HURST-ROSCHE, INC.

STRUCTURE GEOTECHNICAL REPORT

FAI ROUTE 74 (I-74)
SECTION (37-24HVB) BR
HENRY COUNTY

EXISTING STRUCTURE NO. 037-0019 (E.B.)
PROPOSED STRUCTURE NO. 037-0049 (E.B.)
EXISTING STRUCTURE NO. 037-0020 (W.B.)
PROPOSED STRUCTURE NO. 037-0053 (W.B.)

Bridge Replacements of I-74 Over IL Route 17
West of Woodhull, Illinois

PTB NUMBER: 193-024 Work Order No. 10
CONTRACT NUMBER: 68510

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May 17, 2022

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TABLE OF CONTENTS

APPENDICES

Appendix A – Project Location Map

Appendix B – Boring Location Plan and Boring Logs

Appendix C – Subsurface Data Profile Plot

Appendix D – Consolidation Test Results

Appendix E – Settlement Calculations

Appendix F – Stability Analysis Calculations

Appendix G – Unconfined Compression Test Results

I. INTRODUCTION

A. Scope and Purpose

This Structure Geotechnical Report has been completed for the purpose of presenting foundation recommendations in accordance with current IDOT and engineering standards. A determination of materials present at the proposed structures was completed by means of soil borings completed by Hurst-Rosche, Inc. personnel between November 29 and December 3, 2021. Based on the soil information, in the form of boring logs and laboratory test results, recommendations guiding the design and construction of the proposed project have been presented in this report.

B. Location and Description of Project

The project site is located approximately 0.5 miles west of Woodhull, Illinois, along Interstate 74 in Henry County. The proposed project consists of the removal of two existing four span continuous steel wide flange beam bridges, and construction of two single span PCC IL-Beam bridges. The existing structures were originally built in 1967 and partially reconstructed in 1988 when the bridge deck or portions of the bridge deck on each bridge was replaced. Also, in 1988, the piers supporting the eastbound bridge were widened to allow for widening of the superstructure. Both existing bridges possess a back to back abutment length of 248 ft. 4 inches, exterior span lengths of 54 ft. 6 inches, and interior span lengths of 67 ft. 8 inches. The out to out deck width for the existing eastbound bridge (S.N. 037-0019) varies from 48 ft. 9 inches to 52 ft. 4 inches, while the out to out deck width for the existing westbound bridge (S.N. 037-0020) varies from 48 ft. 9¼ inches to 52 ft. 4¼ inches. The existing bridge abutments are founded on concrete piles, while the piers are founded on timber piles. The existing structures carry Interstate 74 over Illinois Route 17 and over the former Burlington Northern railroad located adjacent to and north of Illinois Route 17. It is understood Burlington Northern no longer has any outstanding interest in the former railroad property within the Interstate 74 right of way.

It is anticipated the new eastbound bridge (Proposed S.N. 037-0049) deck will be 47 ft. 10 inches out to out wide and 156 ft. long from back to back of abutments. The new westbound bridge (Proposed S.N. 037-00053) deck is proposed to be 53 ft. 10 inches out to out wide and 156 ft. long from back to back abutments. Due to the abandonment of the railroad, the two bridges are proposed to be shortened by moving the position of the northern abutments to the south. Due to shortening the length of the new bridges from 248 ft. 4 inches to 156 ft., embankment fill will be required to be placed on the northern end of the two new bridges. It is anticipated the existing southern endslope will not be altered with additional embankment fill. Dog-ear wingwalls are proposed to be constructed at each bridge corner and parallel to the roadway with the top of each wingwall nearly level with the roadway elevation. It is proposed the endslopes be constructed at a 2:1 (H:V) slope beneath the proposed bridge deck with the slope projecting downward from the abutment to the roadway elevation. Erosion control material (i.e., concrete slopewalls) will be placed on each endslope. At the present time, existing embankment sideslopes perpendicular to the roadway are 2:1. Upon completion of the new construction, the embankment sideslopes will remain 2:1. It is also noted the profile grade for Interstate 74 over both of the structures will remain the same as the existing vertical profile.

A project location map has been included in Appendix A.

II. SUBSURFACE CONDITIONS

A. Geology/Physiography

The project site is located in the northern portion of the physiographic region known as the Galesburg Plain within the Central Lowland Province. Present-day surface materials and landforms within the project area are the products of glacial activities that occurred during the Illinoian and Wisconsinan glacial stages. The surface material is typically a loess underlain by soil identified as Kellerville Till of the Glasford Formation. The Kellerville Till was deposited during the Illinoian glacial stage and subsequently covered with deposits from the Wisconsinan time period. Geologic maps depict the loess thickness in the project vicinity to be approximately 15 ft. The Kellerville Till is typically described as a silty till with discontinuous beds of sand and gravel present. Based on National Resources Conservation Services (NRCS) soil survey information, surface soils within the footprint of the existing on- and off-ramps and embankment placement are depicted as loamy orthents which are attributed to disturbance of soils related to construction of the ramps and embankments. Native, undisturbed soils in the immediate project area are typically a silty clay loam within 3.5 ft. to 4 ft. of ground surface, with a silt loam typically present beneath the silty clay loam to a depth of 5 ft. or greater. These surface soils are associated with either the Ipava or Sable soil series.

The project area drains slightly towards the southwest and north where streams are present. In general, the project area has relatively moderate relief due to the aforementioned glacial activities.

The majority of land within the immediate project area is used for agricultural purposes.

Based on the soils encountered during the boring process at the location of the southern abutments (Boring Nos. 1 and 3), embankment fill is present from the existing roadway surface (elev. 838 ft.) to an approximate depth of 29 ft. (elev. 809 ft.). The fill is described as being a stiff to hard silty clay with a small silty loam layer present in Boring No. 3. Beneath the embankment fill, a medium stiff to very stiff silty clay or clay is present and continues to an approximate depth of 35 ft. (elev. 803 ft.). A medium stiff to very stiff silty loam/silt is present from the 35 ft. depth to the 45 ft. depth (elev. 803 ft. to 793 ft.), followed by a stiff silty clay loam or silty clay extending to the 50 ft. depth (788 ft. elev.). A stiff to very stiff silty clay till was noted to begin at the 50 ft. depth (788 ft. elev.) and continue until the 65 ft. depth (773 ft. elev.) where the till material becomes hard and continues until boring termination. It is noted a thin 0.5 ft. layer of muck was identified in Boring No. 1 at the elevation of 792.2 ft., and borings completed in 1964 indicate an organic material was present between the elevation of 790 ft. and 796 ft.

At the location of the proposed northern abutments (Boring Nos. 2 and 4), no embankment fill is currently present, and the existing ground surface is at the approximate elevation of 809.5 ft. From the ground surface to the approximate depth of 4.5 ft. (805 ft. elev.) a very stiff silty clay is present and is underlain by a soft silty clay loam between the depths of 4.5 ft. and 9.5 ft. (805 ft. elev. and 800 ft. elev.). A medium stiff silty loam is present from the 9.5 ft. depth to the 14.5 ft. depth (elev. 800 ft. to 795 ft.), followed by a medium stiff to stiff muck extending to a depth of 19.5 ft. (790 ft. elev.). A medium stiff to stiff clay or silty clay loam is noted to be present at the depth of 19.5 ft. (790 ft. elev.) and continues until the 23.5 ft. depth (elev. 786 ft.). Beneath this layer, silty clay till with a stiffness of stiff to very stiff is present down to an average depth of 43.5 ft. (766 ft. elev.), where the till material becomes hard. This hard till continues until the end of the exploration. Reference to the boring logs presented in Appendix B will provide additional information at specified locations and depths.

Based on the boring logs, it appears approximately 13 ft. of loess is located at the site. The muck layer noted to be present and described above is most likely due to the former presence of a bog and/or small lake formed in a depression created by glacial actions.

In the project vicinity, bedrock is depicted on Illinois State Geological Survey (ISGS) maps and within other documentation as being at an approximate elevation of 704 ft., or approximately 105 ft. below the natural ground surface at the project site.

B. Borings and Sampling

Two structural borings were completed for each of the proposed bridges with one boring being completed near each proposed abutment.

Boring Nos. 1 and 2 were completed in correlation with the westbound bridge (Proposed S.N. 037-0053), while Boring Nos. 3 and 4 were completed in the near proximity of the eastbound bridge (Proposed S.N. 037-0049). Boring Nos. 1 and 3 were completed adjacent to the existing roadway’s east edge and just south of the existing southern abutments. Boring Nos. 2 and 4 were completed just west of the proposed abutment locations. Boring No. 1 was extended to a depth of 70 ft. (elev. 766.2 ft.) below roadway grade, while Boring No. 2 was extended to a depth of 65 ft. (elev. 744.4 ft.) below natural grade. Boring No. 3 was drilled to a depth of 75 ft. (elev. 762.2 ft.) below roadway grade, while Boring No. 4 was extended to a depth of 75 ft. (734.7 ft. elev.) below natural grade. All borings were completed in order to gather geotechnical information for the founding of the proposed bridges.

Borings were completed utilizing a truck mounted CME 75 drill rig advancing hollow stem augers. Split spoon samples, using a 2.5 inch O.D. sampler, were collected at 2.5 ft. or 5 ft. intervals (AASHTO T206). Shelby tube samples were collected at select depths in adjacent boreholes to Boring Nos. 2 and 4 utilizing AASHTO T207 methods. In general, split spoon samples were tested for unconfined compressive strength utilizing a Rimac tester.

Water table readings were taken upon completion of each boring and approximately 24 hours after completion of each boring.

Logs of the borings, along with a boring location map, have been included in Appendix B.

A subsurface data profile plot has been developed from the completed boring logs and has been presented in Appendix C. This profile presents an overview of the soils and related boring data for each boring. Reference should be made to the boring logs for any additional information at a particular boring location. The boring location map presented in Appendix B may also be referenced for boring locations.

Soil boring logs and descriptions have been based on information from the completed borings and from applicable soil and geological maps, such as NRCS soil survey maps.

C. Bedrock Characteristics

Bedrock was not encountered in either of the four structural borings, and as noted previously in this report, bedrock is anticipated to be located 105 ft. below the natural ground surface. It is anticipated the upper bedrock in the project area is shale.

D. Drainage and Groundwater

As stated previously, topographic relief of the immediate project area is relatively flat with drainage flowing to nearby streams located southwest and north of the project area.

Groundwater measurements were recorded at completion and after a delayed period of time (typically 24 hours) after completion of the borings. It is noted the groundwater within existing embankment fill was elevated above the natural ground surface of 809.5 ft. Based on groundwater measurements at Boring Nos. 1 and 3, the depth to groundwater below the roadway grade was approximately 22.5 ft. (814 ft. elev.) at the time of the site investigation. Based on recorded measurements at the locations of Boring Nos. 2 and 4, where embankment fill is not present, it appears groundwater was approximately 5 ft. (804.5 ft. elev.) below the existing natural ground surface at the time of the investigation. Narrative within the NRCS's soil survey for Henry County indicates the seasonal high water table for the project area can be within 0.5 to 1.5 ft. of the natural ground surface within the immediate area of the bridges. Groundwater table information has been provided on the individual boring logs presented in Appendix B and on the subsurface data profile plot in Appendix C.

III. GEOTECHNICAL EVALUATIONS

A. Settlement

It is understood the two proposed bridges are to be shorter in length than the existing bridges by positioning the proposed northern abutments approximately 81 ft. south of the existing abutments due to the abandonment of the Burlington Northern railroad. This will require the placement of approximate 29 vertical feet of embankment fill to establish the roadway profile between the new bridges and existing northern embankment. It is not anticipated additional embankment fill placement will be necessary for the southern abutments. Due to the proposed embankment height (>15 ft.) and the presence of soil that may be susceptible to settlement (>25% moisture content and <0.5 tsf) and the presence of organic material, settlement analysis was completed considering the two layers of suspect soil.

Specifically, silty clay loam between the approximate depths of 4.5 ft. and 9.5 ft. below natural grade and muck between the depths of 14.5 ft. and 19.5 below natural grade were considered for settlement. As part of this analysis, laboratory consolidation testing of each soil was completed. Results of these tests have been presented in Appendix D.

To account for the load from the proposed embankment imposed on the layer of soil under consideration, the dimensions of the embankment fill and a unit weight of 125 pcf were utilized in conjunction with Boussinesq methods to estimate loads imposed by the embankment fill. Calculations for these imposed loads are presented in Appendix E.

Based on consolidation testing, the silty clay loam appears to be normally consolidated with a compression index (C_c) of 0.161. Considering a pressure of 1.8 tsf applied by the embankment fill at the center of the silty clay loam, soil properties, and soil test results, a total primary settlement of 4.0 inches is estimated. As the silty clay loam is a non-organic mineral soil, secondary settlement is not considered to be significant. Consolidation testing of the muck suggests the soil has been over consolidated, and the soil exhibits a recompression index (C_r) of 0.081 and a C_c value of 1.017. An estimated a pressure of 1.7 tsf is applied to the center of the muck layer due to the embankment placement. Considering this additional pressure and soil parameters, primary settlement is estimated to be 1.1 inches. Due to the characteristics of organic soils, secondary consolidation should be evaluated. Utilizing a slope of secondary consolidation (C_α) of 0.007, secondary settlement of 0.5 inches is estimated to occur over a one year period from the end of the muck layer's primary consolidation.

However, if the time necessary for primary consolidation (95%) of the silty clay loam layer is considered (51 days), the estimated secondary consolidation remaining for the muck layer is 0.2 inches after one year.

Based on the noted settlement amounts and coefficient of consolidation (C_v) values obtained from consolidation tests, the time for 50%, 90%, and 95% settlement to occur was estimated. The table below presents a summary of the estimated settlements and corresponding time periods to occur.

Settlement Summary Table

Layer	Estimated Primary Settlement Completed (inches)				Estimated Primary Settlement Remaining (inches)			Estimated Time For Primary Settlement (days)			Estimated Secondary Settlement after 1 yr. (inches)[1]
	Total	At 50%	At 90%	At 95%	At 50%	At 90%	At 95%	At 50%	At 90%	At 95%	
Silty Clay Loam	4.0	2.0	3.6	3.8	2.0	0.4	0.2	9	38	51	--
Muck	1.1	0.6	1.0	1.1	0.5	0.1	0.0	1	2	3	0.2
Total	5.1	2.6	4.6	4.9	2.5	0.5	0.2	9	38	51	0.2

1) Secondary settlement amount is settlement estimated to occur between end of primary consolidation of silty clay loam layer (i.e., largest primary consolidation period of layers analyzed) and one year from start of primary consolidation.

In summary, a total settlement of approximately 5.1 inches of primary consolidation is estimated, while 0.2 inches of secondary settlement of the muck layer is estimated to occur after the primary consolidation time period. At 95% primary consolidation (51 days after embankment placement), 0.4 inches of total settlement is estimated to remain. Per IDOT guidance, settlement in an amount greater than 0.4 inches would develop negative skin friction along the piles. Therefore, in order to eliminate negative skin friction and allow sufficient capacity to be attained with reasonable pile lengths, it is recommended settlement be substantially complete (i.e., ≤0.4 inches remaining) prior to pile driving for the northern abutments.

Should the construction schedule not allow for a waiting time of 51 days, the consolidation time period may be shortened with the placement of additional embankment (i.e., surcharge). Addition of a 10 ft. surcharge on top of the proposed 29 ft. of fill material (39 ft. total), would reduce the time required to reach 0.4 inches of total remaining settlement to approximately 38 days. As indicated in the following stability analysis section, a factor of safety of 1.3 would be anticipated based on extending the vertical height 10 ft. and also maintaining a 2:1 (H:V) slope. Refer to the below slope stability section (Section III.B) for further slope stability discussion.

If wick drains spaced at 3.5 ft. were to be utilized, an estimated time period to achieve a total remaining settlement of 0.4 inches would be 31 days. Refer to Appendix E for wick drain calculations. Based on the above discussion, it is recommended wick drains be installed with a spacing of 3.5 ft. to an elevation of approximately 788 ft. within the entire footprint of the proposed embankment should the time for settlement to occur need to be decreased.

B. Slope Stability

Stability analyses were conducted on representative endslope and sideslope scenarios where new embankment fill is proposed (i.e., northern abutments). GEOSTASE slope stability analysis software was utilized to complete the analyses with the Simplified Bishop method used to formulate a minimum factor of safety and the corresponding trial surface. Foundation soil parameters used for the analyses have been determined from field unconfined compression tests and laboratory unconfined compression tests for select layers. The soil properties for the proposed embankment were obtained from Section 6.4.1 of IDOT's Geotechnical Manual.

Two scenarios were analyzed for the project site. One scenario considers the endslope, and the second scenario considers the sideslope. Each of these scenarios considered a 2:1 slope extending from the bridge's roadway grade elevation of 838 ft. down to the approximate ground elevation of 809 ft. The sideslopes of each approach ramp and each endslope will essentially be identical, therefore, only one set of analyses was completed for the structures (i.e., not for each abutment location) utilizing boring information for the northern abutments. Additionally, no modifications to the southern approach ramp are anticipated. Any horizontal resistance to slope movement that could be provided by abutment piling or similar has not been considered in the stability analyses.

The following soil properties were utilized during analysis of slope stability of the endslope configuration.

Embankment Fill (838 ft. - 809 ft.):
Moist Unit Weight = 125 pcf
Cohesive Strength (c) = 1,000 psf
Internal Friction Angle = 0°

Silty Clay Layer (809 ft. - 805 ft.):
Moist Unit Weight = 120 pcf
Cohesive Strength = 2,700 psf
Internal Friction Angle = 0°

Silty Clay Loam Layer (805 ft. - 800 ft.):
Moist Unit Weight = 123 pcf
Cohesive Strength = 450 psf
Internal Friction Angle = 0°

Silty Loam Layer (800 ft. - 795 ft.):
Moist Unit Weight = 120 pcf
Cohesive Strength = 1,100 psf
Internal Friction Angle = 0°

Muck Layer (795 ft. - 790 ft.)
Moist Unit Weight = 90 pcf
Cohesive Strength = 1,600 psf
Friction Angle (ϕ) = 0°

Silty Clay Loam/Silty Clay Layer (790 ft. - 786 ft.)
Moist Unit Weight = 125 pcf
Cohesive Strength = 1,000 psf
Internal Friction Angle = 0°

Silty Clay Till Layer: (786 ft. - 766 ft.)
Moist Unit Weight = 145 pcf
Cohesive Strength = 1,600 psf
Internal Friction Angle = 0°

For sideslope analysis, a separate analysis was completed for both sides of the sideslope due to the overall width of the embankment utilizing singular boring data from either Boring No. 2 or Boring No. 4. The lowest factor of safety was generated utilizing Boring No. 4 data. The general soil properties for sideslope analysis were the same as the endslope analysis except for slight variations in cohesive strength values, which are noted below. All other soil properties remain the same as used in endslope analysis.

Embankment Fill: c = 1,000 psf
Silty Clay Layer: c = 2,700 psf
Silty Clay Loam Layer: c = 450 psf
Silty Loam Layer: c = 1,100 psf
Muck Layer: c = 1,600 psf
Silty Clay Loam/Silty Clay Layer: c = 1,000 psf
Silty Clay Till Layer: c = 1,600 psf

Both static and seismic loading conditions were considered. A peak horizontal ground acceleration coefficient of 0.038g was utilized for seismic analysis along with a site factor at zero period (0 sec.) of 1.2. The noted seismic values have been presented and discussed in Section III.C.

Analyses considering static conditions resulted in a factor of safety of 2.1 and 1.7 for the finished embankment endslope and sideslope, respectively. When considering seismic conditions, a factor of safety of 2.0 and 1.6 was estimated for the completed embankment endslope and sideslope, respectively. It is noted that existing sideslopes and endslopes of the approach embankments are 2:1, and at the present time no noted issues within the sideslopes were noted.

An additional scenario was analyzed considering a 10 ft. surcharge on top of the proposed 29 ft. vertical embankment should a surcharge be placed to expedite the time required for settlement. This scenario considered the embankment maintained a 2:1 (H:V) sideslope and endslope. Utilizing soil boring data, field unconfined compression strength, and laboratory unconfined compressed strength values for silty clay loam and muck layers, a factor of safety of 1.3 was determined. This factor of safety does not meet IDOT’s minimum factor of safety of 1.5 for analysis utilizing field data but does meet the necessary minimum factor of safety utilizing Shelby tube samples. Should surcharge placement be considered, additional Shelby tube sampling may be necessary to confirm an adequate factor of safety is present. Stability analysis calculations for all scenarios are presented in Appendix F. Unconfined compression test results have been presented in Appendix G.

C. Seismic Considerations

There are no known or recognized fault zones located in Henry County or surrounding counties. Based on soils noted to be present at the project site, the site is identified as having soil site class C as defined in AASHTO's LRFD Bridge Design Manual Table 3.10.3.1-1. The site specific design response spectrum coefficients at 0 seconds (A_S), 0.2 second (S_{DS}), and 1.0 second (S_{D1}) are 0.046g, 0.106g, and 0.067g, respectively. The design spectral acceleration design value at 0 seconds is based on a horizontal peak ground acceleration coefficient of 0.038g and a site factor (F_{pga}) of 1.2. The 0.2 second design spectral acceleration value incorporates a 0.2 second period horizontal response spectral acceleration coefficient (S_s) of 0.088g and a site factor (F_a) of 1.2. The 1.0 second design spectral acceleration value is based on a horizontal response spectral acceleration coefficient (S_1) of 0.039g and a site factor (F_v) of 1.7. Considering the S_{D1} value of 0.067g, a Seismic Performance Zone (SPZ) of 1 should be utilized for this site as obtained from Table 3.10.6-1 in AASHTO's LRFD Bridge Design Manual.

Due to the absence of granular deposits, no liquefaction analysis was completed.

D. Scour

The proposed structure is a grade separation structure only, and therefore scour information is not applicable.

E. Mining Activity

According to available ISGS coal mining maps, no surface or subsurface mining has occurred at or directly beneath the project site. The nearest recorded mine boundary is located approximately 1.8 miles northwest of the project site.

IV. FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

A. Structures

The proposed eastbound bridge (Proposed S.N. 037-0049) is to be constructed between stations 21+74.72 and 23+30.72, and the westbound bridge (Proposed S.N. 037-0053) will be constructed between stations 21+95.29 and 23+51.29. Each of the two structures will be constructed with two abutments and no piers.

Pile design tables presenting pile capacities for given pile lengths and various pile types and dimensions have been presented below. Presented within each table are the nominal required bearing (R_N), the factored resistance available (R_F), estimated pile length, and pile tip elevation. Considering no liquefaction will occur at the site and anticipating that seismic forces will not govern the site location, it is presumed that the presented factored resistance available values will be utilized for design. Therefore, seismic resistance available values are not presented. Bearing values have been calculated in accordance with Section 6.13.2.3.1 within IDOT's Geotechnical Manual and Design Guide "Axial Geotechnical Resistance of Driven Piles". Estimated pile lengths consider bottom abutment elevations as indicated in the footnotes of each table along with a 2 ft. pile embedment into each abutment. For the presented capacities, axial factored loads of 3,692 kips and 3,810 kips were considered for the eastbound bridge abutments and westbound bridge abutments, respectively. Since the abutments are proposed to be integral abutments, IDOT guidelines recommend piles be placed beneath each bridge beam and additional piles may be placed at the midpoint between the beams. However, utilizing this recommended pile positioning will not allow a larger pile size to be utilized while maintaining a minimum spacing of three times the pile diameter. Smaller piles will not develop sufficient capacity without driving the piles to substantial lengths. Therefore, it is recommended the piles not be positioned directly beneath bridge beams nor at the midpoint between bridge beams to allow for adequate spacing between piles and also allow for larger piles to be used for development of necessary capacities. Based on an anticipated spacing of three times the pile diameter of a 16-inch diameter metal shell pile and proposed abutment widths, an axial LRFD factored load of 308 kips/pile for the eastbound bridge (Proposed S.N. 037-0049) abutments and an axial LRFD factored load of 272 kips/pile for the westbound bridge (Proposed S.N. 037-0053) are estimated. Soils information from Boring No. 1 was utilized for the westbound bridge's southern abutment foundation analyses, soils information from Boring No. 2 was utilized for the westbound bridge's northern abutment foundation analyses, Boring No. 3 soils information was utilized for the eastbound bridge's southern abutment foundation analyses, and Boring No. 4 soils information was utilized for the eastbound bridge's northern abutment. The presented factored resistance available values consider anticipated settlement at the northern abutments has occurred to the extent that 0.4 inches or less of settlement remains at the time of pile installation to avoid the effects of downdrag.

Table 4.1
West Bound Bridge (Proposed S.N. 037-0053) - South Abutment (Boring No. 1)

Pile Type & Size	Nominal Required Bearing-R_N (kips)	Factored Resistance Available-R_F (kips)	Estimated Pile Length (ft.)(1)	Pile Tip Elevation (ft.)
Steel HP 10x42	304	167	79	750
	311(2)	171	84	745
Steel HP 12x53	377	208	79	750
	384(2)	211	89	740
Steel HP 12x63	387	213	89	740
	425	234	94	735
	463(2)	255 (3)	99	730
Steel HP 12x74	393	216	89	740
	431	237	94	735
	470	258 (3)	99	730
Steel HP 14x73	386	212	69	760
	430	237	74	755
	462	254	79	750
	467	257	89	740
	511	281	94	735
Steel HP 14x89	391	215	69	760
	436	240	74	755
	468	258	79	750
	473	260	89	740
	517	284	94	735
Steel HP 14x117	400	220	69	760
	447	246	74	755
	480	264	79	750
	485	267	89	740
Metal Shell 14" Dia. (0.321" Walls)	276	152	46	783
	317(2)	174	51	778
Metal Shell 16" Dia. (0.321" Walls)	320	176	46	783
	367(2)	202	51	778
Metal Shell 16" Dia. (0.375" Walls)	390	214	54	775
	702	386	56	773
	736(2)	405	59	770

(1) Estimated pile length is based on an assumed cutoff pile elevation of 828.9 ft. (accounting for a 2 ft. embedment into abutment), a bottom of abutment elevation of 826.9 ft., and a ground surface elevation of 816.9 ft. due to precoring 10 ft. below abutment bottom (where the soil begins contact with the pile) during driving.
(2) Nominal required bearing values at depths greater than this depth exceed the maximum nominal required bearing for this pile size and type.
(3) Presented value is for an elevation below the deepest boring completed at the site (elev. 734 ft.) and is estimated utilizing an average of the last three SPT values available.

