CORPS OF ENGINEERS
U. S. ARMY

DESIGN AND CONSTRUCTION REPORT

LOCKBOURNE TEST TRACK

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For

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Corps of Engineers U. S. Army

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DESIGN AND CONSTRUCTION REPORT

THE OHIO RIVER DIVISION LABORATORIES *
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

Corps of Engineers U. S. Army

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MARIEMONT, OHIO

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Introduction

1. Authority:

The construction and testing of full scale concrete runway slabs at the Lockbourne Air Force Base, Columbus, Ohio, was authorized by the Chief of Engineers in a letter, subject: "Directive for Tests on Concrete Pavement", dated 25 June 1943. (File CE 411.8, Airfields, SPEKM).

2. Purpose:

The purpose of this report is to present a summary of the design and construction details of the full scale concrete pavement test sections and to assemble the results of field and laboratory tests made on the subgrade, base material and concrete, prior to and during construction.

3. Scope:

a. Design: The first section of this report includes: the background for the tests, a resume of the general program, the details of design, the selection and description of the test site, the drainage of the site, and the selection and source of the materials of construction.

b. Construction: The second section of this report describes the equipment and methods employed in constructing the test sections, and presents photographs to illustrate the various operations and completed construction. A set of revised drawings are included as Figures 2 to 5 inclusive showing the various features of the test track as constructed.

c. Physical Properties of Construction Materials: The third section of this report summarizes the physical properties of the subgrades, bases and concrete as determined by field and laboratory tests. The complete test results on samples of the subgrade, base course materials, and concrete are included in Appendices "A", "B", and "C".

d. Discussion: The fourth section of this report is an examination of the physical properties of the materials of construction; and includes a brief discussion of the changes in design and the probable effect if any on the testing of the pavement sections.

Section I

4. Design:

a. Background for Tests: The present testing program at Lockbourne Air Force Base is preceded by the following three studies conducted in the Ohio River Division:

(1) The Service Behavior Tests of the Concrete Pavement at Godman Field, Fort Knox, Kentucky.

(2) The Service Behavior Tests of the Concrete Pavement at Camp Forrest Airfield (North Field), Tullahoma, Tennessee.

(3) Investigation of Concrete Pavements on Different Subgrades at Wright Field, Dayton, Ohio.

The results of these three studies are summarized in the report, titled "Investigation of the Effect of Base Course on Concrete Pavement", submitted in March 1943, by the Soils Section of the Cincinnati Testing Laboratory, Ohio River Division, Mariemont, Ohio, now the Ohio River Division Laboratories.

The three investigations added considerable information to the knowledge of rigid pavement design; however they also revealed a need for additional pertinent data. This led to the present program of testing, involving the construction of full scale concrete pavement test sections, from which it is hoped this additional information will be obtained. To summarize the scope of the investigation, the program should:

(1) Serve to check the basic design curves given in the Engineering Manual and the extent of the validity of the formulas from which the curves are derived.

(2) Evaluate the effect of types and thickness of base course.

(3) Evaluate the effect of subgrade variation.

(4) Test the validity of the rules of base thickness design indicated by the Wright Field Studies.

(5) Evaluate the effect of joint transfer methods and the effect of bases upon the joint transfer problem.

(6) Evaluate the effect of bases upon the joint, corner and edge design.

(7) Evaluate the effect of wire mesh reinforcing.

(8) Serve to clarify the design of overlay concrete.

(9) Evaluate the effect of repetitions of loading on design.

(10) Evaluate the effect of dual wheels.

(11) Correlate these studies and the resulting design methods to field and laboratory tests to make these methods applicable to all overburden conditions.

b. Resume of General Program: The investigation of rigid pavement design to be conducted at Lockbourne Air Force Base, which is located approximately 15 miles south of Columbus, Ohio, consists of testing a traffic lane and comparable static loading slabs of 18 designs. The traffic lane consists of 40 x 40 ft. concrete slabs, both single and overlay, varying in thickness from 5 to 10 inches and placed on different type subgrade with and without bases of different types of materials 6 inches to 12 inches in thickness. Transition slabs between the traffic slabs and turn-around sections at each end combine to form a continuous track which will be tested under the traffic of 20,000, 37,000 and 60,000 pound wheel loads. The 20,000 pound wheel load will only be used to obtain deflection measurements, unless the deflections indicate that some of the sections will fail under traffic. The weaker sections which break up first under traffic will be covered with overlays of various designs so as to supply additional information, and also to carry the traffic. Two 20 x 20 ft. slabs adjacent to and of the same design as the traffic slabs, will be used for static loading tests at the interior edge and corner; and the data obtained will be correlated to the traffic tests. Temperature measuring equipment is installed in one slab of each thickness on natural subgrade, and sand and gravel base, from which temperature differentials between the top and bottom surfaces of the concrete can be recorded. These data will be used to study the warping strains induced in the concrete by changes in the atmospheric temperature. Electrical strain gages will be used to measure the strains on the surface of the concrete produced by the temperature warping of the pavement. The arrangement of the traffic and static test slabs is shown in the plan drawing, Figure 2.

c. Design Details:

(1) Test Slab Designations: The test slabs in the two tangent sections

of the track are designated by a system of letters and numbers which indicate the location and design. The sections in the turns, being all the same design, are designated by letters alone. The test sections in the north tangent of the track have the letters "A" to "K" inclusive, excepting "I", and those in the south tangent are identified by the letters "L" to "U" inclusive. The letters "V", "W", "X", "Y" and "Z" with numerical subscripts denote the sections in the two turns. The slabs in each lane and the static test sections are numbered from "1" to "4" starting with the slab in the inside lane as number "1". The letter and number to the left of the decimal point gives the location of the test slab by section and lane, and the numbers and letters to the right of the decimal designates the design. For example, test slab C2.66S is in section "C", lane "2" and is a 6 inch concrete slab on a 6 inch sand base. (See Figure 2.)

(2) Type of Subgrade: To study the effect of types of subgrade, four sections are included having a subgrade of different characteristics and soil modulus than the site of that at Wright Field. The sections were constructed by excavating the existing subgrade to a depth of six feet and backfilling with compacted sand and gravel in one section, compacted flume sand in a second section, and compacted select subgrade material in the other two sections. The select subgrade material is sand and gravel containing approximately 20 percent silt and clay. A 6-inch concrete slab is used for the four sections, designated as "R", "S", "T" and "U", and will be compared with the 6-inch slab on natural subgrade, section "A".

(3) Types of Base Course: The types of base course to be tested and compared under like dimensional design include: bank-run sand and gravel, both loose and compact; compact sand; and compact crusher-run stone. The test sections designated for this purpose are:

Section "B" - 6 inches of concrete on 6 inches of loose sand and gravel.

Section "C" - 6 inches of concrete on 6 inches of compacted sand.

Section "D" - 6 inches of concrete on 6 inches of compacted sand and gravel.

Section "E" - 6 inches of concrete on 6 inches of crushed stone.

(4) Thickness of Base Course: The effect of thickness of base course is studied by providing several sections using 6, 8 and 10-inch thicknesses of concrete in combination with no base or various thicknesses of base course. The sections provided for this purpose are:

Section "A" - 6 inch slab on natural subgrade.

Section "D" - 6 inch slab on 6 inches of compacted sand and gravel.
Section "N" - (lane 4) 6 inch slab on 12 inches of compacted sand and gravel.
Section "O" - (lane 4) 6 inch slab on 18 inches of compacted sand and gravel
Section "F" - 8 inch slab on natural subgrade.
Section "N" - (lanes 1, 2 and 3) 8 inch slab on 6 inches of compacted sand and gravel.
Section "P" - (lanes 1, 2 and 3) 8 inch slab on 12 inches of compacted sand and gravel.
Section "P" - (lane 4) 8 inch slab on 18 inches of compacted sand and gravel.
Section "K" - 10 inch slab on natural subgrade.
Section "O" - (lanes 1, 2 and 3) 10 inch slab on 6 inches of compacted sand and gravel.
Section "Q" - (lanes 1, 2 and 3) 10 inch slab on 12 inches of compacted sand and gravel.
Section "Q" - (lane 4) 10 inch slab on 18 inches of compacted sand and gravel.

(5) Thickened Edge Pavement: The inside longitudinal edges of the six inch pavement slabs, sections "A", "B", "C", "D" and "E", have a 9 inch thickening as recommended in Chapter XX of the Engineering Manual. Special consideration will be given to routing the traffic with a view to evaluating the effectiveness of the thickened edge versus no thickened edge for similar conditions.

(6) Concrete Overlay Pavement: Two sections, "L" and "M" are provided for the study of the design of concrete overlay pavements. Sections "L" and "M" are 5 and 7 inch overlays respectively on a 6 inch concrete slab placed on natural subgrade. A 3/4-inch sand-asphalt cushion separates the base slab and overlay slab.

In addition to the original designs used in sections "L" and "M", the overlay problem will be studied by an overlay treatment of the weaker slabs required to carry the traffic during the course of the tests. The weaker designs are purposely grouped together to facilitate the overlay treatment after the slabs have failed under traffic.

(7) Joints and Load Transfer Devices: The selection and arrangement of the joints used in the traffic lanes will serve to evaluate: the effect of conventional and experimental load transfer devices on the strength and efficiency of the joint; the effect of base course on the action of the joints; and the effect of thickened edge on the joint problem. The insertion of a limited number of transition slabs between the primary test slabs provides

a means of comparison and also serves to isolate the test slabs, thereby avoiding discontinuities at the joints when one type design joins with another.

(a) Dowels: The 18 transition slabs in the two tangent traffic lanes have alternately doweled and undoweled transverse expansion joints. This arrangement enables the testing under traffic of the two types of joints for each of the more critical designs. The two turnaround sections which are both 10 inches of concrete on 6 inches of compacted sand and gravel are utilized to compare the effect of dowel lengths and spacings. The dowel lengths and spacings specified by the Engineering Manual are used in the east turn and that recommended by the Portland Cement Association are used in the west turn.

(b) The Effect of Base on the Joint Problem: As mentioned in the previous paragraph, the test slabs for each of the more critical designs have both doweled and free transverse expansion joints in addition to the permissible types of contraction joints. The testing of these slabs under traffic and comparison of the results are intended to show the effect of base and base thickness on the joint problem as well as the relative effectiveness on the various load transfer methods.

(c) Experimental Load Transfer Devices: Two experimental types of load transfer devices were installed at typical joints between slabs as shown in Figure 2. The tests of these joints are not concerned so much with the details of the particular design as to try out new concepts concerning basic principles of load transfer problems with particular reference to the wheel loads of heavy aircraft. The reduction of the principles to forms suitable for construction practices was accomplished by a preliminary investigation of small scale laboratory models.

(1) Offset Dowel: The principle of this dowel seeks to overcome certain common faults of the widely used slip dowel. The difficulty of getting slip dowels placed in the concrete in precisely true parallel alignment is generally recognized; and if slip dowels are not set exactly true, the expansion and contraction of the concrete fouls their intended functioning. Moreover, if the common dowel is made sufficiently stiff to transfer a full share of the load from one slab to the other, then it must be so stiff that the freedom of the slab to curl under varying temperature is so restrained that additional stresses are induced in the concrete. The investigation of small scale laboratory models indicated that the ability of a dowel to transfer the load from slab to slab depends more upon its stiffness or lack of vertical flexibility than its shearing strength.

The offset dowel is embedded fixedly into both of the two adjacent slabs, but the parts embedded in each slab are disposed in offset alignment. The embedded parts are connected by the steel plate member "A" (see details of joint, Figure 4), which is intended to act as a deep girder in carrying the heavy loads across the gap between slabs, the plate girder being disposed as a wide angle skew bridge. The torsional flexibility of the plate permits the rotational movement of the slabs when curling under daily differentials of temperature between top and bottom of slab. The horizontal flexibility of the plate permits the direct expansion of the slabs between winter and summer temperatures. The rigidity of the deep plate girder serves to transfer the vertical load. The fundamental principle of this dowel is to provide flexibility for rotational movements and also for horizontal movements in the longitudinal direction of the pavement and at the same time to provide stiffness against vertical movements.

(2) Cushion Key Joint: This type of joint is intended for a single, simple design of construction for universal use in connection with all kinds of joints;--expansion, contraction, dummy, construction, etc., whether transverse or longitudinal. This joint makes use of the simple key construction joint, except that the key is substantially rectangular, instead of beveled, and "cushions" are provided between all concrete surfaces of the two adjacent slabs. It is intended that such construction could be set any place in the concrete without material obstruction to the processes of placing and finishing of the concrete.

In the ordinary beveled key, when the concrete contracts in cold weather, the joint often opens 1/16-inch or more so that with the standard 2 to 1 bevel of the key, the loaded slab must deflect 1/32-inch before its adjacent slab can even begin to share the load. However, if a concrete key is made without the bevel, so that close contact between the concrete key and keyway is maintained at all times, then only a slight curling of the slab under daily temperature differentials exerts sufficient force to crack the key off. Conditions similar to the ordinary key joint are encountered in the dummy joint where the irregular break is expected to form the semblance of a plurality of small keys.

In the "cushion" key, the vertical fillers are of a material having a modulus of elasticity of approximately 300 to 500, to permit direct expansion of the concrete between summer and winter weather. The horizontal filler is a material having a modulus of elasticity of approximately 10,000 to 40,000 (for the thickness shown). A material having this property, when in contact with the concrete, having a modulus of elasticity of approximately 5,000,000; offers no appreciable restraint to the curling of the concrete slabs; but, on the other hand, it is sufficiently stiff to transfer a full share of the load between key and keyway for the reason that the deflection of the horizontal filler is small in comparison to the total deflection of the loaded slab.

(d) Thickened Edge Joints: A longitudinal thickened edge expansion joint, as specified by the Engineering Manual, is used in the east turn, and the joint as recommended by the Portland Cement Association is used in the west turn. A comparison of the results of traffic tests on the two turns may in some measure show the comparative effectiveness of the two types of edge thickening.

(8) Wire Mesh Reinforcing: Three test sections consisting of 8 inches of concrete on natural subgrade with wire mesh of different weights are included in the study. Wire mesh having weights of 68, 91 and 159 pounds per 100 sq. ft. are placed in sections "G", "H" and "J", 2 inches below the upper surface. The results of traffic tests on the three sections should serve to evaluate the effect of wire mesh on the strength of the joints and useful life of the pavement. The sections provided for this purpose are:

Section "G" - 8 inches of concrete on natural subgrade, 68 lb. wire mesh.
Section "H" - 8 inches of concrete on natural subgrade, 91 lb. wire mesh.
Section "J" - 8 inches of concrete on natural subgrade, 159 lb. wire mesh.

d. Selection and Description of the Site: The selection of a location for the study is governed by the requirements that the overburden consist of a clay-type soil uniform in extent and to an appreciable depth. Investigation of the available sites in the Ohio River Division indicated that the soil conditions at the Lockbourne Air Force Base most nearly satisfy the desired requisite.

The area selected for construction of the test sections is near the west boundary of the reservation as shown on the location drawing, Figure 1. A surfaced road which is part of an old highway borders the area on the south, and was used as an access road during construction of the test track. An open ditch along the west edge of the area provided an outlet for the drainage system.

The topography and overlying soil deposits are the result of the Wisconsin stage of glaciation. The topography is level to gently undulating with exceptionally poor natural drainage. Surface and sub-surface water is drained from the reservation by open ditches which drain to the southeast and southwest. The soil deposit is glacial fill which extends to a considerable depth. The upper 10 to 15 feet of this material is predominately a grayish brown silty clay containing little sand and gravel with small to medium size boulders.

e. Drainage: The test sections are drained by a system of surface and sub-surface drains which empty into the open ditch at the west end of the test track. The sub-surface drains consist of 8-inch, 12-inch, and 15-inch perforated concrete pipe laid in a trench and backfilled with filter material. These drains are located around the inside perimeter of the test track, 3 feet from the edge of the pavement and along the south edge of the four deep sections "R", "S", "T" and "U". Surface runoff from the test track, which is pitched one-half of one percent toward the center, is collected by two catch basins located in the area inside of the track. The two catch basins empty into the sub-surface drainage pipe. The location and details of the drainage system as constructed are shown in the revised drawing, Figure 5.

f. Selection and Source of Materials: Local materials were examined and tested to determine their suitability for base course, selected subgrade, and concrete aggregates. Gravel deposits south of Lockbourne, Ohio and approximately three miles from the site were found to be best suited for the sand and gravel base course and selected subgrade materials. Sand base course was selected from the flume deposits of the American Aggregate Sand and Gravel plant in South Columbus, Ohio. Processed sand and gravel from the same plant met the requirements for concrete aggregates. The crushed stone base materials were obtained from the Marble Cliff Quarries in northwest Columbus. The sand-asphalt cushion for the overlay sections and all joint materials were obtained from local suppliers.

Section II

5. Construction:

a. General: The construction of the test track was under the direction of the District Engineer, U. S. Engineer Office, Cincinnati, Ohio, through the Area Engineer, Army Service Forces Depot, Columbus, Ohio. The work was done under contract by the V. N. Holderman Construction Company, Columbus, Ohio. The engineering and inspection was under the supervision of personnel of the Ohio River Division Laboratories formerly the Cincinnati Testing Laboratory. The construction was started on 2 August 1943 and was completed 3 November 1943.

b. Plans and Specifications: The plans and specifications which served as a guide for construction of the test track were prepared jointly by the Ohio River Division Laboratories and the Design and Specification Sections of the District Engineer Office, Cincinnati, Ohio. The specifications conform as closely as possible with the quality of construction specified in the Engineering Manual except in a few instances, where the rules were deliberately violated; for example, the use of loose sand and gravel as base course in Section "B" and the use of Portland Cement Association recommended joints in the west turn.

c. Drainage System: The surface and sub-surface drainage system for the test track was constructed as shown on the revised drawing, Figure 5. Perforated concrete drain pipe was substituted for the vitrified tile originally specified because the latter was not available at the time. Other changes from the original plans included the installation of manholes at the locations shown on the revised plan and the substitution of the 24-inch concrete outlet drain for the open ditch. The two catch basins were constructed slightly larger than called for on the plans to enable the removal of debris. Instead of placing only 6 inches of coarse filter material around the perforated drains as called for on the plans, the trench was filled approximately half full and then the finer filter stone was placed to the bottom of the pavement. The drains were sealed at the top with backfill of relatively impervious natural subgrade soil. The manholes, catch basins and all drains, except the drain along the inside edge of the deep sections "R", "S", "T", and "U", were installed prior to construction of the test sections. The drain along the inside edge of the deep sections was installed during construction of these sections. (See Photograph (c) Plate 1).

d. Preparation of the Subgrade: Rough excavation of the subgrade was accomplished by one Le Tourneau scoop of 7-cubic yard capacity, powered by a "75" caterpillar tractor, and two La Plant-Choate Carrimor scoops of 10-cubic yard capacity. This equipment removed the top soil to within approximately 4 inches of final grade and excavated subgrade material from the deep sections "R", "S", "T", and "U". An "Invincible" crane equipped with a 3/4-cubic yard clamshell bucket assisted the scoops in excavating the soil from the deep sections. Final grading of the subgrade was carried on by an Austin-Western power grader supplemented by hand labor and tools for the final 2 inches. This method of final grading was used for all test sections except the natural subgrade sections "A" and "F" through "K". These latter sections received their final grading with a form rail subgrader and hand methods after the forms were set to line and grade. The subgrader is shown in Photograph (a) Plate 2. In some cases the subgrade was excavated to slightly lower elevation than specified in which event the same excavated material was compacted in the low portions to bring them to the required grade. A soft spot in the subgrade encountered during rough excavation in section "E", lane 2, is shown in Photograph (b), Plate 2. A view of the finished subgrade ready for placing concrete is shown in Photograph (b), Plate 9.

The finished subgrade was covered with damp cotton mats to prevent excessive drying out of the soil before the base course or concrete could be placed. These efforts were not entirely successful because of the unusually dry weather during construction. Photograph (c), Plate 2, shows this method of protecting the subgrade.

e. Placing and Compacting Base Course Materials:

(1) Sections "R", "S", "T", and "U": The placing and compacting of the foundation materials in these sections, referred to as the deep sections, was accomplished simultaneously prior to construction of the other test sections. The first material was placed on 1 September 1943 and the sections were completed to approximate grade on 13 September 1943.

Selected subgrade material was placed and compacted to a depth of 5.0 feet in section "R" and 5.5 feet in section "S". Sand and gravel base course material was placed in section "T" and sand base course material was placed in section "U". The material in both sections "T" and "U" were compacted to a depth of 6.0 feet. The selected subgrade and base course materials were hauled from their source to stock piles near the site where a crane equipped with a 3/4-cubic yard clamshell bucket handled and reloaded the materials into dump trucks which delivered the material to the proper section. The three stock piles and the method of handling the materials are shown in Photograph (a), Plate 1.

The materials were spread in approximately 6-inch layers by means of a bulldozer and patrol grader. The stock piling, rehandling and spreading operations assured a uniformly mixed material. The spreading was followed by sprinkling the materials to the required moisture content after which the layers received at least six passes with a sheeps-foot roller pulled by a "75" caterpillar tractor. The sections were brought up to grade in lifts of approximately 6 inches with none of the sections ever more than two lifts ahead of other sections. Each layer, whenever necessary, was wetted prior to the placement and rolling of the succeeding layer. The rolling and sprinkling equipment is shown in Photograph (b), Plate 1, and a general view of the deep section during construction is shown in Photograph (c), Plate 1.

Density and moisture content determinations were taken continually during construction of the sections.

(2) Section "C": The base for this section consists of a 6-inch compacted layer of sand which is from the same source as the material used in section "U". The rolling of the sand in this section by the usual method was not very successful due to the fact that there was only the one 6-inch layer over the natural subgrade. A fair degree of compaction was achieved by thoroughly wetting the sand with water.

(3) Section "B": This section consists of a 6-inch layer of loose sand and gravel. The material was roughly spread by hand in a 6-inch layer and leveled by striking off the surface to the desired grade with a form rail subgrader. (See Photograph (a), Plate 2).

(4) Section "E": The base course for section "E" consists of a 6-inch compacted layer of crusher-run stone. The crushed stone was placed on the natural subgrade in a 3-inch layer which was wetted and then rolled five times with a smooth two-wheeled 7.5 ton roller. The surface was then choked with screenings and flat-rolled an additional two times. A second 3 inch layer of crushed stone was then placed, wetted, rolled and choked with screenings in the same manner as the first layer.

(5) Other Sections: This includes all other sections having a bank-run sand and gravel base. The placing and compacting of the sand and gravel in these sections was done in a manner similar to that described for sections "R", "S", "T", and "U".

In all sections having a base, except the turns, the final grading operations consisted of striking off the surface with a subgrader, filling the low areas, removing excess material and then rolling the surface with a 7-1/2-ton smooth roller. The turns received the same treatment except that the final grading was done entirely by hand.

f. Joints: The joints were assembled and secured in their proper location as soon as final grading operations were completed. The locations and details of the various joints as constructed are shown in the revised drawings, Figures 2 and 4. The following paragraphs give a description of the joints and their construction in the test track.

(1) Construction Joints:

(a) Longitudinal Keyed Joint: This joint, used to separate the two traffic lanes except where indicated on the plan, (Figure 2), was constructed by securely fastening a metal or wooden strip against the metal forms. The strip was removed with the form when the forms were stripped from the concrete and the exposed edge was painted with joint sealing material. The joint was completed by casting concrete in the adjacent lane against the existing portion of the joint. The key is off center by approximately 1-inch in the 8 and 10-inch pavements due to the fact that the contractor was permitted to use 7 and 9-inch forms with a 1-inch board fastened to the bottom. This occurs also in the 13-inch thickened edge keyed joint in the west turn where a 6 and a 7-inch form was used one on top of the other. In this case, the strip was placed over the joint made by the two forms and spot welded to the top and bottom forms as shown in Photograph (a), Plate 3. Other views of the keyed joint are shown in Photographs (b) and (c), Plate 3.

(b) Doweled Butt Joint: This joint was used in the reinforced sections "G", "H", and "J" as a longitudinal construction joint between the inside and outside traffic slabs and was also used in the east turn to separate the two traffic lanes in sections "W_1" and "W_2". The joint was used as a transverse construction joint in the east turn between sections "X_1-X_2", "W_1-W_2", "V_1-V_2" and "V_3-V_4". Dowel lengths and spacings as specified in Chapter XX of The Engineering Manual were used in these joints. The dowel bars were held in place at the specified spacing in 2 x 10-inch timber bulkheads for the transverse joints as shown in Photograph (a), Plate 4. In the longitudinal joints, the dowel bars were placed through holes in the steel forms immediately following the placing of concrete. Photographs (b) and (c), Plate 4, show the longitudinal joint and a transverse joint after the forms and bulkhead were stripped. The length of the dowel bar protruding from the concrete after the forms were stripped was painted and greased before concrete was placed in the adjacent slab.

Dowel lengths and spacings as recommended by the Portland Cement Association were used in the west turn, in the longitudinal joint between traffic lanes in sections "W_3" and "W_4", and in the transverse joints between "Z_1-Z_2", "Z_3-Z_4", "W_3-W_4 and "Y_1-Y_2". Deformed bars were inadvertently used in place of smooth bars for the longitudinal joint in sections "W_3" and "W_4" and in the four transverse joints of the inside traffic lane. An attempt to grind the deformations from the deformed bars was unsuccessful so the joints were completed with the bars functioning as tie bars rather than slip dowels. The transverse joints in the outside traffic lane of the west turn have the specified smooth dowel bars with one end painted and greased. Photographs (a), (b) and (c), Plate 5, show the joint construction in the inside lane of the west turn.

(2) Expansion Joints:

(a) Transverse Doweled Joint: Transverse doweled joints are used with the traffic lane at the locations shown in the Plan, Figure 2. Engineering Manual specified dowel lengths and spacings are used in all joints except those in the west turn where dowel lengths and spacings recommended by the Portland Cement Association are used.

The joint consists ofa 3/4-inch premoulded bituminous fiber filler which extends from the subgrade or base course to 3/4 inches below the surface of the pavement, and is continuous from edge to edge of pavement. The filler and dowel bars are securely held in place by prefabricated heavy wire joint assemblies. A 3/4-inch redwood strip, fastened to the top of the filler and removed after placing concrete, provided the space required for the bituminous joint seal. The redwood spacer strips were employed because the contractor was unable to furnish the metal caps commonly used for this purpose. All dowel bars in the joints of the inside traffic lane are greased and capped at one end; whereas, the dowels in the outside lane are painted in addition to the greasing and capping. Trouble was encountered keeping the joints in line in the first sections of pavement placed but this difficulty was remedied by using 2 x 4-inch wood caps as shown in Photograph (c), Plate 6. Other views of the transverse expansion joint construction are shown in Photographs (a) and (b), Plate 6.

(b) Longitudinal Thickened Edge Joint: This joint is used in the two turns between the two traffic lanes as indicated in the Plan of the test track, Figure 2.

The construction of the joint in the east turn is as specified in Chapter XX of the Engineering Manual which requires an edge thickness equal to 1-1/2 times the slab thickness or 15 inches for the 10 inch slab. The edge thickening starts at the longitudinal dummy joints which are 10 feet each side of the expansion joint. The expansion joint consists of a 3/4-inch premoulded bituminous fiber filler, 14-3/4 inches in width, capped with a 3/4-inch redwood spacer strip which was removed after placing concrete and the space filled with bituminous joint seal. The bituminous filler was placed against the forms before concrete was placed in the inside lane as shown in Photograph (a), Plate 7. Nails driven through the filler held the material in place against the edge of the concrete after the forms were stripped.

The construction of the longitudinal expansion joint in the west turn is as recommended by the Portland Cement Association. The construction differs from the Engineering Manual in the manner of edge thickening which according to P.C.A. should be 1-1/3 times the slab thickness in a distance of 3.0 feet. Therefore, a 13-inch thickened edge in a distance of 3.0 feet was used for the 10-inch slab in the west turn. Except for the edge thickening, the construction details are identical to those used for the joint in the east turn.

(c) Redwood Joint: The redwood or free joint was used in alternate transition slabs and at other locations in the test track, as shown in the Plan, Figure 2. This joint consists of a 3/4-inch redwood filler having widths equal to the slab thickness less 3/4 of an inch. The 3/4-inch removable redwood spacer strips fastened to the top edge of the filler provided the recess for the bituminous seal. The joints were securely held in place by driving steel pins into the subgrade or base course along each side of the filler. Views of the redwood joints in place are shown in Photographs (b) and (c), Plate. 7.

The redwood joints between the traffic and static slabs and in the static sections were pulled just after the concrete had received its initial set, leaving open joints. This was done to eliminate any disturbance or load transfer between the slabs when the sections are tested. The open joints in the static sections on natural subgrade were filled with bituminous seal, whereas, those on the base course were left open.

(3) Dummy Joints: The ribbon joint was substituted for the dummy groove joint at the request of the contractor and with permission of the Contracting Officer and personnel of the Ohio River Division Laboratories.

(a) Dummy Ribbon Joint Without Tie Bars: This joint was used in all traffic slabs except those in sections "V_1", "V_2", "V_3" and "V_4" in the east turn, "Z_1", "Z_2", "Z_3" and "Z_4" in the west turn, and in the reinforced section "J". The transverse dummy joint was omitted in sections "G", "H" and "J". The joint consists of a premoulded bituminous filler approximately 1/8 inch in thickness cut in widths equal to one-quarter of the slab thickness. The ribbon, which was furnished in rolls, was placed in the fresh concrete with the aid of a special jointing machine which rides on the forms behind the finisher. Photograph (a), Plate 8, is a close-up view of the machine, showing the manner in which the ribbon was placed to form the longitudinal dummy joint. The transverse joint was formed by forcing a steel grooving bar into the fresh concrete and threading the ribbon into the groove by hand. In the turn sections, the ribbon was placed by hand as shown in Photograph (c), Plate 8.

(b) Dummy Ribbon Joint With Tie Bars: This joint is identical to the plain ribbon joint except for the inclusion of 5/8-inch round deformed tie bars 2'-6" long spaced 30 inches on center. The tie bars were securely held at the proper depth and spacing by means of heavy wire dowel assemblies as shown in Photograph (b), Plate 8. The bituminous ribbon was placed by hand as shown in Photograph (c), Plate 8.

The dummy ribbon joint with tie bars was used adjacent to the thickened edge longitudinal expansion joints in sections "V_1", "V_2", "V_3" and "V_4" in the east turn and in sections "Z_1", "Z_2", "Z_3", and "Z_4" in the west turn.

(4) Experimental Joints: The two experimental joints referred to as the "Offset Dowel Joint" and the "Cushion Key Joint" were constructed as shown in the detail drawing, Figure 4.

(a) Offset Dowel Joint: This joint was installed in the traffic lane at each end of section "J". The joint was assembled in 10-ft. lengths. The offset dowel is shown in Photograph (a), Plate 9. The 1/2-inch filler board fits over one end of the dowel and is recessed to receive the plate member "A" (see Details, Figure 4). The 3/8-inch filler board, cut to receive the other end of the dowel, fits against the plate member "A", and when the two boards are nailed or bolted together, the dowels are held securely in place at the specified spacing. The assembled joints were fitted between the forms and were made secure by driving steel pins along each side of the filler board. Photograph (b), Plate 9, shows the joint in place between forms. The redwood strip fastened to the top edge of the filler board was removed after placing the concrete, and the space filled with bituminous joint seal.

(b) Cushion Key Joint: This joint was installed in the outside lane of the east turn between sections "X_1-X_2" and sections "W_1-W_2". The joint is a prefabricated key type joint constructed as shown in the sectional drawing, Figure 4. The vertical members of the joint are 1/4-inch redwood and the horizontal members of the key are 1/4-inch synthetic board. A removable spacer strip fastened to the top of the joint provides a 3/4-inch recess for the bituminous seal. The joint was securely fastened to short lengths of reinforcing rods driven in the base course along one side of the joint. The photographs in Plate 10 show a detail view of the joint and two views of the joint in place prior to placing concrete.

g. Concrete:

(1) General: Transit-mix concrete having a cement factor of 5.5 sacks of normal portland cement per cubic yard was used for all traffic and static test sections. The aggregates were batched at the American Aggregate Corporation's sand and gravel plant in South Columbus, Ohio and were hauled in batch trucks to a charging plant located at Lockbourne, Ohio where the cement and water was added. The mixer trucks delivered the concrete from the charging plant to the test track, a distance of approximately 1.5 miles, in approximately 15 minutes. The size of the batch carried by the mixer trucks was approximately 2.5 cubic yards. The consistency of the concrete was controlled on the job by the inspectors who instructed the addition of water when required or rejected the batch if too wet. Reference is made to Appendix "C" of this report for complete information on the mix proportions, physical properties of the aggregates, cement and concrete.

(2) Placing: The first concrete was placed in the inside lane of the west turn on 30 September 1943 and the final concrete was placed in static overlay sections "L" and "M" on 29 October 1943. A complete record of concrete placement in the test track is given in Table 1. Temperature and precipitation data are also included in the Table.

The concrete was placed in the test sections in a continuous operation except in the two turns where the concrete was placed in alternate sections between the transverse doweled construction joints. The concrete in the inside lane was placed directly from the mixer trucks operating from both sides of the lane. In the outside traffic lane and static sections, the concrete was placed directly from the mixer trucks and by means of a crane equipped with a bottom dump concrete bucket. The crane and bucket were employed to avoid driving the heavy mixer trucks on the new concrete in the completed sections.

(3) Finishing: All concrete in the test track, except in the two turns and overlay sections "L" and "M" was finished with a Jaeger-Lakewood finishing machine supplemented by hand methods. Vibrators were used along the forms and joints. The turns and sections "L" and "M" were finished by hand methods which included screeding, floating and transverse belting with a length of cotton matting.

(4) Curing: All concrete in the test track was cured with saturated cotton mats. The pavement was covered as soon as the concrete had its initial set. Water was applied to the mats when required to keep them saturated during the 8-day curing period.

(5) Photographs of Concrete Placement: The placing, finishing and curing of the concrete test slabs is illustrated by the photographs in Plates 11 and 12.

(6) Test Specimens:

(a) Control Beams and Cylinders: Three to four 4 x 4 x 16-inch beams were cast from representative concrete taken from each test slab and about three 6 x 12-inch cylinders were cast each day from representative concrete. The specimens were shipped to the Division Laboratory for curing and testing; all tests were made at 28 days.

(b) Field Beams and Tests: For each test slab, two field beams having a width and depth equal to the slab thickness and a length equal to four times the slab thickness, were cast in wood forms on representative subgrade or base near each test section. The beams received the same curing as the corresponding test slab and will remain in the field until the slabs are tested. A record of the laboratory and field specimens is given in Tables 2, 2a and 2b.

Seven large field beams 1.5 x 10.0 ft. by the slab thickness were cast on the subgrade or base corresponding to the 6, 8 and 10-inch slabs on natural subgrade and the 6, 8 and 10-inch slabs on sand and gravel base course. The large field beams received the same curing as the test slabs and will be tested under a statically applied uniform strip or line load in the same manner and at the same time as the static test slabs. Photograph (a), Plate 13, shows the slump test and the moulds used for casting the field and laboratory beams. An 8-mould form for 10 x 10 x 40-inch field beams is shown in Photograph (b), Plate 13. Photograph (c) on the same Plate shows the wood form for the 8-inch x 18-inch x 10-ft. beam placed on natural subgrade between static slabs "E 3.66" and "F 3.80".

h. Wire Mesh Reinforcing in Sections "G", "H" and "J":

(1) Light Weight, Section "G": The light weight mesh was fabricated from 0.245-inch steel rods welded together on 6-inch centers. The wire fabric was furnished in sheets 9'-8" wide by 10'-6" long. The weight of the mesh as computed from field measurements was found to be approximately 67.9 pounds per 100 sq. ft. Each 20 x 40-ft. test section required 8 sheets placed with the long dimension in the longitudinal direction. Placing the sheets 2 inches from the joints and edge provided three laps of approximately 9 inches and a 4 inch space along the longitudinal center line of the slab. The mesh was placed after sufficient concrete had been placed and uniformly spread on the subgrade to locate the mesh 2 inches below the surface of the pavement. The lapped ends of the mesh were securely tied together. A ribbon joint was placed along the longitudinal center line but was omitted on the transverse axis because of the lapping of the wire fabric along this line.

(2) Medium Weight, Section "H": The medium weight mesh was fabricated from 0.282-inch round steel rods welded together on 6-inch centers and cut in sheets having the same overall dimensions as the lighter mesh. The weight of the mesh computed from field measurements was found to be approximately 89.2 pounds per 100 square feet. The placing of the mesh in the inside traffic slab of section "H" was identical to section "G". The mesh in the outside traffic slab was inadvertently butted longitudinally instead of lapped, causing the fourth sheet to lap the third sheet approximately 28 inches. The transverse ribbon joints were omitted in both traffic slabs of section "H".

(3) Heavy Weight, Section "J": The heavy weight mesh was fabricated from 0.282 inch round steel rods spaced on 2-inch centers and welded to 0.179-inch steel rods spaced on 16-inch centers. The mesh was cut in sheets 5'-8" in width by 10'-6" in length. The weight computed from field measurements is approximately 159.2 pounds per 100 square feet. Each 20 x 40-ft. test slab required 16 sheets which were lapped and tied both longitudinally and transversely. Both longitudinal and transverse ribbon joints were omitted in section "J".

The photographs in Plate 14 show views of wire mesh sheets and the heavy wire mesh in place in slab J1.8R-0.

i. Sand-Asphalt Cushion for Overlay Slabs: The sand-asphalt cushion used in the two overlay sections "L" and "M" consists of fine gravel and coarse to medium sand mixed with approximately 4 percent emulsified asphalt. A mechanical analysis of a sample of the aggregate shows 52 percent fine gravel and 48 percent coarse to medium sand. (See grainsize curve, Figure 43, in Appendix B). The emulsified asphalt was also used for priming the surface of the concrete before placing the cushion. The cushion and primer were furnished by a supplier in Columbus, Ohio and hauled in trucks to the site. The emulsified asphalt was substituted for the RC-3 asphalt and RT-2 primer which were required by the specifications, since they were not available locally. The primer was broomed uniformly over the cleaned surface of the concrete and was permitted to become tacky before placing the cushion. The sand-asphalt mixture was placed cold and spread uniformly over the surface of the concrete in a 1-inch layer. (See Photograph (a), Plate 15). Dry sand was scattered over the surface of the uncompacted layer and then the material was rolled with a 7-1/2-ton two wheeled smooth roller. (See Photograph (b), Plate 15). The compacted thickness of the layer was approximately 3/4 of an inch. Photograph (c), Plate 15, is a view of a portion of the sand-asphalt cushion showing the texture of the material.

j. Installation of Temperature Recording Equipment: Electrical resistance thermometers called thermohms, were installed in 6, 8 and 10-inch pavements on natural subgrade and in 6, 8 and 10-inch slabs on sand and gravel base course. Three thermohms were placed in the static section of each of the six designs. One thermohm was placed 5/8 inches below the top surface, one in the mid-plane, and one 5/8 inches from the bottom surface. The location and position of the 18 thermohms are given in the following table:

Table A

Location of Thermohms

Thermohm No.	Test Slab	Coordinates		Position in Slab
		x	y	
A 1	A 3.60	6	46	Top
A 2	A 3.60	6	46	Middle
A 3	A 3.60	6	46	Bottom
F 1	F 3.80	34	46	Top
F 2	F 3.80	34	46	Middle
F 3	F 3.80	34	46	Bottom
K 1	K 3.100	34	46	Top
K 2	K 3.100	34	46	Middle
K 3	K 3.100	34	46	Bottom
D 1	D 3.66	6	46	Top
D 2	D 3.66	6	46	Middle
D 3	D 3.66	6	46	Bottom
P 1	P 3.812	34	46	Top
P 2	P 3.812	34	46	Middle
P 3	P 3.812	34	46	Bottom
0 1	0 3.106	6	46	Top
0 2	0 3.106	6	46	Middle
0 3	0 3.106	6	46	Bottom

The three thermohms for each slab were cast in small concrete blocks which were set to the required pavement elevation and securely held in place during placement of the concrete by steel pins driven along each side of the block. Photograph (c), Plate 9 shows the thermohms cast in blocks for placing in the concrete slabs.

The lead wires from the thermohms were carried under the transition slabs and into the field office to a six-point Micromax Recorder. The Micromax records the resistance change in the thermohms due to the temperature changes in the concrete. The resistance values are converted to temperatures in degrees by means of calibration curves of temperature versus resistance for each thermohm. The Micromax provides a continuous record of the temperature changes for any six thermohms.

k. Weather Conditions During Construction: The prevailing weather during the period of construction was conducive to uniform and good quality work, hence very little delay in execution of the work could be contributed to unfavorable weather conditions. The unusual dryness favored the general excavation and grading operations, and was especially favorable for the excavating and backfilling of the four deep sections "R", "S", "T" and "U".

A graphical record of daily temperatures and precipitation, recorded by the weather station at the base during construction, is presented in Figures 6 and 7.

l. Cold Weather Protection for Test Track: The original plan of operations was to start the service behavior tests on completion of the 28-day concrete curing period or as soon thereafter as the necessary heavy loading equipment could be made available. This would bring the testing into the winter months with sub-freezing temperatures. To prevent the subgrade and base course from freezing during the waiting period, it was decided to cover the test track with straw and tarpaulins. The covering of the track was completed on 1 December 1943. Photographs of the protective covering are shown in Plate 16. Attempts to obtain the heavy loading equipment for conducting the traffic tests during the winter months were unsuccessful so the starting date for the testing program was postponed until early spring. The straw and tarpaulin covering was left on the test track and was not removed until 18 March 1944.

Section III

6. Physical Properties of the Subgrades, Bases and Concrete:

a. Subgrades: There are two types of subgrade involved; first, the natural subgrade resulting from bringing the test track foundation to grade, and second, the subgrades created by excavating 6 feet below the natural subgrade elevation and then backfilling with selected materials. The tests to evaluate the physical properties of these subgrades were of two types; those made in the field of the subgrade in place, and those made of samples of the subgrade materials in the laboratory.

(1) Field Tests: The tests of this type are the Plate Bearing Tests and the Unit Weight and Moisture Content Measurements of the subgrade soils in place. The procedure and results of these tests are given in detail in Appendix "A" of this report. For purposes of comparison, the results of the Field Bearing Tests are summarized with respect to the value of the subgrade modulus "k" taken at a deformation of 0.05"; i.e., "k" is defined as the slope of the chord of the load deformation curve between zero and 0.05-inch deformation. These values of "k" are given with respect to the various test track sections in Table 4, along with correlating laboratory tests, which include correction of the measured "k" for the effect of saturation. To further study the variation of "k" for all sections of the track, the values of "k" have been plotted for individual sections and are averaged by the graphs of Figure 8.

The unit weight and moisture content determinations of the subgrade are summarized in Table 3.

(2) Laboratory Tests: The results of these tests are given in detail in Appendix B. Of particular interest is the summary of classification test results for the natural subgrade given in Table I of Appendix B, wherein it is indicated that the predominate natural subgrade soils are lean and heavy clays (CH and CL) with some few fine sands and silts (ML and SF). Grainsize curves showing the analysis of materials used in the specially constructed subgrades are given by Figures 38, 39 and 40 of Appendix "B".

b. Bases: The results of the field and laboratory tests of the base materials and structures are given in the Appendices "A" and "B".

(1) Field Tests: The results of the field bearing tests are given on Figures 30 to 37 inclusive of Appendix "A". Complete results of all unit weight determinations and "k" values of the bases in place are given by Tables 23 to 33 inclusive of Appendix "A". The dry unit weights for the compacted sand and gravel bases vary from 128.0 to about 133.0 lbs. per cu.ft.

(2) Laboratory Tests: These tests are grainsize analyses of the different materials used; the results are given in Appendix "B".

c. Concrete: The results of physical tests of the concrete are given in detail by Appendix "C", with the results of tests of the ingredients, as cement and aggregate. The physical properties of the concrete presented herein are limited entirely to tests made during construction.

Section IV

7. Discussion:

a. Design and Construction: These phases are adequately discussed in Sections II and III of this report and will be given no further comment at this time.

b. Physical Properties: The pertinent physical properties which are most important in connection with actual tests of the track are the subgrade bearing values, or subgrade moduli, and the flexural strength of the concrete. As indicated previously in this report, the attempt was made to keep the subgrade moduli as uniform as possible by the selection of the site, except in the case of the specially constructed subgrades, and to keep the flexural strength of the concrete uniform by control of the water cement ratio. However, at the present time some variation is indicated in both moduli of the natural subgrade and the flexural strength of the concrete.

(1) Subgrade Moduli: The variation of this value is clearly indicated by the average plotted for all the test sections in Figure 8. There are not a sufficient number of tests to show this variation by slabs, but there are a sufficient number of these preliminary tests to indicate very definitely that in a few cases there is a large variation between the subgrade moduli for given sections, for example Sections "A" and "B" (see Figure 8). These variations will be fixed in more detail by the measurement of slab deflections under both static and dynamic loads and where possible by further plate bearing tests of the subgrades after the slab has been tested and removed.

(2) Flexural Strength of the Concrete: This variation is fully discussed in Appendix "C". As previously indicated, the results of flexural strength tests are limited to tests of laboratory cured specimens made during construction. No test results of the field beams, or beams sawed from the slabs, are included; these results will be presented with the report of the traffic and static loading tests of the test track sections.

c. Testing: While some few departures have been made from the original design as indicated in Section III, they are of minor importance and should in no way complicate results so long as they are known. Again, the physical properties of the natural subgrade and the concrete deviate in some cases from the uniformity desired. In this case, too, it is by far the most important that the degree and extent of these inconsistencies be known whereupon their only effect can be to modify or extend the conclusions drawn from the test results.

Corps of Engineers | U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

TABLES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

Table 1

Record of Concrete Placement

Slab	Date Placed	Temperature in Degrees F. Max.	Min.	Avg.	Precip. in Inches
A1.60	9-30-43	84	49	66	0.00
A2.60	10-7-43	79	34	56	0.00
A3.60	10-20-43	67	33	50	0.00
B1.66L	9-30-43	84	49	66	0.00
B2.66L	10-7-43	79	34	56	0.00
B3.66L	10-20-43	67	33	50	0.00
C1.66S	9-30-43	84	49	66	0.00
C2.66S	10-7-43	79	34	56	0.00
C3.66S	10-19-43	59	30	44	0.00
D1.66	9-30-43	84	49	66	0.00
D2.66	10-7-43	79	34	56	0.00
D3.66	10-19-43	59	30	44	0.00
E1.66M	9-30-43	84	49	66	0.00
E2.66M	10-7-43	79	34	56	0.00
E3.66M	10-19-43	59	30	44	0.00
F1.80	9-30-43	84	49	66	0.00
F2.80	10-7-43	79	34	56	0.00
F3.80	10-19-43	59	30	44	0.00
G1.8R-0	10-15-43	61	42	52	0.20
G2.8R-0	10-19-43	59	30	44	0.00
G3.8R-0	10-22-43	62	42	52	0.00
H1.8R-0	10-15-43	61	42	52	0.20
H2.8R-0	10-19-43	59	30	44	0.00
H3.8R-0	10-22-43	62	42	52	0.00
J1.8R-0	10-15-43	61	42	52	0.20
J2.8R-0	10-19-43	59	30	44	0.00
J3.8R-0	10-22-43	62	42	52	0.00

Table 1 (Cont'd)

Record of Concrete Placement

Slab	Date Placed	Temperature in Degrees F. Max.	Min.	Avg.	Precip. in. Inches
K1.100	10-15-43	61	42	52	0.20
K2.100	10-19-43	59	30	44	0.00
K3.100	10-22-43	62	42	52	0.00
L1.5-60	10-1-43	82	40	52	0.00
	10-21-43	81	40	60	0.01
L2.5-60	10-12-43	84	46	65	0.00
	10-20-43	67	33	50	0.00
L3.5-60	10-21-43	81	40	60	0.01
	10-29-43	68	35	52	0.00
M1.7-60	10-1-43	82	40	61	0.00
	10-21-43	81	40	60	0.01
M2.7-60	10-12-43	84	46	65	0.00
	10-20-43	67	33	50	0.00
M3.7-60	10-21-43	81	40	60	0.01
	10-29-43	68	35	52	0.00
N1.86	10-1-43	82	40	61	0.00
N2.86	10-12-43	84	46	65	0.00
N3.86	10-21-43	81	40	60	0.01
N4.612	10-23-43	55	43	49	0.00
O1.106	10-1-43	82	40	61	0.00
O2.106	10-12-43	84	46	65	0.00
O3.106	10-21-43	81	40	60	0.01
O4.618	10-23-43	55	43	49	0.00
P1.812	10-1-43	82	40	61	0.00
P2.812	10-12-43	84	46	65	0.00
P3.812	10-21-43	81	40	60	0.01
P4.818	10-23-43	55	43	49	0.00

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

Table 1 (Cont'd)

Record of Concrete Placement

Slab	Date Placed	Temperature in Degrees F.			
		Max.	Min.	Avg.	Precip. in Inches
Q1.1012	10-1-43	82	40	61	0.00
Q2.1012	10-12-43	84	46	65	0.00
Q3.1012	10-21-43	81	40	60	0.01
Q4.1018	10-23-43	55	43	49	0.00
R1.612	10-1-43	82	40	61	0.00
R2.612	10-8-43	79	43	61	0.00
R3.612	10-20-43	67	33	50	0.00
S1.66	10-1-43	82	40	61	0.00
S2.66	10-8-43	79	43	61	0.00
S3.66	10-20-43	67	33	50	0.00
T1.60	10-1-43	82	40	61	0.00
T2.60	10-8-43	79	43	61	0.00
T3.60	10-20-43	67	33	50	0.00
U1.60	10-1-43	82	40	61	0.00
U2.60	10-8-43	79	43	61	0.00
U3.60	10-20-43	67	33	50	0.00
		East Turn			
$X_1$1.106	10-2-43	75	49	62	0.00
$X_1$2.106	10-15-43	61	42	52	0.20
$X_2$1.106	10-8-43	79	43	61	0.00
$X_2$2.106	10-15-43	61	42	52	0.20
$W_1$1.106	10-8-43	79	43	61	0.00
$W_1$2.106	10-15-43	61	42	52	0.20
$W_2$1.106	10-2-43	75	49	62	0.00
$W_2$2.106	10-15-43	61	42	52	0.20

Table 1 (Cont'd)

Record of Concrete Placement

Slab	Date Placed	Temperature in Degrees F. Max.	Min.	Avg.	Precip. in Inches
$V_1$1.106	10-2-43	75	49	62	0.00
$V_1$2.106	10-15-43	61	42	52	0.20
$V_2$1.106	10-8-43	79	43	61	0.00
$V_2$2.106	10-19-43	59	30	44	0.00
$V_3$1.106	10-8-43	79	43	61	0.00
$V_3$2.106	10-19-43	59	30	44	0.00
$V_4$1.106	10-2-43	75	49	62	0.00
$V_4$2.106	10-15-43	61	42	52	0.20
		West Turn			
$Z_1$1.106	9-30-43	84	49	66	0.00
$Z_1$2.106	10-7-43	79	34	56	0.00
$Z_2$1.106	10-1-43	82	40	61	0.00
$Z_2$2.106	10-8-43	79	43	61	0.00
$Z_3$1.106	10-1-43	82	40	61	0.00
$Z_3$2.106	10-8-43	79	43	61	0.00
$Z_4$1.106	9-30-43	84	49	66	0.00
$Z_4$2.106	10-7-43	79	34	56	0.00
$W_3$1.106	9-30-43	84	49	66	0.00
$W_3$2.106	10-7-43	79	34	56	0.00
$W_4$1.106	10-1-43	82	40	61	0.00
$W_4$2.106	10-8-43	79	43	61	0.00
$Y_1$1.106	10-1-43	82	40	61	0.00
$Y_1$2.106	10-8-43	79	43	61	0.00
$Y_2$1.106	9-30-43	84	49	66	0.00
$Y_2$2.106	10-7-43	79	34	56	0.00

Table 2

Record of Concrete Test Specimens, South Tangent

Slab	Number of Specimens Taken			Date Taken	Slump in Inches		
	Cyl.	Lab. Beams	Field Beams		Max.	Min.	Avg.
L1.5-60	--	4	2	10-1	3-1/4	3	3-1/8
L2.5-60	--	3	2	10-12	--	--	3-1/2
L3.5-60	--	4	2	10-21	--	--	2-1/2
M1.7-60	--	4	2	10-1	3	2-3/4	2-7/8
M2.7-60	--	3	2	10-12	--	--	1
M3.7-60	--	4	2	10-21	--	--	2
N1.86	--	4	2	10-1	2-3/4	2-1/4	2-1/2
N2.86	--	3	2	10-12	--	--	2-1/2
N3.86	3	4	2	10-21	--	--	3
N4.612	--	4	--	10-23	--	--	2
O1.106	--	3	2	10-1	3	2-1/2	2-3/4
O2.106	--	3	2	10-12	--	--	2
O3.106	--	4	2	10-21	--	--	2
O4.1018	--	4	--	10-23	--	--	2-1/2
P1.812	--	3	2	10-1	2-3/4	2-1/4	2-1/2
P2.812	3	3	2	10-12	--	--	2-1/2
P3.812	--	3	2	10-21	--	--	2-1/2
P4.818	3	4	2	10-23	--	--	2-3/4
Q1.1012	--	3	2	10-1	--	--	3
Q2.1012	--	3	2	10-12	--	--	3-1/2
Q3.1012	--	3	2	10-21	--	--	2-1/2
Q4.1018	--	4	2	10-23	--	--	1-3/4

Table 2 (Cont'd)

Record of Concrete Test Specimens, South Tangent

Slab	Number of Specimens Taken			Date Taken	Slump in Inches		
	Cyl.	Lab. Beams	Field Beams		Max.	Min.	Avg.
R1.612	--	3	2	10-1	--	--	2-1/2
R2.612	--	3	2	10-8	--	--	2-3/4
R3.612	--	4	2	10-20	--	--	2-1/2
S1.66	--	3	2	10-1	3	2-1/2	2-3/4
S2.66	--	3	2	10-8	--	--	2-1/2
S3.66	--	4	2	10-20	--	--	2
T1.60	--	3	2	10-1	--	--	5
T2.60	3	3	2	10-8	--	--	3
T3.60	--	4	2	10-20	--	--	3
U1.60	--	3	2	10-1	2-1/2	2-1/4	2-3/8
U2.60	--	3	2	10-8	--	--	3
U3.60	--	4	2	10-20	--	--	1-3/4
L1.5-60	--	4	2	10-21	--	--	3
L2.5-60	--	4	2	10-20	--	--	3
L3.5-60	3	3	2	10-29	--	--	2-1/2
M1.7-60	--	4	2	10-21	--	--	2-1/2
M2.7-60	3	4	2	10-20	--	--	3
M3.7-60	--	3	2	10-29	--	--	2
Totals	18	139	76	Average Slump			2-5/8

Table 3

Record of Concrete Test Specimens, North Tangent

Slab	Number of Specimens Taken: Cyl.	Number of Specimens Taken: Lab. Beams	Number of Specimens Taken: Field Beams	Date Taken	Slump in Inches: Max.	Slump in Inches: Min.	Slump in Inches: Avg.
A1.60	--	3	2	9-30	3-3/4	2-1/2	3-1/8
A2.60	--	3	2	10-7	2	3	2-1/2
A3.60	--	4	2	10-20	--	--	2
B1.66L	--	3	2	9-30	3-1/2	2-3/4	3-1/8
B2.66L	--	3	2	10-7	3	2-1/2	2-3/4
B3.66L	--	4	2	10-20	--	--	2-3/4
C1.66S	--	3	2	9-30	4-1/4	2	3-1/8
C2.66S	--	3	2	10-7	2-1/2	2-1/2	2-1/2
C3.66S	--	4	2	10-19	--	--	4-1/2
D1.66	--	3	2	9-30	4-1/4	2	3-1/8
D2.66	3	4	2	10-7	3	1-1/2	2-1/4
D3.66	--	4	2	10-19	--	--	2-1/2
E1.66M	3	3	2	9-30	2-1/2	2-1/2	2-1/2
E2.66M	--	4	2	10-7	--	--	3
E3.66M	3	4	2	10-19	2	2	2

Table 3 (Cont'd)

Record of Concrete Test Specimens, North Tangent

Slab	Number of Specimens Taken: Cyl.	Lab. Beams	Field Beams	Date Taken	Slump in Inches: Max.	Min.	Avg.
F1.80	--	3	2	9-30	3	1-3/4	2-3/8
F2.80	--	4	2	10-7	--	--	4
F3.80	--	4	2	10-19	--	--	1-1/4
G1.8R-0	--	4	2	10-15	--	--	2-1/4
G2.8R-0	--	3	2	10-19	--	--	2-1/2
G3.8R-0	--	4	2	10-22	--	--	3-1/2
H1.8R-0	3	4	2	10-15	--	--	4-3/4
H2.8R-0	--	3	2	10-19	--	--	2-1/2
H3.8R-0	--	4	2	10-22	--	--	2
J1.8R-0	--	4	2	10-15	--	--	2-1/2
J2.8R-0	--	3	2	10-19	--	--	1
J3.8R-0	--	4	2	10-22	--	--	3
K1.100	--	3	2	10-15	--	--	3-1/2
K2.100	--	3	2	10-19	--	--	2-1/2
K3.100	--	4	2	10-22	--	--	3
Totals	12	106	60	Average Slump			2-3/4

Table 4

Record of Concrete Test Specimens, East and West Turn

Slab	Number of Specimens Taken: Cyl.	Lab. Beams	Field Beams	Date Taken	Slump in Inches: Max.	Min.	Ave.
			East Turnaround				
$X_1$1.106	--	3	2	10-2	--	--	2-1/2
$X_1$2.106	--	3	2	10-15	--	--	2-3/4
$X_2$1.106	--	3	1	10-8	--	--	3
$X_2$2.106	--	3	1	10-15	--	--	3
$W_1$1.106	Placed with $X_2$1.106			10-8	Same as $X_2$1.106		
$W_1$2.106	--	3	1	10-15	--	--	2-1/4
$W_2$1.106	--	--	--	10-2	--	--	2
$W_2$2.106	--	3	1	10-15	--	--	2
$V_1$1.106	--	3	--	10-2	--	--	2-1/2
$V_1$2.106	--	3	1	10-15	--	--	2
$V_2$1.106	--	4	1	10-8	--	--	2-1/2
$V_2$2.106	--	3	2	10-19	--	--	2-1/2
$V_3$1.106	Placed with $V_2$1.106			10-8	Same as $V_2$1.106		
$V_3$2.106	--	3	1	10-19	--	--	2-1/2
$V_4$1.106	--	3	2	10-2	3-1/4	3	3-1/8
$V_4$2.106	--	3	1	10-15	--	--	2
Totals		40	16	Average Slump			2-1/2

Table 4 (Cont'd)

Record of Concrete Test Specimens, East and West Turn

Slab	Number of Specimens Taken			Date Taken	Slump in Inches		
	Cyl.	Lab. Beams	Field Beams		Max.	Min.	Ave.
			West Turnaround				
$Z_1$1.106	No specimen or slump taken						
$Z_1$2.106	--	3	1	10-7	--	--	3-1/2
$Z_2$1.106	--	--	1	10-1	--	--	2-1/2
$Z_2$2.106	--	2	1	10-8	--	--	4
$Z_3$1.106	--	3	1	10-1	--	--	3
$Z_3$2.106	--	2	1	10-8	--	--	2-1/2
$Z_4$1.106	--	3	2	9-30	--	--	2-3/4
$Z_4$2.106	--	3	1	10-7	--	--	2-1/2
$W_3$1.106	--	--	1	9-30	--	--	3-1/4
$W_3$2.106	--	3	1	10-7	--	--	5-1/2
$W_4$1.106	--	3	1	10-1	--	--	3-3/4
$W_4$2.106	--	3	1	10-8	--	--	3
$Y_1$1.106	--	--	1	10-1	--	--	2-1/2
$Y_1$2.106	--	3	1	10-8	--	--	2-3/4
$Y_2$1.106	--	3	1	9-30	--	--	2-3/4
$Y_2$2.106	--	3	1	10-7	--	--	3
Totals		34	16	Average Slump			3-1/8

Table 5

Average Unit Weight and Moisture Content of Subgrade in Place

Section	No. of Tests	Ave. Moisture Content (Percent)	Ave. Unit Weight In lbs. per cu. ft.	
			Wet	Dry
		Natural Subgrade		
A	12	17.8	126.3	107.2
B	14	19.4	126.5	106.0
C	12	21.2	127.1	104.9
D	12	21.0	125.6	104.4
E	12	22.4	124.8	101.9
F	13	23.5	123.2	99.8
G	12	23.9	123.1	99.4
H	12	22.6	125.3	102.4
J	12	21.0	127.1	104.9
K	13	20.6	127.2	105.8
L	12	18.4	129.9	109.8
M	12	18.9	128.9	108.4

Table 5 (Cont'd)

Average Unit Weight and Moisture Content of Subgrade in Place

Section	No. of Tests	Ave. Moisture Content (Percent)	Ave. Unit Weight In lbs. per cu. ft.	
			Wet	Dry
N	14	19.2	128.1	107.6
O	14	19.4	126.9	106.5
P	14	20.8	125.4	103.8
Q	14	19.7	128.1	107.2
East Turn	27	18.1	129.6	109.9
West Turn	17	17.6	127.7	108.7
Subgrades Constructed of Selected Materials				
R	11	9.2	137.0	125.5
S	9	8.8	135.3	124.3
T	19	6.6	141.2	132.4
U	18	4.4	122.6	117.4

Table 6

Summary of Measured and Corrected "k" Values
With Water Contents and Unit Weights for Natural Subgrade

Test Slab	Bearing Test No	Coordinates		Subgrade Modulus "k" In lbs. per cu. in.			Water Content In %		Unit Weight From Consol. Tests In lbs. per cu.ft.	
		x	y	Measured	Corrected Quick Dry	Corrected Slow Dry	Under Bearing Plate	From Consol. Test	Wet	Dry
A1.60	25	20	10	210	156	No Test	19.1	13.0	134.2	118.8
A2.60	7	10	30	108	No Sample		22.0	----	----	----
A3.60	61	20	50	174	145	174	20.0	22.9	125.1	101.8
B1.66 L	6	30	10	116	76	No Test	15.2	13.0	134.2	118.8
B2.66 L	31	20	30	166	110	124	17.8	16.8	132.1	113.8
B3.66 L	55	20	50	136	115	136	20.6	22.9	125.1	101.8
C1.63 S	No Test	--	--	---	---	---	---	---	---	---
C2.66 S	8	30	30	90	60	70	23.0	16.8	132.1	113.8
C3.66 S	56	20	50	86	85	86	20.3	21.1	126.7	104.6
D1.66	No Test	--	--	---	---	---	---	---	---	---
D2.66	9	30	25	72	42	67	19.3	23.0	120.7	98.0
D3.66	58	20	50	80	80	80	17.7	21.1	126.7	104.6

Table 6 (Cont'd)

Summary of Measured and Corrected "k" Values
With Water Contents and Unit Weights for Natural Subgrade

Test Slab	Bearing Test No.	Coordinates		Subgrade Modulus "k" In lbs. per cu. in.			Water Content In %		Unit Weight From Consol. Tests In lbs. per cu. ft.	
					Corrected					
		x	y	Measured	Quick Dry	Slow Dry	Under Bearing Plate	From Consol. Test	Wet	Dry
E1.66 M	5	30	10	82	49	No Test	25.5	20.9	124.8	103.2
E2.66 M	30	20	30	118	80	98	21.0	26.4	120.2	95.1
E3.66 M	59	20	50	138	84	141	19.2	22.7	123.1	100.3
F1.80	24	20	10	70	43	No Test	23.7	27.4	120.3	94.4
F2.80	29	20	30	90	63	75	24.1	26.4	120.2	95.1
F3.80	60	20	50	76	51	78	20.7	22.7	123.1	100.3
G1.8R-0	4	30	20	78	48	No Test	26.7	27.4	120.3	94.4
G2.8R-0	28	20	30	70	43	" "	25.2	27.4	120.3	94.4
G3.8R-0	73	20	50	80	45	110	16.1	27.6	118.7	93.0
H1.8R-0	3	30	10	44	29	80	30.1	25.2	119.6	95.5
H2.8R-0	27	20	30	96	60	100	21.6	25.9	122.8	97.6
H3.8R-0	74	20	50	68	50	100	16.7	25.9	122.8	97.6

Table 6 (Cont'd)

Summary of Measured and Corrected "k" Values
With Water Contents and Unit Weights for Natural Subgrade

Test Slab	Bearing Test No.	Coordinates		Subgrade Modulus "k" In lbs. per cu. in.			Water Content In %		Unit Weight From Consol. Tests In lbs. per cu. ft.	
					Corrected					
		x	y	Measured	Quick Dry	Slow Dry	Under Bearing Plate	From Consol. Test	Wet	Dry
J1.8R-0	25	20	10	118	60	148	18.7	21.3	119.7	98.6
J2.8R-0	2	10	30	86	49	No Test	24.0	25.9	122.5	97.3
J3.8R-0	75	20	50	96	72	68	15.4	21.6	121.7	100.1
K1.100	1	5	10	114	93	No Test	23.0	17.5	125.0	106.4
K2.100	26	20	30	186	86	" "	14.4	25.9	122.5	97.3
K3.100	No Test	--	--	---	--	---	---	---	---	---
L1.5-60	22	20	10	92	42	100	18.7	20.6	128.4	106.4
L2.5-60	38	20	30	92	48	306	15.5	20.1	127.8	106.4
L3.5-60	No Test	--	--	---	--	---	---	---	---	---
M1.7-60	21	20	10	86	40	95	19.4	20.6	128.4	106.4
M2.7-60	39	20	30	114	89	No Test	20.9	21.7	126.4	103.9
M3.7-60	72	20	50	74	56	118	18.7	21.7	117.1	96.2

Table 6 (Cont'd)

Summary of Measured and Corrected "k" Values
With Water Contents and Unit Weights for Natural Subgrade

Test Slab	Bearing Test	Coordinates		Subgrade Modulus "k" In lbs. per cu. in.			Water Content In %		Unit Weight From Consol. Tests In lbs. per cu. ft.	
		x	y	Measured	Corrected Quick Dry	Corrected Slow Dry	Under Bearing Plate	From Consol. Test	Wet	Dry
N1.86	17	20	10	80	53	219	20.6	23.5	125.6	101.8
N2.86	45	20	30	150	85	208	19.6	21.8	124.8	102.5
N3.86	64	20	50	90	61	No Test	17.1	19.5	126.8	106.1
N4.612	77	20	70	70	40	35	15.2	19.2	125.9	105.6
O1.106	16	20	10	72	48	208	20.9	23.5	125.6	101.8
O2.106	44	20	30	104	60	157	16.7	21.8	124.8	102.5
O3.106	63	20	50	112	75	No Test	20.9	19.5	126.8	106.1
O4.618	No Test	--	--	--	--	---	---	---	---	---
P1.812	15	20	10	76	35	89	20.3	22.8	125.2	102.0
P2.812	43	20	30	124	62	152	18.1	22.9	123.5	100.5
P3.812	62	20	50	76	45	120	18.9	23.1	125.1	101.6
P4.818	76	20	70	60	30	67	17.3	16.2	133.4	114.8
Q1.1012	14	20	10	76	35	90	23.6	22.8	125.2	102.0
Q2.1012	42	20	30	106	55	133	20.8	22.9	123.5	100.5
Q3.1012	57	20	50	80	50	128	15.9	23.1	125.1	101.6
Q4.1018	No Test	--	--	---	--	---	---	---	---	---

Table 6 (Cont'd)

Summary of Measured and Corrected "k" Values
With Water Contents and Unit Weights for Natural Subgrade

Test Slab	Bearing Test	Coordinates		Subgrade Modulus "k" In lbs. per cu. in.			Water Content In %		Unit Weight From Consol. Tests In lbs. per cu. ft.	
		x	y	Measured	Corrected Quick Dry	Corrected Slow Dry	Under Bearing Plate	From Consol. Test	Wet	Dry
$V_2$1.106	20	0	10	70	70	70	17.4	22.4	119.1	97.3
$V_2$2.106	46	0	30	130	98	90	16.7	21.5	120.3	99.0
$W_2$1.106	19	0	10	94	68	52	11.8	17.6	126.2	107.4
$W_2$2.106	47	0	30	148	39	No Test	10.8	14.8	129.1	112.4
$X_2$1.106	18	0	10	80	60	47	15.6	17.6	126.2	107.4
$X_2$2.106	48	0	30	184	49	No Test	13.0	14.8	129.1	112.4
$Y_2$2.106	32	0	30	156	64	No Test	20.1	20.5	122.9	102.0
$W_4$2.106	36	0	30	204	150	150	15.9	21.0	121.6	100.5
$Z_4$2.106	35	0	30	166	90	118	20.3	23.0	115.1	93.1
$Z_2$2.106	37	0	30	260	152	170	21.3	15.3	118.9	102.9

