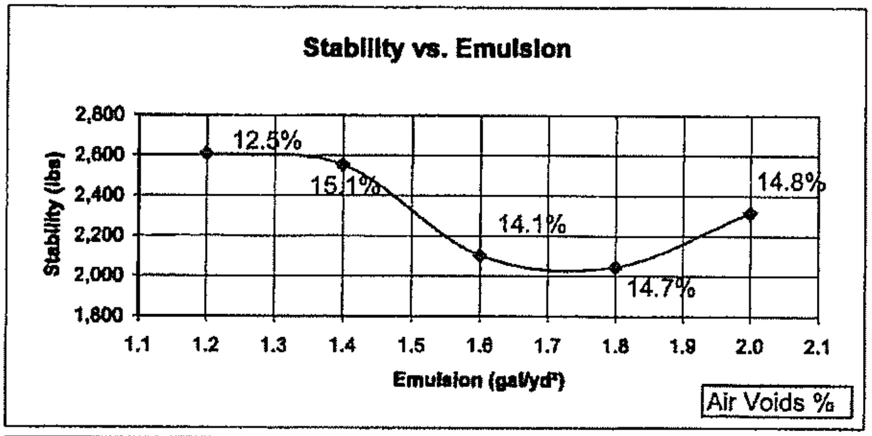
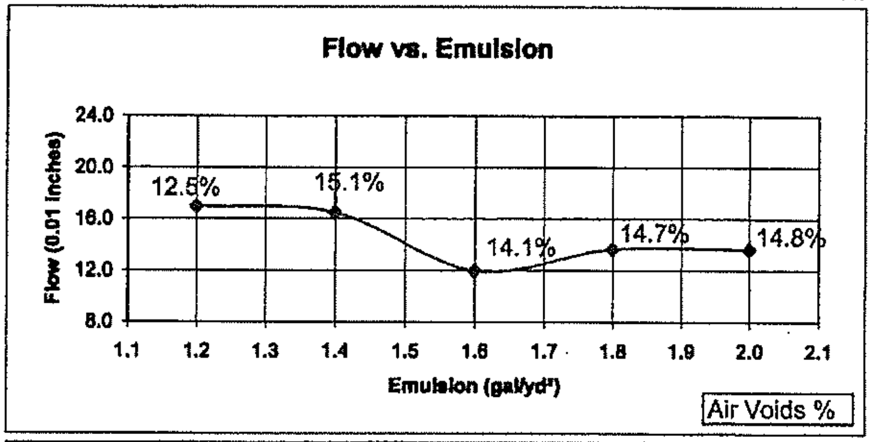


Table of Average Test Results

Emulsion Rate (gal/yd²)	Wet Density (pcf)	Soaked ITS (kPa)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	141.3	440	2,264	154.8	91
1.4	137.1	506	2,196	156.8	87
1.6	138.0	512	2,210	155.3	89
1.8	137.7	485	2,205	156.0	88
2.0	140.0	409	2,242	155.5	90

OSU Airport Phase III
EDP #09060G
Heated and Soaked Stability, Flow, and Density
Section 2- 73% Asphalt and 27% Base





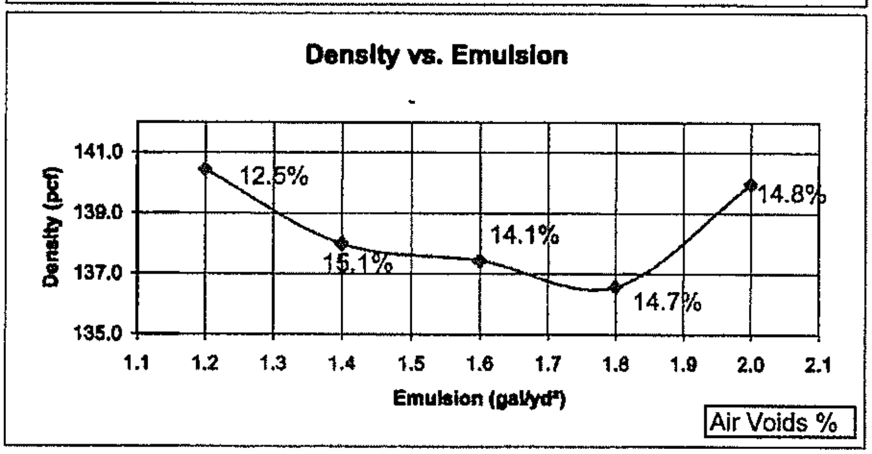


Table of Average Test Results

Emulsion Rate (gal/yd²)	Wet Density (pcf)	Stability (lbs)	Flow (0.01 in)	Wet Density (kg/m3)	Maximum Theoretical Density (pcf)	Compaction Based on MTD (%)
1.2	140.4	2,610	17.0	2,250	154.8	91
1.4	138.0	2,555	16.5	2,211	156.8	88
1.6	137.4	2,105	12.0	2,202	155.3	88
1.8	136.6	2,047	13.7	2,188	156.0	88
2.0	140.0	2,320	13.7	2,242	155.5	90

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

THEORETICAL MAXIMUM SPECIFIC GRAVITY AND DENSITY
ASTM D2041

PROJECT INFORMATION:

PROJECT NAME: OSU Airport Phase III
LOCATION: Columbus, Ohio
EDP #: 09060G
DATE TESTED: June 10, 2009
TEST METHOD: ASTM D2041
DATE OBTAINED: June 5, 2009
CORE LOCATION C-1 to C-8
SAMPLE DESCRIPTION: Mix 1 - 53% Asphalt and 47% Base

TESTED BY:	SM	SM	SM	SM	SM			
HFRE (gal)	1.2	1.4	1.6	1.8	2.0			
PORTLAND CEMENT (%)	2.0	2.0	2.0	2.0	2.0			

FLASK DATA:								
FLASK CALIBRATED WT, g:	1487.7	1488.3	1755.5	1755.5	1488.3			
FLASK MEASURED WT, g:	1487.3	1488.2	1755.8	1755.8	1488.3			
MASS OF FLASK, SAMPLE, + WATER, $M_{pws,t}$, g:	7249.1	7262.8	7240.3	7486.2	7370.4			
MASS OF FLASK + WATER, $M_{pw,t}$, g AT TEST TEMP:	5945.5	5942.7	6046.9	6046.9	5942.7			
TEST TEMPERATURE, °C:	25.0	25.0	25.0	25.0	25.0			

SAMPLE DATA:								
DRY SAMPLE MASS, g:	2147.7	2175.9	1969.4	2366.8	2350.7			
WATER CONTENT, %:	5.6	4.7	4.9	4.7	4.8			

SPECIFIC GRAVITIES:								
G_t (AT TEST TEMP.):	2.544	2.542	2.538	2.552	2.547			
Maximum Theoretical Density (PCF)	158.38	158.26	157.97	158.83	158.52			

REMARKS:

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

THEORETICAL MAXIMUM SPECIFIC GRAVITY AND DENSITY
ASTM D2041

PROJECT INFORMATION:

PROJECT NAME: OSU Airport Phase III
LOCATION: Columbus, Ohio
EDP #: 09060G
DATE TESTED: June 10, 2009
TEST METHOD: ASTM D2041
DATE OBTAINED: June 5, 2009
CORE LOCATION C-9 to C-26
SAMPLE DESCRIPTION: Mix 2 - 73% Asphalt and 27% Base

TESTED BY:	SM	SM	SM	SM	SM			
HFRE (gal)	1.2	1.4	1.6	1.8	2.0			
PORTLAND CEMENT (%)	2.0	2.0	2.0	2.0	2.0			

FLASK DATA:								
FLASK CALIBRATED WT, g:	1831.5	1755.5	1488.3	1755.2	1863.0			
FLASK MEASURED WT, g:	1832.5	1755.8	1488.2	1760.1	1487.3			
MASS OF FLASK, SAMPLE, + WATER, $M_{pws,t}$, g:	7517.6	7559.7	7261.0	7481.0	7394.0			
MASS OF FLASK + WATER, $M_{pw,t}$, g AT TEST TEMP:	6142.0	6046.9	5942.7	6079.4	5945.5			
TEST TEMPERATURE, °C:	25.0	25.0	25.0	25.0	25.0			

SAMPLE DATA:								
DRY SAMPLE MASS, g:	2301.0	2508.8	2199.9	2332.4	2415.7			
WATER CONTENT, %:	6.1	5.0	4.6	4.5	5.0			

SPECIFIC GRAVITIES:								
G_t (AT TEST TEMP.):	2.486	2.519	2.495	2.506	2.498			
Maximum Theoretical Density (PCF)	154.77	156.78	155.32	155.97	155.47			

REMARKS:

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

THEORETICAL MAXIMUM SPECIFIC GRAVITY AND DENSITY
ASTM D2041

PROJECT INFORMATION:

PROJECT NAME: OSU Airport Phase III
LOCATION: Columbus, Ohio
EDP #: 09060G
DATE TESTED: June 10, 2009
TEST METHOD: ASTM D2041

DATE OBTAINED: June 5, 2009
CORE LOCATION C-2
SAMPLE DESCRIPTION: Verification Mix 1 - 89% Asphalt and 11% Base

TESTED BY:	SM							
HFRE (gal)	1.2							
PORTLAND CEMENT (%)	2.0							

FLASK DATA:								
FLASK CALIBRATED WT, g:	1831.5							
FLASK MEASURED WT, g:	1832.5							
MASS OF FLASK, SAMPLE, + WATER, $M_{pws,t}$, g:	7656.0							
MASS OF FLASK + WATER, $M_{pw,t}$, g AT TEST TEMP:	6142.0							
TEST TEMPERATURE, °C:	25.0							

SAMPLE DATA:								
DRY SAMPLE MASS, g:	2538.0							
WATER CONTENT, %:	4.3							

SPECIFIC GRAVITIES:								
G_t (AT TEST TEMP.):	2.478							
Maximum Theoretical Density (PCF)	154.27							

REMARKS:

EDP Consultants, Inc.
9375 Chillicothe Rd., Kirtland, OH, 44094
Phone 440-256-6500 Fax 440-256-6507

THEORETICAL MAXIMUM SPECIFIC GRAVITY AND DENSITY
ASTM D2041

PROJECT INFORMATION:

PROJECT NAME: OSU Airport Phase III
LOCATION: Columbus, Ohio
EDP #: 09060G
DATE TESTED: June 10, 2009
TEST METHOD: ASTM D2041

DATE OBTAINED: June 5, 2009
CORE LOCATION C-12
SAMPLE DESCRIPTION: Verification Mix 2 - 40% Asphalt and 60% Base

TESTED BY:	SM							
HFRE (gal)	1.2							
PORTLAND CEMENT (%)	2.0							

FLASK DATA:								
FLASK CALIBRATED WT, g:	1755.2							
FLASK MEASURED WT, g:	1759.9							
MASS OF FLASK, SAMPLE, + WATER, $M_{pws,t}$, g:	7556.7							
MASS OF FLASK + WATER, $M_{pw,t}$, g AT TEST TEMP:	6079.4							
TEST TEMPERATURE, °C:	25.0							

SAMPLE DATA:								
DRY SAMPLE MASS, g:	2413.5							
WATER CONTENT, %:	5.4							

SPECIFIC GRAVITIES:								
G_t (AT TEST TEMP.):	2.578							
Maximum Theoretical Density (PCF)	160.46							

REMARKS:

EXHIBIT 3

RESOURCE INTERNATIONAL, INC.