Table 4.2
West Bound Bridge (Proposed S.N. 037-0053) - North Abutment (Boring No. 2)

Pile Type & Size	Nominal Required Bearing-R_N (kips)	Factored Resistance Available-R_F (kips)	Estimated Pile Length (ft.)$^{(1)}$	Pile Tip Elevation (ft.)
Steel HP 10x42	292	160	93	736
	323$^{(2)}$	178 $^{(3)}$	98	731
Steel HP 12x53	361	198	93	736
	398$^{(2)}$	219 $^{(3)}$	98	731
Steel HP 12x63	364	200	93	736
	440	242 $^{(3)}$	103	726
Steel HP 12x74	357	196	84	745
	407	224 $^{(3)}$	98	731
Steel HP 14x73	426	235	84	746
	440	242	93	736
	483	266 $^{(3)}$	98	731
Steel HP 14x89	432	238	84	746
	446	245	93	736
	489	269 $^{(3)}$	98	731
Steel HP 14x117	443	244	84	746
	457	251	93	736
	502	276 $^{(3)}$	98	731
Metal Shell 14" Dia. (0.321" Walls)	364	200	64	766
	390$^{(2)}$	215	66	763
Metal Shell 16" Dia. (0.321" Walls)	362	199	59	771
	423	233	64	766
	453$^{(2)}$	249	66	763
Metal Shell 16" Dia. (0.375" Walls)	362	199	59	771
	423	233	64	766
	453	249	66	763
	768$^{(2)}$	422	69	761

(1) Estimated pile length is based on an assumed cutoff pile elevation of 829.4 ft. (accounting for a 2 ft. embedment into abutment), a bottom of abutment elevation of 827.4 ft., and a ground surface elevation of 827.4 ft. (where the soil begins contact with the pile) during
(2) Nominal required bearing values at depths greater than this depth exceed the maximum nominal required bearing for this pile size and type.
(3) Presented value is for an elevation below the deepest boring completed at the site (elev. 734 ft.) and is estimated utilizing an average of the last three SPT values available.

Table 4.3
East Bound Bridge (Proposed S.N. 037-0049) - South Abutment (Boring No. 3)

Pile Type & Size	Nominal Required Bearing-R_N (kips)	Factored Resistance Available-R_F (kips)	Estimated Pile Length (ft.)[1]	Pile Tip Elevation (ft.)
Steel HP 10x42	305	167	79	751
	311[2]	171	89	741
Steel HP 12x53	378	208	79	751
	384[2]	211	89	741
Steel HP 12x63	388	213	89	740
	425	234	94	735
	464[2]	255 [3]	99	730
Steel HP 12x74	393	216	89	740
	431	237	94	735
	470	259 [3]	99	730
Steel HP 14x73	433	238	72	758
	463	255	79	750
	468	257	89	740
	511	281	94	735
	557	306 [3]	99	730
Steel HP 14x89	390	215	69	760
	439	241	72	758
	469	258	79	750
	474	261	89	740
	518	285	94	735
	564	310 [3]	99	730
Steel HP 14x117	400	220	69	760
	450	247	72	758
	481	265	79	750
	486	267	89	740
	530	292	94	735
Metal Shell 14" Dia. (0.321" Walls)	334	184	51	779
	504[2]	277	56	774
Metal Shell 16" Dia. (0.321" Walls)	388	214	51	779
	602[2]	331	56	774
Metal Shell 16" Dia. (0.375" Walls)	402	221	52	778
	430	236	54	776
	602	331	56	774
	621[2]	341	58	772

(1) Estimated pile length is based on an assumed cutoff pile elevation of 829.3 ft. (accounting for a 2 ft. embedment into abutment), a bottom of abutment elevation of 827.3 ft., and a ground surface elevation of 827.3 ft. (where the soil begins contact with the pile) during
(2) Nominal required bearing values at depths greater than this depth exceed the maximum nominal required bearing for this pile size and type.
(3) Presented value is for an elevation below the deepest boring completed at the site (elev. 734 ft.) and is estimated utilizing an average of the last three SPT values available.

Table 4.4
East Bound Bridge (Proposed S.N. 037-0049) - North Abutment (Boring No. 4)

Pile Type & Size	Nominal Required Bearing-R_N (kips)	Factored Resistance Available-R_F (kips)	Estimated Pile Length (ft.)(1)	Pile Tip Elevation (ft.)
Steel HP 10x42	294	162	88	739
	325(2)	179 (3)	98	729
Steel HP 12x53	365	201	88	739
	400(2)	220 (3)	98	729
Steel HP 12x63	369	203	88	739
	404	222 (3)	98	729
Steel HP 12x74	375	206	88	739
	410	225 (3)	98	729
Steel HP 14x73	436	240	83	744
	443	244	93	734
	487	268 (3)	98	729
Steel HP 14x89	441	243	83	744
	449	247	93	734
	493	271 (3)	98	729
Steel HP 14x117	453	249	83	744
	460	253	93	734
	505	278 (3)	98	729
Metal Shell 14" Dia. (0.321" Walls)	431	237	58	769
	478(2)	263	63	764
Metal Shell 16" Dia. (0.321" Walls)	302	166	53	774
	518	285	58	769
	575(2)	316	63	764
Metal Shell 16" Dia. (0.375" Walls)	302	166	53	774
	518	285	58	769
	575	316	63	764
	503	276	73	754
	580(2)	319	78	749

(1) Estimated pile length is based on an assumed cutoff pile elevation of 829.6 ft. (accounting for a 2 ft. embedment into abutment), a bottom of abutment elevation of 827.6 ft., and a ground surface elevation of 827.6 ft. (where the soil begins contact with the pile) during
(2) Nominal required bearing values at depths greater than this depth exceed the maximum nominal required bearing for this pile size and type.
(3) Presented value is for an elevation below the deepest boring completed at the site (elev. 734 ft.) and is estimated utilizing an average of the last three SPT values available.

Considering anticipated axial loads, the above noted bearing values, and the proposed utilization of integral abutments, a single row of metal shell piles is recommended to found each of the abutments. Should bearing/resistance values at elevations lower than the end of boring elevations be required, then additional soils information at greater depths would need to be obtained (i.e., deeper borings would need to be completed).

It is recommended a minimum of one test pile be completed at each of the abutment locations.

Due to the proposed use of integral abutments, steel H-piles and metal shell piles are the only type of foundation allowed by IDOT to support the structures. Therefore, drilled shafts and other pile types were not considered. If H-piles are considered as the pile type to support the structures, it is recommended pile driving shoes be utilized due to hard till being present. Due to the hard/stiff materials located at the site and comparing maximum nominal required bearing values and nominal required bearing values, it is recommended that 16-inch diameter metal shell piles with 0.375-inch walls be utilized along with conical tips should metal shell piles be chosen. Due to the limited wall thickness (0.25-inch) of 12-inch diameter metal shells, the nominal required bearing values, and the presence of hard till it is anticipated 12-inch diameter metal shell piles will not be a viable option for supporting the structure, and therefore, the corresponding required bearing/factored resistance values have not been presented. Similarly, the factored resistance values for 14-inch diameter metal shells with 0.25-inch thick walls were not presented. Hard till material begins to be present between the approximate elevations of 773 ft. and 761 ft. and therefore driving of piles significantly beyond these elevations may result in the maximum nominal bearing value being exceeded.

Due to stiff (i.e., Q_u > 3.0 tsf) soils indicated to be present near the location of the southern abutment for the westbound bridge and the proposed construction of integral abutments, the upper 10 ft. of piles at this abutment are to be precored and the annular space around each pile filled with sodium bentonite. Specifically, a 24-inch diameter precored hole should be completed between the elevations of 826.9 ft. and 816.9 ft. for all pile sizes except for HP 14 piles. If HP 14 piles are utilized, a 30-inch diameter precored hole should be provided per IDOT’s ABD memo 19.8.

Cost comparison of viable foundation options should be considered by the structural engineer during final design.

It is anticipated wingwalls will be integrated into the adjacent abutment.

For lateral load analyses, the following parameters should be utilized in calculations.

Lateral Soil Parameters

Southern Abutment - Westbound Bridge, Proposed S.N. 037-0053 (Boring No. 1)

Soil Layer	Soil Strain - E_{50}	Soil Modulus -k (pci)	Soil Unit Weight (pcf)	Cohesive Shear Strength - c (psf)	Internal Friction Angle (degrees)
Silty Clay (Fill) 838 ft. - 808 ft.	0.005	1,000	120	3,200	0
Clay 808 ft. - 803 ft.	0.005	1,000	120	2,100	0
Silty Loam 803 ft. - 798 ft.	0.005	1,000	120	2,400	0
Silt 798 ft. - 793 ft.	0.005	1,000	120	2,500	0
Muck 793 ft. - 792 ft.	0.006	750	90	2,000	0
Silty Clay Loam 792 ft. - 788 ft.	0.007	500	120	1,800	0
Silty Clay Till, Stiff 788 ft. - 783 ft.	0.009	300	125	1,000	0
Silty Clay Till, Very Stiff 783 ft. - 773 ft.	0.005	1,000	145	2,300	0
Silty Clay Till, Hard 773 ft. - 735 ft.	0.004	2,000	145	4,400	0

Northern Abutment - Westbound Bridge, Proposed S.N. 037-0053 (Boring No. 2)

Soil Layer	Soil Strain - E_{50}	Soil Modulus -k (pci)	Soil Unit Weight (pcf)	Cohesive Shear Strength - c (psf)	Internal Friction Angle (degrees)
Cohesive Fill Material 838 ft. - 809 ft.	0.009	300	125	1,000	0
Silty Clay 809 ft. - 806 ft.	0.005	1,000	120	2,800	0
Silty Clay Loam 806 ft. - 801 ft.	0.02	30	120	450	0
Silty Loam 801 ft. - 795 ft.	0.007	500	120	1,150	0
Silt 795 ft. - 793 ft.	0.007	500	120	1,600	0
Muck 793 ft. - 788 ft.	0.005	1,000	90	2,400	0
Clay 788 ft. - 781 ft.	0.009	300	120	1,000	0
Silty Clay Till, Stiff 781 ft. - 771 ft.	0.005	1,000	125	3,700	0
Silty Clay Till, Very Stiff 771 ft. - 761 ft.	0.005	1,000	145	3,600	0
Silty Clay Till, Hard 761 ft. - 744 ft.	0.004	2,000	145	4,300	0

Southern Abutment - Eastbound Bridge, Proposed S.N. 037-0049 (Boring No. 3)

Soil Layer	Soil Strain - E_{50}	Soil Modulus -k (pci)	Soil Unit Weight (pcf)	Cohesive Shear Strength - c (psf)	Internal Friction Angle (degrees)
Silty Clay (Fill) 838 ft. - 826 ft.	0.005	1,000	120	2,100	0
Silty Loam (Fill) 826 ft. - 819 ft.	0.007	500	120	1,800	0
Silty Clay (Fill) 819 ft. - 809 ft.	0.005	1,000	120	2,800	0
Silty Clay 809 ft. - 804 ft.	0.009	300	120	1,000	0
Silty Loam 804 ft. - 793 ft.	0.007	500	120	1,200	0
Silty Clay 793 ft. - 789 ft.	0.007	500	120	1,400	0
Silty Clay Till, Stiff 789 ft. - 779 ft.	0.007	500	125	1,650	0
Silty Clay Till, Very Stiff 779 ft. - 774 ft.	0.005	1,000	145	3,400	0
Silty Clay Till, Hard 774 ft. - 735 ft.	0.004	2,000	145	4,400	0

Northern Abutment - Eastbound Bridge, Proposed S.N. 037-0049 (Boring No. 4)

Soil Layer	Soil Strain - E_{50}	Soil Modulus -k (pci)	Soil Unit Weight (pcf)	Cohesive Shear Strength - c (psf)	Internal Friction Angle (degrees)
Cohesive Fill Material 838 ft. - 809 ft.	0.009	300	125	1,000	0
Silty Clay 809 ft. - 803 ft.	0.007	500	120	1,700	0
Silty Clay Loam 803 ft. - 798 ft.	0.02	30	120	450	0
Silty Loam 798 ft. - 796 ft.	0.01	100	120	900	0
Muck 796 ft. - 791 ft.	0.01	100	90	850	0
Silty Clay Loam Till 791 ft. - 789 ft.	0.009	300	125	1,000	0
Silty Clay Till 789 ft. - 776 ft.	0.007	500	125	1,300	0
Silty Clay Till, Very Stiff 776 ft. - 771 ft.	0.005	1,000	145	2,600	0
Silty Clay Till, Hard 771 ft. - 735 ft.	0.004	2,000	145	4,400	0

B. Embankment Fills

As mentioned previously, due to the shorter length of the proposed structures as compared to the existing structures' lengths, new endslopes for the northern abutments will need to be constructed by placing approximately 29 vertical ft. of embankment soils with a base width of approximately 264 ft. It is proposed both the sideslopes and endslopes will be constructed with 2:1 (H:V) slopes to match existing slopes. A cohesive soil was considered as an embankment fill material for the slope stability analysis.

Regardless of the material type used for embankment fill, techniques to minimize erosion should be implemented. It is recommended a vegetative cover or other erosion control practice be established on all exposed slopes immediately after final grades have been met. Burlap, soil erosion matting, or other equivalent product may be needed to aid in establishing vegetation in areas outside of proposed endslope protection. Additionally, silt fences and/or drainage control structures should be used during the construction process.

As recommended in this report's section regarding settlement, placement of embankment should be completed after installation of wick drains. A minimum 24-inch thick drainage blanket consisting of clean, drainable sand or granular material is to be placed over the original ground surface and is to be daylighted at the sides of the embankment prior to embankment placement. Material used in the drainage blanket is to meet the criteria outlined in Section 6.17 of the IDOT Geotechnical Manual.

C. Construction Considerations

If any materials unsuitable for the foundation of fills are encountered, they should be undercut and backfilled with suitable material as directed by the resident engineer. The upper horizon soils (topsoil) are not considered to be suitable for embankment fill. Therefore, it is recommended topsoil within areas of proposed fill placement be stripped prior to backfill placement and the exposed subgrade surface be prepared accordingly.

All fills should be placed and compacted in accordance with IDOT's Standard Specifications for Road and Bridge Construction to assure the embankment will be stable and relatively incompressible. If on-site materials encountered during excavation operations do not possess classification characteristics similar to those described within this report, the excavated material should be tested to ensure required strength and pavement support characteristics can be obtained. If material from off site is required for fill placement, a suitable, uniform source should be located.

The southern abutments for both proposed structures are in close proximity to the existing southern abutments and associated piles. Considering an estimated pile length of 56 ft. for 16-inch diameter metal shell piles and a pile spacing of three times the pile diameter, there may be minor conflict between the new piles and existing battered piles near the tips of the new piles. It is recommended additional evaluation be completed during final design in regards to this possible conflict, including but not limited to, a review of as-built pile data for the existing southern abutment piles to verify possible conflicts with proposed piles and adjustments to the positioning of the proposed piles be made as necessary. Due to the shortening of the structures, the northern abutments will be positioned where existing substructure objects are not present.

Due to the proposed bridge length being shorter than the existing bridge length, the existing northern concrete slopewall will be in the location of proposed embankment fill. To allow existing embankment fill to have intimate contact with new embankment fill, the existing concrete slopewall is recommended to be removed. Preparation of the existing slope surface should then be completed in accordance with Section 205 within IDOT's Standard Specifications for Road and Bridge Construction.

It is anticipated that existing wingwalls at each abutment location will be demolished in their entirety.

Based upon IDOT District 4 recommendations, crossovers north and south of the existing structures will be utilized during construction to allow for construction of each new structure independent of each other, and thus, stage construction is not anticipated.

As required by IDOT specifications and guidelines, erosion control techniques and devices should be implemented in drainageway areas where denuded soils are present. Control devices may include straw bale filters, drainageway check dams, or riprap placement. To assist in minimizing erosion, seeding operations on all sideslopes should be commenced as soon as final grades have been met or construction activities in these areas have ceased.

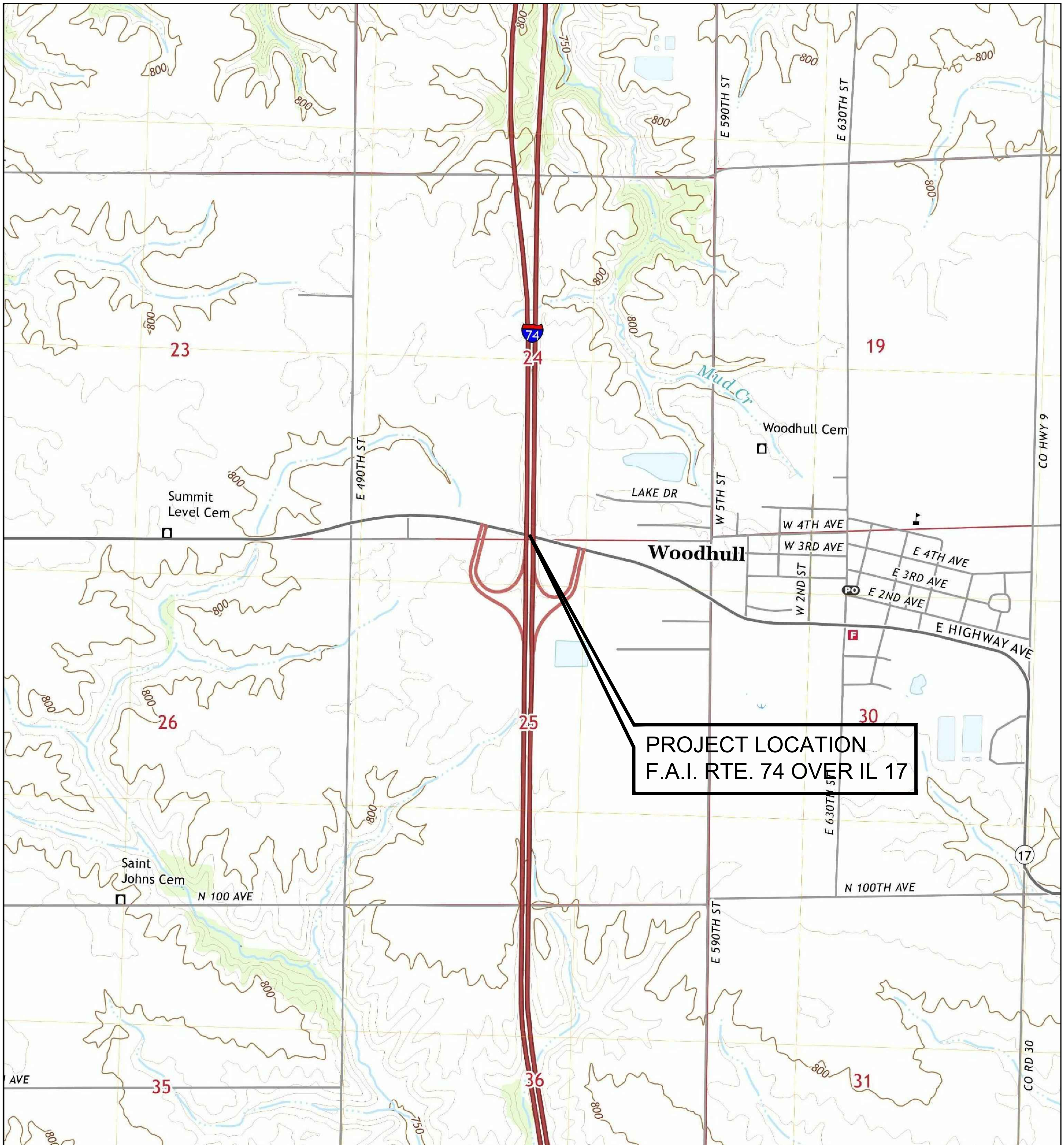
V. LIMITATIONS OF REPORT

This report has been completed for the Illinois Department of Transportation (IDOT) and has been prepared in accordance with IDOT and other generally accepted soil and foundation engineering practices. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report should be reviewed and the conclusions of this report verified and/or modified in writing.

The analysis and recommendations presented in this report are based on data obtained from soil borings completed at the project site, and other pertinent information presented in this report. Information presented is not intended to be a guarantee that all soils in the project area will possess the same characteristics. There may be, and often is, a considerable variation in soils within the same general area.

APPENDIX A

PROJECT LOCATION MAP



AERIAL PHOTO

APPROXIMATE SCALE 1"= 2000'

N

PROJECT LOCATION MAP

F.A.I. RTE. 74

SECTION (37-24HVB) BR

EXIST. SN 037-0019 / PROPOSED SN 037-0049 (E.B.)

EXIST. SN 037-0020 / PROPOSED SN 037-0053 (W.B)

HENRY COUNTY, ILLINOIS

HURST-ROSCHE, INC

1400 EAST TREMONT

HILLSBORO, ILLINOIS

DESIGNED BY: MEE	CHECKED BY: MEE	H/R PROJ. NO.
DRAWN BY: NAL	DATE: FEBRUARY 2022	192–2211

X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Dwg\GEOTECH\Loc_Map.dwg, 2/14/2022 12:58:02 PM

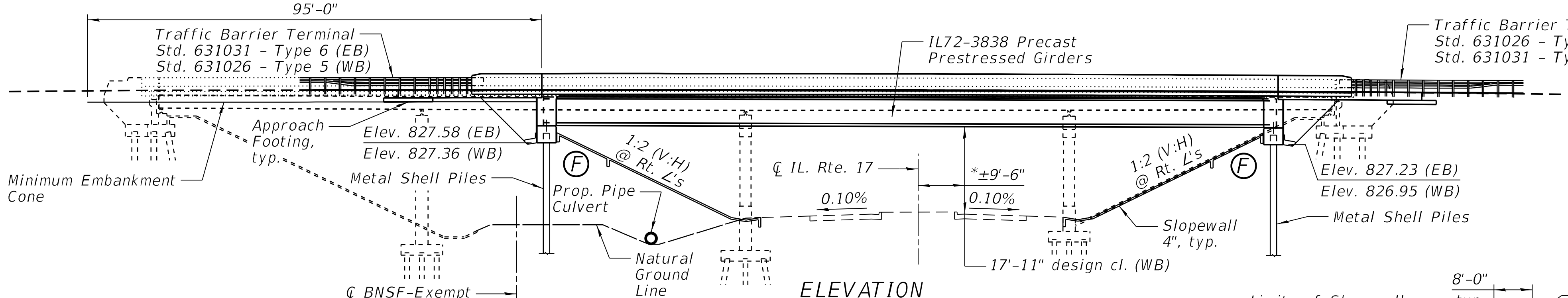
APPENDIX B

BORING LOCATION PLAN AND BORING LOGS

Benchmark: BM#10003, Brass Disc in center of medians of IL. Rte. 17 and I-74. Elevation = 813.02, Sta. 22+64.70 (I-74), 0.00' RT.

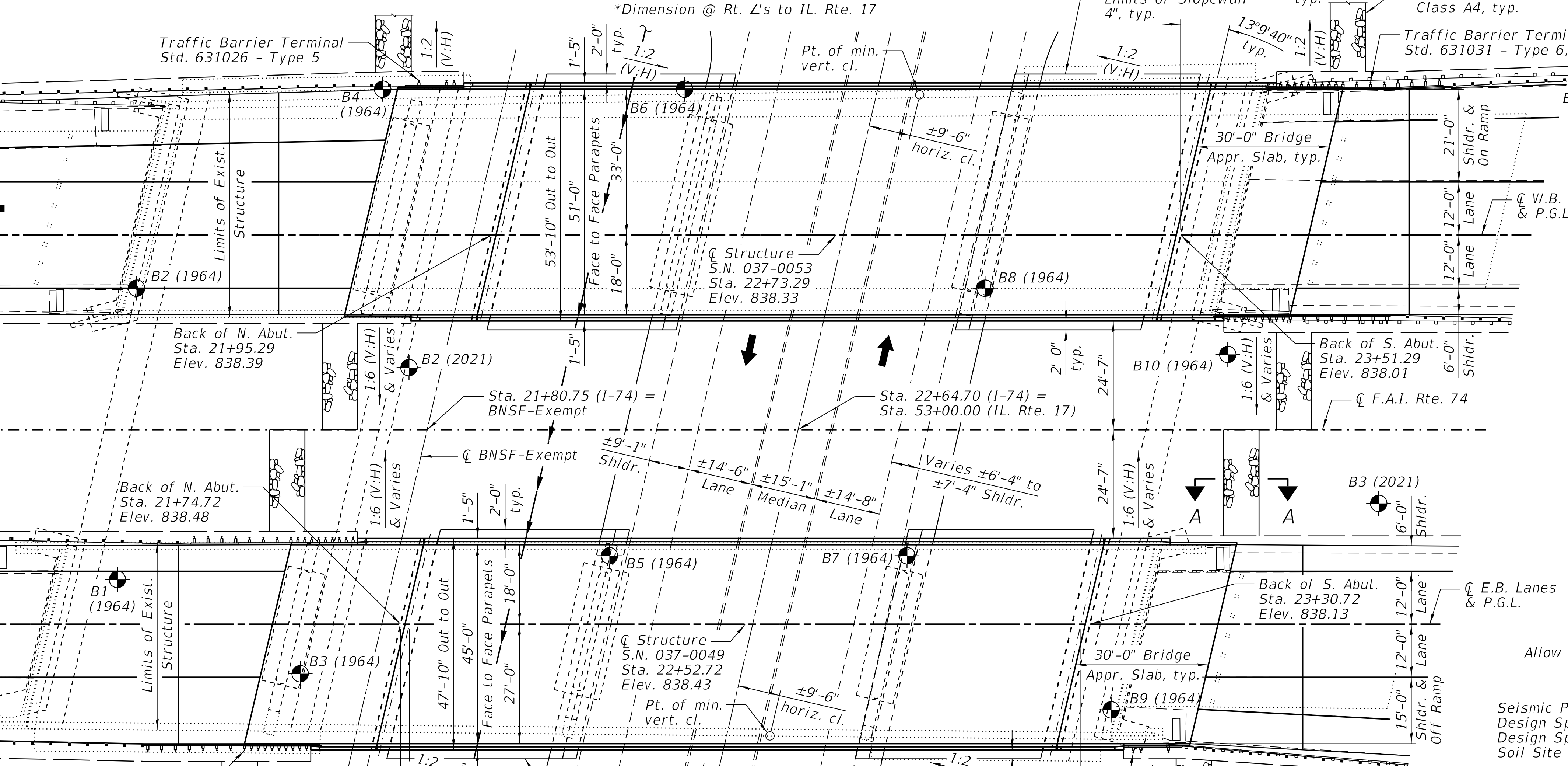
Existing Structures: S.N. 037-0019 (E.B.) and S.N. 037-0020 (W.B.), built in 1967 as Section 37-24HVB on F.A.I. Rte. 74; Sta. 22+64.70. The structures were reconstructed in 1988 when portions of the concrete deck were replaced. The headwalls and wingwalls on the abutments were reconstructed during this rehabilitation. The steel in the superstructure was painted in 1999. The existing four span structures have a concrete deck on continuous wide flange beams supported by open concrete abutments and pile bent concrete piers. The out-to-out deck for the West Bound bridge varies from 48'-9¼" to 52'-4¼" and the East Bound bridge varies from 42'-2⅝" to 44'-7⅝". Both bridges are 248'-4" back-to-back of the abutments and are skewed 13°9'40" left-forward. Traffic shall be maintained utilizing crossovers during construction.

No Salvage.