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

FIGURES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

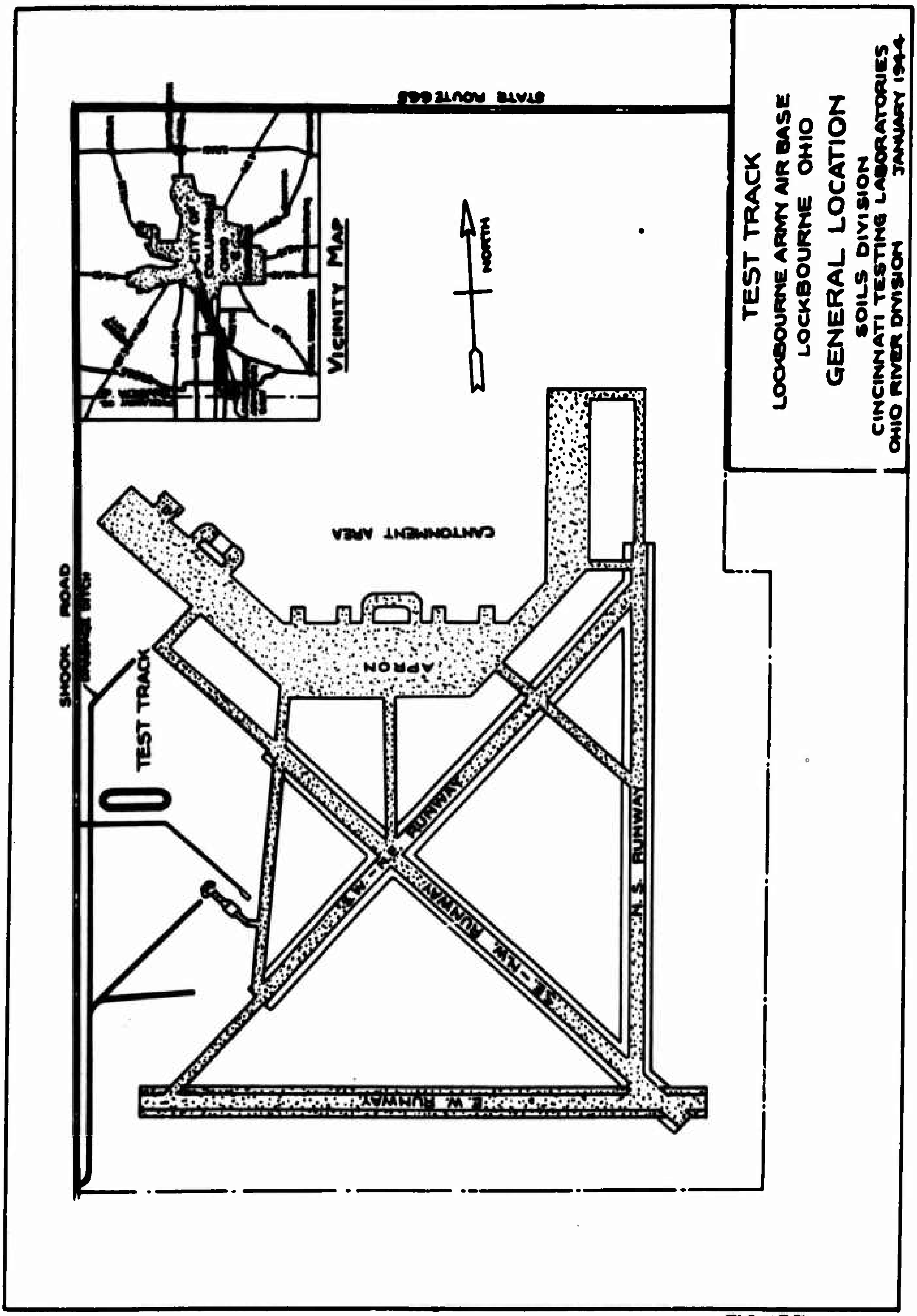
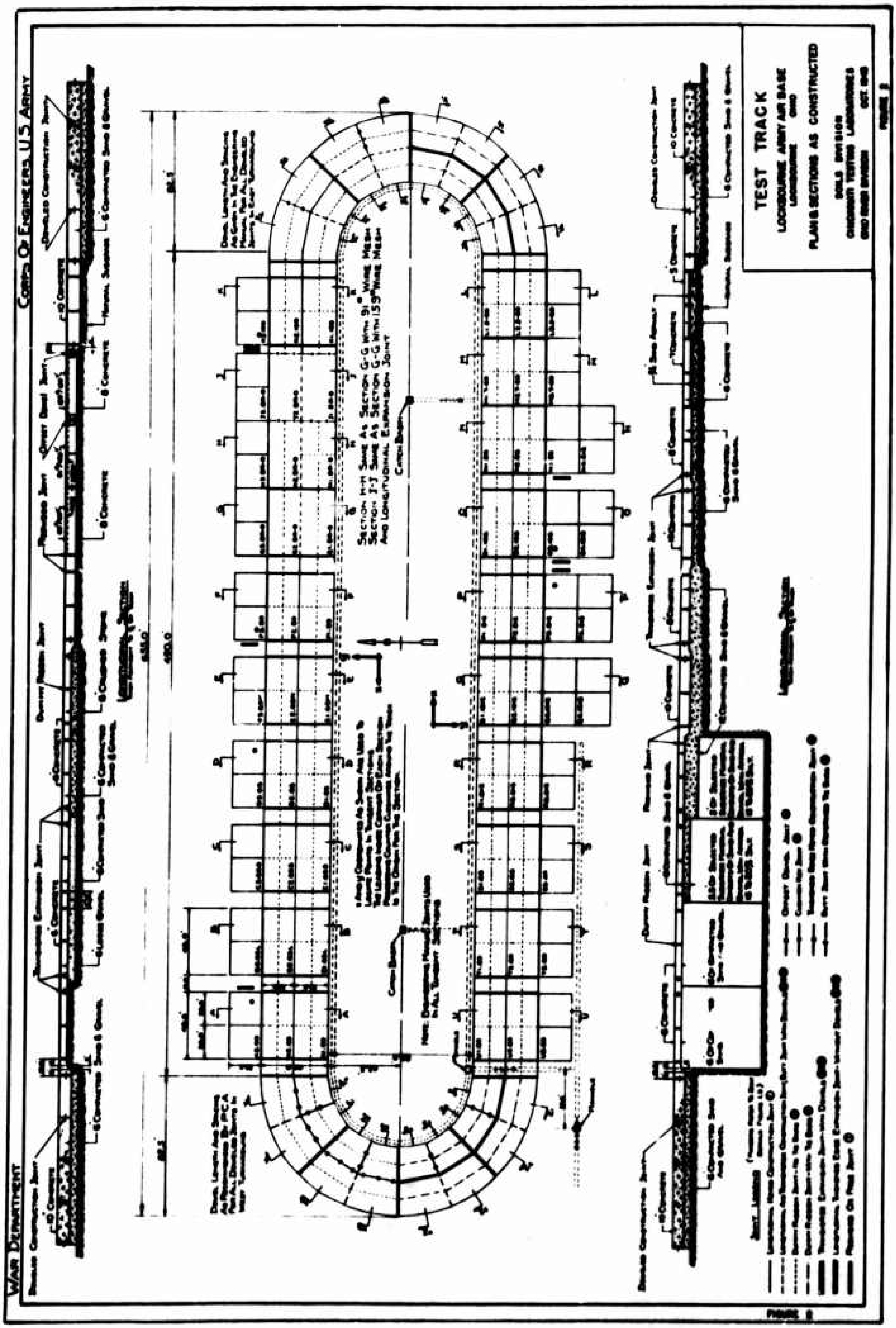

TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
GENERAL LOCATION
SOILS DIVISION
CINCINNATI TESTING LABORATORIES
OHIO RIVER DIVISION
JANUARY 1944
VICINITY MAP
NORTH
CANTONMENT AREA
APRON
SHOOK ROAD
TEST TRACK
E.W. RUNWAY
N.S. RUNWAY
SE-NW RUNWAY
RUNWAY

FIGURE 1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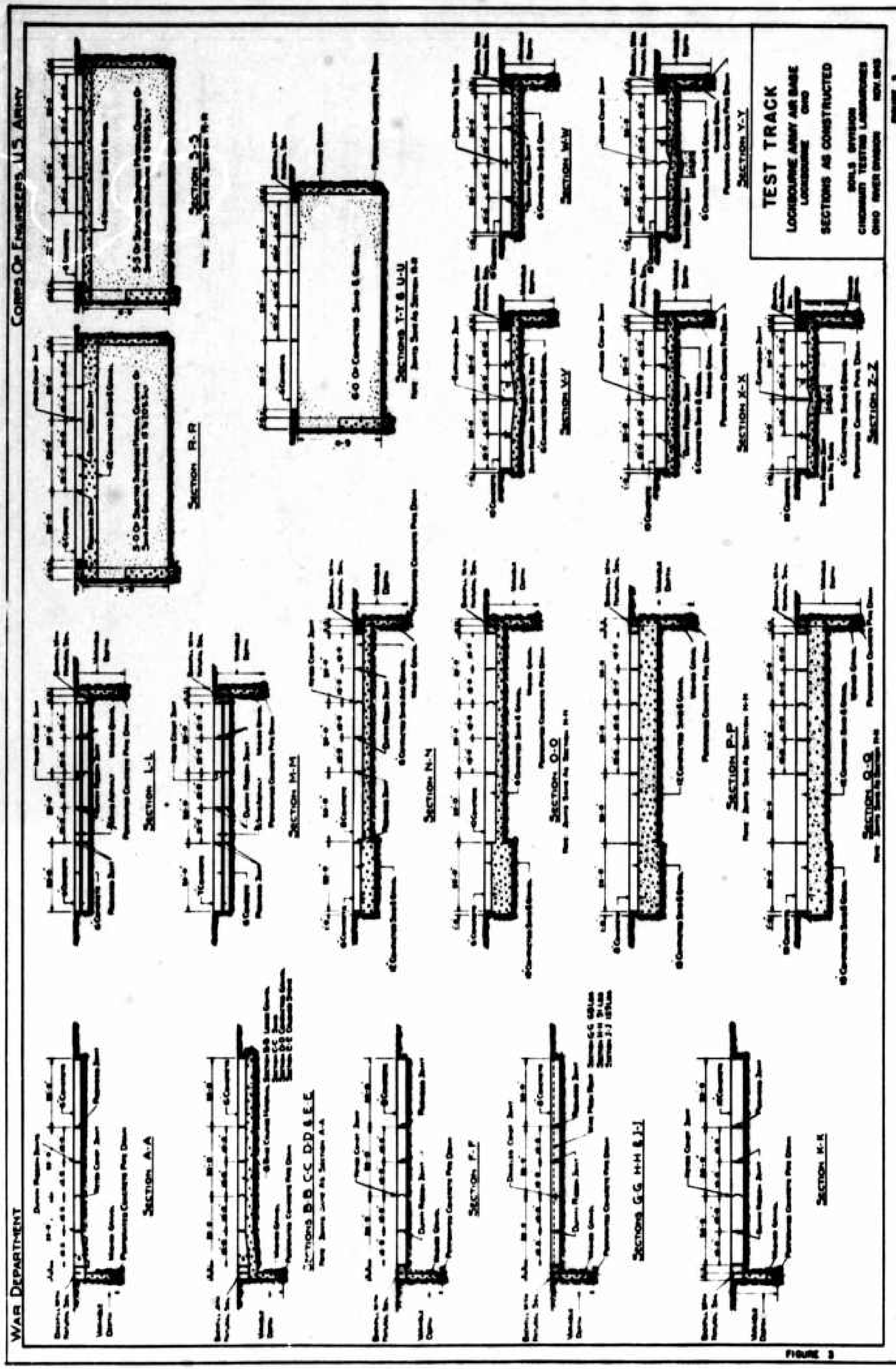
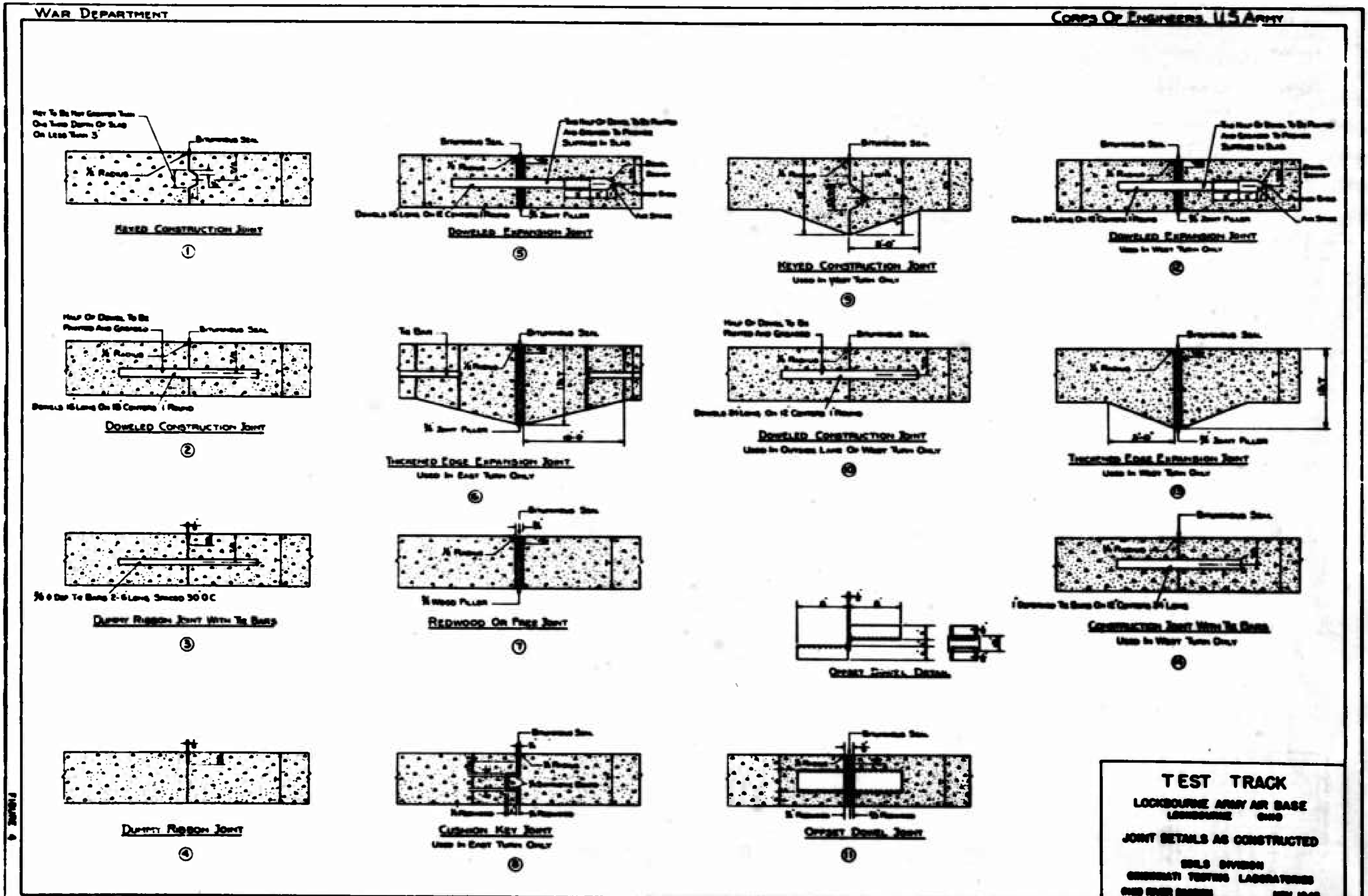
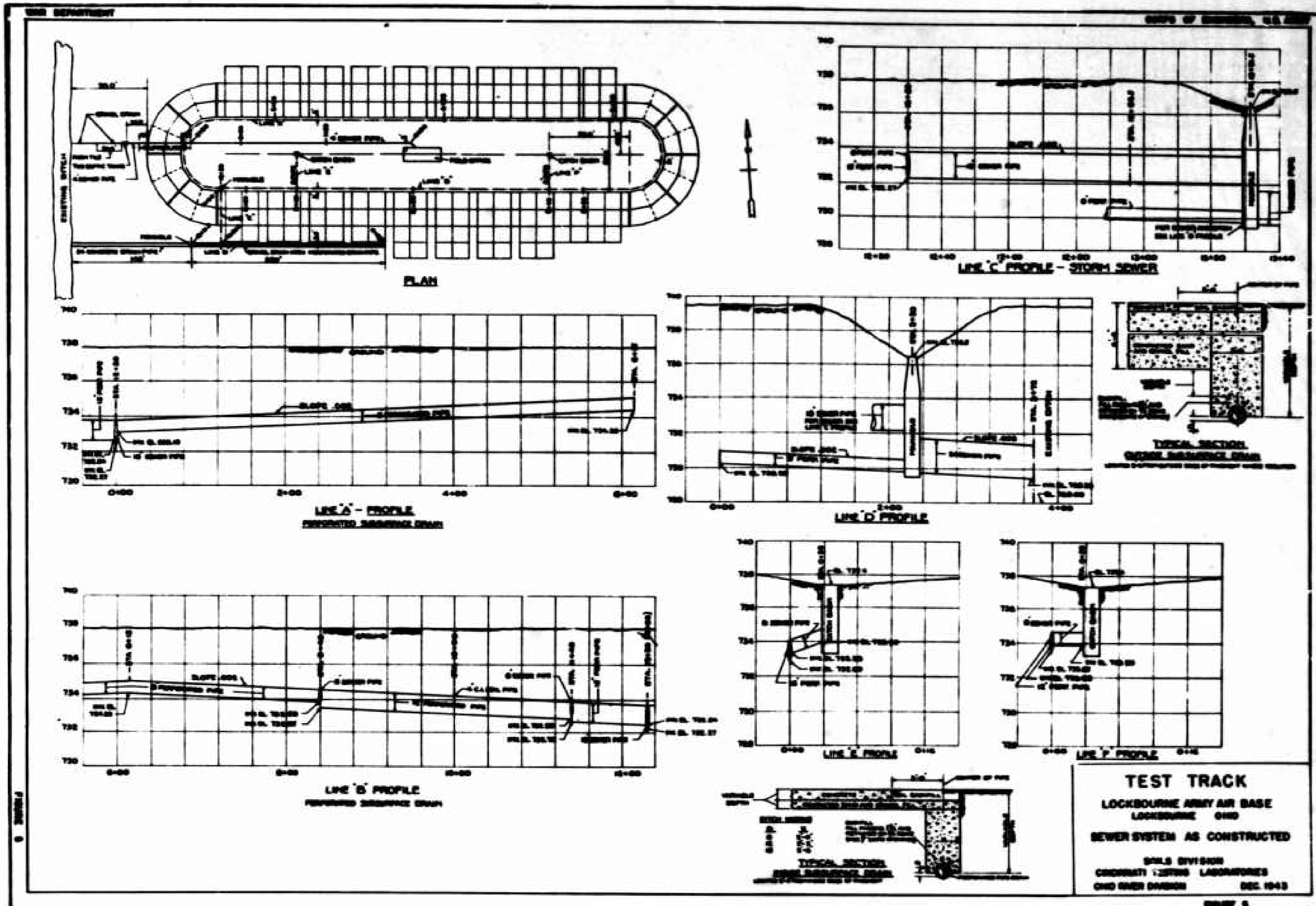
CORPS OF ENGINEERS, U.S. ARMY
TEST TRACK
LOCKBOURNE ARMY AIR BASE
PLANS & SECTIONS AS CONSTRUCTED

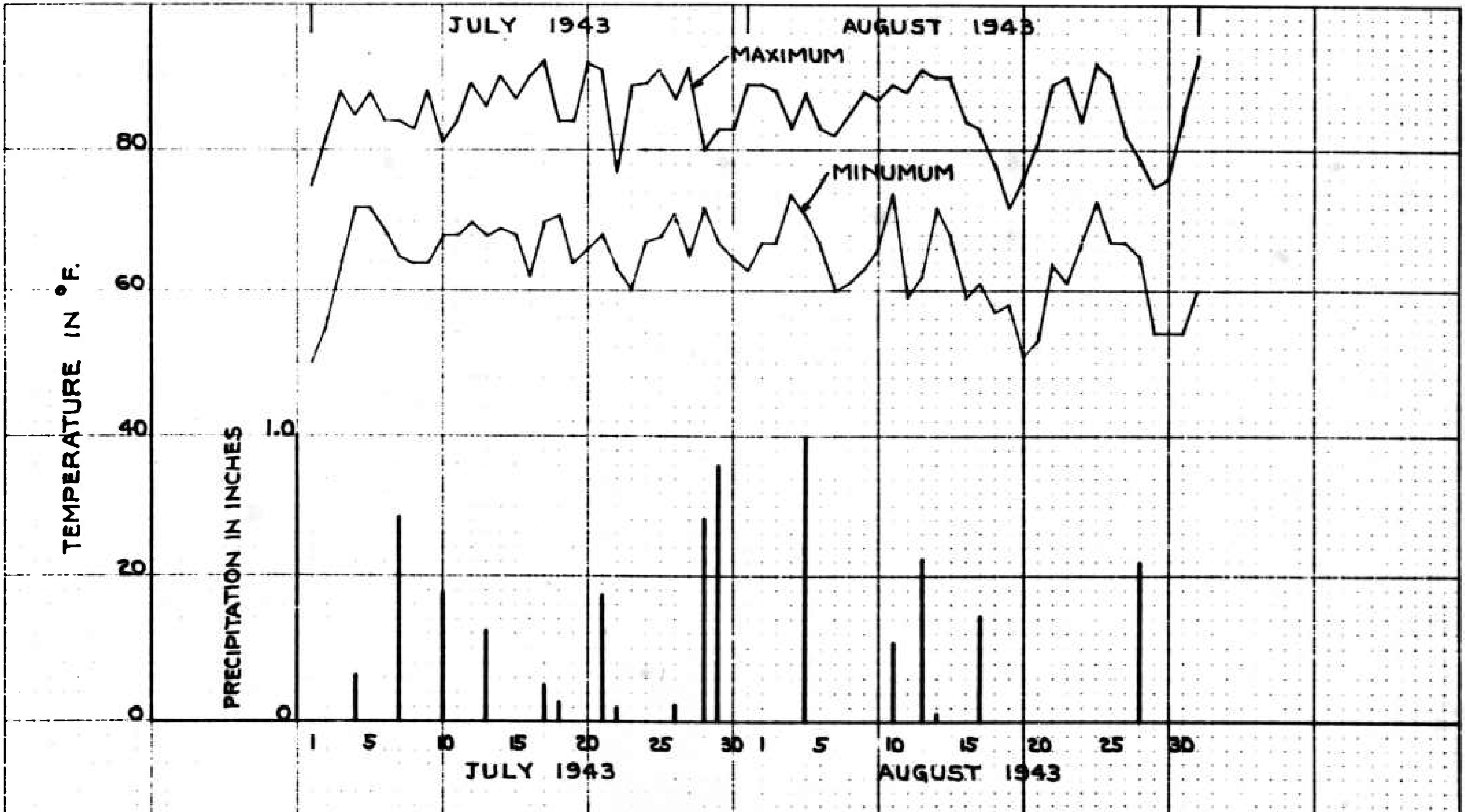

WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
SECTION A-A
SECTIONS B-B, C-C, D-D & E-E
SECTION F-F
SECTIONS G-G, H-H & J-J
SECTION K-K
SECTION L-L
SECTION M-M
SECTION N-N
SECTION O-O
SECTION P-P
SECTION Q-Q
SECTION R-R
SECTION S-S
SECTIONS T-T & U-U
SECTION V-V
SECTION W-W
SECTION X-X
SECTION Y-Y
SECTION Z-Z
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
SECTIONS AS CONSTRUCTED
SOILS DIVISION
CINCINNATI TESTING LABORATORIES
OHIO RIVER DIVISION
FIGURE 3



WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
KEYED CONSTRUCTION JOINT
DOWELED CONSTRUCTION JOINT
DUMMY RIBBON JOINT WITH TIE BARS
DUMMY RIBBON JOINT
DOWELED EXPANSION JOINT
THICKENED EDGE EXPANSION JOINT
USED IN EAST TURN ONLY
REDWOOD OR FIBER JOINT
CUSHION KEY JOINT
USED IN EAST TURN ONLY
KEYED CONSTRUCTION JOINT
USED IN WEST TURN ONLY
DOWELED CONSTRUCTION JOINT
USED IN OUTSIDE LANE OF WEST TURN ONLY
OFFSET DOWEL DETAIL
OFFSET DOWEL JOINT
DOWELED EXPANSION JOINT
USED IN WEST TURN ONLY
THICKENED EDGE EXPANSION JOINT
USED IN WEST TURN ONLY
CONSTRUCTION JOINT WITH TIE BARS
USED IN WEST TURN ONLY
TEST TRACK
LOCKBOURNE ARMY AIR BASE
JOINT DETAILS AS CONSTRUCTED
SOILS DIVISION
CINCINNATI TESTING LABORATORIES

FIGURE 4

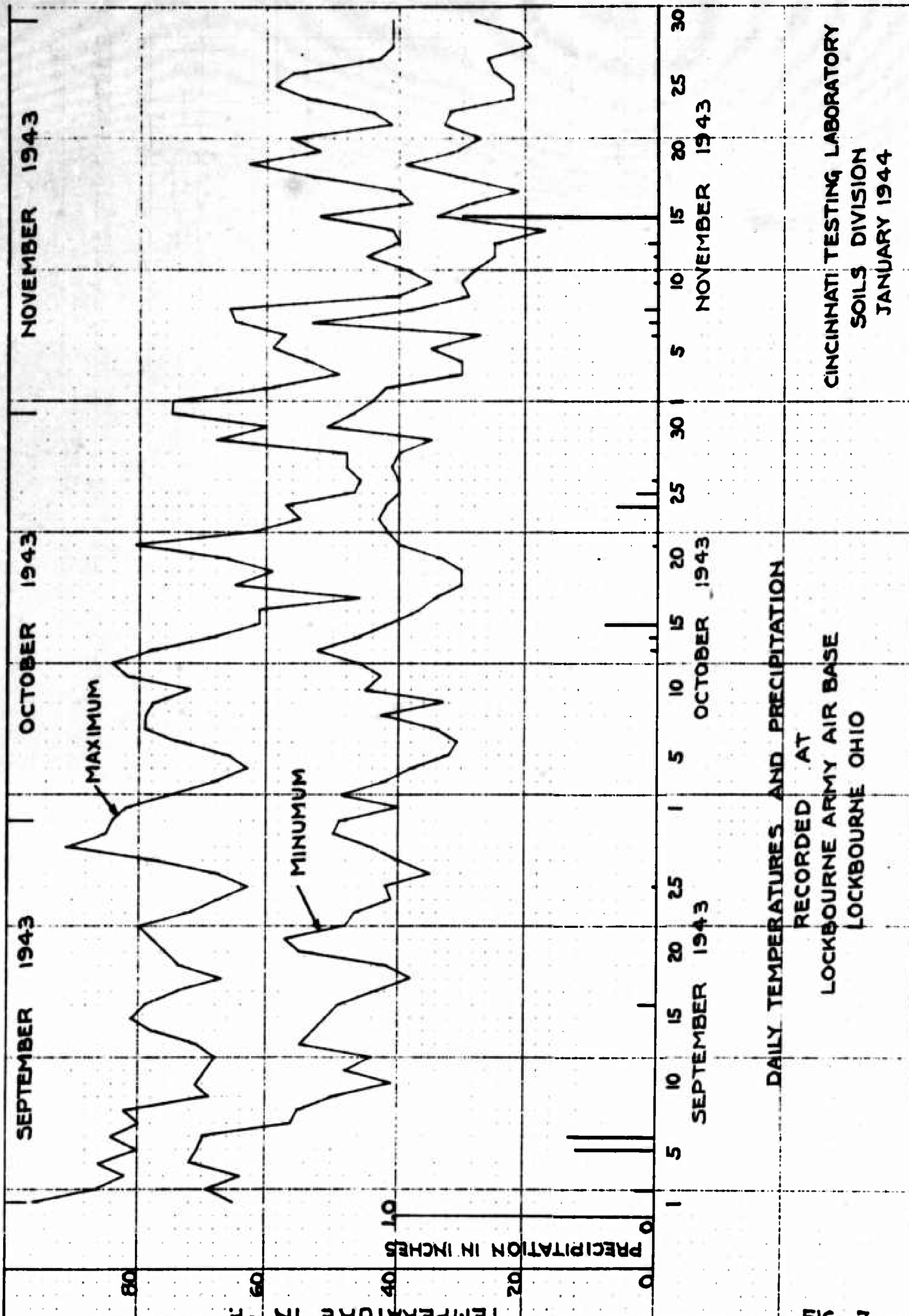

PLAN
LINE 'C' PROFILE - STORM SEWER
LINE 'A' - PROFILE
PERFORATED SUBSURFACE DRAIN
LINE 'D' PROFILE
TYPICAL SECTION
LINE 'B' PROFILE
PERFORATED SUBSURFACE DRAIN
LINE 'E' PROFILE
LINE 'F' PROFILE
TYPICAL SECTION
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
SEWER SYSTEM AS CONSTRUCTED
SOILS DIVISION
CINCINNATI TESTING LABORATORIES
OHIO RIVER DIVISION
DEC. 1943
FIGURE 5



DAILY TEMPERATURES AND PRECIPITATION
RECORDED AT
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY
SOILS DIVISION
JANUARY 1944

FIG. 6



DAILY TEMPERATURES AND PRECIPITATION
RECORDED AT
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO

FIG. 7

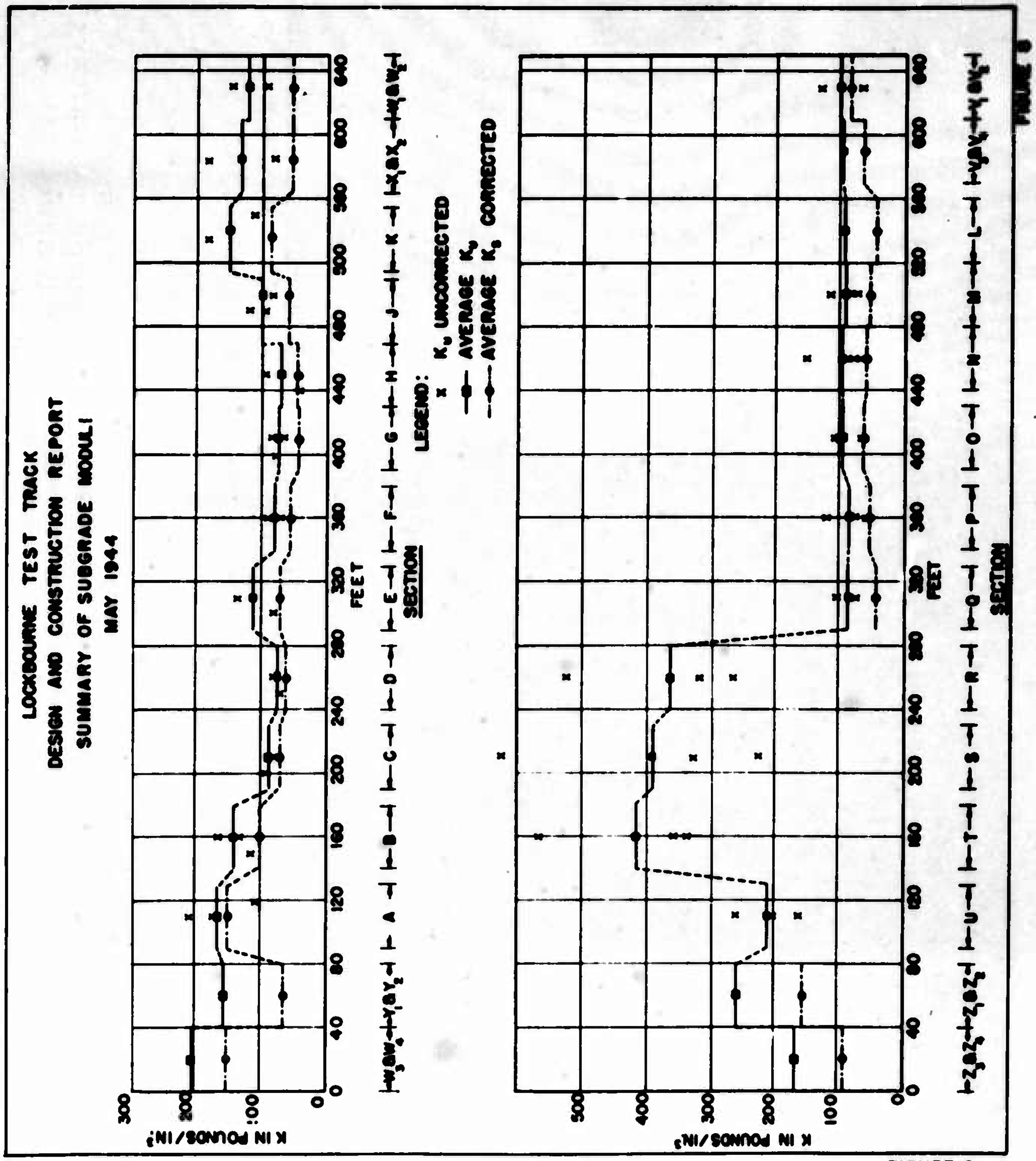

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT
SUMMARY OF SUBGRADE MODULI
MAY 1944
LEGEND:
K IN POUNDS/IN³
FEET
SECTION

FIGURE 8

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

PLATES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS

(a)
STOCK PILES OF SELECTED SUBGRADE AND BASE COURSE MATERIALS. MATERIALS, FROM LEFT TO RIGHT, SELECTED SUBGRADE, FLUME SAND & BANK-RUN SAND & GRAVEL. 9-7-43

(b)
ROLLING AND SPRINKLING EQUIPMENT IN SECTIONS R,S,T, & U. 9-10-43.

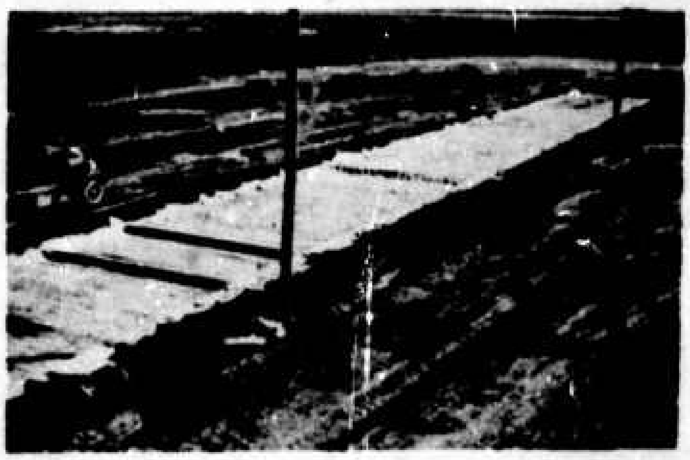
(c)
GENERAL VIEW OF SUBGRADE CONSTRUCTION OF SECTIONS R,S,T & U, LOOKING WEST FROM SECTION Q. 9-7-43

LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS

(a)
SUBGRADER USED FOR FINAL GRADING
9-21-43.

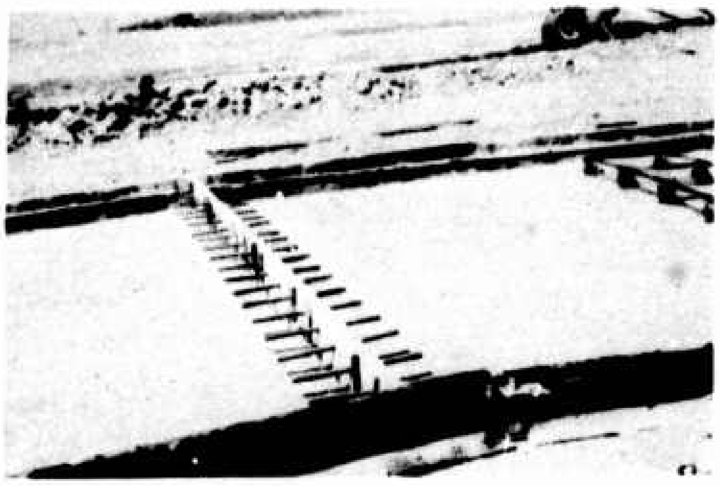
(b)
ROUGH EXCAVATION OF LANE 2, SECTION E, SHOWING SOFT SPOT IN SUBGRADE. 10-1-43.



(c)
VIEW ALONG NORTH SIDE OF TRACK, LOOKING EAST FROM CUPOLA, SHOWING COTTON MATS PROTECTING FINAL GRADE PRIOR TO CONCRETING.
9-29-43.

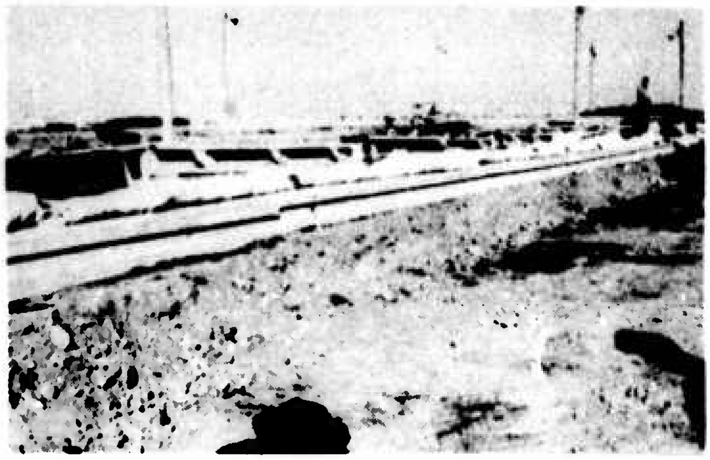
LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS



(a)

KEYED LONGITUDINAL CONSTRUCTION JOINT, WEST TURN, IN SECTIONS, Y_1 AND Y_2. 9-29-43.



(b)

KEYED LONGITUDINAL CONSTRUCTION JOINT BETWEEN LANES 1 AND 2, SOUTH TANGENT, SECTIONS F & Q. 10-5-43.

(c)

KEYED LONGITUDINAL CONSTRUCTION JOINT BETWEEN LANES 1 AND 2, WEST TURN, SECTION Y_1. 10-7-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

(a)
TIMBER BULKHEAD FOR TRANSVERSE DOWELED CONSTRUCTION JOINT LANE 1, BETWEEN SECTIONS V_1 & V_2, EAST TURN. 10-1-43.

(b)
LONGITUDINAL DOWELED CONSTRUCTION JOINT BETWEEN LANES 1&2, SECTION W_2, EAST TURN. 10-7-43.

(c)
TRANSVERSE DOWELED CONSTRUCTION JOINT BETWEEN SECTIONS X_1 AND X_2, LANE 1, EAST TURN. 10-7-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

(a)
TRANSVERSE CONSTRUCTION JOINT WITH TIE BARS, BETWEEN SECTIONS Z_3 AND Z_4, LANE 1, WEST TURN. BULKHEAD IN PLACE. 9-30-43.

(b)
TRANSVERSE CONSTRUCTION JOINT WITH TIE BARS BETWEEN SECTIONS Y_1 AND Y_2, LANE 1, WEST TURN. BULKHEAD REMOVED. 10-1-43.

(c)
LONGITUDINAL CONSTRUCTION JOINT WITH TIE BARS, PRIOR TO STRIPPING FORMS, BETWEEN LANES 1 AND 2, SECTION W_3, WEST TURN. 9-30-43.

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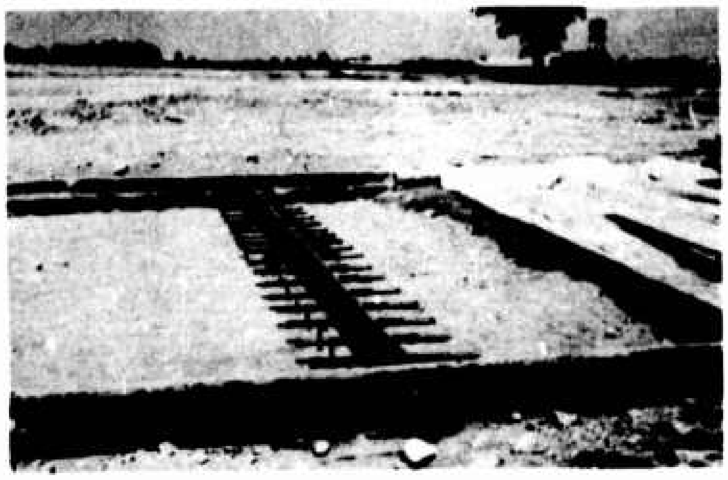
CONSTRUCTION PHOTOGRAPHS



(a)

TRANSVERSE DOWELED EXPANSION JOINT BETWEEN TRANSITION AND SECTION Y_2, LANE 1, WEST TURN 9-29-43.

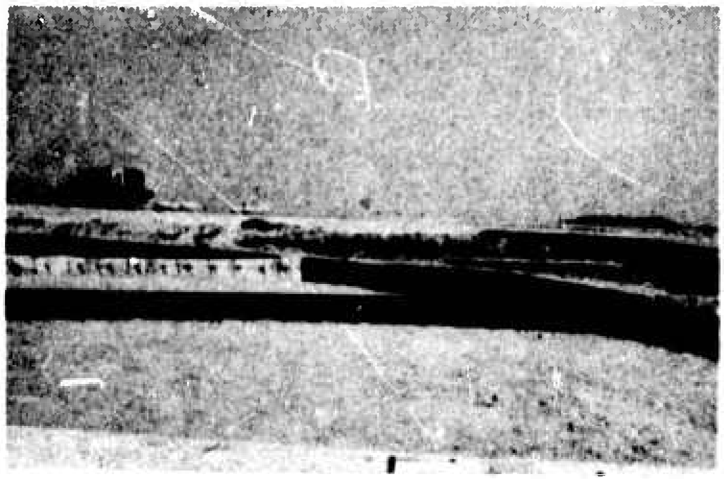
(b)

VIEW SHOWING DETAILS OF TRANSVERSE DOWELED EXPANSION JOINT IN PHOTOGRAPH (a). 9-29-43.

(c)

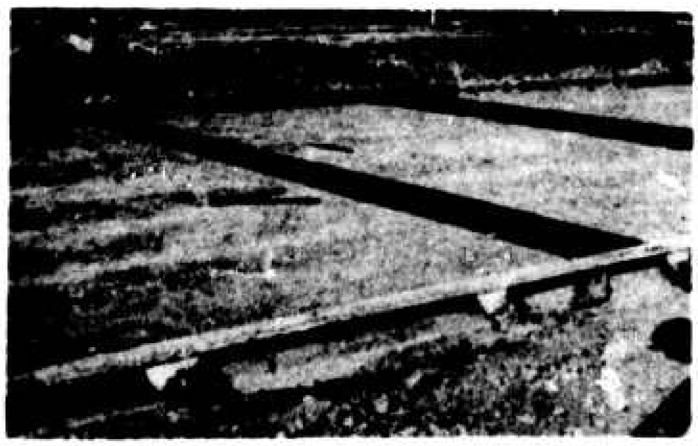
2"X4" TIMBER CAPS USED TO HOLD TRANSVERSE DOWELED EXPANSION JOINTS IN LINE WHILE PLACING CONCRETE. 10-1-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS



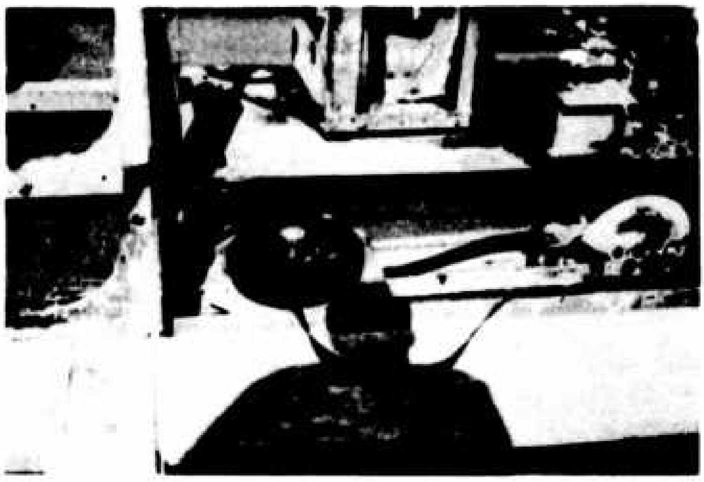
(a)
VIEW OF JOINTS IN LANE 1 OF EAST TURN SHOWING TRANSVERSE AND LONGITUDINAL JOINT FILLER PRIOR TO PLACING CONCRETE. 10-1-43.

(b)
GENERAL VIEW OF JOINTS PRIOR TO PLACING CONCRETE, SECTIONS R, S, T & U, SOUTH TANGENT. 9-28-43.



(c)
TYPICAL VIEW OF REDWOOD JOINTS PRIOR TO PLACING CONCRETE. 9-28-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS



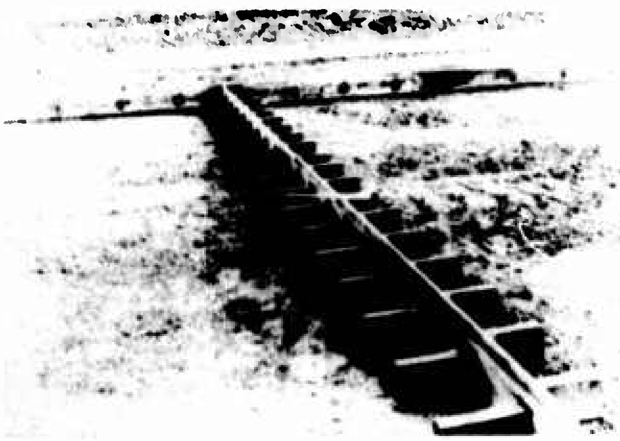
(a)
VIEW SHOWING PLACEMENT OF BITUMINOUS RIBBON TO FORM LONGITUDINAL DUMMY JOINT IN TANGENT SECTION. 10-1-43.

(b)
TIE BARS IN PLACE FOR LONGITUDINAL DUMMY JOINT, LANE 1, WEST TURN. 9-29-43.

(c)
MANUAL PLACING OF BITUMINOUS RIBBON TO FORM LONGITUDINAL DUMMY JOINT IN TURNS. 9-30-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

(a)
OFFSET DOWEL. 9-24-43.



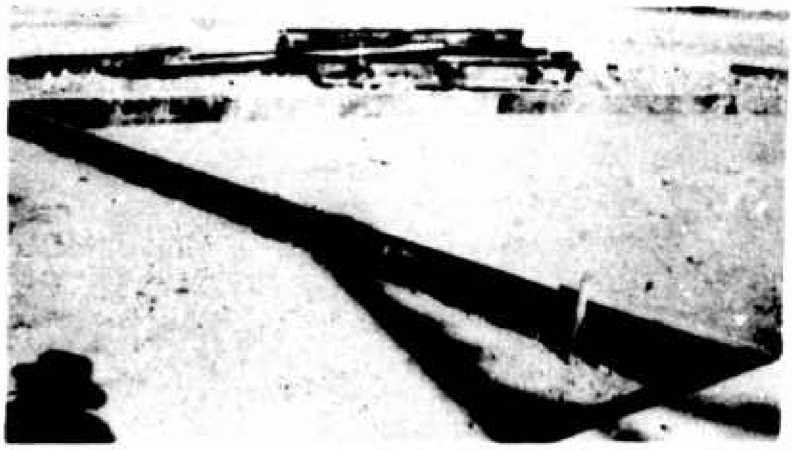
(b)
ASSEMBLED OFFSET DOWEL JOINT IN PLACE PRIOR TO PLACING CONCRETE. 9-24-43.

(c)
PRECAST THERMOHM ASSEMBLIES. 10-21-43.

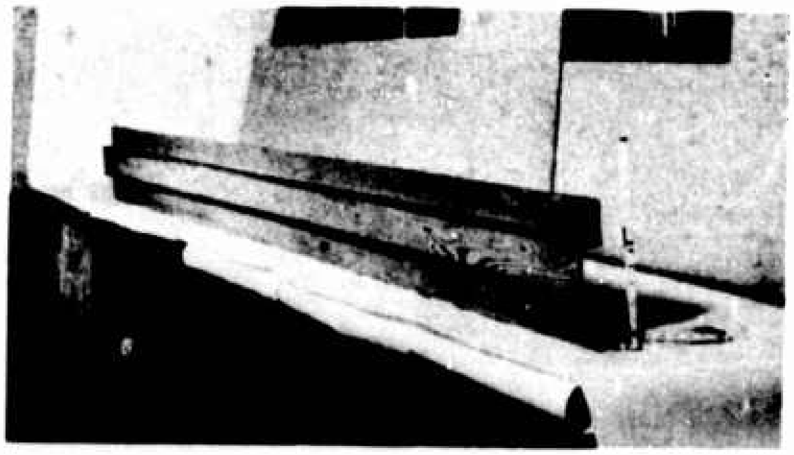
LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS

(a)
KEYED CUSHION JOINT IN PLACE BETWEEN SECTIONS W_1 & W_2, LANE 2 EAST TURN, SHOWING KEY-WAY. 10-14-43.



(b)
KEYED CUSHION JOINT SHOWING KEY. 10-14-43.



(c)
DETAIL OF CUSHION KEY JOINT.

LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS

(a)
MIXER TRUCKS PLACING CONCRETE IN LANE 1 OF WEST TURN AT SECTION U. 9-30-43.

(b)
GENERAL VIEW OF CONCRETING OPERATIONS, STATIC SECTION F, SHOWING CRANE, EQUIPPED WITH BOTTOM DUMP BUCKET, PLACING CONCRETE. 10-19-43.

(c)
VIEW OF COMPLETED SECTIONS G, H, & J, LANE 2, SHOWING FINISHED PAVEMENT BEING COVERED WITH COTTON MATS FOR CURING. 10-19-43.

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CONSTRUCTION PHOTOGRAPHS

(a)
CONCRETE PLACEMENT IN LANE 1, SECTION Q. 10-1-43.

(b)
JAEGER-LAKEWOOD FINISHING MACHINE WITH VIBRATORS. 10-1-43.

(c)
VIEW SHOWING MOIST CONDITION OF CONCRETE SURFACE AFTER 6 DAYS CURING WITH SATURATED COTTON MATS. 10-7-43.

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CONSTRUCTION PHOTOGRAPHS

(a)
(1) SLUMP TEST. (2) BEAM GANG MOULDS FOR FIELD CURING. (3) DOUBLE BEAM MOULD FOR LAB. CURING. 10-1-43.

(b)
TYPICAL GANG FORM AT SECTION Y_1 FOR FIELD CURED CONTROL BEAMS. 9-29-43.

(c)
TYPICAL FORM FOR CASTING AN 8"X 8"X10' BEAM FOR STATIC LOAD TESTING IN SITU. 10-21-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

(C)
68# WIRE MESH REINFORCING 6"X6" MESH IN SECTIONS 8'-8"X10'-6". 10-21-43.

(b)
159# WIRE MESH REINFORCING 16"X2" MESH, IN SECTIONS 8'-8"X10'-6". 10-21-43.

(C)
159# WIRE MESH REINFORCING IN PLACE LANE 1, SECTION J. 10-19-43.

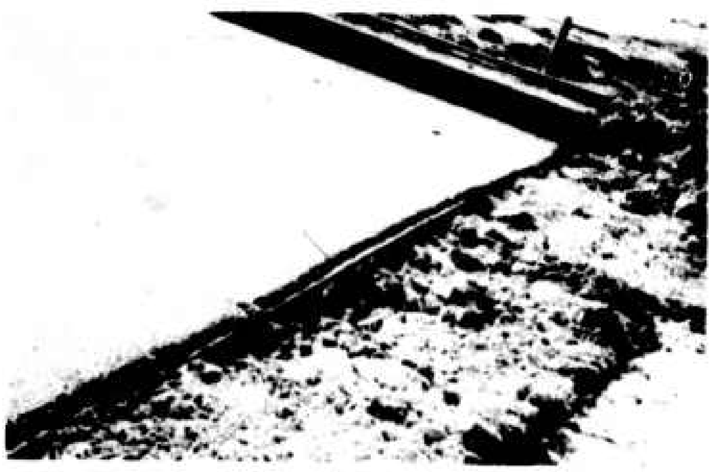
LOCKBOURNE TEST TRACK

CONSTRUCTION PHOTOGRAPHS

(a)
PLACING SAND-ASPHALT CUSHION IN OVERLAY SECTIONS M & L. 10-20-43.

(b)
ROLLING SAND-ASPHALT CUSHION IN SECTIONS M & L. 10-20-43.

(c)
COMPACTED 3/4 INCH SAND-ASPHALT CUSHION IN LANE I, SECTION M, SHOWING TEXTURE OF MATERIAL. 10-20-43.



LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

(a)
TYPICAL VIEW SHOWING THICKNESS OF STRAW COVERING USED ON THE TEST TRACK DURING THE WINTER OF 1943 & 44. 11-24-43.

(b)
GENERAL VIEW OF PLACING STRAW ON TRACK. 11-30-43.

(c)
VIEW SHOWING COMPLETED PROTECTIVE COVERING OF TARPAULINS AND STRAW USED ON THE TRACK DURING THE WINTER OF 1943 & 44. 11-27-43.

LOCKBOURNE TEST TRACK
CONSTRUCTION PHOTOGRAPHS

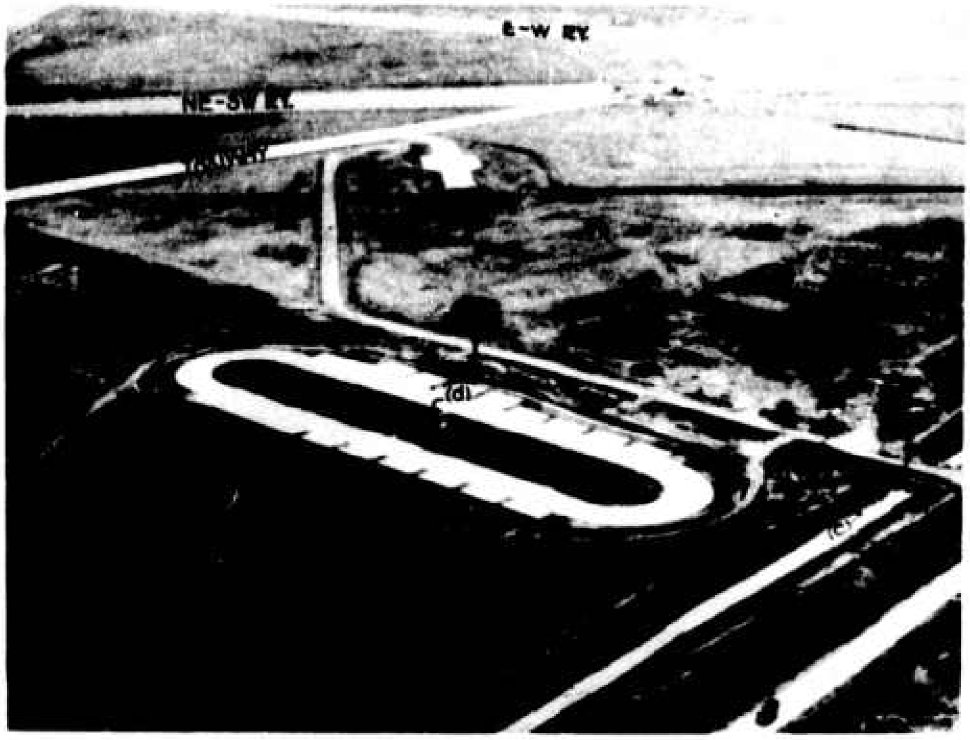
(a)
FIELD BEARING TEST SETUP USING 10 YD. CARRIMOR SCRAPER FOR LOAD REACTION. 10 - 21 - 43.

(b)
DETAILS OF FIELD BEARING TEST SETUP USING CRANE FOR LOAD REACTION. 9 - 25 - 43.

(c)
FIELD BEARING TEST SETUP USING 7½ YD. LE TOURNEAU SCRAPER FOR LOAD REACTION. 10 - 21 - 43.

LOCKBOURNE TEST TRACK

AERIAL PHOTOGRAPHS



DISTANT VIEW SHOWING:

(a) TRACK SHORTLY AFTER COMPLETION.
(b) LOCATION WITH RESPECT TO FLYING FIELD.
(c) CONNECTION TO DRAINAGE DITCH.
(d) FIELD OFFICE.

CLOSER VIEW SHOWING:

(a) CONCRETE CONTROL BEAMS.
(b) TWO DIMENSIONAL CORRELATION BEAMS.
(c) STATIC LOADING EQUIPMENT.
(d) SURFACE DRAINAGE DITCH.

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LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "A"

Field Tests and Exploration
of Subgrade and Base Materials.

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

Corps of Engineers U. S. Army

OHIO RIVER DIVISION LABORATORIES
MARIEMONT OHIO

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX "A"

Field Tests and Exploration of Subgrade and Base Materials

1. Purpose and Scope:

This appendix presents the method and complete results of the preliminary sub-surface explorations and the field tests conducted on the natural subgrade and base course materials during construction of the test sections.

2. Sub-Surface Exploration:

Prior to the construction of the Test Track, 42 auger holes located as shown on Figure 1, were used to explore the character and extent of the natural subgrade to a depth of at least six feet with several holes as deep as ten feet. A log of each hole giving the limits of the subgrade soils and the depth to ground water was recorded, and jar samples of the soils were taken for laboratory analysis.

The drilling of a well near the field office for water supply indicated the nature of the subgrade soils to a depth of 68 feet. The observations showed 10 to 15 feet of brown silty clay underlain by a deep deposit of gray sandy silt extending to a depth of approximately 68 feet. At this depth water bearing sand and gravel was encountered.

3. Field Testing:

a. Location of Tests by Coordinates: The unit weight and field bearing tests are located in the test sections by an "x", "y" coordinate system. In each case the "x-axis" is the inside edge of the test sections and its direction is counter clockwise. The "y-axis" is the leading edge of each test section. The direction of the "x" and "y" axes is shown by the heavy arrows in the test layout drawing, Figure 1.

b. Unit Weight and Moisture Content: Unit weight tests of the natural subgrade were made in each test section prior to placing base course or concrete.

Four tests were made for each test slab, except in a few cases where the number of tests was limited to two to avoid delay in construction. The number of tests in the base course was limited to two for each test slab, except when an additional check test was required.

The test procedure consisted of carefully digging a hole (approximately 0.1 cubic foot in volume) in the subgrade or base course, and then weighing the material removed to the nearest 0.1 of a pound. A sample of the material removed was taken for water content determination. The dry sand method, using calibrated Ottawa sand, was used to determine the volume of the hole. A water content determination was made of a portion of the original soil removed and is reported as a percentage of the dry weight of the soil.

c. Field Bearing Tests: Field bearing tests were made on the natural subgrade, selected subgrade, and base course. The location of the tests are given by the "x", "y" coordinates on the load-deformation curve sheets and are indicated on the test layout drawing, Figure 1.

The test procedure consisted of applying normal loads to a 30-inch diameter bearing plate, set on the subgrade or subbase, and measuring the deformation produced by each load. A thin sand cushion was placed between the steel plate and the material being tested to provide an equitable transmission of the load to the soil and to permit accurate leveling of the bearing plate. A 24 and an 18-inch diameter steel plate were placed on top of the 30-inch diameter bearing plate to provide rigidity and better distribution of the load. A 30-ton capacity hydraulic jack, fitted with a calibrated bourdon type pressure gage, acting against heavy construction equipment was used to apply the load. The vertical deformations were measured by two 1/1000-inch extensometer gages located on the edge of the 30-inch diameter plate diametrically opposite each other and in contact with the plate. Typical bearing test assemblies, using available heavy construction equipment for load reaction, are shown in the photographs of Plate 17. Loads were applied in small increments and deformation readings at each extensometer were taken at time intervals of 1.0, 2.25, 4.0, 6.25, 9.0, 16.0, 25.0, 36.0, etc., minutes for each increment of load. After complete consolidation was obtained under a given load increment, the load was increased and readings taken as before. The final deformation under each load was obtained by averaging the total movements indicated by the two extensometer gages.

4. Test Results:

a. Sub-Surface Exploration: The logs of the 42 auger borings are presented in the sub-surface exploration drawing, Figure 2. Mechanical analysis and water content determination were made on each auger boring jar sample of the subgrade soil.

The depths to free water recorded in the field logs of the auger borings are not included on the sub-surface exploration sheet, Figure 2. This free water is not natural ground water but entrapped surface water which varies with the season and amount of precipitation. The auger borings were made on 30 July 1943 and the precipitation for that month was approximately 4.0 inches. At that time, the depth to free water, measured in the test holes, varied from 2.5 to 8.1 feet. The water was nearest the ground surface in the low portion of the test area which includes test sections "E" through "J". Farm tile drains were removed from the subgrade during the excavation and grading of test sections "G", "H" and "J". The average depths and elevations of the free water for each line of auger borings are given as follows:

Test Holes	Depth in Feet to Water	Elevation of Water
Line "S"	5.4	734.0
Line "C"	3.2	735.8
Line "N"	3.4	735.8

b. Unit Weight and Water Contents: Complete results of the unit weight and water content determinations of the natural subgrade are given in Tables 1 to 18 inclusive. The results of tests in the four deep sections "R", "S", "T" and "U" are given in Tables 19 to 22 inclusive. The results of the tests of the sand and gravel base course are presented in Tables 23 to 31 inclusive and those for the sand and crushed stone bases are given in Tables 32 and 33.

c. Field Bearing Tests: The results of the field bearing tests are presented as load-deformation curves as shown in Figures 3 to 37 inclusive. The measured soil moduli "k" in pounds per square inch, taken from the curves at 0.05 of an inch deformation, are included in the tables.

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "A"

Field Tests and Exploration
of Subgrade and Base Materials.