Planning
Engineering
Construction Managemen
Technology

June 23, 2009

Mr. Steve Slusher
Stantec
Project Manager
1500 Lake Shore Drive
Suite 100
Columbus, Ohio 43204

RE: Review of Document
"Mix Design, OSU Airport Phase III
Columbus, Ohio, EDP # 09060G, June 16, 2009"
Rii # W-09-049

Dear Mr. Slusher,

Per your request, we have reviewed the following document:

> "Mix Design, OSU Airport Phase III, Columbus, Ohio, EDP # 09060G, dated June 16, 2009," prepared by EDP Consultants, Inc.

The above report on mix design describes the details of field sampling, laboratory testing of field samples, mix design of recycled materials, testing of the mixes in the laboratory and recommendations for rebuilding by Full Depth Reclaiming the material.

Based on our review of the report, we find it consistent with the current practice of Full Depth Reclamation of Asphalt Pavements and the relevant sections of Item P-200 titled "Reclaimed, Pulverized and Stabilized Base Course".

The report indicates that the results of mix testing meet the typical minimum strength specifications for FDR projects which are: 1,200 lbs stability, 250 kPa dry ITS, and 70% retained strength when soaked. Since we are not aware of minimum specifications established by the Highway/Airport agencies, therefore, the statement on page 2, last paragraph of Item P-200, which states "Approval of the mix design by engineer is solely for monitoring quality control and in no way releases the Contractor from his responsibilities" may be considered important in this connection.

No comments on the structural design of pavement are offered here.

6350 Presidential Gateway
Columbus, Ohio 43231
Phone: (614) 823.4949
Fax: (614) 823.4990
ResourceInternational.com

We thank you for the opportunity to review the document listed above. Please call us at (614) 823-4949, if you have any questions regarding the comments stated in this letter.

Sincerely,
Resource International, Inc.

Chhote L. Saraf, Ph.D., P.E.
Senior Consultant

Copy to: Jim Norden, Rii

EXHIBIT 4

GEOTECHNICAL CONSULTANTS INC.

MAIN OFFICE
720 Greencrest Drive
Westerville, OH 43081
614.895.1400 **phone**
614.895.1171 **fax**

YOUNGSTOWN OFFICE
8433 South Avenue
Building 1, Suite 1
Boardman, OH 44514
330.965.1400 **phone**
330.965.1410 **fax**

DAYTON OFFICE
2380 Bellbrook Avenue
Xenia, OH 45385
937.736.2053 **phone**

www.gci2000.com

GEOTECHNICAL
CONSULTANTS INC.

GCI PROJECT No. 18-G-22020

Subsurface Exploration and Geotechnical Engineering Report

OSU Airport Hangar
West Case Road
Columbus, Ohio

Prepared for:
The Ohio State University

July 25, 2018

MAIN OFFICE
720 Greencrest Drive
Westerville, OH 43081
614.895.1400 **phone**
614.895.1171 **fax**

YOUNGSTOWN OFFICE
8433 South Avenue
Building 1, Suite 1
Boardman, OH 44514
330.965.1400 **phone**
330.965.1410 **fax**

DAYTON OFFICE
2380 Bellbrook Avenue
Xenia, OH 45385
937.736.2053 **phone**

GEOTECHNICAL
CONSULTANTS INC.

www.gci2000.com

July 25, 2018

Mr. Kenneth Garrett
The Ohio State University
400 Emerson Classroom Building
2009 Millikin Road
Columbus, Ohio 43210

Reference: **Subsurface Exploration and Geotechnical Engineering Report**
OSU Airport Hangar Project
West Case Road - Columbus, Ohio
GCI Project No. 18-G-22020

Dear Mr. Garrett:

As you requested and authorized, Geotechnical Consultants, Inc. (GCI) performed a subsurface exploration and prepared a geotechnical engineering report for the above referenced project. In summary, the borings encountered a topsoil cover (thickness ranging from 0.3 to 0.9 feet) over minor fill in two borings, all underlain by natural lean clay (including glacial till soils). The fill was encountered below the surface topsoil in borings B-1 and B-12 and extended to depths of 2 to 2.5 feet below grade. We did not encounter bedrock within the depths of the borings performed. We encountered groundwater seepage in six of the 22 borings at depths of 3 to 12 feet below existing grade.

Geotechnical considerations for the project include proper removal of topsoil and vegetation, removal of any existing construction that might interfere with the new construction, addressing the existing fill, stabilization of any soft subgrades, and proper placement of structural fill, as needed. Provided the geotechnical considerations are properly addressed, it is GCI's opinion that this site is suitable for support of the proposed hangar structure using conventional shallow foundations and concrete slab-on-grade construction. We discuss geotechnical considerations and provide foundation recommendations in the report.

After you have reviewed the report, feel free to contact us with any questions you may have. We appreciate the opportunity to provide our services for this project and hope to continue providing our services through construction.

Respectfully submitted,
Geotechnical Consultants, Inc.

Curtis L. Miller

Curtis L. Miller, P.E.
Principal

STATE OF OHIO
CURTIS L. MILLER
E-58404
REGISTERED
PROFESSIONAL ENGINEER

Melissa A. Bradley

Melissa A. Bradley, P.E.
In-House Reviewer

Distribution: Mr. Kenneth Garrett @ The Ohio State University – 5 bound, pdf email
GCI File No. 18-G-22020

TABLE OF CONTENTS

INTRODUCTION

As requested by Ms. Holly Wood of Brandstetter/Carroll Inc. and authorized by Mr. Kenneth Garrett representing The Ohio State University (OSU), Geotechnical Consultants, Inc. (GCI) performed a subsurface exploration and prepared this geotechnical engineering report for a new OSU Airport Hangar project (OSU Project No. 180409) in Columbus, Ohio. Brandstetter/Carroll Inc provided GCI with a Site Plan (dated June 1, 2018) showing the proposed hangar building, new parking areas, and new drive areas. After drilling was completed, we were also provided with a topographic survey of the site showing the existing site elevations (prepared by Stantec; dated April 2018).

Our study consisted of twelve (12) standard penetration borings (B-1 to B-12) drilled within the proposed building areas, three (3) borings (P-1 to P-3) in proposed parking areas, and seven (7) borings (R-1 to R-7) in the proposed roadway. GCI field located the borings using the site layout plan and existing site landmarks; locations should be considered approximate. GCI estimated the ground elevations at the boring locations using the provided topographic survey. We attach a sketch showing the approximate boring locations and copies of the boring logs in the appendix.

The intent of this study was to evaluate subsurface conditions and offer geotechnical recommendations relative to earthwork, foundations, slabs, and pavements for the proposed hangers on the east side of the site. We issue this report prior to the receipt of final site layout and grading plans. GCI should review these plans when available, and provide additional recommendations and borings, if necessary.

We prepared this report for the exclusive use of The Ohio State University, Brandstetter/Carroll Inc., and their consultants for specific application to the above referenced project in Columbus, Ohio in accordance with generally accepted soil and foundation engineering practices. We make no warranty, expressed or implied.

SITE LOCATION AND PROJECT DESCRIPTION

The existing OSU airport is located at 2160 West Case Road in Columbus, Ohio. The project site is on the southeast portion of the facility. The general site location is shown on an attached map (DeLorme Street Mapping).

At the time of drilling, the site was a grass covered area. There is some mounding along the southwest and south portions of the site. The aerial photograph below shows the approximate site boundary and existing site features at the time of our work.

Aerial photograph (Google Maps)

The proposed development consists of constructing new hangar buildings (totaling 81,500 square feet) on the east side of the existing construction. New paved parking and drive areas will be to the west and south of the structures. An access drive will be constructed south of the proposed construction, but east of the existing construction, and will connect to West Case Road to the south. Based on the existing grades and surrounding development, we do not anticipate grades will change more than 2 to 3 feet, except where the existing soil mound is located on the south and southwest portions of the site.

SUBSURFACE CONDITIONS

GCI mobilized a rotary drill rig (CME with automatic sampling hammer) to the site on July 10 and 11, 2018. We drilled twelve (12) standard penetration borings (B-1 to B-12) within the proposed building areas, three (3) borings P-1 to P-3 in the proposed parking area, and seven (7) borings (R-1 to R-7) within the proposed access roadway. We terminated the roadway and pavement borings at depths of 5.5 to 10 feet below grade, while the building borings extended to depths of 15 to 20 feet below existing grade.

We have attached boring logs, a copy of the Boring Location Plan, and a summary table of encountered subsurface conditions in the appendix. We summarize the subsurface findings below. Refer to the individual boring logs for more detailed subsurface information at specific boring locations.

Surface Cover

The borings encountered a topsoil cover ranging in thickness from 0.3 to 0.9 feet.

Below the topsoil at borings B-1 and B-12, we encountered possible fill material consisting of a mixture of lean clay, sand, and gravel. The fill was very similar to the consistency of the natural soils, and the exact transition from fill to natural soils was difficult to determine. The fill extended to approximate depths of 2.5 to 2 feet below grade. We noted the fill was medium stiff in cohesive consistency.

Natural Soils

Below the surface cover, the borings encountered moderately plastic brown mottled gray lean clay (classified as CL under the Unified Soil Classification System). We noted staining in the upper portions of these soils, which is typically associated with water filtering down through the overlying topsoil. The lean clay extended to depths ranging from 2 feet to 4.7 feet below existing grade. Standard penetration test borings indicated that the upper lean clay mantle was generally medium stiff to stiff in cohesive consistency.

We did note some softer soils from the 4' to 5.5 foot depth in boring B-8; we recorded weight of hammer (WH) only to advance the split spoon sampler at this location. Conversely, the pocket penetrometer readings taken in the lab on these samples were 3.5 and 4, which suggests the low field readings were probably associated with the wet sand and gravel layer at that depth.

Below the upper lean clay mantle and possible fill, the borings encountered moderately plastic brown glacial till (lean clay with sand – CL). We noted random silty sand and gravel layers in the till. The pavement borings (P-1 to P-3 and R-1 to R-7) terminated within the brown till at depths of 5.5 to 10 feet below grade.

The till changed color from brown to gray in the remaining borings (B-1 to B-12) at depths ranging from 9.5 to 12.5 feet below existing grade. The gray till was visually classified as sandy lean clay with gravel (CL), contained more embedded sand and gravel, and was noted as less plastic when compared to the upper level brown lean clay soils and brown till. We also noted random silty sand and gravel layers in the gray till. Standard penetration testing indicated the glacial till soils were medium stiff to very stiff in cohesive consistency, becoming very stiff to hard with depth. We terminated these borings in the gray till at depths of 15 to 20 feet below existing grade.