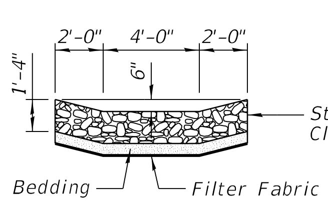


ELEVATION

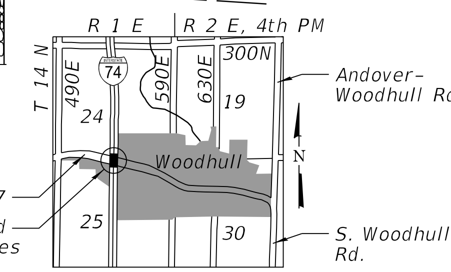
*Dimension @ Rt. ∠'s to IL. Rte. 17



PLAN



SECTION A-A



LOCATION SKETCH

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge
Design Specifications,
9th Edition

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)

PRECAST PRESTRESSED UNITS

f'c = 8,500 psi
f'ci = 6,500 psi
fpu = 270,000 psi (0.6" ø low lax. strands)
fpbt = 202,300 psi (0.6" ø low lax. strands)

HIGHWAY CLASSIFICATION

F.A.I. Route 74 (Eastbound)
Functional Class: Interstate
A.D.T.: 7,700 (2019), 7,358 (2032)
D.H.V.: 770 (2019), 736 (2032)
A.D.T.T.: 2,387 (2019), 2,281 (2032)
Design Speed: 70 M.P.H.
Posted Speed: 70 M.P.H.
One Way Traffic

HIGHWAY CLASSIFICATION

F.A.I. Route 74 (Westbound)
Functional Class: Interstate
A.D.T.: 7,700 (2019), 7,256 (2032)
D.H.V.: 770 (2019), 726 (2032)
A.D.T.T.: 2,387 (2019), 2,250 (2032)
Design Speed: 70 M.P.H.
Posted Speed: 70 M.P.H.
One Way Traffic

HIGHWAY CLASSIFICATION

IL. Route 17 (Eastbound)
Functional Class: Minor Arterial
A.D.T.: 3,950 (2019), 4,701 (2032)
D.H.V.: 395 (2019), 470 (2032)
A.D.T.T.: 948 (2019), 1,128 (2032)
Design Speed: 45 M.P.H.
Posted Speed: 45 M.P.H.
One Way Traffic

HIGHWAY CLASSIFICATION

IL. Route 17 (Westbound)
Functional Class: Minor Arterial
A.D.T.: 3,250 (2019), 4,497 (2032)
D.H.V.: 325 (2019), 450 (2032)
A.D.T.T.: 455 (2019), 630 (2032)
Design Speed: 45 M.P.H.
Posted Speed: 45 M.P.H.
One Way Traffic

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

SEISMIC DATA

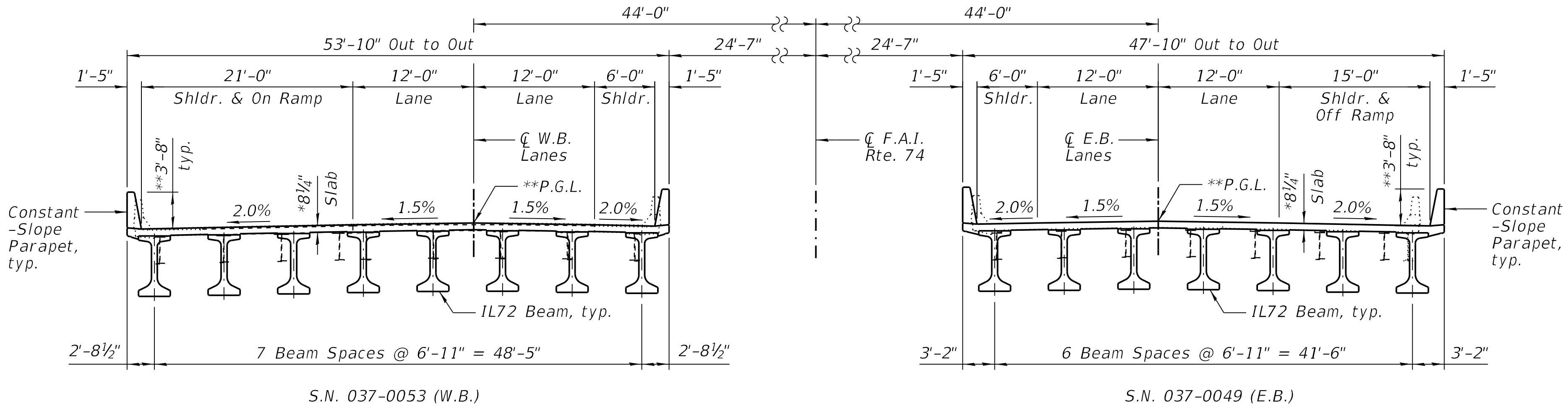
Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.067 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.106 g
Soil Site Class = C

I-74 OVER IL. RTE. 17
AND BNSF-EXEMPT
F.A.I. RTE. 74 - SEC. 37-24HVB-I
HENRY COUNTY
STATION 22+64.70
STRUCTURE NO. 037-0049 (E.B.)
STRUCTURE NO. 037-0053 (W.B.)

Farnsworth GROUP, 2709 McGRAW DRIVE, BLOOMINGTON, ILLINOIS 61704, (309) 663-8435 / info@f-w.com	DESIGNED - VAS	REVISED	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
	CHECKED - JML	REVISED	
	DRAWN - DJM	REVISED	
DATE - 05/02/2022	CHECKED - VAS	REVISED	

GENERAL PLAN
STRUCTURE NO. 037-0049 (EB) & 037-0053 (WB)
SHEET NO. 1 OF 2 SHEETS

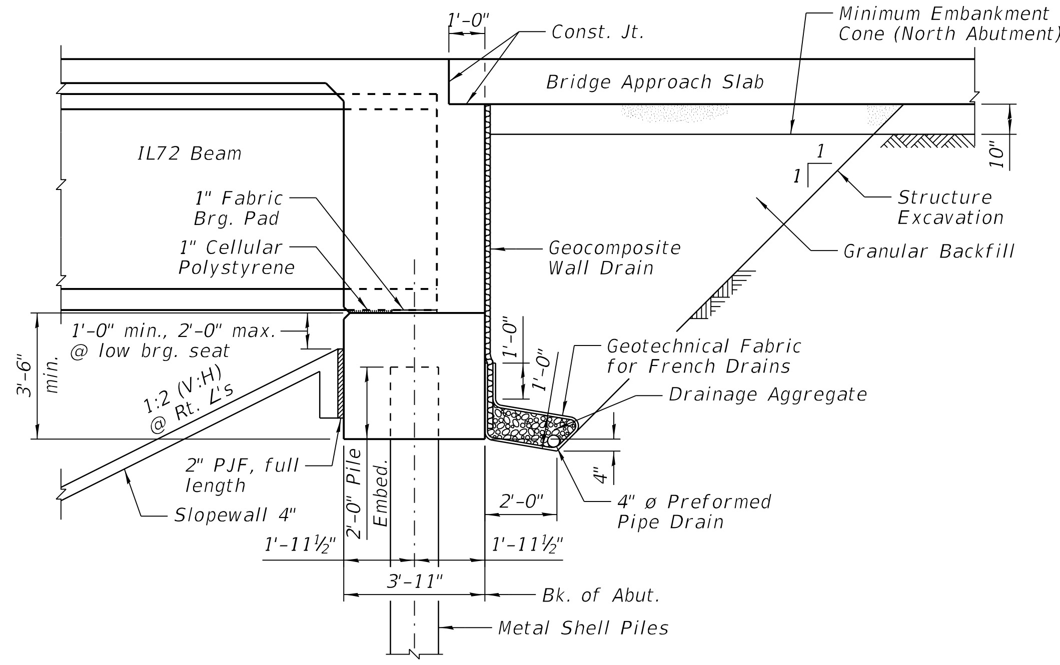
F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	37-24HVB-I	HENRY	2	1
		CONTRACT NO. 68510		
		ILLINOIS FED. AID PROJECT		



CROSS SECTION

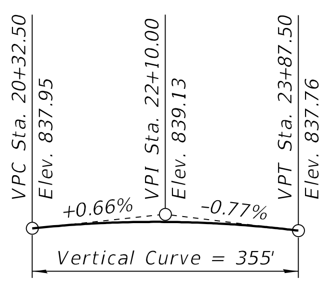
(Looking South)

* Prior to grinding
** After grinding



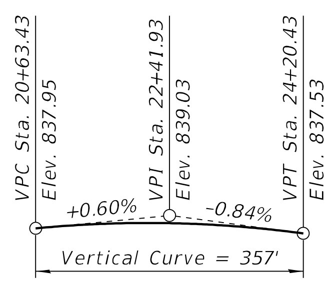
SECTION THRU ABUTMENT

(Horizontal dimensions @ Rt. ∠'s)



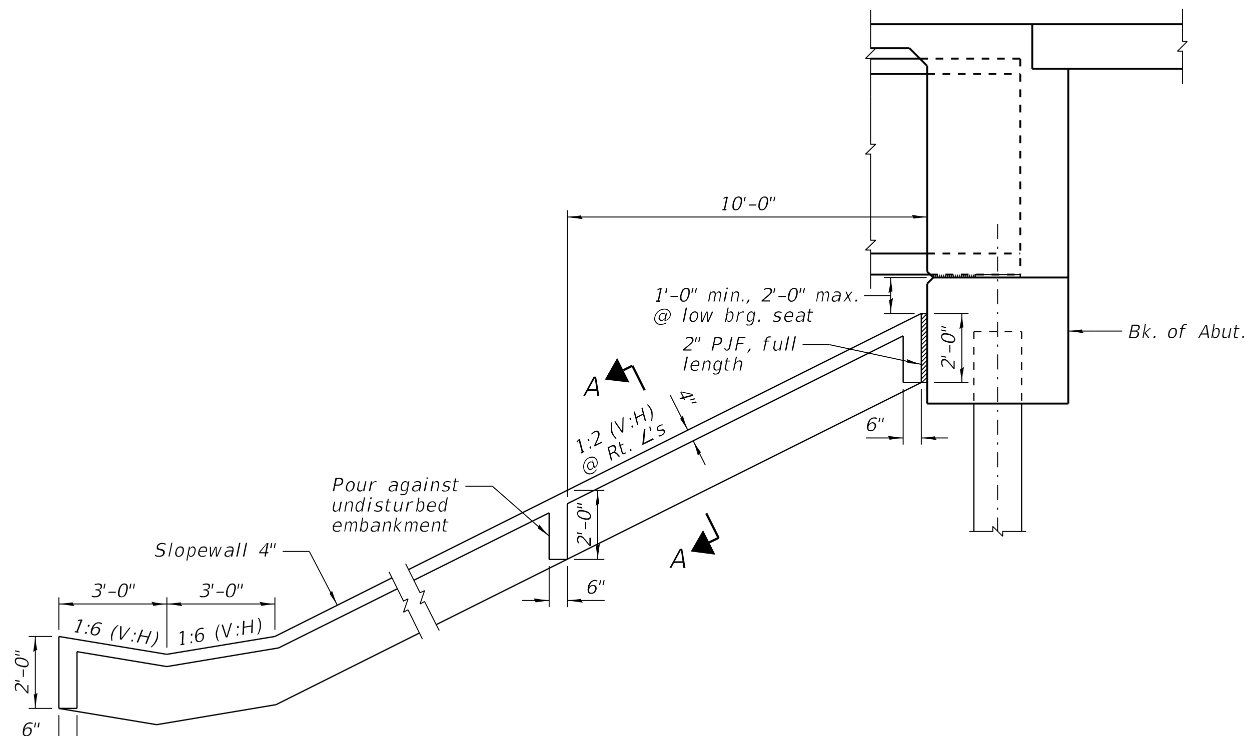
PROPOSED I-74 PROFILE GRADE

(Along ℄ E.B. Lanes)



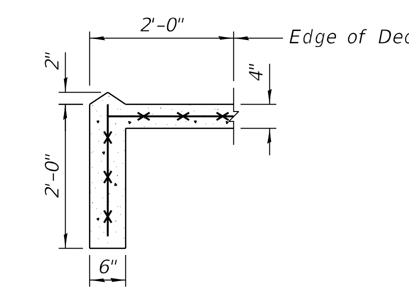
PROPOSED I-74 PROFILE GRADE

(Along ℄ W.B. Lanes)

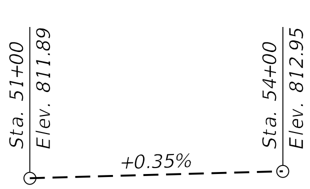


SECTION THRU SLOPEWALL

(Horizontal dimensions @ Rt. ∠'s)

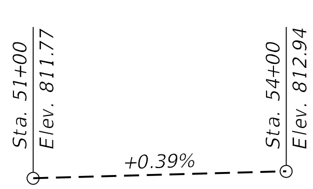


SECTION A-A



EXISTING IL. RTE. 17 PROFILE GRADE

(Along inside edge of pavement E.B. Lane)



EXISTING IL. RTE. 17 PROFILE GRADE

(Along inside edge of pavement W.B. Lane)

I-74 OVER IL. RTE. 17
AND BNSF-EXEMPT
F.A.I. RTE. 74 - SEC. 37-24HVB-I
HENRY COUNTY
STATION 22+64.70
STRUCTURE NO. 037-0049 (E.B.)
STRUCTURE NO. 037-0053 (W.B.)

Farnsworth GROUP
2709 McGRAW DRIVE
BLOOMINGTON, ILLINOIS 61704
(309) 663-8435 / info@f-w.com

	DESIGNED - VAS	REVISED
	CHECKED - JML	REVISED
	DRAWN - DJM	REVISED
DATE - 05/02/2022	CHECKED - VAS	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 037-0049 (EB) & 037-0053 (WB)

SHEET NO. 2 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	37-24HVB-I	HENRY	2	2

CONTRACT NO. 68510

ILLINOIS FED. AID PROJECT

2021 Boring Logs

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 11/29/21

ROUTE FAI 74 **DESCRIPTION** WB I-74 Over IL 17 near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 25, **TWP.** 14N, **RNG.** 1E, 4th **PM**,
Latitude , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 1
Station 24+64
Offset 31.0 ft LT
Ground Surface Elev. 836.20 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion Dry ft
First Encounter ft
After 24 **Hrs.** 813.9 ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Asphalt	835.70				
Aggregate (CA-6)	835.20				
SILTY CLAY, Dark Gray, Moist, Very Stiff, Trace of Sand and Gravel			2 / 2 / 5	2.2 B	14
		-5	2 / 3 / 5	2.4 B	20
Stiff	830.20		1 / 3 / 5	1.9 B	19
Dark Gray and Light Gray, Very Stiff	827.70	-10	3 / 7 / 8	3.8 B	18
Black and Gray	825.20		2 / 6 / 9	3.3 B	16
Light Gray and Orangish-Brown, Hard	822.70	-15	5 / 6 / 9	4.5 P	18
Stiff	820.20		5 / 6 / 9	--	--
No Sand or Gravel	817.70	-20	4 / 5 / 8	2.0 B	18

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
No Sand or Gravel *(continued)*					
Black, Mottled, Hard	815.20	▽	5 / 9 / 10	4.7 B	18
Light Gray and Black, Very Stiff	812.70	-25	5 / 11 / 12	2.6 B	20
Black, Hard	810.20		6 / 9 / 11	4.4 B	29
CLAY, Light Gray, Orangish-Brown, Mottled, Moist, Very Stiff	807.70	-30	3 / 4 / 5	2.1 B	30
SILTY LOAM, Light Gray, Orangish-Brown, Mottled, Moist, Very Stiff	802.70	-35	3 / 4 / 6	2.4 B	22
SILT, Dark Brown, Moist, Very Stiff	797.70	-40	4 / 9 / 11	2.5 P	37

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 11/29/21

ROUTE FAI 74 **DESCRIPTION** WB I-74 Over IL 17 near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 25, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 1
Station 24+64
Offset 31.0 ft LT
Ground Surface Elev. 836.20 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion Dry ft
First Encounter ft
After 24 **Hrs.** 813.9 ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT, Dark Brown, Moist, Very Stiff *(continued)*				
792.70				
MUCK, Dark Brown, Moist, Stiff 792.20		4	2.0 P	57
SILTY CLAY LOAM, Light Gray, Moist, Stiff	-45	5 5	1.8 P	32
787.70				
SILTY CLAY TILL, Light Gray, Moist, Stiff, Trace of Sand and Gravel	-50	5 6 6	1.0 B	17
782.70				
Very Stiff	-55	6 7 9	2.0 B	16
	-60	10 12 16	2.6 B	15
Very Stiff *(continued)*				
772.70				
Dark Gray, Dry to Moist, Hard	-65	10 23 27	4.7 B	15
767.70				
Dark Brown 766.20	-70	17 47 36	4.9 B	18
End of Boring	-75			
	-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 12/1/21

ROUTE FAI 74 **DESCRIPTION** WB I-74 Over IL 17 near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 24, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 2
Station 22+57
Offset 30.0 ft RT
Ground Surface Elev. 809.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion 804.4 ft
First Encounter ft
After 24 **Hrs.** 805.1 ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY, Dark Gray, Moist, Very Stiff		2 4 5	2.8 P	34
805.90				
SILTY CLAY LOAM, Light Gray, Orangish-Brown, Mottled, Medium Stiff	-5	1 2 2	0.5 B	27
Shelby Tube Pushed from 5'-7' Recovery: 24" 803.40				
Soft		1 1 2	0.4 B	34
800.90				
SILTY LOAM, Light Gray, Orangish-Brown, Mottled, Moist, Medium Stiff	-10	1 2 3	1.0 B	25
		2 4 2	--	33
795.90				
Gray 795.40		1	1.3 P	37
SILT, Dark Brown, Moist, Stiff	-15	2 6	1.6 B	38
793.40				
MUCK, Dark Brown, Moist, Very Stiff		3 4 8	2.5 P	119
791.40				
Shelby Tube Pushed from 18'-20' Recovery: 24" 790.90				
Dry to Moist	-20	2 2 2	2.3 P	176
Dry to Moist *(continued)*				
788.40				
CLAY, Gray, Moist, Medium Stiff, Trace of Sand		2 2 2	0.9 B	30
785.90				
Stiff, No Sand	-25	2 3 4	1.1 B	24
783.40				
SILTY CLAY TILL, Gray, Moist, Medium Stiff, Trace of Sand and Gravel		2 4 2	0.9 B	18
780.90				
Dry to Moist, Stiff	-30	4 6 7	1.7 B	16
	-35	4 5 6	2.0 B	15
770.90				
Very Stiff	-40	7 10 13	3.4 B	14

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 12/1/21

ROUTE FAI 74 **DESCRIPTION** WB I-74 Over IL 17 near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 24, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 2
Station 22+57
Offset 30.0 ft RT
Ground Surface Elev. 809.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion 804.4 ft
First Encounter ft
After 24 **Hrs.** 805.1 ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff *(continued)*	765.90				
Dry to Moist			7		
			10	3.8	13
		-45	13	B	
	760.90				
Hard			15		
			22	>4.85	12
		-50	30	B	
			12		
			17	4.7	13
		-55	21	B	
			12		
			15	4.4	15
		-60	17	B	

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Hard *(continued)*	745.90				
Very Stiff			9		
			15	3.2	18
	744.40	-65	19	B	
End of Boring					
		-70			
		-75			
		-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 11/30/21

ROUTE	FAI 74	**DESCRIPTION**	EB I-74 over IL 17 Near Woodhull, IL	**LOGGED BY**	EJA
SECTION	(37-24HVB)BR	**LOCATION**	, **SEC.** 25, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**		
COUNTY	Henry	**DRILLING METHOD**	HSA	**HAMMER TYPE**	Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 3
Station 23+84
Offset 27.0 ft LT
Ground Surface Elev. 837.20 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion 813.0 ft ▼
First Encounter ft
After 24 **Hrs.** 814.3 ft ▽

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY, Brown, Moist, Stiff, Trace of Sand and Gravel			2 5 8	1.7 B	19
	833.70				
Gray, Orange, Mottled, No Sand or Gravel		-5	2 4 6	1.9 B	23
	831.20				
Very Stiff			2 3 4	2.4 B	23
		-10	2 4 4	2.2 B	20
	826.20				
SILTY LOAM, Gray, Orangish-Brown, Mottled, Moist, Stiff			3 4 5	1.0 B	21
		-15	3 4 6	2.1 B	22
	821.20				
Very Stiff			4 6 6	2.2 S	19
	818.70				
SILTY CLAY, Gray, Orangish-Brown, Mottled, Moist, Very Stiff		-20	4 5 7	2.5 B	20
SILTY CLAY, Gray, Orangish-Brown, Mottled, Moist, Very Stiff *(continued)*			5 8 11	2.8 B	22
▽	813.70				
Gray, Orange and Black ▼		-25	4 6 10	3.0 B	28
	811.20				
Gray, Orange, Mottled	810.70		4	2.8 P	24
Black, Dry to Moist, Hard			6 10	>4.5 P	28
	808.70				
Light Gray, Orangish-Brown, Mottled, Moist, Medium Stiff		-30	2 3 3	1.0 B	28
	803.70				
SILTY LOAM, Light Gray, Orangish-Brown, Moist, Stiff		-35	3 4 4	1.6 B	25
	798.70				
Light Gray, Moist to Wet, Medium Stiff		-40	2 3 3	0.8 B	29

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 11/30/21

ROUTE FAI 74 **DESCRIPTION** EB I-74 over IL 17 Near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 25, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 3
Station 23+84
Offset 27.0 ft LT
Ground Surface Elev. 837.20 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion 813.0 ft
First Encounter ft
After 24 **Hrs.** 814.3 ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Light Gray, Moist to Wet, Medium Stiff *(continued)*				
793.70				
Stiff 793.20		2	1.3 P	38
SILTY CLAY, Dark Gray, Moist, Stiff	-45	4 4	1.4 B	23
788.70				
SILTY CLAY TILL, Gray, Moist, Stiff, Trace of Sand and Gravel		3		
	-50	4 5	1.5 B	20
		4		
	-55	6 8	1.8 B	15
778.70				
Dry to Moist, Very Stiff		12		
	-60	14 14	3.4 B	15

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Dry to Moist, Very Stiff *(continued)*				
773.70				
Dark Gray, Hard		7		
	-65	15 17	4.7 B	12
		19		
	-70	27 34	4.9 B	16
		13		
762.20	-75	16 33	4.7 B	17
End of Boring				
	-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 12/3/21

ROUTE FAI 74 **DESCRIPTION** EB I-74 over IL 17 Near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 24, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 4
Station 22+36
Offset 35.0 ft RT
Ground Surface Elev. 809.70 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion -- ft
First Encounter ft
After 16 **Hrs.** 804.0 ft ▽

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY, Black, Dry, Very Stiff			2		
			6	3.5	26
			4	P	
	806.20				
Light Gray, Orangish-Brown, Mottled, Moist, Stiff			3		
			4	1.7	30
	804.70	-5	4	B	
Shelby Tube Pushed from 5'-7' Recovery: 22"	803.70 ▽				
SILTY CLAY LOAM, Gray, Orangish-Brown, Mottled, Moist to Wet, Soft			1		
			1	0.4	28
			1	B	
	800.70		1		
Shelby Tube Pushed from 9'-11' Recovery: 23"			1	0.5	26
		-10	2	B	
	798.70				
SILTY LOAM, Gray, Orangish-Brown, Mottled, Moist, Medium Stiff			1		
			1	0.9	31
			2	B	
	796.70				
Shelby Tube Pushed from 13'-15' Recovery: 24"	796.20		2		
MUCK, Dark Brown, Moist, Medium Stiff			4	1.0	66
		-15	4	S	
			3		
			4	0.7	135
			8	S	
	791.20				
SILTY CLAY, Light Gray, Moist, Soft	790.70		1	0.5	59
				P	
		-20	2	1.0	32

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY LOAM TILL, Gray, Moist, Medium Stiff, Trace of Sand *(continued)*	788.70		2	B	
			1		
SILTY CLAY TILL, Gray, Moist, Stiff, Trace of Sand			3	1.1	24
			4	B	
	786.20				
Trace of Gravel			3		
			4	1.7	21
		-25	6	B	
			2		
			3	1.1	18
			5	B	
			2		
			5	1.2	17
		-30	6	B	
	776.20				
Dry to Moist, Very Stiff			11		
			9	2.6	15
		-35	12	B	
	771.20				
Hard			9		
			14	4.7	12
	769.70	-40	18	B	

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Hurst-Rosche

SOIL BORING LOG

Date 12/3/21

ROUTE FAI 74 **DESCRIPTION** EB I-74 over IL 17 Near Woodhull, IL **LOGGED BY** EJA

SECTION (37-24HVB)BR **LOCATION** , **SEC.** 24, **TWP.** 14N, **RNG.** 1E, 4th **PM**, **Latitude** , **Longitude**

COUNTY Henry **DRILLING METHOD** HSA **HAMMER TYPE** Auto

STRUCT. NO. 037-0053 (Proposed)
Station

BORING NO. 4
Station 22+36
Offset 35.0 ft RT
Ground Surface Elev. 809.70 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
Upon Completion -- ft
First Encounter ft
After 16 **Hrs.** 804.0 ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY CLAY TILL, Gray, Dry to Moist, Hard, Trace of Sand and Gravel		9		
		15	>4.85	14
	-45	20	B	
		15		
		22	>4.85	13
	-50	27	B	
756.20				
Very Stiff		9		
		12	3.4	15
	-55	17	S	
751.20				
Hard		4		
		10	4.9	15
	-60	12	B	
Hard *(continued)*		14		
		17	4.0	17
	-65	20	B	
741.20				
Trace of Wood		10		
		14	4.0	16
	-70	24	B	
736.20				
Moist		8		
		10	4.3	17
734.70	-75	11	B	
End of Boring				
	-80			

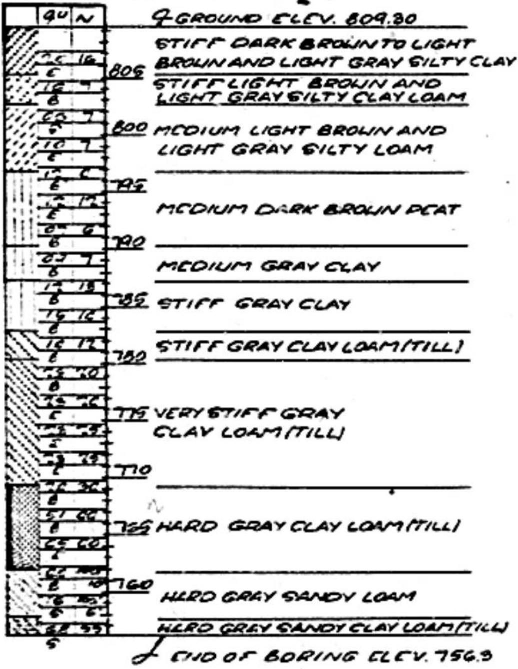
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