TABLES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

APPENDIX A

Table 1

Summary of Field Test Results of Natural Subgrade, Section "A"

Test Section Designation	Type of Test	Field Bearing Tests: Test No	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight in lbs./ft.^{3} Wet	Unit Weight in lbs./ft.^{3} Dry
A1.60	Traffic	23	9-28	20	10	19.1	210	19	9-20	34	5	17.0	122.7	104.8
"	"							20	9-20	11	6	16.0	124.1	106.9
"	"							21	9-20	34	15	13.7	124.5	109.7
"	"							22	9-20	10	15	18.3	125.8	106.1
A2.60	Traffic	7	9-17	10	30	22.0	108	109	10-2	35	36.5	17.6	128.7	109.3
"	"							110	10-2	32	27	17.3	128.0	109.0
"	"							111	10-4	13	28	16.7	125.0	107.2
"	"							112	10-4	9	35	18.9	127.0	106.9
A3.60	Static	61	10-13	20	50	20.0	174	213	10-19	4.5	56.5	19.3	125.3	105.0
"	"							214	10-19	9.0	45.5	20.2	126.1	104.9
"	"							215	10-19	31.0	45.0	18.8	130.1	109.8
"	"							216	10-19	28.0	54.0	19.3	128.1	107.3
		Averages					164					17.8	126.3	107.2

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

APPENDIX A

Table 2

Summary of Field Test Results of Natural Subgrade, Section "B"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
B1.66L	Traffic	6	9-16	30	10	15.2	116	13	9-18	25	5	14.1	130.1	114.0
"	"							14	9-18	15	5	25.6	118.8	94.5
"	"							15	9-18	30	15	15.5	125.2	108.6
"	"							16	9-18	10	15	18.4	129.8	109.2
"	"							17	9-20	27	6	17.6	125.1	106.6
"	"							18	9-20	13	7	23.0	122.8	99.7
B2.66L	Traffic	31	9-29	20	30	17.8	166	93	10-1	30	25.5	20.9	126.2	104.7
"	"							94	10-1	13.5	26.5	22.2	124.0	101.3
"	"							95	10-1	12	35	19.8	125.9	105.1
"	"							96	10-1	27.5	35.5	19.5	127.5	106.7
B3.66L	Static	55	10-13	20	50	20.6	136	161	10-13	34	47.5	19.3	129.0	108.0
"	"							162	10-13	30	54	21.2	128.5	105.9
"	"							163	10-13	13	44.5	18.4	127.0	107.1
"	"							164	10-13	7	53	16.6	131.8	112.9
		Averages					139					19.4	126.5	106.0

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX A

Table 3

Summary of Field Test Results of Natural Subgrade, Section "C"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
C1.66S	Traffic	--	--	--	--	--	--	9	9-18	25	15	22.0	126.9	103.9
"	"							10	9-18	15	15	20.0	123.2	102.8
"	"							11	9-18	10	5	20.4	129.3	107.4
"	"							12	9-18	30	5	23.4	121.9	98.7
C2.66S	Traffic	8	9-17	30	30	23.0	90	97	10-1	31.5	36.5	20.1	129.1	107.3
"	"							98	10-1	23.0	31.5	22.1	122.0	100.0
"	"							99	10-2	6.5	36.5	21.6	127.0	104.5
"	"							100	10-2	11.5	26.0	20.3	130.5	108.3
C3.66S	Static	56	10-13	20	50	20.3	86	165	10-13	35	47	21.2	127.3	105.0
"	"							166	10-13	6	46	20.6	130.0	107.8
"	"							167	10-13	32	54	22.4	128.3	104.9
"	"							168	10-13	11	55.5	20.3	129.7	107.7
		Averages					88					21.2	127.1	104.9

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

APPENDIX A

Table 4

Summary of Field Test Results of Natural Subgrade, Section "D"

Test Section Designation	Type of Test	Field Bearing Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in	Unit Weight In lbs./ft.^{3} Wet	Dry
D1.66	Traffic	--	--	--	--	--	--	5	9-18	25	15	20.9	125.9	104.1
"	"							6	9-18	15	15	20.8	125.0	103.6
"	"							7	9-18	15	5	22.0	124.7	102.1
"	"							8	9-18	25	5	21.9	126.0	103.4
D2.66	Traffic	9	9-21	30	25	19.3	72	101	10-2	32.5	26	20.7	123.5	102.4
"	"							102	10-2	27	37	22.4	128.0	104.4
"	"							103	10-2	10	36.5	24.6	126.8	101.7
"	"							104	10-2	7	26.5	21.2	126.0	103.8
D3.66	Static	58	10-13	20	50	17.7	80	169	10-13	33	56	18.9	127.1	107.1
"	"							170	10-13	28	48	19.5	128.0	107.1
"	"							171	10-13	8.5	45.5	19.6	129.0	107.9
"	"							172	10-13	7	55.5	18.9	125.1	105.3
		Averages					76					21.0	125.6	104.4

*Water Content Under Bearing Plate
** "k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 5

Summary of Field Test Results of Natural Subgrade, Section "E"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
E1.66M	Traffic	5	9-15	30	10	25.5	82	1	9-18	10	5	24.4	124.1	99.7
"	"							2	9-18	10	15	24.1	123.9	99.6
"	"							3	9-18	30	5	22.6	122.9	100.2
"	"							4	9-18	30	15	23.7	127.1	102.9
E2.66M	Traffic	30	9-29	20	30	21.0	118	105	10-2	27	36	20.2	126.2	105.0
"	"							106	10-2	29.5	28.5	22.3	127.8	104.1
"	"							107	10-2	8.5	37	24.0	126.0	101.7
"	"							108	10-2	7.5	25.5	24.2	122.0	98.1
E3.66M	Static	59	10-13	20	50	19.2	138	173	10-13	32	55	18.8	125.0	105.2
"	"							174	10-13	28	45	21.9	123.8	101.5
"	"							175	10-13	11	56	20.8	125.9	104.1
"	"							176	10-13	8	44	22.2	123.0	100.5
		Averages					113					22.4	124.8	101.9

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 6

Summary of Field Test Results of Natural Subgrade, Section "F"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
F1.80	Traffic	24	9-28	20	10	23.7	70	23	9-20	15	5	24.5	120.4	96.8
"	"							24	9-20	25	5	24.5	120.7	96.8
"	"							25	9-20	12	15	23.5	121.2	98.2
"	"							26	9-20	30	15	23.8	124.0	100.2
F2.80	Traffic	29	9-29	20	30	24.1	90	129	10-5	30	29	22.4	119.8	97.7
"	"							130	10-5	31	34.5	18.8	126.7	106.7
"	"							139	10-7	35	35.5	22.8	122.9	100.1
"	"							140	10-7	13	24	25.0	122.0	97.7
"	"							141	10-7	10	35	24.5	122.8	98.5
F3.80	Static	60	10-13	20	50	20.7	76	209	10-19	36	44	22.6	125.7	102.4
"	"							210	10-19	34	54	25.0	122.8	98.1
"	"							211	10-19	12	44.5	25.2	125.0	99.7
"	"							212	10-19	10	56	22.6	128.2	104.8
Averages							79					23.5	123.2	99.8

*Water Content Under Bearing Plate

**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 7

Summary of Field Test Results of Natural Subgrade, Section "G"

Test Section Desig-nation	Type of Test	Field Bearing Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
G1.8R-0	Traffic	4	9-15	30	20	26.7	78	49	9-22	14	5	25.5	118.0	94.0
"	"							50	9-22	27	3	26.4	119.6	94.6
"	"							51	9-22	31	16	24.9	120.1	96.2
"	"							52	9-22	15	16	26.0	116.8	92.7
G2.8R-0	Traffic	28	9-29	20	30	25.2	70	193	10-18	39	25	22.0	126.3	103.6
"	"							194	10-18	31.5	34.5	24.8	123.1	98.8
"	"							195	10-18	13	36.5	23.1	125.1	101.6
"	"							196	10-18	10.5	24	21.2	124.2	102.5
G3.8R-0	Static	73	10-21	20	50	16.1	80	221	10-21	28	44	23.7	125.0	101.2
"	"							222	10-21	33	54	21.7	124.9	102.7
"	"							223	10-21	13	43	23.8	129.8	104.9
"	"							224	10-21	10	54	24.1	124.3	100.0
	Averages						76					23.9	123.1	99.4

*Water Content Under Bearing Plate
** "k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 8

Summary of Field Test Results of Natural Subgrade, Section "H"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
H1.8R-0	Traffic	3	9-15	30	10	30.1	44	45	9-22	10	5	22.0	124.8	103.9
"	"							46	9-22	9	14	20.7	125.0	103.5
"	"							47	9-22	27	16	26.7	119.9	94.6
"	"							48	9-22	27	5	22.0	123.7	101.0
H2.8R-0	Traffic	27	9-28	20	30	21.6	96	197	10-18	31	35	24.3	126.2	101.5
"	"							198	10-18	29	26	24.7	123.6	99.2
"	"							199	10-18	8	34	21.0	126.8	104.7
"	"							200	10-18	10	23	26.0	126.1	100.0
H3.8R-0	Static	74	10-21	20	50	16.7	68	229	10-21	33	46	21.7	124.2	102.3
"	"							230	10-21	34	54	16.9	126.8	108.2
"	"							231	10-21	13	45	21.0	132.5	109.5
"	"							232	10-21	10	54	23.6	124.5	100.8
	Averages						69					22.6	125.3	102.4

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 9

Summary of Field Test Results of Natural Subgrade, Section "J"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
J1.8R-0	Traffic	25	9-28	20	10	18.7	118	41	9-22	10	7	21.2	129.9	107.0
"	"							42	9-22	7	16	19.9	127.2	106.1
"	"							43	9-22	29	5	21.7	128.1	105.2
"	"							44	9-22	30	16	20.3	128.6	106.6
J2.8R-0	Traffic	2	9-14	10	30	24.0	86	201	10-18	32	36	22.2	123.0	100.5
"	"							202	10-18	31	26.5	20.8	126.1	104.5
"	"							203	10-18	11.5	35.5	18.9	124.3	104.8
"	"							204	10-18	11	25	21.2	125.9	103.7
J3.8R-0	Static	75	10-21	20	50	15.4	96	233	10-22	35	42	21.4	129.2	106.5
"	"							234	10-22	33	56	22.6	128.7	104.9
"	"							235	10-22	15	46	20.2	125.0	103.8
"	"							236	10-22	6	56	21.6	129.7	106.5
	Averages						100					21.0	127.1	104.9

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (No correction for saturation)

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Table 10

Summary of Field Test Results of Natural Subgrade, Section "K"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
K1.100	Traffic	1	9-14	5	10	23.0	114	36	9-21	12	5	20.3	127.8	106.0
"	"							37	9-21	10	16	18.5	128.0	108.0
"	"							38	9-21	28	4	20.8	119.8	99.1
"	"							39	9-21	30	15	21.4	126.9	104.2
"	"							40	9-21	30	4	20.8	121.8	105.0
K2.100	Traffic	26	9-28	20	30	14.4	186	205	10-18	29	34.5	20.2	125.1	104.0
"	"							206	10-18	28	24	24.2	126.1	101.4
"	"							207	10-18	10	25	20.0	130.4	108.8
"	"							208	10-18	11	36	22.4	129.0	105.2
K3.100	Static	--	--	--	--	--	--	237	10-22	35	45	21.6	125.4	103.2
"	"							238	10-22	35.5	55	23.8	123.9	100.1
"	"							239	10-22	10	45	19.1	132.1	110.9
"	"							240	10-22	4	55	14.7	137.0	119.5
	Averages						150					20.6	127.2	105.8

*Water Content Under Bearing Test
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 11

Summary of Field Test Results of Natural Subgrade, Section "L"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs/in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
L1.5-60	Traffic	22	9-25	20	10	18.7	92	73	9-23	10	5	20.5	124.8	103.4
"	"							74	9-23	13	16.5	20.0	128.2	107.4
"	"							75	9-24	30.5	5	21.8	127.3	104.7
"	"							76	9-24	31	16	18.6	126.7	106.8
L2.5-60	Traffic	38	10-1	20	30	15.5	92	157	10-11	10	25	15.6	132.8	114.9
"	"							158	10-11	12.5	36	15.5	130.1	112.8
"	"							159	10-11	30.5	23.5	19.8	126.4	105.7
"	"							160	10-11	28	36.5	19.1	129.0	108.1
L3.5-60	Static	--	--	--	--	--	--	225	10-21	6	54	17.1	133.9	114.0
"	"							226	10-21	11	45	16.2	135.1	116.2
"	"							227	10-21	33	48	20.4	128.2	106.6
"	"							228	10-21	29	55	16.1	135.7	116.7
		Averages					92					18.4	129.9	109.8

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 12

Summary of Field Test Results of Natural Subgrade, Section "M"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
M1. 7-60	Traffic	21	9-25	20	10	19.4	86	69	9-23	12	4.5	19.8	127.0	106.1
"	"							70	9-23	8.5	14	19.6	126.9	106.1
"	"							71	9-23	28	6	21.0	125.1	103.3
"	"							72	9-23	29	17	21.2	129.1	106.5
M2. 7-60	Traffic	39	10-1	20	30	20.9	114	142	10-7	9	26.5	20.9	127.0	105.0
"	"							143	10-7	10	35	19.9	125.1	104.5
"	"							144	10-7	29	35.5	19.7	126.8	105.9
"	"							145	10-7	27	23	19.6	127.7	106.8
M3. 7-60	Static	72	10-21	20	50	18.7	74	217	10-21	10	55	13.9	137.8	120.9
"	"							218	10-21	13	48	18.2	130.7	110.2
"	"							219	10-21	30	55	13.0	134.2	118.9
"	"							220	10-21	34	45	20.4	128.8	106.8
	Averages						91					18.9	128.9	108.4

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 13

Summary of Field Test Results of Natural Subgrade, Section "N"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
N1.86	Traffic	17	9-23	20	10	20.6	80	65	9-23	11	4.5	20.8	127.1	105.5
"	"							66	9-23	30	5.5	21.0	122.9	101.5
"	"							67	9-23	30	15	20.2	123.0	102.1
"	"							68	9-23	30	16	21.6	124.9	102.7
N2.86	Traffic	45	10-2	20	30	19.6	150	135	10-7	6	24	20.4	128.1	106.3
"	"							136	10-7	6.5	33	17.4	130.0	110.7
"	"							137	10-7	31	26	21.1	125.3	103.5
"	"							138	10-7	24	31	19.8	128.3	107.3
N3.86	Static	64	10-15	20	50	17.1	90	189	10-18	4	47.5	14.1	132.0	115.5
"	"							190	10-18	9	54	20.4	131.2	109.0
"	"							191	10-18	27	46	17.8	131.0	111.2
"	"							192	10-18	29	54	14.3	134.1	117.2
N4.612	Static	77	10-22	20	70	15.2	70	247	10-22	15	64	17.5	130.8	111.1
"	"							248	10-22	30	75	21.9	124.9	102.3
	Averages						98					19.2	128.1	107.6

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 14

Summary of Fielc Results of Natural Subgrade, Section "O"

Test Section Designation	Type of Test	Field				Tests		Unit Weight Tests						
		Test No.	Date Made (1943)	L		W.C. in %*	k** in lbs./in.^{3}	Test No.	Date Made (1943)	Location		W.C. in %	Unit Weight In lbs./ft.^{3}	
				x						x	y		Wet	Dry
O1.106	Traffic	16	9-23	20		20.9	72	61	9-23	8	7	21.9	124.8	102.3
"	"							62	9-23	9	15	19.6	121.8	101.8
"	"							63	9-23	34	5.5	22.3	126.0	102.9
"	"							64	9-23	32	15	23.7	125.0	101.1
O2.106	Traffic	44	10-2	20	30	16.7	104	131	10-6	9.5	34	18.4	127.9	107.9
"	"							132	10-6	11.5	25	22.0	128.9	105.5
"	"							133	10-6	34	25	20.4	123.0	102.1
"	"							134	10-6	35	36	22.0	129.0	105.7
O3.106	Static	63	10-15	20	50	20.9	112	185	10-15	10	46	20.8	123.0	102.0
"	"							186	10-15	12	55	23.5	124.1	100.7
"	"							187	10-15	35	54	11.1	131.0	118.0
"	"							138	10-18	31	46	21.9	126.9	104.1
O4.618	Static	--	--	--	--	--	--	243	10-22	12	70	13.5	132.6	116.8
"	"							244	10-22	30	68	10.6	133.2	120.7
Averages							96					19.4	126.9	106.5

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 15

Summary of Field Test Results of Natural Subgrade, Section "P"

Test Section Designation	Type of Test	Field Bearing Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight in lbs./ft.^{3} Wet	Dry
P1.812	Traffic	15	9-23	20	10	20.3	76	57	9-23	13	5	22.4	122.8	100.0
"	"							58	9-23	8	15	21.2	122.4	100.9
"	"							59	9-23	30.5	6.5	23.8	124.8	100.8
"	"							60	9-23	33.5	15	21.4	125.9	103.6
P2.812	Traffic	43	10-2	20	30	18.1	124	125	10-5	9.5	36	19.7	125.7	105.0
"	"							126	10-5	12	28.5	17.5	128.9	109.5
"	"							127	10-5	29.5	31	21.2	124.0	102.1
"	"							128	10-5	33	26.5	24.5	122.9	98.7
P3.812	Static	62	10-15	20	50	18.9	76	181	10-15	10	47	22.0	122.0	100.0
"	"							182	10-15	16	57	19.3	124.5	104.2
"	"							183	10-15	36	45	20.6	125.8	104.2
"	"							184	10-15	34	56	19.9	126.0	105.1
P4.818	Static	76	10-22	20	70	17.3	60	245	10-22	10	67	23.5	126.0	102.0
"	"							246	10-22	35	56	14.1	134.2	117.6
	Averages						112					20.8	125.4	103.8

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 16

Summary of Field Test Results of Natural Subgrade, Section "Q"

Test Section Designation	Type of Test	Field Bearing Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
Q1.1012	Traffic	14	9-23	20	10	23.6	76	53	9-23	12	4	25.1	123.9	98.9
"	"							54	9-23	12	15	20.6	124.1	103.0
"	"							55	9-23	28	5	22.7	122.0	99.5
"	"							56	9-23	30.5	16	20.8	124.7	103.1
Q2.1012	Traffic	42	10-1	20	30	20.8	106	121	10-5	11.5	27	20.3	129.8	107.6
"	"							122	10-5	13	35	20.6	127.9	106.0
"	"							123	10-5	31.5	34.5	21.2	127.8	105.1
"	"							124	10-5	28.5	29.5	19.5	132.1	110.7
Q3.1012	Static	57	10-15	20	50	15.9	80	177	10-15	10	46	16.7	127.1	109.1
"	"							178	10-15	17	53	14.5	133.7	116.7
"	"							179	10-15	32	54	21.7	125.5	103.2
"	"							180	10-15	33	47	23.9	128.2	103.7
Q4.1018	Static	--	--	--	--	--	--	241	10-22	11	70	14 0	129.0	113.1
"	"							242	10-22	32	67	13.9	138.1	121.2
		Averages					87					19.7	128.1	107.2

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 17

Summary of Field Test Results of Natural Subgrade, East Turn

Field Bearing Tests								Unit Weight Tests								
Test No.	Date of Test	Location: Section	Location: Lane	Coordinates x	Coordinates y	W.C. in %*	k** in lbs./in.^{3}	Test No.	Date of Test	Location: Section	Location: Lane	Coordinates x	Coordinates y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
								77	9-24	V_4	1	3.5	4.0	23.0	127.7	103.7
								78	9-24	V_4	1	12.5	16.0	21.8	124.1	102.2
								79	9-25	V_3	1	7.0	8.0	21.2	129.9	106.9
20	9-24	V_2	1	0	10	17.4	70	80	9-25	V_3	1	15.0	11.5	21.2	128.8	106.0
								81	9-25	V_2	1	5.0	4.0	21.6	126.0	103.8
								82	9-25	V_2	1	11.0	14.0	22.1	124.2	101.8
								83	9-25	V_1	1	2.5	7.0	19.8	126.1	105.3
19	9-24	W_2	1	0	10	11.8	94	84	9-25	V_1	1	9.0	11.0	17.7	130.9	111.2
								85	9-25	W_2	1	5.5	3.0	18.0	132.9	112.6
								86	9-25	W_2	1	12.5	14.0	15.8	132.0	114.1
								87	9-25	W_1	1	3.0	8.0	15.8	136.1	117.8
18	9-24	X_2	1	0	10	15.6	80	88	9-25	W_1	1	10.0	11.5	15.8	134.8	115.3
								89	9-25	X_2	1	2.0	6.0	18.5	129.1	109.1
								90	9-25	X_2	1	12.0	17.0	15.6	137.0	118.6
								91	9-27	X_1	1	4.0	6.5	21.2	128.0	105.4
						Ave.	81	92	9-27	X_1	1	13.0	14.0	15.6	128.9	111.5

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Table 17 (Cont'd)

Summary of Field Test Results of Natural Subgrade, East Turn

Field Bearing Tests								Unit Weight Tests									
Test No.	Date of Test	Location				W.C. in %*	k** in lbs./in.^{3}	Test No.	Date of Test	Location				W.C. in %	Unit Weight In lbs./ft.^{3}	
		Section	Lane	Coordinates x	Coordinates y					Section	Lane	Coordinates x	Coordinates y		Wet	Dry
								146	10-11	V_4	2	9.0	27.0	20.4	131.0	108.8
								147	10-11	V_4	2	13.0	35.0	21.8	126.0	103.6
								148	10-11	V_3	2	3.0	35.0	18.6	132.9	112.1
46	10-5	V_2	2	0	30	16.7	130	149	10-11	V_3	2	8.5	25.0	19.2	131.0	109.7
								150	10-11	V_2	2	10.0	30.0	17.5	129.1	110.0
47	10-5	W_2	2	0	30	10.8	148	151	10-11	V_1	2	9.5	30.0	10.1	118.2	107.3
								152	10-11	W_2	2	10.0	30.0	12.0	128.3	114.7
								153	10-11	V_2	2	14.0	23.0	22.3	127.3	104.0
48	10-5	X_2	2	0	30	13.0	184	154	10-11	W_1	2	10.0	30.0	16.7	131.5	112.8
								155	10-11	X_2	2	10.0	30.0	10.6	137.7	124.4
						Ave.	154	156	10-11	X_1	2	10.0	30.0	14.5	130.0	113.5

*Water Content Under Bearing Plate

**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 18

Summary of Field Test Results of Natural Subgrade, West Turn

Field Bearing Tests								Unit Weight Tests								
Test No.	Date of Test	Location				W.C. in %*	k** in lbs./in.^{3}	Test No.	Date of Test	Location				W.C. in %	Unit Weight In lbs./ft.^{3}	
		Section	Lane	Coordinates x	Coordinates y					Section	Lane	Coordinates x	Coordinates y		Wet	Dry
No bearing tests on Subgrade of inside lane (Lane 1)								27	9-21	Y_2	1	8.5	10	25.5	121.7	96.9
								28	9-21	Y_1	1	8.5	10	17.7	133.3	113.4
								29	9-21	W_4	1	8.5	10	18.8	129.6	109.1
								30	9-21	W_3	1	8.5	10	16.9	122.8	105.0
								31	9-21	Z_4	1	8.5	10	21.0	127.1	105.1
								32	9-21	Z_3	1	8.5	10	17.1	128.0	109.2
								33	9-21	Z_2	1	8.5	10	11.7	133.0	119.1
								34	9-21	Y_2	1	8.5	10	18.4	129.9	109.5
								35	9-21	Z_1	1	8.5	10	13.7	136.2	120.0
32	9-29	Y_2	2	0	30	20.1	156	113	10-4	Y_2	2	8.5	30	16.0	130.8	112.6
								114	10-4	Y_1	2	8.5	30	16.7	130.2	111.9
36	9-30	W_4	2	0	30	15.9	204	115	10-4	W_4	2	8.5	30	16.8	126.2	108.3
								116	10-5	W_3	2	8.5	30	17.2	121.7	103.5
35	9-30	Z_4	2	0	30	20.3	166	117	10-5	Z_4	2	8.5	30	20.9	127.9	105.7
								118	10-5	Z_3	2	8.5	30	19.8	119.8	100.0
37	10-1	Z_2	2	0	30	21.3	260	119	10-5	Z_2	2	8.5	30	17.5	123.7	105.1
								120	10-5	Z_1	2	8.5	30	13.9	128.5	112.8
		Ave.					197							17.6	127.7	108.7

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

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Table 19

Summary of Field Test Results of Selected Subgrade, Section "R"

Test Section Designation	Type of Test	Field Bearing Tests: Test No.	Field Bearing Tests: Date Made (1943)	Field Bearing Tests: Location x	Field Bearing Tests: Location y	Field Bearing Tests: W.C. in %*	Field Bearing Tests: k** in lbs./in.^{3}	Unit Weight Tests: Test No.	Unit Weight Tests: Date Made (1943)	Unit Weight Tests: Elevation	Unit Weight Tests: Location x	Unit Weight Tests: Location y	Unit Weight Tests: W.C. in %	Unit Weight In lbs./ft.^{3}: Wet	Unit Weight In lbs./ft.^{3}: Dry
R1.612	Traffic	10	9-21	20	10	8.4	360	9	9-8	733.5	20	11	8.4	137.9	127.1
"	"							24	9-10	734.7	10	8	8.6	141.0	129.9
"	"							27	9-11	736.5	30	8	8.0	147.1	136.3
"	"							38	9-13	736.2	10	8	9.6	148.2	135.5
R2.612	Traffic	41	10-1	20	30	6.3	340	1	9-3	732.0	20	30	9.6	137.1	125.2
"	"							3	9-7	732.6	20	30	11.9	132.1	118.2
"	"							6	9-8	733.0	20	25	10.2	131.9	119.5
"	"							37	9-13	736.0	20	30	9.9	135.9	123.7
R3.612	Static	52	10-6	20	50	5.4	564	17	9-9	733.6	20	52	7.2	131.3	122.4
"	"							23	9-10	734.6	30	54	9.0	128.8	118.0
"	"							36	9-13	736.0	15	57	8.3	135.9	125.1
		Averages					421						9.2	137.0	125.5

* Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 20

Summary of Field Test Results of Selected Subgrade, Section "S"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests							
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Eleva-tion	Location x	Location y	W.C in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
S1.66	Traffic	11	9-22	20	10	6.2	226	16	9-9	734.2	20	8	9.2	147.9	135.1
"	"							26	9-11	735.7	30	8	9.2	141.0	128.9
"	"							39	9-13	736.3	15	8	8.0	131.0	121.1
S2.66	Traffic	40	10-1	20	30	6.9	624	4	9-7	733.0	20	30	10.6	134.0	121.2
"	"							8	9-8	733.5	20	20	9.6	130.0	118.8
"	"							32	9-11	736.0	30	30	7.5	132.0	122.8
S3.66	Static	51	10-6	20	50	6.8	330	14	9-9	734.0	20	52	7.9	134.0	124.2
"	"							33	9-11	736.1	30	59	9.8	135.0	123.1
"	"							40	9-13	736.3	30	52	7.1	132.5	123.6
	Averages						393						8.8	135.3	124.3

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 21

Summary of Field Test Results of Sand & Gravel Subgrade. Section "T"

Test Section Desig-nation	Type of Test	Field Bearing Tests: Test No.	Field Bearing Tests: Date Made (1943)	Field Bearing Tests: Location x	Field Bearing Tests: Location y	Field Bearing Tests: W.C. in %*	Field Bearing Tests: k**in lbs./in.^{3}	Unit Weight Tests: Test No.	Unit Weight Tests: Date Made (1943)	Unit Weight Tests: Eleva-tion	Unit Weight Tests: Location x	Unit Weight Tests: Location y	Unit Weight Tests: W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
T1.60	Traffic	12	9-22	20	10	4.7	320	12	9-9	734.5	20	8	6.8	140.2	131.6
"	"							21	9-10	735.0	30	8	9.7	144.1	131.4
"	"							30	9-11	735.7	20	3	7.3	142.2	132.6
"	"							31	9-11	736.2	10	18	6.8	135.7	127.1
"	"							42	9-13	736.8	10	6	7.0	151.6	141.6
"	"							16	9-28	737.3	6	13.5	5.7	134.2	127.3
"	"							17	9-28	737.2	29	4.5	4.9	140.0	133.5
"	"							29	9-29	737.2	20	10	4.1	138.9	133.1
T2.60	Traffic	34	9-30	20	30	5.9	270	2	9-3	732.0	20	30	5.6	135.2	128.2
"	"							5	9-7	733.0	20	30	7.2	134.8	125.3
"	"							22	9-10	735.0	25	30	8.7	136.0	125.3
"	"							62	10-7	737.4	10	33.5	4.2	141.0	135.1
"	"							63	10-7	737.3	31.5	26	5.1	141.7	134.6
T3.60	Static	50	10-6	20	50	4.3	524	10	9-8	733.7	20	52	7.1	135.6	126.4
"	"							15	9-9	734.0	20	52	6.6	145.8	136.8
"	"							20	9-10	734.7	10	52	6.7	138.9	130.2
"	"							41	9-13	736.7	25	57	6.9	146.8	137.2
"	"							87	10-15	737.5	16	54	7.4	149.8	139.2
"	"							88	10-15	737.4	33	44	7.9	150.0	139.1
	Averages						371						6.6	141.2	132.4

*Water Content Under Bearing Plate

**"k"taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 22

Summary of Field Test Results of Sand Subgrade, Section "U"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests							
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Test No.	Date Made (1943)	Eleva-tion	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
U1.60	Traffic	13	9-22	20	10	3.8	260	11	9-9	734.8	20	8	5.2	119.3	113.2
"	"							19	9-10	734.9	10	8	5.4	115.0	109.0
"	"							34	9-11	735.7	15	3	5.3	127.2	120.8
"	"							35	9-11	735.6	10	3	5.8	127.1	120.3
"	"							43	9-13	736.3	25	3	4.0	123.4	118.8
"	"							14***	9-28	737.2	6	4.5	3.7	119.3	115.2
"	"							15***	9-28	737.3	32.5	16	4.0	119.4	114.8
U2.60	Traffic	33	9-30	20	30	3.6	160	7	9-8	733.0	20	40	4.2	112.1	107.2
"	"							25	9-10	735.6	10	30	4.8	123.8	118.1
"	"							60***	10-7	737.4	11	33.5	4.0	118.7	114.0
"	"							61***	10-7	737.3	35	27	3.3	115.6	111.8
U3.60	Static	49	10-6	20	50	3.7	200	13	9-9	734.0	20	52	4.8	126.0	120.3
"	"							18	9-10	734.6	30	52	4.5	125.9	120.2
"	"							28	9-11	735.1	10	52	5.2	124.1	117.9
"	"							29	9-11	735.2	30	52	5.1	130.0	123.5
"	"							44	9-13	736.5	10	52	4.3	129.8	124.1
"	"							85***	10-5	737.5	9	55	2.7	125.8	122.4
"	"							86***	10-5	737.4	31	45	3.6	125.0	120.8
	Average						207						4.4	122.6	117.4

*Water Content Under Bearing Plate

**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

***Unit Wt. Tests at Final Grade

APPENDIX A

Table 23

Summary of Field Test Results of Sand and Gravel Base Course, Section "D"

Test Section Designation	Type of Test	Field Bearing Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Unit Weight Tests: Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Dry
D1.66	Traffic	--	--	--	--	--	--	9	9-27	12	4.5	6.5	132.0	123.9
"	"							10	9-27	29	15.5	6.0	132.9	125.2
"	"							37	9-30	20	10.0	4.4	135.0	129.1
D2.66	Traffic	53	10-6	20	30	7.2	80	56	10-6	33.5	36	6.4	134.2	126.1
"	"							57	10-6	6.5	25	6.2	135.2	127.2
D3.66	Static	67	10-18	20	50	7.1	88	95	10-19	6	46	5.7	133.2	126.2
"	"							96	10-19	29	55	5.4	126.1	119.8
	Averages						84					5.8	132.7	125.4

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 24

Summary of Field Test Results of Sand and Gravel Base Course, Section "N"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
N1.86	Traffic	--	--	--	--	--	--	28	9-29	9	7.5	5.5	137.9	130.6
"	"							33	9-29	27	15	5.8	138.2	131.0
"	"							36	9-30	20	10	5.4	140.3	133.1
N2.86	Traffic	--	--	--	--	--	--	74	10-12	8	30	6.3	139.0	130.5
"	"							75	10-12	30	36	7.3	138.0	128.3
N3.86	Static	--	--	--	--	--	--	106	10-20	10	47	6.6	144.7	135.7
"	"							107	10-20	30	53	6.6	146.1	137.2
N4.612	Static	79	10-23	20	70	6.6	58	115	10-23	5	66	5.9	129.5	122.2
"	"							116	10-23	30	73	8.4	137.1	126.5
	Averages											6.4	139.0	130.6

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 25

Summary of Field Test Results of Sand and Gravel Base Course, Section "O"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
O1.106	Traffic	--	--	--	--	--	--	26	9-29	11	4.5	6.8	142.9	133.8
"	"							27	9-29	36.5	15.5	6.3	141.0	132.4
"	"							35	9-29	20	10	6.0	146.2	138.0
O2.106	Traffic	--	--	--	--	--	--	72	10-2	12	26	8.3	141.0	130.0
"	"							73	10-2	32	36	6.3	135.1	127.0
O3.106	Static	71	10-20	20	50	8.8	78	101	10-20	12	43.5	6.5	142.2	133.8
"	"							102	10-20	31	57	7.3	142.9	132.9
O4.618	Static	--	--	--	--	--	--	113	10-23	10	65	5.2	129.0	122.2
"	"							114	10-23	27	76	7.3	144.9	134.8
		Averages										6.7	140.6	131.7

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 26

Summary of Field Test Results of Sand and Gravel Base Course, Section "P"

Test Section Designation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location		W.C. in %*	k**in lbs./in.³	Test No	Date Made (1943)	Location		W.C in %	Unit Weight In lbs./ft.³	
				x	y					x	y		Wet	Dry
P1.812	Traffic	--	--	--	--	--	--	24	9-28	10	4.5	5.5	140.0	132.6
"	"							25	9-28	33	11.5	5.3	138.1	131.1
"	"							34	9-29	20	10	5.1	137.0	130.1
P2.812	Traffic	--	--	--	--	--	--	70	10-12	7.5	27	5.5	135.8	128.5
"	"							71	10-12	32	36	5.2	135.3	128.7
P3.812	Static	70	10-20	20	50	6.4	68	103	10-20	5.5	56	7.2	141.0	131.2
"	"							104	10-20	28	45	8.8	136.1	125.3
"	"							105	10-20	10	50	6.8	134.9	126.4
P4.818	Static	78	10-23	20	70	5.9	90	111	10-23	10.5	64	7.8	144.8	134.3
"	"							112	10-23	35	76	6.6	138.4	130.0
		Averages					79					6.4	138.1	129.8

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 27

Summary of Field Test Results of Sand and Gravel Base Course, Section "Q"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
Q1.1012	Traffic	--	--	--	--	--	--	22	9-28	8	8	5.6	137.4	130.2
"	"							23	9-28	32	15	6.1	135.9	127.8
"	"							32	9-29	20	10	4.6	136.9	130.8
Q2.1012	Traffic	54	10-11	20	30	6.7	116	68	10-11	33	35.5	8.1	144.2	133.4
"	"							69	10-11	8	24	7.6	145.0	134.9
Q3.1012	Static	69	10-20	20	50	7.2	50	99	10-20	36	56	5.4	135.8	128.7
"	"							100	10-20	12	43	5.8	126.9	120.0
"	"							108	10-21	7	54	9.1	144.9	132.5
Q4.1018	Static	--	--	--	--	--	--	109	10-23	10	75	8.5	146.0	134.6
"	"							110	10-23	32	68	7.6	143.0	133.0
	Averages						83					6.8	139.6	130.6

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 28

Summary of Field Test Results of Sand and Gravel Base Course, Section "R"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k** in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
R1.612	Traffic	--	--	--	--	--	--	20	9-28	7.5	5.5	4.7	138.0	132.0
"	"							21	9-28	31	10	4.1	148.8	138.7
"	"							31	9-29	20	10	4.8	147.5	140.8
R2.612	Traffic	--	--	--	--	--	--	66	10-8	5.5	25.5	4.0	134.8	129.3
"	"							67	10-8	28.5	33	3.4	134.8	130.0
R3.612	Static	--	--	--	--	--	--	91	10-15	9	56	6.5	131.9	123.8
"	"							92	10-15	28	47	7.0	133.9	125.0
	Averages											4.9	138.5	131.4

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

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Table 29

Summary of Field Test Results of Sand and Gravel Base Course, Section "S"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location		W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location		W.C. in %	Unit Weight In lbs./ft.^{3}	
				x	y					x	y		Wet	Dry
S1.66	Traffic	--	--	--	--	--	--	18	9-28	5	6.5	4.5	139.1	133.2
"	"							19	9-28	15	13.5	5.9	143.0	135.1
"	"							30	9-29	20	10	4.9	136.2	130.0
S2.66	Traffic	--	--	--	--	--	--	64	10-8	11	28	4.1	137.1	132.7
"	"							65	10-8	32	35	4.0	138.8	133.1
S3.66	Static	--	--	--	--	--	--	89	10-15	10	56	6.9	134.2	125.8
"	"							90	10-15	28	45	8.0	142.9	132.1
	Averages											5.5	138.8	131.7

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

APPENDIX A

Table 30

Summary of Field Test Results of Sand and Gravel Base, East Turn

Test No.	Date of Test (1943)	Location		Coordinates		Water Content In %	Unit Weight In lbs./ft.^{3}	
		Section	Lane	x	y		Wet	Dry
38	9-30	V_4	1	9.5	10.0	5.2	133.0	126.2
39	9-30	V_3	1	12.0	5.5	5.4	134.4	127.4
40	9-30	V_2	1	7.5	6.5	5.3	133.7	126.7
41	10-1	V_1	1	6.5	15.0	5.0	135.0	128.6
42	10-1	W_2	1	11.0	7.5	5.6	138.2	131.1
43	10-1	W_1	1	12.0	16.0	6.0	136.8	128.9
44	10-1	X_2	1	9.0	11.0	6.0	133.6	125.9
45	10-1	X_1	1	8.5	3.5	5.1	138.0	131.2
76	10-13	V_4	2	7.0	24.0	5.9	131.9	124.5
77	10-14	V_4	2	6.0	36.5	6.8	139.0	130.3
78	10-14	V_3	2	8.0	33.0	7.8	141.2	131.3
79	10-14	V_2	2	4.0	34.0	7.3	136.7	127.1
80	10-14	V_1	2	7.0	33.0	6.6	137.9	129.3
81	10-14	W_2	2	9.0	34.0	7.1	139.2	129.9
82	10-14	W_1	2	14.5	26.0	6.0	140.3	132.4
83	10-14	X_2	2	6.0	27.5	6.9	139.9	130.8
84	10-14	X_1	2	3.0	30.0	6.1	142.1	133.9
		Averages				6.1	137.1	129.1

APPENDIX A

Table 31

Summary of Field Test Results of Sand and Gravel Base, West Turn

Test No.	Date of Test (1943)	Location				Water Content In %	Unit Weight In lbs./ft.^{3}	
		Section	Lane	Coordinates x	Coordinates y		Wet	Dry
1	9-27	Y_1	1	0	13	5.0	119.0	113.3
5	9-27	Y_1	1	6	12	4.8	132.9	126.8
2	9-27	W_3	1	0	11.5	4.7	129.8	123.9
6	9-27	W_3	1	6	11	4.2	134.3	128.9
3	9-27	Z_3	1	0	10	5.4	136.8	129.3
4	9-27	Z_1	1	0	9	5.3	138.0	130.9
46	10-6	Y_2	2	9.5	30	6.6	133.0	124.8
47	10-6	Y_1	2	9.5	30	6.5	136.1	128.0
48	10-6	W_4	2	9.5	30	6.5	137.1	128.8
49	10-6	W_3	2	9.5	30	7.4	145.9	135.7
50	10-6	Z_4	2	9.5	30	6.8	145.0	135.9
51	10-6	Z_3	2	9.5	30	7.9	136.5	126.7
52	10-6	Z_2	2	9.5	30	7.1	138.9	129 5
53	10-6	Z_1	2	9.5	30	7.2	145.2	135.3
		Averages				6.1	136.3	128.4

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX A

Table 32

Summary of Field Test Results of Sand Base, Section "C"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No	Date Made (1943)	Location		W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location		W.C. in %	Unit Weight In lbs./ft.^{3}	
				x	y					x	y		Wet	Dry
C1.66S	Traffic	--	--	--	--	--	--	11	9-27	11	3	10.2	128.9	116.8
"	"							12	9-27	35.5	17.5	7.4	123.3	114.8
"	"							13	9-27	29.5	16	6.4	123.1	115.7
C2.66S	Traffic	--	--	--	--	--	--	54	10-6	33	34	3.7	118.3	114.3
"	"							55	10-6	11.5	26	5.5	121.0	114.8
C3.66S	Static	66	10-18	20	50	5.0	72.0	97	10-19	6	46	5.7	133.2	126.2
"	"							98	10-19	29	55	5.4	126.1	119.8
	Averages											6.3	124.8	117.5

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

APPENDIX A

Table 33

Summary of Field Test Results of Crushed Stone Base, Section "E"

Test Section Desig-nation	Type of Test	Field Bearing Tests						Unit Weight Tests						
		Test No.	Date Made (1943)	Location x	Location y	W.C. in %*	k**in lbs./in.^{3}	Test No.	Date Made (1943)	Location x	Location y	W.C. in %	Unit Weight In lbs./ft.^{3} Wet	Unit Weight In lbs./ft.^{3} Dry
E1.66M	Traffic	--	--	--	--	--	--	7	9-27	14	3.5	3.5	134.1	129.7
"	"							8	9-27	31	17	3.8	137.0	132.1
E2.66M	Traffic	--	--	--	--	--	--	58	10-7	30.5	35	5.5	136.0	128.9
"	"							59	10-7	9.0	26.5	4.9	141.0	134.5
E3.66M	Static	68	10-18	20	50	5.3	108	93	10-19	6	46.5	4.7	144.0	137.8
"	"							94	10-19	30	54	5.2	143.2	136.1
Averages												4.6	139.2	133.2

*Water Content Under Bearing Plate
**"k" taken from curve at 0.05" Deformation (Not corrected for saturation)

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

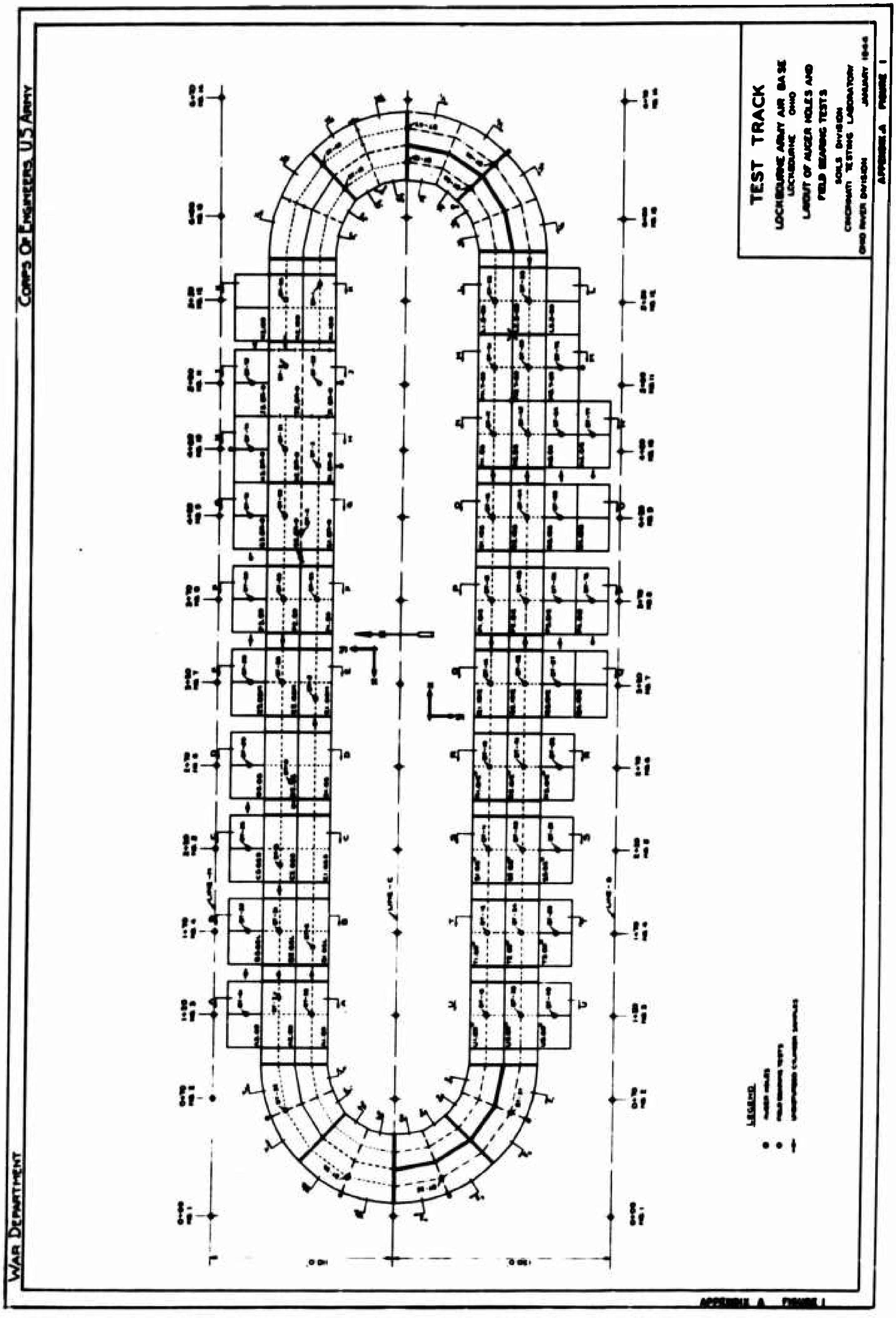
APPENDIX "A"

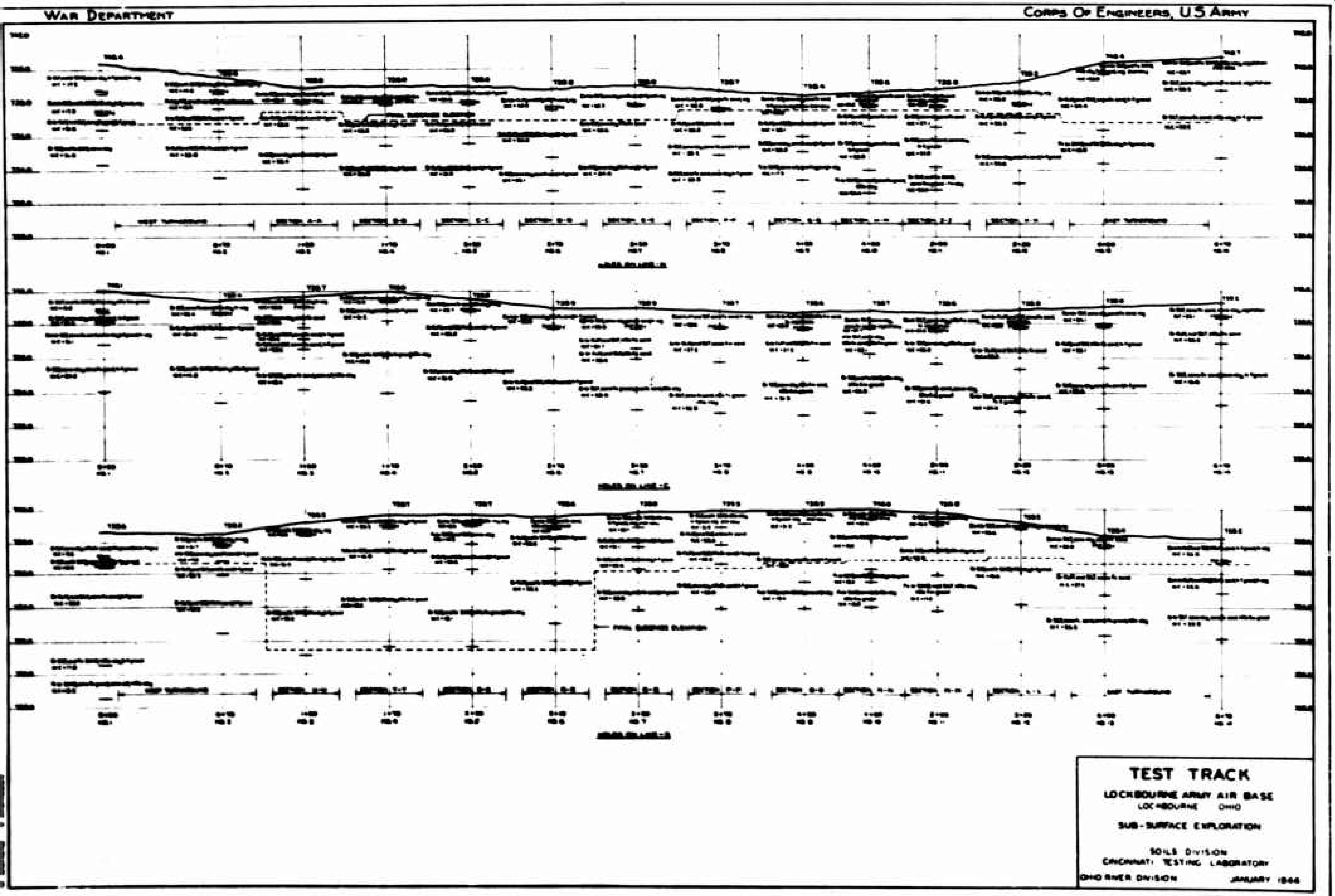
Field Tests and Exploration
of Subgrade and Base Materials.

FIGURES

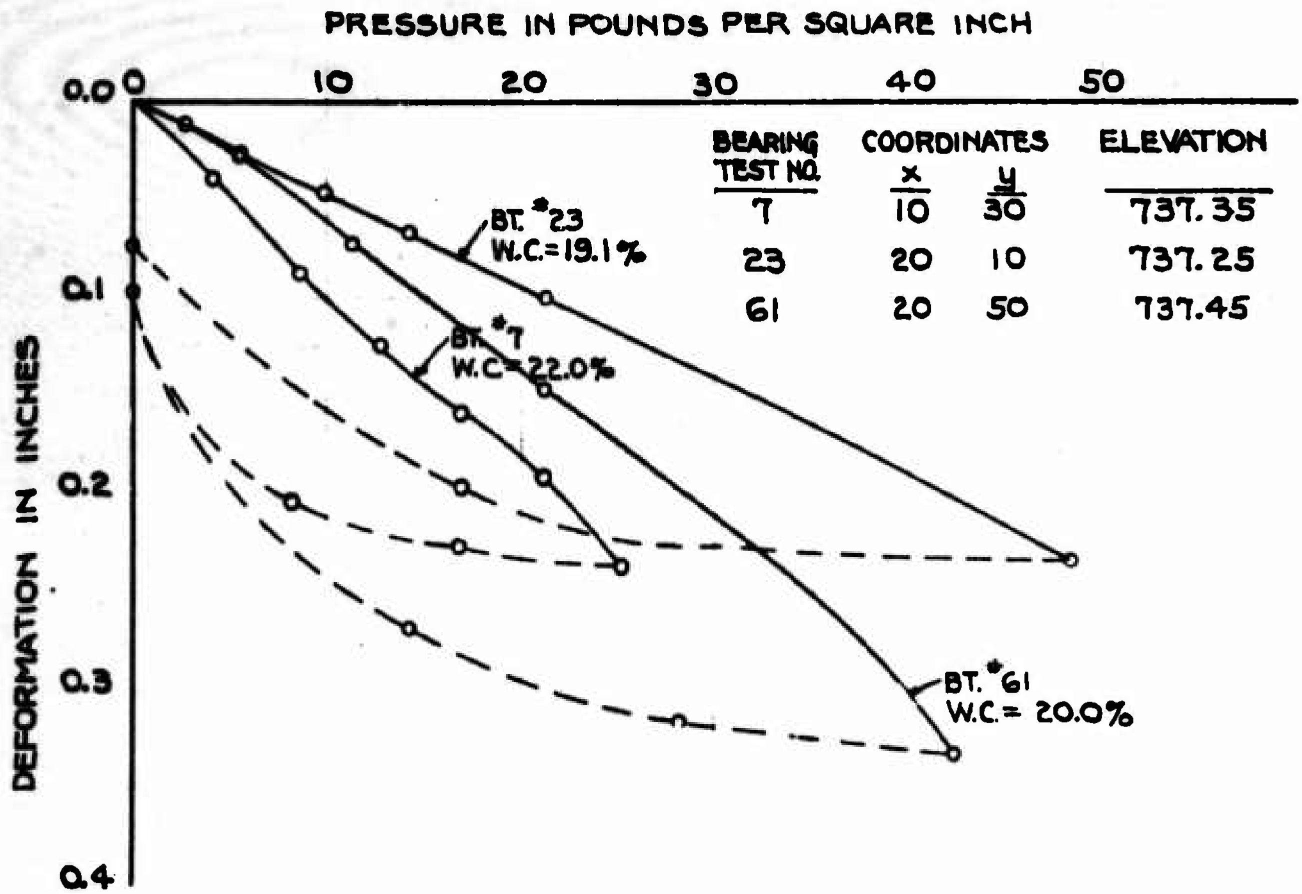
THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory


WAR DEPARTMENT
CORPS OF ENGINEERS U.S. ARMY
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
LAYOUT OF AUGER HOLES AND
FIELD BEARING TESTS
SOILS DIVISION
CINCINNATI TESTING LABORATORY
OHIO RIVER DIVISION
JANUARY
APPENDIX A FIGURE 1
LEGEND
APPENDIX A FIGURE 1



APPENDIX A FIGURE 2



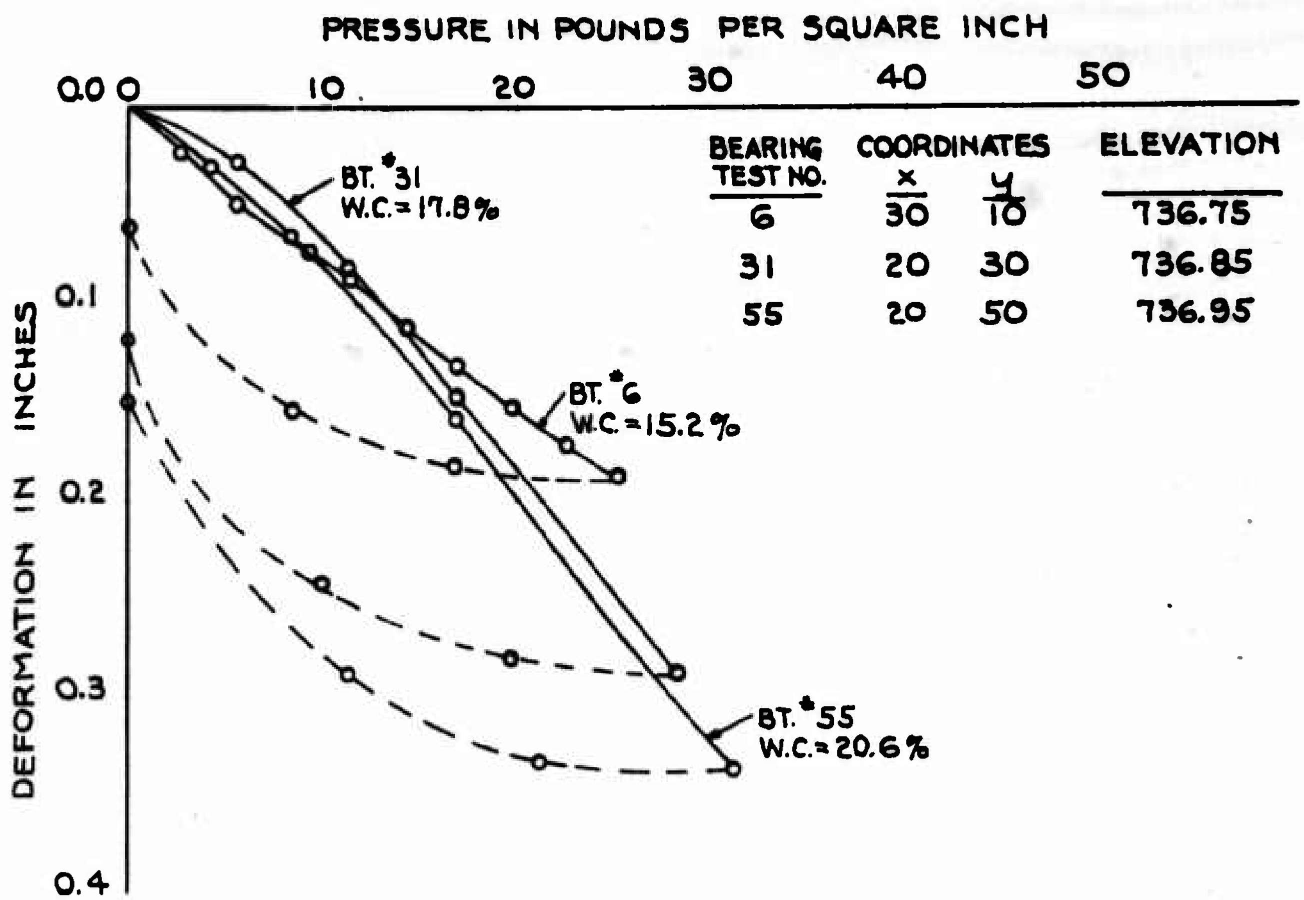
BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
7	10	30	737.35
23	20	10	737.25
61	20	50	737.45

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W. C. %
19	34	5	122.7	104.8	17.0
20	11	6	124.1	106.9	16.0
21	34	15	124.5	109.7	13.7
22	10	15	125.8	106.1	18.3
109	35	36.5	128.7	109.3	17.6
110	32	27	128.0	109.0	17.3
111	13	28	125.0	107.2	16.7
112	9	35	127.0	106.9	18.9
213	4.5	56.5	125.3	105.0	19.3
214	9	45.5	126.1	104.9	20.2
215	31	45	130.1	109.8	18.8
216	28	54	128.1	107.3	19.3

SECTION A-A
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 3

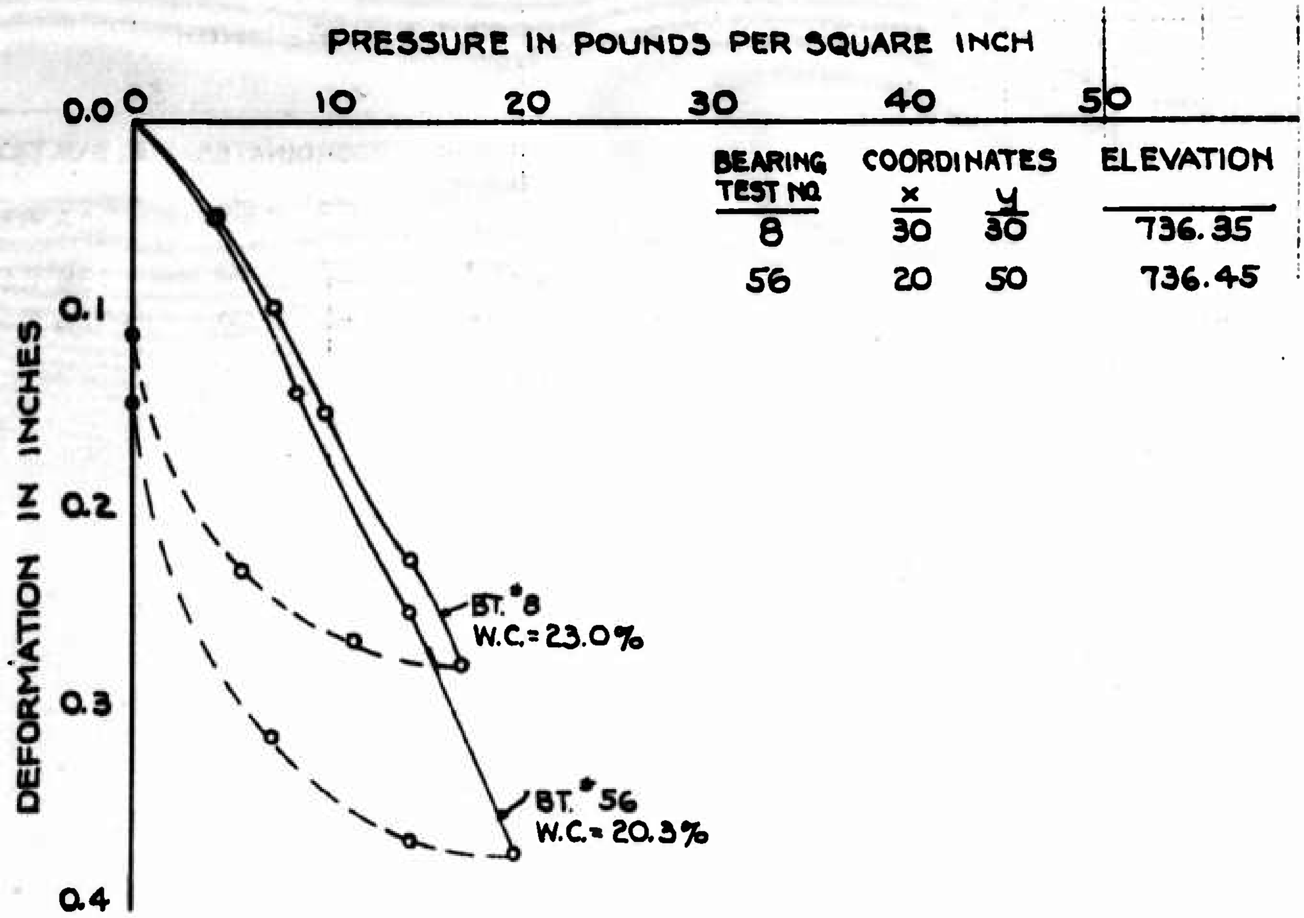


TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W. C. %
13	25	5	130.1	114.0	14.1
14	15	5	118.8	94.5	25.6
15	30	15	125.2	108.6	15.5
16	10	15	129.8	109.2	18.4
17	27	6	125.1	106.6	17.6
18	13	7	122.8	99.7	23.0
93	30	25.5	126.2	104.7	20.9
94	13.5	26.5	124.0	101.3	22.2
95	12	35	125.9	105.1	19.8
96	27.5	35.5	127.5	106.7	19.5
161	34	47.5	129.0	108.0	19.3
162	30	54	128.5	105.9	21.2
163	13	44.5	127.0	107.1	18.4
164	7	53	131.8	112.9	16.6

SECTION B-B
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 4

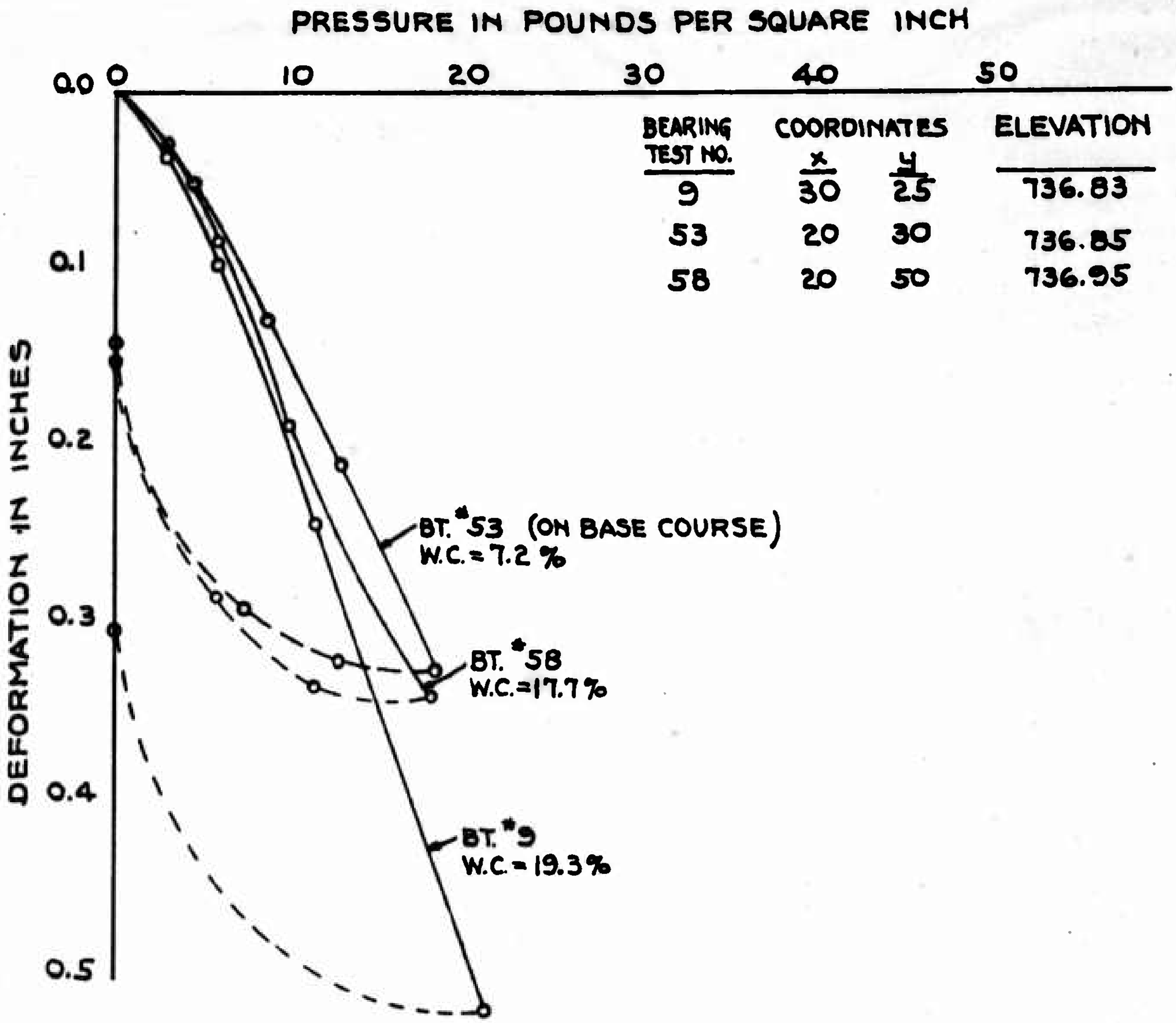


TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W.C. %
9	25	15	126.9	103.9	22.0
10	15	15	123.2	102.8	20.0
11	10	5	129.3	107.4	20.4
12	30	5	121.9	98.7	23.4
97	31.5	36.5	129.1	107.3	20.1
98	23	31.5	122.0	100.0	22.1
99	6.5	36.5	127.0	104.5	21.6
100	11.5	26	130.5	108.3	20.3
165	35	47	127.3	105.0	21.2
166	6	46	130.0	107.8	20.6
167	32	54	128.3	104.9	22.4
168	11	55.5	129.7	107.7	20.3

SECTION C-C
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 5



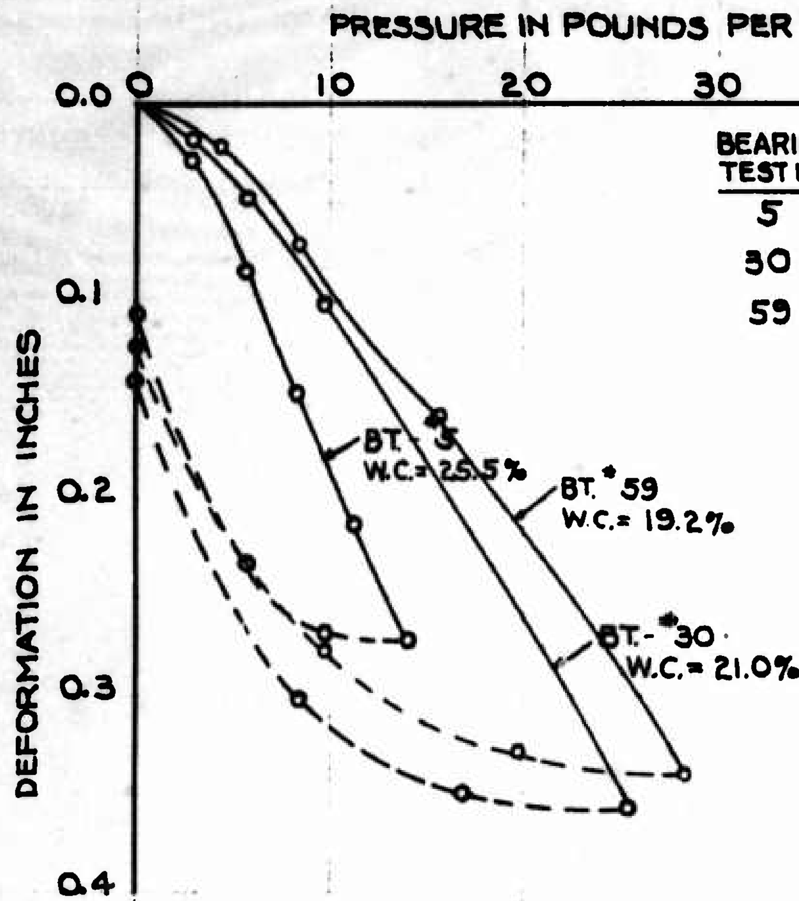
BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
9	30	25	736.83
53	20	30	736.85
58	20	50	736.95

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W. C. %
5	25	15	125.9	104.1	20.9
6	15	15	125.0	103.6	20.8
7	15	5	124.7	102.1	22.0
8	25	5	126.0	103.4	21.9
101	32.5	26	123.5	102.4	20.7
102	27	37	128.0	104.4	22.4
103	10	36.5	126.8	101.7	24.6
104	7	26.5	126.0	103.8	21.2
169	33	56	127.1	107.1	18.9
170	28	48	128.0	107.1	19.5
171	8.5	45.5	129.0	107.9	19.6
172	7	55.5	125.1	105.3	18.9

SECTION D-D
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 6



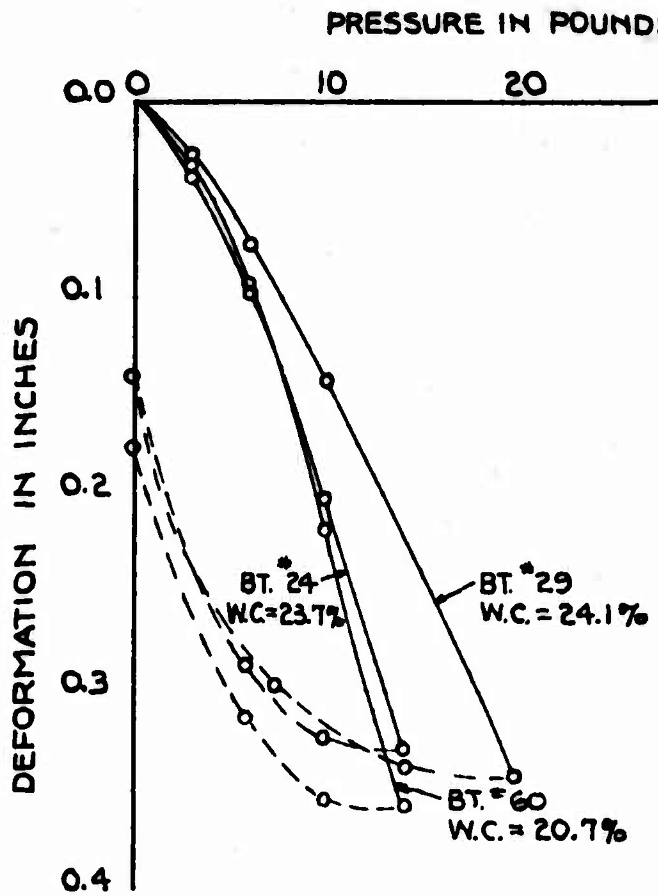
BEARING TEST NO.	COORDINATES x	y	ELEVATION
5	30	10	736.76
30	20	30	736.85
59	20	50	736.95

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS/CU.FT. WET	DRY	W.C. %
1	10	5	124.1	99.7	24.4
2	10	15	123.9	99.6	24.1
3	30	5	122.9	100.2	22.6
4	30	15	127.1	102.9	23.7
105	27	36	126.2	105.0	20.2
106	29.5	28.5	127.8	104.1	22.3
107	8.5	37	126.0	101.7	24.0
108	7.5	25.5	122.0	98.1	24.2
173	32	55	125.0	105.2	18.8
174	28	45	123.8	101.5	21.9
175	11	56	125.9	104.1	20.8
176	8	44	123.0	100.5	22.2

SECTION E-E
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 7



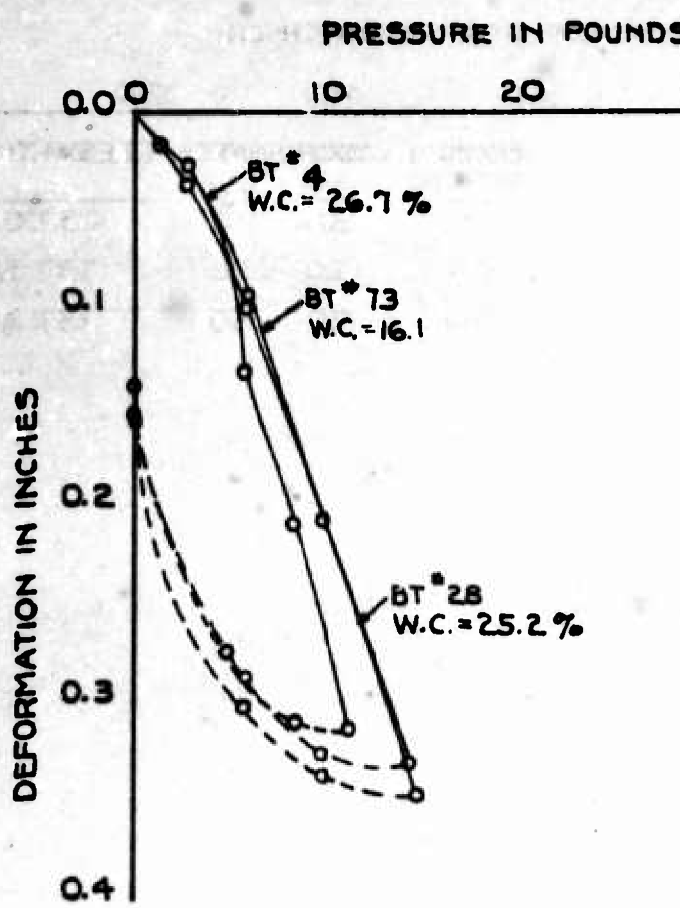
BEARING TEST NO.	COORDINATES x	y	ELEVATION
24	20	10	737.08
29	20	30	737.18
60	20	50	737.28

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W. C. %
23	15	5	120.4	96.8	24.5
24	25	5	120.7	96.8	24.5
25	12	15	121.2	98.2	23.5
26	30	15	124.0	100.2	23.8
129	30	29	119.8	97.7	22.4
130	31	34.5	126.7	106.7	18.8
139	35	35.5	122.9	100.1	22.8
140	13	24	122.0	97.7	25.0
141	10	35	122.8	98.5	24.5
209	36	44	125.7	102.4	22.6
210	34	54	122.8	98.1	25.0
211	12	44.5	125.0	99.7	25.2
212	10	56	128.2	104.8	22.6

SECTION F-F
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 8

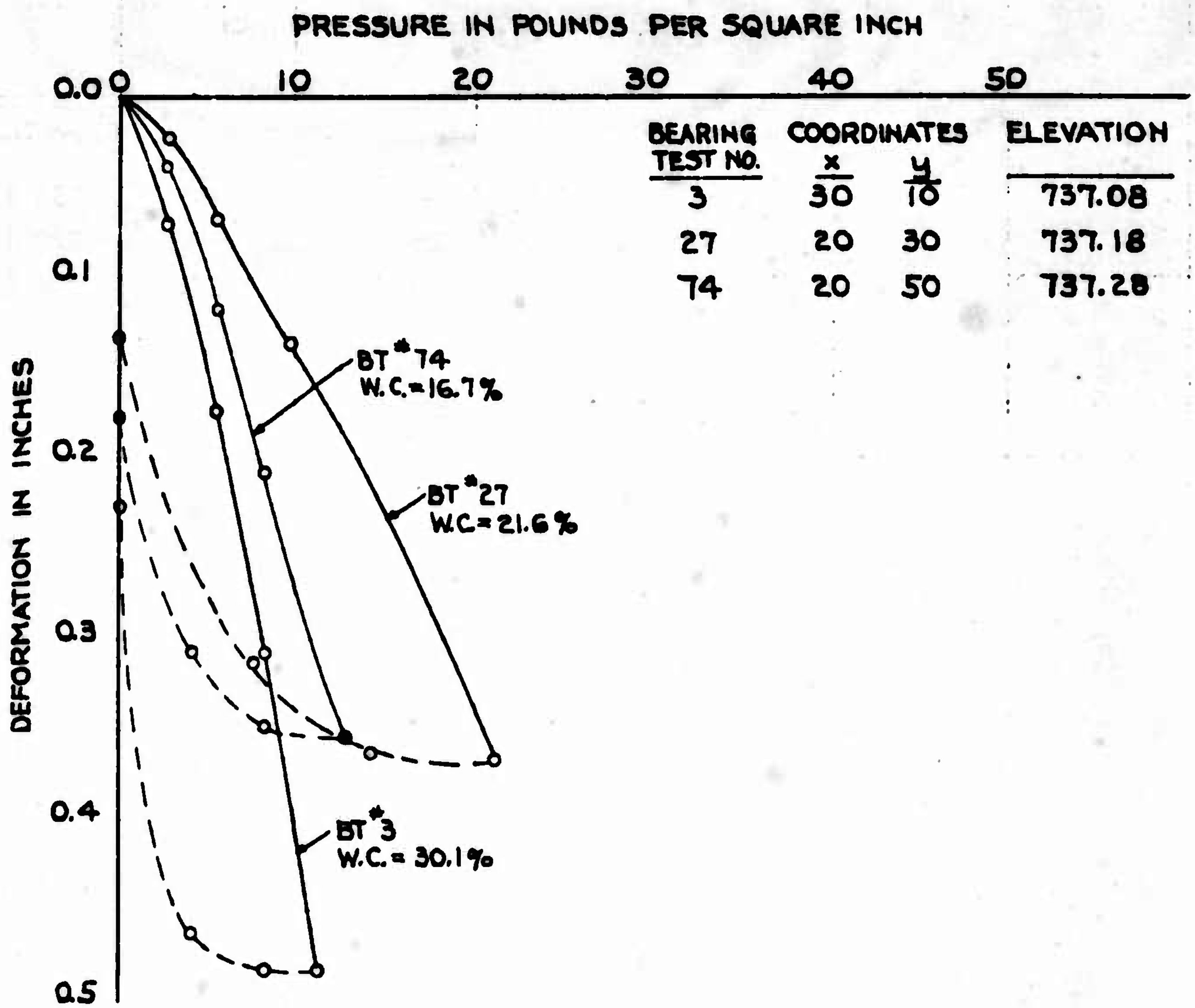


BEARING TEST NO.	COORDINATES x	y	ELEVATION
4	30	20	737.13
28	20	30	737.18
73	20	50	737.23

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W. C. %
49	14	5	118.0	94.0	25.5
50	27	3	119.6	94.6	26.4
51	31	16	120.1	96.2	24.9
52	15	16	116.8	92.7	26.0
193	39	25	126.3	103.6	22.0
194	31.5	34.5	123.1	98.8	24.8
195	13	36.5	125.1	101.6	23.1
196	10.5	24	124.2	102.5	21.2
221	28	44	125.0	101.2	23.7
222	33	54	124.9	102.7	21.7
223	13	43	129.8	104.9	23.8
224	10	54	124.3	100.0	24.1