Bedrock

We did not encountered bedrock within the maximum drilled depth of the borings (20 feet).

Groundwater

We encountered groundwater seepage in borings B-2, B-3, and B-7 to B-10 at depths between 3 feet (B-8) and 12 feet (B-2) below existing grade. By completion of the drilling operations, the groundwater had dissipated in boring B-8, had not changed significantly in borings B-7 and B-9, and had risen 3 to 4.5 feet in borings B-2, B-3, and B-10. The remaining borings were dry during and by completion of the drilling process.

GCI's drillers generally described the retrieved soil samples as moist to very moist, with an occasional wet sample noted near water levels. Note that soil moisture conditions and groundwater observations fluctuate due to changes in precipitation, climate, stabilization time and other factors that may differ from the time the measurements were made.

LABORATORY TESTING

GCI performed a laboratory testing program consisting of Atterberg Limits, gradation analyses, and natural moisture contents on select slit spoon samples from borings B-3 and B-8. We also performed moisture content, Atterberg Limits, gradation analysis, Standard Proctor, and California Bearing Ratio (CBR) testing on a bulk soil sample from 1 to 4 feet below grade at roadway boring R-3 location. The purpose of the testing was to provide information to aid in sample classification, to evaluate the characteristics of the subsurface strata, and to provide a CBR value for pavement design.

Under the ASTM/Unified Classification System, we classified the natural clay-based soils as lean clay with sand and sandy lean clay (both are classified as CL in the Unified/ASTM Soils Classification System), which are generally consistent with our visual classifications. Natural moisture contents in the upper 4 feet of the soil profiles ranged from 16.7 percent to 24.1 percent. The moisture of the soils below about 4 feet range from 8.9 percent to 12.1 percent. Typically, clayey soils with moisture contents above 20% can be difficult to work with and may require moisture conditioning to use as structural fill.

The bulk sample testing resulted in a Standard Proctor Maximum Dry Density of 108.6 pounds per cubic foot (PCF), occurring at an optimum moisture content of 18.7%. The natural moisture content of the bulk sample was 22%, suggesting some moisture conditioning could be required to properly prepare the subgrade soils and achieve compaction. CBR testing resulted in a value of 5.0, with a low volume change potential of 1.3%.

Refer to the laboratory test results in the appendix for additional details.

ANALYSES AND CONCLUSIONS

GEOTECHNICAL EVALUATION

Based on our borings, it is GCI's opinion that the site geotechnical conditions are suitable for the proposed hangar buildings using conventional shallow foundations and slab-on-grade construction, provided the site is properly prepared as discussed in the following paragraphs.

Existing Construction

We do not know if any portion of the existing development interferes with the proposed construction. We recommend any existing elements that are within the construction limits should be completely removed to expose stable natural soils; this includes existing utilities and soft/organic trench backfill. Utilities that are abandoned outside the proposed construction limits should be plugged to prevent loss of soil. Any excavation voids should be properly backfilled with structural fill.

Site Stripping

Topsoil, vegetation, and other organic materials are not suitable for foundation, floor slab, or pavement support. The unsuitable material should be completely removed to expose stable natural soils prior to placing new fill, underslab aggregate, or pavement base aggregate. Stripping should extend to a minimum of 5 feet laterally beyond proposed building and pavement areas. Topsoil and organic matter can be stockpiled for reuse in landscaping mounds, redistributed in proposed green spaces areas, or disposed at an off-site location.

Existing Fill

We recommend the fill mounds be removed in proposed construction areas (and to 10 feet outside construction limits) to expose stable natural soils.

We encountered possible fill in two borings B-1 and B-12. The fill was very similar to the mottled natural lean clay soils, which made it difficult to discern the transition point. We recommend any foundations be extended through the fill to bear in the underlying natural soils.

Provided the fill is stable below a proof roll, we feel the fill is suitable to support slab and pavement construction. The client will need to accept the minor risk that the fill could consolidate below new loads, but provided a thorough proof roll is performed and any soft areas are stabilized, we feel the risk is minor.

Alternately, any existing fill could be completely removed and replaced with new structural fill to eliminate any risks associated with the possible existing fill.

Subgrade Stability

We recommend that the site earthwork contractor proof-roll the soil subgrades using a fully-loaded, tandem-axle dump truck (or equivalent) after performing site stripping and prior to fill placement or construction of slabs. The purpose of the proof-roll is to identify potential soft, yielding subgrade areas. Soft spots identified during the proof-roll should be undercut to firm, stable conditions or otherwise stabilized prior to placing controlled fill to finished subgrade elevation.

We found a soft zone at the 4’ to 5.5’ depth in boring B-8. We anticipate this soft zone resulted from a saturated sand and gravel layer; however, soft zones will need to be addressed during foundation construction. The severity of soft, very moist subgrade conditions will depend on the time of year earthwork is performed, and the amount of moisture within the subgrade soils. We expect fewer problems with soft subgrades if earthwork and mass grading operations are performed during traditionally drier times of the year (i.e. late spring, summer, and early fall).

Stabilization of soft subgrades by disking, aerating/drying, and re-compaction may be feasible during traditionally drier times of the year. During wet seasons, partial undercutting and replacing of wet soils with structural fill, drying with soil additives such as lime, or use of geosynthetics may be needed to create a stable subgrade before placing controlled fills. The use of soil additives such as lime and flyash or installation of geosynthetics should be reviewed by our office prior to use in the field.

Fill Placement and Compaction

Structural fill can be placed to design grade once the subgrades are brought to firm and stable conditions. Non-organic, clay-based site soils and non-organic existing fill soils are suitable for reuse in new, controlled fills provided proper moisture control is maintained. Depending on the time of year of earthwork, the site soils may require drying to achieve compaction. Fill materials within building pads and pavement areas should be placed in a controlled manner as described in the ***Site Preparation and Earthwork*** section of this report.

FOUNDATIONS

In our opinion, the one-story, slab-on-grade hangar structures can be constructed on conventional spread footings and continuous wall foundations. Provided the site is prepared as described herein, all footings should bear on stable, natural soils or new, controlled fill placed directly over stable natural soils. Footings bearing on acceptable soils can be designed using a maximum allowable bearing capacity not to exceed 3,000 pounds per square foot.

We recommend minimum sizes of 16 inches wide for wall footings and 30 inches square for column pads to prevent a “punch” effect. All exterior footings should extend to local frost bearing depth (32 inches) or to stable bearing (as stated above), whichever is deeper. Interior footings in heated areas may be placed as shallow as feasible, if bearing on acceptable soils.

Typical to local practice, if soft or unstable, natural soils are encountered at footing subgrade, undercut to stable soils. Undercut areas can be backfilled to design bottom-of-footing elevation using controlled density fill (CDF) to allow footing construction at design grade. Soft, unstable bearing soils should be reviewed by the soil engineer prior to undercuts. Alternatively, the foundations can be constructed on firm, stable site soils at the bottom-of-footing undercut.

FLOOR SLAB

Conventional concrete slab-on-grades are suitable for the proposed hangar buildings. The subgrade should be thoroughly proof-rolled and any soft, yielding areas brought to a stable condition prior to slab construction or placement of aggregate base.

GCI recommends placing a minimum of 6 inches of granular fill (such as ODOT Item 304 or crushed limestone) under the floor slabs to serve as a capillary cut-off and to provide a uniform, firm subbase. A subgrade modulus of 150 pci can be used for slab design with 6 inches of aggregate placed for heavy-duty slab design. Place a vapor barrier below the slab in areas where moisture could cause problems with floor finishes or where slabs extend below grade.

SEISMIC FACTOR

Our borings encountered stable lean clay and glacial till soils. In accordance with the Ohio Building Code, we estimate the site has a Site Class D – stiff soil profile.

BELOW-GRADE WALLS

Retaining walls allowed to move freely at the top of the wall should be designed using active lateral earth pressure. Walls restrained at both top and bottom should be designed to resist an at-rest lateral soil pressure. The design loading depends on the type of backfill material used and boundary support conditions. The following table provides recommended equivalent fluid pressures for two types of soils and loading conditions.

Soil Type	Equivalent Active Fluid Pressure (pcf)	Equivalent At-Rest Fluid Pressure (pcf)
Lean Clay (site soils)	**55**	**70**
Sand and Gravel (properly compacted)	**35**	**55**

We do not recommend using cohesive soils as wall backfill due to their poor drainage characteristics and potential for lateral wall loads resulting from surface frost. We recommend that granular material (less than 15% passing the No. 200 sieve) be used for all wall backfill. The stone should be placed at a 35° angle from the vertical to allow use of the lower values above. We recommend that footing drains and underslab drains leading to a permanent sump pump be installed to minimize the build-up of hydrostatic forces behind the below-grade walls. GCI also suggests damp-proofing of below-grade walls.

EXCAVATIONS

The existing site soils can be excavated with conventional track hoe equipment. We did not encounter bedrock within the borings and we do not expect bedrock will impact shallow excavations or site development work. **All site excavations should comply with current OSHA regulations.**

GROUNDWATER

We encountered groundwater seepage in 6 of the 22 borings at depths of 3 to 12 feet below grade. By completion of drilling the water levels in these borings were measured at 5 to 9 feet below grade (the water had dissipated in one boring). It is GCI's opinion that groundwater will not have a significant impact on shallow foundation excavations and shallow utility trench excavations associated with the proposed building footprint. If water is encountered in shallow site excavations, the excavations should be dewatered to allow footing construction and utility trench backfilling in dry conditions. We expect groundwater seepage flows in shallow excavations can be handled with portable sump pumps and working mats of crushed stone, as needed. Contact GCI for additional recommendations if excessive groundwater conditions are encountered.

PAVEMENTS – Conventional Automobile/Truck Traffic

Provided the site is properly prepared, conventional aggregate base and flexible asphalt wearing course pavements can be used. Prior to pavement construction, the subgrade should be carefully proof-rolled, and stabilized as necessary. Lab testing resulted in a California Bearing Ratio (CBR) value of 5.

We assume that traffic will consist of automobiles and occasional trucks. Based on our experience with similar projects and soils, and assuming properly prepared subgrades, we recommend a minimum light-duty pavement section consisting of 3 inches of asphalt over 8 inches of aggregate base. For heavy-duty traffic areas, including the main traffic aisles and areas subjected to occasional truck deliveries, we suggest a pavement section consisting of a minimum of 4 inches of asphalt over 10 inches of aggregate base. **These designs are not adequate for tarmac pavements, which would require specific analysis.**

Providing adequate subbase drainage is important to future pavement performance. Finger drains connecting to weep-holes in inlets, proper grading of pavement subgrades and surfaces to shed run-off, and underdrains in pavement swales are suggested subbase drainage methods and should be designed by the site civil engineer.

Pavement areas should be thoroughly proof-rolled and steel-wheel rolled to a smooth surface prior to placement of base aggregate. Subgrade preparation during wet seasons may require the use of engineering fabrics or geogrids.

SITE PREPARATION AND EARTHWORK

We provide general guidelines for site preparation and earthwork operations below.