1964 Boring Logs

BORING NO. 1

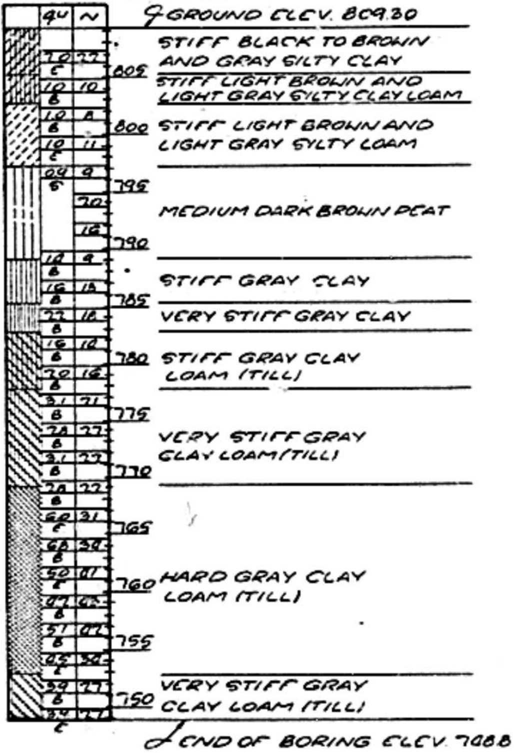
35' RT. OF ℄ STA. 21+15

NO. ABUT. W. BRIDGE



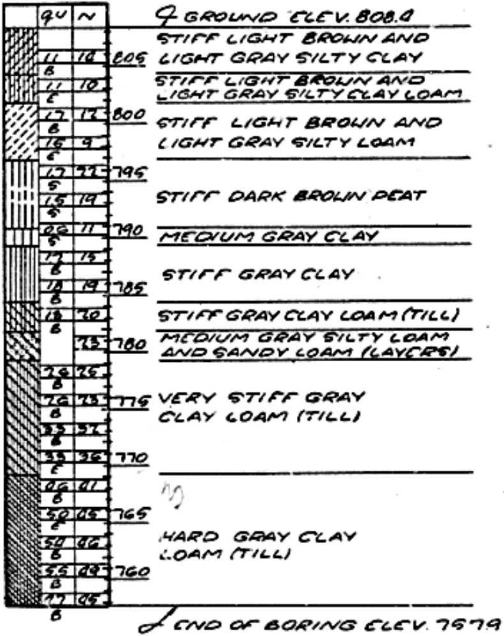
BORING NO. 2

32' LT. OF ℄ STA. 21+15
NO. ABUT. E. BRIDGE



BORING NO. 3

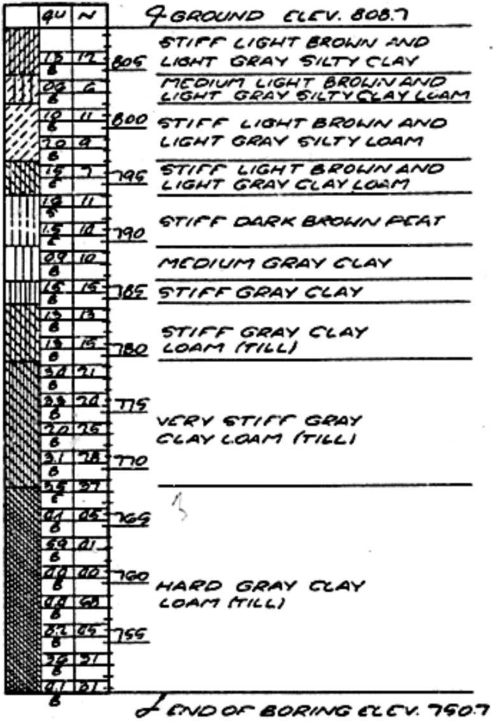
GO' RT. OF ℄ STA 21+71
PIER 1 W. BRIDGE



BORING NO. 4

77' LT. OF ℄ STA. 21+71

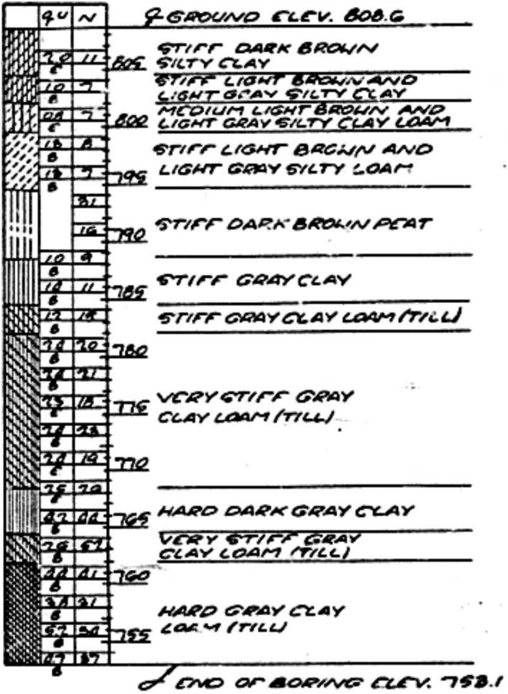
PIER 4 E. BRIDGE



74	97-28 HVB	HENRY
FED. ROAD DIST. NO. 7	ILLINOIS	PROJECT

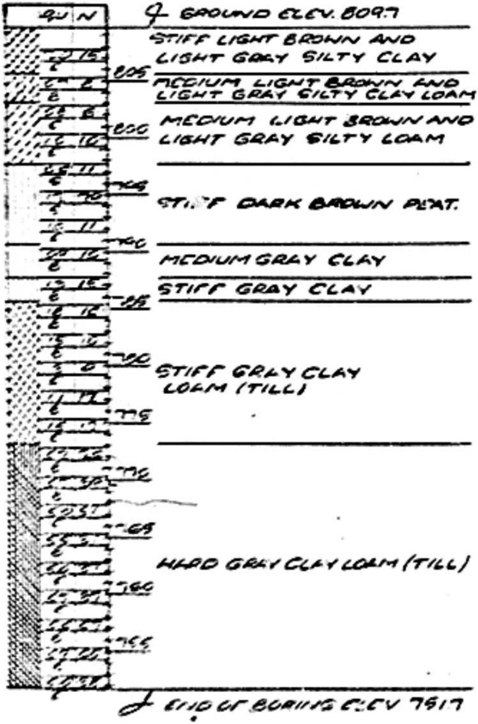
BORING NO. 5

32' RT. OF ℄ STA. 22+39
PIER 2 W. BRIDGE



BORING NO.6

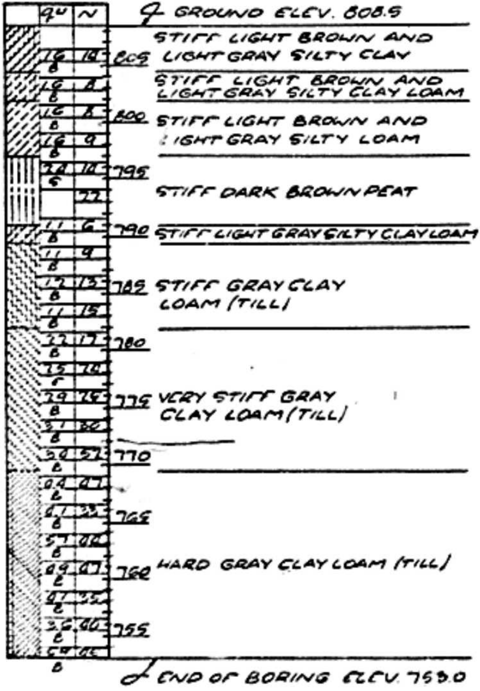
TTLT OF ℄ STA. 22/39
PIER 5 C. BRIDGE



BORING NO. 7

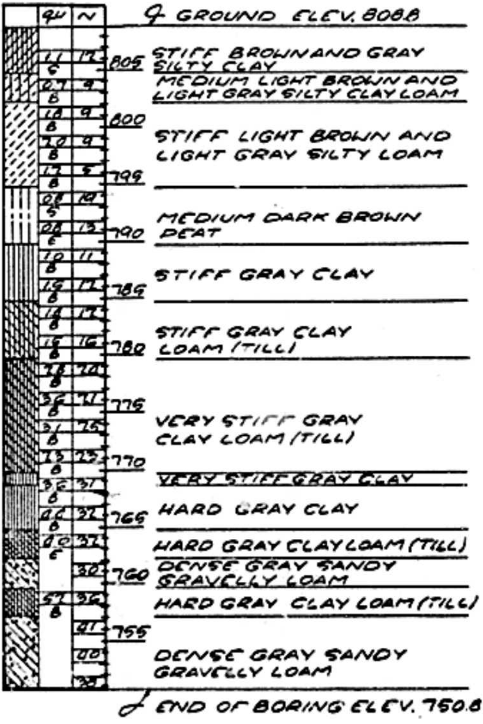
32' RT. OF ℄ STA. 73/07

PIER 3 W. BRIDGE

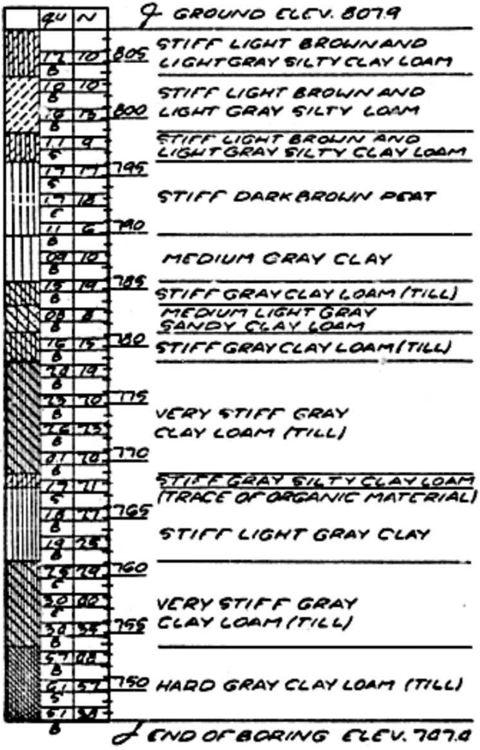


BORING NO. 8

32' LT OF ℄ STA 23+07
PIER 6 E. BRIDGE



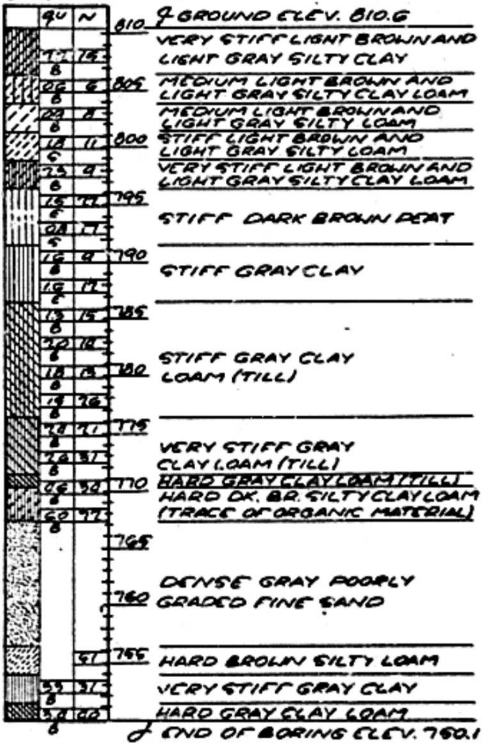
BORING NO.9
65' RT. OF ℄ STA. 73+67
S. ABUT. W. BRIDGE



BORING NO. 10

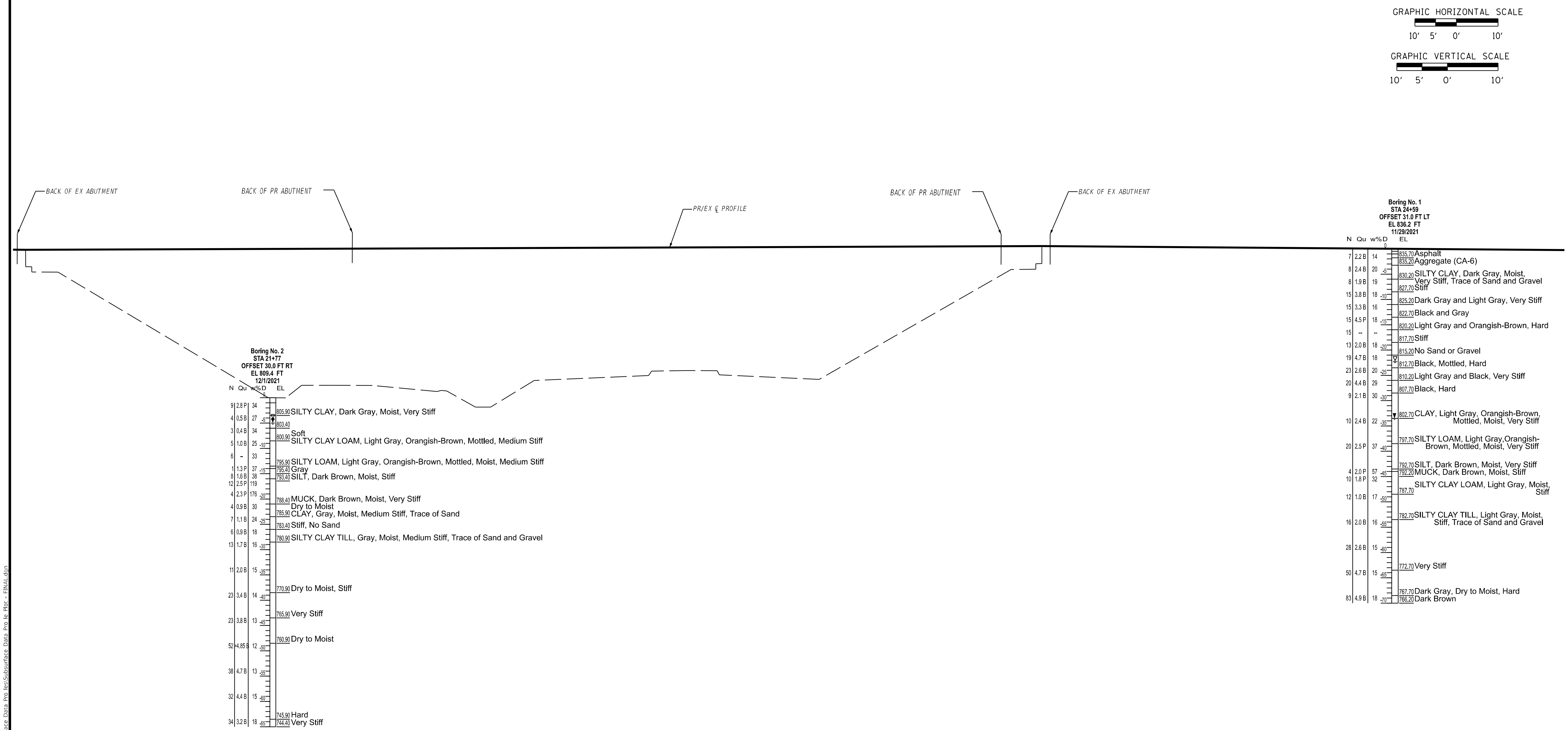
17' LT. OF ℄ STA. 23+62

S. ABUT. C. BRIDGE



APPENDIX C

SUBSURFACE DATA PROFILE PLOT



LEGEND
EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND
▼ = Groundwater Level Upon Completion
∇ = Groundwater Level After __ hours

I-74 OVER IL 17
FAI 74 - SEC. (37-24HVB)BR
HENRY COUNTY
STATION 22+64.70
STRUCTURE NO. 037-0053 (Proposed)

MODEL: Default
FILE NAME: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Dgn\Subsurface Data Pro les\Subsurface Data Pro le Plot - FINAL.dgn

HR	Hurst-Rosche, Inc. 1400 E. TREMONT ST. HILLSBORO, IL PH: 217.532.3959 JOB NO. 192-2211	USER NAME = ealbers	DESIGNED - EJA	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
			DRAWN - EJA	REVISED -	
		PLOT SCALE = 20.0000 ' / in.	CHECKED - -	REVISED -	
		PLOT DATE = 2/15/2022	DATE - 01/11/2022	REVISED -	

SUBSURFACE DATA PROFILE				
SCALE: NONE	SHEET 1 OF 2 SHEETS	STA.	TO STA.	

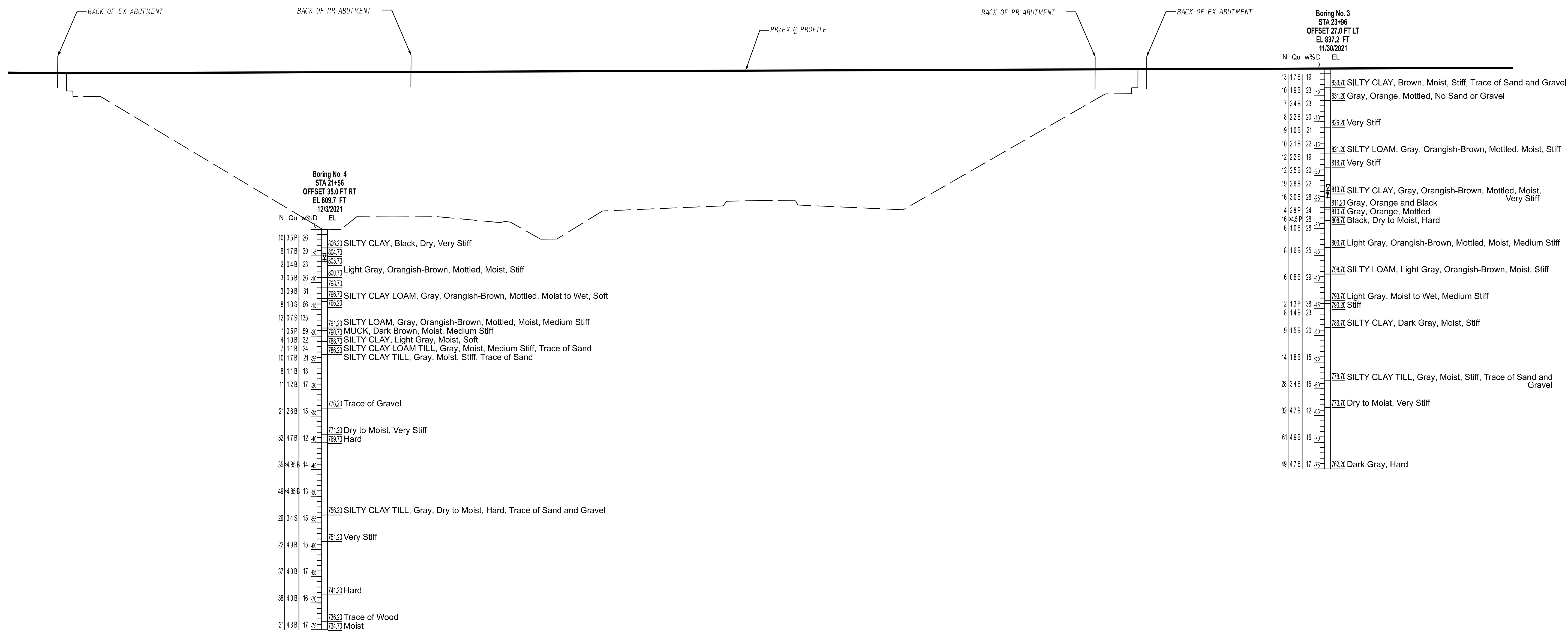
F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	(37-24HVB)BR	HENRY		
		CONTRACT NO. 68510		
		ILLINOIS FED. AID PROJECT		

GRAPHIC HORIZONTAL SCALE

10' 5' 0' 10'

GRAPHIC VERTICAL SCALE

10' 5' 0' 10'



LEGEND
EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND

▼ = Groundwater Level Upon Completion
▽ = Groundwater Level After __ hours

I-74 OVER IL 17
FAI 74 - SEC. (37-24HVB)BR
HENRY COUNTY
STATION 22+64.70
STRUCTURE NO. 037-0049 (Proposed)

MODEL: Default
FILE NAME: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Dgn\Subsurface Data Pro le\Subsurface Data Pro le Plot - FINAL.dgn

Hurst-Rosche, Inc. 1400 E. TREMONT ST. HILLSBORO, IL PH: 217.532.3959 JOB NO. 192-2211	USER NAME = ealbers	DESIGNED - EJA	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	SUBSURFACE DATA PROFILE	
		DRAWN - EJA	REVISED -			
	PLOT SCALE = 20.0000 ' / in.	CHECKED - -	REVISED -			
	PLOT DATE = 2/15/2022	DATE - 01/11/2022	REVISED -		SCALE: NONE	SHEET 2 OF 2 SHEETS STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
74	(37-24HVB)BR	HENRY		
		CONTRACT NO. 68510		
	ILLINOIS FED. AID PROJECT			

APPENDIX D

CONSOLIDATION TEST RESULTS

Silty Clay Loam Layer

CONSOLIDATION TEST

Project: I-74 over IL Route 17

Boring: 4
Depth: 6'2"

Date: January 13, 2022
Sample No.: 1
Classification: Silty Clay Loam, Gray, Orangish-Brown and Bl

	Before Test		After Test
	Specimen	Trimmings	Specimen
Tare No.	Ring + Plates	1	33
Tare + Wet Soil (g)	277.36	70.40	258.49
Tare + Dry Soil (g)	--	61.76	230.50
Water (g)	35.97	8.64	27.99
Tare (g)	119.27	32.42	107.19
Dry Soil (g)	122.12	29.34	123.31
Water Content	--	29.45%	22.70%

Area of Specimen	31.6692 sq. cm
Ht. of Specimen	0.9994 in.
Specific Gravity	2.75
Final Dial Reading	0.1279 inch
Ht. of Solids	0.5521 inch
Orginal Ht. of Water	0.4472 inch
Final Ht. of Water	0.3480 inch
Change in Ht. of Specimen	0.1279 inch
Ht. of Specimen at End of Test	0.8715 inch
Initial Void Ratio	0.8102
Final Void Ratio	0.5785
Initial Saturation	100.0 %
Final Saturation	109.0 %
Initial Dry Density	94.8 pcf
Initial Wet Density	122.7 pcf

CONSOLIDATION TEST

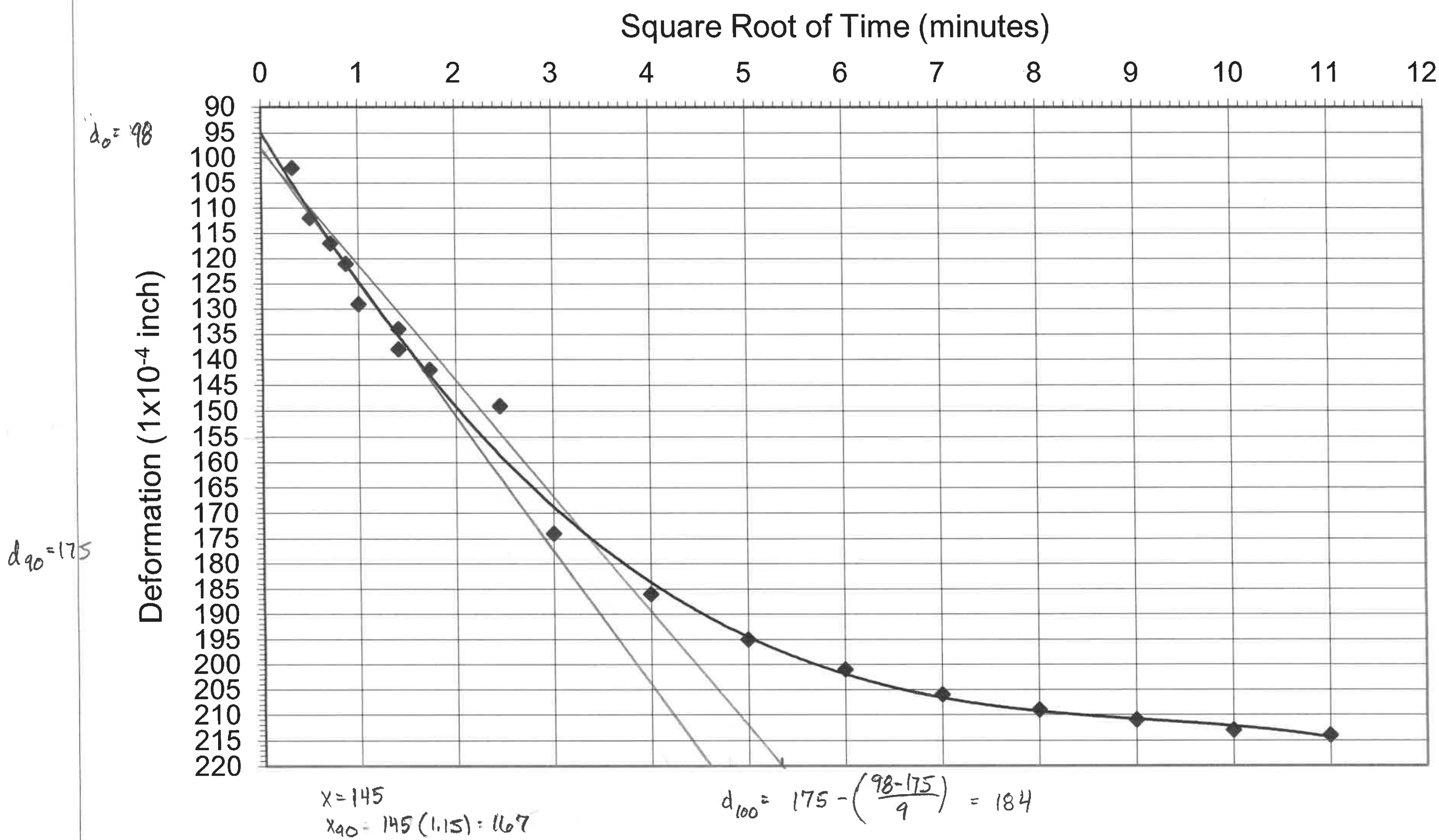
Project: I-74 over IL Route 17

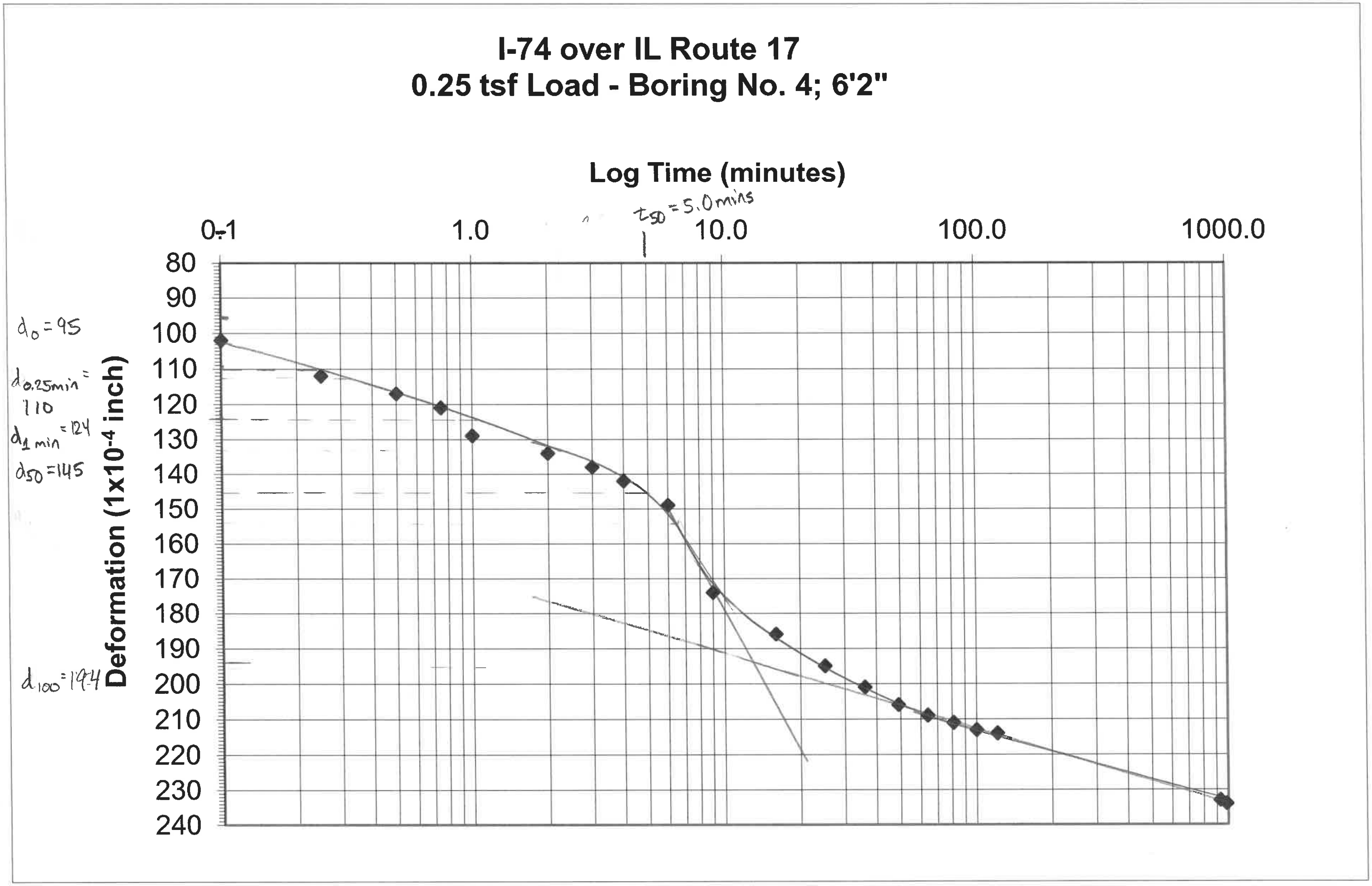
Boring: 4
Depth: 6'2"