SECTION G-G
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
OCT. 1943

FIGURE 9



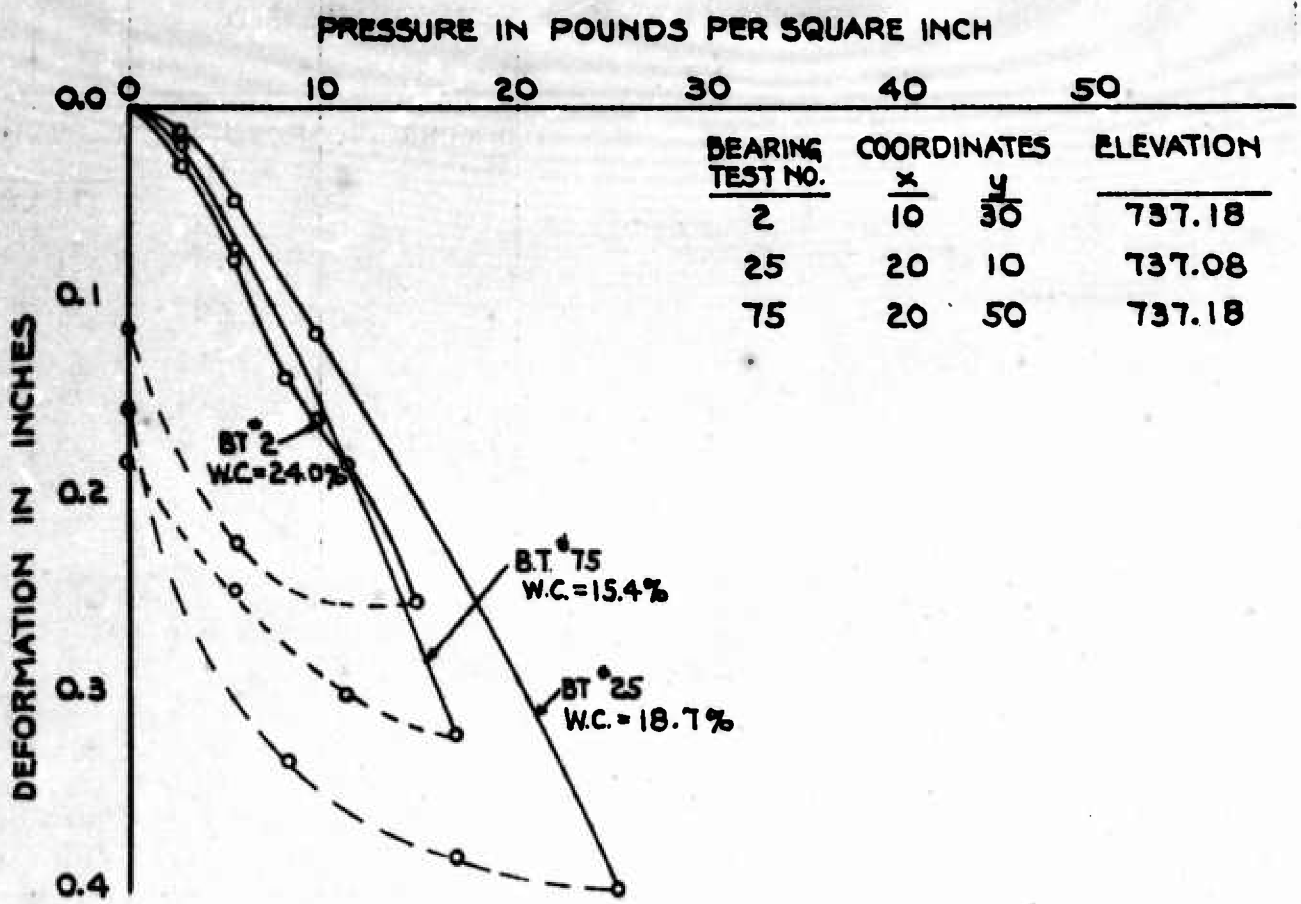
BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
3	30	10	737.08
27	20	30	737.18
74	20	50	737.28

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS/CU.FT. WET	UNIT WEIGHT IN LBS/CU.FT. DRY	W.C. %
45	10	5	124.8	103.9	22.0
46	9	14	125.0	103.5	20.7
47	27	16	119.9	94.6	26.7
48	27	5	123.7	101.0	22.0
197	31	35	126.2	101.5	24.3
198	29	26	123.6	99.2	24.7
199	8	34	126.8	104.7	21.0
200	10	23	126.1	100.0	26.0
229	33	46	124.2	102.3	21.7
230	34	54	126.8	108.2	16.9
231	13	45	132.5	109.5	21.0
232	10	54	124.5	100.8	23.6

SECTION H-H
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

OCT. 1943

FIGURE 10

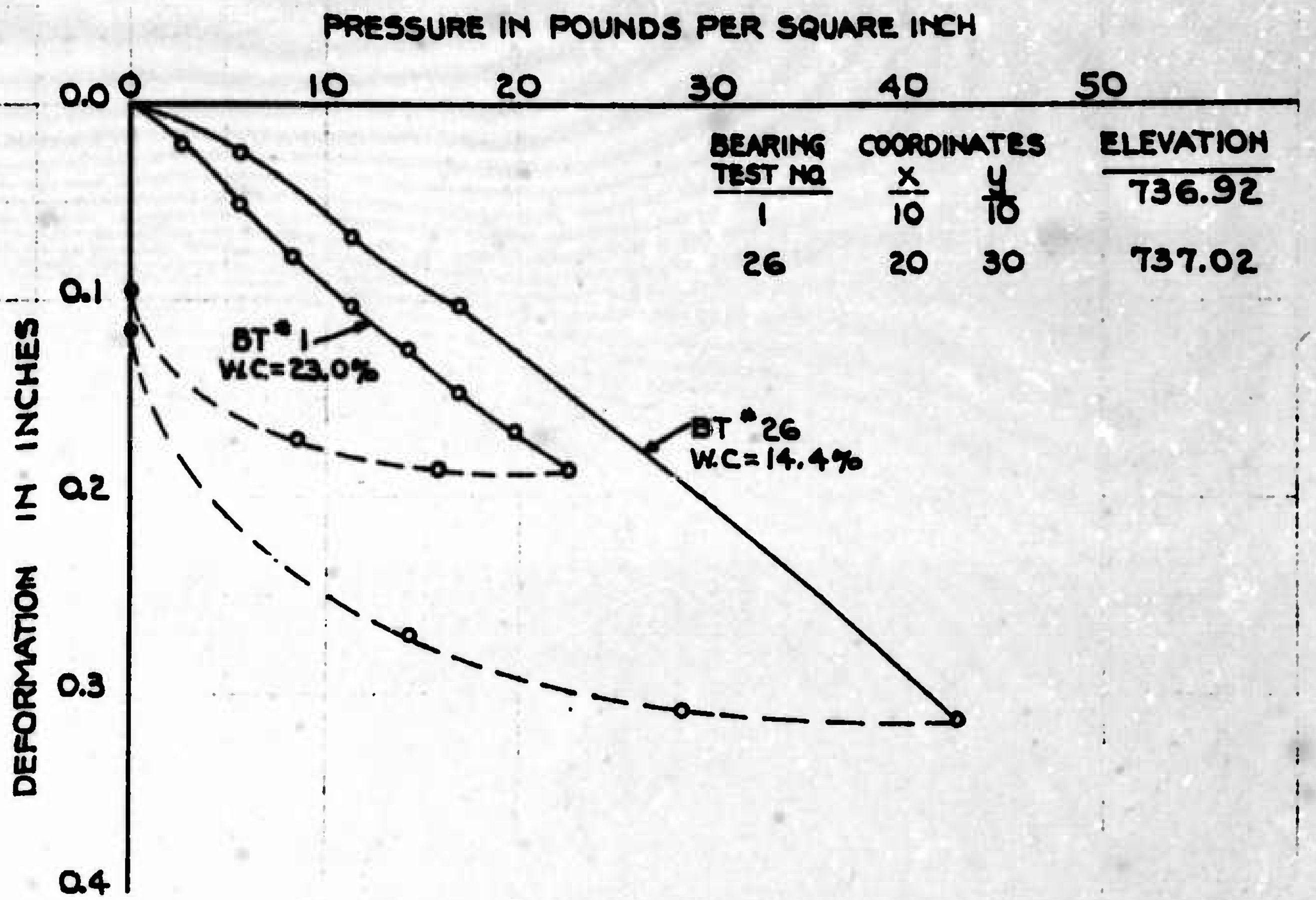


BEARING TEST NO.	COORDINATES x	y	ELEVATION
2	10	30	737.18
25	20	10	737.08
75	20	50	737.18

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS/CU. FT. WET	DRY	W. C. %
41	10	7	129.9	107.0	21.2
42	7	16	127.2	106.1	19.9
43	29	5	128.1	105.2	21.7
44	30	16	128.6	106.6	20.3
201	32	36	123.0	100.5	22.2
202	31	26.5	126.1	104.5	20.8
203	11.5	35.5	124.3	104.8	18.9
204	11	25	125.9	103.7	21.2
233	35	42	129.2	106.5	21.4
234	33	56	128.7	104.9	22.6
235	15	46	125.0	103.8	20.2
236	6	56	129.7	106.5	21.6

SECTION J-J
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO.
CINCINNATI TESTING LABORATORY
SOILS DIVISION
OCT. 1943

FIGURE 11



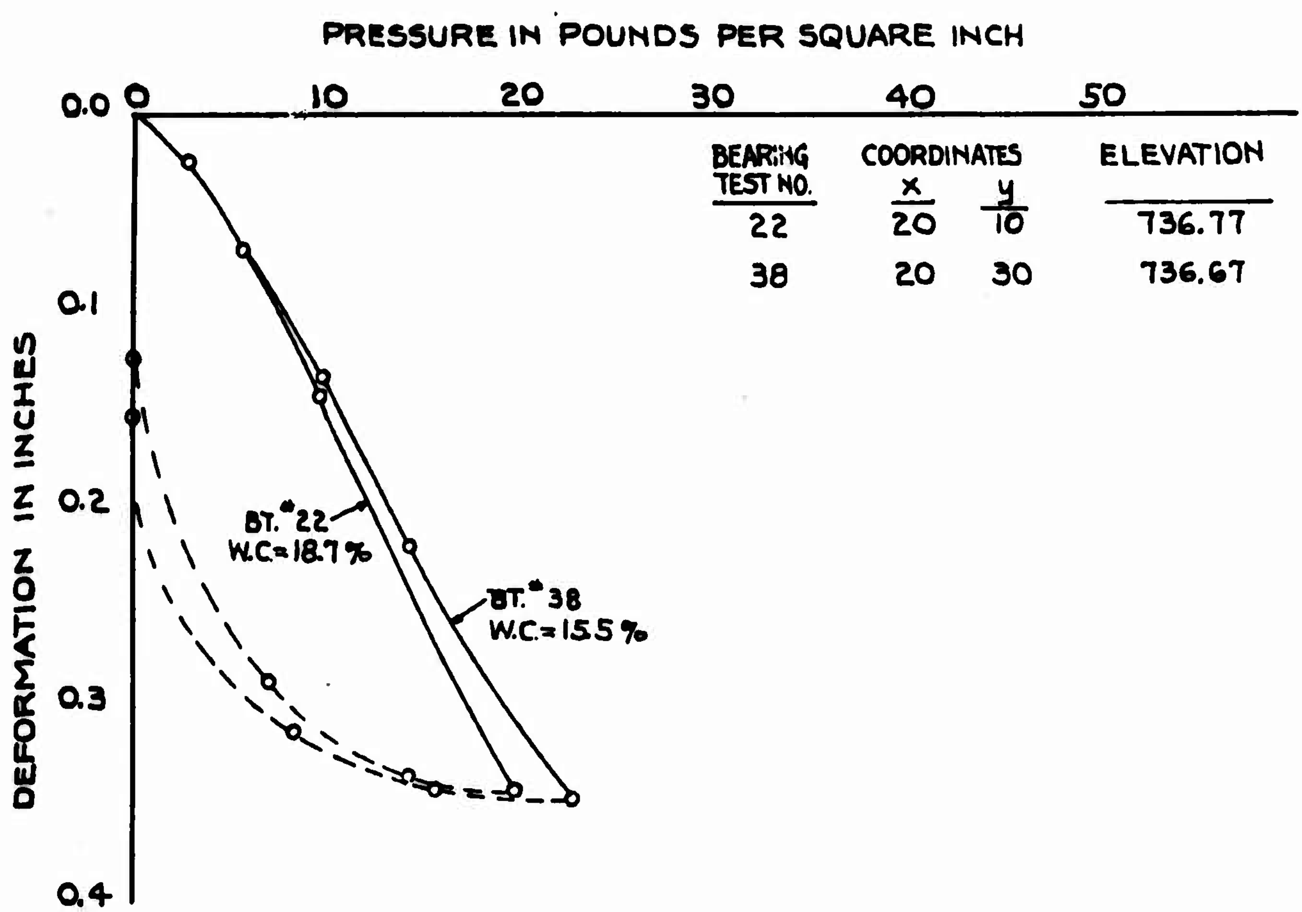
TEST NO.	COORDINATES X	COORDINATES Y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W.C. %
36	12	5	127.8	106.0	20.3
37	10	16	128.0	108.0	18.5
38	28	4	119.8	99.1	20.8
39	30	15	126.9	104.2	21.4
40	30	4	121.8	105.0	20.8
205	29	34.5	125.1	104.0	20.2
206	28	24	126.1	101.4	24.2
207	10	25	130.4	108.8	20.0
208	11	36	129.0	105.2	22.4
237	35	45	125.4	103.2	21.6
238	35.5	55	123.9	100.1	23.8
239	10	45	132.1	110.9	19.1
240	4	55	137.0	119.5	14.7

SECTION K-K
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO

C.T.L. SOILS DIVISION

OCT. 1943

FIGURE 12



TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W. C. %
73	10	5	124.8	103.4	20.5
74	13	16.5	128.2	107.4	20.0
75	30.5	5	127.3	104.7	21.8
76	31	16	126.7	106.8	18.6
157	10	25	132.8	114.9	15.6
158	12.5	36	130.1	112.8	15.5
159	30.5	23.5	126.4	105.7	19.8
160	28	36.5	129.0	108.1	19.1
225	6	54	133.9	114.0	17.1
226	11	45	135.1	116.2	16.2
227	33	48	128.2	106.6	20.4
228	29	55	135.7	116.7	16.1

SECTION L-L

SUBGRADE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

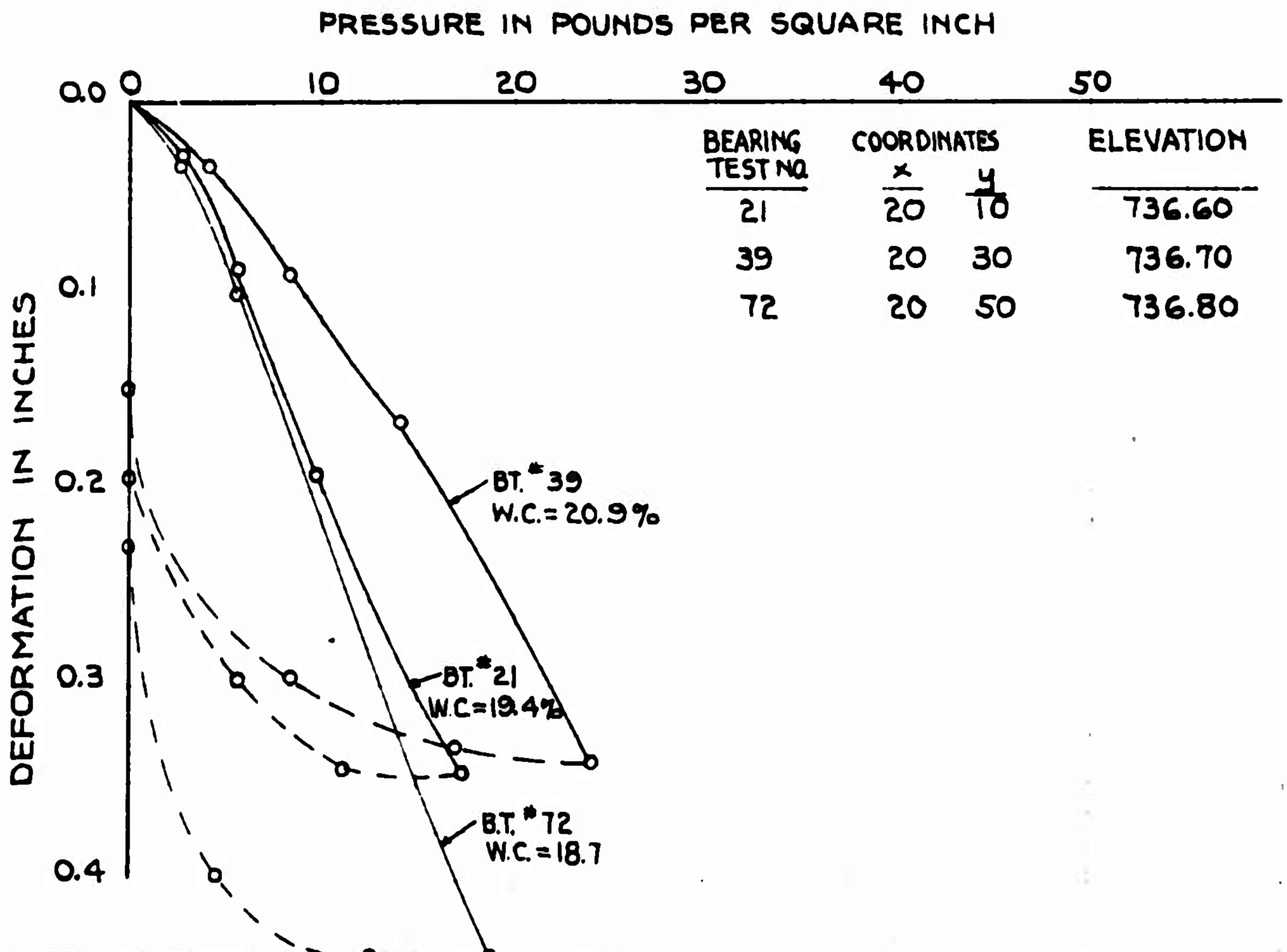
LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

OCT. 1943

FIGURE 13



BEARING TEST NO.	COORDINATES x	y	ELEVATION
21	20	10	736.60
39	20	30	736.70
72	20	50	736.80

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT. WET	DRY	W. C. %
69	12	4.5	127.0	106.1	19.8
70	8.5	14	126.9	106.1	19.6
71	28	6	125.1	103.3	21.0
72	29	17	129.1	106.5	21.2
142	9	26.5	127.0	105.0	20.9
143	10	35	125.1	104.5	19.9
144	29	35.5	126.8	105.9	19.7
145	27	23	127.7	106.8	19.6
217	10	55	137.8	120.9	13.9
218	13	48	130.7	110.2	18.2
219	30	55	134.2	118.9	13.0
220	34	45	128.8	106.8	20.4

SECTION M-M

SUBGRADE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

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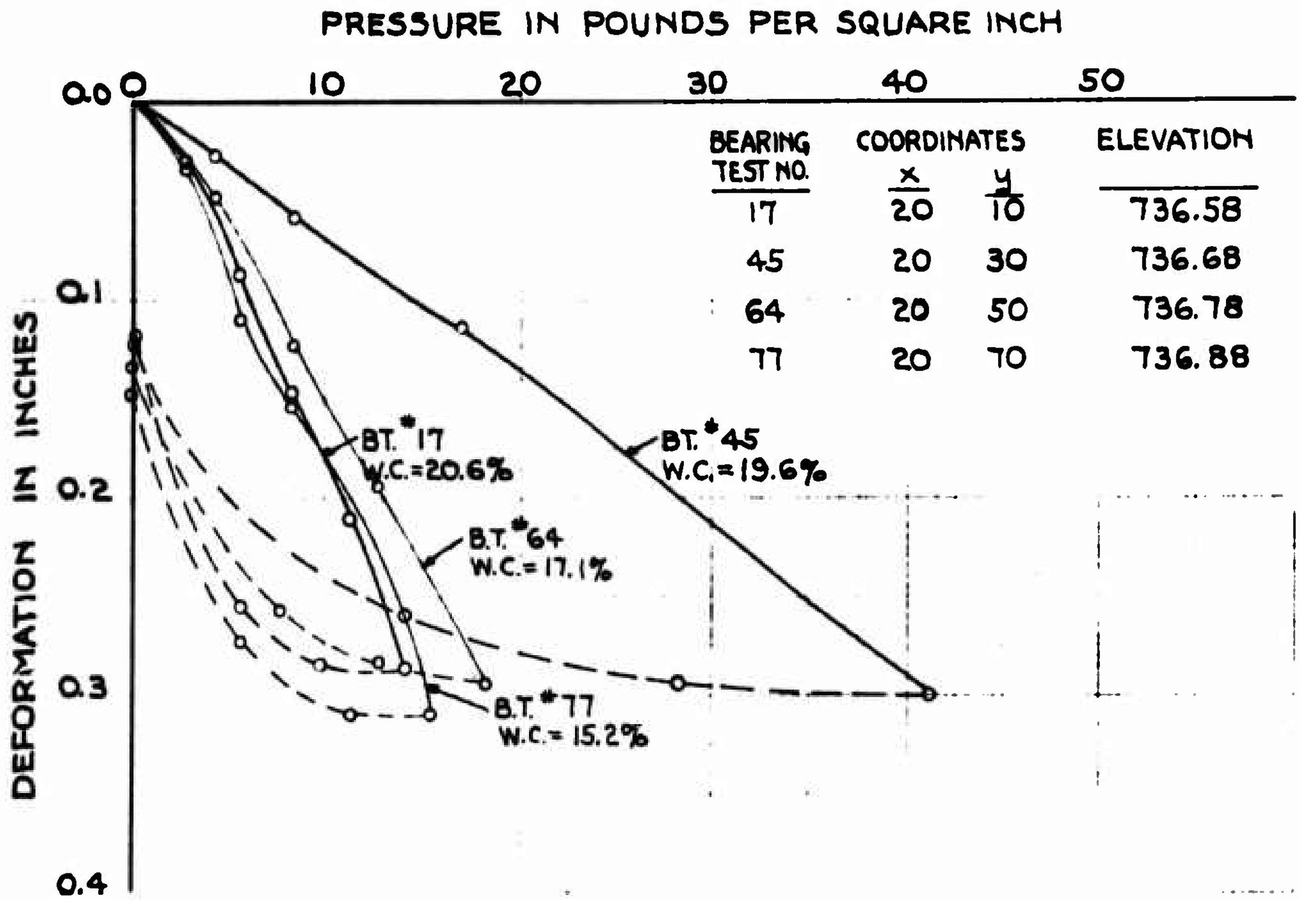
FIGURE 14



TEST NO	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W.C. %
65	11	4.5	127.1	105.5	20.8
66	30	5.5	122.9	101.5	21.0
67	30	15	123.0	102.1	20.2
68	30	16	124.9	102.7	21.6
135	6	24	128.1	106.3	20.4
136	6.5	33	130.0	110.7	17.4
137	31	26	125.3	103.5	21.1
138	24	31	128.3	107.3	19.8
189	4	47.5	132.0	115.5	14.1
190	9	54	131.2	109.0	20.4
191	27	46	131.0	111.2	17.8
192	29	54	134.1	117.2	14.3
247	15	64	130.8	111.1	17.5
248	30	75	124.9	102.3	21.9

SECTION N-N
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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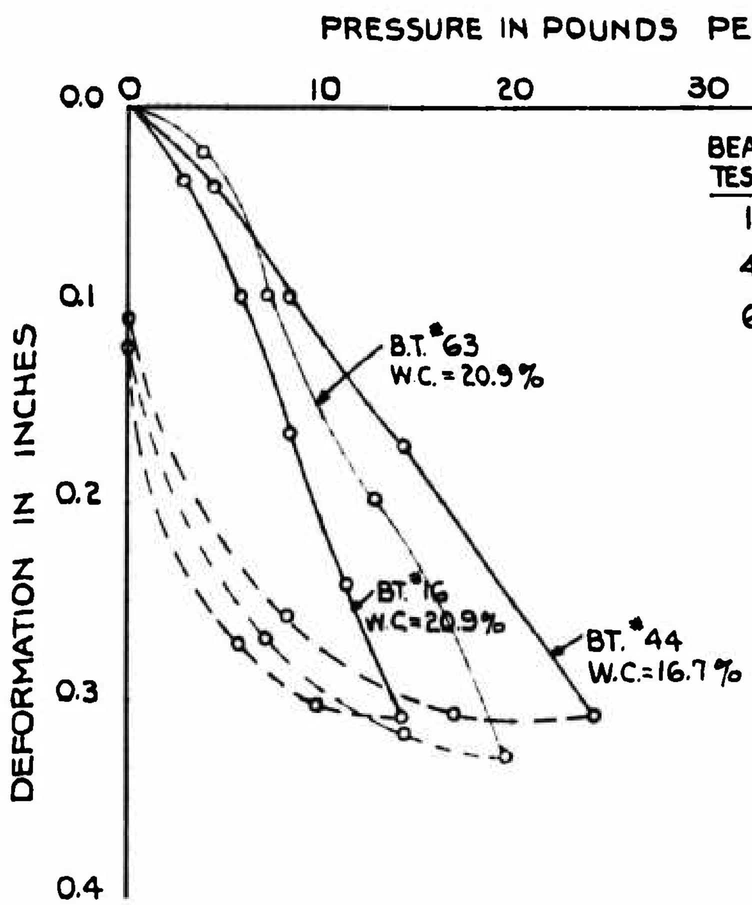
FIGURE 15



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
16	20	10	736.41
44	20	30	736.51
63	20	50	736.61

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT WET	UNIT WEIGHT IN LBS./CU.FT DRY	W. C %
61	8	7	124.8	102.3	21.9
62	9	15	121.8	101.8	19.6
63	34	5.5	126.0	102.9	22.3
64	32	15	125.0	101.1	23.7
131	9.5	34	127.9	107.9	18.4
132	11.5	25	128.9	105.5	22.0
133	34	25	123.0	102.1	20.4
134	35	36	129.0	105.7	22.0
185	10	46	123.0	102.0	20.8
186	12	55	124.1	100.7	23.5
187	35	54	131.0	118.0	11.1
188	31	46	126.9	104.1	21.9
243	12	70	132.6	116.8	13.5
244	30	68	133.2	120.7	10.6

SECTION O-O
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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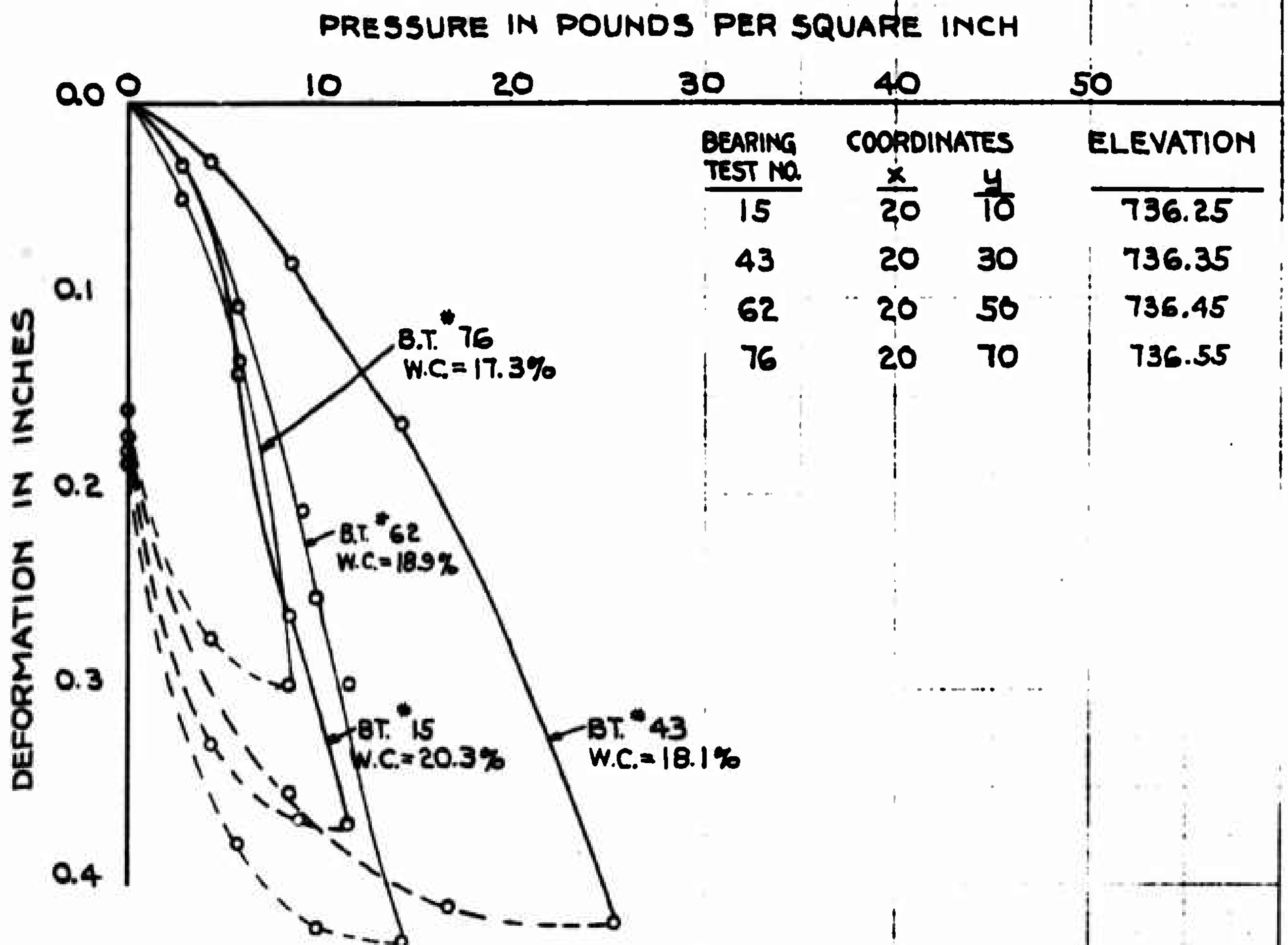
FIGURE 16



BEARING TEST NO.	COORDINATES x	y	ELEVATION
15	20	10	736.25
43	20	30	736.35
62	20	50	736.45
76	20	70	736.55

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT WET	DRY	W.C. %
57	13	5	122.8	100.0	22.4
58	8	15	122.4	100.9	21.2
59	30.5	6.5	124.8	100.8	23.8
60	33.5	15	125.9	103.6	21.4
125	9.5	36	125.7	105.0	19.7
126	12	28.5	128.9	109.5	17.5
127	29.5	31	124.0	102.1	21.2
128	33	26.5	122.9	98.7	24.5
181	10	47	122.0	100.0	22.0
182	16	57	124.5	104.2	19.3
183	36	45	125.8	104.2	20.6
184	34	56	126.0	105.1	19.9
245	10	67	126.0	102.0	23.5
246	35	56	134.2	117.6	14.1

SECTION P-P
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
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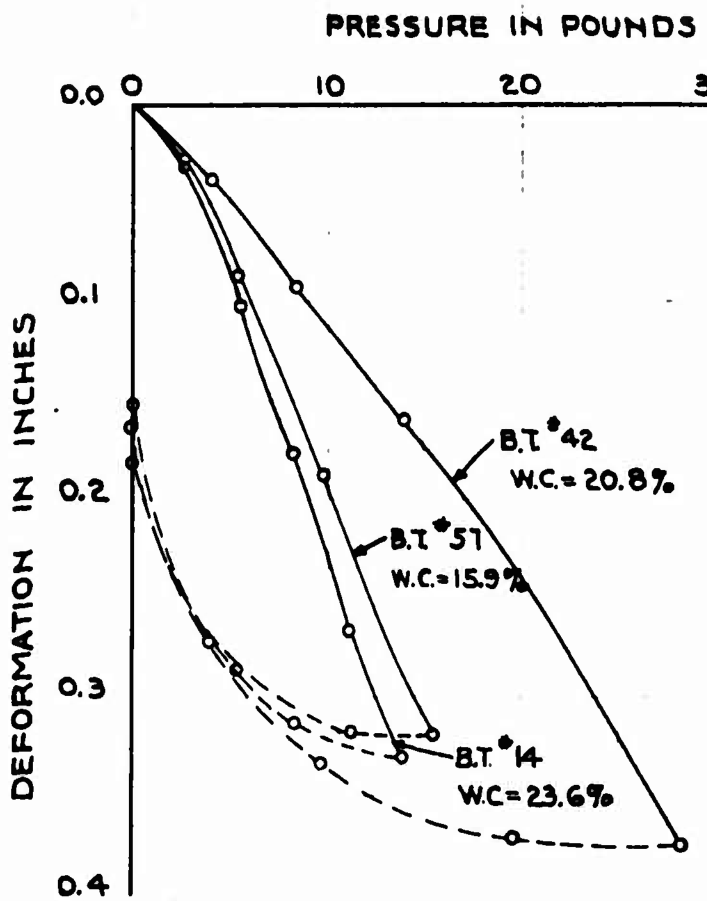
FIGURE 17



BEARING TEST NO.	COORDINATES x	y	ELEVATION
14	20	10	735.92
42	20	30	736.02
57	20	50	736.12

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT. WET	DRY	W.C. %
53	12	4	123.9	98.9	25.1
54	12	15	124.1	103.0	20.6
55	28	5	122.0	99.5	22.7
56	30.5	16	124.7	103.1	20.8
121	11.5	27	129.8	107.6	20.3
122	13	35	127.9	106.0	20.6
123	31.5	34.5	127.8	105.1	21.2
124	28.5	29.5	132.1	110.7	19.5
177	10	46	127.1	109.1	16.7
178	17	53	133.7	116.7	14.5
179	32	54	125.5	103.2	21.7
180	33	47	128.2	103.7	23.9
241	11	70	129.0	113.1	14.0
242	32	67	138.1	121.3	13.9

SECTION Q-Q

SUBGRADE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

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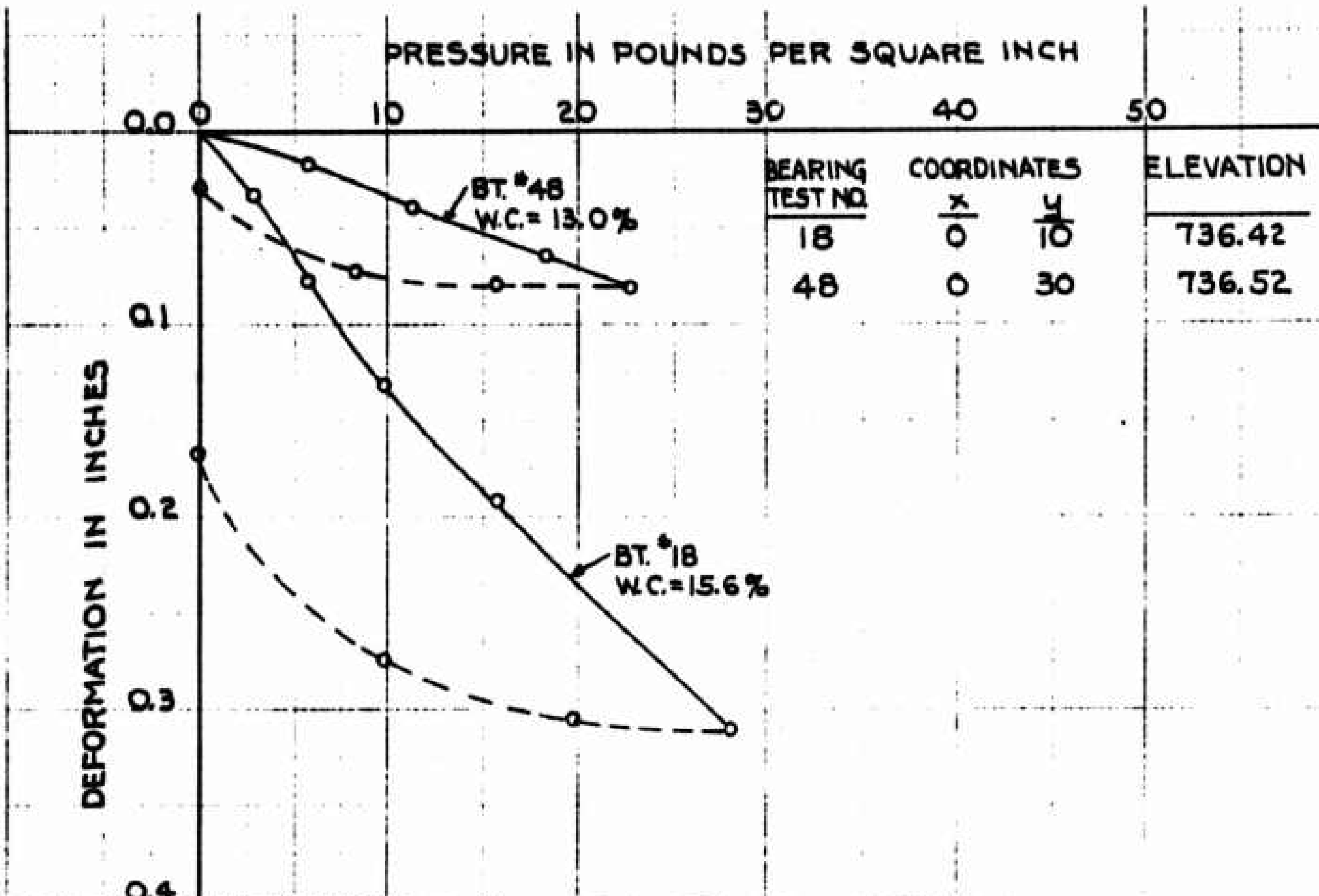
FIGURE 18



TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W. C. %
87	3	8	136.1	117.8	15.8
88	10	11.5	134.8	115.3	16.8
89	2	6	129.1	109.1	18.5
90	12	17	137.0	118.6	15.6
91	4	6.5	128.0	105.4	21.2
92	13	14	128.9	111.5	15.6
154	10	30	131.5	112.8	16.7
155	10	30	137.7	124.4	10.6
156	10	30	130.0	113.5	14.5

SECTION W_1 & X_2
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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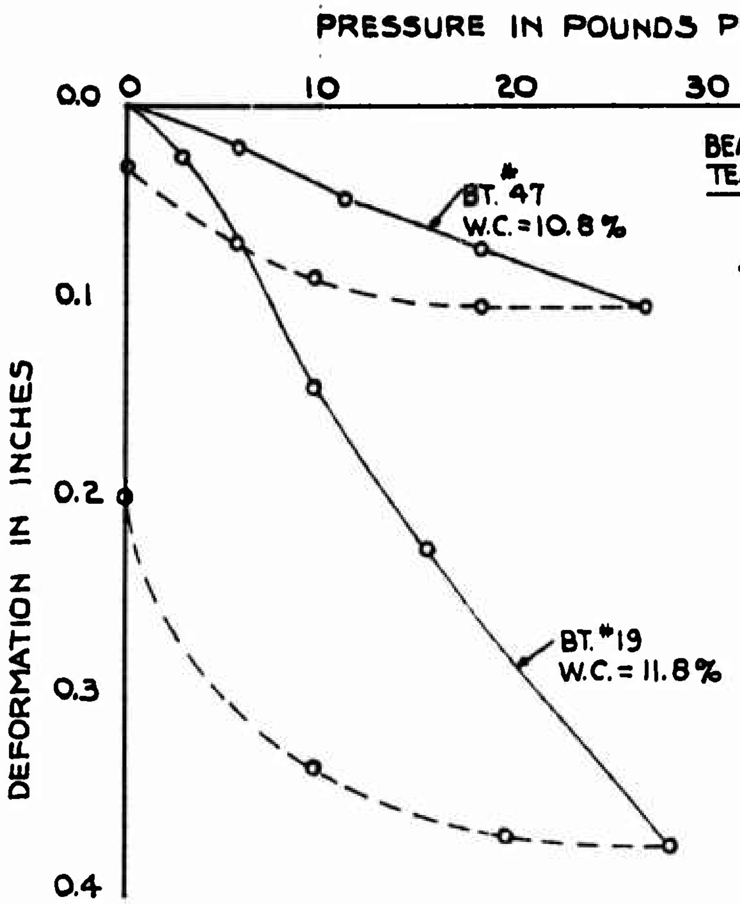
FIGURE 19



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
19	0	10	736.42
47	0	30	736.52

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT WET	UNIT WEIGHT IN LBS./CU.FT DRY	W.C. %
83	2.5	7	126.1	105.3	19.8
84	9	11	130.9	111.2	17.7
85	5.5	3	132.9	112.6	18.0
86	12.5	14	132.0	114.1	15.8
151	9.5	30	118.2	107.3	10.1
152	10	30	128.3	114.7	12.0

SECTION V_1 & W_2
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
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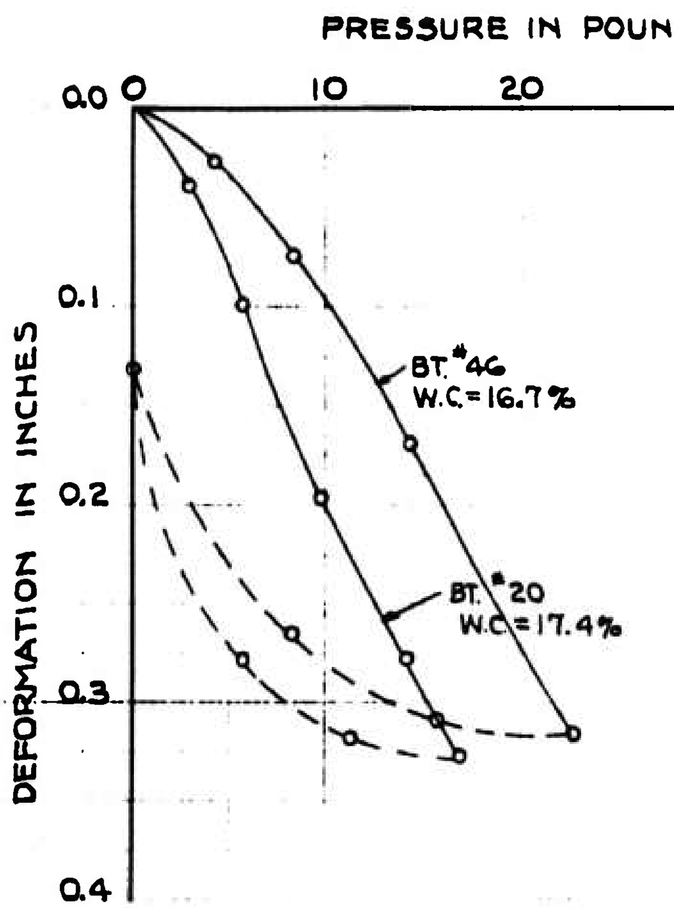
FIGURE 20



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
20	0	6	736.40
46	0	30	736.52

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W. C. %
77	3.5	4	127.7	103.7	23.0
78	12.5	16	124.1	102.2	21.8
79	7	8	129.9	106.9	21.2
80	15	11.5	128.8	106.0	21.2
81	5	4	126.0	103.8	21.6
82	11	14	124.2	101.8	22.1
146	9	27	131.0	108.8	20.4
147	13	35	126.0	103.6	21.8
148	3	35	132.9	112.1	18.6
149	8.5	25	131.0	109.7	19.2
150	10	30	129.1	110.0	17.5
153	14	23	127.3	104.0	22.3

SECTION V_2 & V_3

SUBGRADE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

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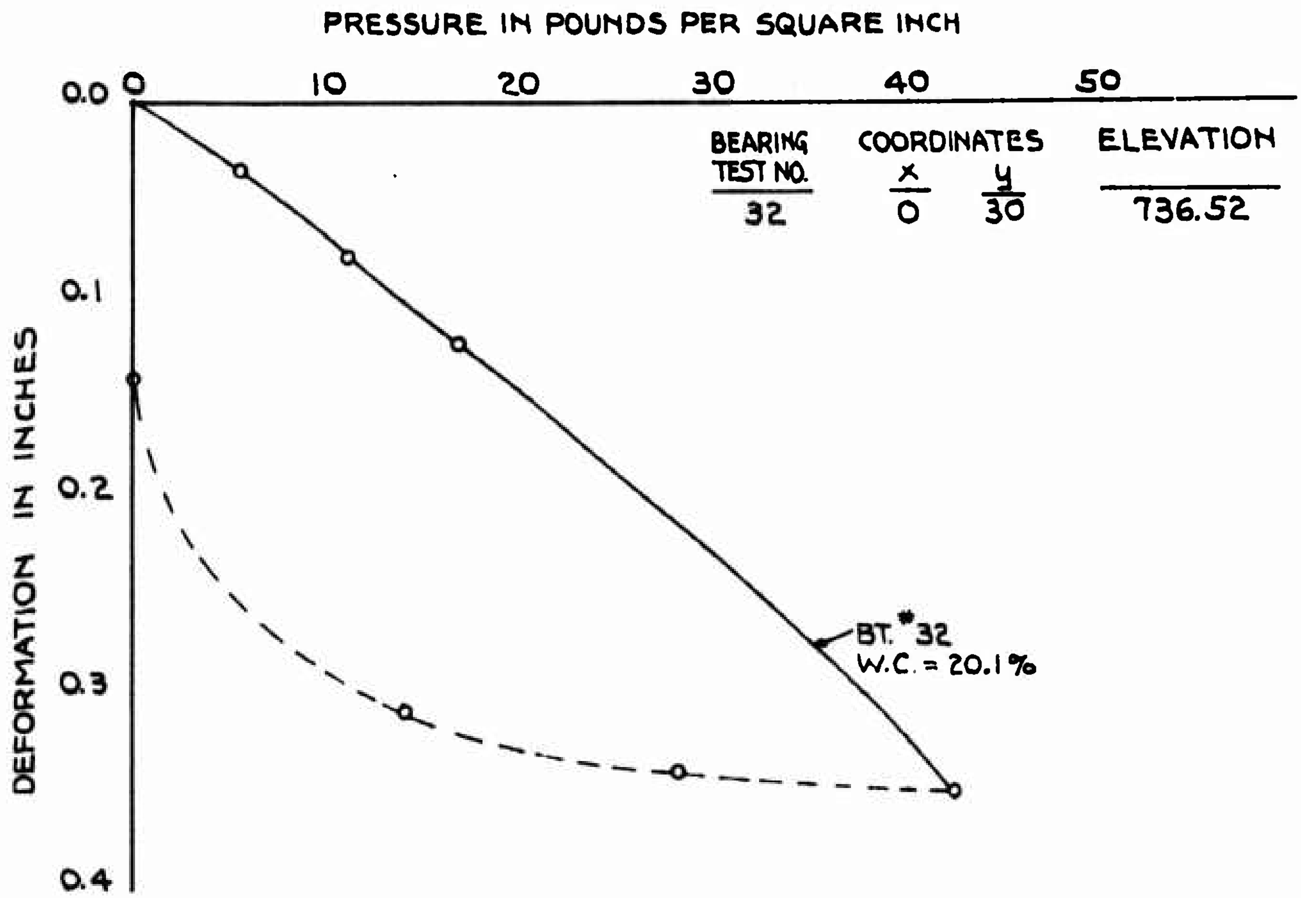
FIGURE 21



TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W.C. %
27	8.5	10	121.7	96.9	25.5
28	8.5	10	133.3	113.4	17.7
113	8.5	30	130.8	112.6	16.0
114	8.5	30	130.2	111.9	16.7
34	8.5	10	129.9	109.5	18.4

SECTION Y_1 & Y_2
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
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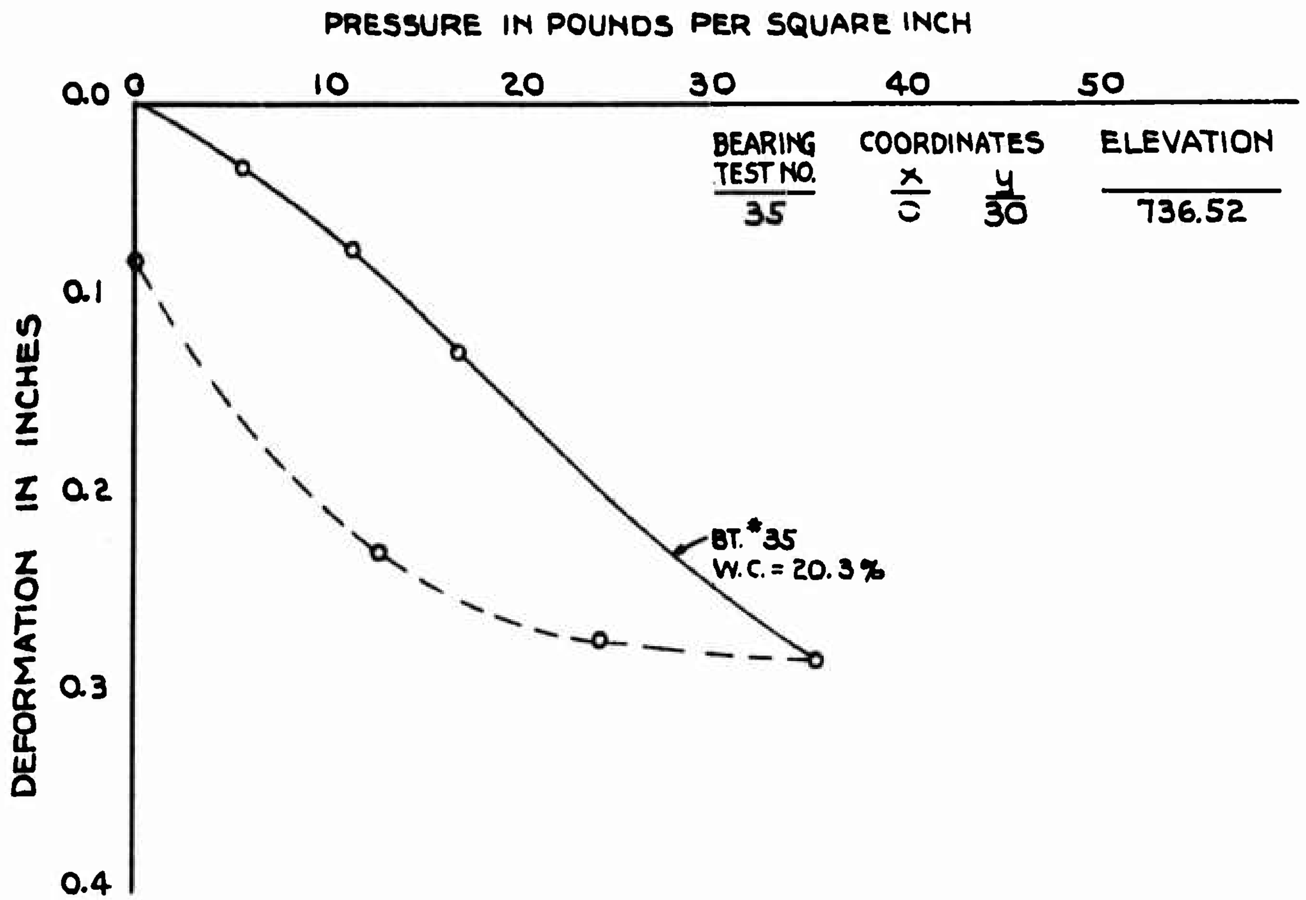
FIGURE 22



TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W. C. %
31	8.5	10	127.1	105.1	21.0
32	8.5	10	128.0	109.2	17.1
117	8.5	30	127.9	105.7	20.9
118	8.5	30	119.8	100.0	19.8

SECTION Z_3 & Z_4
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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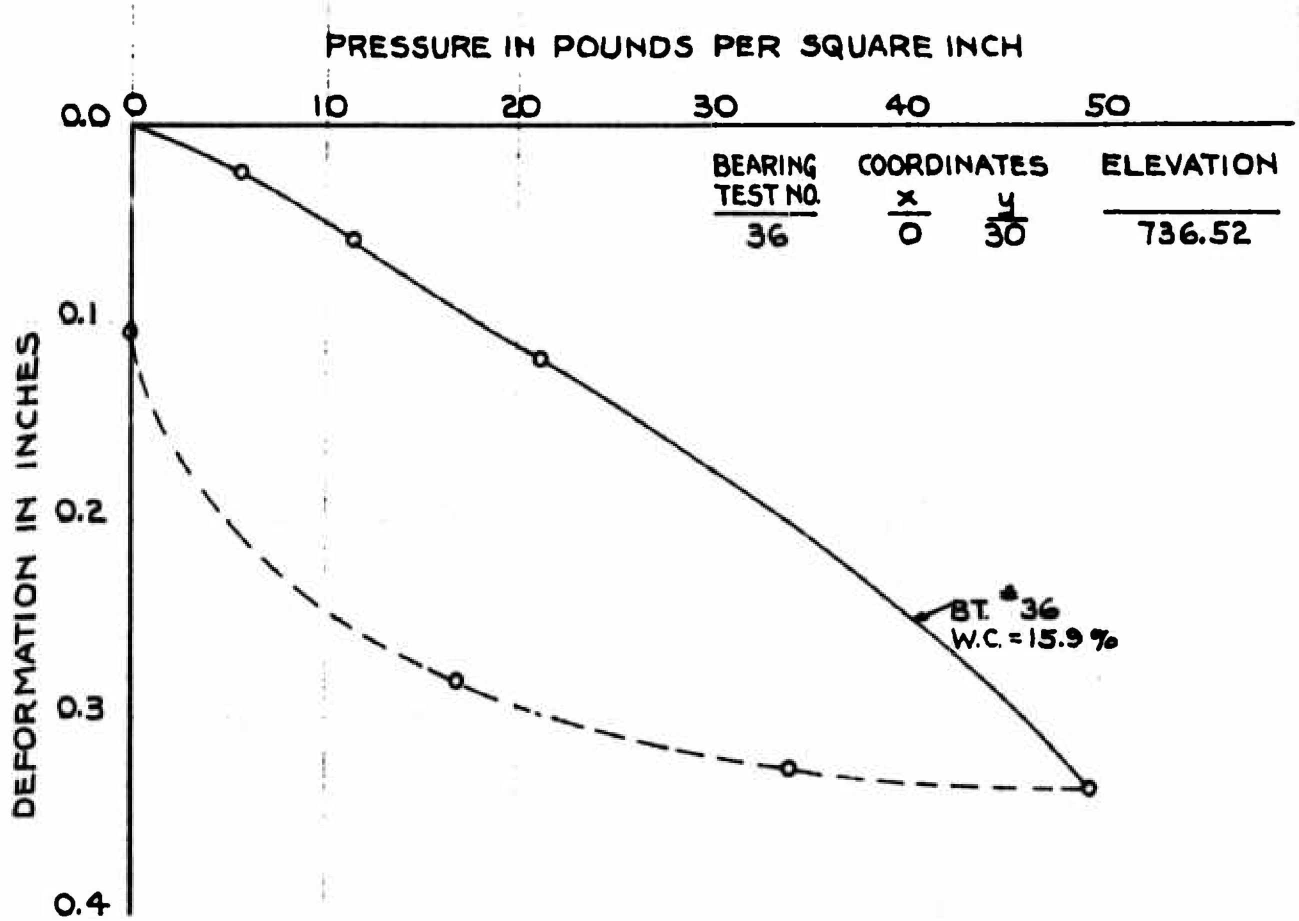
FIGURE 23



TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT. WET	DRY	W.C. %
29	8.5	10	129.6	109.1	18.8
30	8.5	10	122.8	105.0	16.9
115	8.5	30	126.2	108.3	16.8
116	8.5	30	121.7	103.5	17.2

SECTION W_3 & W_4
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
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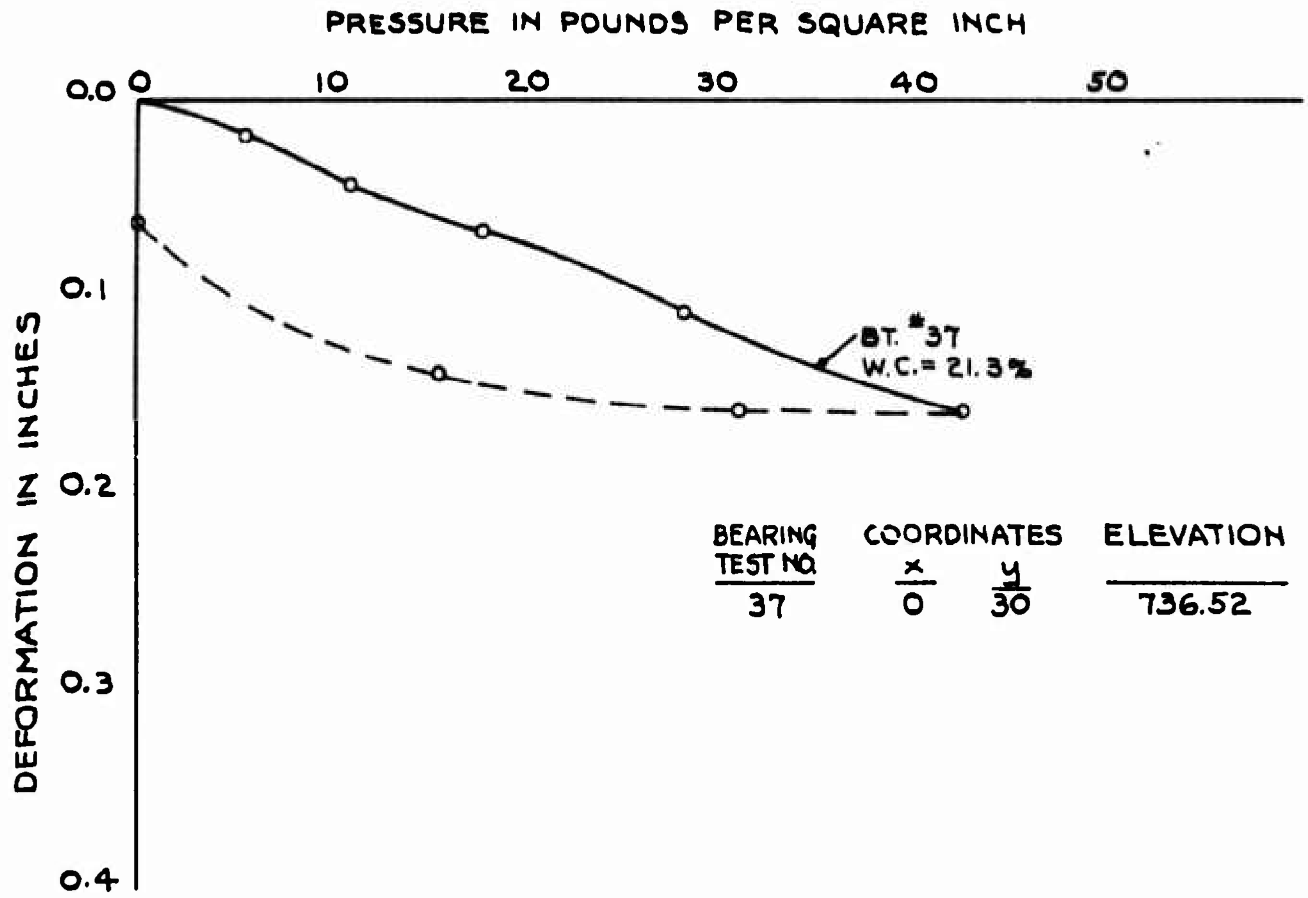
FIGURE 24



TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT. WET	DRY	W. C. %
33	8.5	10	133.0	119.1	11.7
35	8.5	10	136.2	120.0	13.7
119	8.5	30	123.7	105.1	17.5
120	8.5	30	128.5	112.8	13.9

SECTION Z_1 & Z_2
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
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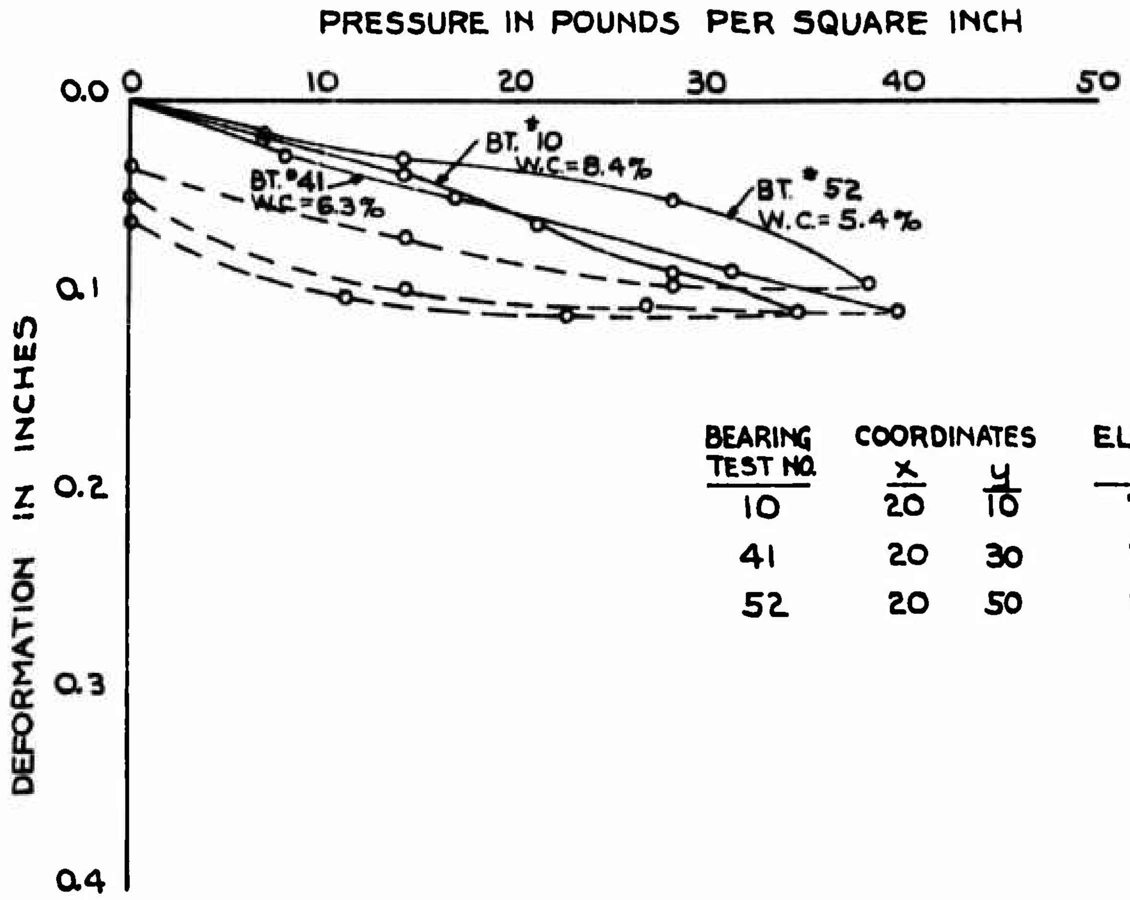
FIGURE 25



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
10	20	10	736.25
41	20	30	736.35
52	20	50	736.45

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W.C. %
9	20	11	137.9	127.1	8.4
24	10	8	141.0	129.9	8.6
27	30	8	147.1	136.3	8.0
38	10	8	148.2	135.5	9.6
1	20	30	137.1	125.2	9.6
3	20	30	132.1	118.2	11.9
6	20	25	131.9	119.5	10.2
37	20	30	135.9	123.7	9.9
17	20	52	131.3	122.4	7.2
23	30	54	128.8	118.0	9.0
36	15	57	135.9	125.1	8.3

SECTION R-R
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
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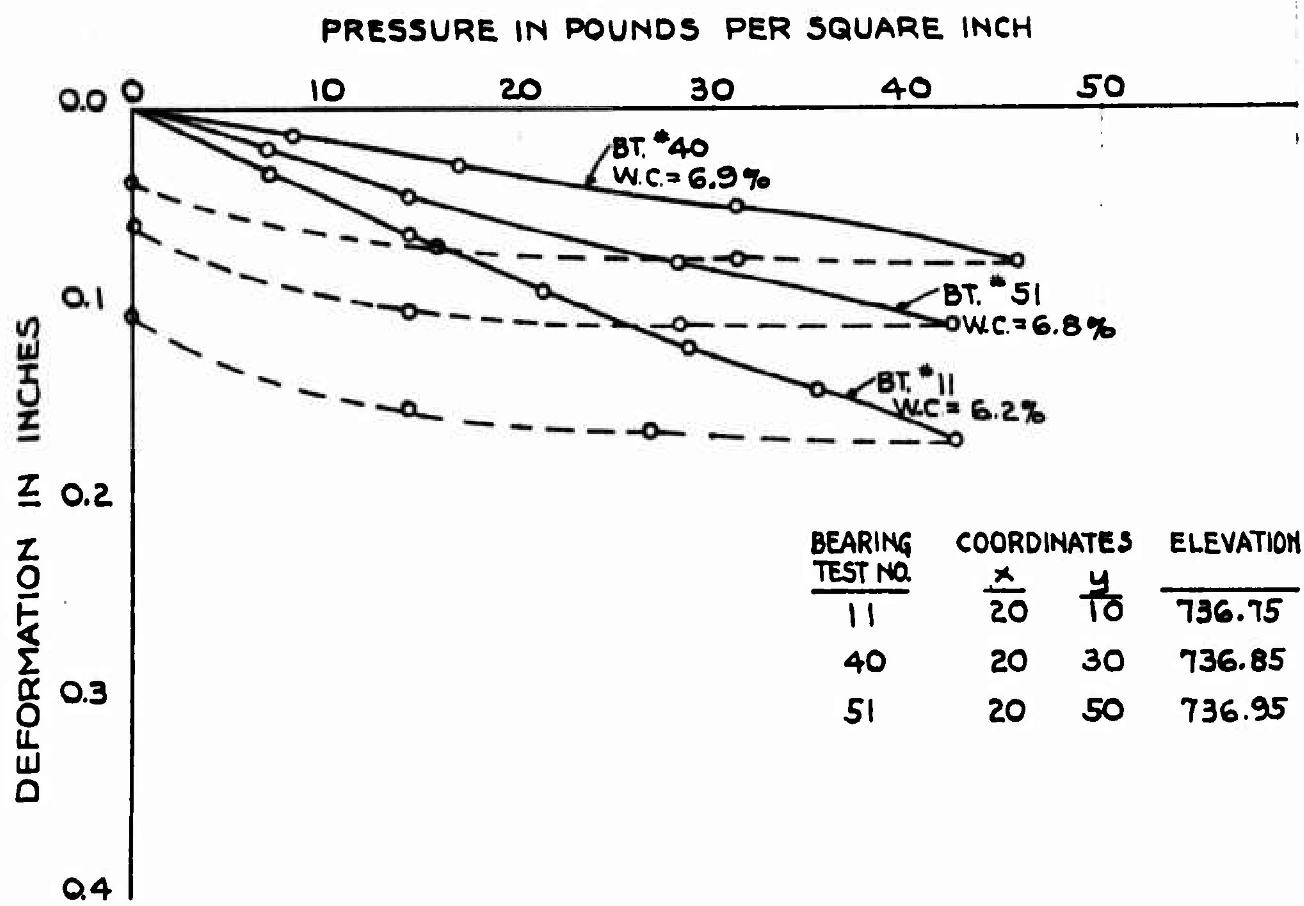
FIGURE 26

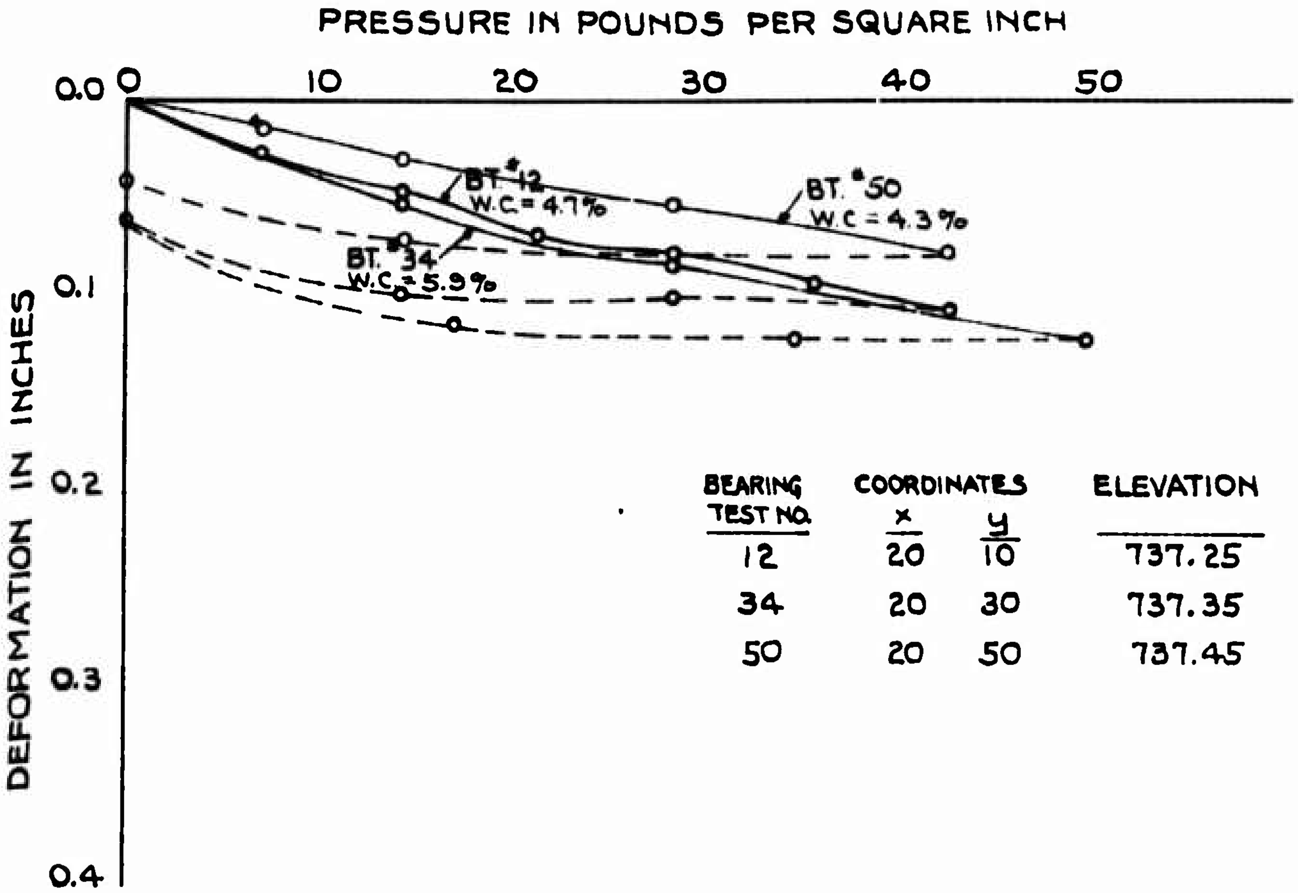


BEARING TEST NO.	COORDINATES x	y	ELEVATION
11	20	10	736.75
40	20	30	736.85
51	20	50	736.95

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU.FT WET	DRY	W.C %
16	20	8	147.9	135.1	9.2
26	30	8	141.0	128.9	9.2
39	15	8	131.0	121.1	8.0
4	20	30	134.0	121.2	10.6
8	20	20	130.0	118.8	9.6
32	30	30	132.0	122.8	7.5
14	20	52	134.0	124.2	7.9
33	30	59	135.0	123.1	9.8
40	30	52	132.5	123.6	7.1