1. Remove existing construction elements as needed, in accordance with the recommendations in the report.

2. Remove topsoil, vegetation, and root mat systems from below the proposed building footprint and pavement areas plus a minimum of 5 feet beyond. Stockpile topsoil for redistribution in proposed green space areas, reuse in landscaping mounds, or to backfill on-site borrow pits, otherwise haul the topsoil off-site.

3. Remove the fill mounds from below proposed construction areas, plust to 10 feet outside construction limits.

   If the remove and replace option is chosen for the possible fill areas, remove the existing fill from below the proposed building, plus 10 feet laterally.

4. Proof-roll the exposed soil subgrades with a fully-loaded, tandem-axle dump truck (or equivalent) to identify potential soft subgrade areas. Undercut soft areas or otherwise stabilize soft spots identified during the proof-roll prior to placing controlled fill to design grade.

5. Place controlled fills to design grade within the proposed building footprint, as required. Non-organic existing fill and natural soils are suitable for reuse in controlled fills. **Off-site borrow materials should be reviewed by our office prior to use.**

6. Place controlled fills in maximum 8-inch thick loose lifts and compact each lift to a minimum of 98% of the maximum Standard Proctor dry density (ASTM D-698). The moisture in the fill soils should be controlled to within ±3% of the optimum Standard Proctor moisture content. **Depending on the time of year of earthwork, moisture adjustment of the site soils may be required to achieve proper compaction.** Cohesive soils will compact best with a sheepsfoot roller. Granular soils compact best with a vibratory smooth-drum compactor.

7. Construct foundations and start building construction after the building pads are filled to grade. Refer to the ***Foundations*** section of this report.

8. The building pad and pavement areas should be steel-wheel rolled to a smooth surface prior to placement of the underslab aggregate course. Subgrade preparation during wet seasons may require the use of engineering fabric of geogrid.

9. It is recommended that GCI be retained to observe proof-rolling operations, cut and fill operations, and foundation excavations.

10. Precautions should be taken when performing earthwork operations during winter weather or when freezing temperatures may occur. Contact GCI for additional recommendations on cold-weather earthwork operations, if applicable.

CONSTRUCTION MATERIALS ENGINEERING AND TESTING

GCI provides construction materials engineering and testing services. For project continuity throughout construction, we recommend that GCI be retained to observe, test, and document:

- earthwork procedures (stripping, fill placement, compaction, utility trench backfill, etc.),
- slab preparation (proof-rolling, excavations, undercuts, etc.),
- concrete placement and compressive strength testing (footings, slabs, pavements, etc.), and
- structural steel (welds, bolts, etc.).

The purpose of this work is to assess that the intent of our recommendations is being followed and to make timely changes to our recommendations (as needed) in the event site conditions vary from those encountered in our borings. Please contact our field department to initiate these services.

FINAL

We recommend that GCI review final site layout and grading plans. Recommendations contained in this report may be changed based on review of final site plans. If any changes in the nature, design or locations of the construction are planned, conclusions and recommendations should not be considered valid unless verified in writing by GCI. The recommendations contained in this report are the opinion of GCI based on the subsurface conditions found in the borings and available development information.

It should be noted that the nature and extent of variations between borings might not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report. This report has been prepared for design purposes only and should not be considered sufficient to prepare an accurate bid document.

If you have any questions or need for any additional information, please contact our office. It has been a pleasure to be of service to you on this project, and we hope to continue our services through construction.

GEOTECHNICAL
CONSULTANTS INC.

APPENDIX – OSU Airport Hangar Project

General Notes for Soil Sampling and Classifications
General Site Location Map (DeLorme Street Atlas USA – 2014)
Boring Location Plan
Summary of Encountered Subsurface Conditions
Test Boring Logs (B-1 to B-12, P-1 to P-3, and R-1 to R-7)
Laboratory Test Results

GEOTECHNICAL CONSULTANTS INC.

MAIN OFFICE
720 Greencrest Drive
Westerville, OH 43081
614.895.1400 **phone**
614.895.1171 **fax**

YOUNGSTOWN OFFICE
8433 South Avenue
Building 1, Suite 1
Boardman, OH 44514
330.965.1400 **phone**
330.965.1410 **fax**

DAYTON OFFICE
2380 Bellbrook Avenue
Xenia, OH 45385
937.736.2053 **phone**

www.gci2000.com

GENERAL NOTES FOR SOIL SAMPLING AND CLASSIFICATIONS

BORINGS, SAMPLING AND GROUNDWATER OBSERVATIONS:

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standard methods of exploration of subsurface conditions. The borings were drilled using a truck-mounted drill rig using auger boring methods with standard penetration testing performed in each boring at intervals ranging from 1.5 to 5.0 feet. The stratification lines on the logs represent the approximate boundary between soil types at that specific location and the transition may be gradual.

Water levels were measured at drill locations under conditions stated on the logs. This data has been reviewed and interpretations made in the text of the report. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time the measurements were made.

The Standard Penetration Test (ASTM-D-1586) is performed by driving a 2.0 inch O.D. split barrel sampler a distance of 18 inches utilizing a 140 pound hammer free falling 30 inches. The number of blows required to drive the sampler each 6 inches of penetration are recorded. The summation of the blows required to drive the sampler for the final 12 inches of penetration is termed the Standard Penetration Resistance (N). Soil density/consistency in terms of the N-value is as follows:

COHESIONLESS DENSITY		COHESIVE CONSISTENCY	
0-10	Loose	0-4	Soft
10-30	Medium Dense	4-8	Medium Stiff
30-50	Dense	8-15	Stiff
50 +	Very Dense	15-30	Very Stiff
		30 +	Hard

SOIL MOISTURE TERMS

Soil Samples obtained during the drilling process are visually characterized for moisture content as follows:

MOISTURE CONTENT	DESCRIPTION
Damp	Soil moisture is much drier than the Atterberg plastic limit (where soils are cohesive) and generally more than 3% below Standard Proctor “optimum” moisture conditions. Soils of this moisture generally require added moisture to achieve proper compaction.
Moist	Soil moisture is near the Atterberg plastic limit (cohesive soils) and generally within ±3% of the Standard Proctor “optimum” moisture content. Little to no moisture conditioning is anticipated to be required to achieve proper compaction and stable subgrades.
Very Moist	Soil moisture conditions are above the Atterberg plastic limit (cohesive soils) and generally greater than 3% above Standard Proctor “optimum” moisture conditions. Drying of the soils to near “optimum” conditions is anticipated to achieve proper compaction and stable subgrades.
Wet	Soils are saturated. Significant drying of soils is anticipated to achieve proper compaction and stable subgrades.

SOIL CLASSIFICATION PROCEDURE:

Soil samples obtained during the drilling process are preserved in plastic bags and visually classified in the laboratory. Select soil samples may be subjected to laboratory testing to determine natural moisture content, gradation, Atterberg limits and unit weight. Soil classifications on logs may be adjusted based on results of laboratory testing.

Soils are classified in accordance with the ASTM version of the Unified Soil Classification System. ASTM D-2487 “Classification of Soils for Engineering Purposes (Unified Soil Classification System) describes a system for classifying soils based on laboratory testing. ASTM D-2488 “Description and Identification of Soil (Visual-Manual Procedure) describes a system for classifying soils based on visual examination and manual tests.

Soil classifications are based on the following tables (see reverse side):

GENERAL NOTES FOR SOIL SAMPLING AND CLASSIFICATIONS

PARTICLE SIZE DEFINITION			CONSTITUENT MODIFIERS	
Boulders:		>12”		
Cobbles:		3” to 12”	Trace	Less than 5%
Gravel:	Coarse:	3/4” to 3”	Few	5-10%
	Fine:	No. 4 (3/16”) to 3/4”	Little	15-25%
Sand:	Coarse	No. 10 (2.0mm) to No. 4 (4.75mm)	Some	30-45%
	Medium	No. 40 (0.425mm) to No. 10 (2.0mm)	Mostly	50-100%
	Fine	No. 200 (0.074mm) to No. 40 (0.425mm)		
Silt & Clay		<0.074mm; classification based on overall plasticity; in general clay particles <0.005mm.		

ASTM/UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS
(more than 50% of materials is larger than No. 200 sieve size)

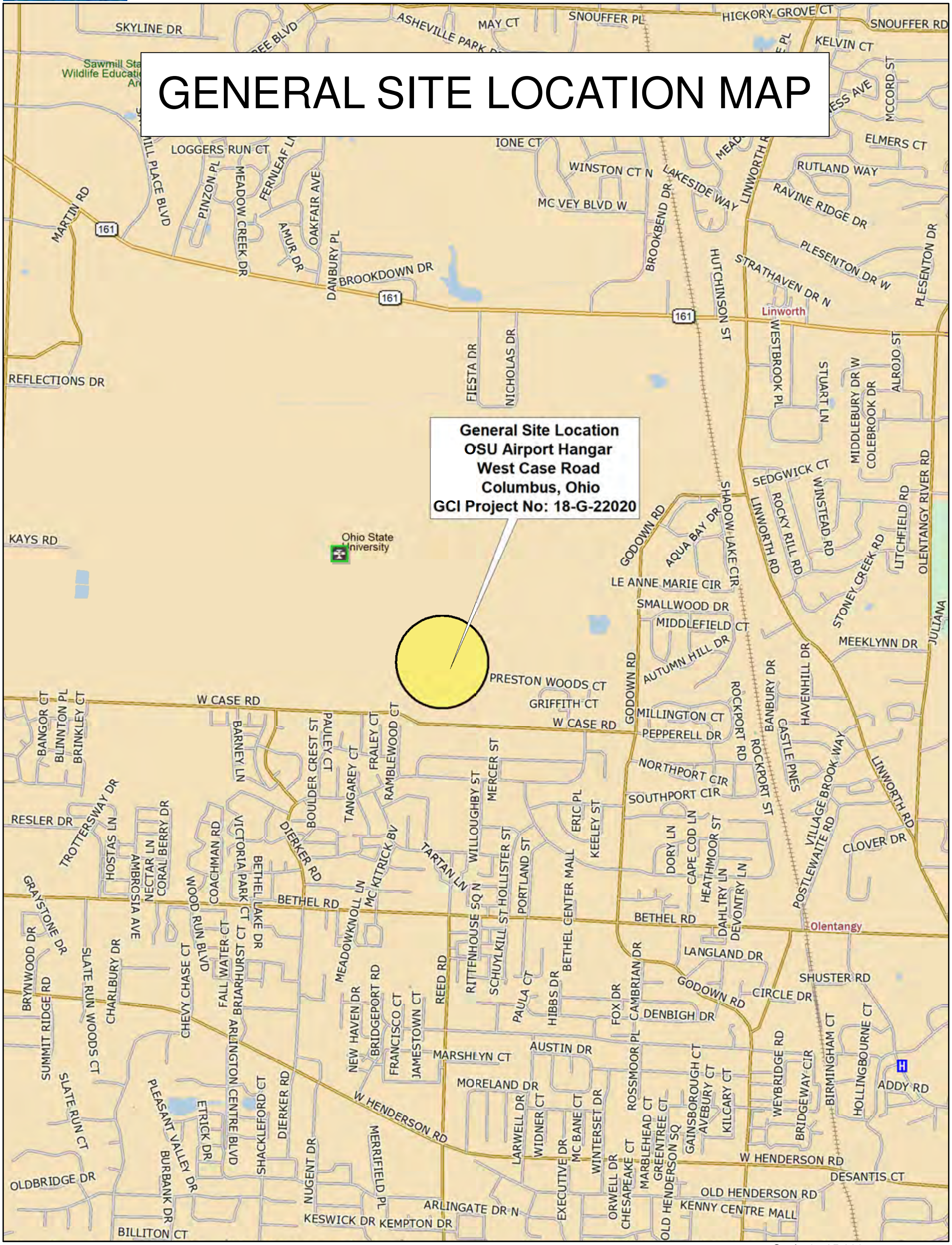
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size		*Clean Gravel (less than 5% fines)*
	GW	Well-graded gravel, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines
		Gravels with fines (more than 12% fines)
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS More than 50% of coarse fraction smaller than No. 4 sieve size		*Clean Sands (Less than 5% fines)*
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly-graded sands, gravelly sands, little or no fines
		Sands with fines (More than 12% fines)
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ……………………………………………GW, GP, SW, SP
Greater than 12 percent ……………………………………………GM, GC, SM, SC
5 to 12 percent ……………………………Borderline cases requiring dual symbols: SP-SM, GP-GM, etc.