Date: January 13, 2022
Sample No.: 1
Classification: Silty Clay Loam, Gray, Orangish-Brown and Bl

Pressure (TSF)	D_{100} (inch x 10^{-4})	D_{50} (inch x 10^{-4})	Void Ratio	t_{50} (min)	c_v in^2/min
0.25	194	144	0.775	5.0	0.0096
0.5	377	334	0.742	8.0	0.0057
1	638	582	0.695	3.0	0.0145
2	882	810	0.650	3.3	0.0126
4	1107	1008	0.610	2.2	0.0181
8	1354	1254	0.565	2.1	0.0179
4	1370	--	0.562	--	--
2	1355	--	0.565	--	--
1	1332	--	0.569	--	--
0.5	1316	--	0.572	--	--
0.25	1283	--	0.578	--	--

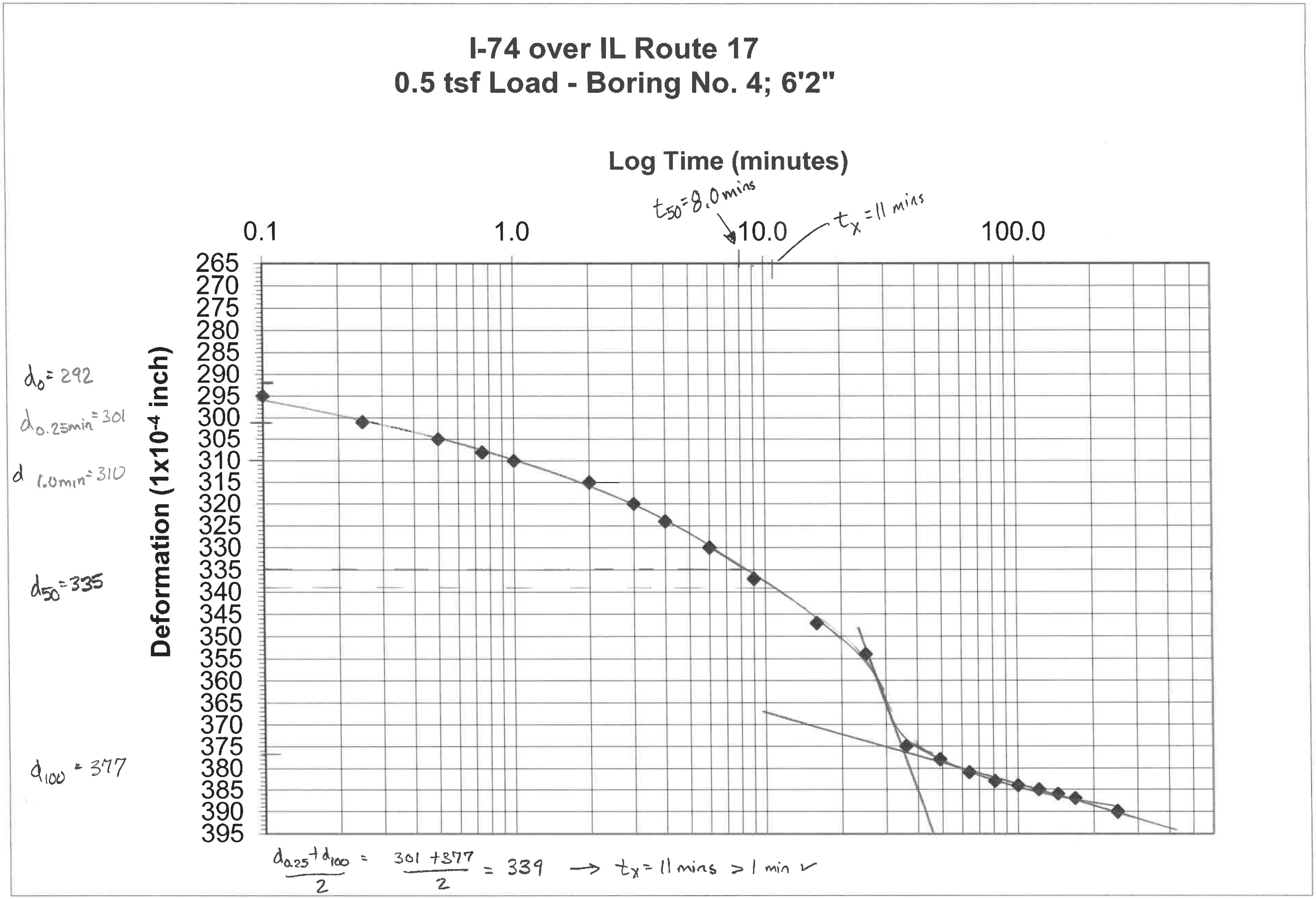
I-74 over IL Route 17
0.25 tsf Load - Boring No. 4; 6'2"





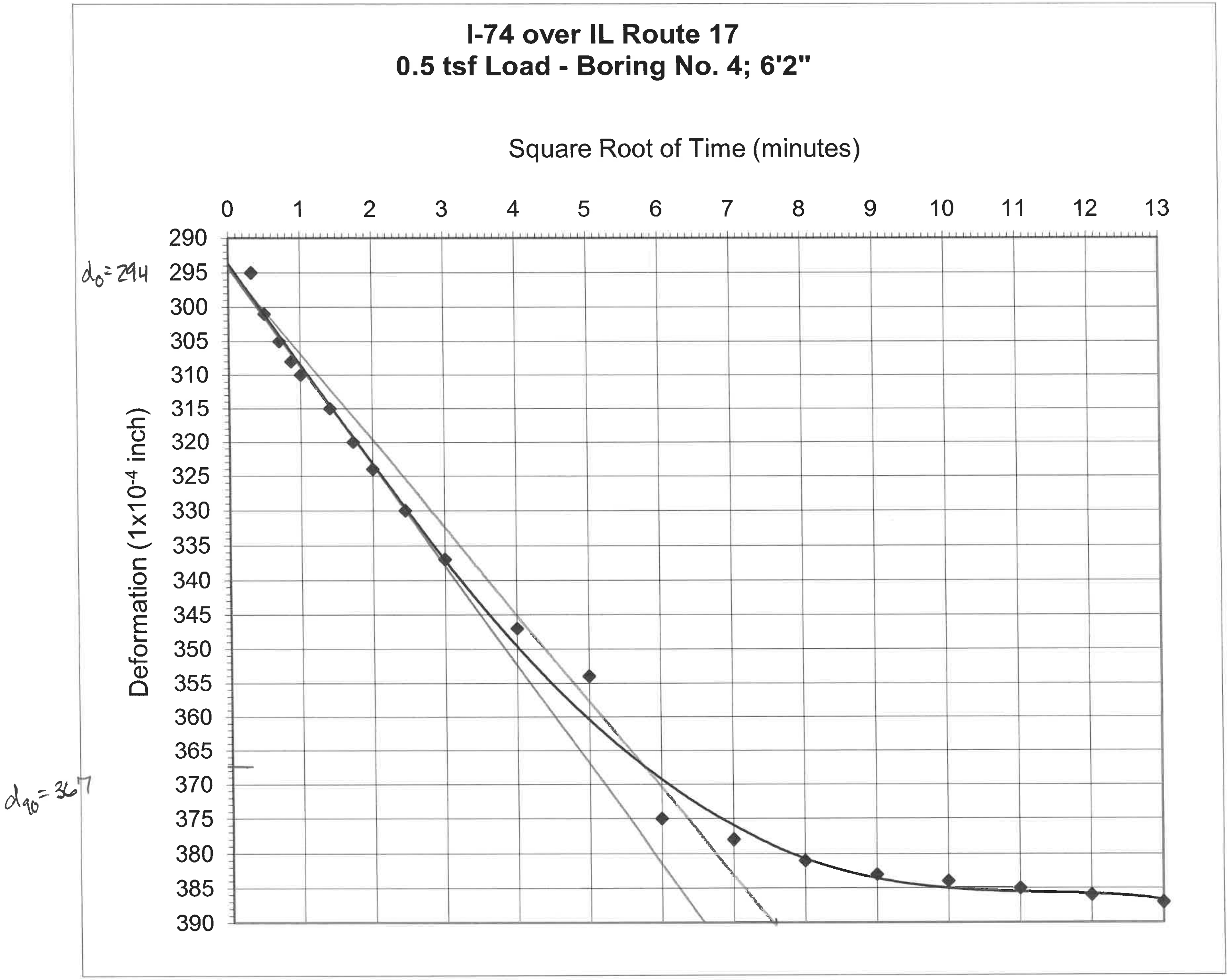
$d_{0.25min} = 110$ $d_{0.25min} + d_{100} \div 2 = 153 \rightarrow t_1 = 6.4 > 1$ ✓ $d_0 = 95$

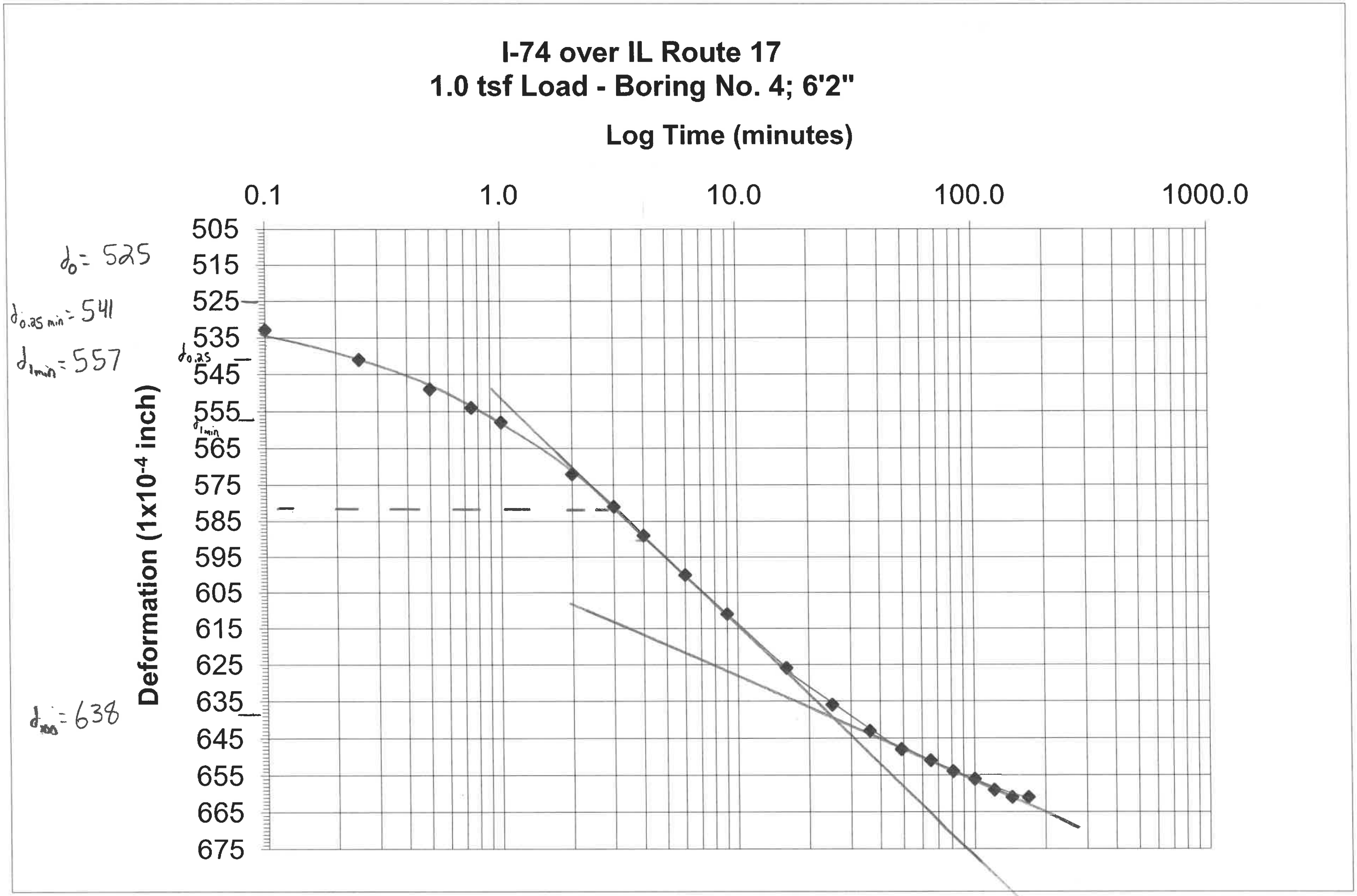
$d_{100} = 194$ $d_{50} = \frac{95+194}{2} = 145 \rightarrow t_{50} = 5.0$ mins



$d_0 = 292$ $\quad d_{50} = \frac{292+377}{2} = 335$

$d_{100} = 377$


I-74 over IL Route 17
0.5 tsf Load - Boring No. 4; 6'2"
Square Root of Time (minutes)
0 1 2 3 4 5 6 7 8 9 10 11 12 13
Deformation (1x10-4 inch)
290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390
d0=294
d90=367