SECTION 5-5
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
OCT. 1943

FIGURE 27



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
12	20	10	737.25
34	20	30	737.35
50	20	50	737.45

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W. C. %
12	20	8	140.2	131.6	6.8
16	6	13.5	134.2	127.3	5.7
17	29	4.5	140.0	133.5	4.9
29	20	10	138.9	133.1	4.1
30	20	3	142.2	132.6	7.3
31	10	18	135.7	127.1	6.8
42	10	6	151.6	141.6	7.0
2	20	30	135.2	128.2	5.6
5	20	30	134.8	125.3	7.2
22	25	30	136.0	125.3	8.7
62	10	33.5	141.0	135.1	4.2
63	31.5	26	141.7	134.6	5.1
10	20	52	135.6	126.4	7.1
15	20	52	145.8	136.8	6.6
20	10	52	138.9	130.2	6.7
41	25	57	146.8	137.2	6.9
87	16	54	149.8	139.2	7.4
88	33	44	150.0	139.1	7.9
21	30	8	144.1	131.4	9.7

SECTION T-T
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION
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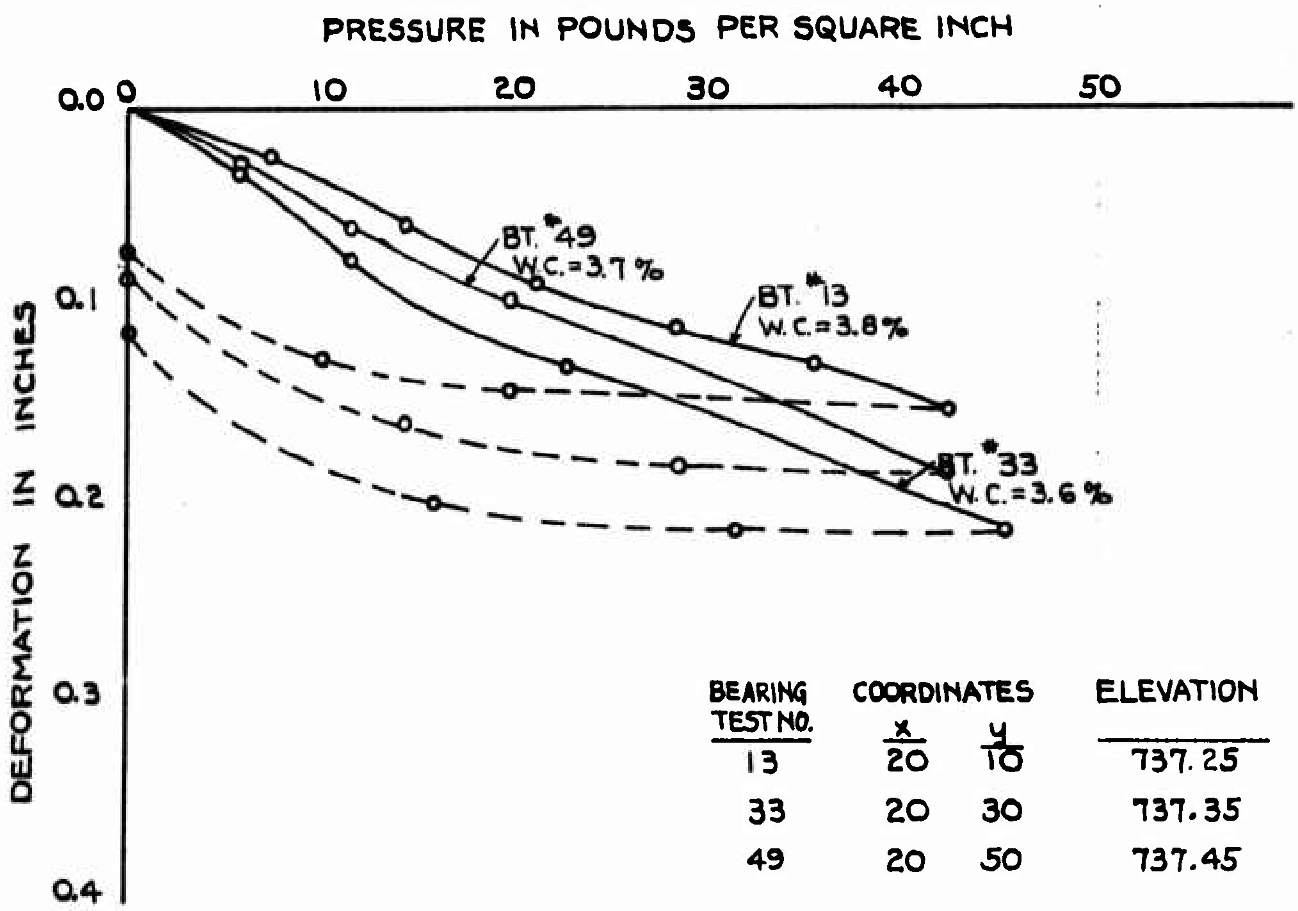
FIGURE 28



BEARING TEST NO.	COORDINATES x	y	ELEVATION
13	20	10	737.25
33	20	30	737.35
49	20	50	737.45

TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT WET	DRY	W. C. %
11	20	8	119.3	113.2	5.2
14	6	4.5	119.3	115.2	3.7
15	32.5	16	119.4	114.8	4.0
19	10	8	115.0	109.0	5.4
34	15	3	127.2	120.8	5.3
35	10	3	127.1	120.3	5.8
43	25	3	123.4	118.8	4.0
7	20	40	112.1	107.2	4.2
25	10	30	123.8	118.1	4.8
60	11	33.5	118.7	114.0	4.0
61	35	27	115.6	111.8	3.3
13	20	52	126.0	120.3	4.8
18	30	52	125.9	120.2	4.5
28	10	52	124.1	117.9	5.2
29	30	52	130.0	123.5	5.1
44	10	52	129.8	124.1	4.3
85	9	55	125.8	122.4	2.7
86	31	45	125.0	120.8	3.6

SECTION U-U
SUBGRADE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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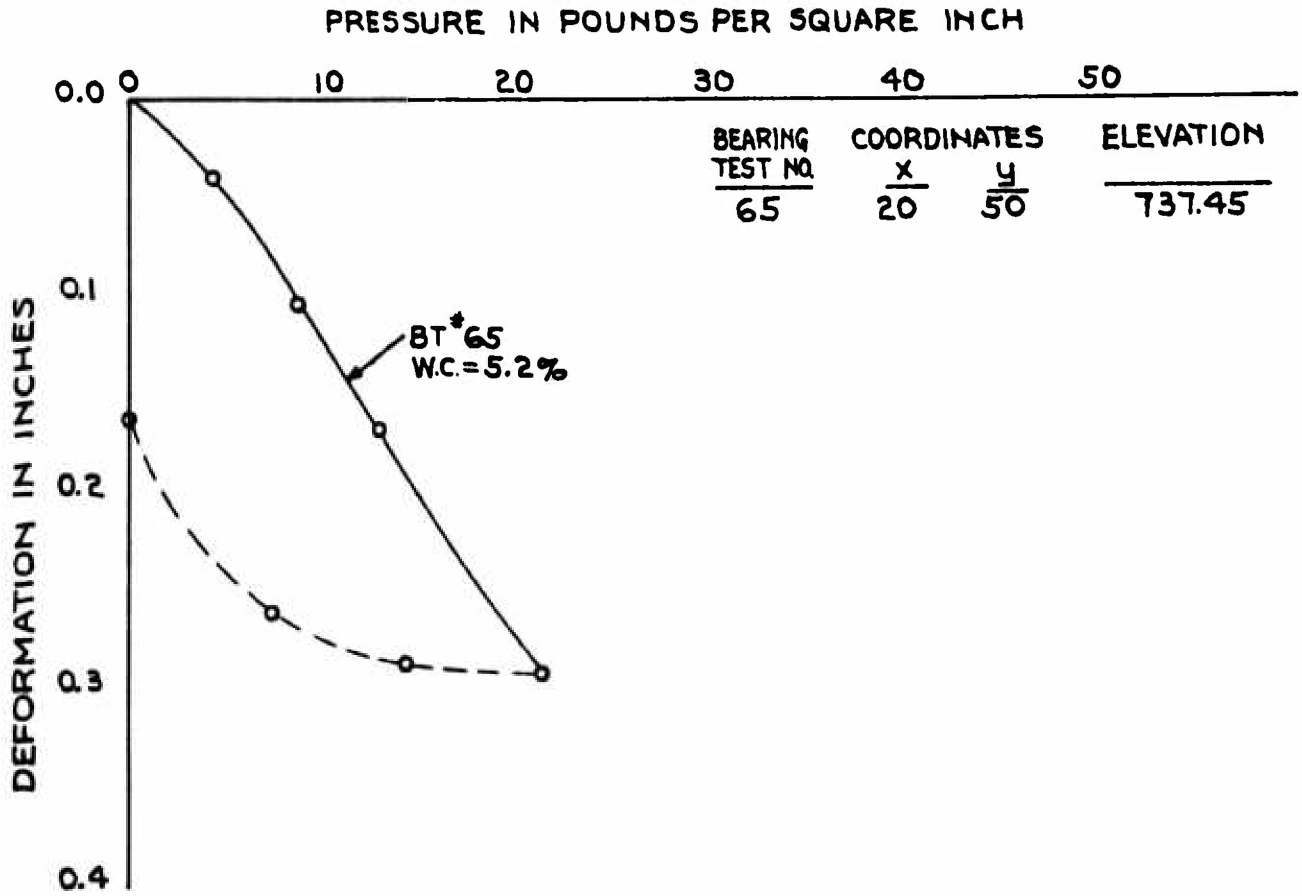
FIGURE 29



SECTION B-B
BASE COURSE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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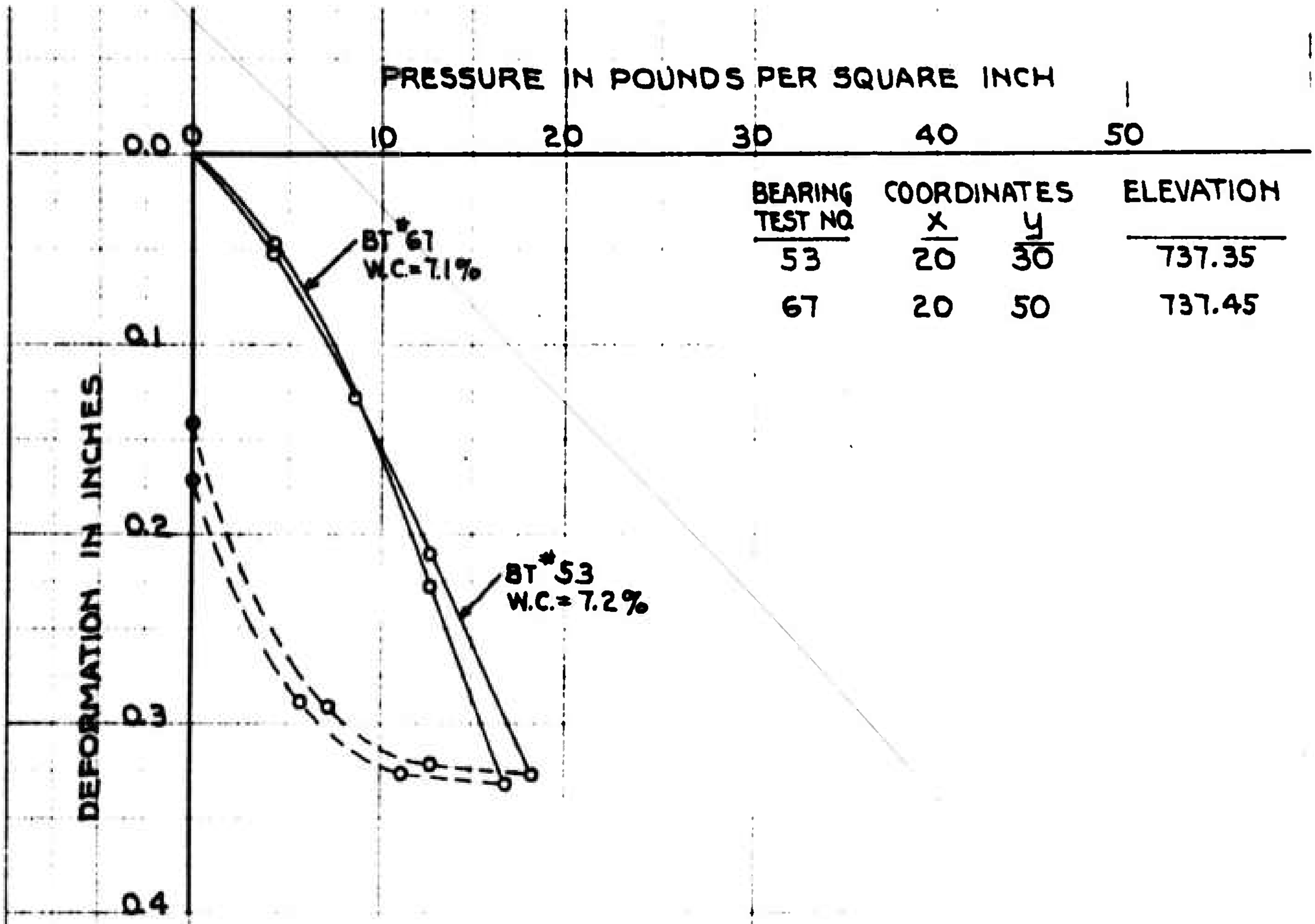
FIGURE 30



BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
53	20	30	737.35
67	20	50	737.45

TEST NO.	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W.C %
9	12	4.5	132.0	123.9	6.5
10	29	15.5	132.9	125.2	6.0
37	20	10	135.0	129.1	4.4
56	33.5	36	134.2	126.1	6.4
57	6.5	25	135.2	127.2	6.2
95	6	46	133.2	126.2	5.7
96	29	55	126.1	119.8	5.4

SECTION D-D
BASE COURSE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

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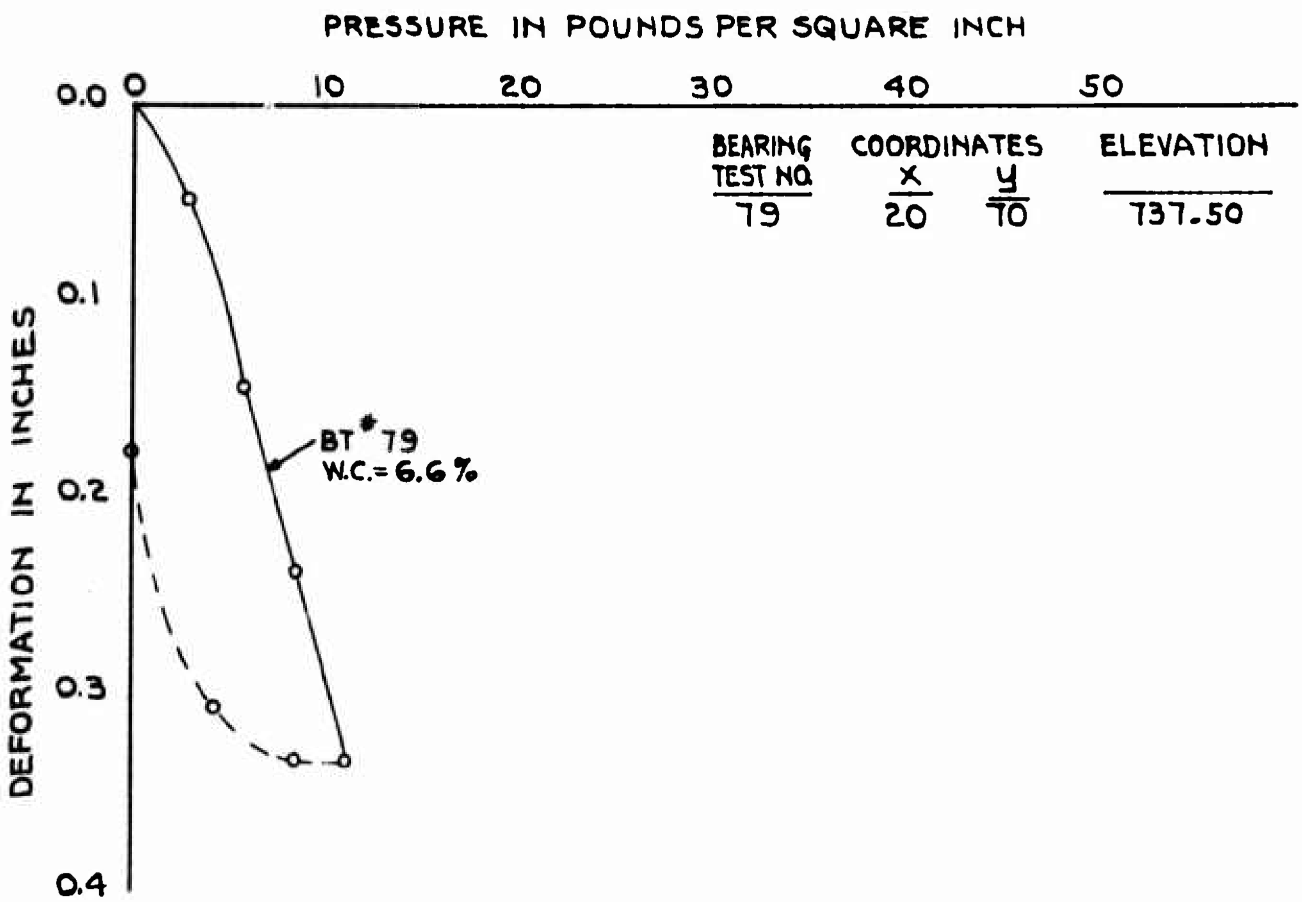
FIGURE 31



TEST NO.	COORDINATES X	Y	UNIT WEIGHT IN LBS./CU.FT. WET	DRY	W.C. %
28	9	7.5	137.9	130.6	5.5
33	27	15	138.2	131.0	5.8
36	20	10	140.3	133.1	5.4
74	8	30	139.0	130.5	6.3
75	30	36	138.0	128.3	7.3
106	10	47	144.7	135.7	6.6
107	30	53	146.1	137.2	6.6
115	5	66	129.5	122.2	5.9
116	30	73	137.1	126.5	8.4

SECTION N-N

BASE COURSE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

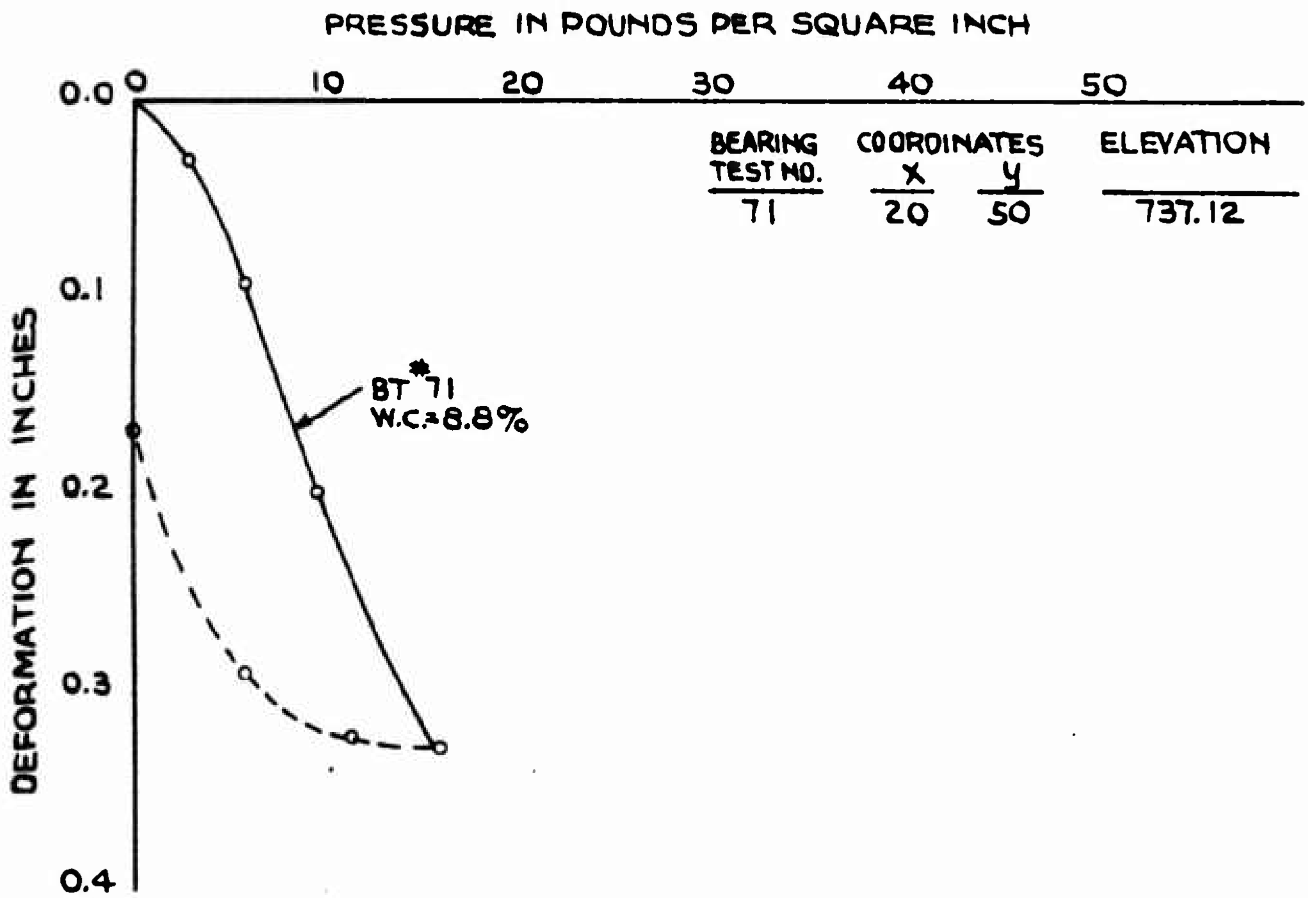
LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

JAN. 1944

FIGURE 32

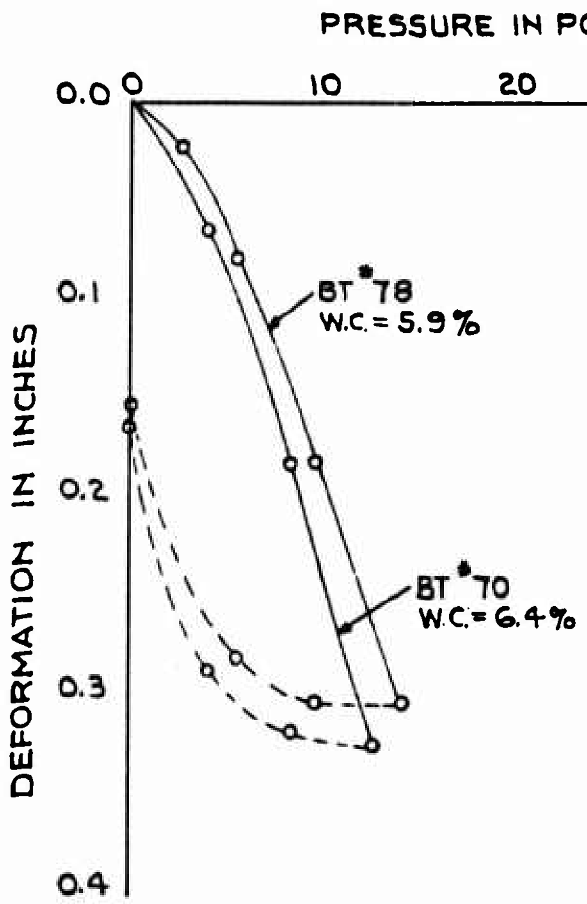


TEST NO.	COORDINATES X	COORDINATES Y	UNIT WEIGHT IN LBS./CU. FT. WET	UNIT WEIGHT IN LBS./CU. FT. DRY	W.C. %
26	11	4.5	142.9	133.8	6.8
27	36.5	15.5	141.0	132.4	6.3
35	20	10	146.2	138.0	6.0
72	12	26	141.0	130.0	8.3
73	32	36	135.1	127.0	6.3
101	12	43.5	142.2	133.8	6.5
102	31	57	142.9	132.9	7.3
113	10	65	129.0	122.3	5.2
114	27	76	144.9	134.8	7.3

SECTION O-O
BASE COURSE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

JAN. 1944

FIGURE 33



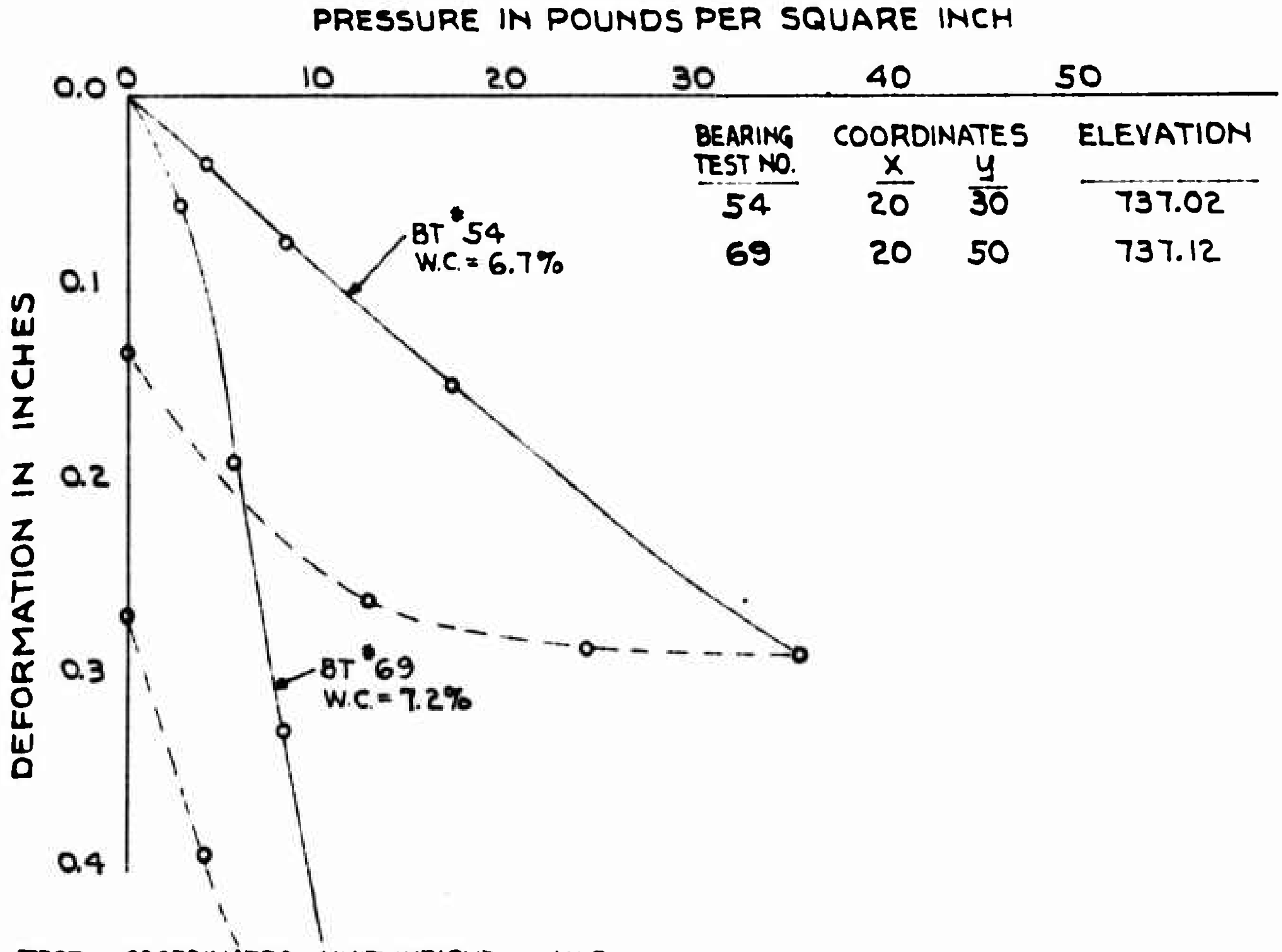
BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
70	20	50	737.28
78	20	70	737.33

TEST NO	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS./CU.FT. WET	UNIT WEIGHT IN LBS./CU.FT. DRY	W.C. %
24	10	4.5	140.0	132.6	5.5
25	33	11.5	138.1	131.1	5.3
34	20	10	137.0	130.1	5.1
70	7.5	27	135.8	128.5	5.5
71	32	36	135.3	128.7	5.2
103	5.5	56	141.0	131.2	7.2
104	28	45	136.1	125.3	8.8
105	10	50	134.9	126.4	6.8
111	10.5	64	144.8	134.3	7.8
112	35	76	138.4	130.0	6.6

SECTION P-P
BASE COURSE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

JAN. 1944

FIGURE 34



BEARING TEST NO.	COORDINATES X	COORDINATES Y	ELEVATION
54	20	30	737.02
69	20	50	737.12

TEST NO.	COORDINATES X	COORDINATES Y	UNIT WEIGHT IN LBS./CU. FT WET	UNIT WEIGHT IN LBS./CU. FT DRY	W.C. %
22	8	8	137.4	130.2	5.6
23	32	15	135.9	127.8	6.1
32	20	10	136.9	130.8	4.6
68	33	35.5	144.2	133.4	8.1
69	8	24	145.0	134.9	7.6
99	36	56	135.8	128.7	5.4
100	12	43	126.9	120.0	5.8
108	7	54	144.9	132.5	9.1
109	10	75	146.0	134.6	8.5
110	32	*68	143.0	133.0	7.6

SECTION Q-Q

BASE COURSE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

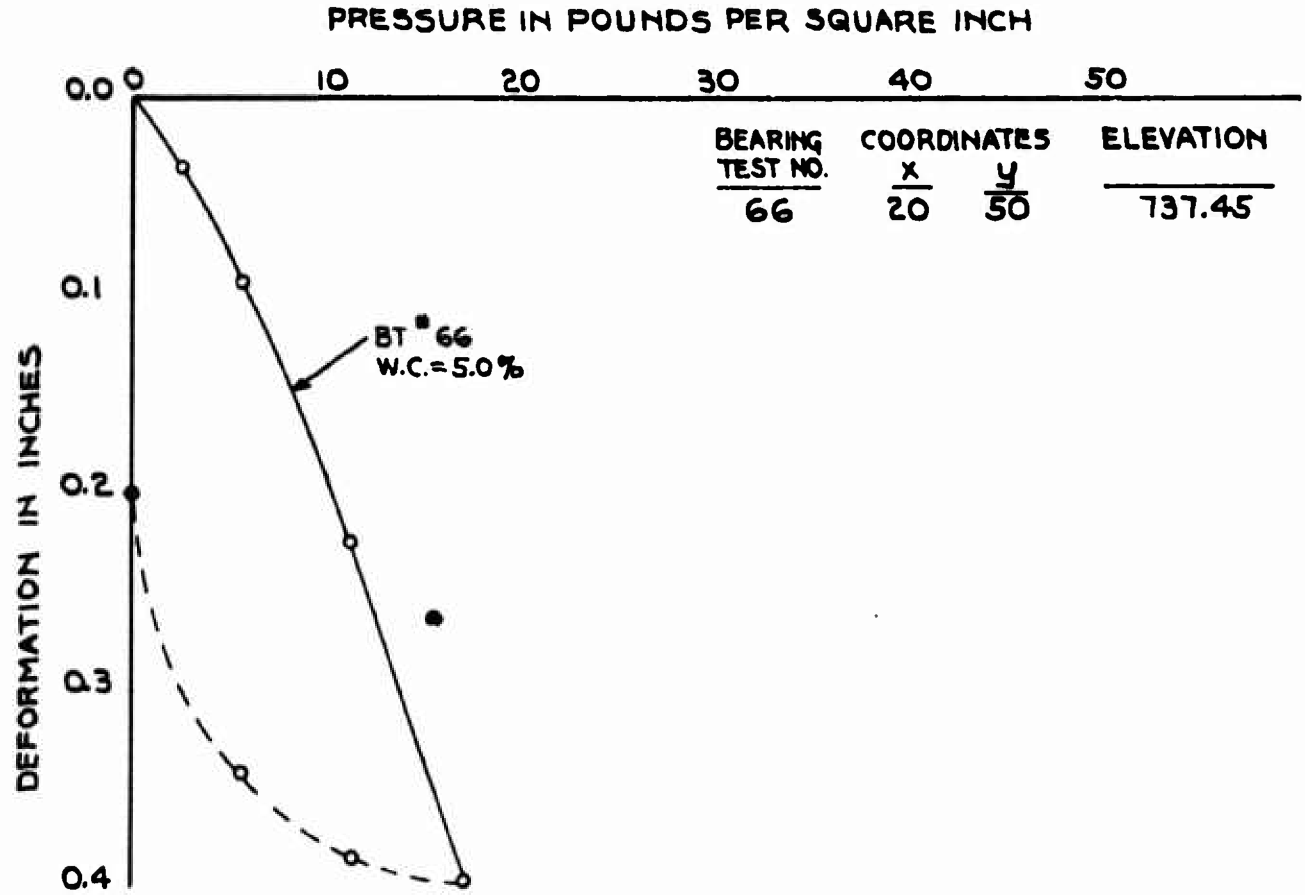
LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

JAN. 1944

FIGURE 35



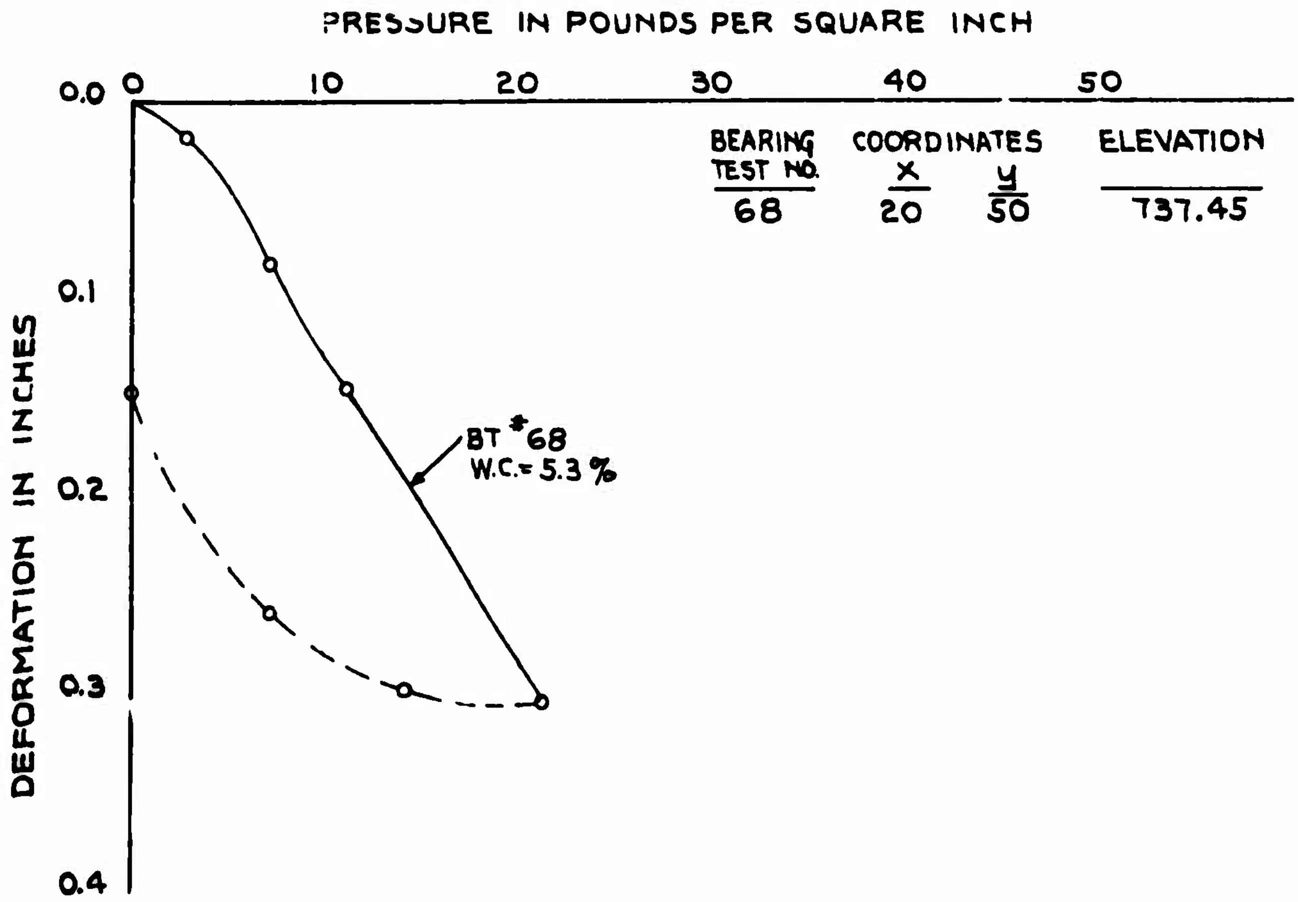
BEARING TEST NO.	COORDINATES x	COORDINATES y	ELEVATION
66	20	50	737.45

TEST NO	COORDINATES x	COORDINATES y	UNIT WEIGHT IN LBS/CU. FT WET	UNIT WEIGHT IN LBS/CU. FT DRY	W. C. %
11	11	3	128.9	116.8	10.2
12	35.5	17.5	123.3	114.8	7.4
13	29.5	16	123.1	115.7	6.4
54	33	34	118.3	114.3	3.7
55	11.5	26	121.0	114.8	5.5
97	6	46	133.2	126.2	5.7
98	29	55	126.1	119.8	5.4

SECTION C-C
BASECOURSE BEARING TESTS
TEST TRACK
LOCKBOURNE ARMY AIR BASE
LOCKBOURNE OHIO
CINCINNATI TESTING LABORATORY
SOILS DIVISION

JAN. 1944

FIGURE 36



TEST NO.	COORDINATES x	y	UNIT WEIGHT IN LBS./CU. FT. WET	DRY	W. C. %
7	14	3.5	134.1	129.7	3.5
8	31	17	137.0	132.1	3.8
58	30.5	35	136.0	128.9	5.5
59	9	26.5	141.0	134.5	4.9
93	6	46.5	144.0	137.8	4.7
94	30	54	143.2	136.1	5.2

SECTION E-E

BASE COURSE BEARING TESTS

TEST TRACK

LOCKBOURNE ARMY AIR BASE

LOCKBOURNE OHIO

CINCINNATI TESTING LABORATORY

SOILS DIVISION

JAN. 1944

FIGURE 37

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "B"

Laboratory Tests of
Subgrade and Base Materials

THE OHIO RIVER DIVISION LABORATORIES *
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

Corps of Engineers U. S. Army

OHIO RIVER DIVISION LABORATORIES
MARIEMONT, OHIO

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX "B"

Laboratory Tests of Subgrade and Base Materials

1. Type and Location of Samples:

Samples of the subgrade soil for laboratory tests include jar samples recovered from the auger borings and undisturbed cylinder samples taken from test pits. Bag samples of the selected subgrade and base course materials were taken from the stock piles and from the materials in place. The locations of the auger borings and test pits are shown in the test layout drawing, Figure 1, Appendix "A".

2. Scope of Laboratory Test Program:

a. Jar Samples: The laboratory tests of the auger boring jar samples include water content and grainsize determinations.

b. Undisturbed Cylinder Samples: Laboratory tests of the undisturbed subgrade samples, taken from test pits near each field bearing test, include the following:

(1) Water Contents and Unit Weights.
(2) Mechanical Analyses and Atterberg Limits.
(3) Consolidation Tests.
(4) Permeability.
(5) California Bearing Ratio and Expansion Tests.

c. Bag Samples: Mechanical analyses were made on samples of the selected subgrade and base course materials, and Atterberg limit tests were made on the material passing a #35 Tyler sieve.

3. Testing Procedure:

a. Water Contents and Unit Weights: Small representative samples of the soil were weighed and then dried to a constant weight in a drying oven. The water contents are expressed in percentages of the oven dry weights of the sample. The unit wet and dry weights of the undisturbed material were determined from the consolidation test data.

b. Mechanical Analyses and Atterberg Limit Tests: All mechanical analyses were made on samples using sieve and hydrometer methods. The Atterberg limit tests were conducted on the portion of the material passing a #35 Tyler sieve. The test procedure was similar to that used by the Bureau of Public Roads.

c. Consolidation Tests:

(1) Slow Wet Consolidation: A specimen of the soil is cut from the undisturbed cylinder sample to fit inside of the metal consolidation ring, which has an inside diameter of approximately 4.25 inches and a thickness of 1.25 inches. The ring containing the soil sample is assembled in the consolidation machine and the sample is allowed to become saturated under a load of 0.7 pounds per square inch. After saturation of the sample, successive vertical load increments are applied every 24 hours, and time-deformation readings are recorded for each load increment. Conditions of free drainage are maintained at the top and bottom of the sample during consolidation.

(2) Slow Dry Consolidation: The procedure for this test is identical to the slow wet consolidation except that no saturation is permitted.

(3) Quick Dry Consolidation: The procedure for this type of test is the same as that for the slow dry consolidation except that the load increments are applied successively at two minute intervals Separate specimens are cut from each undisturbed sample for the slow wet, slow dry and quick consolidation tests.

d. Permeability: A permeability test was made during each slow wet consolidation test after the sample had consolidated completely under a load of 1.015 tons per square foot. A graduated glass tube is connected to the base of the metal consolidation ring by a piece of rubber tubing to form a variable head type permeameter.

e. California Bearing Ratio and Expansion: California bearing ratio and expansion tests were made on soil specimens cut from each undisturbed cylinder sample. The procedure used for the tests is that specified in Section 2, Chapter XX of the Engineering Manual. A 15-pound surcharge was used on the samples during the soaking period. Loading of the penetration piston (area 3 sq. in.) was obtained by use of a 90,000 pound capacity Southwark Emery Compression Machine and the loads were measured to the nearest ten pounds. No surcharge was used for the penetration test.

4. Test Results:

a. Auger Boring Jar Samples: The water content and grainsize determinations for all the soil samples recovered from the auger borings are given on the sub-surface exploration sheet, Figure 2, Appendix "A"

b. Undisturbed Cylinder Samples:

(1) Summary of Classification Tests: The results of the laboratory tests to determine water content, unit weight, grainsize, Atterberg limits, specific gravity and permeability of the undisturbed soils samples are summarized in Table 1. This table also includes classification of the soils according to Dr. Casagrande's system which is recommended in the Engineering Manual for airfield projects.

(2) Consolidation Tests: The consolidation test data are plotted as load-deformation curves and are presented in Figures 1 to 37 inclusive.

(3) California Bearing Ratio and Expansion Tests: The results of the California bearing ratio and expansion tests are summarized in Tables 2 to 5 inclusive. The tables include the water contents and unit weights determined from the C.B.R. test data.

c. Bag Samples of Selected Subgrade and Base Materials:

(1) Mechanical Analyses: The results of mechanical analyses of the selected subgrade and sand and gravel base materials are presented as grainsize curves in Figures 38, 39 and 40. The grainsize of the flume sand used in sections "C" and "U" is shown in Figure 41. The results of tests on the crushed stone and stone dust used for base in section "E" are presented in Figure 42. This figure also shows the results of a mechanical analysis of a sample of the bank-run sand and gravel base course material used in lanes 3 and 4 of sections "N", "O", "P" and "Q". This material which differs somewhat from the material in the other sand and gravel sections was obtained from the pit after the original stock pile had been exhausted.

(2) Atterberg Limits on Fines: The results of Atterberg limit tests on the material passing the #35 Tyler sieve, taken from the selected subgrade and sand and gravel base course samples, are tabulated as follows:

Location	M.I.T. Classification	Liquid Limit	Plastic Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio
	Selected Subgrade					
Test #23 Section R	Fc. Gravel(44)and fc. SAND(38), little silt and clay(18)	23.3	16.3	7.0	14.4	1.912
Test #38 Section R	Fc. GRAVEL(45)and fc. SAND(38)little silt and clay(17)	24.1	19.3	4.8	----	-----
Test #32 Section S	Fc. GRAVEL(40)and fc. SAND(40), some silt and clay(20)	25.0	17.7	7.3	14.0	1.917
Test #40 Section S	Fc. GRAVEL(49)and fc. SAND(34), little silt and clay(17)	----	----	----	----	----
	Sand and Gravel Base Course					
Test #21 Section T	Fc. GRAVEL(54)and fc. SAND(35), little silt and clay(11)	----	----	----	----	----
Test #42 Section T	Fc. GRAVEL(56)and fc. SAND(35), tr. silt and clay(09)	21.0	16.5	4.5	15.4	1.886

Note: The test number is the number of the unit weight test from which the sample for mechanical analysis and limit tests was taken.

d. Samples of Sand Used for Sand-Asphalt Cushion: The result of a mechanical analysis of a sample of the sand used for the sand-asphalt cushion in sections "M" and "L" is shown in Figure 43.

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "B"

Laboratory Tests of
Subgrade and Base Materials

TABLES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT
APPENDIX B
SUMMARY OF LABORATORY TEST RESULTS
OF SUBGRADE SOILS
TABLE I

MATERIAL AT BEARING TEST NO.	LOCATION			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE		PERMEABILITY*	TRUE SP. GR.	M.I.T. CLASSIFICATION				CASA CLASS.
	SECTION	COORDINATES X	COORDINATES Y				LIMIT	RATIO	$k \times 10^{6}$ cm/sec		% CLAY	% SILT	% SAND	% GRAVEL	
23	A	20	10	25.1	19.3	5.8	13.6	1.903	.02060	2.80	21	48	22	9	ML
61	A	20	50	50.1	24.8	25.3	13.3	1.938	.00017	2.78	36	47	12	5	CH
6	B	30	10	25.1	19.3	5.8	13.6	1.903	.02060	2.80	21	48	22	9	ML
31	B	20	30	41.5	27.1	14.4	12.8	1.914	.01490	2.82	5	63	28	4	ML
55	B	20	50	50.1	24.8	25.3	13.3	1.938	.00017	2.78	36	47	12	5	CH
8	C	30	30	41.5	27.1	14.4	12.8	1.914	.01490	2.82	5	63	28	4	ML
56	C	20	50	49.0	24.4	24.6	12.6	1.955	.000096	2.78	31	40	23	6	CH
9	D	30	25	44.2	30.6	13.6	10.3	1.972	.00032	2.74	30	50	19	1	CL
58	D	20	50	49.0	24.4	24.6	12.6	1.955	.000096	2.78	31	40	23	6	CH
5	E	30	10	45.7	28.4	17.3	9.8	1.995	.00007	2.72	33	52	14	1	CL
30	E	20	30	42.4	20.5	21.9	14.2	1.935	.000045	2.74	27	56	16	1	CL
59	E	20	50	48.9	22.8	26.1	11.7	1.974	.000045	2.76	34	50	15	1	CH
24	F	20	10	47.5	32.5	15.0	7.4	2.045	.01890	2.71	38	44	17	1	CH
29	F	20	30	42.4	20.5	21.9	14.2	1.935	.000045	2.74	27	56	16	1	CL
60	F	20	50	48.9	22.8	26.1	11.7	1.974	.000045	2.76	34	50	15	1	CH
4	G	30	20	47.5	32.5	15.0	7.4	2.045	.01890	2.71	38	44	17	1	CH
28	G	20	30	47.5	32.5	15.0	7.4	2.045	.01890	2.71	38	44	17	1	CH
73	G	20	50	49.6	28.6	21.0	13.7	1.877	.000035	2.67	33	49	18	0	CH
3	H	30	10	49.8	36.2	13.6	9.0	2.009	.000037	2.74	32	48	19	1	CL
27	H	20	30	46.9	22.0	24.9	9.7	1.993		2.80	31	39	16	14	CL
74	H	20	50	46.9	22.0	24.9	9.7	1.993		2.80	31	39	16	14	CL
25	J	20	10	39.3	19.8	19.5	13.8	1.909	.04270	2.73	23	49	22	6	CL
2	J	10	30	46.4	34.9	11.5	9.7	2.003	.000067	2.71	32	48	19	1	CL
75	J	20	50	50.3	23.2	27.1	11.2	1.999	.000027	2.75	33	47	19	1	CH
1	K	5	10	26.0	21.8	14.2	13.0	1.910	.00880	2.74	16	36	39	3	SF
26	K	20	30	46.4	34.9	11.5	9.7	2.003	.000067	2.71	32	48	19	1	CL
18	X_2	0	10	28.6	17.7	10.9	15.2	1.890	.01120	2.80	20	42	36	2	ML TO CL
48	X_2	0	30	26.8	17.8	9.0	14.9	1.903	1.040	2.74	16	33	27	24	ML TO SF
19	W_2	0	10	28.6	17.7	10.9	15.2	1.890	.01120	2.80	20	42	36	2	ML TO CL
47	W_2	0	30	26.8	17.8	9.0	14.9	1.903	1.040	2.74	16	33	27	24	ML TO SF
20	V_2	0	10	42.9	21.2	21.7	14.3	1.892	.01550	2.74	30	46	22	2	CL
46	V_2	0	30	46.3	22.4	23.9	12.5	1.963	.00071	2.73	27	44	24	5	CL
22	L	20	10	40.7	25.6	15.1	9.2	2.024	.03870	2.65	30	31	39	0	CL
38	L	20	30	42.1	22.2	19.9	12.6	1.966	.000068	2.73	34	41	24	1	CL
21	M	20	10	40.7	25.6	15.1	9.2	2.024	.03870	2.65	30	31	39	0	CL
39	M	20	30	39.7	22.0	17.7	13.9	1.909	.00010	2.73	26	46	23	5	CL
72	M	20	50	47.4	22.7	24.7	11.9	1.973	.00073	2.74	36	39	23	2	CL TO CH
17	N	20	10	42.3	27.0	15.3	10.6	1.985	.00840	2.66	29	46	24	1	CL
45	N	20	30	45.5	22.3	23.2	12.9	1.937	.000082	2.71	35	40	23	2	CH
64	N	20	50	43.3	21.0	22.3	13.5	1.929	.000062	2.76	37	47	16	0	CH
77	N	20	70	27.5	17.7	10.0	14.7	1.896	.00041	2.81	19	41	40	0	ML
16	O	20	10	42.3	27.0	15.3	10.6	1.985	.00840	2.66	29	46	24	1	CL
44	O	20	30	45.5	22.3	23.2	12.9	1.937	.000082	2.71	35	40	23	2	CH
63	O	20	50	43.3	21.0	22.3	13.5	1.929	.000062	2.76	37	47	16	0	CH
15	P	20	10	44.2	28.0	16.2	11.9	1.953	.00011	2.70	35	44	19	2	CL
43	P	20	30	43.0	23.4	19.6	15.4	1.862	.00018	2.68	26	51	14	9	CL
62	P	20	50	45.5	22.9	22.6	13.7	1.923	.000059	2.73	21	35	29	15	ML TO CL
76	P	20	70	29.5	18.5	11.0	15.0	1.895	.05260	2.74	28	47	22	3	CL
14	Q	20	10	44.2	28.0	16.2	11.9	1.953	.00011	2.70	35	44	19	2	CL
42	Q	20	30	43.0	23.4	19.6	15.4	1.862	.00018	2.68	26	51	14	9	CL
57	Q	20	50	45.5	22.9	22.6	13.7	1.923	.000059	2.73	21	35	29	15	ML TO CL
37	Z_1	0	30	35.3	20.8	14.5	14.2	1.913	.00191	2.73	16	42	24	18	ML
35	Z_2	0	30	52.6	27.5	25.1	12.8	1.905	.07100	2.74	27	51	18	4	CL TO CH
36	W_3	0	30	45.9	22.3	23.6	13.3	1.940	.00028	2.77	25	45	30	0	ML TO CL
32	Y_1	0	30	42.0	20.3	21.7	14.6	1.915	.00027	2.81	18	40	25	17	ML

* MEASURED ON UNDISTURBED SPECIMENS UNDER NORMAL LOAD OF [illegible] TONS/FT²
AND CORRECTED FOR TEMPERATURE TO 4.0°C.

APPENDIX B

Table 2

Results of California Bearing Tests of Undisturbed Samples of Subgrade Soil, North Tangent

Sample Desig-nation	Cond. of Spl.	C. B. R. Value in % Std. at Penetration of .025 (In.)	.050 (In.)	.100 (In.)	.200 (In.)	.300 (In.)	.400 (In.)	.500 (In.)	Water Content Orig.	Water Content Soaked	Unit Weight In lbs./ft.^{3} Dry	Unit Weight In lbs./ft.^{3} Wet	Per Cent Exp.
B. T. #55	Und.								21.5		103.1	125.2	
& #61	Soaked	4.4	4.8	4.7	4.9	4.7	4.6	4.6		22.5	103.1	126.2	0.33
B. T. #8	Und.								21.0		105.3	127.3	
& #31	Soaked	4.8	5.0	5.0	4.8	4.7	4.5	4.5		21.7	105.0	127.5	0.23
B. T. #56	Und.								19.1		106.9	127.4	
& #58	Soaked	3.1	3.2	3.0	3.8	4.9	5.8	5.9		20.7	106.8	128.8	0.23
B. T. #9	Und.								23.8		96.2	119.0	
	Soaked	5.3	4.2	4.0	3.5	3.3	3.2	3.0		25.2	96.0	120.3	0.27
B. T. #59	Und.								23.5		97.5	120.5	
& #60	Soaked	3.5	3.7	3.3	3.1	2.9	2.6	2.6		24.9	97.3	121.4	0.18
B. T. #29	Und.								27.0		94.0	119.6	
& #30	Soaked	5.3	4.2	4.0	3.6	3.2	2.8	2.6		28.5	93.7	120.2	0.25
B. T. #5	Und.								22.7		101.5	124.4	
	Soaked	5.3	5.3	4.7	4.7	4.5	4.2	4.2		23.4	101.4	125.2	0.26
B. T. #4,	Und.								26.1		95.4	120.2	
24 & 28	Soaked	4.9	3.7	3.3	2.9	2.7	2.5	2.4		26.7	95.2	120.2	0.22

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX B

Table 2 (Cont'd)

Results of California Bearing Tests of Undisturbed Samples of Subgrade Soil, North Tangent

Sample Designation	Cond. of Spl.	C.B.R. Value in % Std. at Penetration of .025 (In.)	.050 (In.)	.100 (In.)	.200 (In.)	.300 (In.)	.400 (In.)	.500 (In.)	Water Content Orig.	Water Content Soaked	Unit Weight In lbs./ft.^{3} Dry	Wet	Per Cent Exp.
B.T. #73	Und.								26.5		93.9	119.0	
	Soaked	3.5	4.2	4.3	3.8	3.5	3.2	3.0		27.2	93.6	119.1	0.18
B.T. #27	Und.								26.4		97.9	123.9	
& #74	Soaked	4.4	3.7	3.3	2.9	2.6	2.5	2.3		28.2	97.7	125.2	0.29
B.T. #3	Und.								26.9		93.8	119.0	
	Soaked	3.5	3.2	2.7	2.2	2.1	2.0	1.9		27.6	93.5	119.2	0.08
B.T. #75	Und.								25.9		93.4	117.3	
	Soaked	5.3	4.2	3.7	2.9	2.6	2.3	2.2		27.5	92.8	118.3	0.22
B T. #2	Und.								23.9		98.2	121.5	
& #26	Soaked	5.3	4.2	4.0	3.5	3.2	2.9	2.8		24.9	97.8	122.0	0.20
B.T. #25	Und.								22.6		97.6	119.7	
	Soaked	5.3	4.5	4.0	3.6	3.3	3.2	3.1		25.5	97.2	122.0	0.27
B.T. #1	Und.								16.2		106.5	123.8	
	Soaked	5.3	5.8	4.7	3.8	3.5	3.2	3.2		19.6	106.5	127.5	0.05

APPENDIX B

Table 3

Results of California Bearing Tests of Undisturbed Samples of Subgrade Soil
(Section Q Through L Inclusive)

Sample Desig-nation	Cond. of Spl.	C.B.R. Value in % Std. at Penetration of .025 (In.)	.050 (In.)	.100 (In.)	.200 (In.)	.300 (In.)	.400 (In.)	.500 (In.)	Water Content Orig.	Water Content Soaked	Unit Weight In lbs./ft.^{3} Dry	Unit Weight In lbs./ft.^{3} Wet	Per Cent Exp.
B.T. #14	Und.								24.5		99.2	123.4	
& #15	Soaked	4.4	3.7	3.7	3.5	3.3	3.2	3.1		25.5	98.8	124.0	0.22
B.T. #42	Und.								17.1		103.6	121.5	
& #43	Soaked	3.5	3.2	3.0	2.9	2.7	2.6	2.6		22.9	100.3	123.2	0.44
B.T. #57	Und.								24.2		97.9	121.8	
& #62	Soaked	3.5	3.2	3.2	3.1	3.0	2.9	2.8		24.4	97.9	122.0	0.00
B.T. #16	Und.								23.1		101.0	124.1	
& #17	Soaked	5.3	4.2	4.0	3.8	3.5	3.2	3.2		23.4	101.0	124.6	0.00
B.T. #44	Und.								24.3		96.8	120.5	
& #45	Soaked	4.4	3.7	3.0	2.7	2.5	2.2	2.1		25.5	96.8	121.7	0.37
B.T. #63	Und.								14.8		108.4	124.3	
& #64	Soaked	6.1	6.3	6.0	5.6	5.2	4.9	4.9		17.7	108.2	127.2	0.12
B.T. #77	Und.								17.7		103.8	122.1	
	Soaked	5.3	4.8	4.0	4.0	4.0	4.1	4.2		20.5	103.8	125.3	0.00
B.T. #21	Und.								20.6		105.9	127.8	
& #22	Soaked	5.3	4.8	5.0	4.9	4.6	4.3	4.2		21.0	105.9	128.3	0.18
B.T. #39	Und.								14.0		106.8	121.8	
	Soaked	3.5	3.2	3.0	2.9	2.8	2.7	2.8		15.6	106.2	122.9	0.24
B.T. #38	Und.								19.2		104.5	124.7	
	Soaked	6.1	5.8	5.0	4.4	4.1	3.8	3.6		20.0	104.3	125.2	0.22
B.T. #72	Und.								21.8		94.4	115.0	
	Soaked	5.3	4.8	4.7	3.8	3.4	3.0	3.0		26.8	93.9	119.0	0.59

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX B

Table 4

Results of California Bearing Tests of Undisturbed Samples of Subgrade Soil, East Turn

Sample Desig- nation	Cond. of Spl.	C. B. R. Value in % Std. at Penetration of .025 (In.)	.050 (In.)	.100 (In.)	.200 (In.)	.300 (In.)	.400 (In.)	.500 (In.)	Water Content Orig.	Water Content Soaked	Unit Weight In lbs./ft.^{3} Dry	Unit Weight In lbs./ft.^{3} Wet	Per Cent Exp.
B. T. #18	Und.								16.1		106.3	123.5	
& #19	Soaked	4.4	4.2	4.0	3.8	3.5	3.4	3.3		18.9	106.0	126.0	0.14
B. T. #20	Und.								22.7		96.2	117.8	
	Soaked	3.5	2.7	2.0	1.8	1.9	1.9	2.0		25.3	95.7	120.0	0.29
B. T. #47	Und.								12.5		118.2	133.0	
& #48	Soaked	9.6	9.0	8.3	8.4	8.4	8.3	8.3		14.7	118.2	135.3	0.00

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

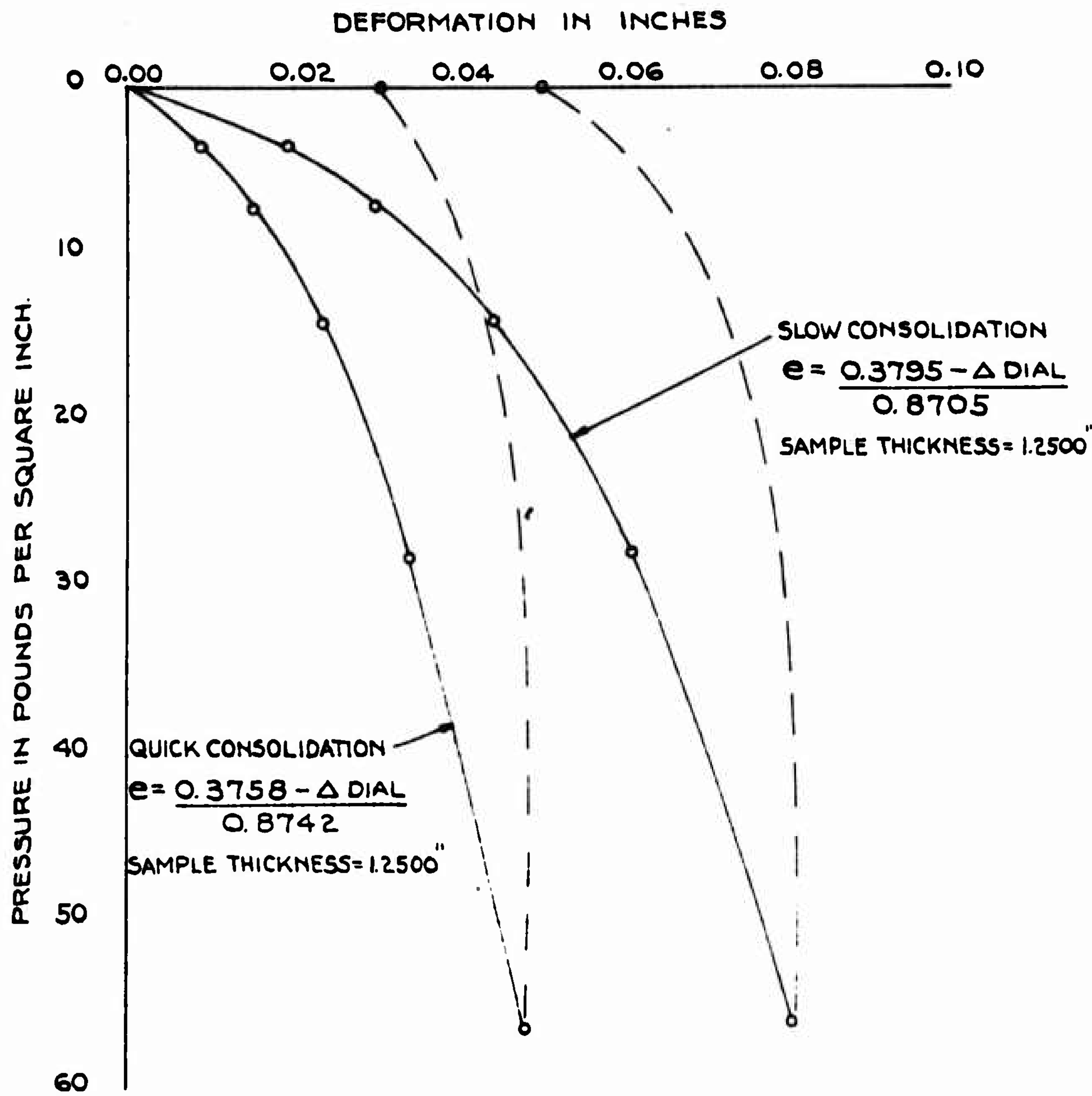
APPENDIX "B"

Laboratory Tests of
Subgrade and Base Materials

FIGURES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. [redacted]1

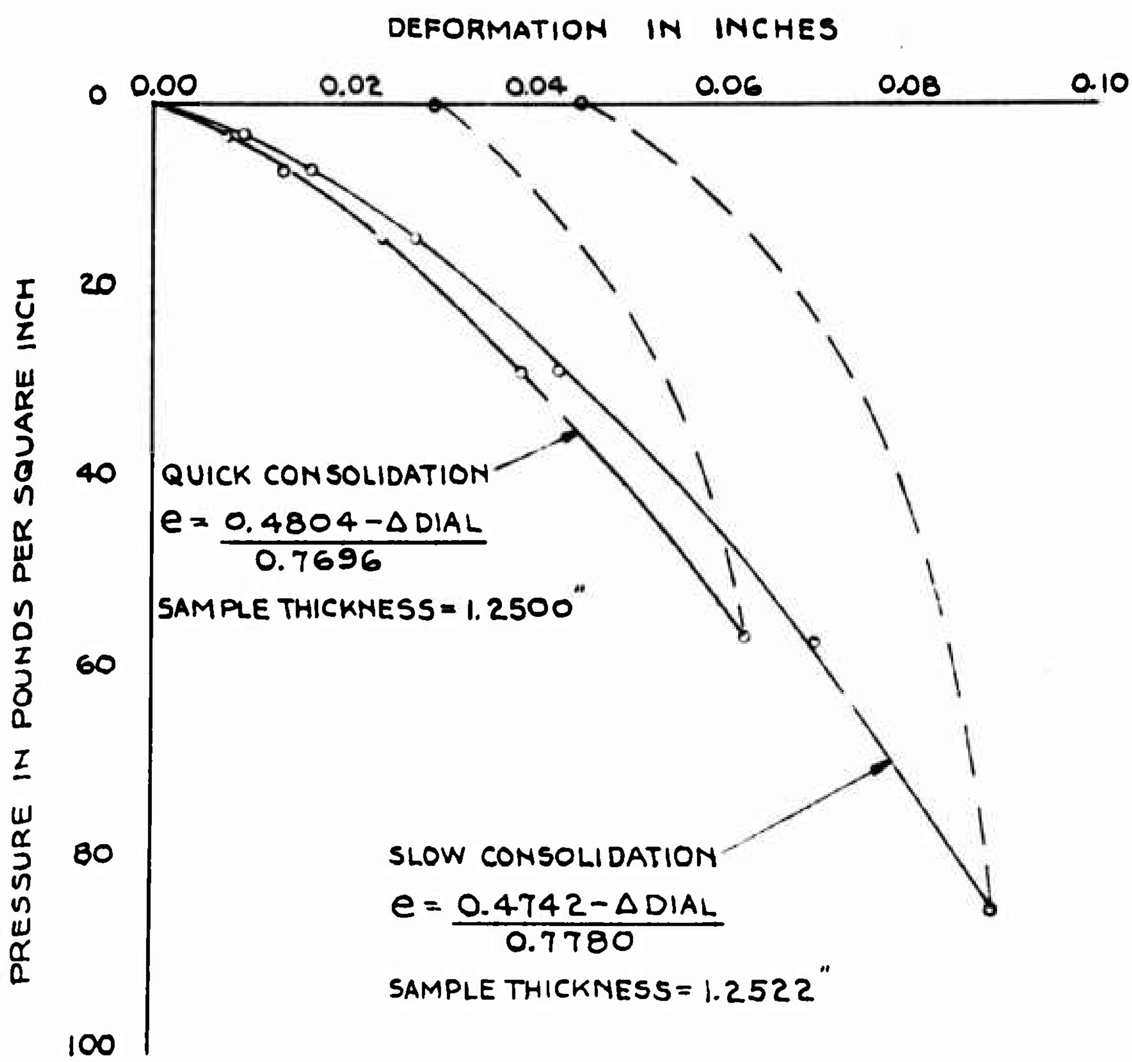
SP. GR. 2.69

CLASSIFICATION: Br. SILT(49) and f.c. SAND(32) little gravel(15) tr. clay(04)

OCT. 1943

APPENDIX B

FIG. 1



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 1-T

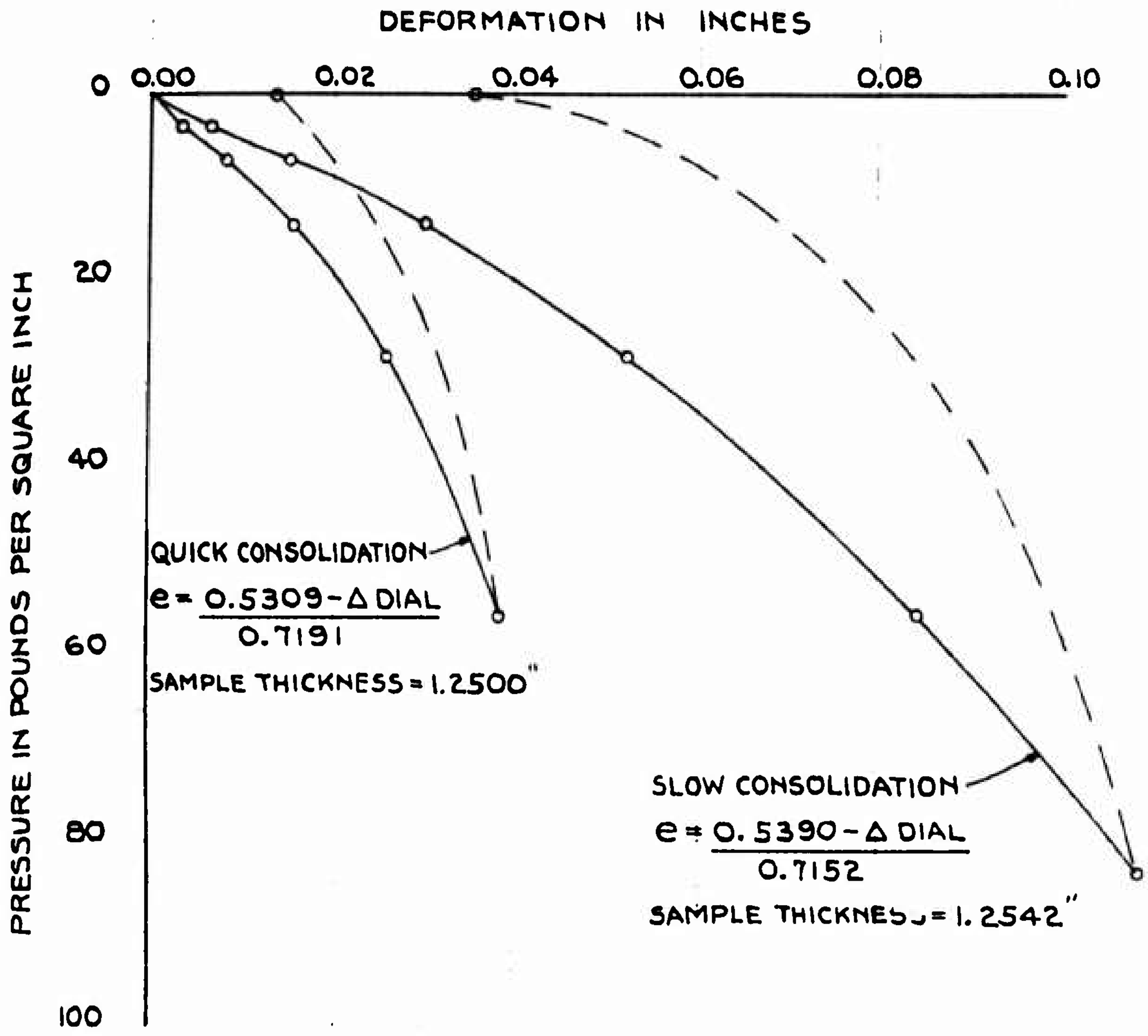
SP. GR. 2.74

CLASSIFICATION: Lt. Br. F.c. SAND(39) and SILT(36) little clay(16) tr. gravel(09)