FINE-GRAINED SOILS
(50% or more of material is smaller than No. 200 sieve size)

SILTS AND CLAYS Liquid Limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	CL-ML	Inorganic silty clay of slight plasticity, P.I. between 4 and 7
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid Limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays or medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

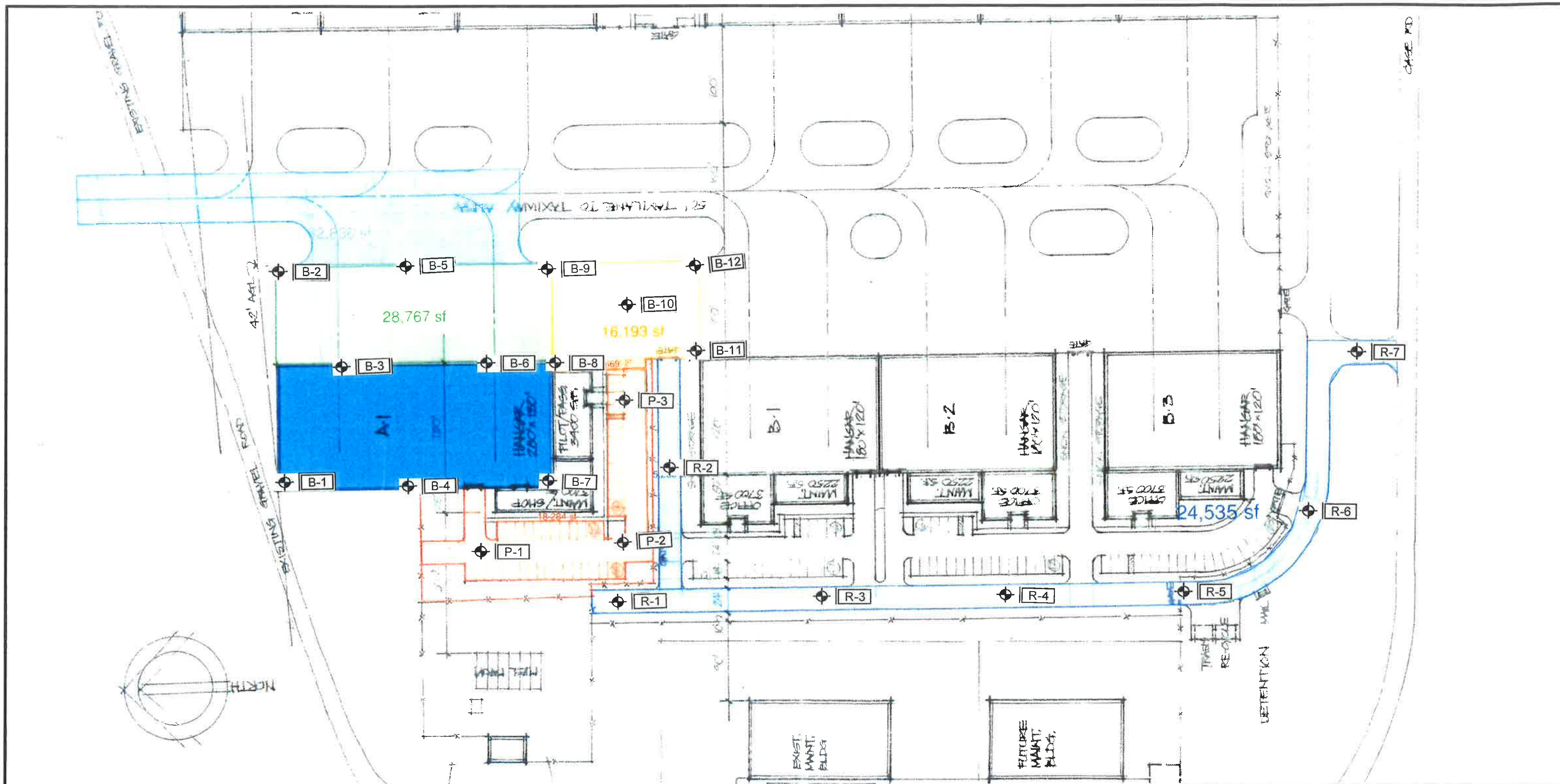


TN
MN (7.2°W)

Scale 1 : 25,000

0 600 1200 1800 2400 3000 ft
0 200 400 600 800 1000 m

1" = 2,083.3 ft   Data Zoom 13-0



Approximate Boring Location

BORING LOCATION PLAN

OSU Airport Hangar Project

West Case Road - Columbus, Ohio

Base map by Brandstetter Carroll Inc

Project No.: 18-G-22020

Date: 7/12/18 | **Drawn By: CLM**

Scale: 1"=100' (approximate)

Summary of Encountered Subsurface Conditions

OSU Airport Hangar Project
West Case Road - Columbus, Ohio
GCI Job Number: 18-G-22020

Borehole	Surface Elevation (feet) *	Surface Layer	Topsoil Thickness (ft.)	Bottom of Fill Cover (feet)	Groundwater: Level Encountered (ft)		Groundwater: Level at Completion (ft)		Depth to Mottled Lean Clay (ft)	Depth to Brown Till (ft)	Depth to Gray Till (ft)	Bottom of Boring Depth (ft)
					Depth	Elevation*	Depth	Elevation*				
B- 1	892.0	Topsoil	0.5	2.5	--	--	--	--	--	2.5	12.0	20.0
B- 2	889.0	Topsoil	0.9	--	12	877.0	9	880.0	0.9	4.0	10.0	15.0
B- 3	890.0	Topsoil	0.7	--	11.5	878.5	7	883.0	0.7	3.0	9.5	15.0
B- 4	891.0	Topsoil	0.7	--	--	--	--	--	0.7	2.8	12.5	15.0
B- 5	890.0	Topsoil	0.6	--	--	--	--	--	0.6	2.5	11.0	20.0
B- 6	890.0	Topsoil	0.5	--	--	--	--	--	0.5	4.5	9.5	15.0
B- 7	890.5	Topsoil	0.4	--	8	882.5	8	882.5	0.4	2.0	11.5	20.0
B- 8	890.0	Topsoil	0.8	--	3	887.0	--	--	0.8	4.7	11.0	15.0
B- 9	889.5	Topsoil	0.5	--	8	881.5	8	881.5	0.5	2.8	12.5	15.0
B-10	890.0	Topsoil	0.9	--	9	881.0	5	885.0	0.9	4.0	12.5	20.0
B-11	890.5	Topsoil	0.8	--	--	--	--	--	0.8	3.8	11.5	15.0
B-12	890.0	Topsoil	0.3	2.0	--	--	--	--	--	2.0	12.0	15.0
P- 1	891.0	Topsoil	0.9	--	--	--	--	--	0.9	4.0	--	5.5
P- 2	891.0	Topsoil	0.6	--	--	--	--	--	0.6	4.5	--	5.5
P- 3	891.0	Topsoil	0.9	--	--	--	--	--	0.9	4.0	--	5.5
R- 1	892.0	Topsoil	0.7	--	--	--	--	--	0.7	3.4	--	10.0
R- 2	891.0	Topsoil	0.8	--	--	--	--	--	0.8	3.0	--	5.5
R- 3	892.0	Topsoil	0.4	--	--	--	--	--	0.4	4.7	--	10.0
R- 4	892.0	Topsoil	0.7	--	--	--	--	--	0.7	3.0	--	5.5
R- 5	891.5	Topsoil	0.5	--	--	--	--	--	0.5	4.5	--	10.0
R- 6	892.0	Topsoil	0.6	--	--	--	--	--	0.6	3.7	--	5.5
R- 7	889.0	Topsoil	0.8	--	--	--	--	--	0.8	4.7	--	10.0

Average Topsoil Depth
at boring locations: 0.7'

**NOTE: Surface elevations were interpolated from topographic data on plans provided; GCI did not field verify the elevations.*

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio**
BORING NO. **B- 1**
SURF. ELEV. **892.0 ±**
CLIENT **The Ohio State University**
PROJ. NO. **18-G-22020**
DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	2	3	2	Moist	0.5	Topsoil
									Fill consisting of a mixture of lean clay, sand, and gravel; stained
	4	2.0-3.5	SS	2	4	11	Moist	2.5	
									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4	4.0-5.5	SS	4	5	9	Moist		
5									
	4.5	8.5-10.0	SS	12	14	17	Moist		
10									
								12.0	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	4.5	13.5-15.0	SS	17	20	25	Moist		
15									
	4.5	18.5-20.0	SS	21	29	35	Moist		
									BOTTOM OF BORING: 20'
								20.0	

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B- 2**

PROJ. NO. **18-G-22020** SURF. ELEV. **889.0 ±**

CLIENT **The Ohio State University** DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		**Cohesive Consistency**	
9.0 FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2.5	0.0-1.5	SS	2	2	5	Moist	0.9	Topsoil
	3.0-3.5	2.0-3.5	SS	2	3	4	Moist	4.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
5	NR	4.0-5.5	SS	4	5	7	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
10	4.	8.5-10.0	SS	14	15	17	Moist	10.0	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
									Water Seepage at 12'
15	4	13.5-15.0	SS	9	12	13	Moist	15.0	
									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B- 3**