$d_{0.25\,min} = 541$

$d_{100} = 638$

$$\frac{d_{0.25\,min} + d_{100}}{2} = 590$$

$t_1 = 4 > 1$ ✓

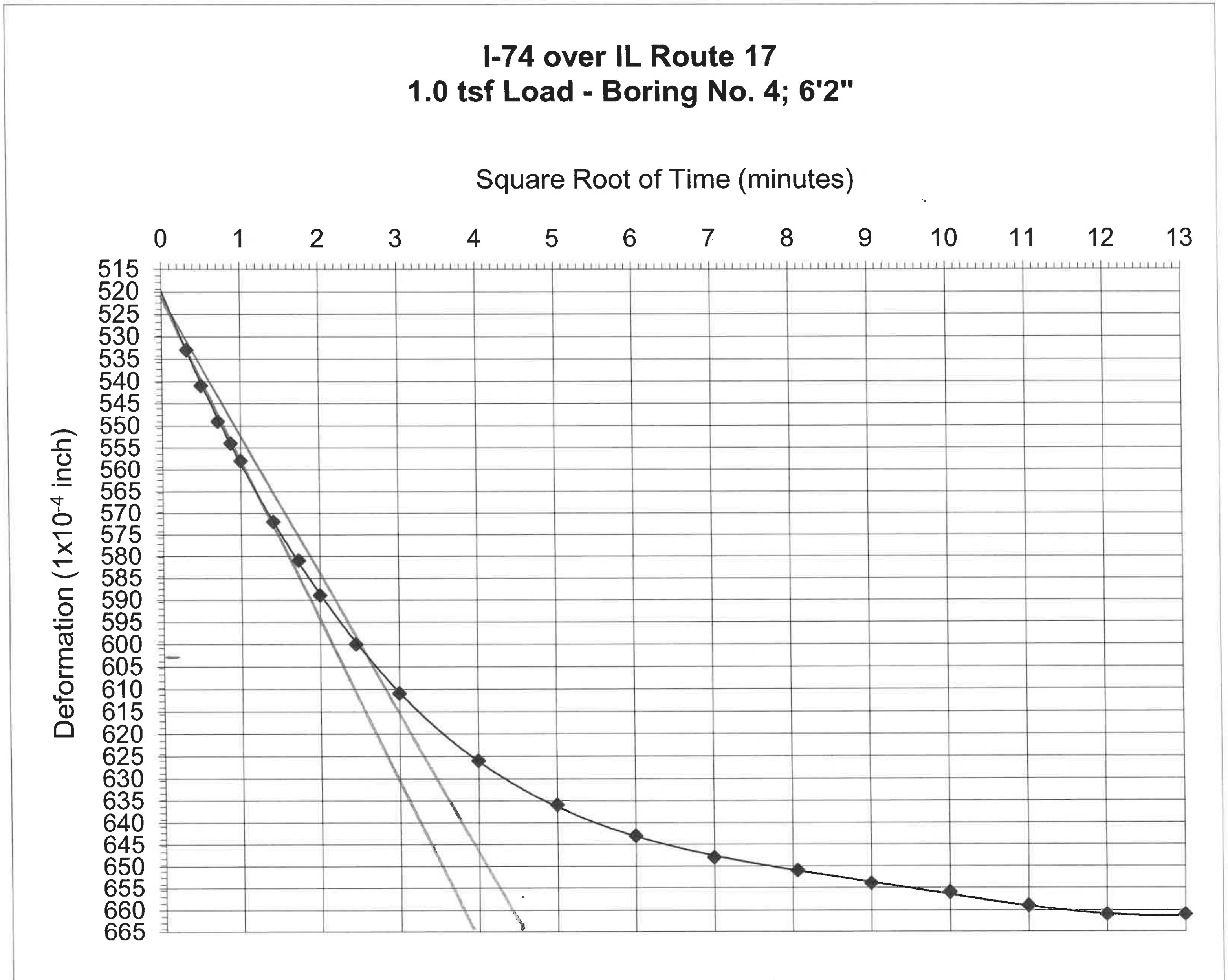
$$d_{50} = \frac{525 + 638}{2}$$

$d_{50} = 582$

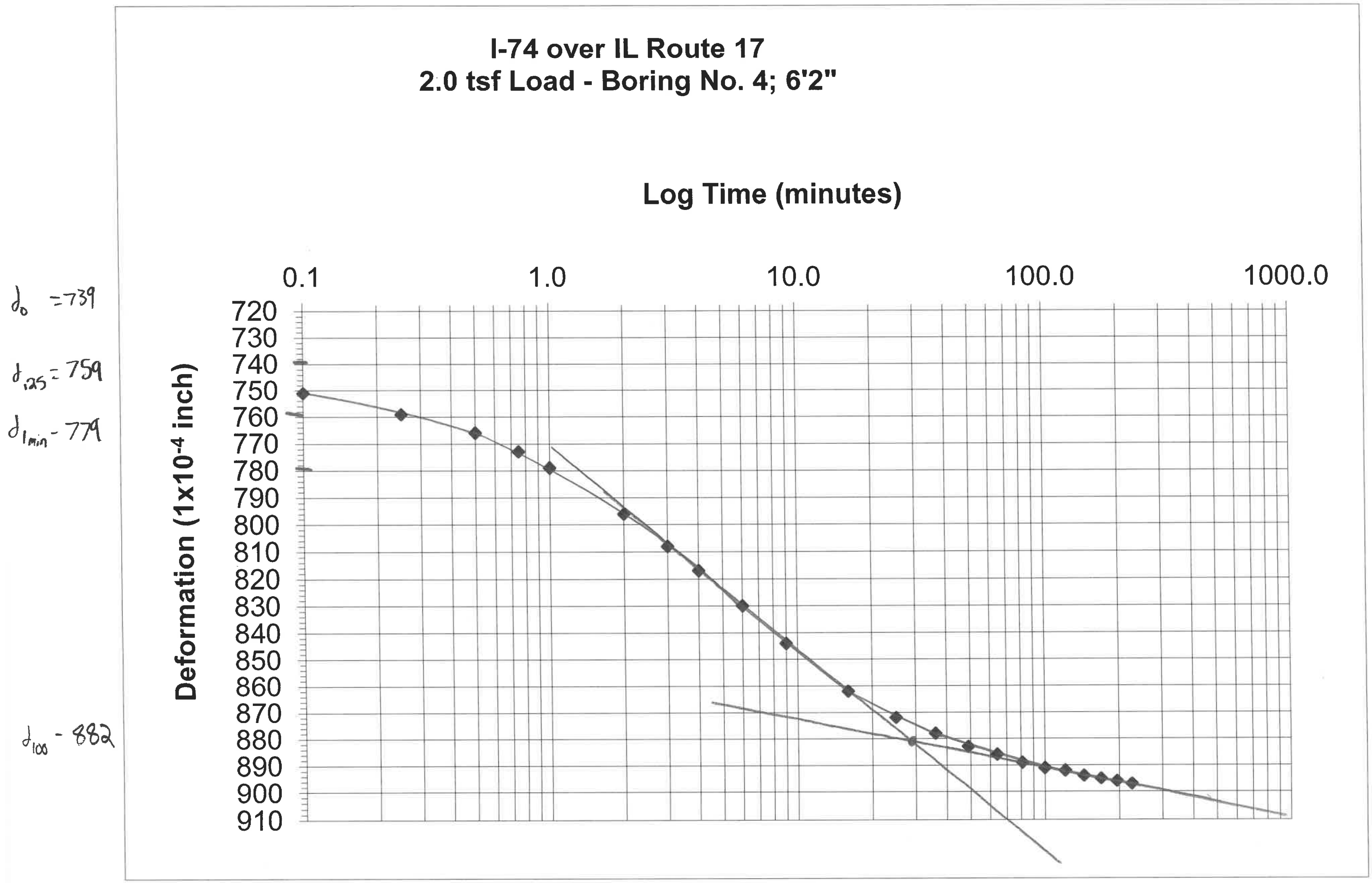
$t_{50} = 3$ min

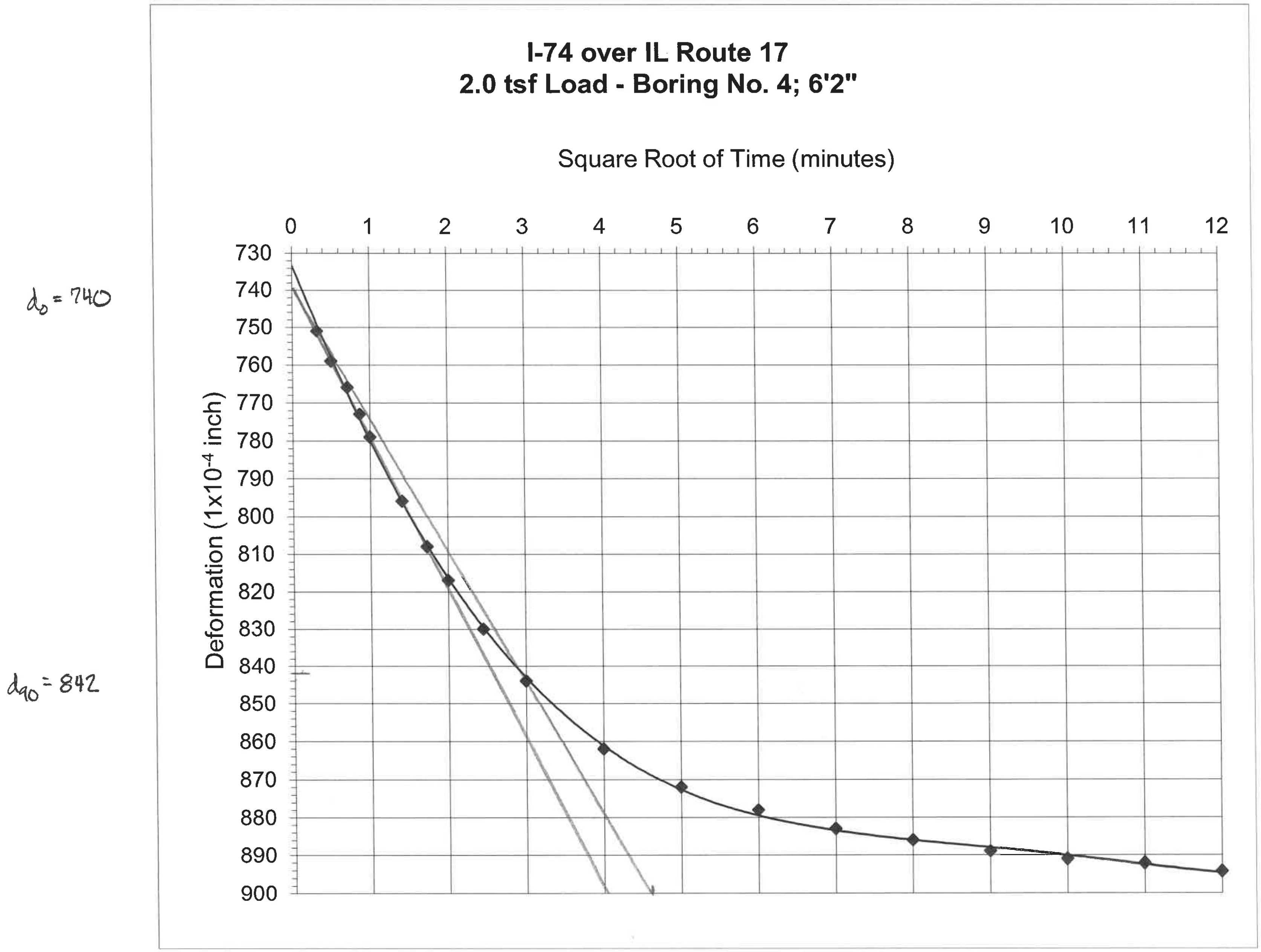
$d_0 = 521$

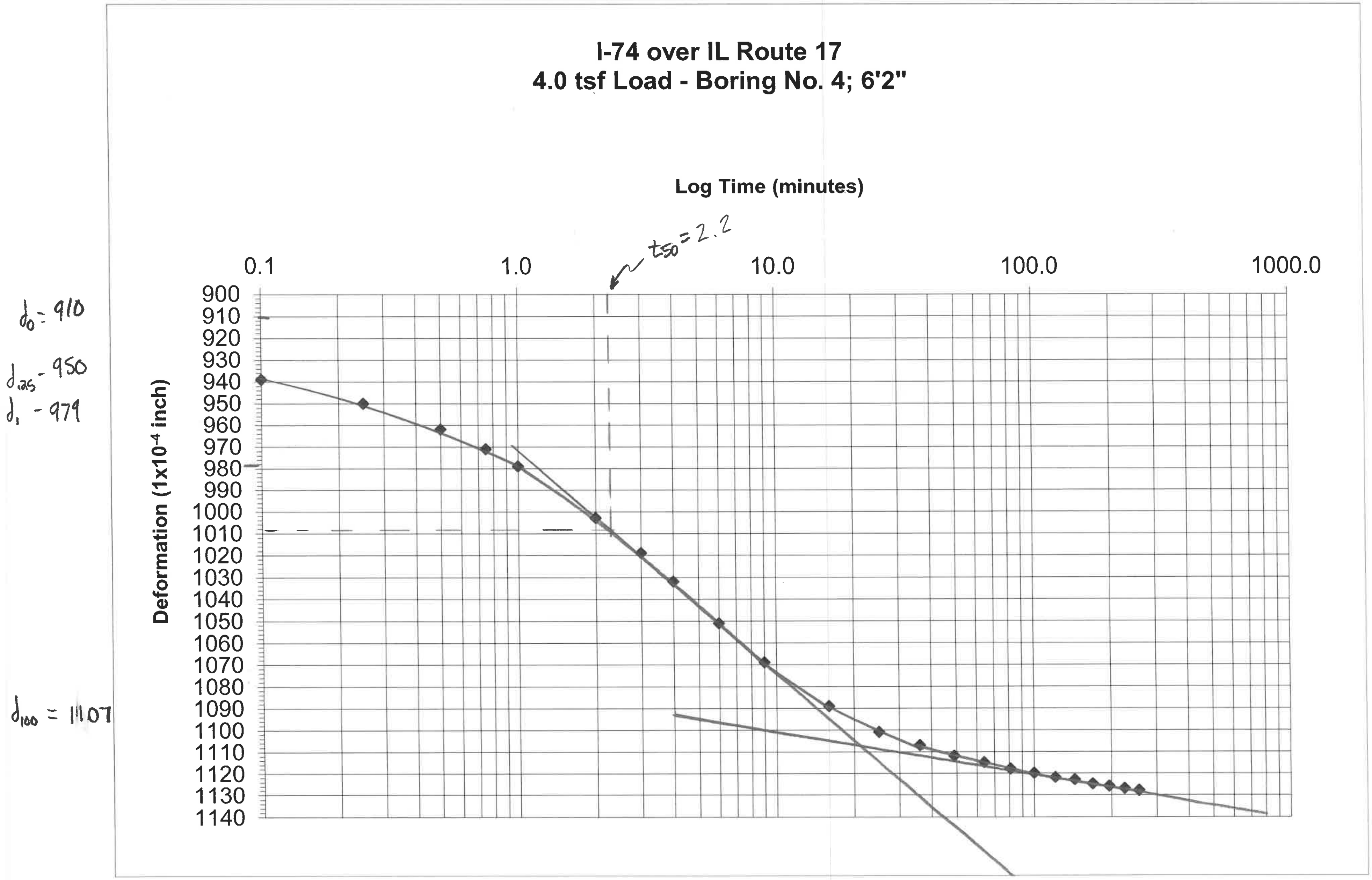
$d_{90} = 603$



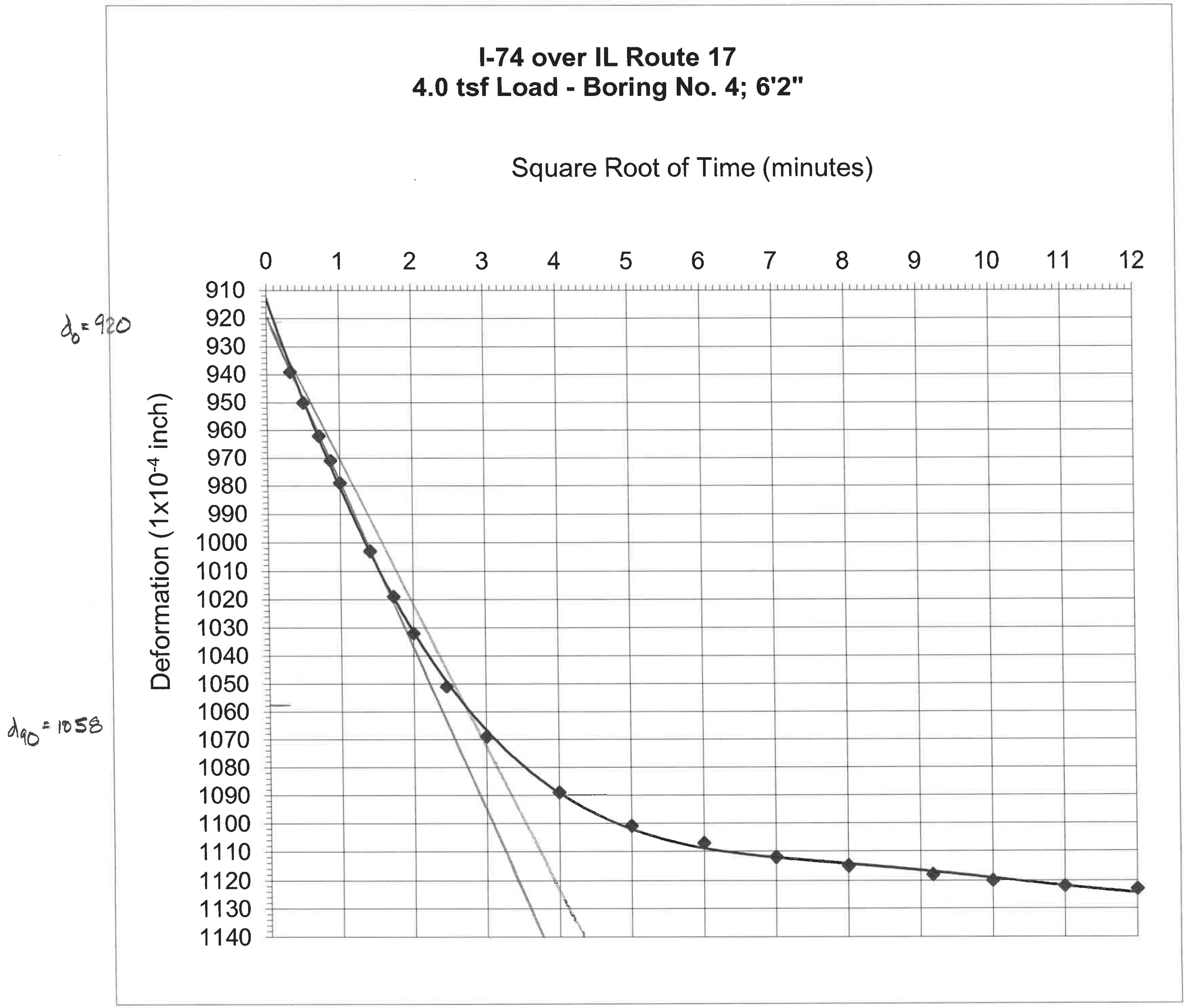
$d_{100} = d_{90} - \left(\frac{d_0 - d_{90}}{9}\right)$ $d_{100} = 603 - \left(\frac{521 - 603}{9}\right) \rightarrow 612.1 = d_{100}$

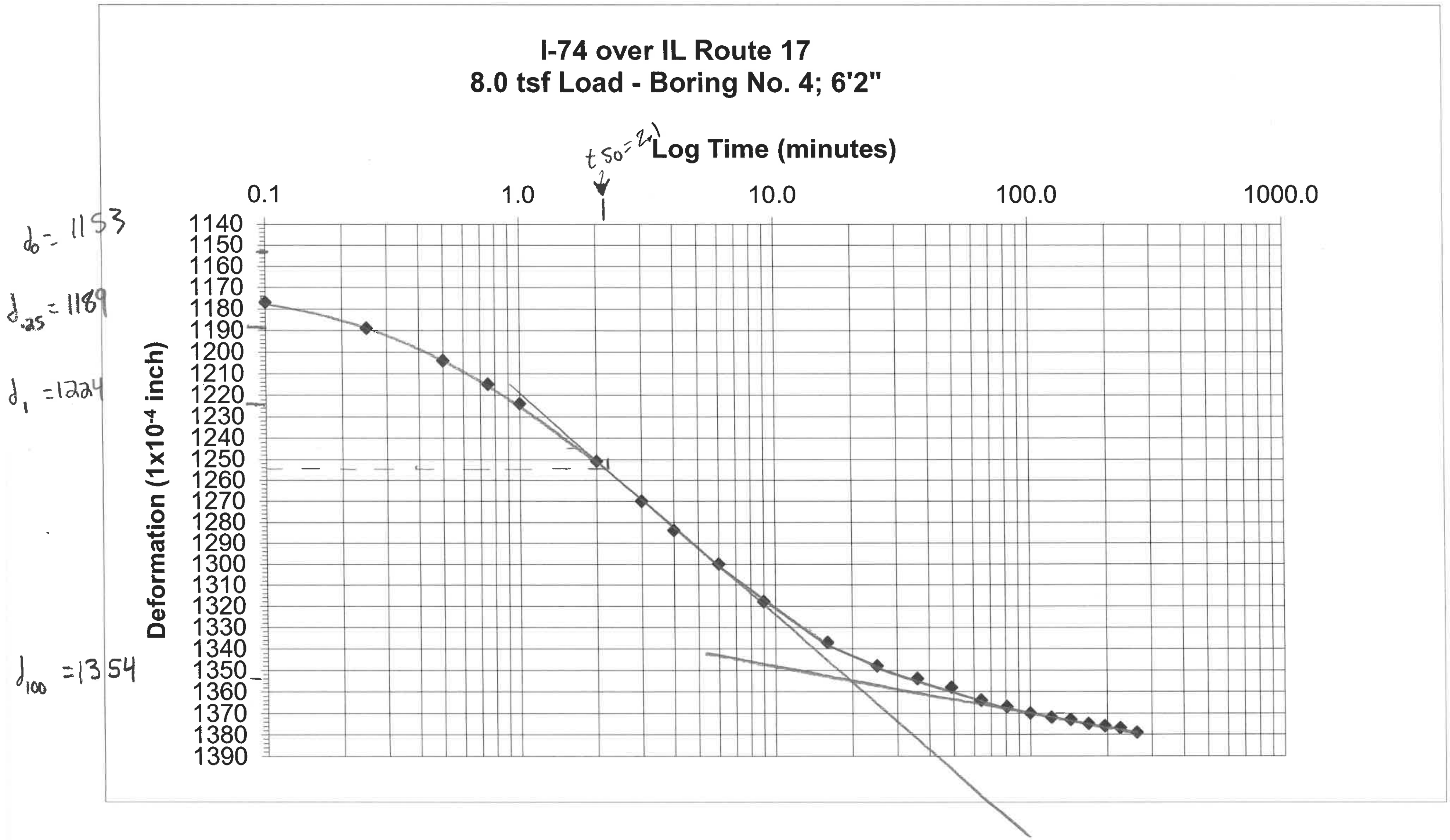

d0 = 739
d.25 = 759
d1min - 779
d100 - 882
I-74 over IL Route 17
2.0 tsf Load - Boring No. 4; 6'2"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
720
730
740
750
760
770
780
790
800
810
820
830
840
850
860
870
880
890
900
910

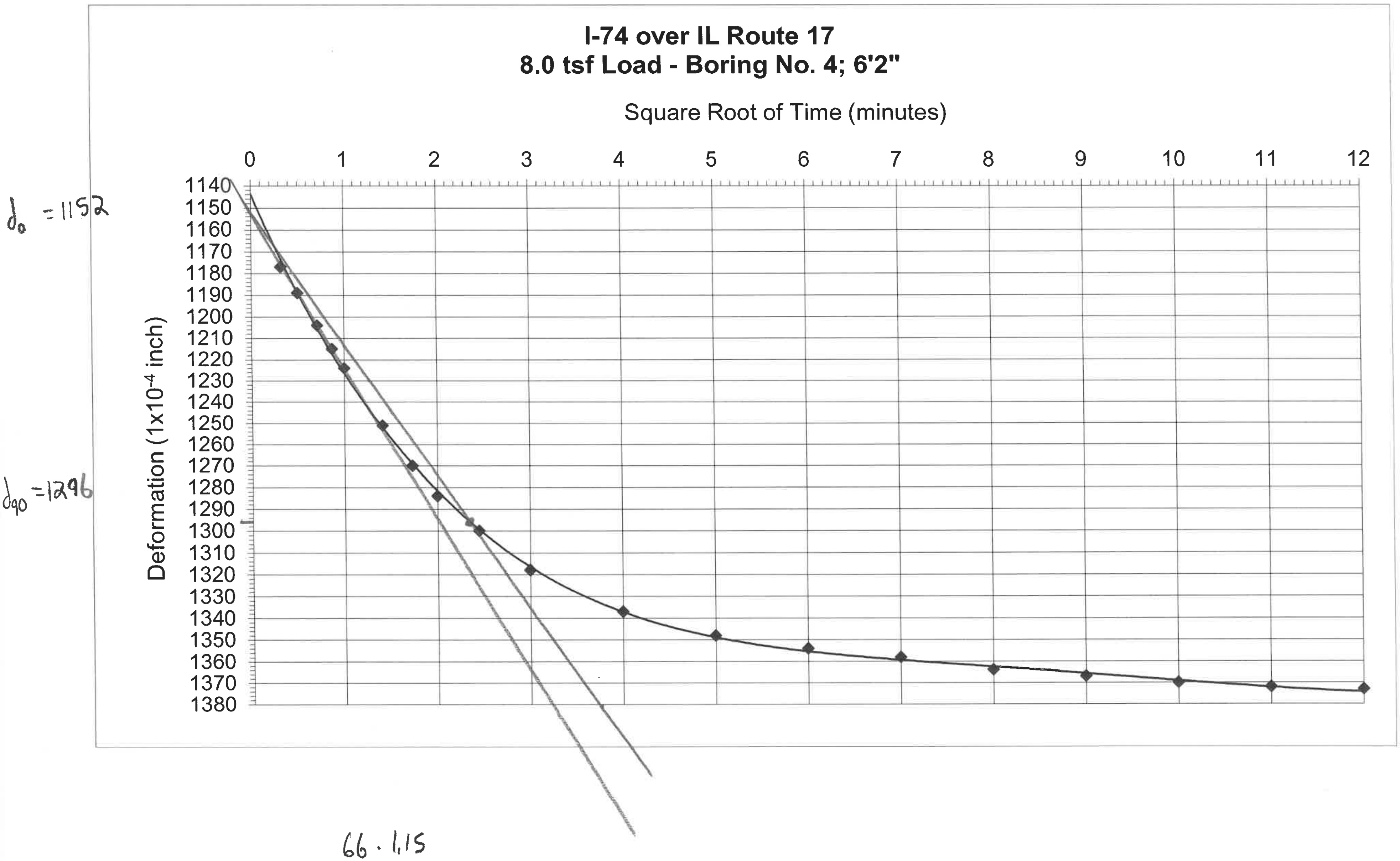

I-74 over IL Route 17
2.0 tsf Load - Boring No. 4; 6'2"
Square Root of Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
11
12
Deformation (1x10-4 inch)
730
740
750
760
770
780
790
800
810
820
830
840
850
860
870
880
890
900
d0 = 740
d90 = 842



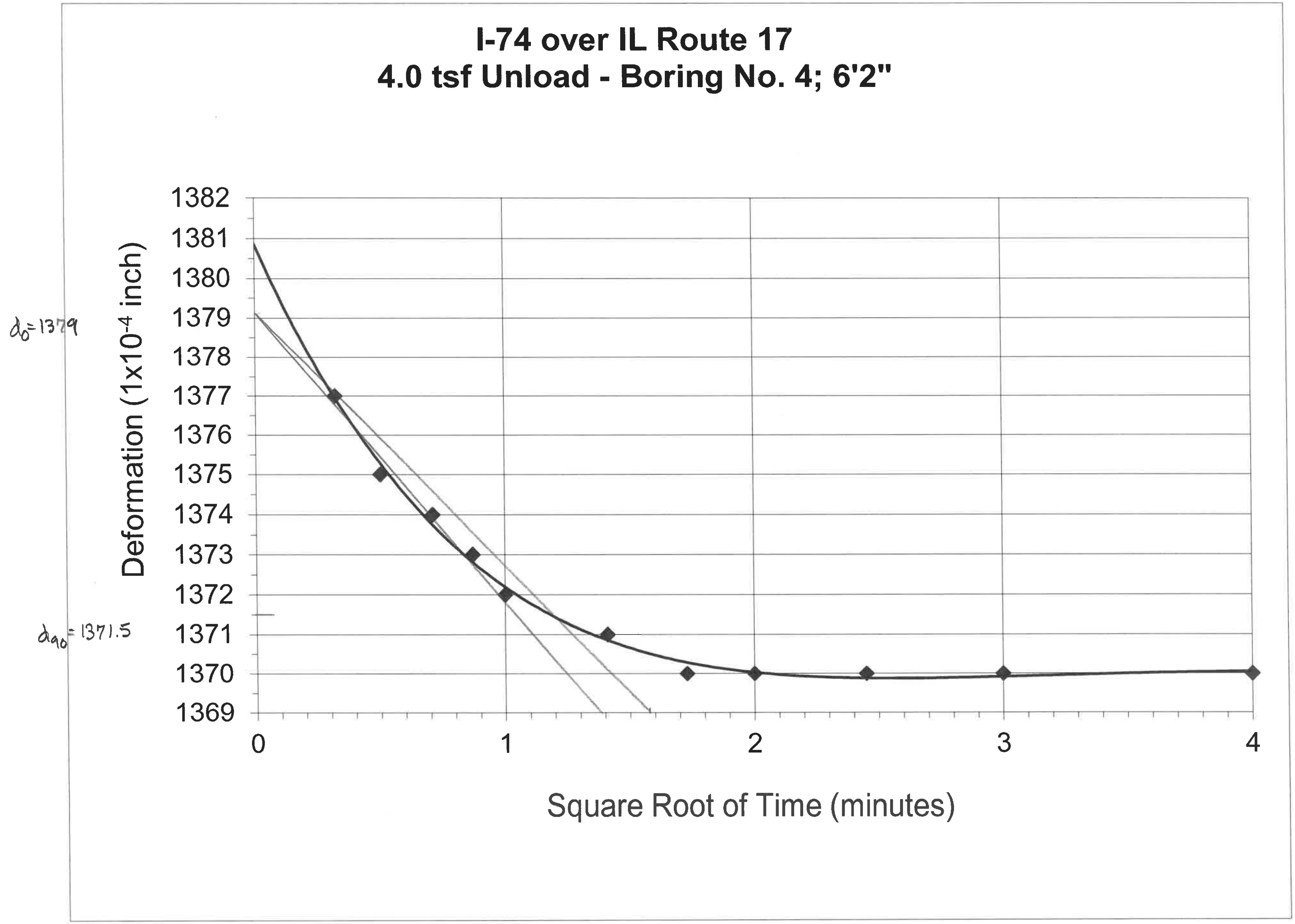
I-74 over IL Route 17
4.0 tsf Load - Boring No. 4; 6'2"
Log Time (minutes)
t50 = 2.2
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
900
910
920
930
940
950
960
970
980
990
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100
1110
1120
1130
1140
d0 = 910
d.25 - 950
d1 - 979
d100 = 1107


I-74 over IL Route 17
4.0 tsf Load - Boring No. 4; 6'2"
Square Root of Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
11
12
Deformation (1x10-4 inch)
910
920
930
940
950
960
970
980
990
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100
1110
1120
1130
1140
d0=920
d90=1058

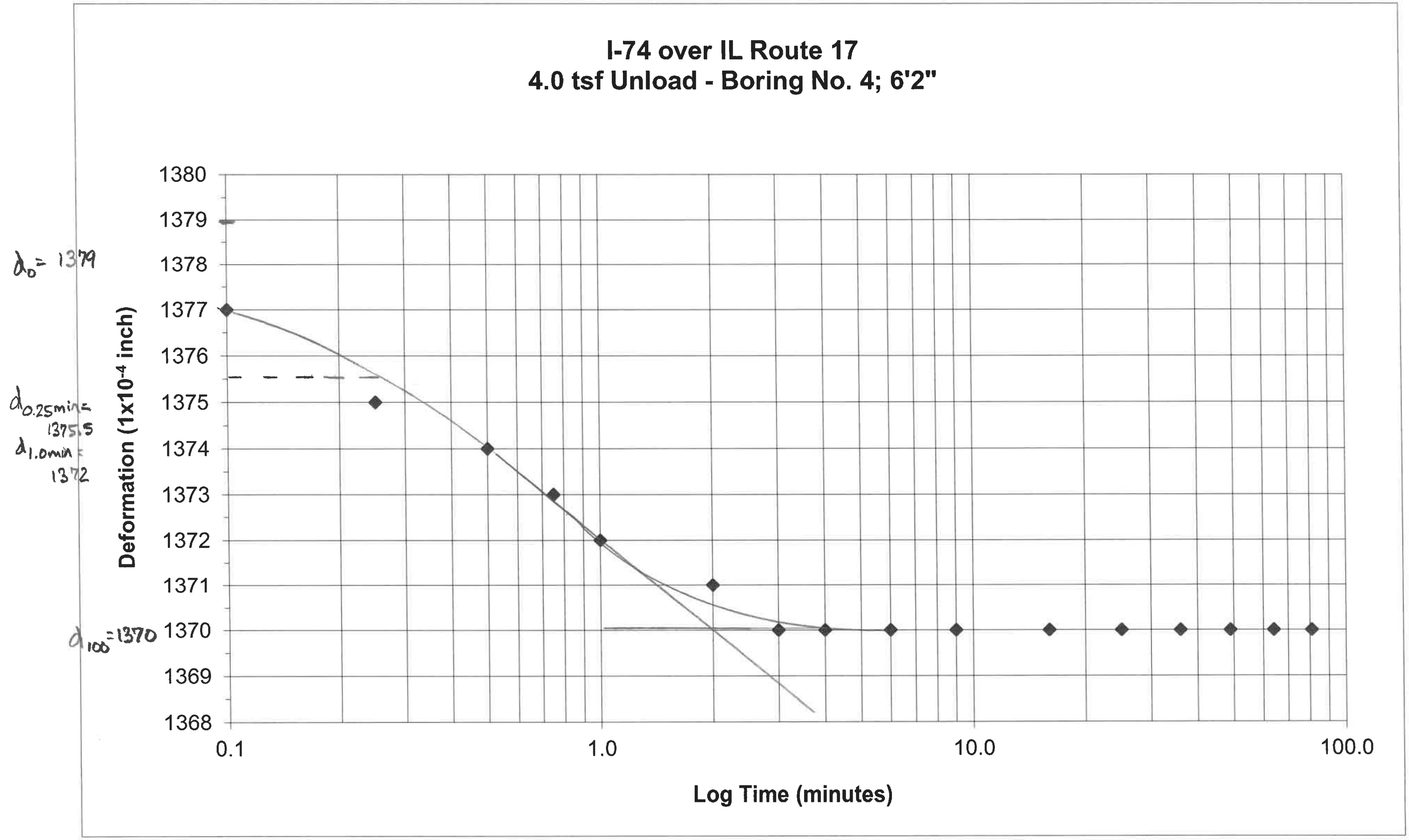

I-74 over IL Route 17
8.0 tsf Load - Boring No. 4; 6'2"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
1140
1150
1160
1170
1180
1190
1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
1300
1310
1320
1330
1340
1350
1360
1370
1380
1390
d0 = 1153
d.25 = 1189
d1 = 1224
d100 = 1354
t50 = 2.1

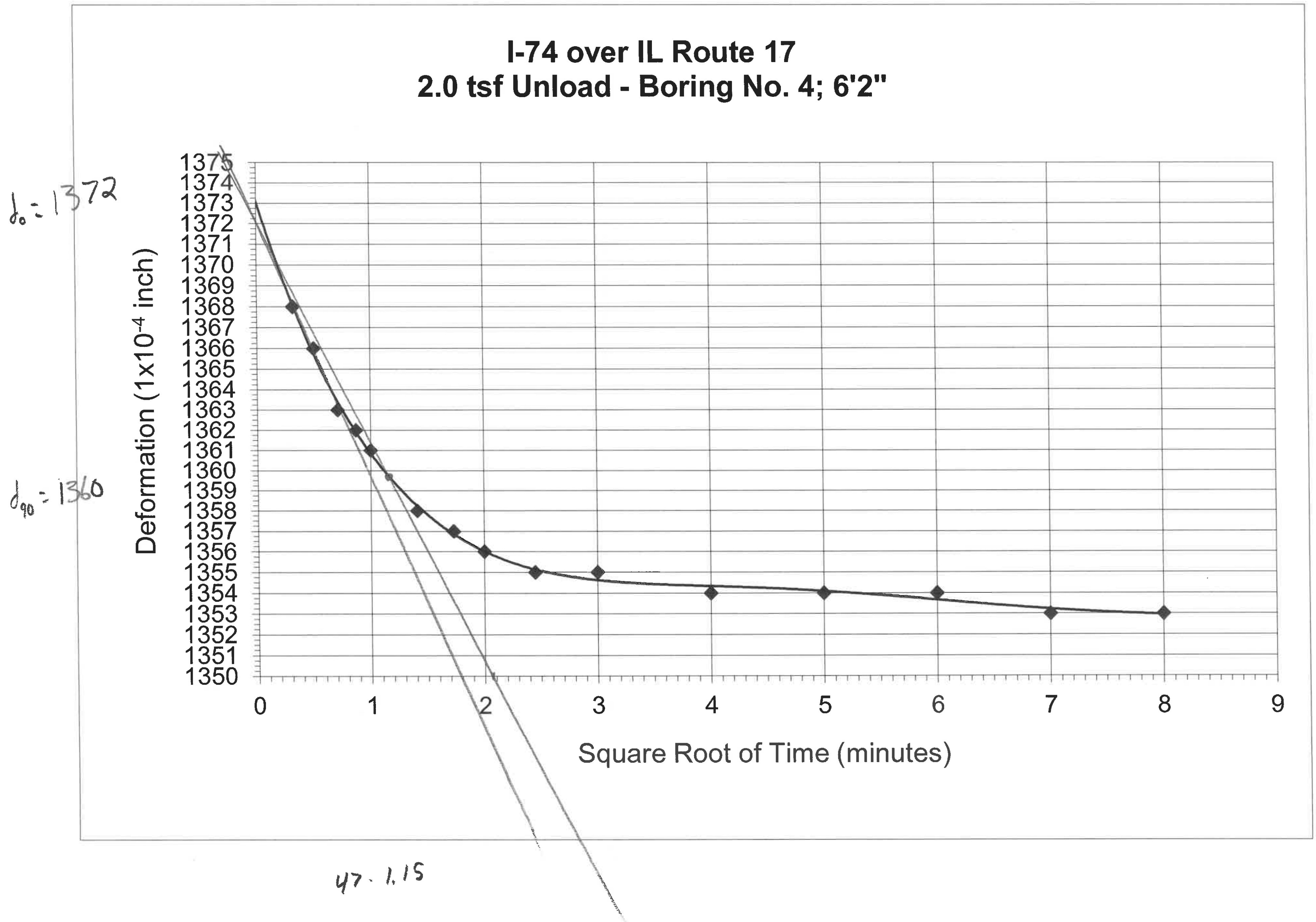


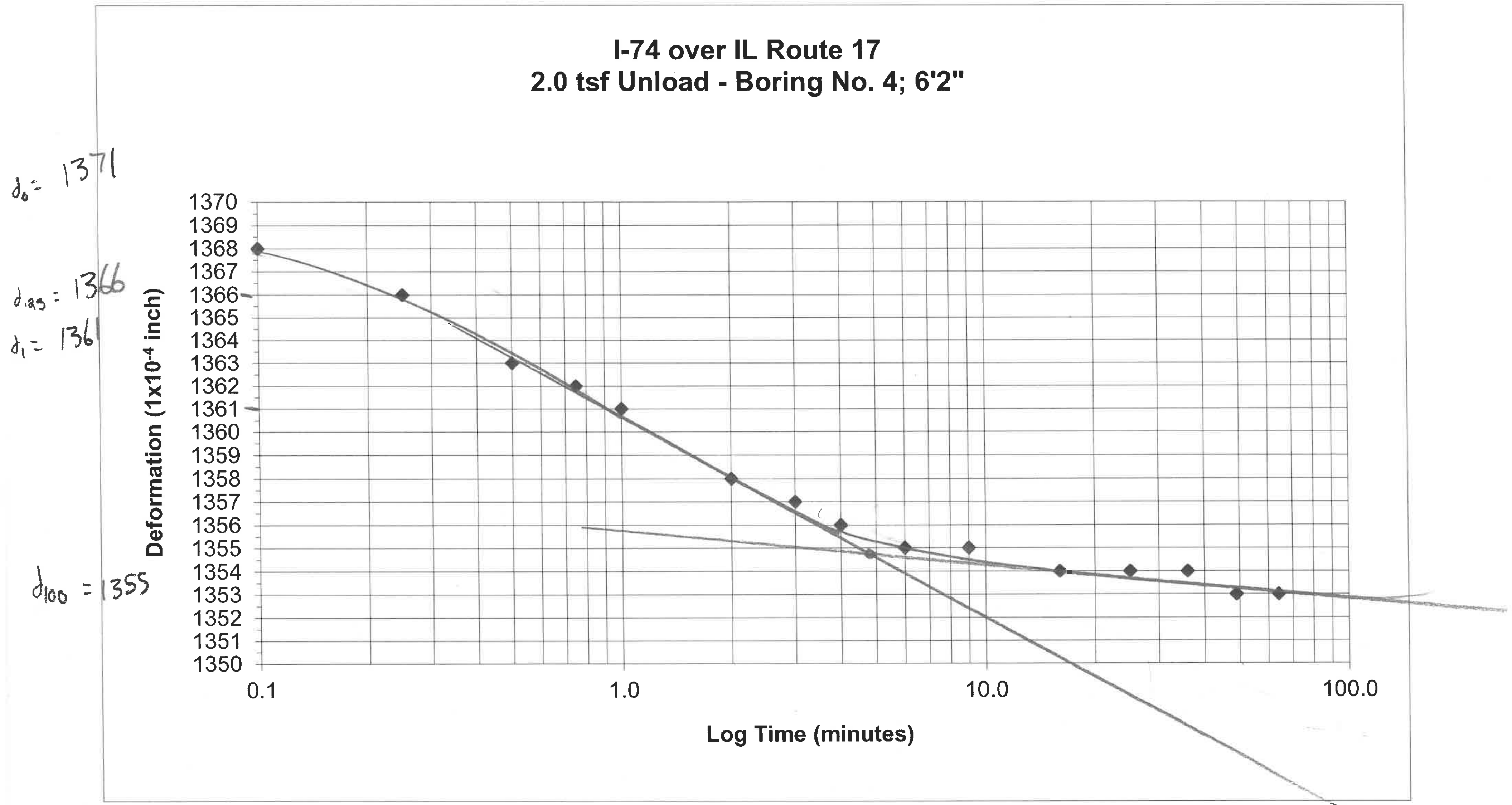
I-74 over IL Route 17
8.0 tsf Load - Boring No. 4; 6'2"
Square Root of Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
11
12
Deformation ($1x10^{-4}$ inch)
1140
1150
1160
1170
1180
1190
1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
1300
1310
1320
1330
1340
1350
1360
1370
1380
d_o = 1152
d_{90} = 1296
66 · 1.15