OCT. 1943

APPENDIX B

FIG. 2



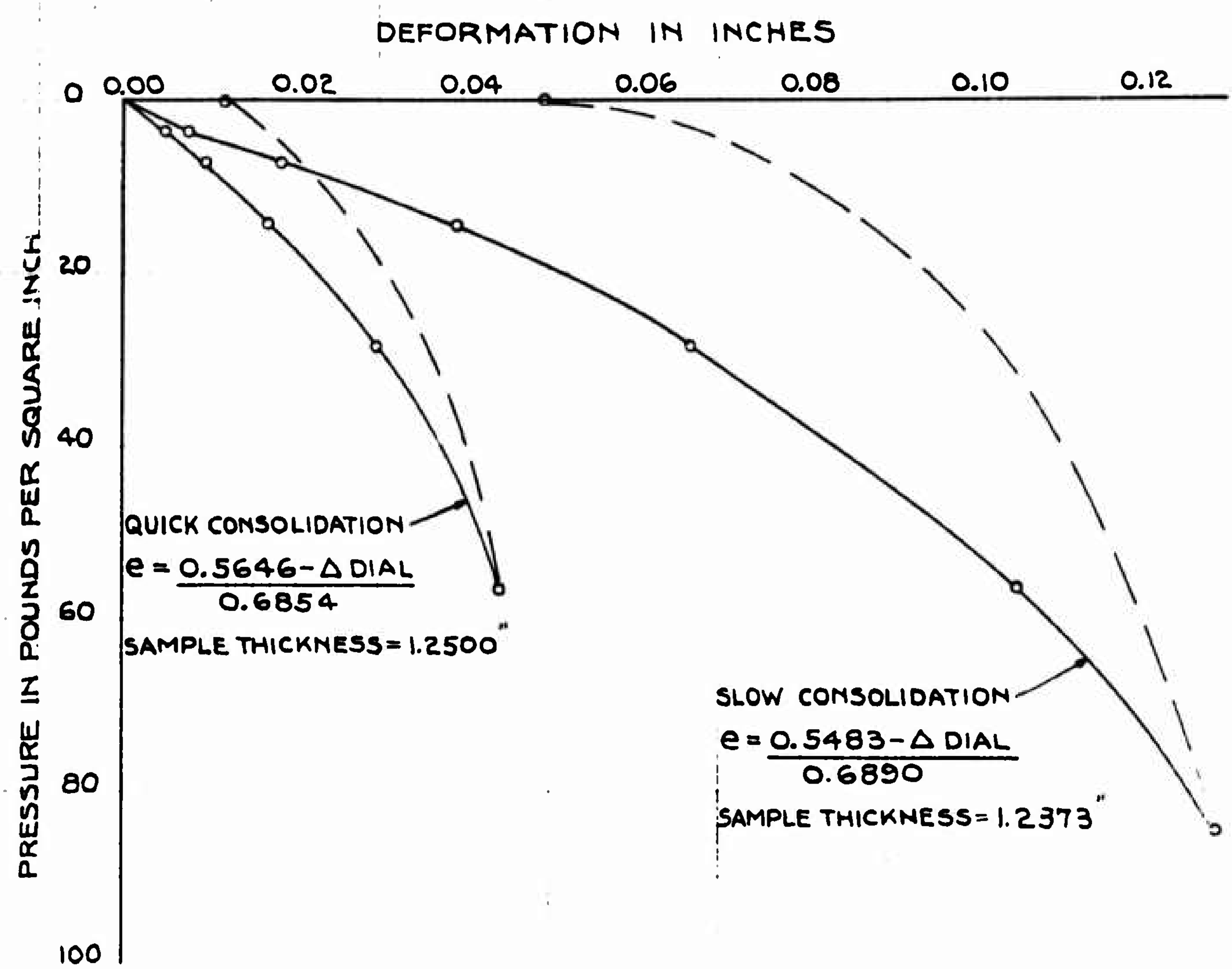
LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 2-T & 26-T
SP. GR. 2.71

CLASSIFICATION: Lt. Br. CLAY(32) and SILT(48) little f.c. sand(19) tr. gravel(01)

OCT. 1943
APPENDIX B

FIG. 3



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 3-T

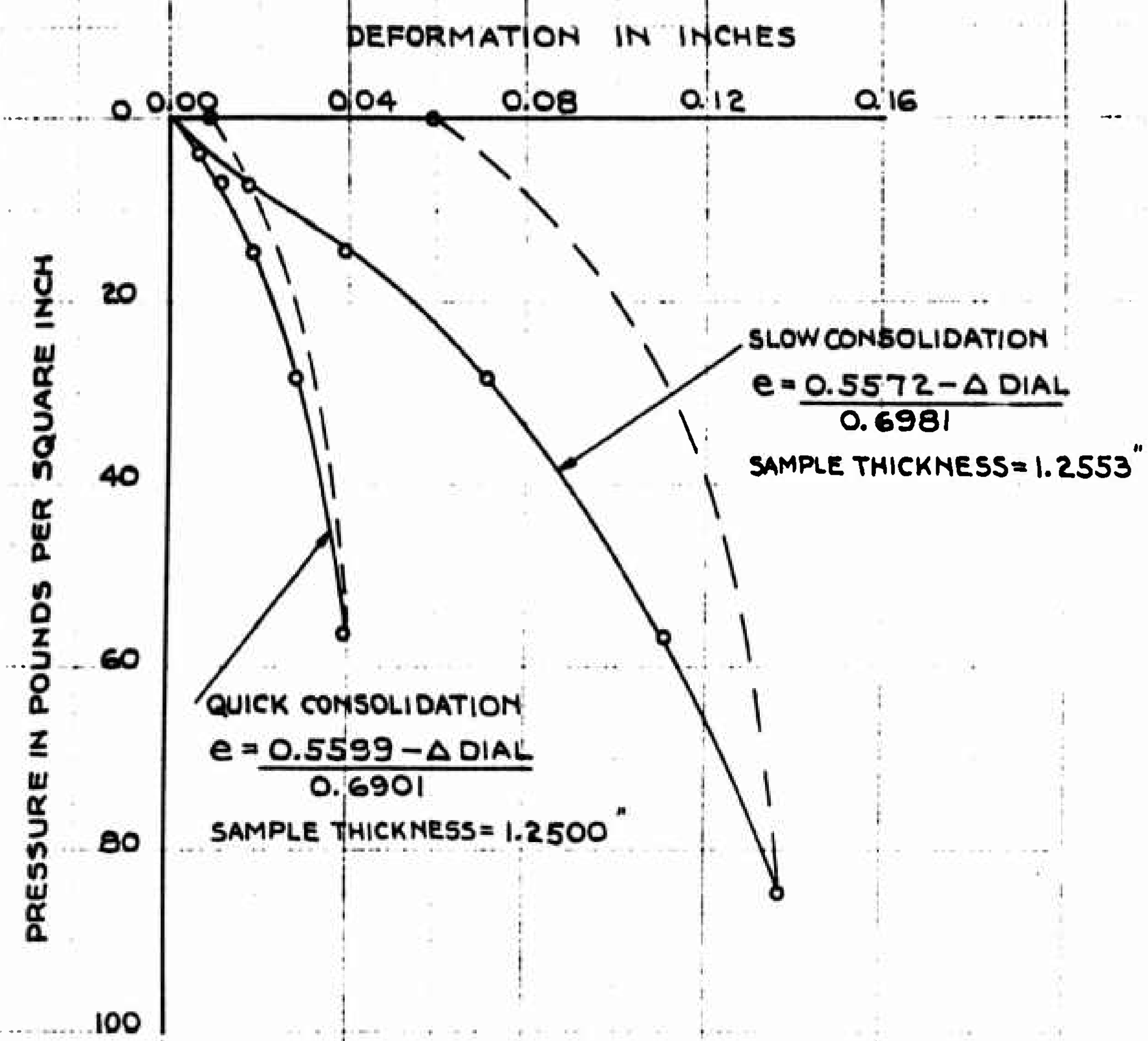
SP. GR. 2.74

CLASSIFICATION: Br. Gr. CLAY(32) and SILT(48) little f.c. sand(19) tr. gravel(01)

OCT. 1943

APPENDIX B

FIG. 4



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 4-T, 24-T & 28-T

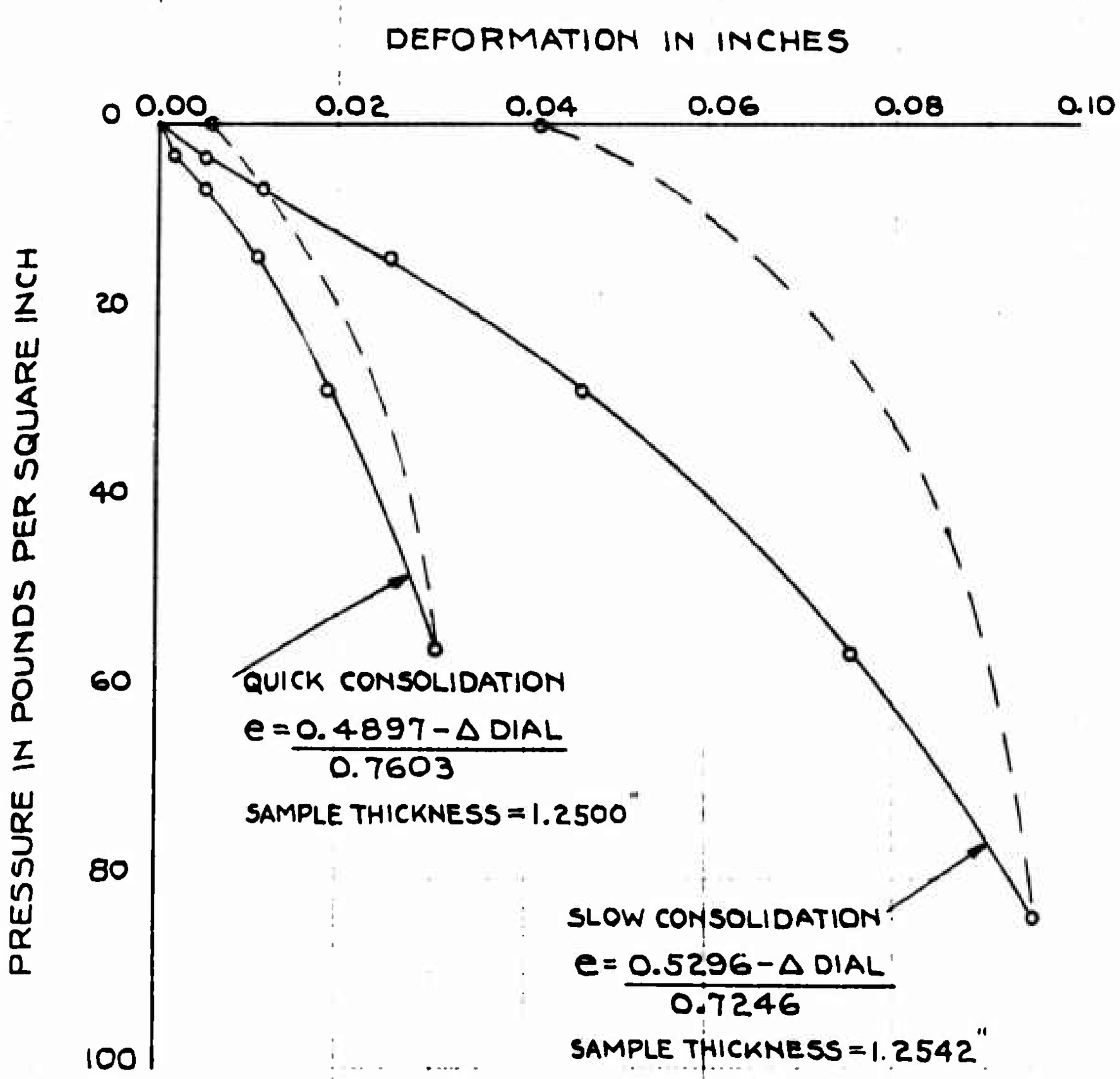
SP. GR. 2.71

CLASSIFICATION: Gr. CLAY (38) and SILT (44) little f.c. sand (17) tr. gravel (01)

OCT. 1943

APPENDIX B

FIG. 5



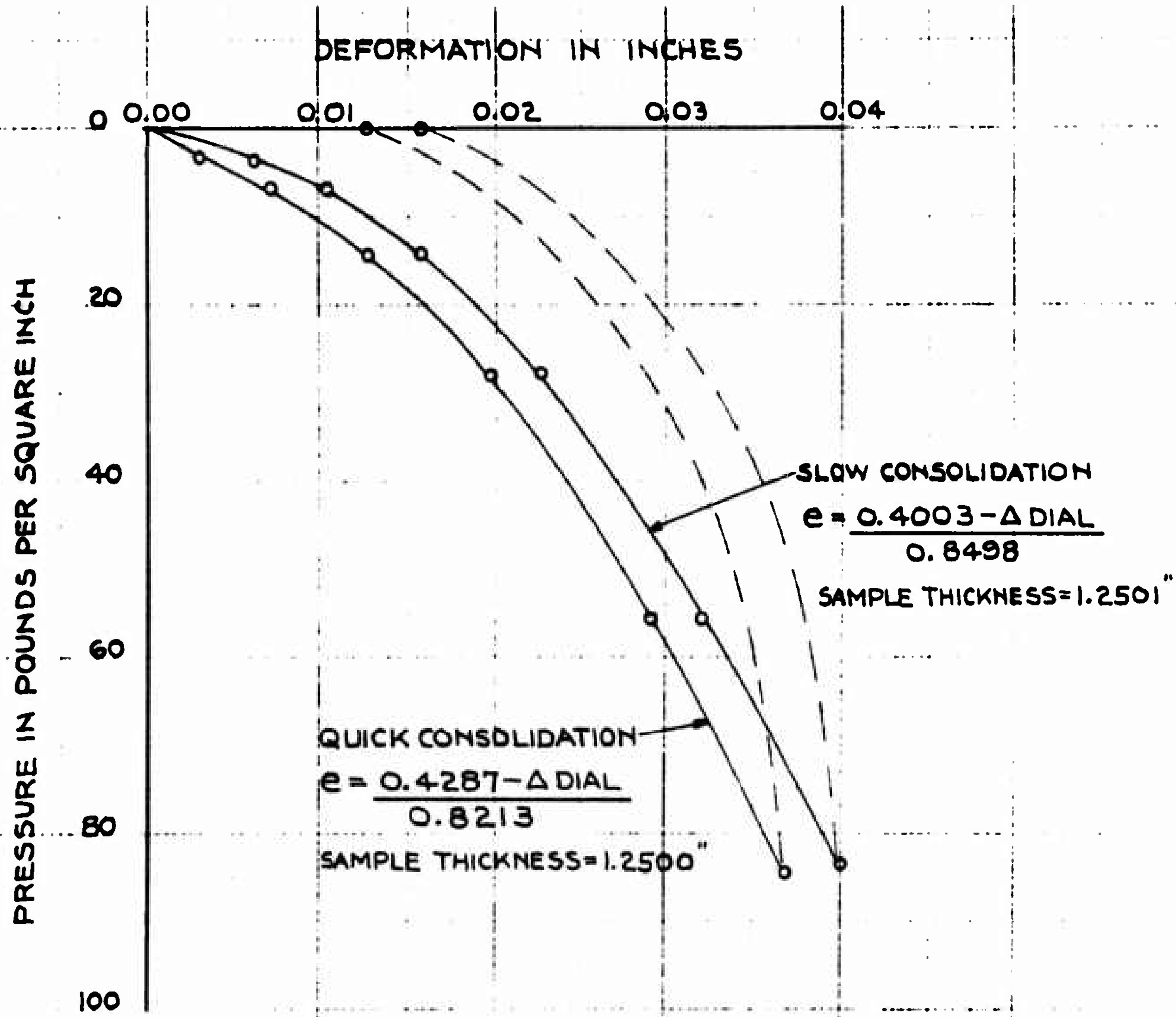
LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 5-T
SP. GR. 2.72

CLASSIFICATION: CLAY (33) and SILT (52) little f.c. sand (14) tr. gravel (01)
Light Brown Color.

OCT. 1943
APPENDIX B

FIG. 6



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

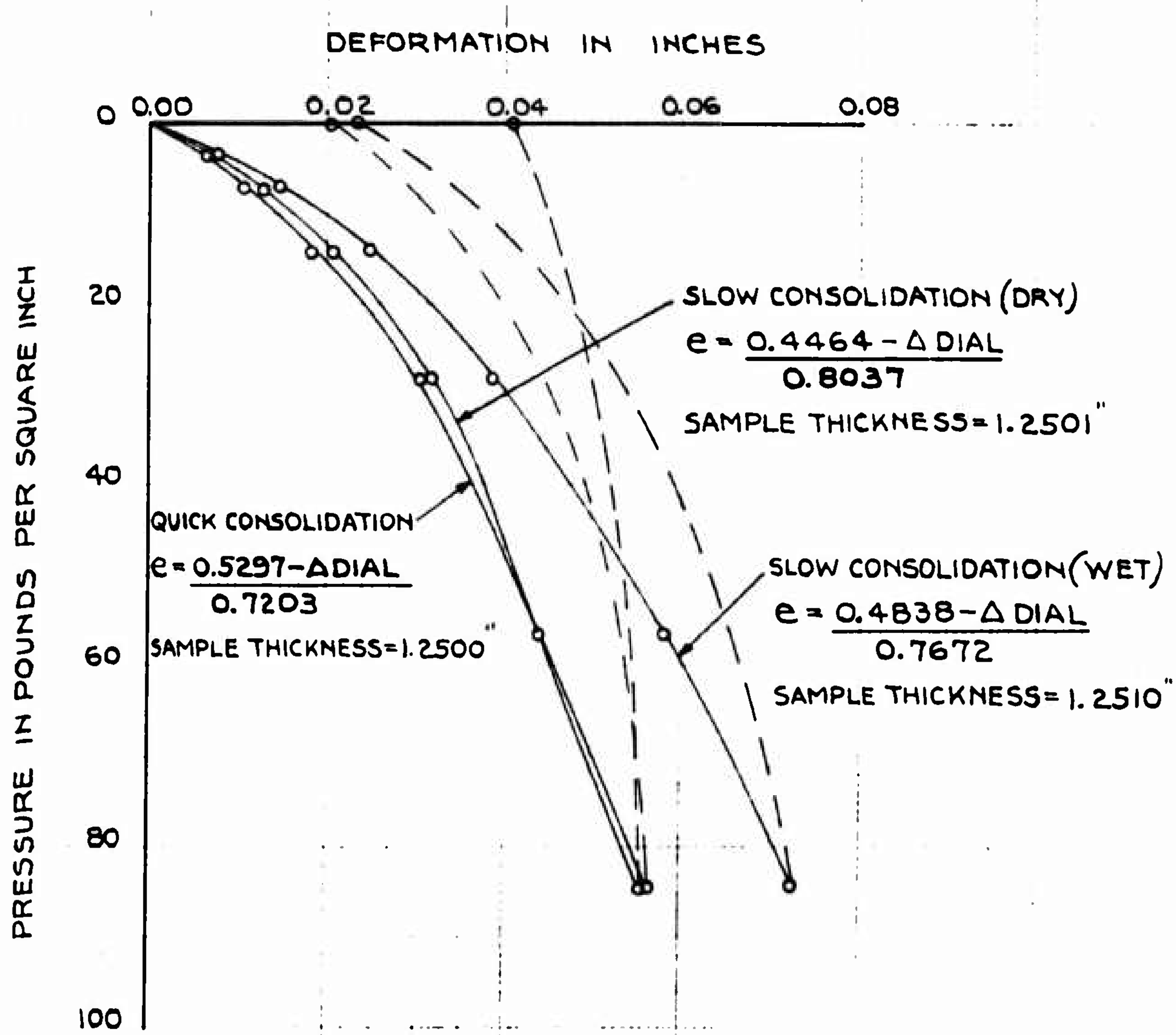
BEARING TEST NO. 6-T & 23-T

SP. GR. 2.80

CLASSIFICATION: SILT(48) some f.c. sand(22) some clay(21) tr. gravel(09)
BROWN - COLOR.

OCT. 1943
APPENDIX B

FIG. 7



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 8-T& 31-T

SP. GR. 2.82

CLASSIFICATION: SILT(63) some f.c. sand(28) tr. clay(05) tr. gravel(04) tr. organic material

Brown - Color

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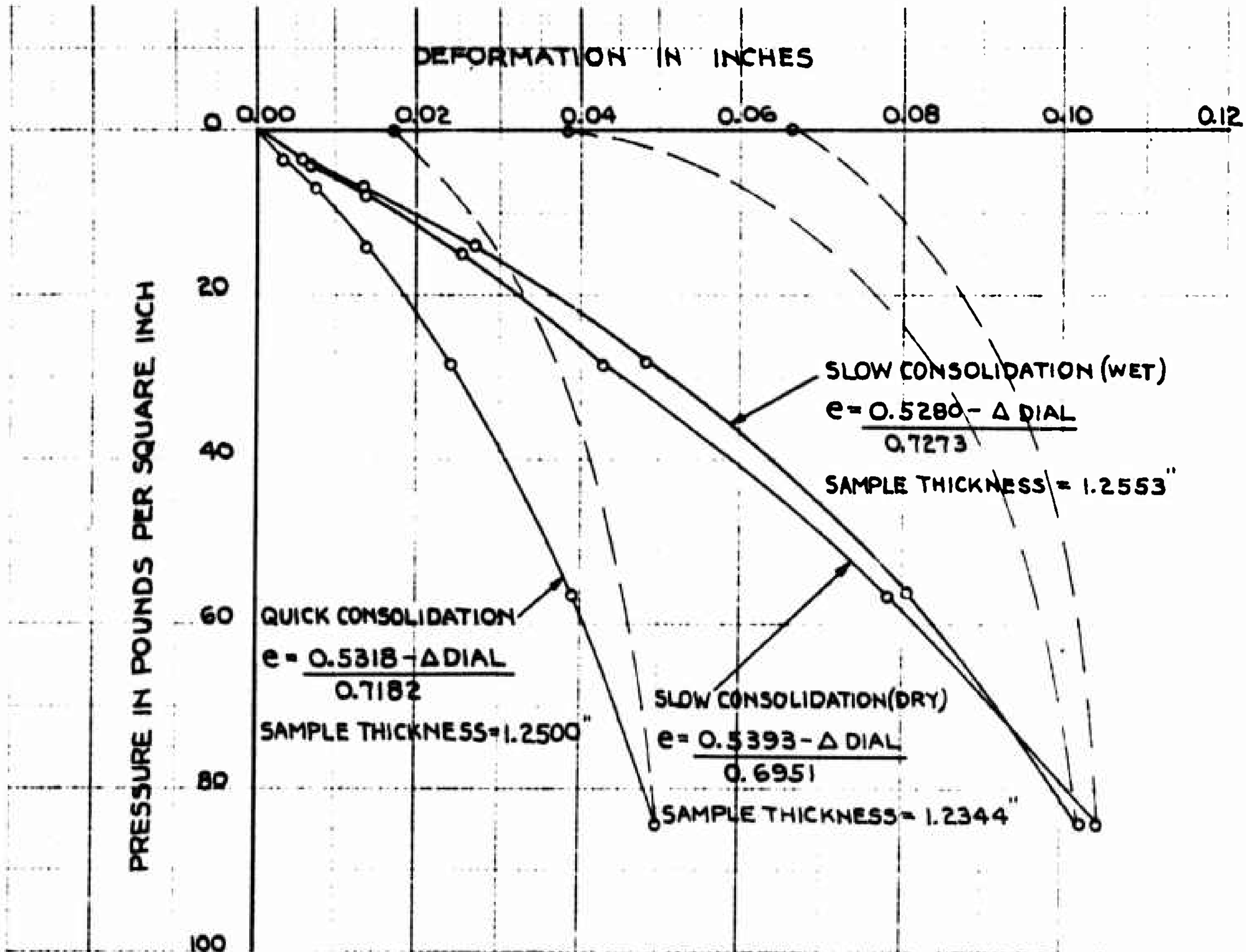
APPENDIX B

FIG. 8



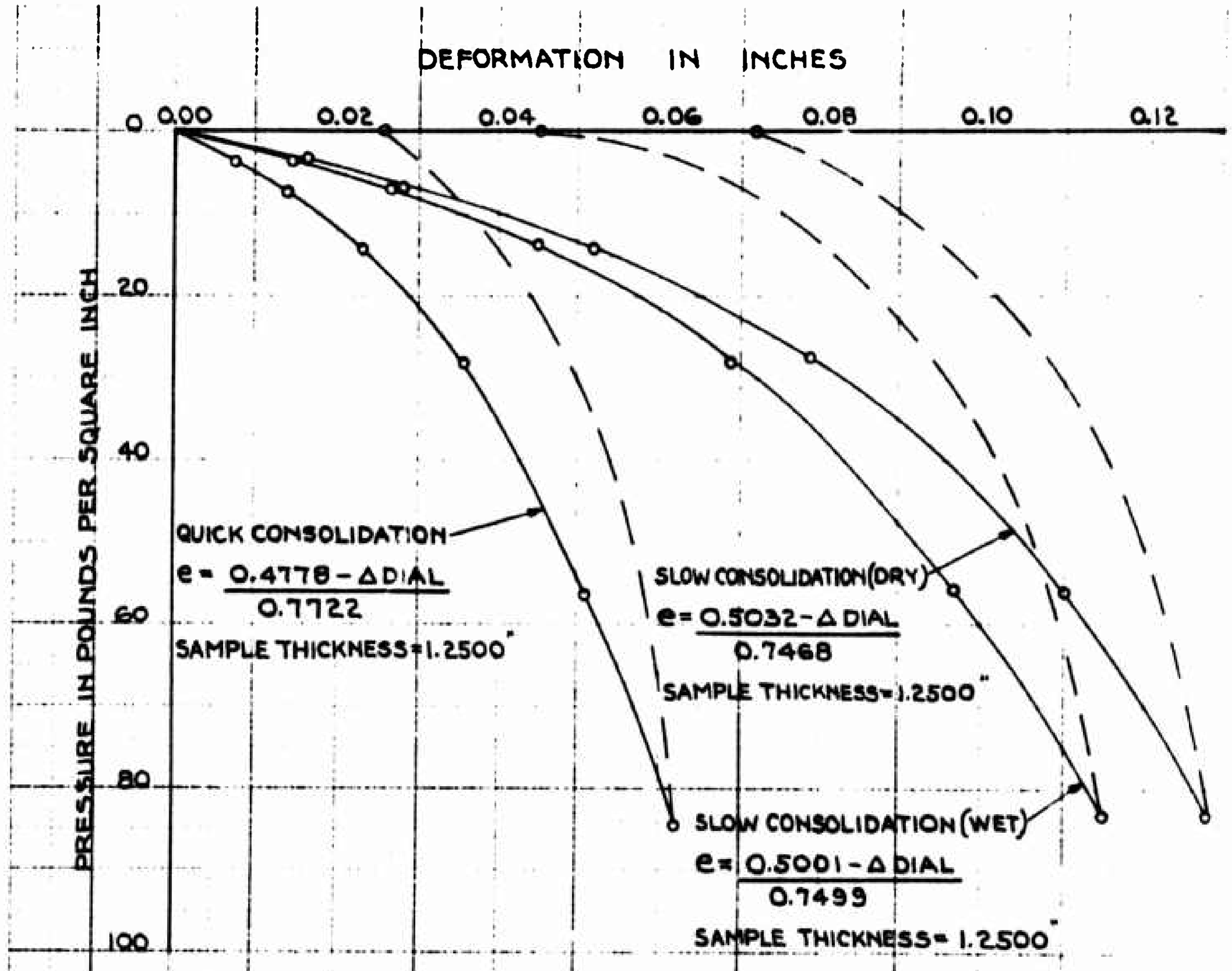
LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 9-T
SP. GR 2.74

CLASSIFICATION: CLAY(30) and SILT(50) little f.c. sand(19) tr. gravel (01) tr. organic material.
Brown Color.

OCT. 1943
APPENDIX B

FIG. 9



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 14-T & 15-T

SP. GR. 2.70

CLASSIFICATION Gr. Br. CLAY (35) and SILT (44) little f. c. sand (19) tr. gravel (02)

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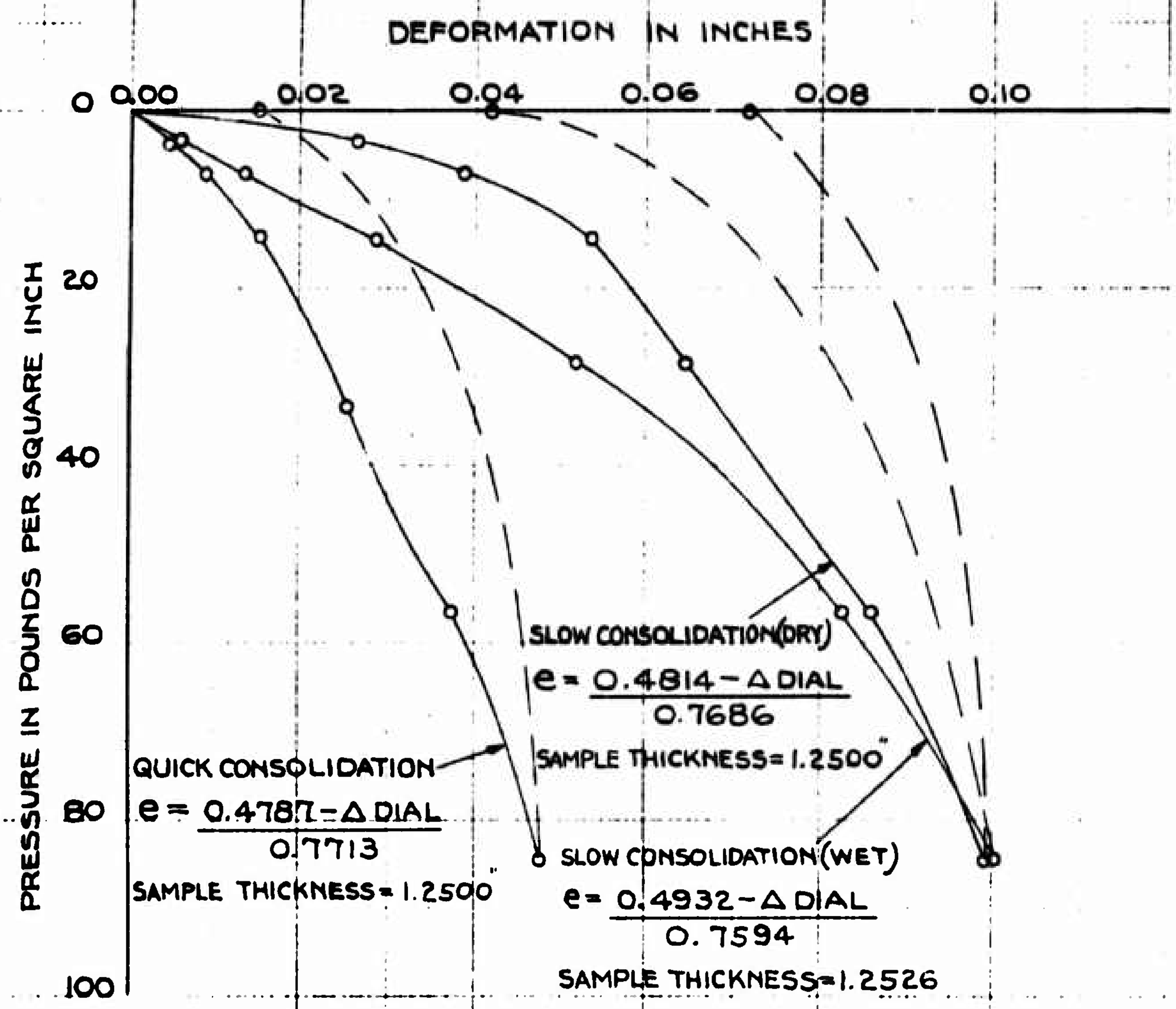
APPENDIX B

FIG. 10



LOCKBOURNE TEST TRACK.

LOCKBOURNE, OHIO.

BEARING TEST NO. 16-T & 17-T

SP. GR. 2.66

CLASSIFICATION: Gr. br. SILT (46) some clay (29) some f.c. sand (24) tr. gravel (01) tr. organic material

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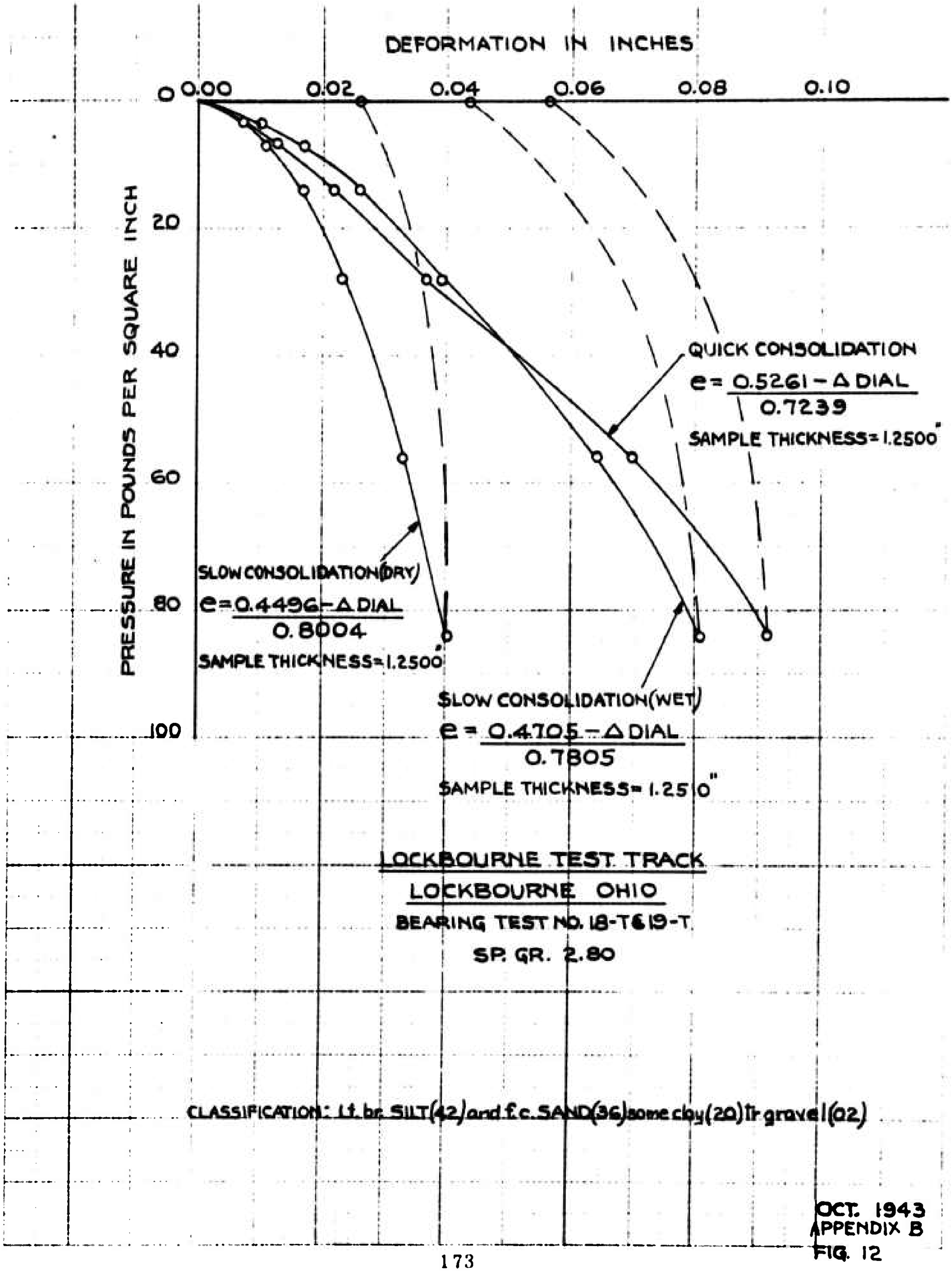
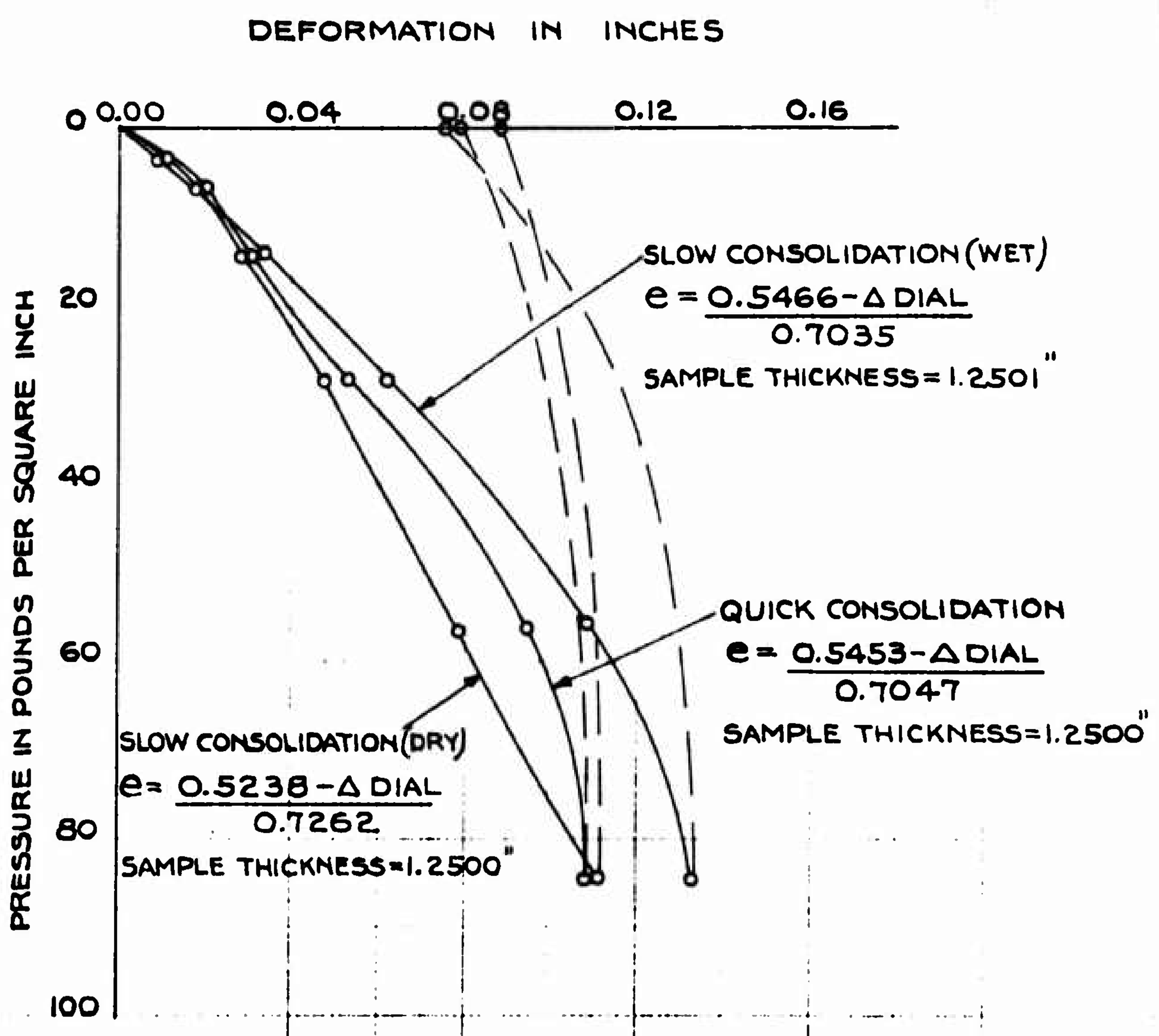
APPENDIX B

FIG. 11



DEFORMATION IN INCHES
0.00
0.02
0.04
0.06
0.08
0.10
PRESSURE IN POUNDS PER SQUARE INCH
0
20
40
60
80
100
QUICK CONSOLIDATION
e = 0.5261 − Δ DIAL / 0.7239
SAMPLE THICKNESS = 1.2500"
SLOW CONSOLIDATION (DRY)
e = 0.4496 − Δ DIAL / 0.8004
SAMPLE THICKNESS = 1.2500"
SLOW CONSOLIDATION (WET)
e = 0.4705 − Δ DIAL / 0.7805
SAMPLE THICKNESS = 1.2510"
LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO
BEARING TEST NO. 18-T619-T
SP. GR. 2.80
CLASSIFICATION: Lt. br. SILT (42) and f.c. SAND (36) some clay (20) tr gravel (02)
OCT. 1943
APPENDIX B
FIG. 12



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 20-T

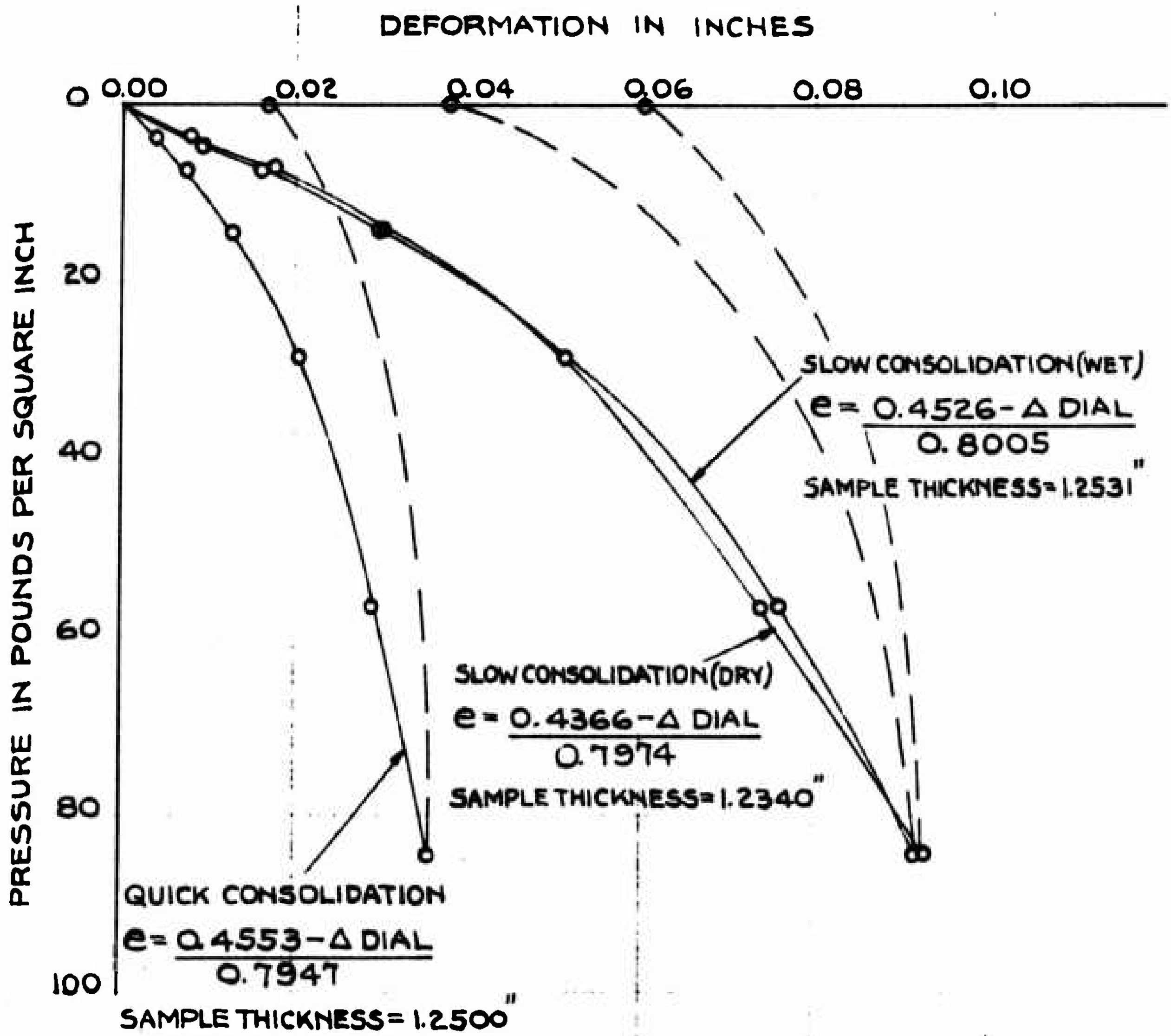
SP. GR. 2.74

CLASSIFICATION: Br. CLAY(30) and SILT(46) some f.c. sand(22) Tr. gravel(02)

OCT. 1943

APPENDIX B

FIG. 13



LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 21-T & 22-T

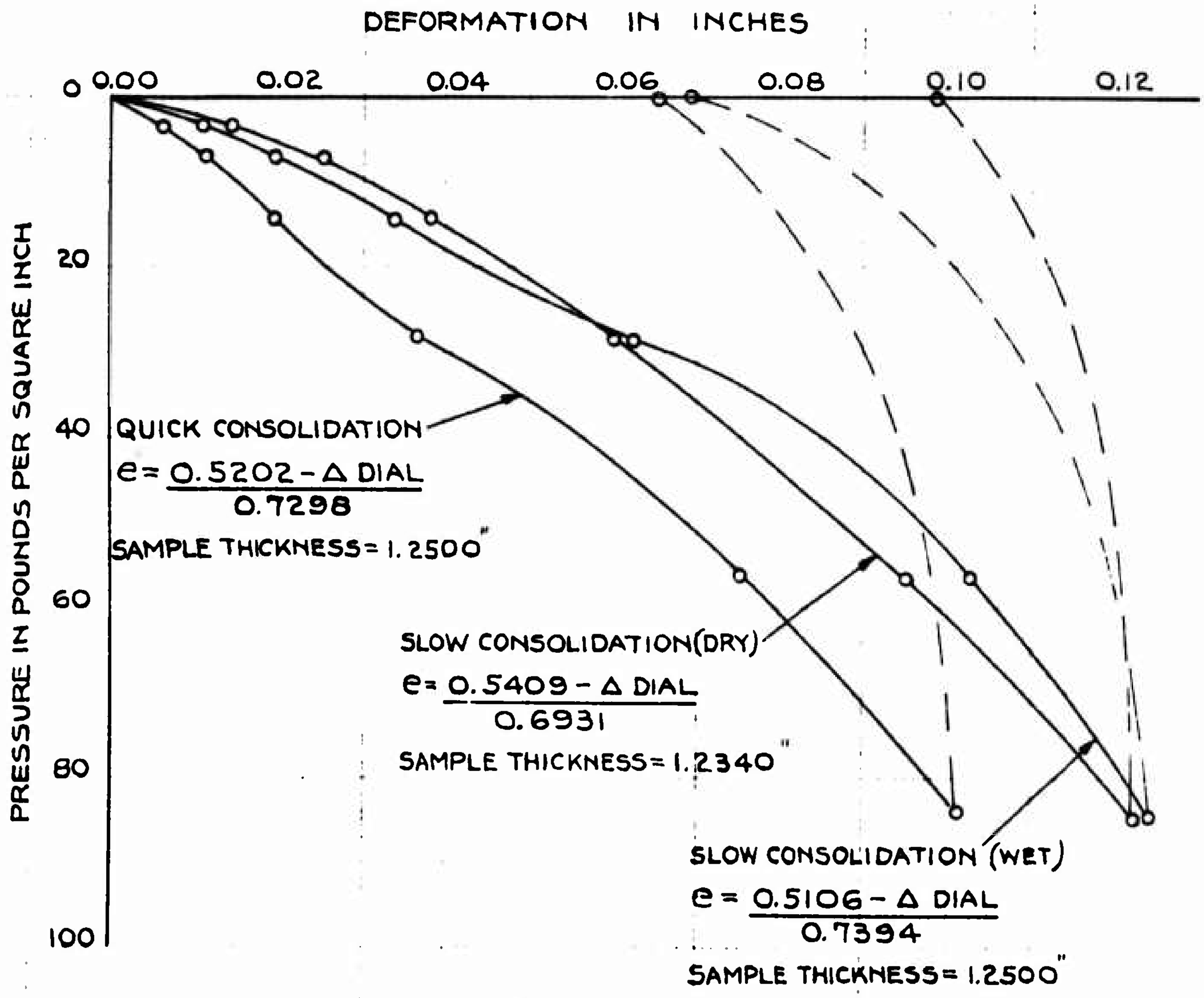
SP. GR. 2.65

CLASSIFICATION: Gr. br. CLAY (30) and f.c. SAND (39) and SILT (31)

OCT. 1943

APPENDIX B

FIG. 14

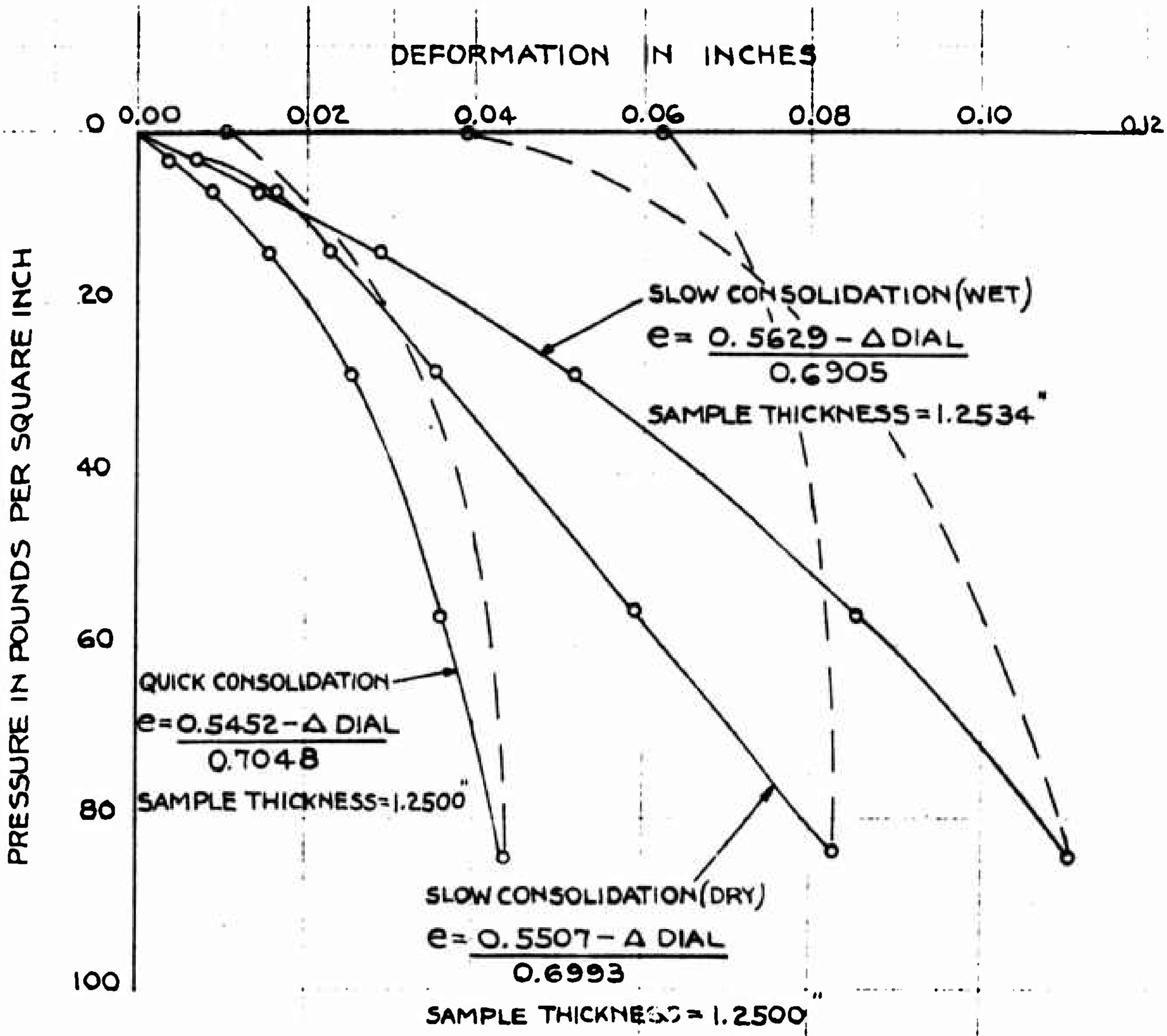


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 25-T
SP. GR. 2.73

CLASSIFICATION: Lt. br. SILT (49) some clay (23) some f.c. sand (22) tr. gravel (06)

OCT. 1943
APPENDIX B
FIG. 15



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO 27-T

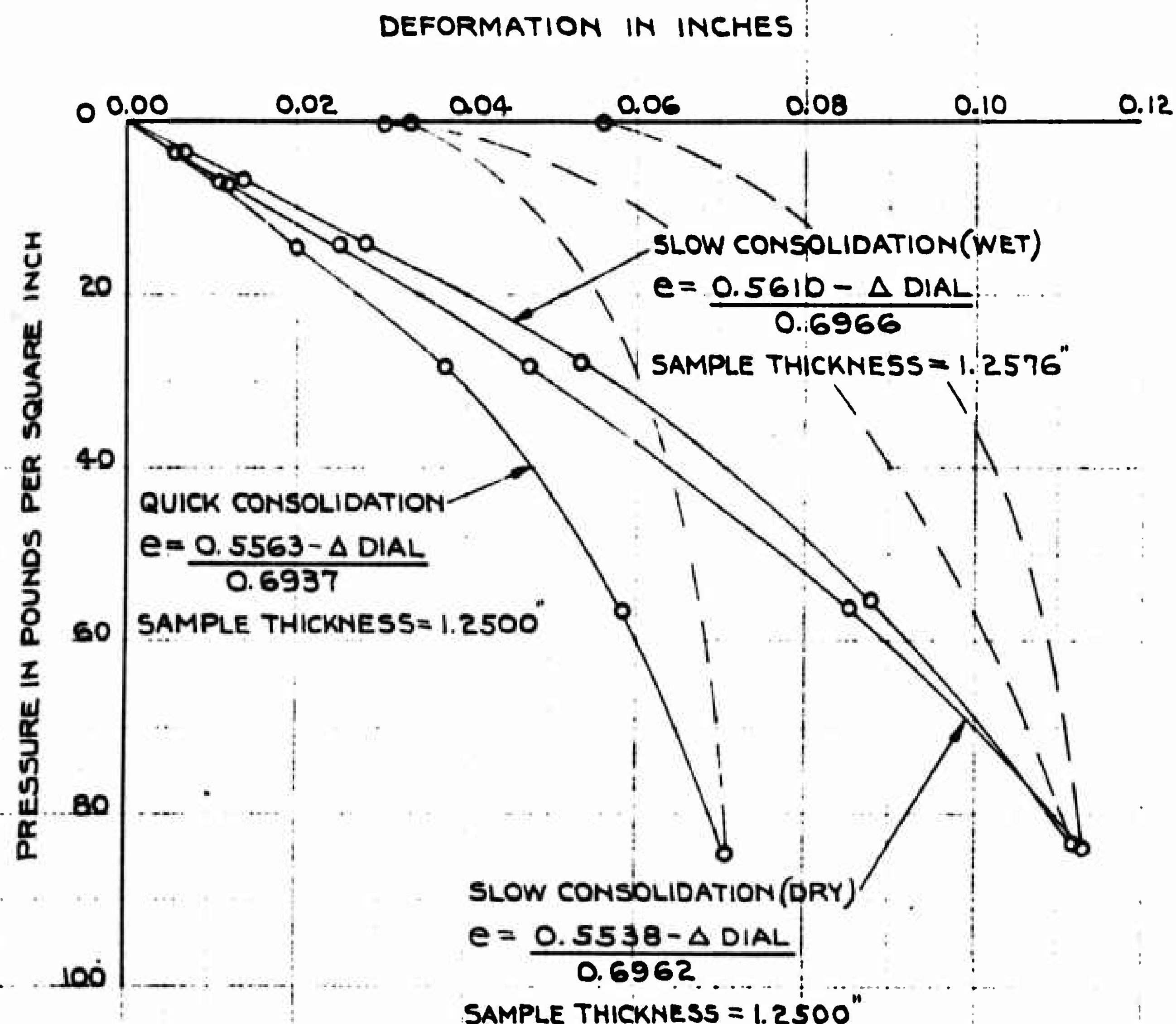
SP. GR. 2.80

CLASSIFICATION: Gr. br. CLAY (31) and SILT (39) little f.c. sand (16) little gravel (14) tr. organic material.

NOV. 1943

APPENDIX B

FIG. 16

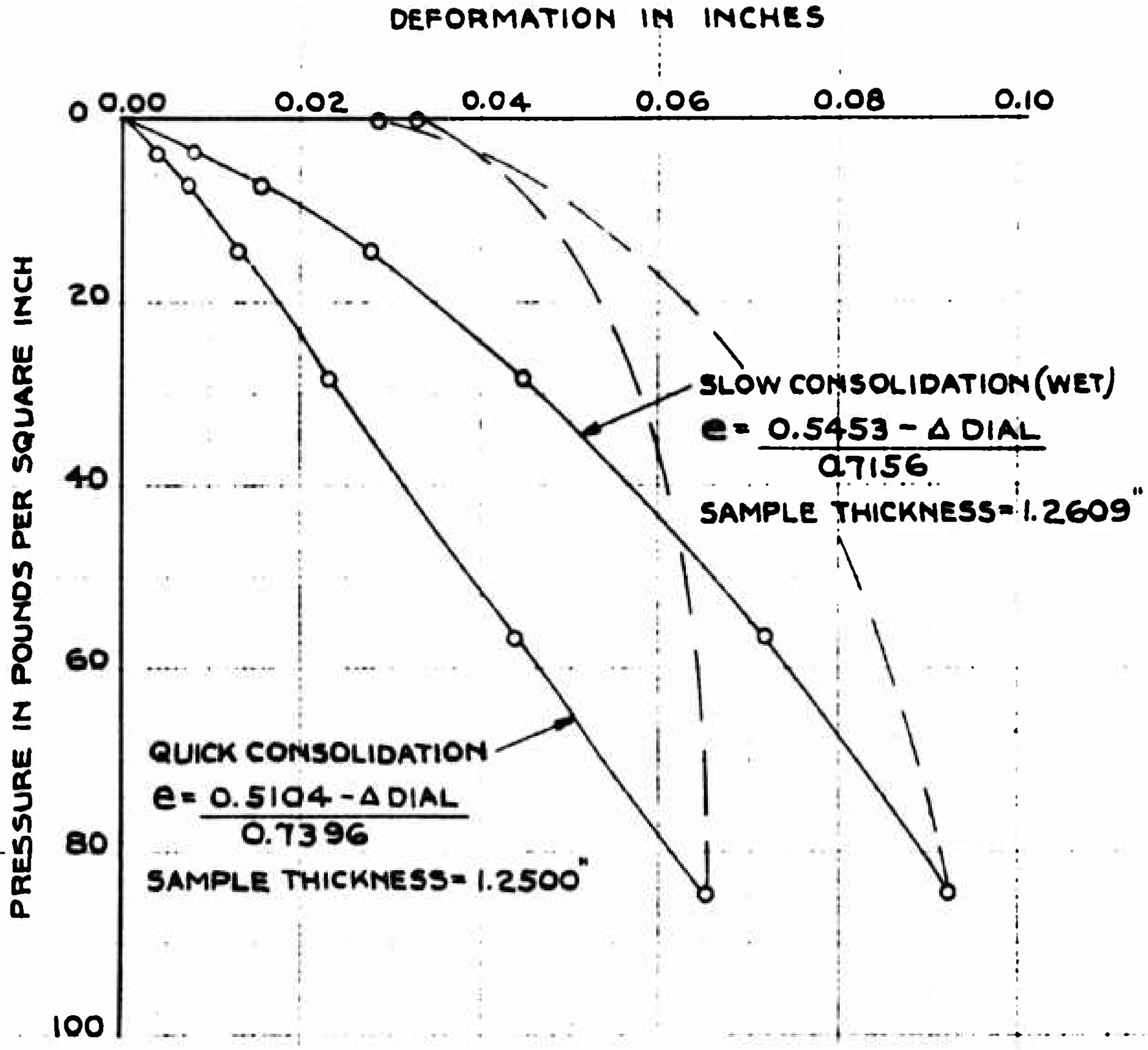


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TESTS NO. 29-T & 30-T
SP. GR. 2.74

CLASSIFICATION: Br. SILT (56) some clay (27) little f.c. sand (16) tr. f. gravel (01)

DEC. 1943
APPENDIX B
FIG. 17

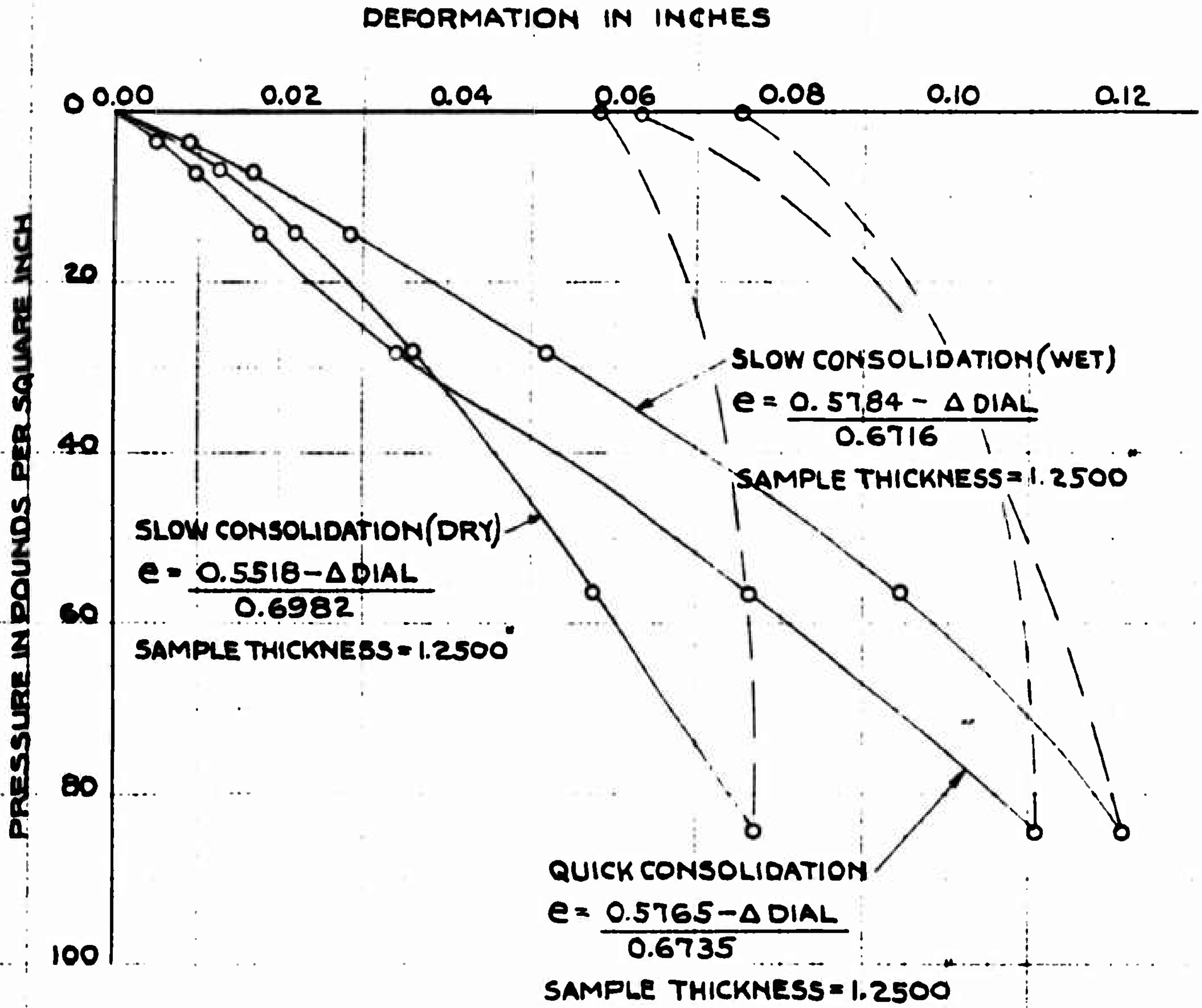


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 32-T
SP. GR. 2.81

CLASSIFICATION: Br. SILT(40) some f.c. sand(25) little clay(18) little f.m. gravel(17)

DEC. 1943
APPENDIX B
FIG. 18



LOCKBOURNE TEST TRACK

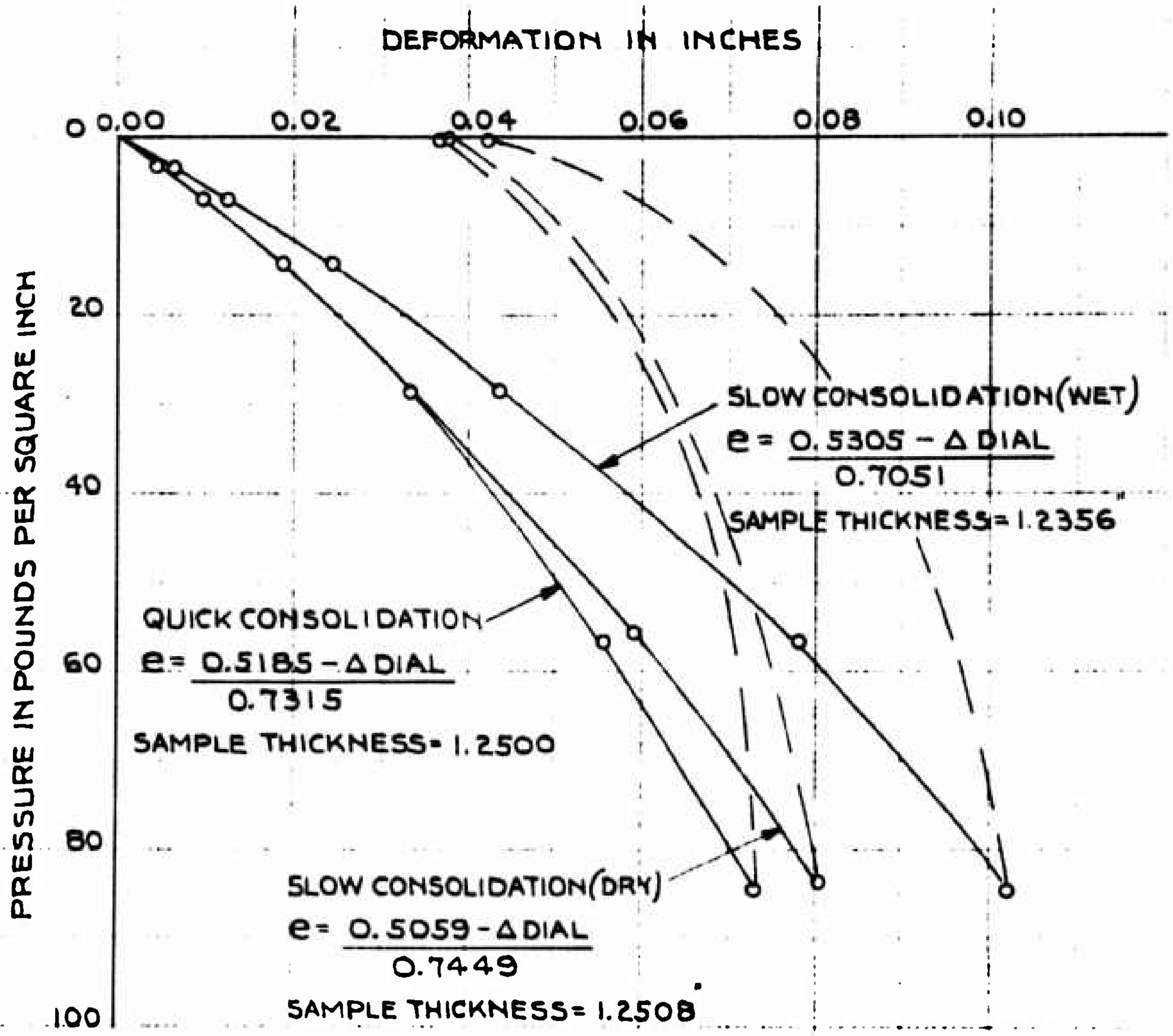
LOCKBOURNE OHIO

BEARING TEST NO. 35-T

SP. GR. 2.74

CLASSIFICATION: Gr. Br. SILT (51) some clay (27) little f.c. sand (18) tr. rock frag's. (04)