PROJ. NO. **18-G-22020** SURF. ELEV. **890.0 ±**

CLIENT **The Ohio State University** DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
	Trace	Less than 5%				
7.0 FEET BELOW SURFACE AT COMPLETION	Few	5 to 10%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Little	15 to 25%	10 - 30	Medium Dense	4 - 8	Medium Stiff
					8 - 15	Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Some	30 to 45%	30 - 50	Dense	15 - 30	Very Stiff
	Mostly	50 to 100%	50 +	Very Dense	30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2.5-3.0	0.0-1.5	SS	4	3	2	Moist	0.7	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2.5	2.0-3.5	SS	3	4	4	Moist	3.0	
									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4	4.0-5.5	SS	4	5	6	Moist		
5									
	4.5	8.5-10.0	SS	12	18	22	Moist	9.5	
10									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
									Water Seepage at 11.5'
	4	13.5-15.0	SS	10	13	16	Moist	15.0	
15									
									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B- 4**

SURF. ELEV. **891.0 ±**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
_____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
_____ FEET BELOW SURFACE AT _____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	4	7	8	Moist	0.7	Topsoil
								2.8	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4	2.0-3.5	SS	21	9	14	Moist		
	3.5-4.0	4.0-5.5	SS	6	6	11	Moist	12.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
	4	8.5-10.0	SS	5	6	8	Moist		
10									
	4.5	13.5-15.0	SS	16	18	25	Moist	15.0	Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
15									
									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B- 5**

SURF. ELEV. **890.0 ±**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
______ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
______ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3.5	0.0-1.5	SS	4	5	5	Moist	0.6	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4.5	2.0-3.5	SS	3	4	7	Moist	2.5	
									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4.5	4.0-5.5	SS	5	8	9	Moist		
5									
	4.5	8.5-10.0	SS	7	8	11	Moist		
10									
								11.0	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	4.5	13.5-15.0	SS	9	17	14	Moist		
15									
	4.5	18.5-20.0	SS	19	25	30	Moist		
								20.0	BOTTOM OF BORING: 20'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME OSU Airport Hangar Project - West Case Road - Columbus, Ohio BORING NO. B- 6

SURF. ELEV. 890.0 ±

CLIENT The Ohio State University PROJ. NO. 18-G-22020 DATE DRILLED 7/10/2018

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler	
			Cohesionless Density	Cohesive Consistency
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10 Loose	0 - 4 Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30 Medium Dense	4 - 8 Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50 Dense	8 - 15 Stiff
	Some	30 to 45%	50 + Very Dense	15 - 30 Very Stiff
	Mostly	50 to 100%		30 + Hard

LOCATION OF BORING See Boring Location Plan

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	--	0.0-1.5	SS	3	3	5	Moist	0.5	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2.0-2.5	2.0-3.5	SS	3	4	5	Moist		
	--	4.0-5.5	SS	6	6	7	Moist	4.5	
5									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4.5	8.5-10.0	SS	10	12	16	Moist	9.5	
10									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	4.5	13.5-15.0	SS	9	13	18	Moist	15.0	
15									BOTTOM OF BORING: 15'

* The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

TEST BORING LOG

PROJECT NAME OSU Airport Hangar Project - West Case Road - Columbus, Ohio

BORING NO. B- 7

PROJ. NO. 18-G-22020

SURF. ELEV. 890.5 ±

CLIENT The Ohio State University

DATE DRILLED 7/10/2018

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
8.0 FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING See Boring Location Plan

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	2	2	3	Moist	0.4	Topsoil
								2.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	1.5-2.0	2.0-3.5	SS	3	4	6	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	3.5-4.0	4.0-5.5	SS	3	4	6	Moist		
5									
	3.5-4.0	8.5-10.0	SS	9	14	21	Moist		Water Seepage at 8'
10								11.5	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	4.5	13.5-15.0	SS	9	11	14	Moist		
15									
	4.5	18.5-20.0	SS	16	18	19	Moist		
								20.0	BOTTOM OF BORING: 20'

* The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B- 8**

SURF. ELEV. **890.0 ±**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
______ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
______ FEET BELOW SURFACE AT _____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	3	3	2	Moist	0.8	Topsoil
	2.5	2.0-3.5	SS	2	3	2	Moist		Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand Water Seepage at 3'
5	3.5-4.0	4.0-5.5	SS	WH	WH	3	Wet to Very Moist	4.7	
									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4	8.5-10.0	SS	7	10	14	Moist		
10								11.0	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	4	13.5-15.0	SS	15	17	21	Moist		
15								15.0	
									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

TEST BORING LOG

PROJECT NAME: OSU Airport Hangar Project - West Case Road - Columbus, Ohio
BORING NO. B- 9
SURF. ELEV. 889.5 ±
CLIENT: The Ohio State University
PROJ. NO. 18-G-22020
DATE DRILLED 7/10/2018

GROUND WATER OBSERVATION	Proportions Used	140 lb Wt. x 30" fall on 2" O.D. Sampler	
		Cohesionless Density	**Cohesive Consistency**
	Trace — Less than 5%		
8.0 FEET BELOW SURFACE AT COMPLETION	Few — 5 to 10%	0 - 10 Loose	0 - 4 Soft
____ FEET BELOW SURFACE AT 24 HOURS	Little — 15 to 25%	10 - 30 Medium Dense	4 - 8 Medium Stiff
	Some — 30 to 45%	30 - 50 Dense	8 - 15 Stiff
			15 - 30 Very Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Mostly — 50 to 100%	50 + Very Dense	30 + Hard

LOCATION OF BORING: **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2.5	0.0-1.5	SS	4	2	2	Moist	0.5	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2.5	2.0-3.5	SS	1	2	2	Moist to Very Moist	2.8	
									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	3.5	4.0-5.5	SS	3	3	3	Moist to Very Moist		
5									
	4	8.5-10.0	SS	8	8	10	Moist		Water Seepage at 8'
10									
								12.5	
									Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
	--	13.5-15.0	SS	9	13	15	Moist		
								15.0	
15									
									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B-10**

SURF. ELEV. **890.0 ±**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** DATE DRILLED **7/10/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
5.0 FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2.5	0.0-1.5	SS	3	3	3	Moist	0.9	Topsoil
	2.5	2.0-3.5	SS	3	4	5	Very Moist	4.0	Brown Mottled Gray Lean Clay (CL) - stained, moderate to higher plasticity, trace sand
	3.5	4.0-5.5	SS	3	5	5	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
	4	8.5-10.0	SS	7	8	10	Moist		
									Water Seepage at 9'
10								12.5	
	3.5	13.5-15.0	SS	5	7	10	Moist		Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
15									
	4	18.5-20.0	SS	8	9	12	Moist	20.0	BOTTOM OF BORING: 20'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **B-11**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** SURF. ELEV. **890.5 ±** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION

None FEET BELOW SURFACE AT COMPLETION

_____ FEET BELOW SURFACE AT 24 HOURS

_____ FEET BELOW SURFACE AT ____ HOURS

Proportions Used	
Trace	Less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		**Cohesive Consistency**	
0 - 10	Loose	0 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
50 +	Very Dense	15 - 30	Very Stiff
		30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	--	0.0-1.5	SS	4	3	3	Moist	0.8	Topsoil
	3.5	2.0-3.5	SS	2	2	3	Moist	3.8	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4.5	4.0-5.5	SS	5	6	7	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
	3.5-4.0	8.5-10.0	SS	7	8	10	Moist		
10								11.5	
	4.5	13.5-15.0	SS	15	19	21	Moist	15.0	Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
15									BOTTOM OF BORING: 15'

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME: OSU Airport Hangar Project - West Case Road - Columbus, Ohio
BORING NO.: B-12
SURF. ELEV.: 890.0 ±
CLIENT: The Ohio State University
PROJ. NO.: 18-G-22020
DATE DRILLED: 7/11/2018

GROUND WATER OBSERVATION

None FEET BELOW SURFACE AT COMPLETION
_____ FEET BELOW SURFACE AT 24 HOURS
_____ FEET BELOW SURFACE AT _____ HOURS

Proportions Used

Trace	Less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

140 lb Wt. x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0 - 10	Loose	0 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
50 +	Very Dense	15 - 30	Very Stiff
		30 +	Hard

LOCATION OF BORING: **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2	0.0-1.5	SS	2	3	5	Moist	0.3	Topsoil
								2.0	Fill consisting of a mixture of lean clay, sand, and gravel
	3	2.0-3.5	SS	3	4	7	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4	4.0-5.5	SS	6	7	7	Moist		
5									
	4	8.5-10.0	SS	6	8	10	Moist		
10								12.0	
	4.5	13.5-15.0	SS	16	17	19	Moist	15.0	Gray Sandy Lean Clay with Gravel (CL) - low plasticity, little to some fine to coarse sand, little gravel (glacial till); random silty sand and gravel layers noted
15									BOTTOM OF BORING: 15'

* The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **P- 1**

PROJ. SURF. ELEV. **891.0 ±**

CLIENT **The Ohio State University** NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	2	3	2	Moist	0.9	Topsoil
	3	2.0-3.5	SS	3	3	5	Moist	4.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
5	2.5	4.0-5.5	SS	4	6	7	Moist	5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
10									BOTTOM OF BORING: 5.5'
15									

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **P- 2**

SURF. ELEV. **891.0 ±**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
_____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
_____ FEET BELOW SURFACE AT _____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3.5	0.0-1.5	SS	6	3	3	Moist	0.6	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2.5	2.0-3.5	SS	3	3	4	Moist		
	4.5	4.0-5.5	SS	3	5	5	Very Moist to Moist	4.5	
5								5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
									BOTTOM OF BORING: 5.5'
10									
15									

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **P- 3**

PROJ. SURF. ELEV. **891.0 ±**

CLIENT **The Ohio State University** NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
	Trace	Less than 5%				
None FEET BELOW SURFACE AT COMPLETION	Few	5 to 10%	0 - 10	Loose	0 - 4	Soft
______ FEET BELOW SURFACE AT 24 HOURS	Little	15 to 25%	10 - 30	Medium Dense	4 - 8	Medium Stiff
					8 - 15	Stiff
______ FEET BELOW SURFACE AT _____ HOURS	Some	30 to 45%	30 - 50	Dense	15 - 30	Very Stiff
	Mostly	50 to 100%	50 +	Very Dense	30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	2	3	4	Moist	0.9	Topsoil
	2.0-2.5	2.0-3.5	SS	3	3	3	Moist	4.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
5	4.5	4.0-5.5	SS	6	6	8	Moist	5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
10									BOTTOM OF BORING: 5.5'
15									

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio**
BORING NO. **R- 1**
SURF. ELEV. **892.0** ±
CLIENT **The Ohio State University**
PROJ. NO. **18-G-22020**
DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	--	0.0-1.5	SS	3	4	5	Moist	0.7	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4	2.0-3.5	SS	4	4	4	Moist	3.4	
	4	4.0-5.5	SS	7	7	9	Moist		Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
	3.5-4.0	8.5-10.0	SS	8	11	15	Moist	10.0	
10									
									BOTTOM OF BORING: 10'
15									

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **R- 2**

CLIENT **The Ohio State University** PROJ. NO. **18-G-22020** SURF. ELEV. **891.0 ±** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
______ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
______ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	2.5	0.0-1.5	SS	2	3	4	Moist	0.8	Topsoil
								3.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2	2.0-3.5	SS	3	3	4	Moist		
	4	4.0-5.5	SS	4	5	7	Moist	5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
									BOTTOM OF BORING: 5.5'
10									
15									