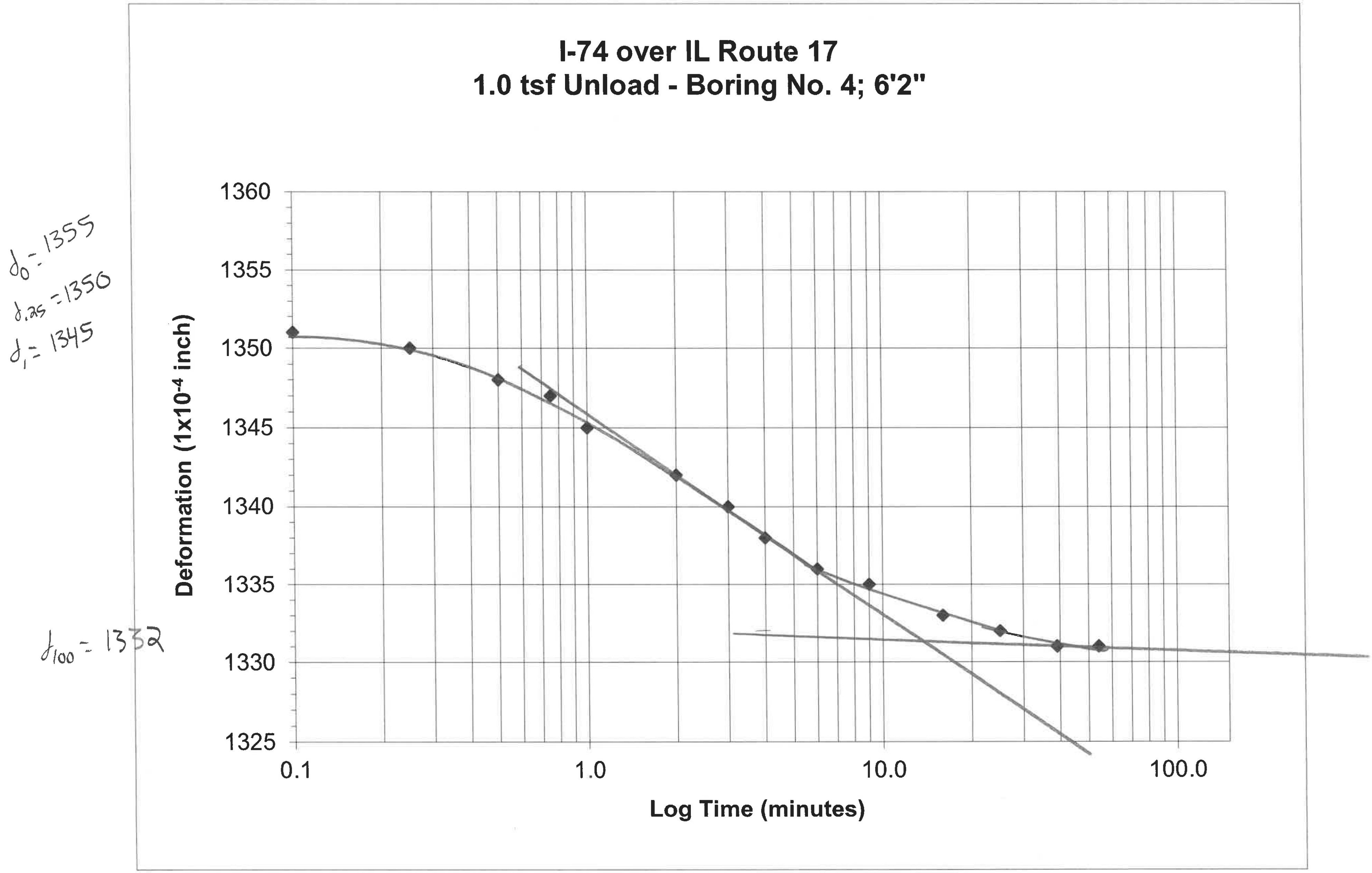
I-74 over IL Route 17
4.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
Square Root of Time (minutes)
1382
1381
1380
1379
1378
1377
1376
1375
1374
1373
1372
1371
1370
1369
0
1
2
3
4
d0=1379
d90=1371.5

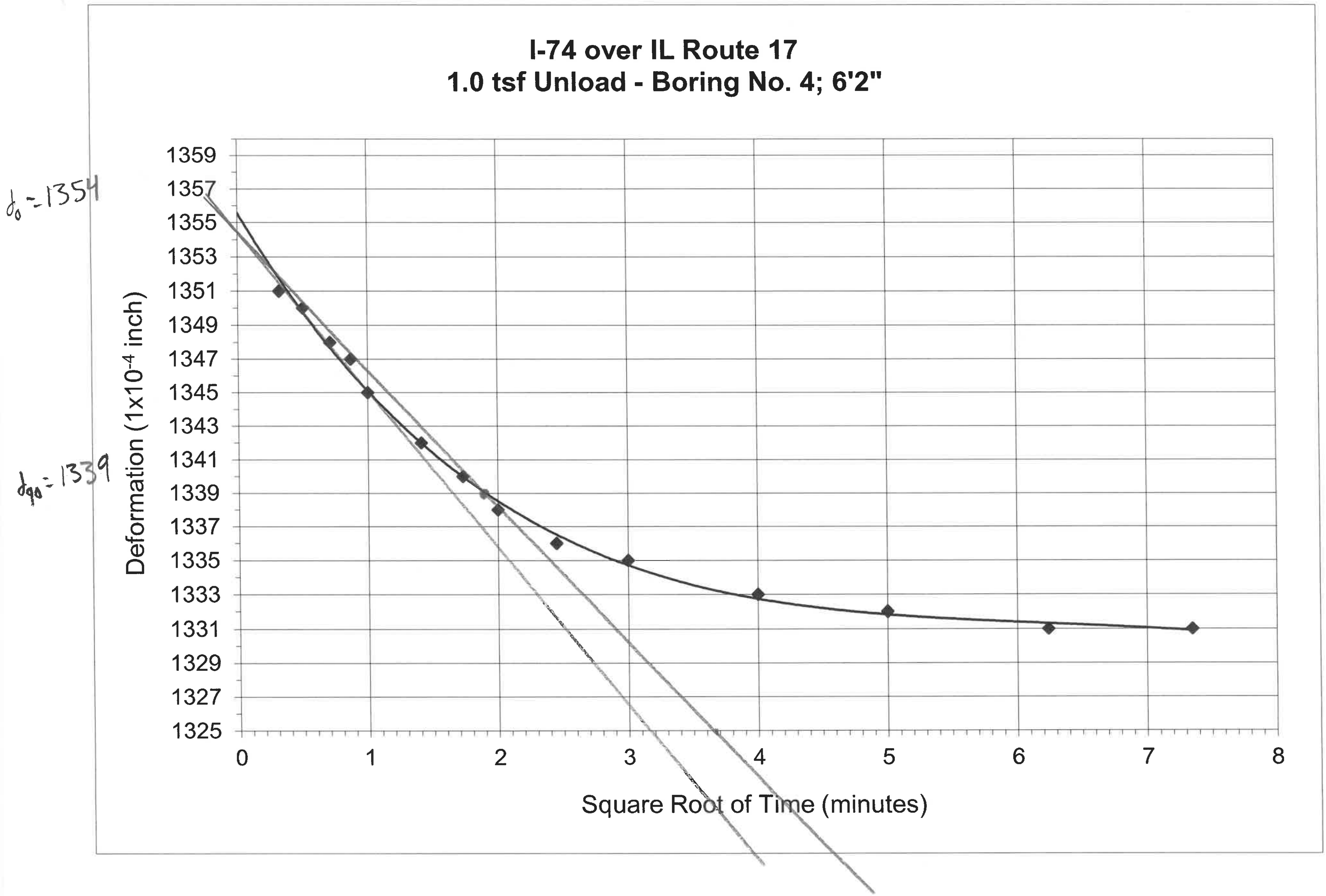

I-74 over IL Route 17
4.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
1380
1379
1378
1377
1376
1375
1374
1373
1372
1371
1370
1369
1368
0.1
1.0
10.0
100.0
Log Time (minutes)
d0= 1379
d0.25min= 1375.5
d1.0min= 1372
d100=1370

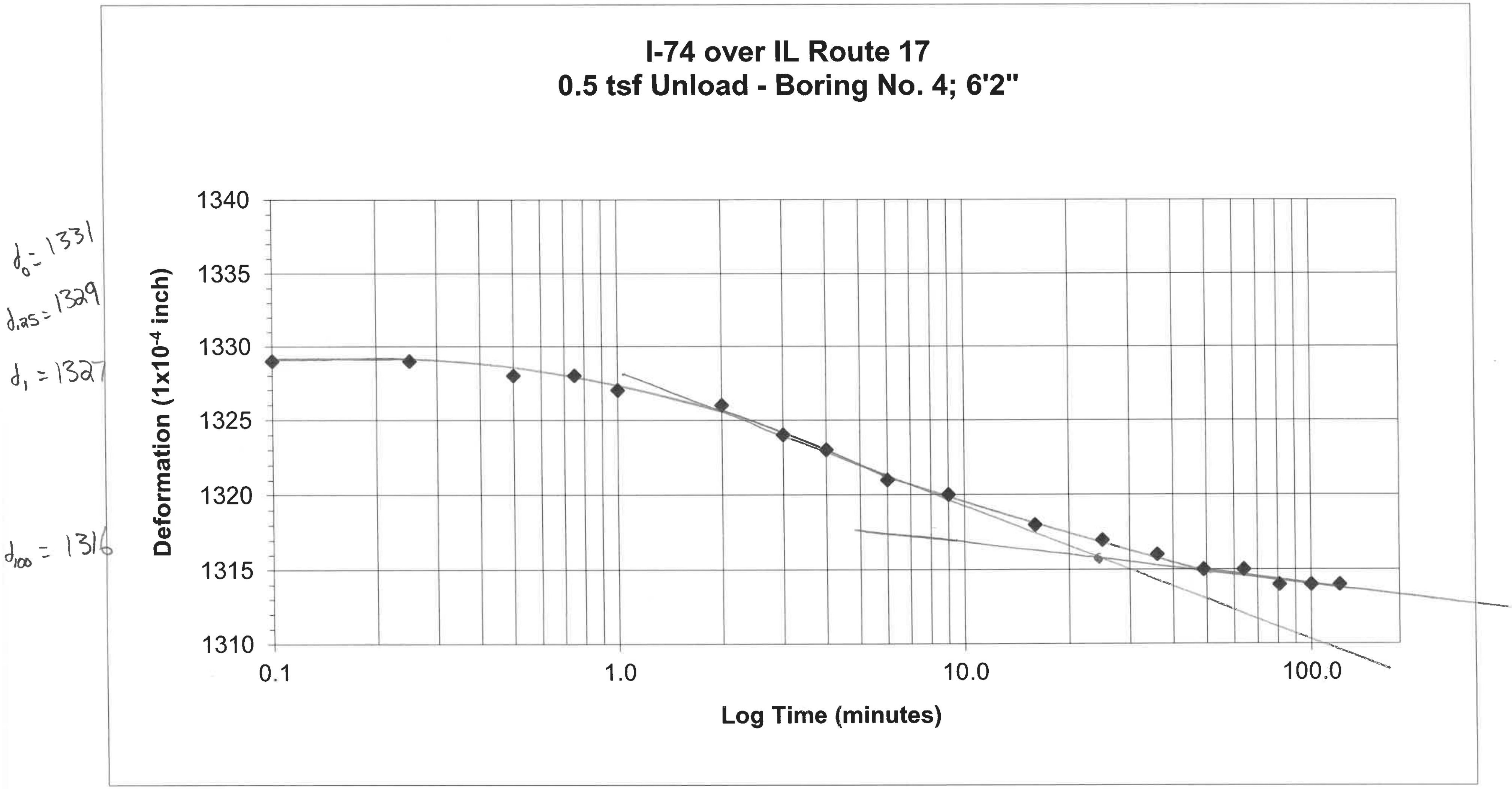

I-74 over IL Route 17
2.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
1375
1374
1373
1372
1371
1370
1369
1368
1367
1366
1365
1364
1363
1362
1361
1360
1359
1358
1357
1356
1355
1354
1353
1352
1351
1350
0
1
2
3
4
5
6
7
8
9
Square Root of Time (minutes)
d0 = 1372
d90 = 1360
47 · 1.15



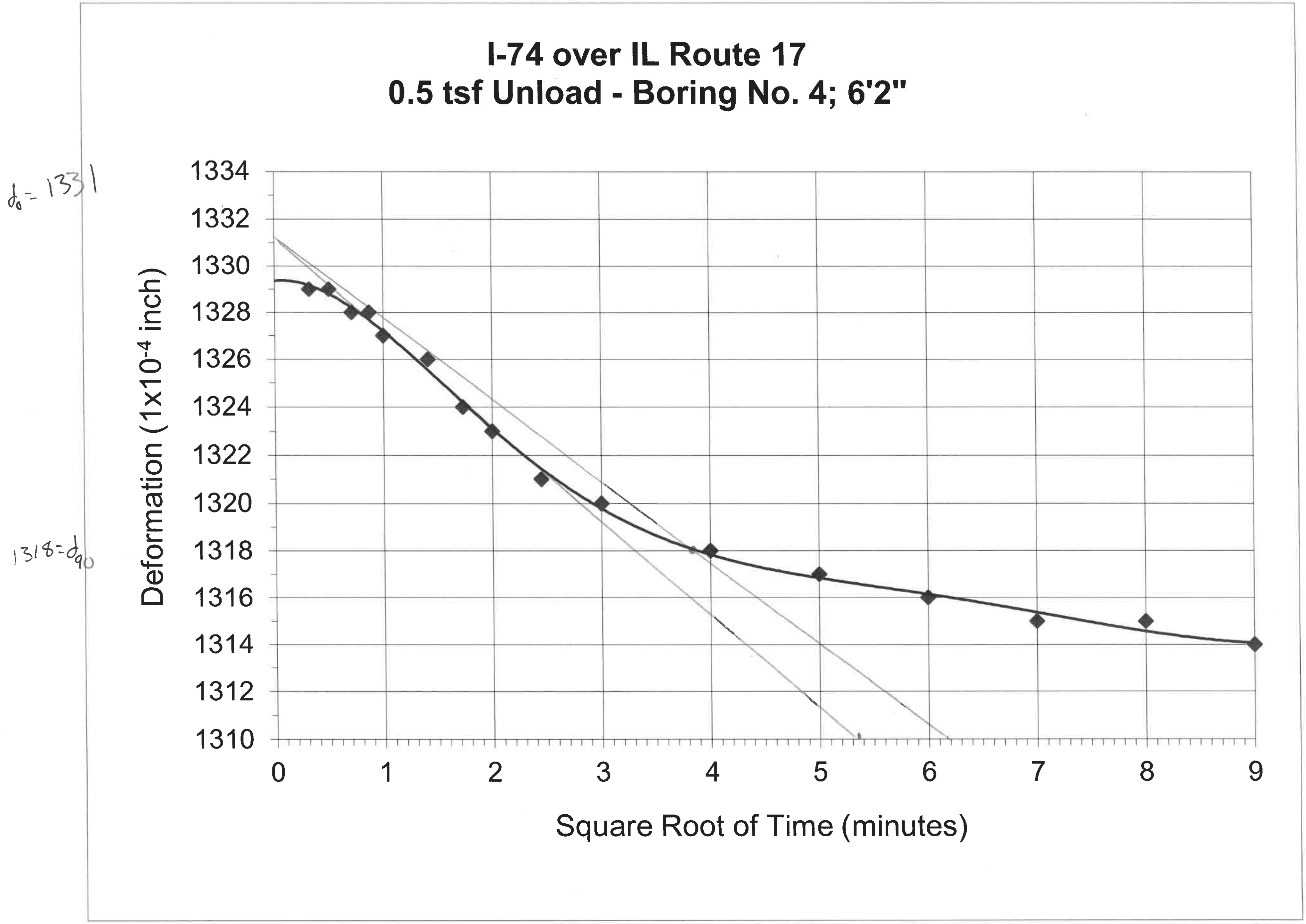
I-74 over IL Route 17
2.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
Log Time (minutes)
1370
1369
1368
1367
1366
1365
1364
1363
1362
1361
1360
1359
1358
1357
1356
1355
1354
1353
1352
1351
1350
0.1
1.0
10.0
100.0
d0 = 1371
d.25 = 1366
d1 = 1361
d100 = 1355


I-74 over IL Route 17
1.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
1360
1355
1350
1345
1340
1335
1330
1325
0.1
1.0
10.0
100.0
Log Time (minutes)
d0 = 1355
d.25 = 1350
d1 = 1345
d100 = 1332

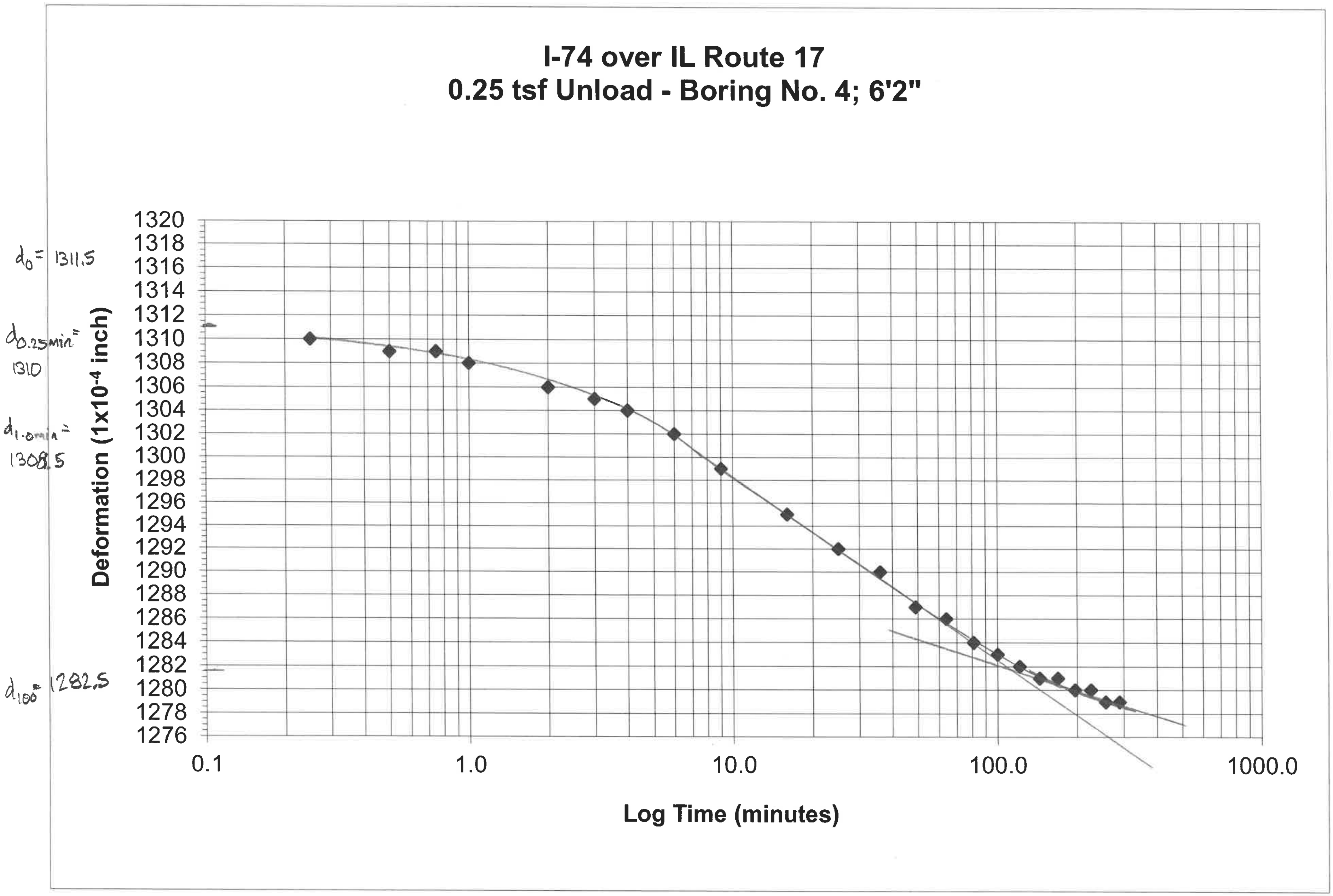

I-74 over IL Route 17
1.0 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
Square Root of Time (minutes)
1359
1357
1355
1353
1351
1349
1347
1345
1343
1341
1339
1337
1335
1333
1331
1329
1327
1325
0
1
2
3
4
5
6
7
8



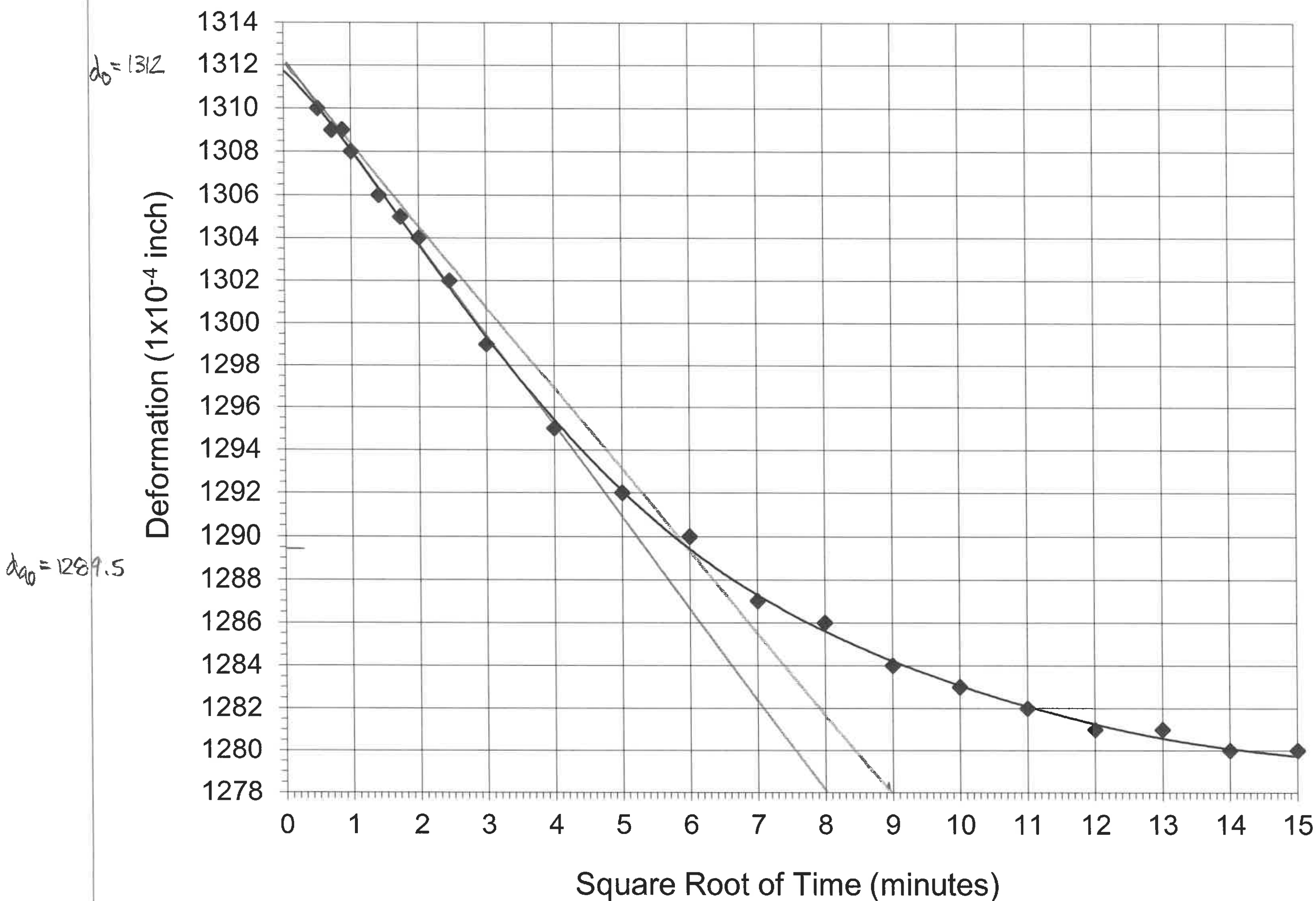
I-74 over IL Route 17
0.5 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
1340
1335
1330
1325
1320
1315
1310
0.1
1.0
10.0
100.0
Log Time (minutes)
d0 = 1331
d.25 = 1329
d1 = 1327
d100 = 1316