DEC. 1943
APPENDIX B
FIG. 19



LOCKBOURNE TEST TRACK

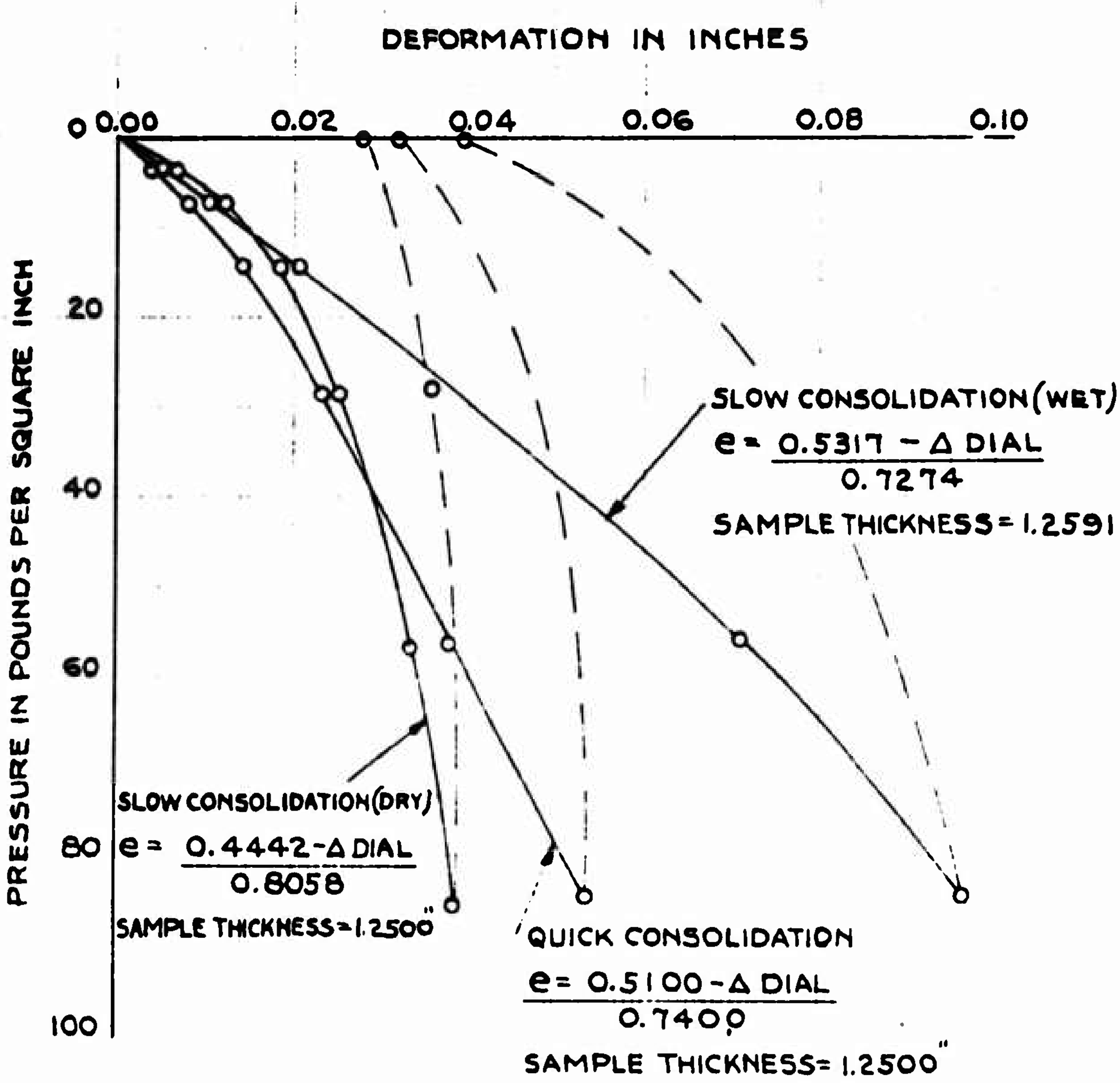
LOCKBOURNE OHIO

BEARING TEST NO. 36-T

SP. GR. 2.77

CLASSIFICATION: Gr.br. SILT(45) and f.c. SAND(30) some clay(25)

DEC. 1943
APPENDIX B
FIG. 20

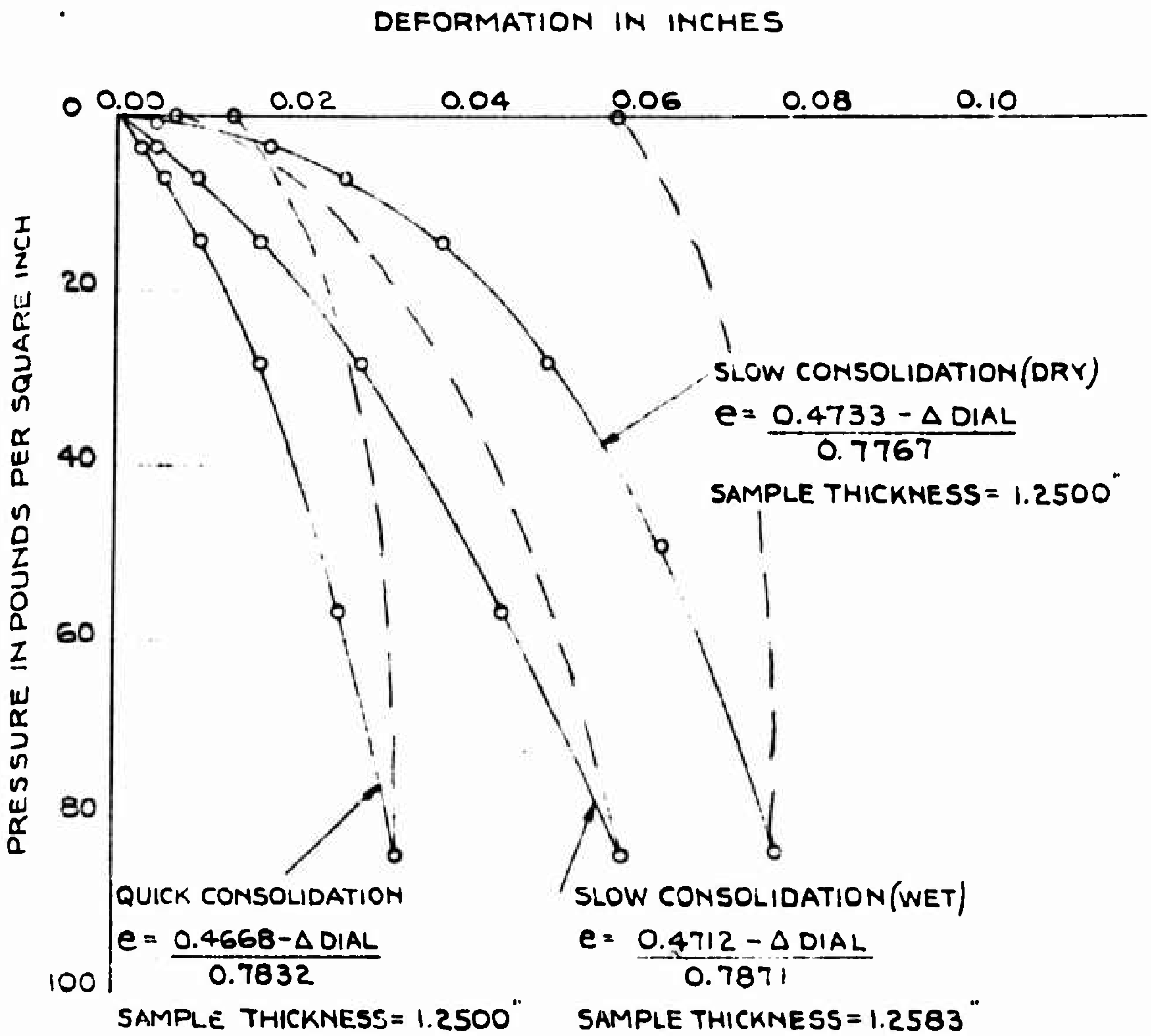


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 37-T
SP. GR. 2.73

CLASSIFICATION: Br. SILT (42) some f.c. sand (24) little f.m. gravel (18) little clay (16)

DEC. 1943
APPENDIX B
FIG. 21



LOCKBOURNE TEST TRACK

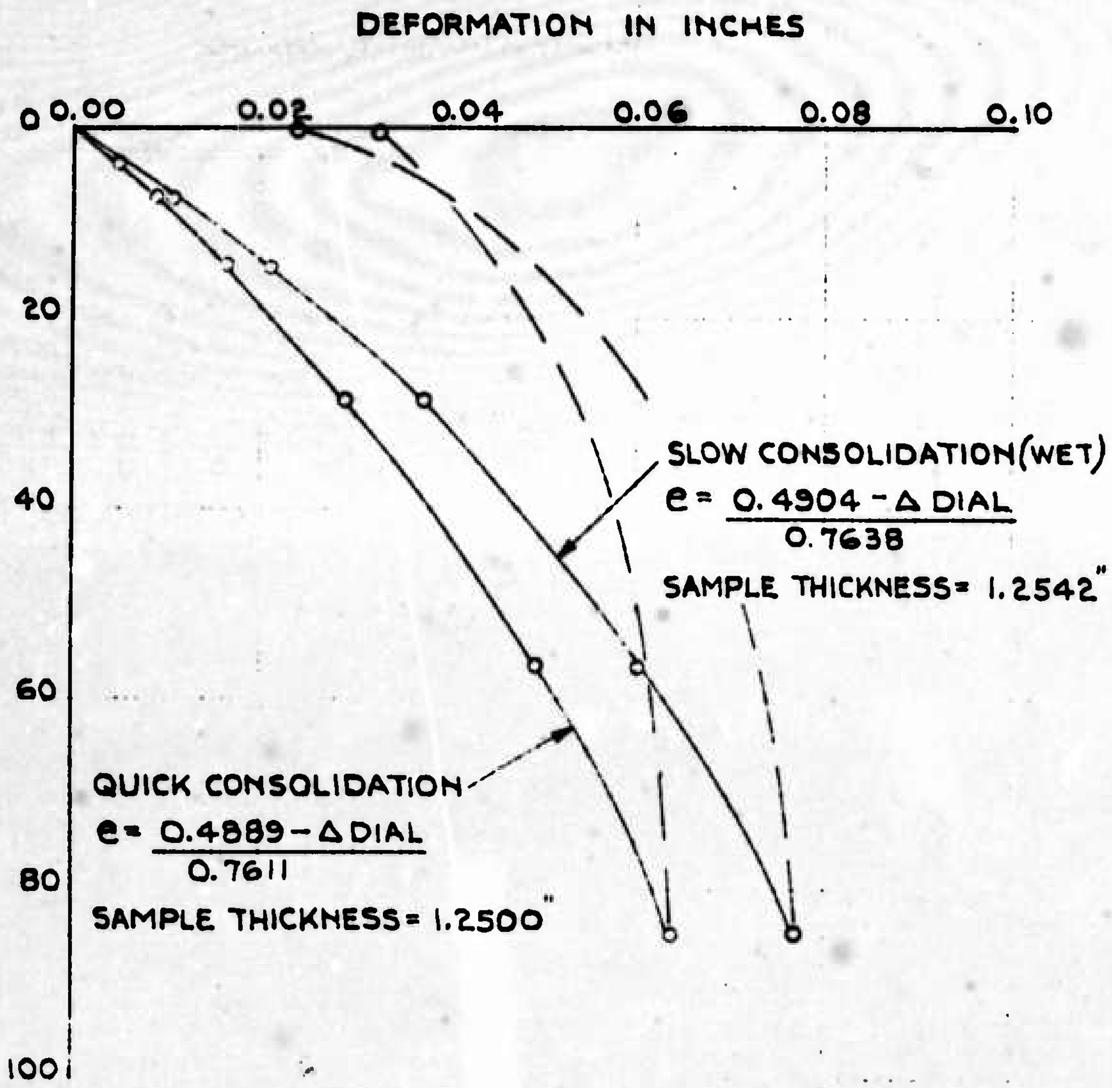
LOCKBOURNE OHIO

BEARING TEST NO. 38-T

SP. GR. 2.73

CLASSIFICATION: Gr. br. CLAY (34) and SILT (41) some f. c. sand (24) tr. f. gravel (01)

DEC. 1943
APPENDIX B
FIG. 22



LOCKBOURNE TEST TRACK

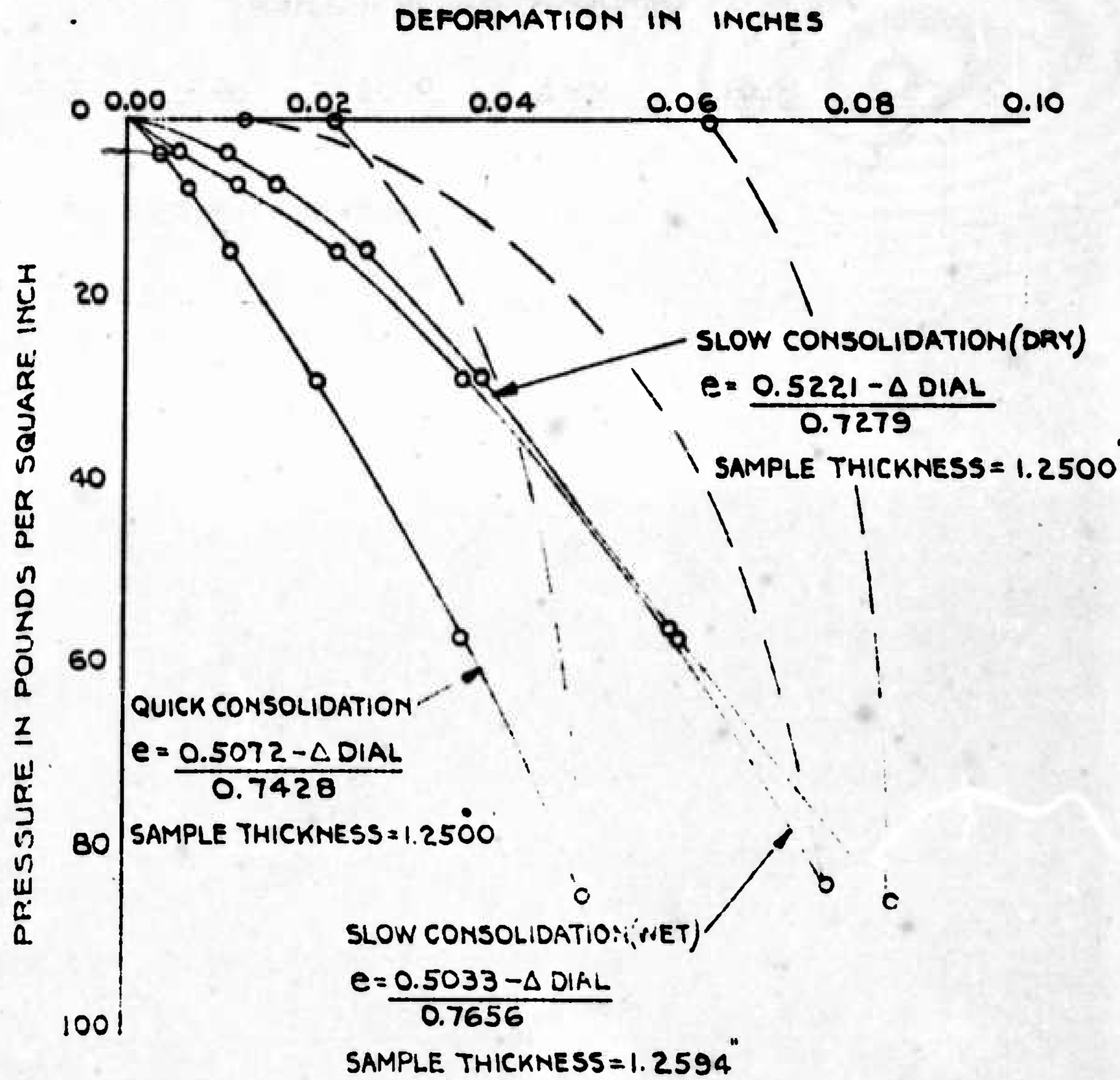
LOCKBOURNE OHIO

BEARING TEST NO. 39-T

SP. GR. 2.73

CLASSIFICATION: Br. SILT (46) some clay (26) some f.c. sand (23) tr. rock frags (05)

DEC. 1943
APPENDIX B
FIG. 23

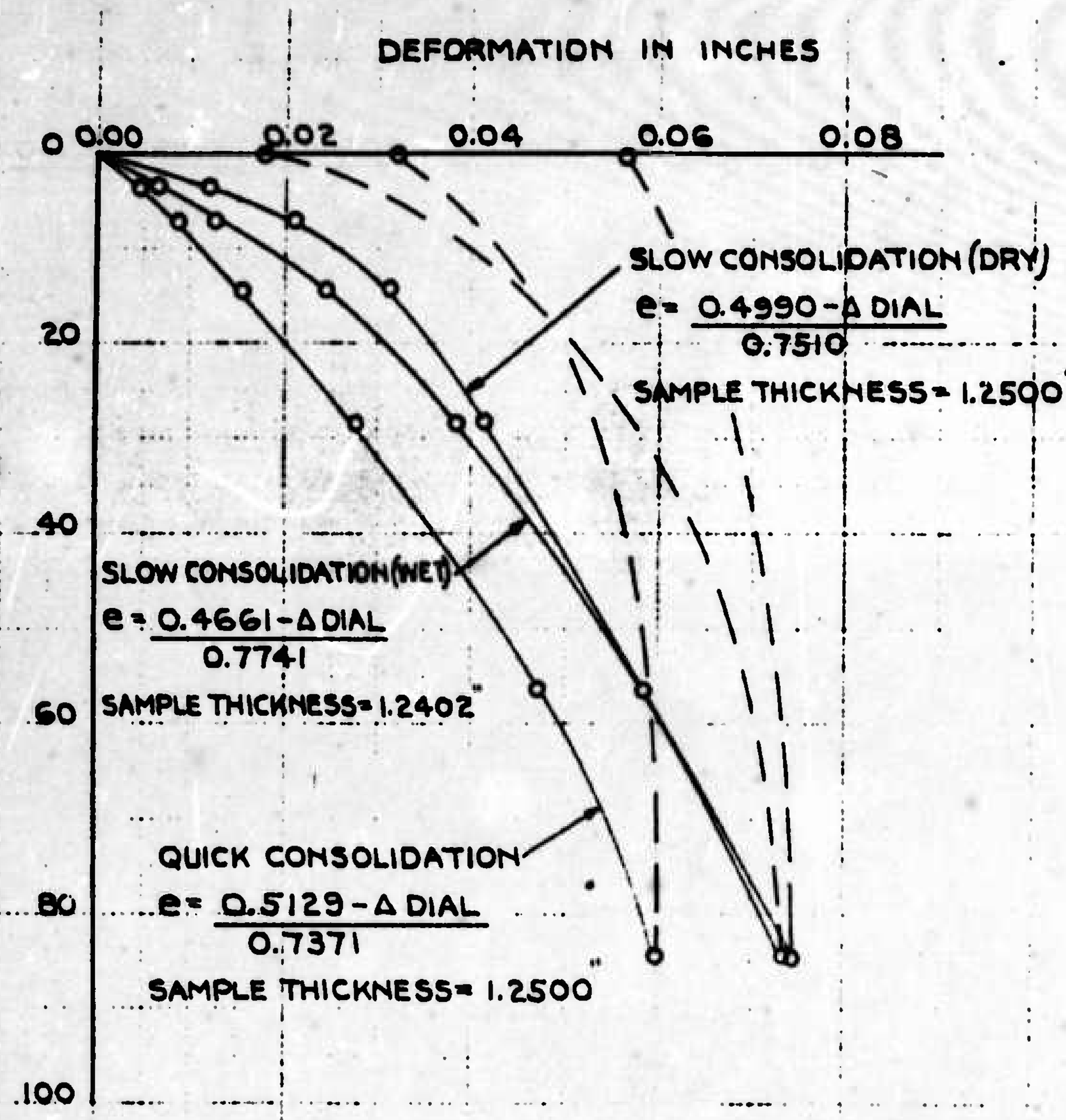


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 42-T & 43-T
SP. GR. 2.68

CLASSIFICATION: Br. SILT (51) some clay (26) little f.c. sand (14) tr. f. gravel (09)

DEC. 1943
APPENDIX B
FIG. 24



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 44-T & 45-T

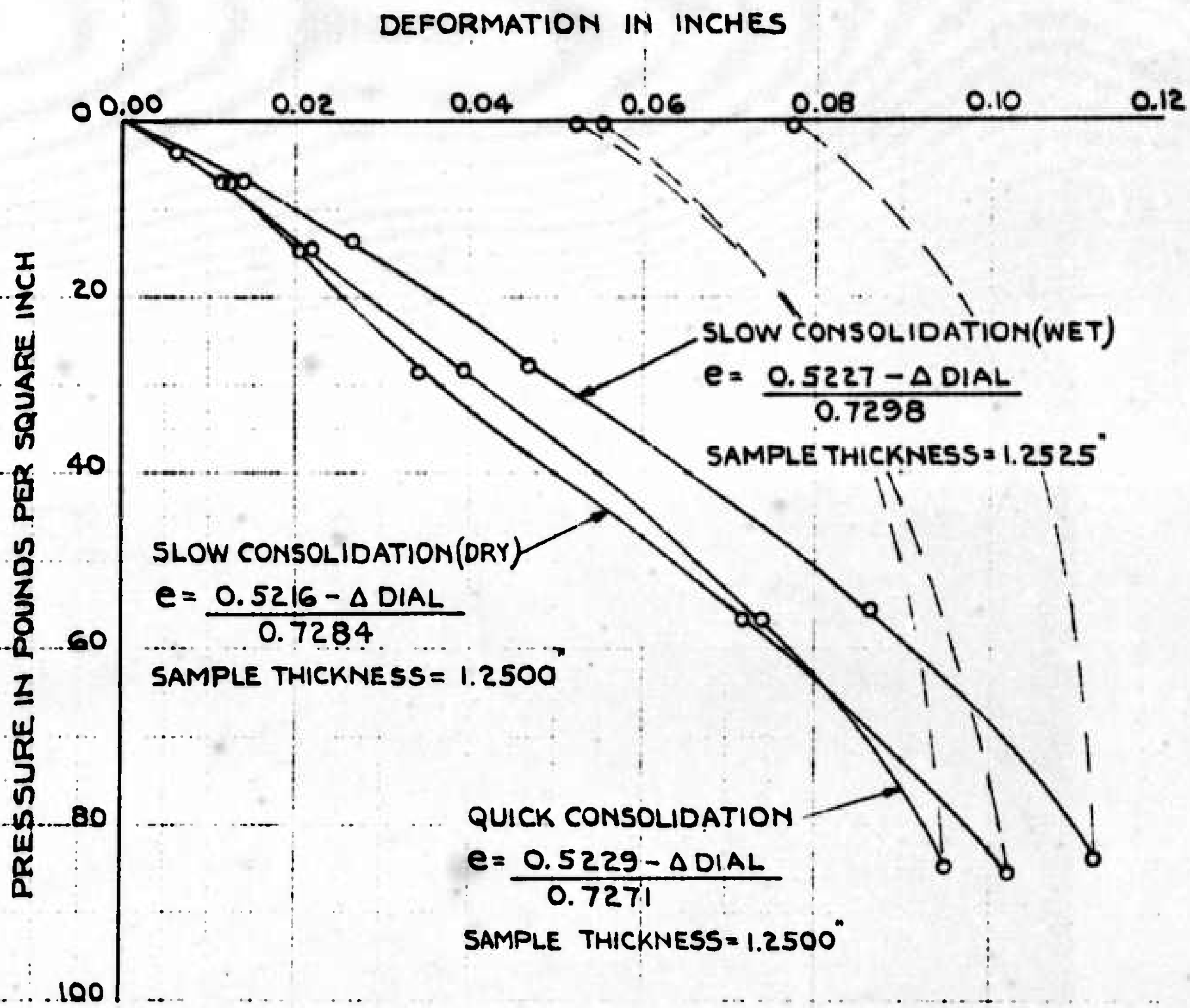
SP. GR. 2.71

CLASSIFICATION: Br. CLAY (35) and SILT (40) little f.c. sand (23) tr. f. gravel (02)

DEC. 1943

APPENDIX B

FIG. 25



LOCKBOUBNE TEST TRACK

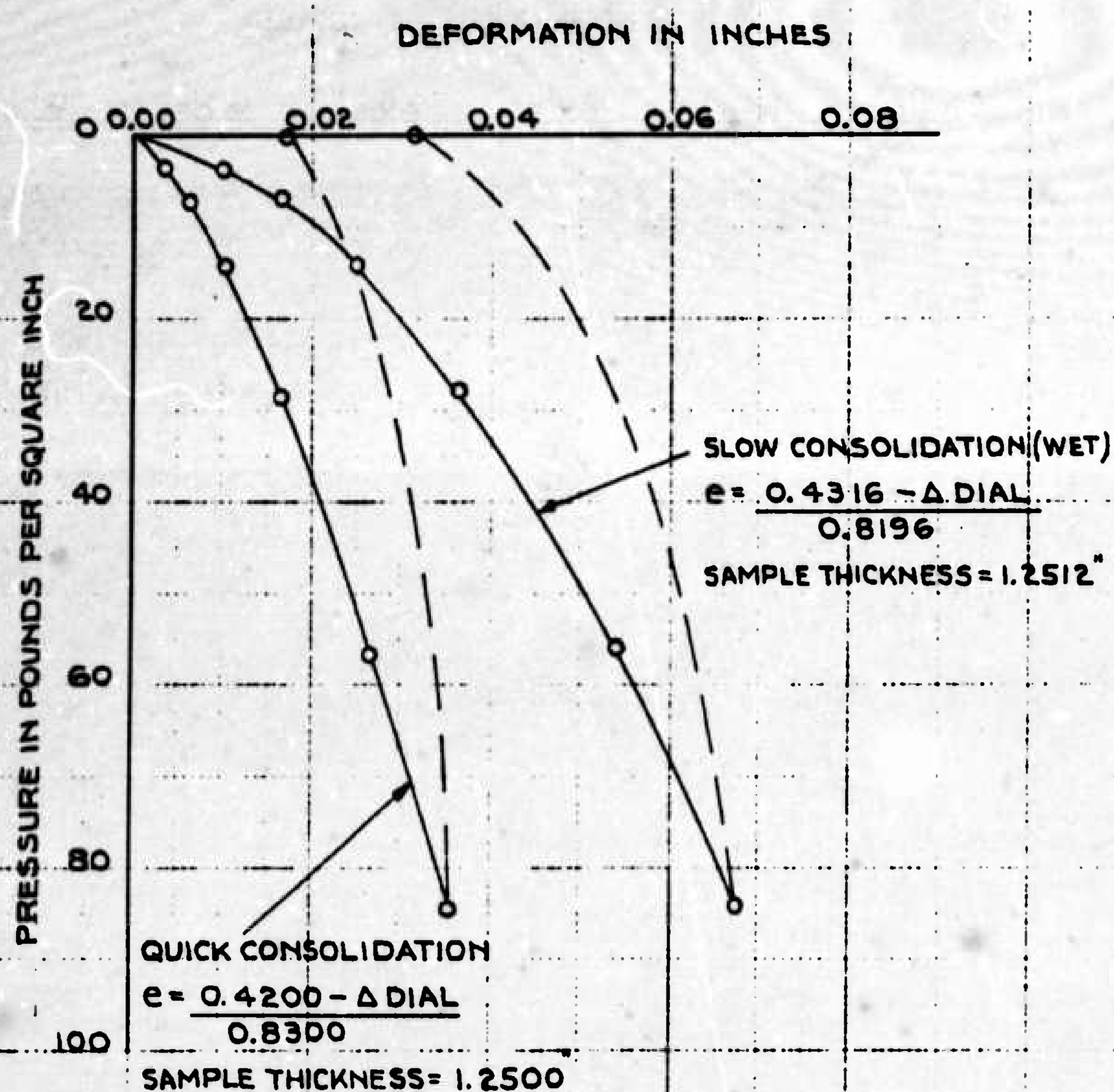
LOCKBOURNE OHIO

BEARING TEST NO. 46-T

SP. GR. 2.73

CLASSIFICATION: Gr. br. SILT (44) some clay (27) some f.c. sand (24) tr. f. gravel (05)

DEC. 1943
APPENDIX B
FIG. 26

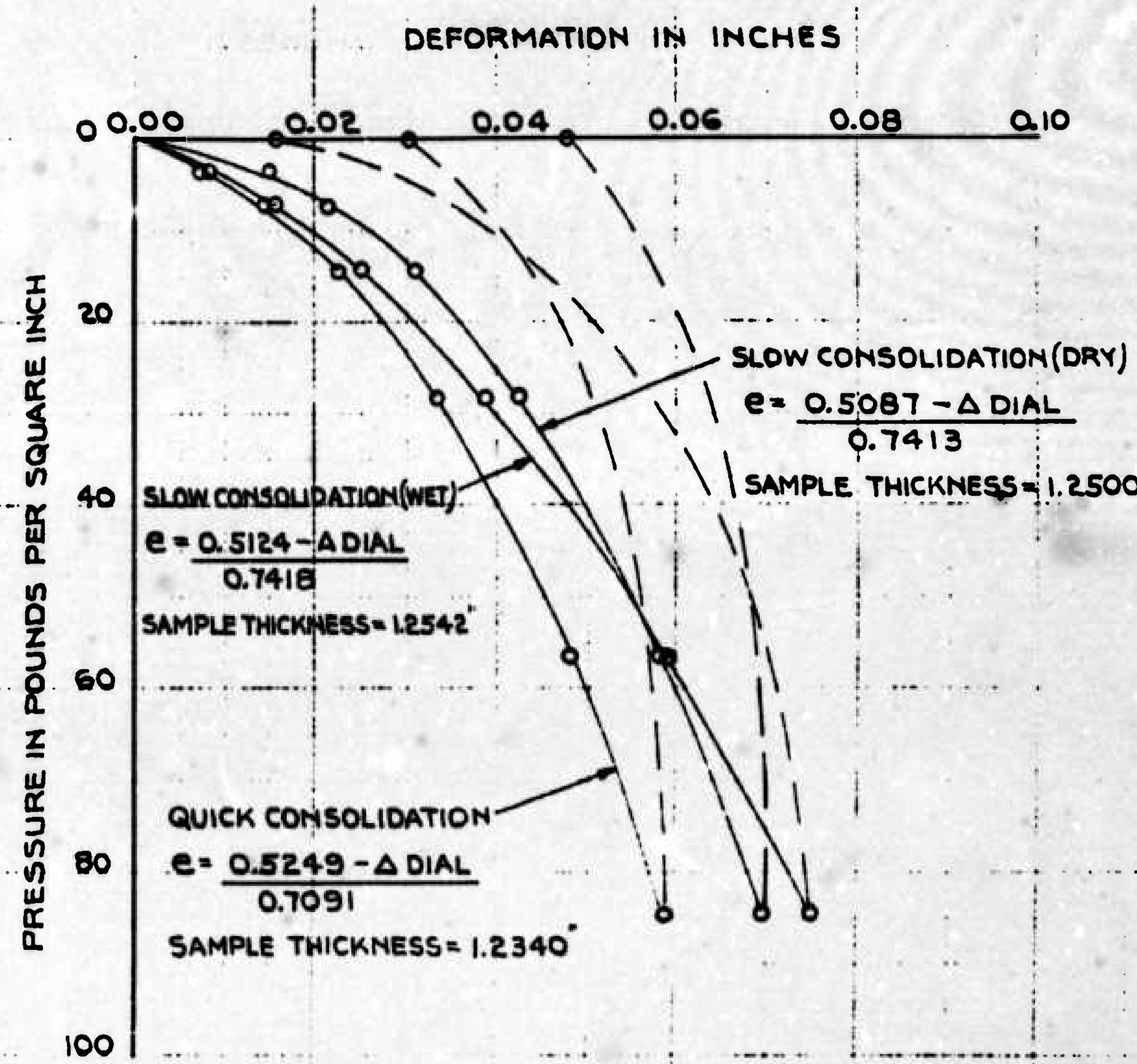


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 47-T & 48-T
SP. GR. 2.74

CLASSIFICATION: Br. SILT(33) some f.c. sand (27) some f.c. gravel (24) little clay (16)

DEC. 1943
APPENDIX B
FIG. 27

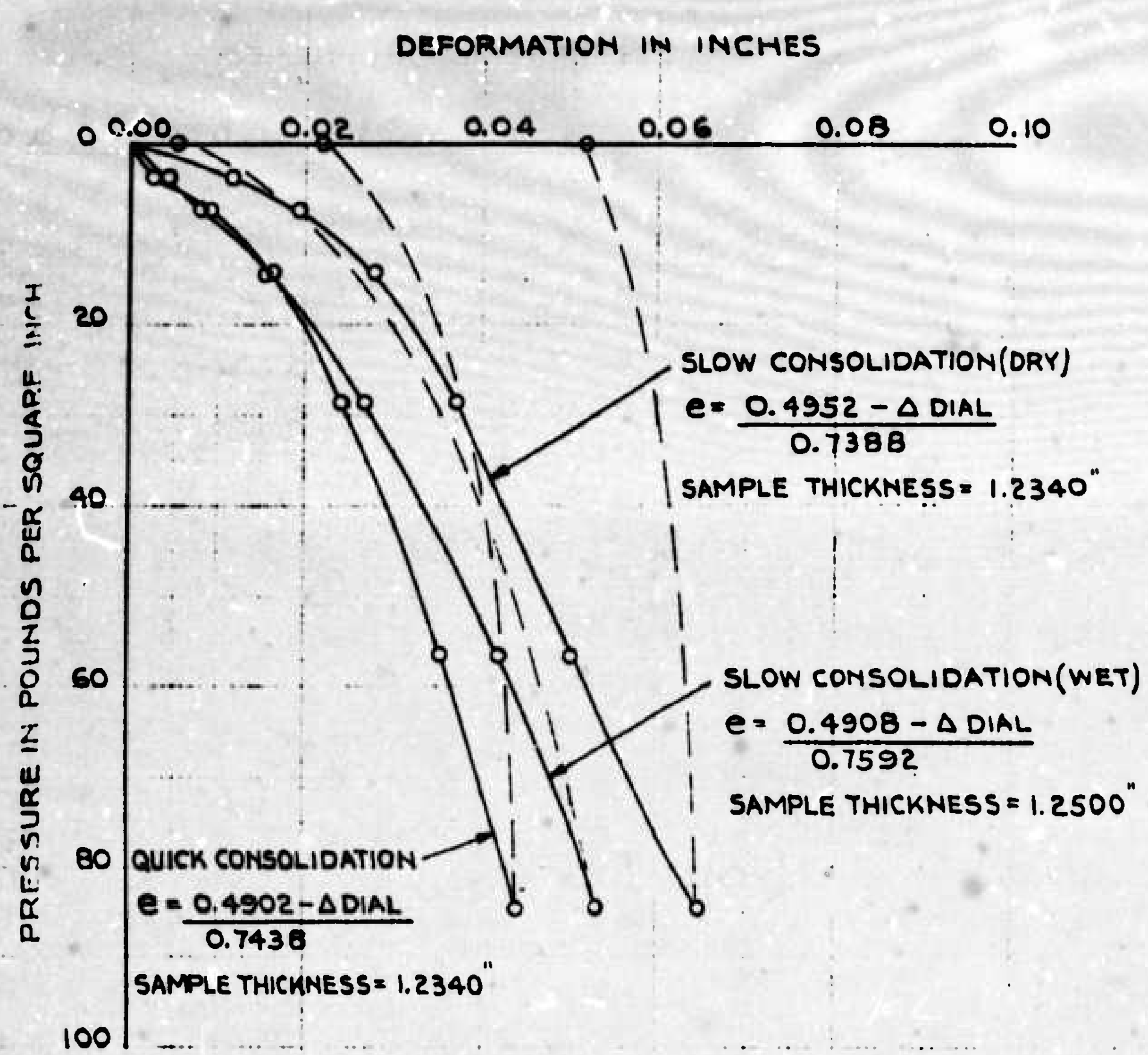


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 55-S & 61-S
SP. GR. 2.78

CLASSIFICATION: Gr. br. CLAY (36) and SILT (47) little f.c. sand (12) tr. f. gravel (05)

DEC. 1943
APPENDIX B
FIG. 28



LOCKBOURNE TEST TRACK

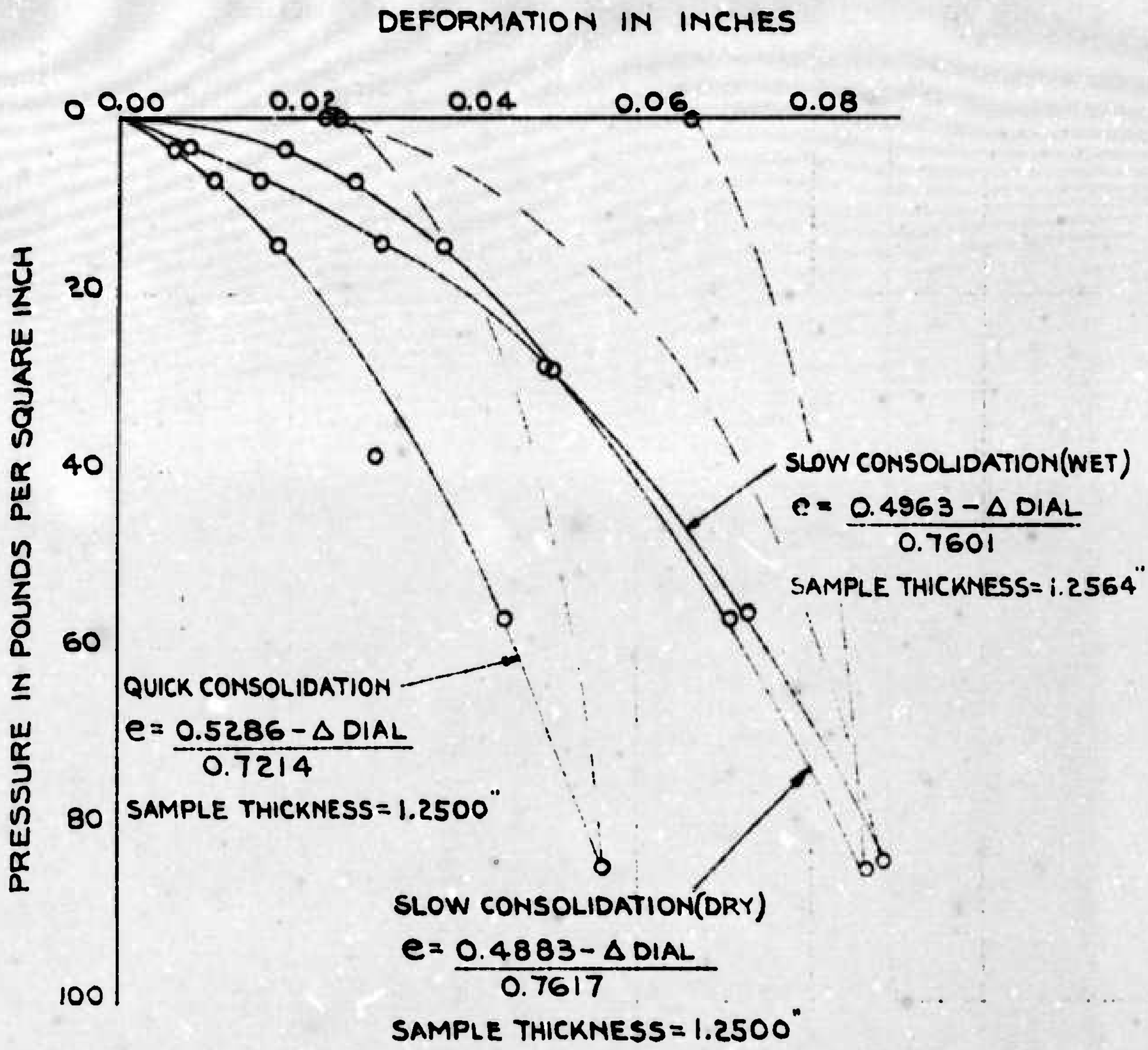
LOCKBOURNE OHIO

BEARING TEST NO.56-S&58-S

SP. GR. 2.78

CLASSIFICATION: Gr. br. CLAY(31) and SILT(40) some f.c. sand(23) tr. f. gravel(06)

DEC. 1943
APPENDIX B
FIG. 29



LOCKBOURNE TEST TRACK

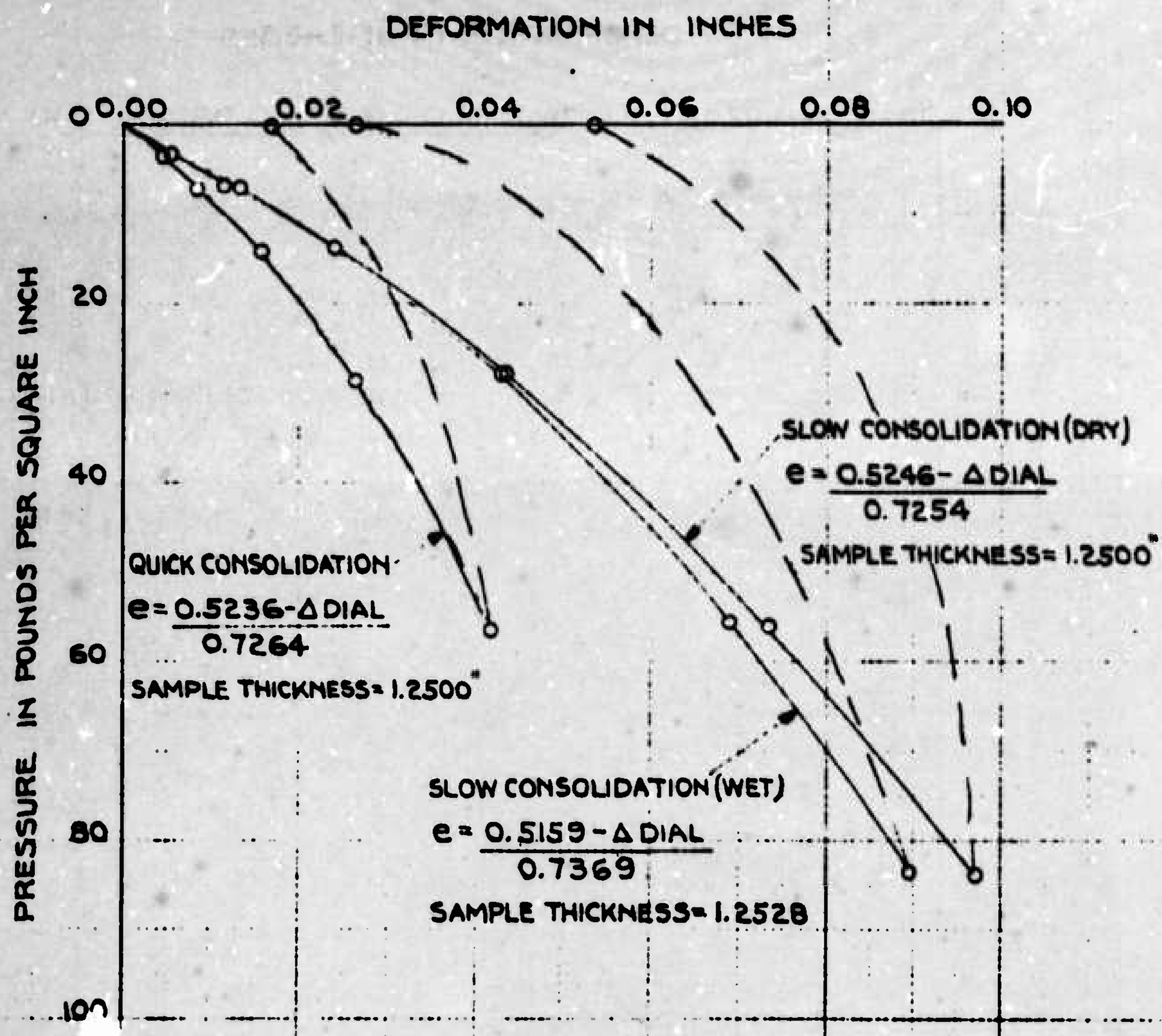
LOCKBOURNE OHIO

BEARING TEST NO. 57-S&62-S

SP. GR. 2.73

CLASSIFICATION: Br. SILT(35) some f.c. sand(29) some clay(12) little f.m. rock frags (15)

DEC. 1943
APPENDIX B
FIG. 30

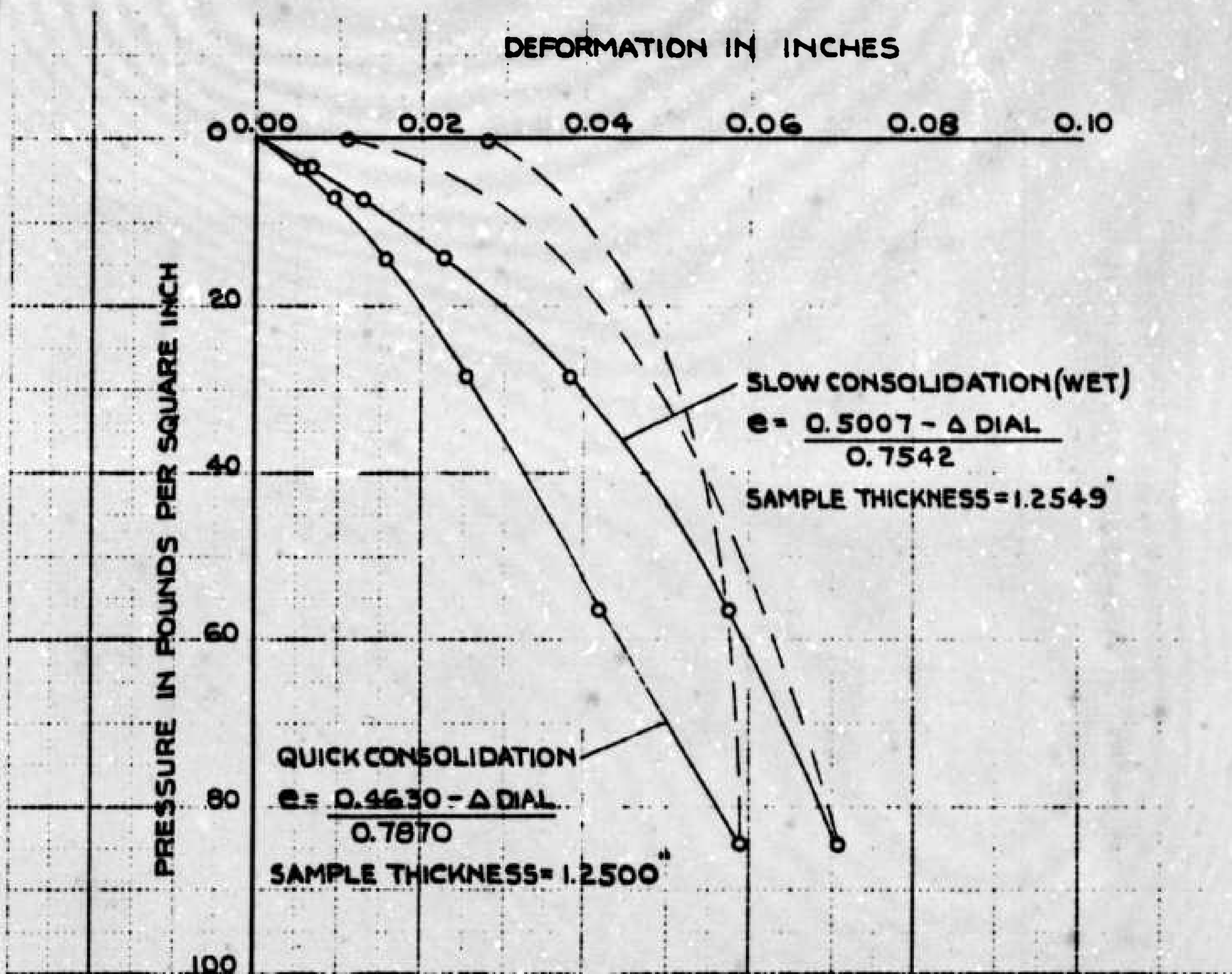


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 59-S & 60-S
SP. GR. 2.76

CLASSIFICATION: Gr. br. CLAY (34) and SILT (50) little f.c. sand (15) tr. f. gravel (01)

DEC. 1943
APPENDIX B
FIG. 31

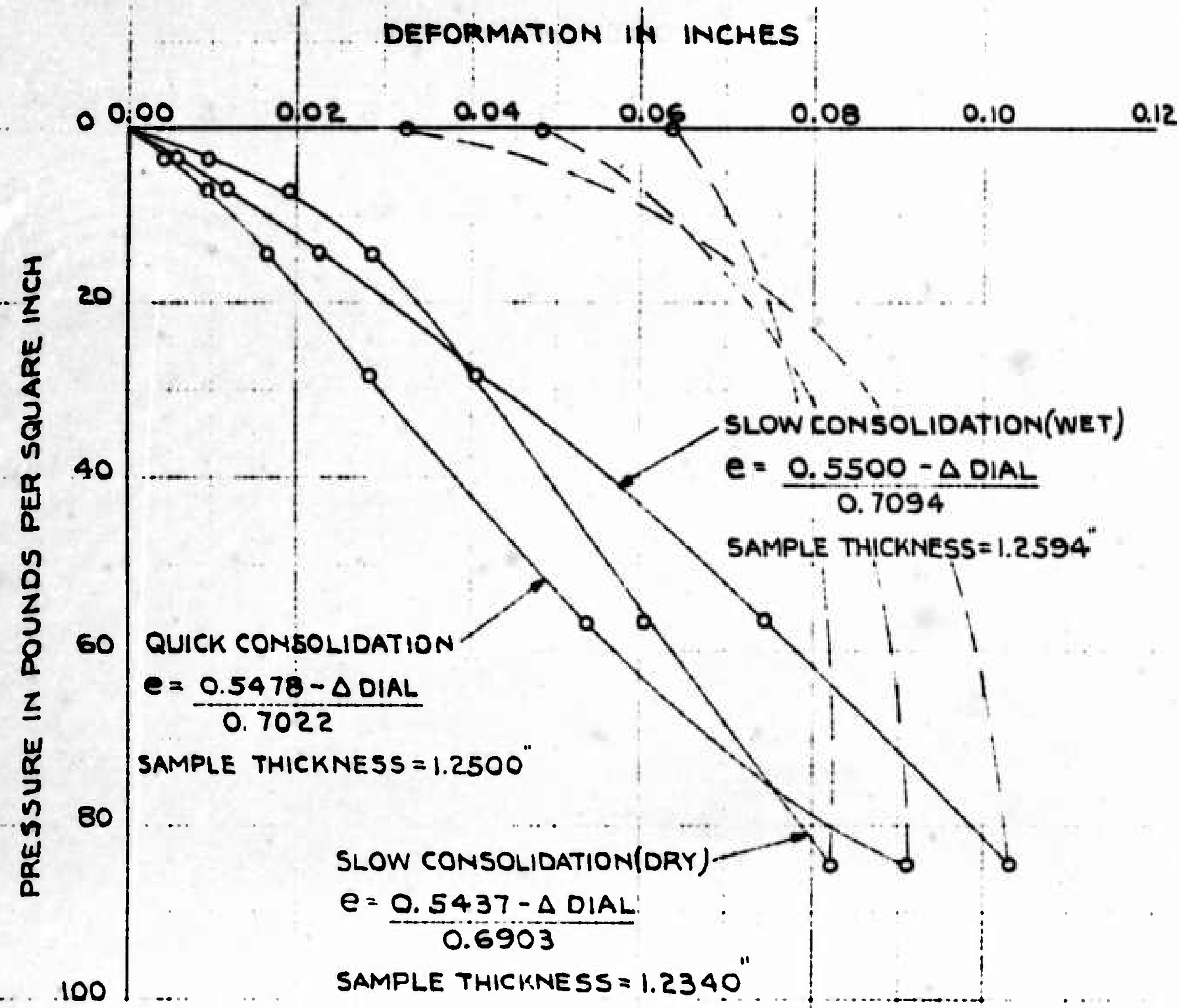


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO.63-S664-5
SP. GR. 2.76

CLASSIFICATION: Br. CLAY (37) and SILT (47) little f.c. sand (16)

DEC. 1943
APPENDIX B
FIG. 32

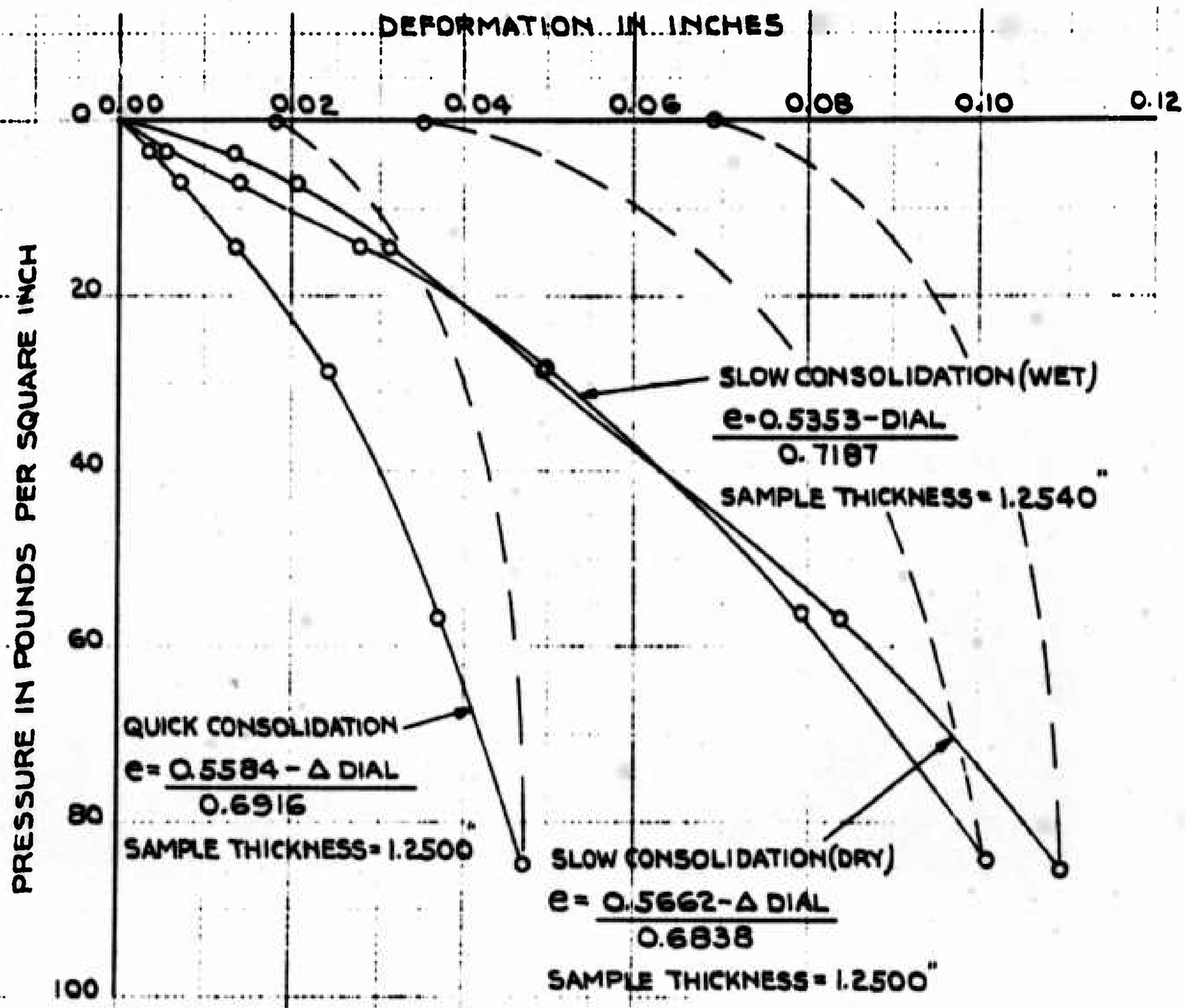


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 72-S
SP. GR. 2.74

CLASSIFICATION: Br. CLAY (36) and SILT (39) some f.c. sand (23) tr. f. gravel (02)

DEC. 1943
APPENDIX B
FIG. 33



LOCKBOURNE TEST TRACK

LOCKBOURNE OHIO

BEARING TEST NO. 73-S & 74-S

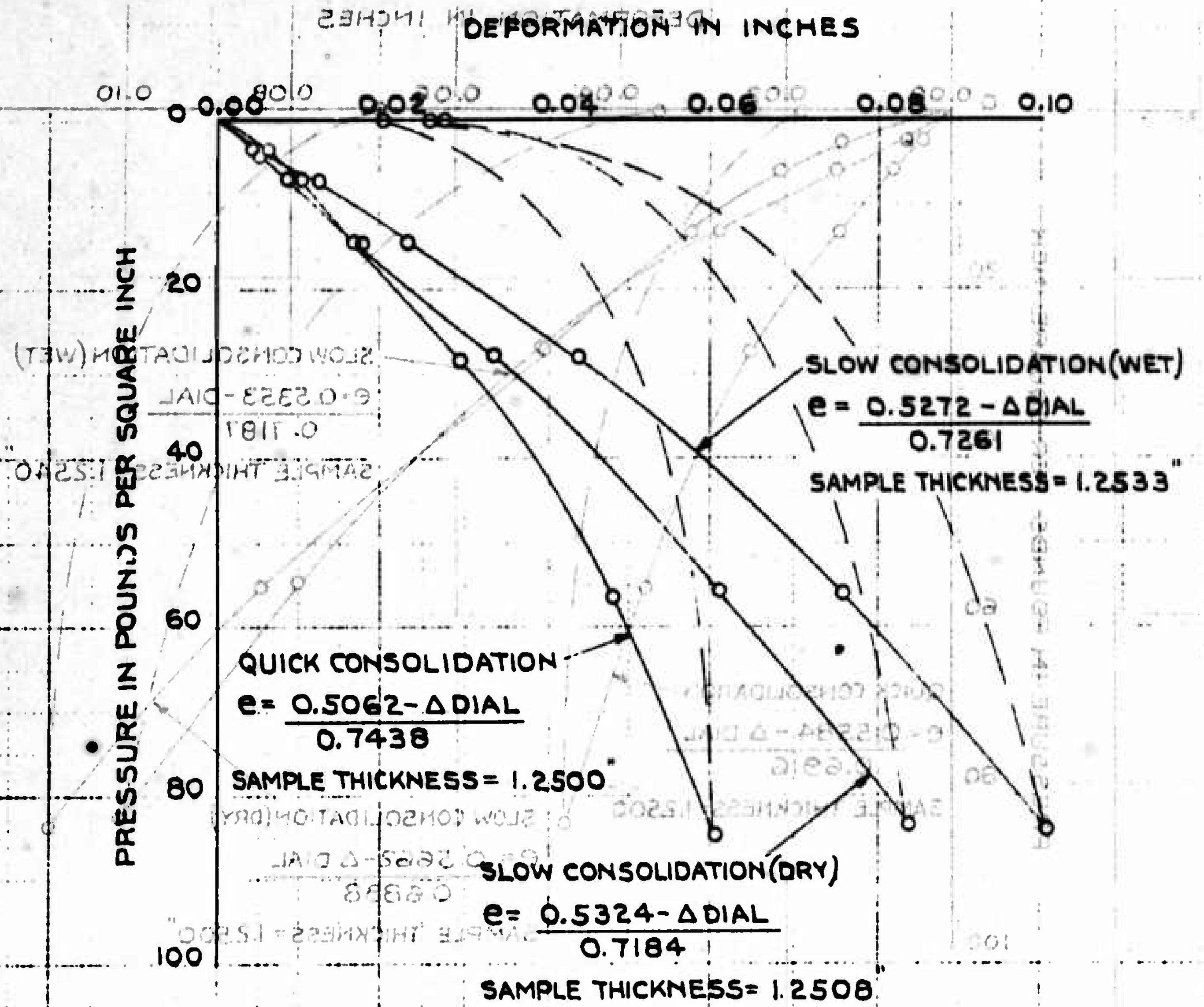
SP. GR. 2.67

CLASSIFICATION: Dark Gr. CLAY (33) and SILT (49) little f.m. sand (18) tr. organic material (veg.)