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME OSU Airport Hangar Project - West Case Road - Columbus, Ohio
BORING NO. R-3
PROJ. NO. 18-G-22020
SURF. ELEV. 892.0 ±
CLIENT The Ohio State University
DATE DRILLED 7/11/2018

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	3	3	4	Moist	0.4	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4	2.0-3.5	SS	2	3	3	Moist		
	3	4.0-5.5	SS	5	6	8	Moist	4.7	
5									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4.5	8.5-10.0	SS	13	17	22	Moist		
10								10.0	
									BOTTOM OF BORING: 10'
15									

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **R- 4**

PROJ. SURF. ELEV. **892.0 ±**

CLIENT **The Ohio State University** NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3.5	0.0-1.5	SS	2	3	2	Moist	0.7	Topsoil
								3.0	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	3	2.0-3.5	SS	3	3	4	Moist		
	2	4.0-5.5	SS	4	4	4	Very Moist	5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
5									
									BOTTOM OF BORING: 5.5'
10									
15									

*** The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **R- 5**

PROJ. SURF. ELEV. **891.5 ±**

CLIENT **The Ohio State University** NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
	Trace	Less than 5%				
None FEET BELOW SURFACE AT COMPLETION	Few	5 to 10%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Little	15 to 25%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Some	30 to 45%	30 - 50	Dense	8 - 15	Stiff
	Mostly	50 to 100%	50 +	Very Dense	15 - 30	Very Stiff
					30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3	0.0-1.5	SS	2	3	5	Moist	0.5	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	4	2.0-3.5	SS	3	3	4	Moist		
	4.5	4.0-5.5	SS	4	5	7	Moist	4.5	
5									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4.5	8.5-10.0	SS	13	17	22	Moist		
10								10.0	
									BOTTOM OF BORING: 10'
15									

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio** BORING NO. **R- 6**

PROJ. SURF. ELEV. **892.0 ±**

CLIENT **The Ohio State University** NO. **18-G-22020** DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
______ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
______ FEET BELOW SURFACE AT _____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	4	0.0-1.5	SS	3	5	5	Moist	0.6	Topsoil
	3.5-4.0	2.0-3.5	SS	3	3	7	Moist	3.7	Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
5	3.5-4.0	4.0-5.5	SS	6	8	9	Moist	5.5	Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
10									
15									BOTTOM OF BORING: 5.5'

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

TEST BORING LOG

PROJECT NAME **OSU Airport Hangar Project - West Case Road - Columbus, Ohio**
BORING NO. **R- 7**
SURF. ELEV. **889.0 ±**
CLIENT **The Ohio State University**
PROJ. NO. **18-G-22020**
DATE DRILLED **7/11/2018**

GROUND WATER OBSERVATION	Proportions Used		140 lb Wt. x 30" fall on 2" O.D. Sampler			
			Cohesionless Density		Cohesive Consistency	
None FEET BELOW SURFACE AT COMPLETION	Trace	Less than 5%	0 - 10	Loose	0 - 4	Soft
____ FEET BELOW SURFACE AT 24 HOURS	Few	5 to 10%	10 - 30	Medium Dense	4 - 8	Medium Stiff
____ FEET BELOW SURFACE AT ____ HOURS	Little	15 to 25%	30 - 50	Dense	8 - 15	Stiff
	Some	30 to 45%	50 +	Very Dense	15 - 30	Very Stiff
	Mostly	50 to 100%			30 +	Hard

LOCATION OF BORING **See Boring Location Plan**

DEPTH	Pocket Penetrometer (tsf)	Sample Depths From To	Type of Sample	Blows per 6" on Sampler From To 0-6	6-12	12-18	Moisture Density or Consist.	Strata Change Depth*	SOIL IDENTIFICATION Remarks include color, type of soil, etc. Rock-color, type, condition, hardness
	3.5	0.0-1.5	SS	2	3	3	Moist	0.8	Topsoil
									Brown Mottled Gray Lean Clay (CL) - stained, moderately plastic, trace sand
	2.5	2.0-3.5	SS	3	4	5	Moist		
	4	4.0-5.5	SS	3	4	6	Moist	4.7	
5									Brown Lean Clay with Sand to Sandy Lean Clay (CL) - moderately plastic, little fine to coarse sand, trace gravel (glacial till); random silty sand and gravel layers noted
	4.5	8.5-10.0	SS	6	7	9	Moist	10.0	
10									
									BOTTOM OF BORING: 10'
15									

* **The stratification lines represent the approximate boundary between soil types and the transition may be gradual.**

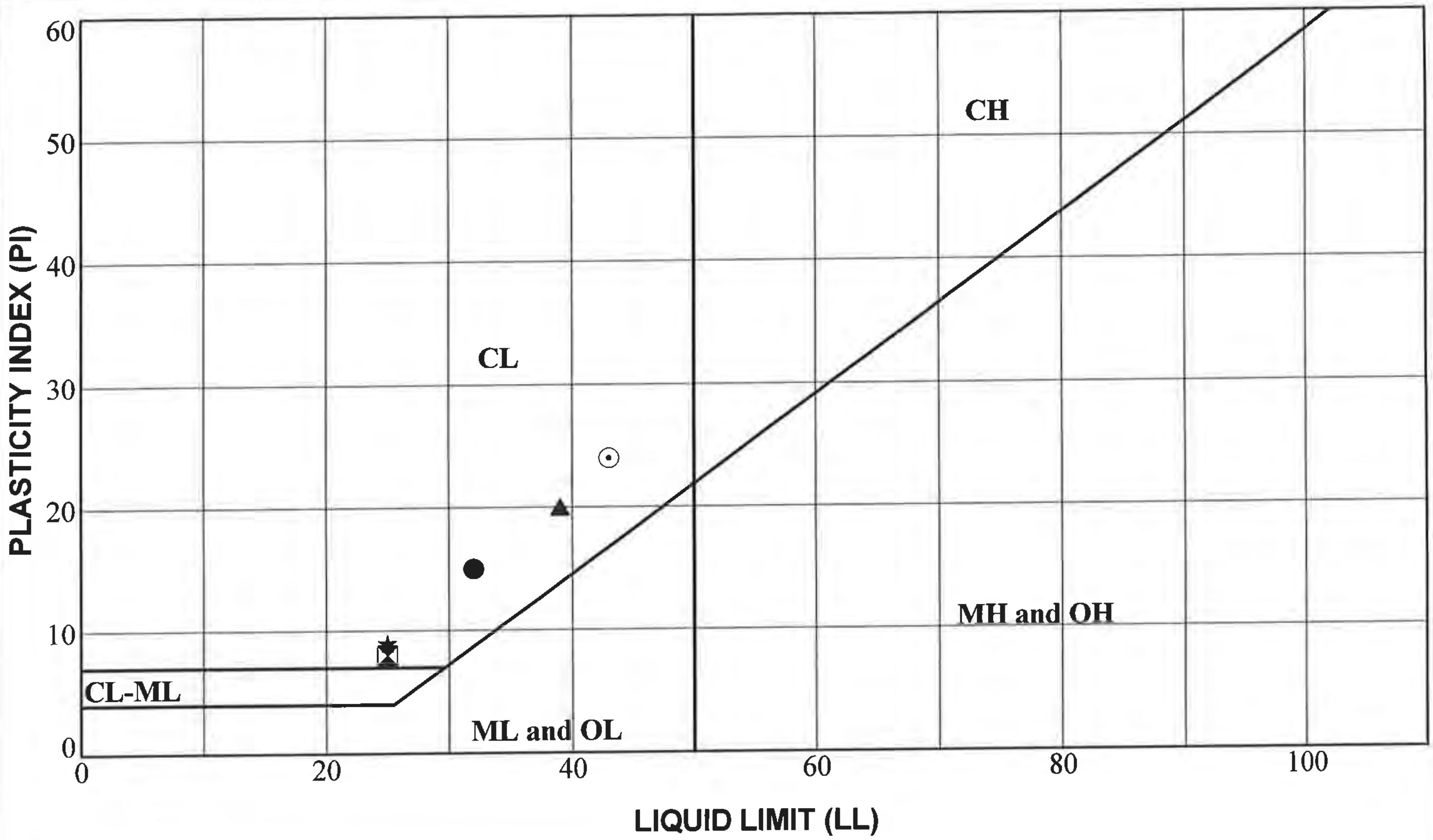
720 Greencrest Drive • Westerville, Ohio 43081 • 614-895-1400

Summary of Laboratory Results

OSU Airport Hangar Project
West Case Road - Columbus, Ohio
GCI Job Number: 18-G-22020

Test Hole	Depth	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines (< #200 Sieve)	% Clay (< 0.005 mm)	Dry Density (pcf)	Optimum Moisture (%)	C.B.R.	Swell (%)	ASTM Class-ification	ASTM Description
B- 3	0.0	17.2						-	-	-	-		
B- 3	2.0	21.7	32	17	15	69.1	40	-	-	-	-	CL	Sandy Lean Clay
B- 3	4.0	16.7	25	17	8	68.5	32	-	-	-	-	CL	Sandy Lean Clay
B- 3	8.5	10.6						-	-	-	-		
B- 3	13.5	12.1						-	-	-	-		
B- 8	0.0	18.7						-	-	-	-		
B- 8	2.0	24.1	39	19	20	79.6	49	-	-	-	-	CL	Lean Clay With Sand
B- 8	4.0	19.1	25	16	9	51.4	20	-	-	-	-	CL	Sandy Lean Clay
B- 8	8.5	11.9						-	-	-	-		
B- 8	13.5	8.9						-	-	-	-		
R- 3	1-4'	22.0	43	19	24	84.7	53	108.6	18.7	5.0	1.3	CL	Lean Clay With Sand

July 2018



LEGEND:

	TEST HOLE	DEPTH	w_n	LL	PL	PI	ASTM CLASSIFICATION
●	B- 3	2.0	21.7	32	17	15	CL
⧗	B- 3	4.0	16.7	25	17	8	CL
▲	B- 8	2.0	24.1	39	19	20	CL
★	B- 8	4.0	19.1	25	16	9	CL
⊙	R- 3	1-4'	22.0	43	19	24	CL