DEC. 1943

APPENDIX B

FIG. 34

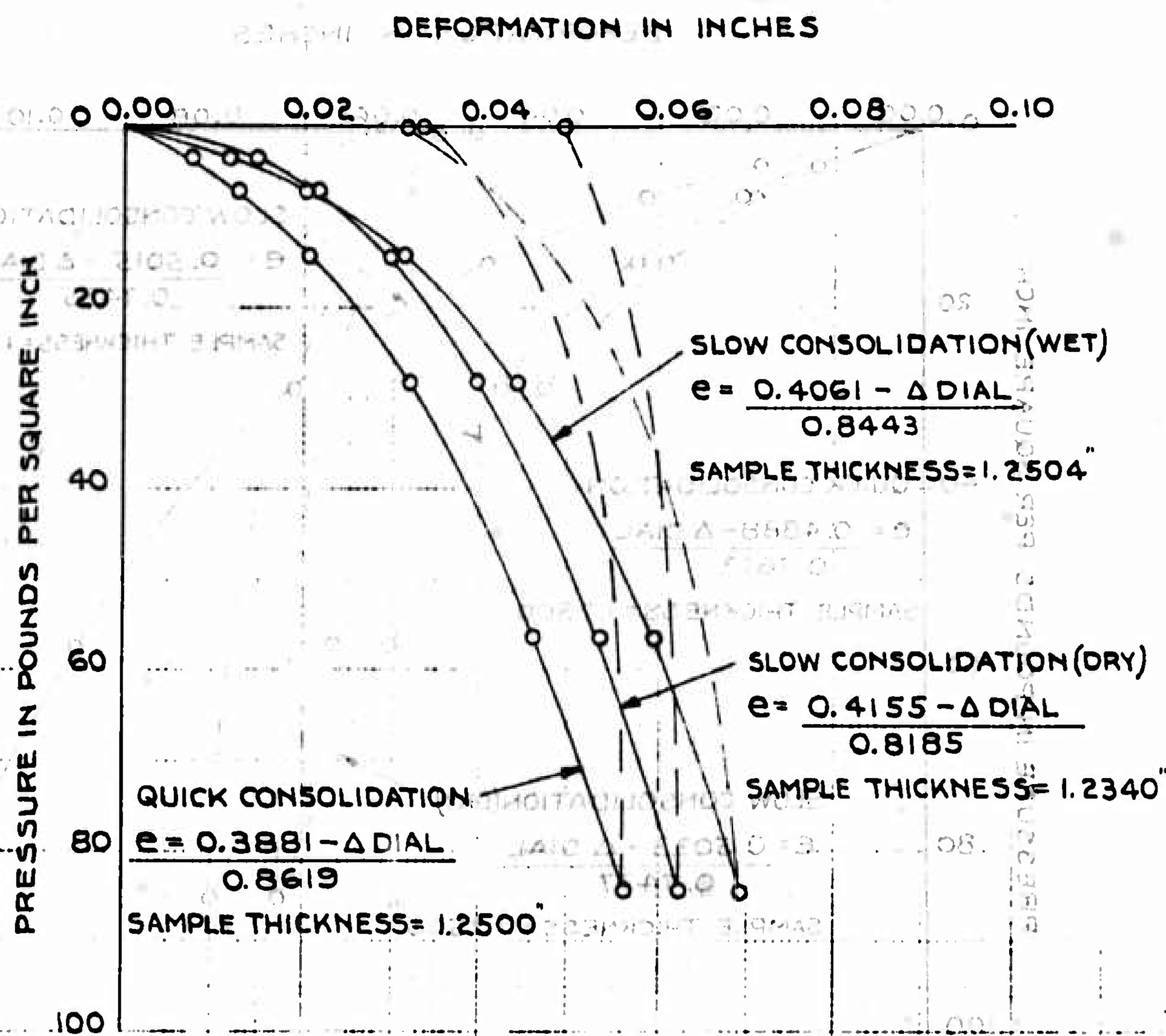


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

BEARING TEST NO. 75-5
SP. GR. 2.75

CLASSIFICATION Gr. br. CLAY (33) and SILT (47) little f.c. sand (19) tr. f. gravel (01)

DEC. 1943
APPENDIX B
FIG. 35



LOCKBOURNE TEST TRACK

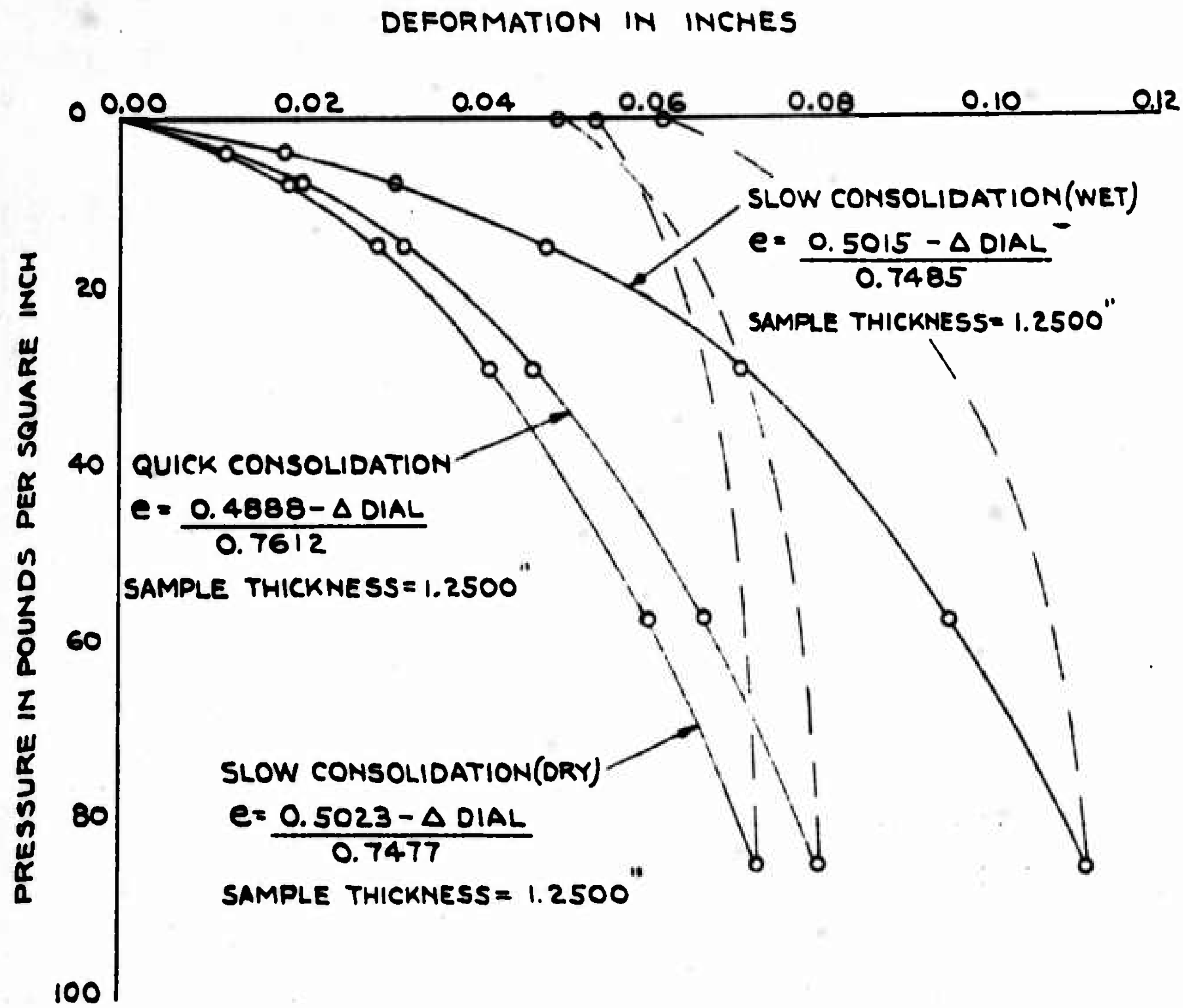
LOCKBOURNE, OHIO

BEARING TEST NO. 76-S

SP. GR. 2.74

CLASSIFICATION: Br. SILT (47) some clay (28) some f.c. sand (22) tr. f. gravel (03)

DEC. 1943
APPENDIX B
FIG. 36

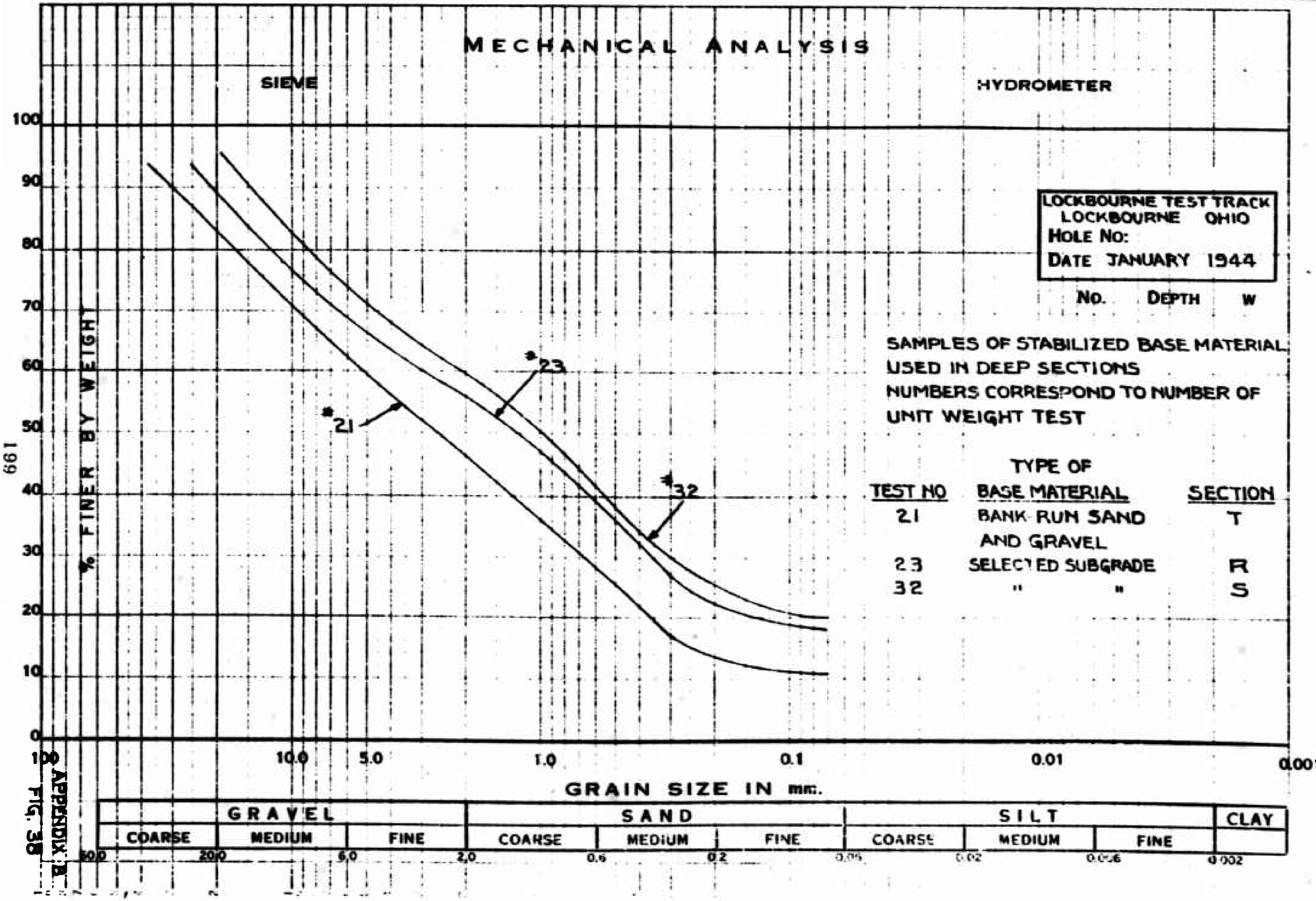


LOCKBOURNE TEST TRACK
LOCKBOURNE OHIO

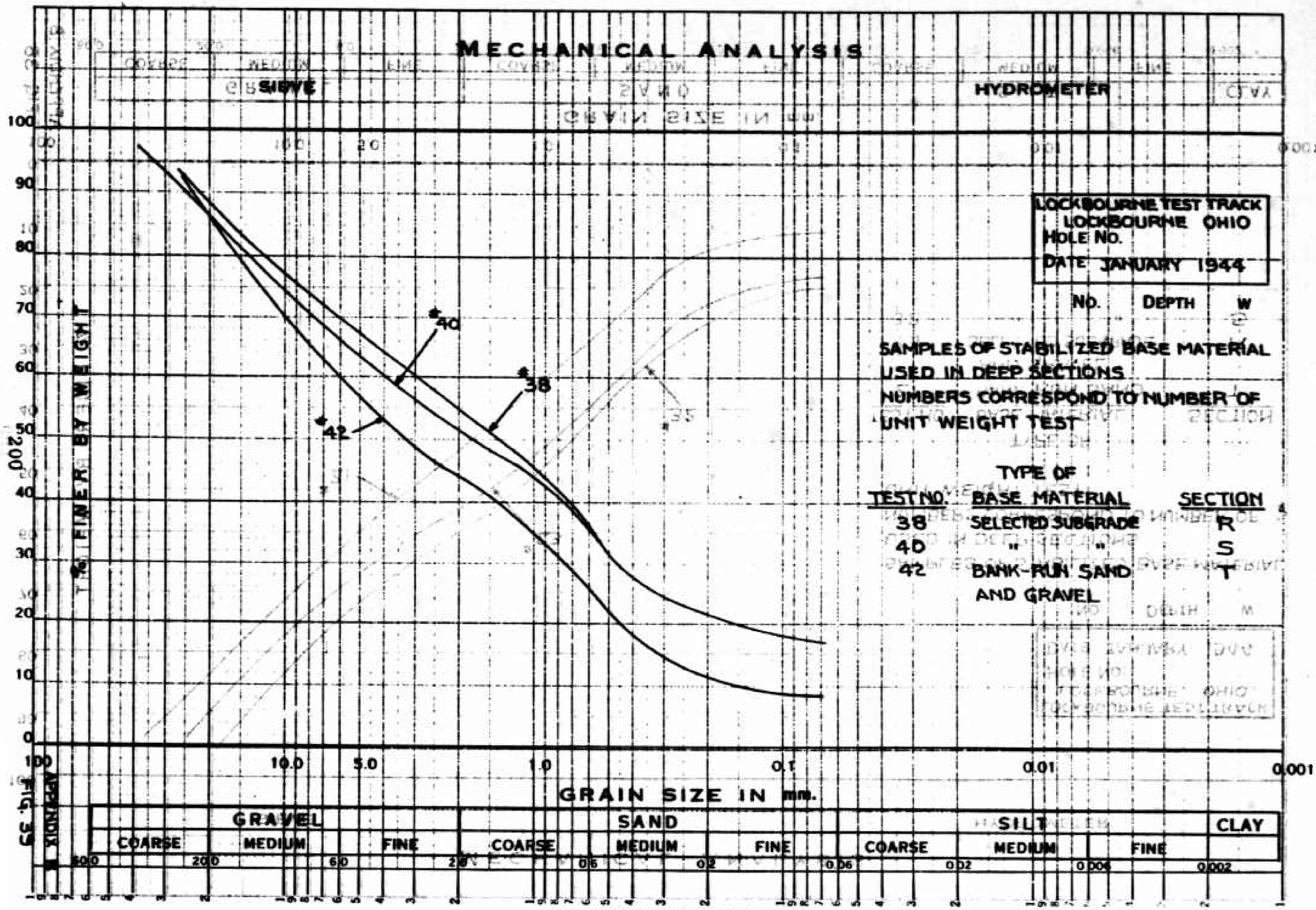
BEARING TEST NO. 77-S
SP. GR. 2.81

CLASSIFICATION: Br. SILT (41) and f.c. SAND (40) little clay (19)

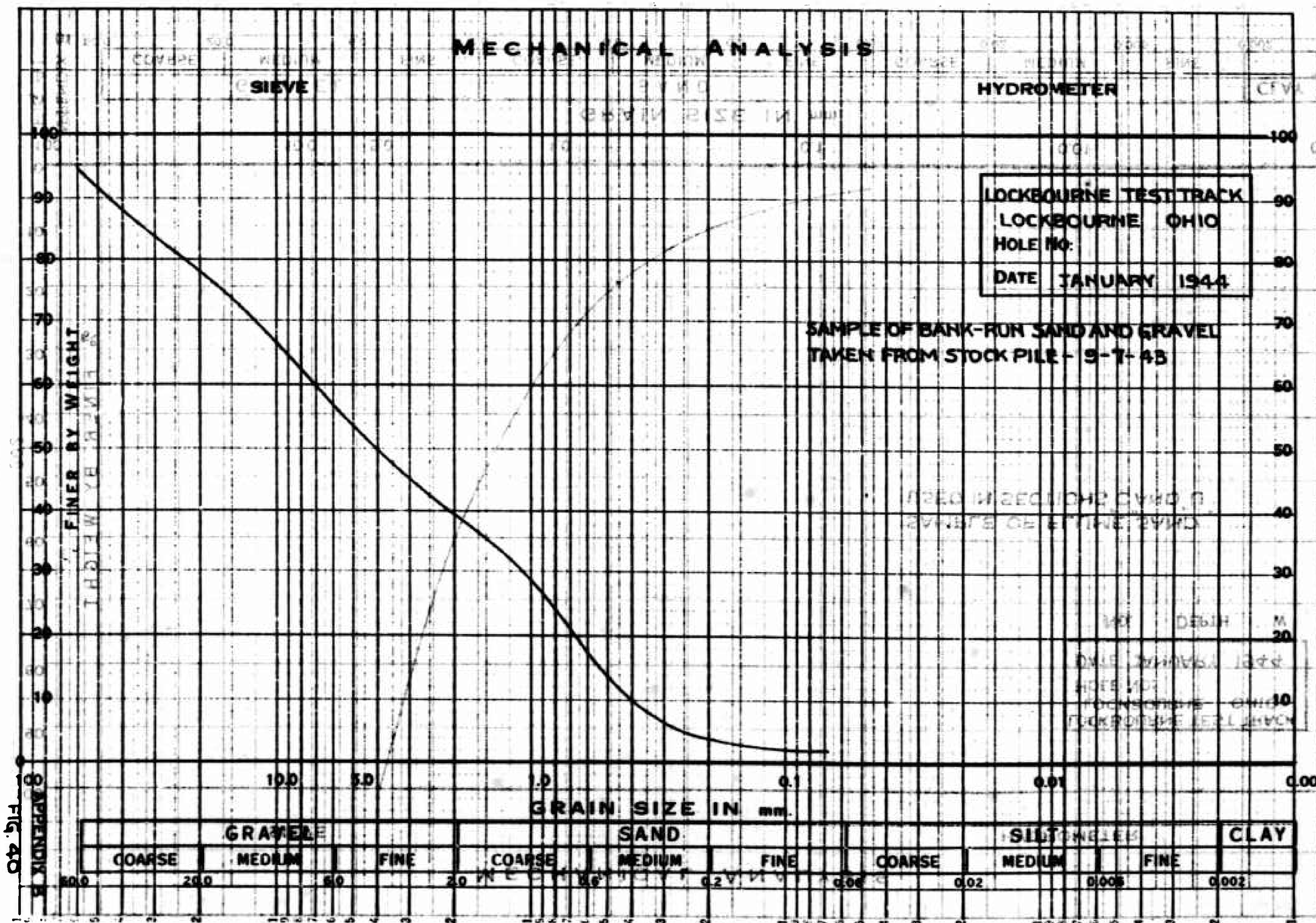
JAN. 1944
APPENDIX B
FIG. 37



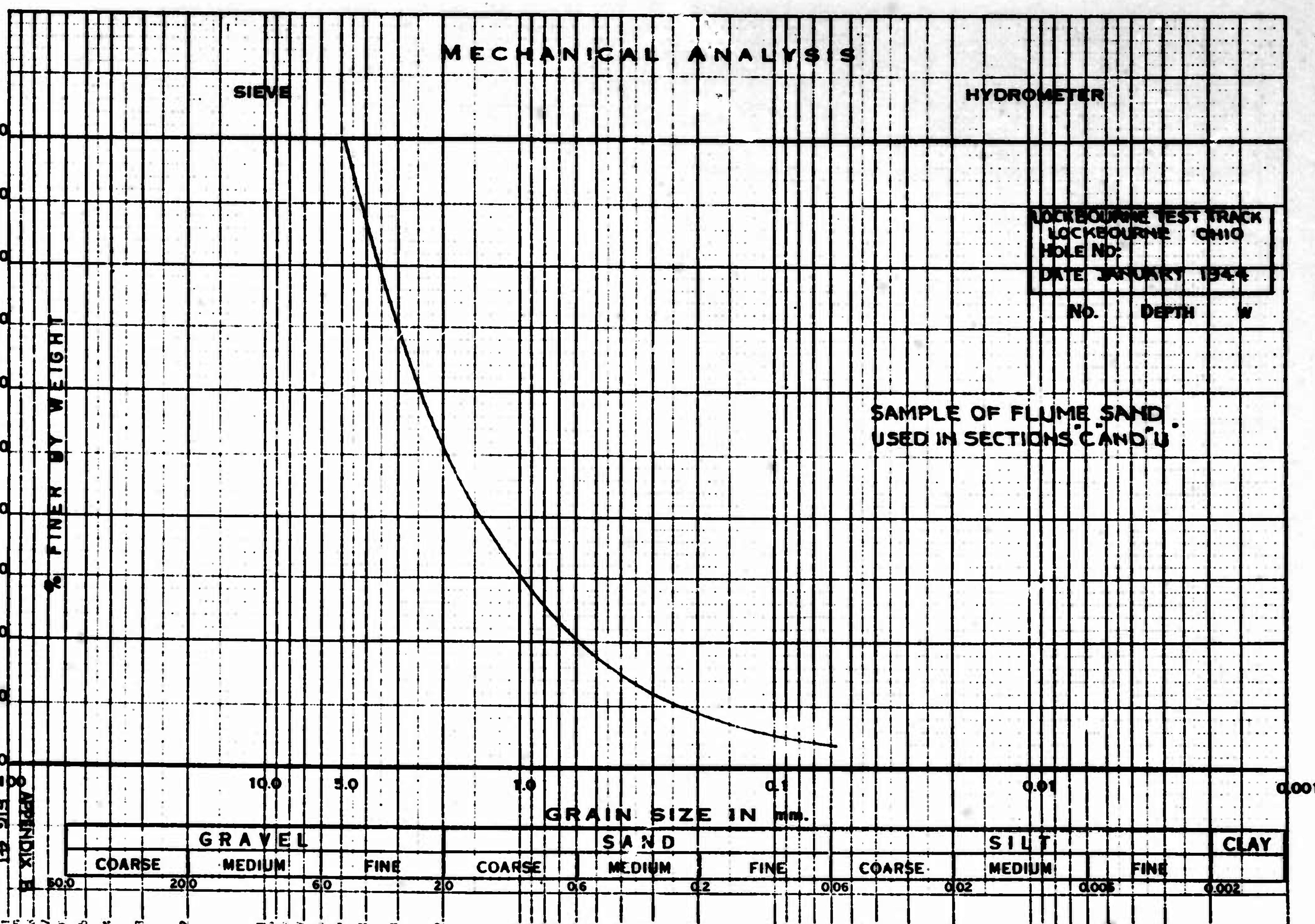
APPENDIX B
FIG. 38



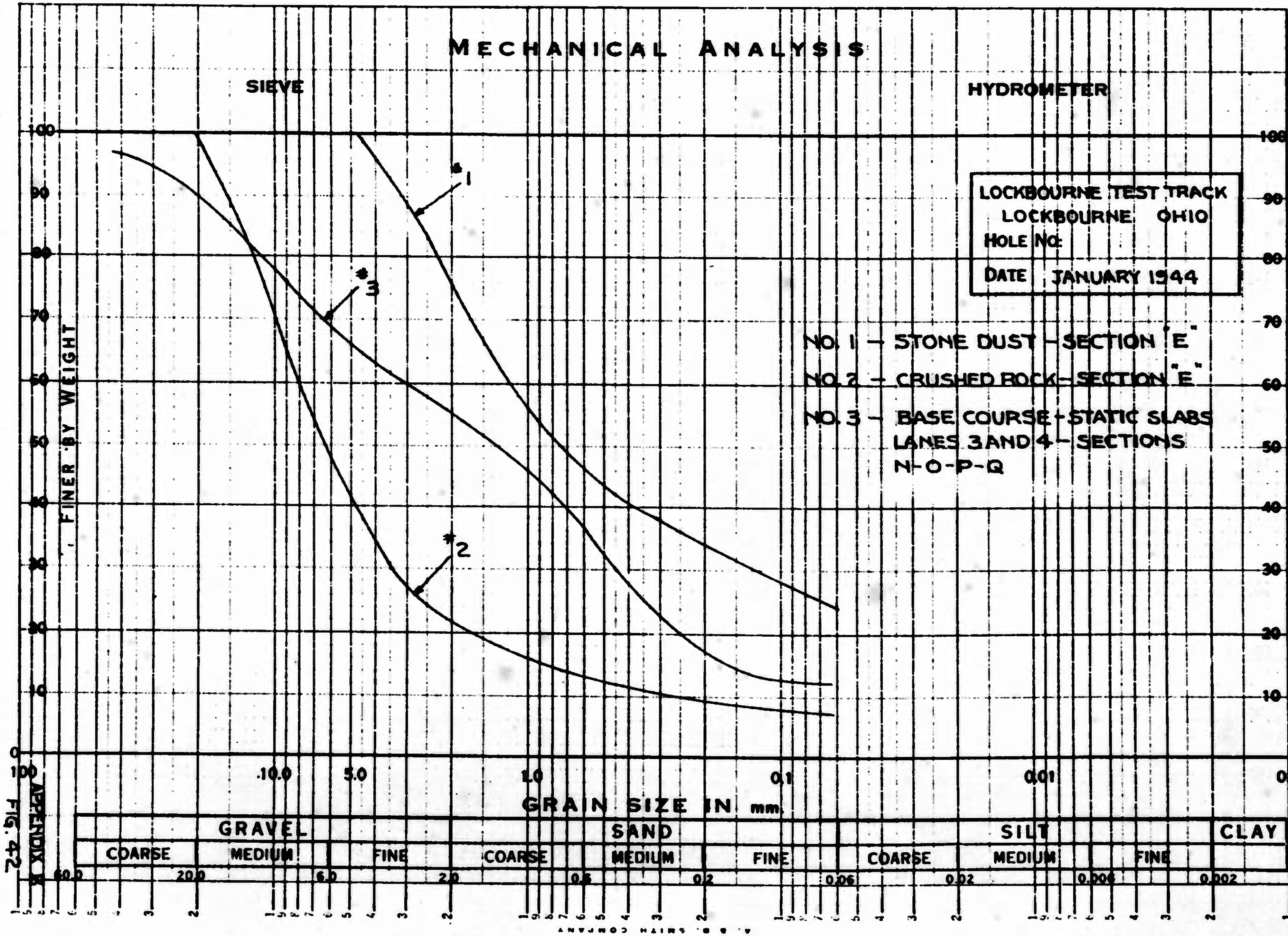
APPENDIX II
FIG. 35



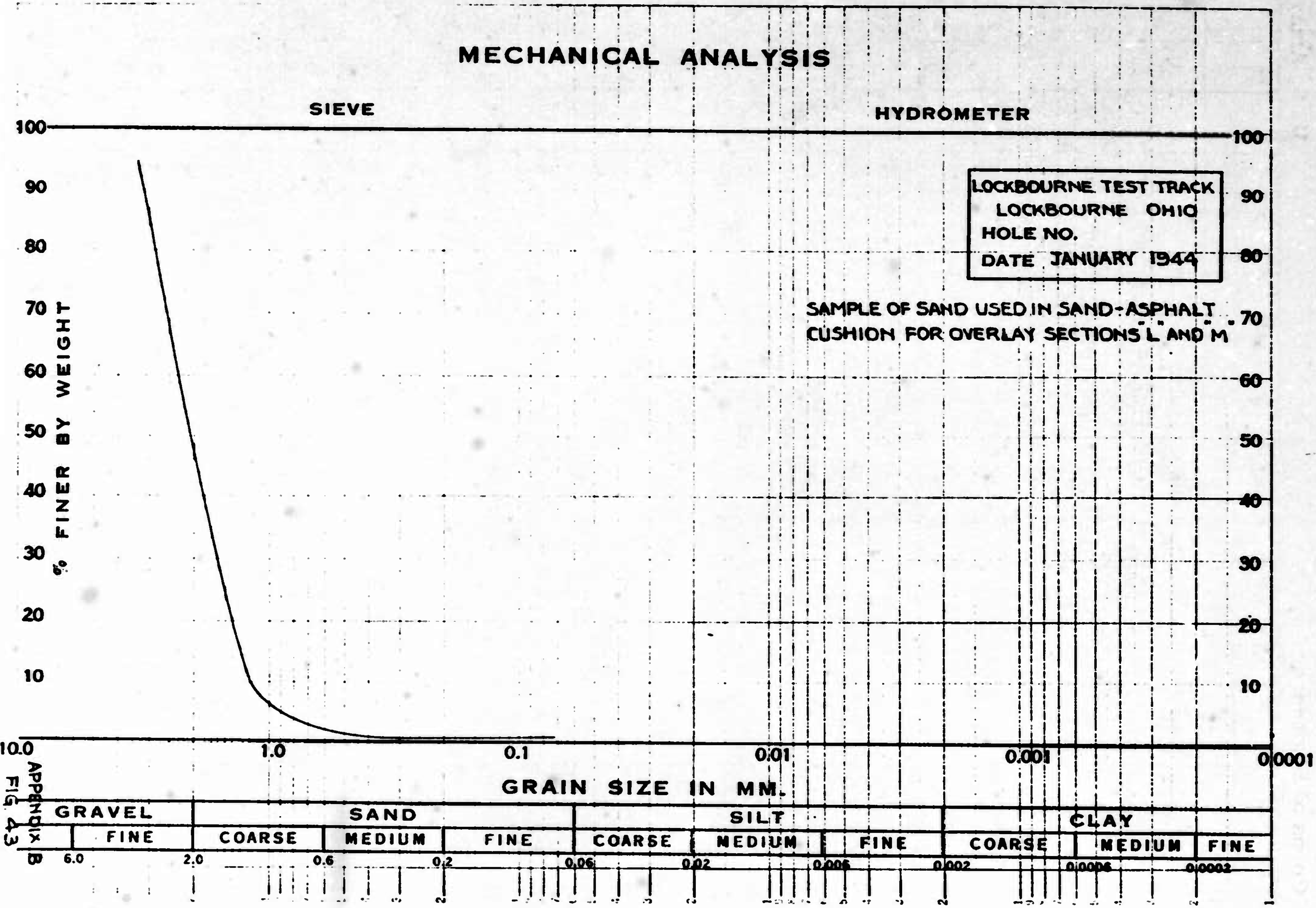
APPENDIX B
FIG. 40



APPENDIX B
FIG. 41



APPENDIX B
FIG. 42



APPENDIX B
FIG. 43

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "C"

Concrete Construction and Results of Laboratory Tests of Concrete Control Specimens and Materials

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

Corps of Engineers U. S. Army

OHIO RIVER DIVISION LABORATORIES
MARIEMONT, OHIO

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX "C"

Concrete Construction and Results of Laboratory Tests of Concrete Control Specimens and Materials

1. Introduction:

This appendix presents the results of tests of concrete specimens cast during construction of the Lockbourne Test Track. Three types of specimens were cast: (a) 4 x 4 x 16-inch beams, (b) 6 x 12-inch cylinders, both of which were laboratory-cured and tested at the age of 28 days, and (c) beams of square sections equal to the thickness of the pavement represented and lengths of approximately four times their thickness. These latter beams were cast on the subgrade adjacent to the pavement and field-cured in the same manner as the pavement, except that they were not protected with straw during the winter of 1943-44. These beams are to be tested at the time that traffic tests are conducted on the pavement; and, inasmuch as these traffic tests have not been completed at this time (May 1944), this appendix is concerned with tests of the laboratory-cured specimens only.

Results of tests of samples of aggregate used in the construction of the test track, as well as of a few concrete specimens cast in the laboratory under controlled conditions, in order to check the field concrete mixture proportions, are also included herein.

2. Materials:

a. Cement: All cement used was obtained from one source; the Columbia Cement Division, Pittsburgh Plate Glass Company, East Fultonham, Ohio. Cement was accepted on mill certification of compliance with Federal Specification E-SS-C-191b, in accordance with the job specification. Results of tests of sample of cement from the two bins from which cement was furnished for this project are presented in Table No. 1. These data were furnished to the laboratory by certified reports from the cement mill. In addition, Table No. 1 presents the results of a laboratory check test of a composite sample of cement obtained at the cement mill by a laboratory representative during this construction.

During construction of the test track, cement from this same mill was used also in construction of the East-West runway at Lockbourne Air Force Base. For this reason it was necessary to use cement from more than one bin in the concrete of the test track. However, the test results indicate that there was no appreciable difference in the cement from the two bins used, and that the cement from both bins complied with all specification requirements. Results of the laboratory check test agreed closely with the data furnished by the cement mill.

b. Aggregate: Concrete aggregate consisted of natural sand and gravel furnished by the American Aggregates Corporation (Welch Avenue Plant), Columbus, Ohio. Results of tests of samples of sand and gravel from this source are presented in Table No. 2. These samples comply with all requirements of the job specification which are indicated in Table No. 2.

3. Concrete Mixture Proportions:

Except for minor adjustment to produce the correct yield, the concrete mixture proportions were the same as those used for concrete pavements at Lockbourne Air Force Base. Throughout construction of the test track, concrete mixture proportions were one part of cement to 6.46 parts of total aggregate (by weight), with a cement content of 5.5 sacks per cubic yard and an estimated water content of 5-1/2 to 6 gallons per sack of cement. The amount of sand (0 to #4) used was approximately 36 percent by weight of total aggregate. Coarse aggregate consisted of two sizes of gravel (#4 to 3/4" and 3/4" to 1-1/2") which were used in the proportion (by weight) of 55 percent of the coarser size to 45 percent of the finer size.

4. Concrete Control:

Transit-mixed concrete was furnished by the W. E. Anderson Company, Columbus, Ohio. Aggregates were batched, by weight, at the plant of the American Aggregates Corporation and hauled in dump trucks to a batching plant operated by the Anderson Company at Lockbourne, Ohio. Here bulk cement and water were added during charging of the truck mixers. Cement was batched by weight and water was measured by means of a meter calibrated to 0.1 gallon.

Because of the current shortage of experienced concrete technicians, no inspection was provided at either of the two batching plants, and the concrete was controlled at the site of the work by means of slump tests and visual examination. This arrangement proved to be rather unsatisfactory since changes in moisture conditions of the aggregate were not detected in time to adjust the amount of water added to the different batches. As a result, every batch of concrete had to be approved at the forms before it was placed, and a number of batches were rejected because they were "too wet". In most instances it became necessary to add water to the batch at the forms, with additional mixing of the concrete, before the desired consistency was obtained. Slump tests were made at frequent intervals in order to measure the consistency of the concrete, and to provide a record of the uniformity of the concrete in the various sections of the test track. It was intended that the average slump should be about 3 inches with a maximum range of $\pm$ 1 inch from the average. In most instances this degree of uniformity is believed to have been achieved.

5. Laboratory Concrete Mixture:

In order to check the concrete mixture proportions used in the Test Track pavement, a batch of concrete was mixed in the laboratory under controlled conditions. Concrete mixture proportions, cement, and aggregate, were the same as those used in the actual construction. The aggregates were submerged in water for 24 hours previous to use, and then surface-dried before the concrete was mixed. A Lancaster open-pan, laboratory type mixer was used. Materials were first mixed dry for 1/2 minute; after which the gaging water was added and the mixing was continued for two additional minutes.

The consistency of the concrete was measured by means of the standard slump cone. The concrete was then wet-screened over a 1-1/4-inch square mesh screen, and six 4 x 4 x 16-inch beams were cast from one batch. These beams were cured in the laboratory fog-room (70°F, 100 percent relative humidity) for 28 days, then tested for dynamic modulus of elasticity, flexural strength, and compressive strength (as modified cubes).

The following tabulation presents the concrete mixture data and the results of tests of the 6 beam specimens cast from the laboratory mixture:

Mixture proportions by weight	1:2.34:4.11
Cement, sacks per cubic yard	5.5
Water, gallons per sack	5.9
Slump, inches	3-1/4
Dynamic modulus of elasticity, p.s.i.	5.15 x . 10^6
Flexural strength, p.s.i. (Avg.)	635
Compressive strength (ends of broken beams tested as modified cubes), p.s.i. (Avg.)	5120

6. Concrete Test Specimens:

In general, throughout the construction period, three 4 x 4 x 16-inch beams were cast to represent the concrete in each 20 x 40-foot section of pavement. One two-gang and one individual mold were used, except that when no individual beam molds were available, two-gang molds were used and four specimens were cast (instead of three) for each section. In addition, one set of three 6 x 12-inch cylinders was cast each day that concrete was placed. Before each group of specimens was cast, the consistency of the concrete was measured by means of a slump cone, the test being conducted in accordance with the requirements of A. S. T. M. Designation C143-39.

In casting the beam specimens, the concrete was placed in the molds in two layers of equal depth, each layer being rodded 25 times with a 5/8-inch diameter steel rod having a bullet pointed end. The specimens were then spaded with a steel trowel along the sides and ends. The 6 x 12-inch cylinders were cast in accordance with the requirements of A. S. T. M. Designation: C31-42. Aggregate larger than 1 inch was removed from the concrete used in casting the 4-inch square beams.

All specimens were cured for approximately 24 hours under damp cotton mats, after which the molds were removed and curing was continued by means of damp cotton mats. The specimens were delivered to the laboratory from 2 to 7 days after casting, and curing was continued in the laboratory fog room (70^{o}F and 100 percent relative humidity) until an age of 28-days was attained, when the tests were conducted.

7. Tests:

The following tests were conducted on the various groups of concrete specimens cast during construction of the test track, and on the few specimens cast previously in the laboratory.

a. Dynamic modulus of elasticity
b. Static modulus of elasticity (flexure)
c. Flexural strength
d. Compressive strength
e. Ring test
f. Density
g. Absorption
h. Freezing and Thawing

8. Test Procedure:

a. Dynamic Modulus of Elasticity: Tests to determine the dynamic modulus of elasticity of the concrete were conducted on all 4 x 4 x 16-inch beam specimens In this test the resonant frequency of flexural vibration of the specimens is measured by means of an electro-dynamic apparatus built in the laboratory, and the dynamic modulus of elasticity of the concrete is calculated by the formula published by Obert and Duvall (1) which follows:

$$E = \frac{4\pi^2 L^4 N^2 D}{k^2 m^4} T, \quad \text{where}$$

E = modulus of elasticity
L = length of specimen
N = frequency of vibration
D = density
k = radius of gyration ($k = \frac{t}{\sqrt{12}}$ for rectangular cross section where t = thickness)
m = numeric (4.73 for fundamental) and
T = correction factor

The electro-dynamic apparatus (see Figure 1), consists of a variable frequency oscillator, a cathode ray oscillograph, a loud speaker, a vibration pickup unit, and two amplifiers. During the test the beam specimen is supported at its nodal points (a distance of 0.224 times the length of the specimen from each end) with the driving rod of the loud speaker pressed firmly against the concrete at the center of the specimen. The source of vibration is the variable frequency oscillator, the output of which is amplified and fed into the loud speaker which transmits it to the specimen by means of the driving rod. As the frequency of the oscillator is changed to approach the natural frequency of the specimen, the amplitude of vibration of the specimen becomes maximum. The frequency corresponding to the maximum amplitude of vibration, is determined by amplifying, and displaying on the cathode ray oscillograph screen, the voltage output of a vibration pickup, and by adjusting the frequency to obtain a maximum deflection of the figure on the screen. Knowing the dimensions, density, and natural frequency of the specimen, the dynamic modulus of elasticity is computed in accordance with the formula given above.

b. Static Modulus of Elasticity:

(1) Flexure: This test was conducted on two 4 x 4 x 16-inch beams selected from those cast on each day on which concrete was placed. The loading procedure for this test was similar to that used for the flexural strength test (see par. 8 c.). Deflections were measured at intervals during application of the load, and the static modulus of elasticity of the concrete was de-

(1) "Discussion of Dynamic Methods of Testing Concrete with Suggestions for Standardization", by L. Obert and W. I. Duvall, Proc. A.S.T.M., Vol. 41, 1941, page 1053.

termined (from load-deflection curves) by using the formula for maximum deflection of a beam subjected to two symmetrical concentrated loads:

$$D = \frac{WA}{12\ EI}\left(3/4\ L^2 - a^2\right),\ \text{or}$$

$$E = \frac{WA}{12\ DI}\left(3/4\ L^2 - a^2\right),\ \text{where}$$

E = modulus of elasticity
W = total load
D = deflection
I = moment of inertia
L = length of span, and
a = distance of support to point of application of load

Deflections of the specimen were measured along its neutral axis at mid-span by means of two 0.0001" Federal dial gages held in angle bars which were clamped to the specimen at mid-beam over the supporting knife edges. The stems of the dial gages rested on gage points independently fixed to the specimen. Views of this testing arrangement are shown in Figure 2.

(2) Compression: Modulus of elasticity of the concrete in compression was determined from stress-strain measurements made on two 6 x 12-inch cylinders from each group. Strain measurements were made by means of two 0.0001" Federal dial gages which were held in frames fastened to the concrete by means of set screws. The stems of the dial gages rested on gage points independently fixed to the concrete by means of additional metal frames. Strains were measured on a gage length of 7 inches as increasing loads were applied to the cylinders in a 300,000 pound hydraulic, compression testing machine. Figure 3 (A) shows the arrangement of the testing apparatus used in these tests.

c. Flexural Strength: This test was conducted on all 4 x 4 x 16-inch beam specimens supported on a span of 13.5 inches, with loads applied at the 3rd points on the top surface of the specimens as cast (see Figure 4 (A). The testing machine is equipped with swivel knife edges and loading was continuous, at a rate sufficient to produce a stress of 150 p.s.i. per minute in the extreme fiber in tension, until failure occurred. The ultimate flexural strength of the concrete was computed by using the formula:

$$fc = \frac{M}{S},\ \text{where}$$

fc = flexural strength (stress in extreme fiber in tension)
M = bending moment, and
S = section modulus of the beam

d. Compressive Strength:

(1) Modified Cubes: Ends of the broken beams (from flexural strength tests) were tested for compressive strength as modified cubes, in accordance with A. S. T. M. Designation: C116-42. The beam ends were capped with a plaster-cement mixture, on the two sides as cast, and compressed in the device shown in Figure 4 (B).

(2) Cylinders: Compressive strength tests of two 6 x 12-inch cylinders from each group were conducted in accordance with the requirements of A. S. T. M. Designation: C39-42. True bearing surfaces were obtained by capping the ends of the cylinders with "Leadite", and the cylinders were broken in a 300, 000 pound hydraulic compression testing machine. These tests were conducted after stress-strain measurements were made; the test arrangement is the same as that shown in Figure 3 (A), except that the dial gages and metal frames were not used.

e. Ring Test: Specimens for the ring test were obtained by sawing one-inch thick discs from 6 x 12-inch cylinders and drilling a one-inch diameter hole at the center of each disc. This provided ring-shaped specimens having an outside diameter of 6 inches, an inside diameter of 1 inch and a thickness of 1 inch. Two specimens were obtained from one cylinder of each group cast during construction of the pavement.

Figure 3 (B) shows the test arrangement, and a typical failure which occurred when pressure was applied along a diameter of the specimen. The tests were conducted in a 90, 000 pound hydraulic compression testing machine.

The strength of the specimens was determined from the dimensions of the specimens and the total load at failure by two methods; first, by means of the theorems of mechanics, and second, by using values obtained from photoelastic studies of similarly shaped bakelite models.

f. Density: Specimens for density tests were 3-inch thick sections sawn from beams after flexural strength tests were conducted. Two specimens were obtained to represent the concrete placed each day. The specimens were submerged in water until their weight remained constant, after which the density of the concrete was determined by dividing the weight of the surface-dried specimen in air, by its volume as measured by displacement in water.

g. Absorption: The saturated slabs from the density tests were dried to constant weight in an oven maintained at approximately 180°F. Absorption of the concrete was determined as a percentage of the dry weight by dividing the difference between the saturated and dry weights of the specimen by its dry weight.

h. Freezing and Thawing: Twenty-eight 4 x 4 x 16-inch beams representing the concrete placed in 14 different locations in the Test Track were subjected to a laboratory freezing and thawing test procedure. Each cycle of freezing and thawing consisted of a freezing period of 4 hours in air at minus 50°F, followed by a thawing period of 2 hours in water at 40°F. Three cycles of alternate freezing and thawing were obtained each day, the specimens remaining in the freezing room for a 10-hour period each night.

At the commencement of this test the specimens were removed from the curing room (at the age of 28 days) and submerged in water at 40°F for 2 hours, after which they were placed in freezing and thawing. Dynamic "E" determinations were recorded at the commencement of the test and at intervals throughout the procedure until a reduction of approximately 75 percent of the initial Dynamic "E" was obtained.

9. <u>Discussion of Results:</u>

Results of tests of the concrete specimens are presented in Tables Nos. 3 to 5 inclusive.

a. Slump: Slump test results indicate that the concrete of 90 percent of the specimens was within one inch of the average slump of 2-3/4 inches, which indicates that the consistency of the concrete was uniform throughout construction of the Test Track.

b. Flexural Strength: It will be noticed that the flexural strength (Table No. 3) of the concrete placed during the first portion of the construction period (September 30 to October 12, 1943) was approximately 10 percent lower than that of concrete placed during the period from October 15 to 23 inclusive. The concrete placed on October 29, was again apparently of lower strength.

No apparent reason can be assigned to this abrupt change in flexural strength when construction of the track was approximately 50 percent complete, inasmuch as the reported consistency of the concrete was apparently uniform throughout the entire construction period, and since no change was made in the source of any of the constituent materials used.

Differences in the composition of the cement from the two bins do not appear to be sufficient to cause the change in strength of the concrete. Since control of the concrete was entirely by slump measurements at the site of the work, changes in water-cement ratio due to change in gradation of the aggregate could possibly cause such a change in strength of the concrete without being noticed at the time. Tests of the fine aggregate sampled at the comencement of construction show approximately 10 percent of material passing the No. 100 sieve. If the percentage of this fine material was reduced, the water requirement for a constant slump would also be reduced, and concrete of greater strength would result. Since no samples of fine aggregate were obtained during the latter portion of the construction period, and since no record is available of the water-cement ratio used, the cause of this change in strength of the concrete cannot be definitely determined.

By separating the flexural strengths into two groups (group 1 for period from September 30 to October 12, and group 2 for period from October 15 to October 23) the test data indicate that the uniformity of the concrete placed during each period was satisfactory, inasmuch as 85 percent of the specimens of group 1, and 82 percent of the specimens of group 2 fall within 10 percent of the average strength of specimens in the individual groups.

It was noticed in the laboratory that many of the beams were not of uniform section throughout their length. This was caused by the use of two-gang molds which had a thin metal separator strip between the two sections. Due to carelessness in casting many of the specimens, this thin separator was permitted to deflect, which resulted in beams having variable thickness. Although this may have caused some variation in strength of the specimens, it had no influence on the difference in strength of the specimens of the two groups mentioned previously.

c. Ring Test: Tests of the ring shaped specimens were conducted in order to obtain data relative to the strength of the concrete. Theoretical analyses of a ring having a small central opening, as well as photo-elastic studies of bakelite ring models, indicate that the force applied along the diameter will cause tensile stresses which are maximum at the top and bottom of the central hole directly under the load. It is contended by some that this test may be used to indicate the tensile strength of concrete. However, the tensile strength values obtained from ring tests are several times as great as those generally obtained from transverse loading tests of beam specimens, or from tests of conventional specimens in direct tension, and there is no evidence that the ring test gives the true tensile strength of a non-homogeneous material such as concrete.

d. Static Modulus of Elasticity: Static modulus of elasticity values are based on the slope of the tangent to stress-strain and load-deflection curves for tests conducted in compression and flexure respectively. In general, these curves were straight lines until 60 or 70 percent of the ultimate load was reached, hence the modulus of elasticity would remain virtually constant through the range of loading upon which the moduli are based.

e. Freezing and Thawing: The laboratory freezing and thawing procedure was unusually severe inasmuch as it was conducted on specimens which were practically saturated after fog-room curing and a two-hour submergence period in water. Results indicate that the pavement would show poor resistance if it were frozen in a saturated condition.

f. Laboratory Specimens: Results of tests of specimens cast in the laboratory were similar to those obtained from specimens cast during construction of the pavement.

10. Summary:

Results of all tests indicate that the strength of the concrete placed during the latter half of the construction period is approximately 10 percent higher than that of the concrete placed during the first half. However, the uniformity of concrete within each of these two periods is good. No explanation appears for the difference in strength of the concrete placed during these two periods.

A comparison of the estimated strength shown in the contract specification and the values obtained from tests of the control specimens cast during construction of the pavement follows:

Identification	Cement Sks/ Cu. Yd.	Water Gal. Sack	28-day Strength, p.s.i. Flexural* (4x4x16-Inch Beams)	Compressive (6x12-inch Cylinders)
Specification	5.5	5-1/2	720	4700
Control Specimen	5.5	5-1/2 to 6	655	4280
% of estimated strength	--	--	91	91

*In 3rd point loading.

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "C"

Concrete Construction and Results of Laboratory Tests of Concrete Control Specimens and Materials

TABLES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX C

Table 1

Cement Analyses

Source: Columbia Cement Division, Pittsburgh Plate Glass Co., East Fultonham, Ohio.

Brand: Columbia
Type: Federal Specification E-SS-C-191b

Type of Test	Lab. Check Tests	Bin 25	Bin 21	Requirements Fed. Spec. E-SS-C-191b
Setting Time, Initial	3:50	3:03	3:00	Over 1 hr.
(Hrs, Min.) Final	5:30	5:03	5:02	Less than 10hrs
Soundness	O. K.	O. K.	O. K.	O. K.
Normal Consistency	25.0	24.5	24.5	----
Tensile Strength, psi, 3 day	320	316	328	Over 150
7 day	380	399	407	Over 275
Autoclave, percent length change	+0.20	+0.261	+0.239	Less than 1%
T. D. A. Content percent	----	0.033	0.03	Less than .045
Silicon Dioxide (SiO_2)	21.02	21.28	20.80	----
Aluminum Oxide (Al_2O_3)	5.83	5.65	6.36	----
Iron Oxide (Fe_2O_3)	2.81	2.84	2.86	----
Calcium Oxide (CaO)	64.92	64.01	65.17	----
Magnesium Oxide (MgO)	1.45	2.95	1.73	Less than 5%
Sulfur Trioxide (SO_3)	1.68	1.75	1.81	Less than 2%
Insoluble Residue	0.10	0.14	0.15	Less than .75%
Ignition Loss	1.54	0.74	0.86	Less than 3.0%
TriCalcium Silicate (C_3S)	56.5	51.8	55.2	----
DiCalcium Silicate (C_2S)	17.5	22.0	18.0	----
TriCalcium Aluminate (C_3A)	10.7	10.2	12.0	----
TetraCalcium Aluminoferrite (C_4AF)	8.6	8.6	8.7	----
Al_2O_3/Fe_2O_3	2.08	1.99	2.22	----
Surface Area $Cm^2/gm.$	1744	1694	1682	1500 to 2000

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT

APPENDIX C

Table 2

Aggregate Tests

Source: American Aggregates Corporation, Columbus, Ohio.

Type of Aggregate: Coarse - Gravel. Fine - Natural Sand

Sizes	Per Cent Passing Coarse Size #3A	Per Cent Passing Coarse Size #4	Per Cent Passing Combined #3A - 55% #4 - 45%	Per Cent Passing Fine Sample #1	Per Cent Passing Fine Sample #2	Job Specification Per Cent Passing Combined Coarse	Job Specification Per Cent Passing Fine
2"	----	----	----	----	----	100	----
1-1/2"	100	----	100	----	----	95-100	----
1"	54.2	100	74.8	----	----	----	----
3/4"	1.5	84.5	38.8	----	----	35-70	----
1/2"	----	48.5	21.8	----	----	----	----
3/8"	----	34.0	15.3	----	----	10-30	----
No. 4	----	2.0	0.9	99.0	100	0-5	95-100
No. 8	----	----	----	89.6	88.7	----	70-90
No. 16	----	----	----	65.2	64.1	----	45-75
No. 30	----	----	----	34.9	37.1	----	25-55
No. 50	----	----	----	17.4	20.5	----	10-30
No. 100	----	----	----	8.5	10.4	----	2-10
Fineness Modulus	7.99	6.80	7.45	2.86	2.79	----	----

Type of Test (A.S.T.M. Designation Unless Otherwise Noted)	Test Results Combined Coarse	Test Results Fine	Job Specification Limits Coarse	Job Specification Limits Fine
Bulk specific gravity (C127 and C128)	2.69	2.61	----	----
24 hour absorption (C127 and C128) in %	1.7	2.8	----	----
Deleterious Materials in %	O.K.	----	5	----
Organic Impurities (C40)	----	O.K.	----	----
Magnesium Sulphate (C88) Weight Loss at 5 cycles in %	3.2	----	8	----
Los Angeles Abrasion (C131) Weight Loss at 500 revolutions in %	33.7	----	35	----
Mortar Strength (Fed. Spec. SS-A-281) Percent of Ottawa sand cubes at 7 days	----	157	----	100

Remarks: Sand Sample #2 was tested for use in East-West runway, Lockbourne Army Air Base which was constructed concurrently with the test track.

APPENDIX C

Table 3

Summary of Tests on 4 x 4 x 16-Inch Concrete Beams

Date Cast	Beam Symbol	Slump in Inches	No. of Specs.	28-day Strengths, psi: Dynamic "E" x 10^{-6}	Flex-ural	Comp. (Mod. Cubes)	Remarks
9/30/43	A1.60	3-3/4	3	4.78	575	3975	
"	B1.66L	2-3/4	3	4.86	705	3875	
"	C1.66S	4-1/4	2	4.76	620	3660	
"	D1.66	4-1/4	3	5.05	615	3820	
"	E1.66M	2-1/2	2	4.94	600	4000	
"	F1.80	1-3/4	3	4.91	570	4390	
"	$Y_2$1.106	2-3/4	2	5.03	570	4345	
"	$Z_4$1.106	2-3/4	3	4.89	560	4150	
			Averages	4.93	605	4030	
10/1/43	L1.5-60	3	4	5.20	625	4635	Base
"	M1.7-60	3	4	5.06	645	4250	Base
"	N1.86	2-1/2	2	5.11	645	3690	
"	O1.106	2-1/2	3	5.19	635	3940	
"	P1.812	2-1/4	3	5.18	675	4155	
"	Q1.1012	3	3	5.15	585	4215	
"	R1.612	2-1/2	3	5.05	665	4105	
"	S1.66	2-1/2	3	5.04	625	4085	
"	T1.60	5	3	5.09	635	4100	
"	U1.60	2-1/2	2	5.06	665	4690	
"	$W_4$1.106	3-3/4	2	5.15	650	4640	
"	$Z_3$1.106	3	3	5.15	685	4550	
			Averages	5.12	650	4250	
10/2/43	$V_1$1.106	2-1/2	3	5.00	545	3530	
"	$V_4$1.106	3	3	5.14	565	3710	
"	$X_1$1.106	2-1/2	3	5.11	575	3850	
			Averages	5.08	560	3700	

APPENDIX C

Table 3 (Cont'd)

Summary of Tests on 4 x 4 x 16-Inch Concrete Beams

Date Cast	Beam Symbol	Slump in Inches	No. of Specs.	28-day Strengths, psi Dynamic "E" x 10^{-6}	28-day Strengths, psi Flex-ural	28-day Strengths, psi Comp. (Mod. Cubes)	Remarks
10/7/43	A2.60	2	2	5.57	570	3900	
"	B2.66L	2-1/2	3	5.51	685	----	
"	C2.66S	2-1/2	3	5.27	670	3830	
"	D2.66	1-1/2	6	5.52	635	4435	
"	E2.66M	3	4	5.36	650	4075	
"	F2.80	4	4	5.24	620	4125	
"	$W_3$2.106	5-1/2	3	5.00	540	4030	
"	$Y_2$2.106	3	3	5.20	585	4370	
"	$Z_1$2.106	3-1/2	2	5.15	620	4440	
"	$Z_4$2.106	3-1/2	3	5.15	610	4360	
		Averages		5.30	620	4170	
10/8/43	R2.612	2-3/4	2	5.40	580	4200	
"	S2.66	2-1/2	2	5.43	590	4340	
"	T2.60	3	3	5.43	620	4580	
"	U2.60	3	3	5.53	575	5060	
"	$V_2$1.106	2-1/2	2	5.35	620	-----	
"	$W_4$2.106	5	2	5.08	630	3995	
"	$X_2$1.106	3	3	5.28	620	4450	
"	$Y_1$2.106	2-3/4	3	5.32	645	4615	
"	$Z_3$2.106	2-1/2	2	5.53	615	3580	
"	$Z_2$2.106	4	2	5.30	625	4245	
		Averages		5.37	620	4340	
10/12/43	L2.5-60	3-1/2	2	5.26	665	4325	Base
"	M2.7-60	1	3	5.00	530	4040	Base
"	N2.86	2-1/2	3	5.29	560	4995	
"	O2.106	2	2	5.32	605	4355	
"	P2.812	2-1/2	3	5.37	580	4525	
"	Q2.1012	3-1/2	3	5.50	625	4100	
		Averages		5.30	595	4390	

APPENDIX C

Table 3 (Cont'd)

Summary of Tests on 4 x 4 x 16-Inch Concrete Beams

Date Cast	Beam Symbol	Slump in Inches	No. of Specs.	28-day Strengths, psi: Dynamic "E" x 10^{-6}	Flex-ural	Comp. (Mod. Cubes)	Remarks
10/15/43	G1.8R-O	2-1/4	4	5.46	710	4225	
"	H1.8R-O	4-3/4	4	5.56	725	4145	
"	J1.8R-O	2-1/2	4	5.38	800	4865	
"	K1.100	3-1/2	3	5.42	700	4825	
"	$V_1$2.106	2	3	5.55	750	5520	
"	$V_4$2.106	2	3	5.57	725	5185	
"	$W_1$2.106	2-1/4	3	5.59	750	4520	
"	$W_2$2.106	2	3	5.54	625	4710	
"	$X_1$2.106	2-3/4	3	5.75	685	4775	
"	$X_2$2.106	3	3	5.27	685	4825	
		Averages		5.50	715	4760	
10/19/43	G2.8R-O	2-1/2	2	5.75	730	4595	
"	H2.8R-O	2-1/2	3	5.61	745	4260	
"	J2.8R-O	1	3	5.49	650	4025	
"	K2.100	2-1/2	3	5.61	620	3910	
"	$V_2$2.106	2-1/4	3	5.77	750	5276	
"	$V_3$2.106	2-1/2	3	5.78	720	4770	
"	C3.66S	4-1/2	4	5.55	700	4215	
"	D3.66	2-1/2	4	5.45	745	4615	
"	E3.66M	2	2	5.30	715	4480	
"	F3.80	1-1/4	4	5.71	745	4810	
		Averages		5.58	710	4500	
10/20/43	L2.5-60	3	4	5.60	610	4210	Overlay
"	M2.7-60	3	3	5.66	630	4680	Overlay
"	A3.60	2	4	5.60	675	4485	
"	B3.66L	2-3/4	3	5.57	675	4540	
"	R3.612	2-1/2	4	5.72	805	5395	
"	S3.66	2	3	5.64	660	4505	
"	T3.60	3	3	5.54	655	4995	
"	U3.60	1-3/4	4	5.43	685	4065	
		Averages		5.60	675	4600	

APPENDIX C

Table 3 (Cont'd)

Summary of Tests on 4 x 4 x 16-Inch Concrete Beams

Date Cast	Beam Symbol	Slump in Inches	No. of Specs.	28-day Strengths, psi Dynamic "E" $\times 10^{-6}$	Flex-ural	Comp. (Mod Cubes)	Remarks
10/21/43	L1.5-60	3	4	5.65	625	4520	Overlay
"	M1.7-60	2-1/2	4	5.63	635	4470	Overlay
"	L3.5-60	2-1/2	4	5.43	655	3840	Base
"	M3.7-60	2	3	5.50	640	4110	Base
"	N3.86	3	4	5.64	755	4930	
"-	O3.106	2	4	5.72	740	4460	
"	P3.812	2-1/2	3	5.84	810	5140	
"	Q3.1012	3	3	5.72	640	4900	
		Averages		5.64	690	4540	
10/22/43	G3.8R-O	3-1/2	4	5.34	650	4185	
"	H3.8R-O	2	4	5.41	580	4160	
"	J3.8R-O	3	4	5.46	730	4350	
"	K3.100	2	3	5.41	695	4150	
		Averages		5.41	665	4210	
10/23/43	N4.612	2	4	5.90	765	4520	
"	P4.818	2-1/2	3	5.33	675	4065	
"	O4.1018	2-1/2	3	5.45	695	3510	
"	Q4.1018	1-3/4	4	5.41	685	4420	
		Averages		5.57	705	4130	
10/29/43	M3.7-60	2-1/2	3	5.56	545	3310	Overlay
"	L3.5-60	2	2	5.51	625	4655	Overlay
		Averages		5.54	580	3980	
Ave. of All Tests (95 Groups)		2-3/4	--	5.37	655	4350	

Note: To convert to strength of "standard highway beams" (6" x 6" x 18"span) use 90% of tabular values shown.

APPENDIX C

Table 4

Results of Special Tests

Specimen	6 x 12-Inch Cylinders				4x4x16-Inch Beams				Density and Max. Absorption			
	Mod. Elast. psi x 10^{-6}	Comp. Str. psi	Ten. Str. psi (Ring Test) Photo Elast.	Ten. Str. psi (Ring Test) Theor. Anal.	Modulus of Elasticity psi x 10^{-6} Specimen	Dyn.	Static	Mod of Rup. psi	Specimen	Sp. Gr. (Sat.)	Den. lbs./ft^3 (Sat.)	% Absorption By Wt.
E1.66M-2	3.06	3930	2040	2200	E1.66M-2	4.96	3.08	630	E1.66M-3	2.41	150.4	7.1
E1.66M-3	3.54	3750	1800	1940	$Z_4$1.106-1	4.93	3.15	610	$Y_2$1.106-1	2.44	152.3	6.5
O1.106-1	3.70	4280	1450	1560	S1.66-2	5.21	3.24	640	P1.812-3	2.43	151.6	6.4
O1.106-2	3.46	4170	----	----	$X_2$2.106-3	5.28	3.28	625	$W_4$1.106-1	2.42	151.0	6.6
D2.66-1	3.93	5130	1660	1790	D2.66-4	5.33	3.36	600	$X_1$1.106-3	2.44	152.3	6.2
D2.66-2	3.58	4880	1660	1790	$V_2$2.106-3	5.63	3.46	585	$Y_2$2.106-1	2.44	152.3	6.3
T2.60-1	4.00	4180	1470	1580	T2.60-1	5.54	3.40	590	C2.66S-2	2.45	152.9	6.2
T2.60-2	3.78	4070	1520	1630	R2.612-1	5.38	3.30	540	$Z_3$2.106-1	2.46	153.5	5.7
P2.812-1	3.05	4400	1690	1820	P2.812-1	5.22	3.28	580	$W_4$2.106-1	2.46	153.5	5.6
P2.812-2	3.54	4160	----	----	N2.86-3	5.19	3.28	580	C3.66S-4	2.45	152.9	6.2
H1.8R-O-1	3.56	4390	1630	1750	H1.8R-O-4	5.61	3.82	790	J2.8R-O-1	2.44	152.3	5.9
H1.8R-O-2	3.30	3980	1480	1590	Q4.1018-3	5.38	4.00	675	M2.7-60-2	2.44	152.3	5.7
E3.66M-1	3.62	4480	1600	1720	E3.66M-1	5.39	3.02	550	R3.612-2	2.46	153.5	5.5
E3.66M-2	3.83	4740	1970	2110	O4.1018-4	5.54	3.39	665	L1.5-60-2	2.44	152.3	5.9
M2.7-60-1	3.92	4210	1340	1440	M2.7-60-3	5.77	3.73	595	Q3.1012-2	2.46	153.5	5.8
M2.7-60-2	4.00	4080	1530	1640	U3.60-1	5.32	3.52	675	P4.818-4	2.43	151.6	7.1
N3.86-1	4.20	4400	1820	1950	N3.86-2	5.82	3.66	760	K3.100-3	2.46	153.5	5.7
N3.86-2	4.05	4250	1640	1760	L1.5-60-4	5.52	3.46	545				
P4.818-1	3.90	4100	1570	1690	J3.8-R-O-1	5.36	3.48	700				
P4.812-2	3.82	4100	----	----	K3.100-1	5.32	3.32	550				
Averages	3.69	4280	1640	1760		5.36	3.39	625		2.44	152.4	6.1

APPENDIX C

Table 5

Freezing and Thawing Test Results

Specimen	Initial Dynamic "E" psi x 10^{-6}	End Results: Cycles of Freezing and Thawing	End Results: Percent Reduction in Dynamic "E"
M1.7-60-1	5.17	5	83
2	5.04	5	81
E2.66M-1	5.24	4	75
4	5.52	4	75
F2.80-2	5.11	15	68
3	5.36	9	74
$V_2$1.106-1	5.03	6	76
4	5.58	6	76
G1.8R-0-2	5.44	4	78
3	5.36	4	78
J1.8R-0-2	5.47	4	62
3	5.28	4	66
D3.66-1	5.28	5	86
2	5.75	5	86
F3.80-1	5.84	Broken	
2	5.49	5	88
L2.5-60 (Top)-3	5.83	12	79
4	5.40	12	46
A3.60-3	5.51	15	78
4	5.72	24	83
M1.7-60 (Top)-3	5.52	9	74
4	5.62	9	83
L3.5-60 (Bot.)-3	5.35	3	68
4	5.63	3	71
H3.8R-0-1	5.25	6	60
2	5.42	6	59
N4.612-1	5.86	6	86
2	5.99	6	79

Corps of Engineers U. S. Army

LOCKBOURNE TEST TRACK

DESIGN AND CONSTRUCTION REPORT

APPENDIX "C"

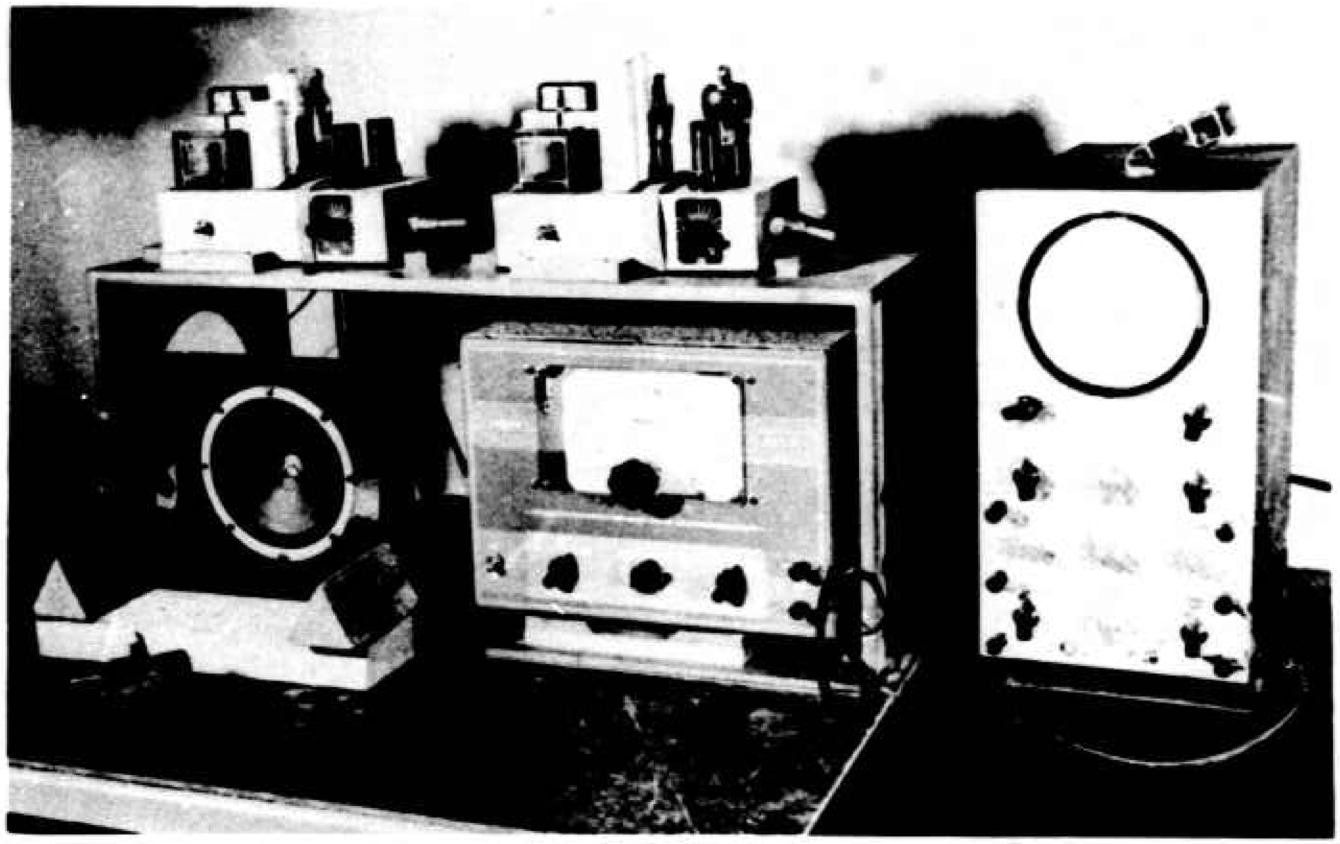
Concrete Construction and Results of Laboratory Tests of Concrete Control Specimens and Materials

FIGURES

THE OHIO RIVER DIVISION LABORATORIES*
MARIEMONT, OHIO
June 1944

*Formerly Cincinnati Testing Laboratory

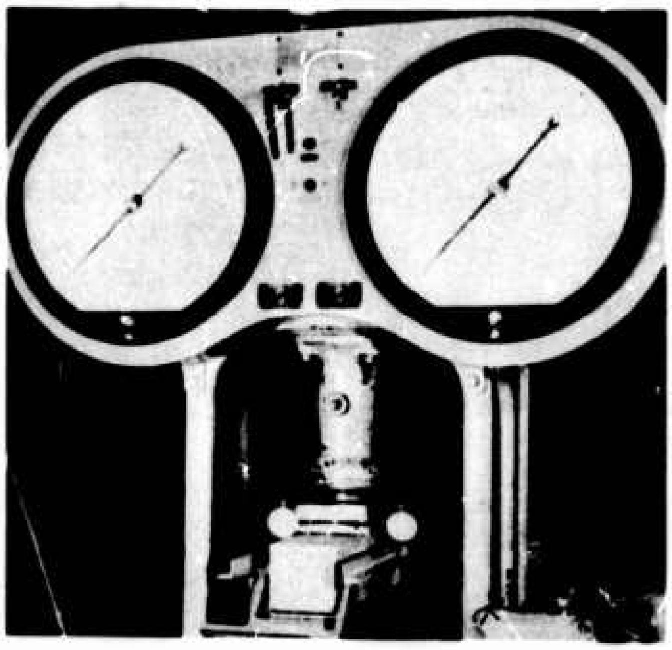
APPENDIX C



APPARATUS USED TO DETERMINE DYNAMIC MODULUS OF ELASTICITY.

FIGURE I

LOCKBOURNE TEST TRACK
DESIGN AND CONSTRUCTION REPORT
APPENDIX C



GENERAL VIEW OF ARRANGEMENT FOR LOAD AND DEFLECTION MEASUREMENTS OF 4 X 4 X 16 INCH CONCRETE BEAM SPECIMENS IN THIRD POINT LOADING.

DETAIL VIEW OF ASSEMBLY FOR MEASURING DEFLECTIONS AT CENTER POINT OF BEAM.

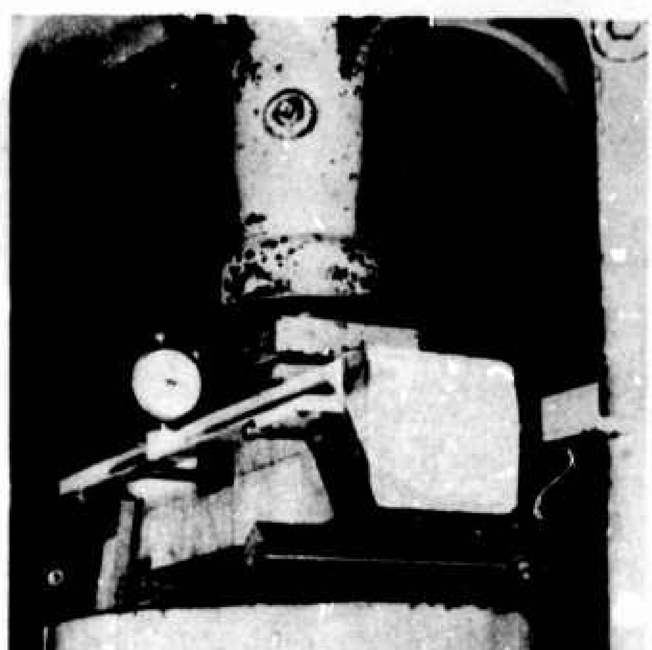
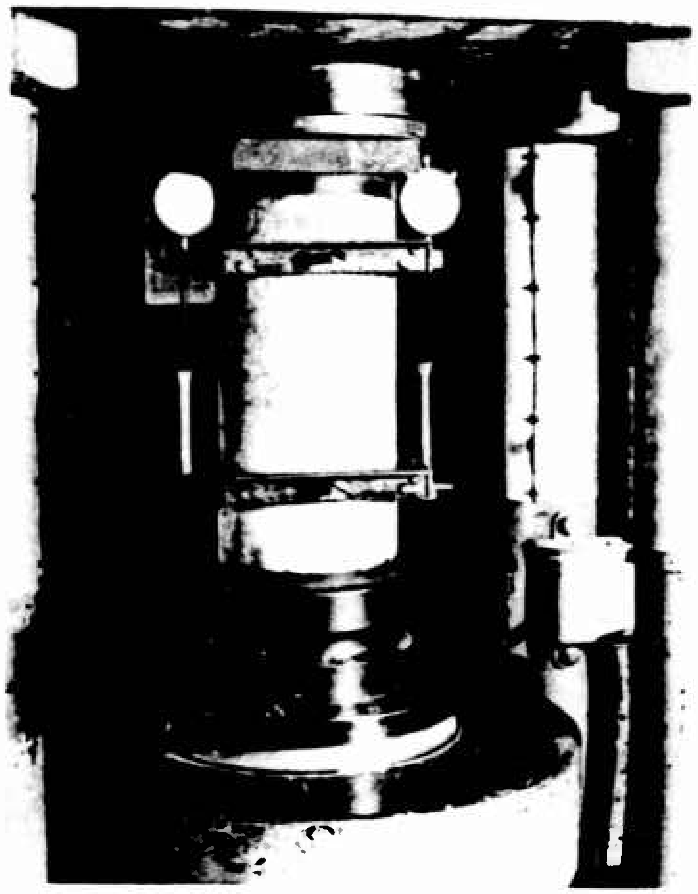
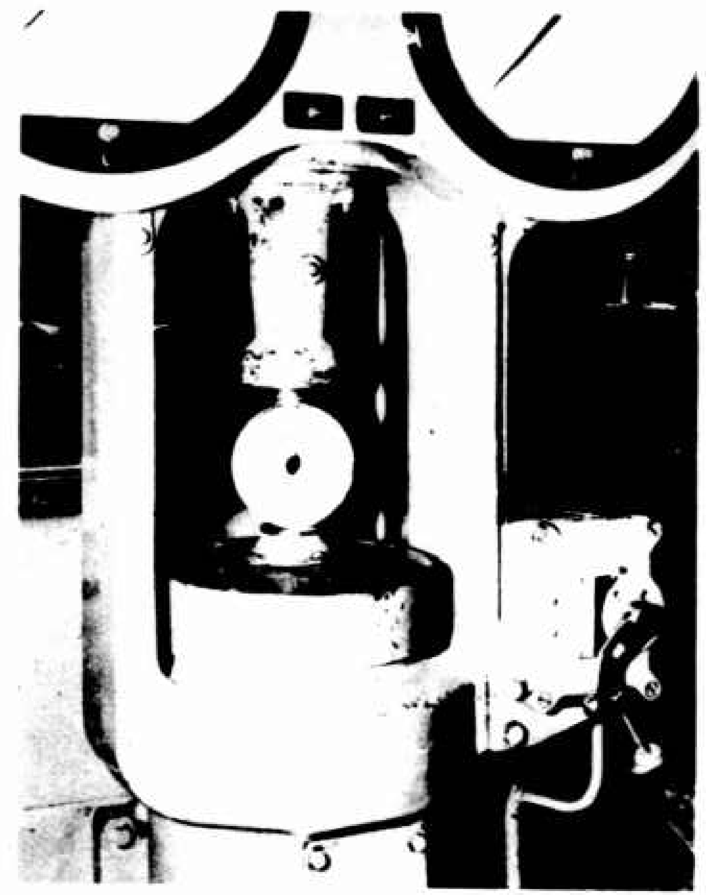


FIGURE 2



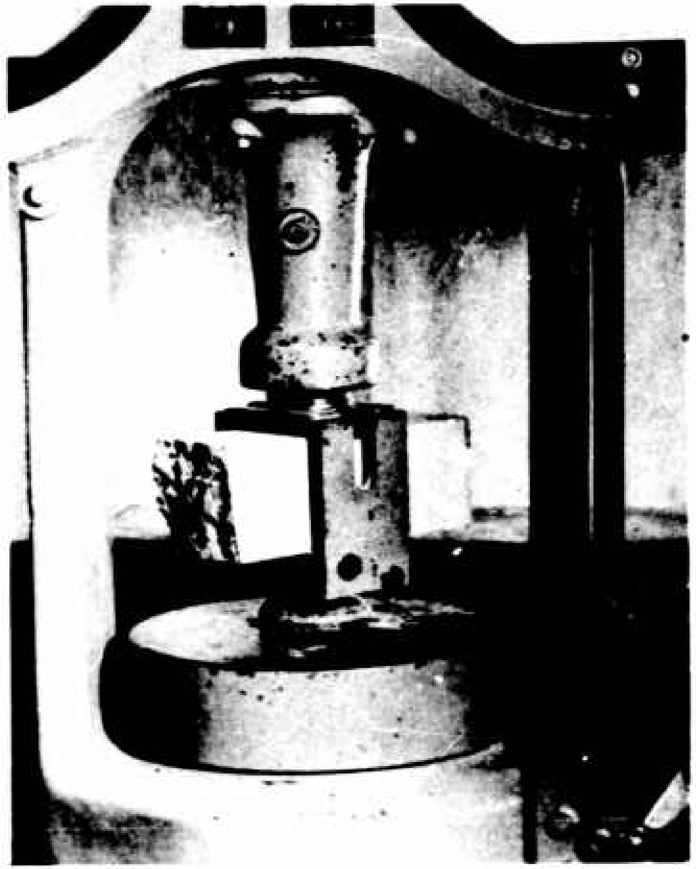
(A) ARRANGEMENT FOR STRESS STRAIN MEASUREMENTS OF A 6 X 12 INCH CYLINDER IN COMPRESSION.



(B) RING FORMED FROM A DISK SAWED FROM A 6 X 12 INCH CYLINDER SHOWING TYPICAL FAILURE AFTER BEING LOADED IN DIAMETRAL COMPRESSION.

FIGURE 3

(A) FLEXURAL STRENGTH TEST OF
4 X 4 X 16 INCH CONCRETE BEAM
IN THIRD POINT LOADING.



(B) COMPRESSIVE STRENGTH OF
BEAMS BROKEN IN FLEXURE.
(TESTED AS MODIFIED CUBES)

FIGURE 4