Job No: *18-G-22020*

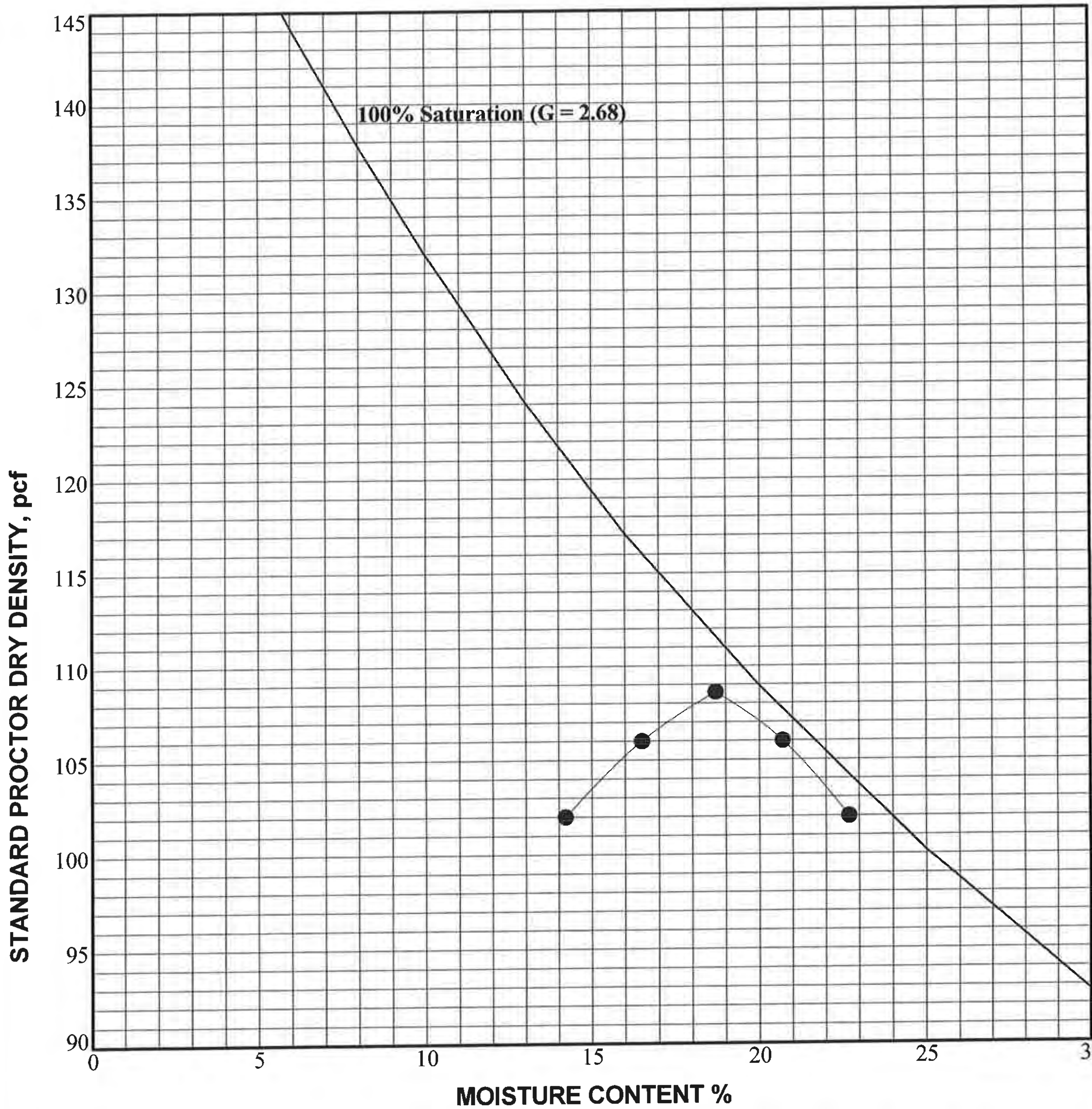
Method: *ASTM D4318*

Date: *July 2018*

ATTERBERG LIMITS TEST RESULTS

OSU Airport Hangar Project
West Case Road - Columbus, Ohio

Geotechnical Consultants, Inc. - Westerville, OH 43081



LEGEND:

	Test Hole	Depth	ASTM Classification	Maximum Dry Density, pcf	Optimum Moisture Content, %	Natural Moisture Content, %	CBR
●	R- 3	1-4'	CL	108.6	18.7	22.0	5.0

Job No: *18-G-22020*

Method: *ASTM D698A*

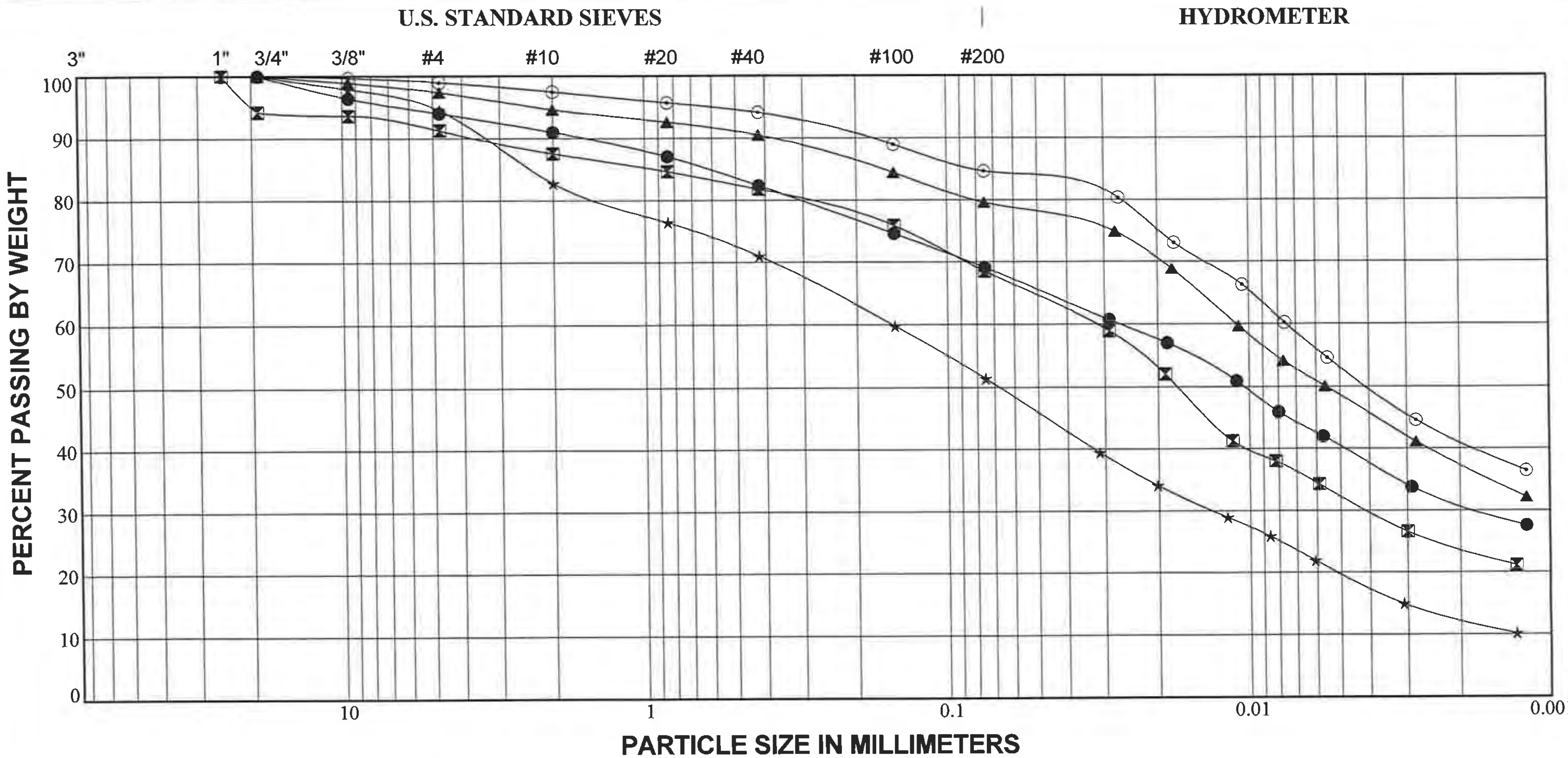
Date: *July 2018*

LABORATORY COMPACTION TEST

OSU Airport Hangar Project

West Case Road - Columbus, Ohio

Geotechnical Consultants, Inc. - Westerville, OH 43081



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

LEGEND:

	TEST HOLE	DEPTH	LL	w_n	PL	ASTM CLASSIFI-CATION	ASTM SOIL DESCRIPTION	C.B.R.
●	B- 3	2.0	32	21.7	17	CL	Sandy Lean Clay	-
⧗	B- 3	4.0	25	16.7	17	CL	Sandy Lean Clay	-
▲	B- 8	2.0	39	24.1	19	CL	Lean Clay With Sand	-
★	B- 8	4.0	25	19.1	16	CL	Sandy Lean Clay	-
⊙	R- 3	1-4'	43	22.0	19	CL	Lean Clay With Sand	5.0

Job No.: *18-G-22020*

Method: *ASTM D421 D422*

Date: *July 2018*

COMBINED PARTICLE SIZE DISTRIBUTION

OSU Airport Hangar Project - West Case Road - Columbus, Ohio

Geotechnical Consultants, Inc. - Westerville, OH 43081

August 7, 2007

Mr. Steve Slusher, P.E.
R.D. Zande and Associates
1500 Lake Shore Drive Suite 100
Columbus, Ohio 43204

RE: Failing Soil Subgrade Taxiway D and Taxiway A
OSU Airport – Taxiway A East Rehabilitation Project
Rii # W-07-043

Dear Mr. Slusher:

Resource International made a site visit at the reference project to make observation and repair recommendations for the failing subgrade at the Taxiway D and Taxiway A intersection at Station 3+52 to 6+70. Rii staff engineer, Dane Redinger, met with R.D. Zande's Jeremy Cawley, project manager, and Bill Slater, resident project representative.

The contractor, George J. Igel & Co., Inc. excavated down to subgrade (approximately elevation 890) this morning. This exposed soil subgrade exhibited 4 to 6 inches of deflection under construction equipment. The subgrade surface soil is described as sandy, clayey silt. After a test pit was excavated, more stable cohesive clayey soil was encountered at 4 inches below the subgrade elevation but still exhibited undesirable (1 to 2 inches) deflection under construction equipment loading. At a depth of 16 inches, the clayey soil appeared stiff and did not show signs of movement.

Rii staff engineer consulted with R.D. Zande representatives and concluded with two possible repair solutions for the failing subgrade:

Option 1 - Lime Modification

- Remove the top 4 inches of the surface subgrade
- Apply 10% Lime/fly ash of the soil's dry unit weight to the entire area and mix according to industry standards to a depth of 16 inches at optimum moisture content
- Compact lime/fly ash and soil in accordance with project specifications
- Protect the area from all construction traffic for a minimum of 48 hours

Option 2 - Undercut and Replace

- Remove the top 16 inches of the surface soil
- Place a Tensar BX-1200 geogrid over the entire area
- Replace the undercut volume with P-209 granular material in two 8-inch lifts compacted in accordance with project specifications.

Because of the uncertainty of the subject situation, it is recommended to perform a test section (10 ft X 30 ft) in the vicinity of the worst area to verify the adequacy of the stabilization option employed. All repair efforts should be done under the observation of a Resource International soils engineering technician or staff engineer.

If you have any questions, please call.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Dane P. Redinger, E.I.
Staff Engineer – Construction Services

Karl E. Berghauer, P.E.
Staff Engineer – Geotechnical Services

DPR/JRN

File: W-07-043 Subgrade Soil Problems