I-74 over IL Route 17
0.5 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10^-4 inch)
1334
1332
1330
1328
1326
1324
1322
1320
1318
1316
1314
1312
1310
0
1
2
3
4
5
6
7
8
9
Square Root of Time (minutes)
d0 = 1331
1318 = d90


I-74 over IL Route 17
0.25 tsf Unload - Boring No. 4; 6'2"
Deformation (1x10-4 inch)
1320
1318
1316
1314
1312
1310
1308
1306
1304
1302
1300
1298
1296
1294
1292
1290
1288
1286
1284
1282
1280
1278
1276
0.1
1.0
10.0
100.0
1000.0
Log Time (minutes)
d0 = 1311.5
d0.25min = 1310
d1.0min = 1308.5
d100 = 1282.5

I-74 over IL Route 17
0.25 tsf Unload - Boring No. 4; 6'2"



Interstate 74 Over IL Route 17

Boring No. 4; 6'2"

0.25 tsf Load

Log Fitting Method

$d_0 := 95$ x 10^{-4} inches

$d_{100} := 194$ x 10^{-4} inches

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 144$ x 10^{-4} inches

Taylor's Method

$d_0 := 98$ x 10^{-4} inches

$d_{90} := 175$ x 10^{-4} inches

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $d_{100} = 184$ x 10^{-4} inches

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 141$ x 10^{-4} inches

0.5 tsf Load

Log Fitting Method

$d_0 := 292$ x 10^{-4} inches

$d_{100} := 377$ x 10^{-4} inches

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 334$ x 10^{-4} inches

Taylor's Method

$d_0 := 294$ x 10^{-4} inches

$d_{90} := 367$ x 10^{-4} inches

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $d_{100} = 375$ x 10^{-4} inches

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 335$ x 10^{-4} inches

Interstate 74 Over IL Route 17

Boring No. 4; 6'2"

1.0 tsf Load

Log Fitting Method

$d_0 := 525 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 638 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 582 \ \text{x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 521 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 603 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 612 \ \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 567 \ \text{x } 10^{-4}\ inches$

2.0 tsf Load

Log Fitting Method

$d_0 := 739 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 882 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 810 \ \text{x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 735 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 830 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 841 \ \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 788 \ \text{x } 10^{-4}\ inches$

4.0 tsf Load

Log Fitting Method

$d_0 := 910 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 1107 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 1008 \ \text{x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 918 \quad \times 10^{-4}$ *inches*

$d_{90} := 1046 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\qquad d_{100} = 1060 \times 10^{-4}$ *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $\qquad d_{50} = 989 \times 10^{-4}$ *inches*

8.0 tsf Load

Log Fitting Method

$d_0 := 1153 \quad \times 10^{-4}$ *inches*

$d_{100} := 1354 \quad \times 10^{-4}$ *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $\qquad d_{50} = 1254 \times 10^{-4}$ *inches*

Taylor's Method

$d_0 := 1152 \quad \times 10^{-4}$ *inches*

$d_{90} := 1296 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\qquad d_{100} = 1312 \times 10^{-4}$ *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $\qquad d_{50} = 1232 \times 10^{-4}$ *inches*

4.0 tsf Unload

Log Fitting Method

$d_0 := 1378 \quad \times 10^{-4}$ *inches*

$d_{100} := 1370 \quad \times 10^{-4}$ *inches*

Taylor's Method

$d_0 := 1378 \quad \times 10^{-4}$ *inches*

$d_{90} := 1371 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\qquad d_{100} = 1370 \times 10^{-4}$ *inches*

Interstate 74 Over IL Route 17

Boring No. 4; 6'2"

2.0 tsf Unload

Log Fitting Method

$d_0 := 1371 \quad \times 10^{-4}$ *inches*

$d_{100} := 1355 \quad \times 10^{-4}$ *inches*

Taylor's Method

$d_0 := 1372 \quad \times 10^{-4}$ *inches*

$d_{90} := 1360 \quad \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 1359 \times 10^{-4}$ *inches*

1.0 tsf Unload

Log Fitting Method

$d_0 := 1355 \quad \times 10^{-4}$ *inches*

$d_{100} := 1332 \quad \times 10^{-4}$ *inches*

Taylor's Method

$d_0 := 1354 \quad \times 10^{-4}$ *inches*

$d_{90} := 1339 \quad \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 1337 \times 10^{-4}$ *inches*

0.5 tsf Unload

Log Fitting Method

$d_0 := 1331 \quad \times 10^{-4}$ *inches*

$d_{100} := 1316 \quad \times 10^{-4}$ *inches*

Taylor's Method

$d_0 := 1331 \quad \times 10^{-4}$ *inches*

$d_{90} := 1318 \quad \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 1317 \times 10^{-4}$ *inches*

0.25 tsf Unload

Log Fitting Method

$d_0 := 1312$ x 10^{-4} *inches*

$d_{100} := 1283$ x 10^{-4} *inches*

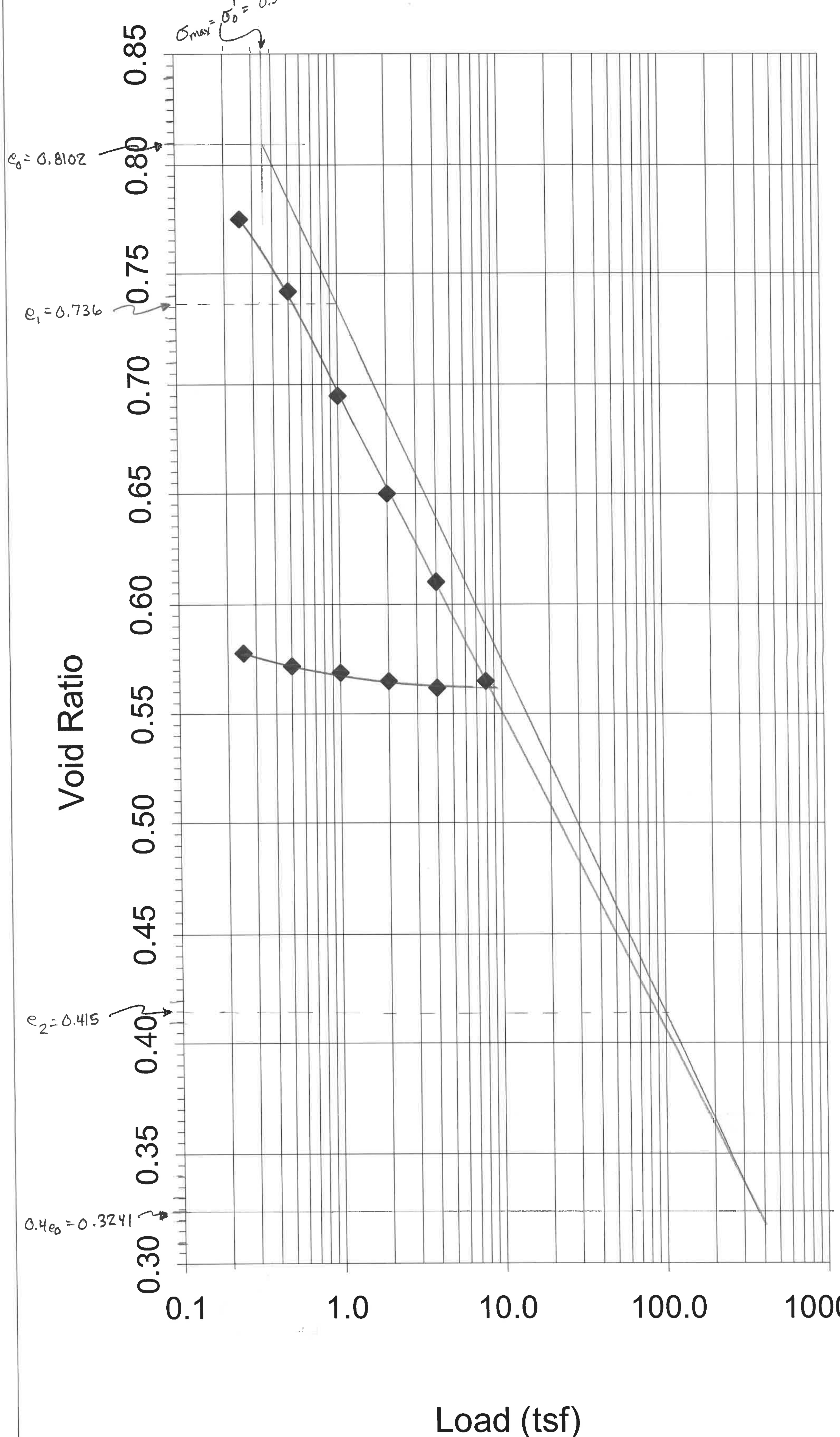
Taylor's Method

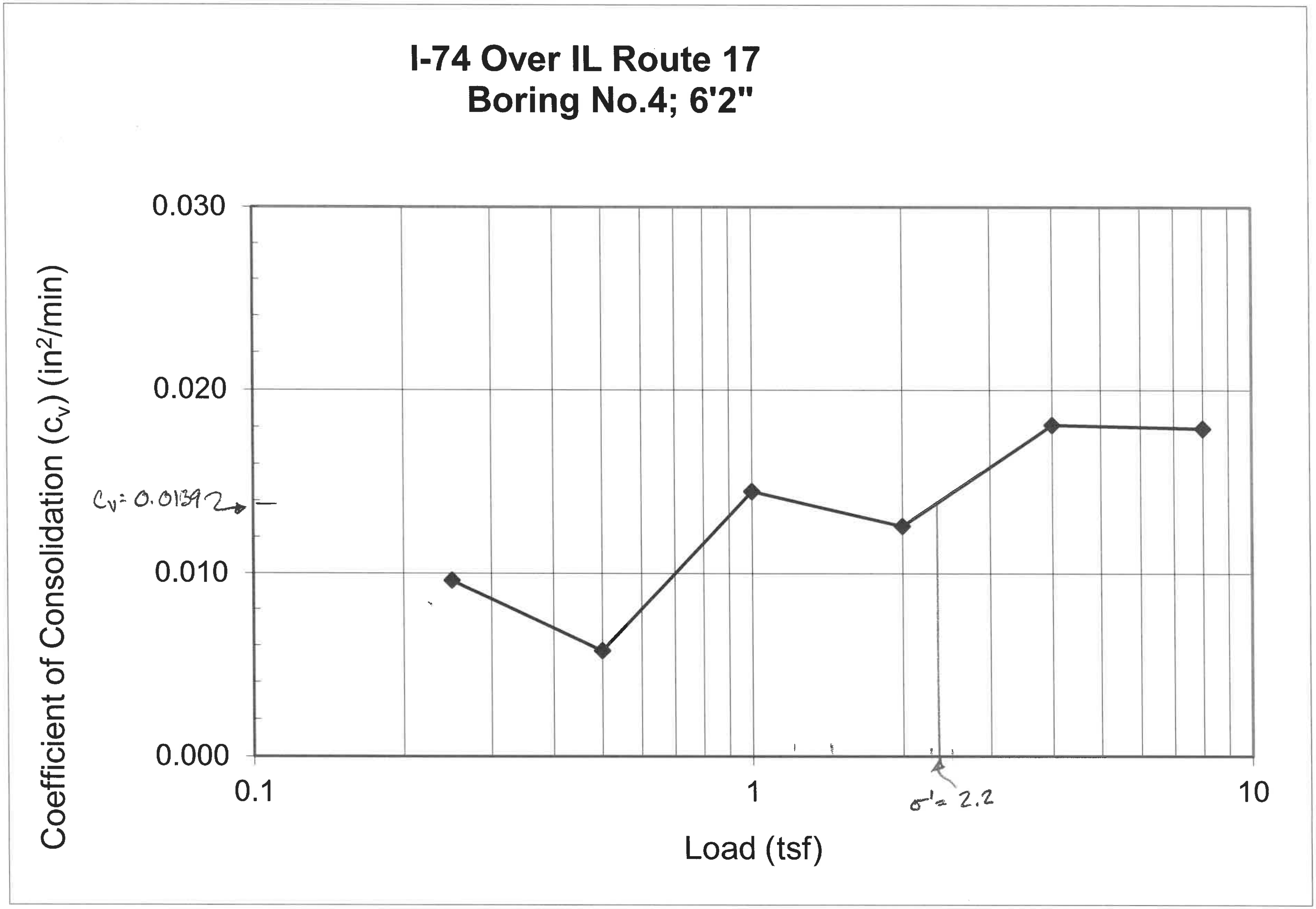
$d_0 := 1312$ x 10^{-4} *inches*

$d_{90} := 1289$ x 10^{-4} *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $d_{100} = 1286$ x 10^{-4} *inches*

I-74 Over IL Route 17
Boring No. 4; 6'2"




I-74 Over IL Route 17
Boring No.4; 6'2"
Coefficient of Consolidation (c_v) (in^2/min)
0.030
0.020
0.010
0.000
0.1
1
10
Load (tsf)
Cv= 0.01392
σ'= 2.2

Muck Layer

CONSOLIDATION TEST

Project: I-74 over IL Route 17

Boring: 2
Depth: 19'5"

Date: January 18, 2022
Sample No.: 2
Classification: Muck, Dark Brown, Moist, Very Stiff

	Before Test		After Test
	Specimen	Trimmings	Specimen
Tare No.	Ring + Plates	1	13
Tare + Wet Soil (g)	277.36	96.10	229.51
Tare + Dry Soil (g)	--	83.27	189.75
Water (g)	64.47	12.83	39.76
Tare (g)	119.27	64.64	114.45
Dry Soil (g)	93.62	18.63	75.30
Water Content	--	68.87%	52.80%

Area of Specimen	31.6692 sq. cm
Ht. of Specimen	0.9994 in.
Specific Gravity	2.75
Final Dial Reading	0.1814 inch
Ht. of Solids	0.4232 inch
Orginal Ht. of Water	0.8015 inch
Final Ht. of Water	0.4943 inch
Change in Ht. of Specimen	0.1814 inch
Ht. of Specimen at End of Test	0.8180 inch
Initial Void Ratio	1.3615
Final Void Ratio	0.9329
Initial Saturation	139.1 %
Final Saturation	125.2 %
Initial Dry Density	72.7 pcf
Initial Wet Density	122.7 pcf

CONSOLIDATION TEST

Project: I-74 over IL Route 17

Boring: 2
Depth: 19'5"

Date: January 18, 2022
Sample No.: 2
Classification: Muck, Dark Brown, Moist, Very Stiff

Pressure (TSF)	D_{100} (inch x 10^{-4})	D_{50} (inch x 10^{-4})	Void Ratio	t_{50} (min)	c_v in^2/min
0.25	90	80	1.340	0.16	0.3025
0.5	181	173	1.319	0.49	0.0969
1	309	294	1.288	0.25	0.1854
2	504	472	1.242	0.17	0.2627
4	910	820	1.146	0.36	0.1151
8	2169	1822	0.849	0.7	0.0470
4	2317	--	0.814	--	--
2	2229	--	0.835	--	--
1	2108	--	0.863	--	--
0.5	1984	--	0.893	--	--
0.25	1889	--	0.915	--	--

Interstate 74 Over IL Route 17

Boring No. 2; 19'5"

0.25 tsf Load

Log Fitting Method

$d_0 := 71$ x 10^{-4} *inches*

$d_{100} := 89$ x 10^{-4} *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 80$ x 10^{-4} *inches*

Taylor's Method

$d_0 := 71$ x 10^{-4} *inches*

$d_{90} := 88$ x 10^{-4} *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $d_{100} = 90$ x 10^{-4} *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 80$ x 10^{-4} *inches*

0.5 tsf Load

Log Fitting Method

$d_0 := 167$ x 10^{-4} *inches*

$d_{100} := 177$ x 10^{-4} *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 172$ x 10^{-4} *inches*

Taylor's Method

$d_0 := 165$ x 10^{-4} *inches*

$d_{90} := 179$ x 10^{-4} *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $d_{100} = 181$ x 10^{-4} *inches*

$d_{50} := \frac{d_0 + d_{100}}{2}$ $d_{50} = 173$ x 10^{-4} *inches*

Interstate 74 Over IL Route 17

Boring No. 2; 19'5"

<u>1.0 tsf Load</u>

Log Fitting Method

$d_0 := 275 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 309 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 292 \text{ x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 279 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 306 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 309 \text{ x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 294 \text{ x } 10^{-4}\ inches$

<u>2.0 tsf Load</u>

Log Fitting Method

$d_0 := 438 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 504 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 471 \text{ x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 440 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 504 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 511 \text{ x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 476 \text{ x } 10^{-4}\ inches$

Interstate 74 Over IL Route 17

Boring No. 2; 19'5"

4.0 tsf Load

Taylor's Method

$d_0 := 708 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 910 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 932 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 820 \text{x } 10^{-4}\ inches$

8.0 tsf Load

Log Fitting Method

$d_0 := 1475 \quad \text{x } 10^{-4}\ inches$

$d_{100} := 2140 \quad \text{x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 1808 \text{x } 10^{-4}\ inches$

Taylor's Method

$d_0 := 1475 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 2100 \quad \text{x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 2169 \text{ x } 10^{-4}\ inches$

$d_{50} := \frac{d_0 + d_{100}}{2} \qquad d_{50} = 1822 \quad \text{x } 10^{-4}\ inches$

4.0 tsf Unload

Taylor's Method

$d_0 := 2341 \quad \text{x } 10^{-4}\ inches$

$d_{90} := 2319 \text{ x } 10^{-4}\ inches$

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90} \qquad d_{100} = 2317 \quad \text{x } 10^{-4}\ inches$

2.0 tsf Unload

Taylor's Method

$d_0 := 2282 \times 10^{-4}$ *inches*

$d_{90} := 2234 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\quad d_{100} = 2229 \times 10^{-4}$ *inches*

1.0 tsf Unload

Taylor's Method

$d_0 := 2174 \times 10^{-4}$ *inches*

$d_{90} := 2115 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\quad d_{100} = 2108 \times 10^{-4}$ *inches*

0.5 tsf Unload

Taylor's Method

$d_0 := 2014 \times 10^{-4}$ *inches*

$d_{90} := 1987 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\quad d_{100} = 1984 \times 10^{-4}$ *inches*

0.25 tsf Unload

Taylor's Method

$d_0 := 1948 \times 10^{-4}$ *inches*

$d_{90} := 1895 \times 10^{-4}$ *inches*

$d_{100} := \frac{d_{90} - d_0}{9} + d_{90}$ $\quad$ $d_{100} = 1889 \times 10^{-4}$ *inches*

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/18/22	0.25	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	0 .080	80	3	77
		0.25	0.50	0 .084	84	3	81
		0.50	0.71	0 .087	87	3	84
		0.75	0.87	0 .090	90	3	87
		1	1.00	0 .092	92	3	89
		2	1.41	0 .093	93	3	90
		3	1.73	0 .094	94	3	91
		4	2.00	0 .095	95	3	92
		6	2.45	0 .097	97	3	94
		9	3.00	0 .099	99	3	96
		16	4.00	0 .102	102	3	99
		25	5.00	0 .103	103	3	100
		36	6.00	0 .104	104	3	101
		49	7.00	0 .105	105	3	102
		64	8.00	0 .107	107	3	104
		81	9.00	0 .108	108	3	105
		100	10.00	0 .109	109	3	106
		121	11.00	0 .109	109	3	106
		144	12.00	0 .110	110	3	107
		169	13.00	0 .110	110	3	107
		196	14.00	0 .111	111	3	108
		225	15.00	0 .112	112	3	109
		256	16.00	0 .114	114	3	111
		289	17.00	0 .114	114	3	111

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/18/22	0.5	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	0 .173	173	5	168
		0.25	0.50	0 .176	176	5	171
		0.50	0.71	0 .178	178	5	173
		0.75	0.87	0 .180	180	5	175
		1	1.00	0 .181	181	5	176
		2	1.41	0 .183	183	5	178
		3	1.73	0 .185	185	5	180
		4	2.00	0 .186	186	5	181
		6	2.45	0 .188	188	5	183
		9	3.00	0 .190	190	5	185
		16	4.00	0 .192	192	5	187
		25	5.00	0 .195	195	5	190
		36	6.00	0 .197	197	5	192
		49	7.00	0 .199	199	5	194
		64	8.00	1 .001	201	5	196
		81	9.00	1 .002	202	5	197
		100	10.00	1 .003	203	5	198
		121	11.00	1 .004	204	5	199
		144	12.00	1 .006	206	5	201
		169	13.00	1 .007	207	5	202
		196	14.00	1 .008	208	5	203
		225	15.00	1 .009	209	5	204
		256	16.00	1 .010	210	5	205
		982	31.34	1 .023	223	5	218
		1038	32.22	1 .024	224	5	219

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/19/22	1.0	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	1 .096	296	9	287
		0.25	0.50	1 .104	304	9	295
		0.50	0.71	1 .109	309	9	300
		0.75	0.87	1 .112	312	9	303
		1	1.00	1 .114	314	9	305
		2	1.41	1 .118	318	9	309
		3	1.73	1 .120	320	9	311
		4	2.00	1 .122	322	9	313
		6	2.45	1 .125	325	9	316
		9	3.00	1 .128	328	9	319
		16	4.00	1 .132	332	9	323
		25	5.00	1 .135	335	9	326
		36	6.00	1 .139	339	9	330
		49	7.00	1 .140	340	9	331
		64	8.00	1 .143	343	9	334
		81	9.00	1 .145	345	9	336
		100	10.00	1 .146	346	9	337
		121	11.00	1 .148	348	9	339
		144	12.00	1 .150	350	9	341
		169	13.00	1 .152	352	9	343
		196	14.00	1 .153	353	9	344
		225	15.00	1 .154	354	9	345
		256	16.00	1 .155	355	9	346
		289	17.00	1 .156	356	9	347
		324	18.00	1 .158	358	9	349
		361	19.00	1 .159	359	9	350
		400	20.00	1 .160	360	9	351
		441	21.00	1 .161	361	9	352
		484	22.00	1 .162	362	9	353
		529	23.00	1 .163	363	9	354
		545	23.35	1 .163	363	9	354
		1377	37.11	1 .176	376	9	367
		1428	37.79	1 .176	376	9	367
		1493	38.64	1 .177	377	9	368
		1554	39.42	1 .177	377	9	368
		1582	39.77	1 .177	377	9	368

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. (1×10^{-4} in)*	CORRECTION (1×10^{-4} in)	CORR. RDGS. (1×10^{-4} in)
1/20/22	2.0	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	2 .075	475	14	461
		0.25	0.50	2 .090	490	14	476
		0.50	0.71	2 .103	503	14	489
		0.75	0.87	2 .110	510	14	496
		1	1.00	2 .114	514	14	500
		2	1.41	2 .124	524	14	510
		3	1.73	2 .130	530	14	516
		4	2.00	2 .134	534	14	520
		6	2.45	2 .140	540	14	526
		9	3.00	2 .146	546	14	532
		16	4.00	2 .156	556	14	542
		25	5.00	2 .163	563	14	549
		36	6.00	2 .169	569	14	555
		49	7.00	2 .176	576	14	562
		64	8.00	2 .181	581	14	567
		81	9.00	2 .185	585	14	571
		100	10.00	2 .189	589	14	575
		121	11.00	2 .193	593	14	579
		144	12.00	2 .196	596	14	582
		169	13.00	3 .000	600	14	586
		196	14.00	3 .003	603	14	589

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/20/22	4.0	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	3 .180	780	21	759
		0.25	0.50	4 .025	825	21	804
		0.50	0.71	4 .065	865	21	844
		0.75	0.87	4 .089	889	21	868
		1	1.00	4 .107	907	21	886
		2	1.41	4 .145	945	21	924
		3	1.73	4 .166	966	21	945
		4	2.00	4 .181	981	21	960
		6	2.45	5 .003	1003	21	982
		9	3.00	5 .025	1025	21	1004
		16	4.00	5 .055	1055	21	1034
		25	5.00	5 .078	1078	21	1057
		36	6.00	5 .097	1097	21	1076
		49	7.00	5 .112	1112	21	1091
		64	8.00	5 .126	1126	21	1105
		81	9.00	5 .138	1138	21	1117
		100	10.00	5 .149	1149	21	1128
		121	11.00	5 .159	1159	21	1138
		144	12.00	5 .169	1169	21	1148
		169	13.00	5 .178	1178	21	1157
		196	14.00	5 .185	1185	21	1164
		225	15.00	5 .193	1193	21	1172
		256	16.00	6 .000	1200	21	1179

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. (1x10^{-4} in)*	CORRECTION (1x10^{-4} in)	CORR. RDGS. (1x10^{-4} in)
1/21/22	8.0	0	0.00	--	N/A	N/A	N/A
	Load	0.1	0.32	8 .045	1645	28	1617
		0.25	0.50	8 .125	1725	28	1697
		0.50	0.71	9 .000	1800	28	1772
		0.75	0.87	9 .057	1857	28	1829
		1	1.00	9 .103	1903	28	1875
		2	1.41	10 .073	2073	28	2045
		3	1.73	10 .138	2138	28	2110
		4	2.00	10 .164	2164	28	2136
		5	2.24	10 .188	2188	28	2160
		6	2.45	10 .198	2198	28	2170
		8	2.83	11 .017	2217	28	2189
		9	3.00	11 .024	2224	28	2196
		16	4.00	11 .058	2258	28	2230
		25	5.00	11 .082	2282	28	2254
		36	6.00	11 .101	2301	28	2273
		49	7.00	11 .118	2318	28	2290
		64	8.00	11 .132	2332	28	2304
		81	9.00	11 .145	2345	28	2317
		100	10.00	11 .157	2357	28	2329
		121	11.00	11 .167	2367	28	2339
		144	12.00	11 .177	2377	28	2349
		169	13.00	11 .186	2386	28	2358
		190	13.78	11 .194	2394	28	2366

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/21/22	4.0	0	0.00	--	N/A	N/A	N/A
	Unload	0.10	0.32	11 .157	2357	21	2336
		0.25	0.50	11 .154	2354	21	2333
		0.50	0.71	11 .150	2350	21	2329
		0.75	0.87	11 .148	2348	21	2327
		1	1.00	11 .146	2346	21	2325
		2	1.41	11 .141	2341	21	2320
		3	1.73	11 .138	2338	21	2317
		4	2.00	11 .137	2337	21	2316
		6	2.45	11 .134	2334	21	2313
		9	3.00	11 .132	2332	21	2311
		16	4.00	11 .129	2329	21	2308
		25	5.00	11 .127	2327	21	2306
		36	6.00	11 .126	2326	21	2305
		51	7.14	11 .125	2325	21	2304
		64	8.00	11 .124	2324	21	2303
		81	9.00	11 .123	2323	21	2302

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/21/22	2.0	0	0.00	--	N/A	N/A	N/A
	Unload	0.1	0.32	11 .086	2286	14	2272
		0.25	0.50	11 .081	2281	14	2267
		0.50	0.71	11 .075	2275	14	2261
		0.75	0.87	11 .070	2270	14	2256
		1	1.00	11 .067	2267	14	2253
		2	1.41	11 .056	2256	14	2242
		3	1.73	11 .050	2250	14	2236
		4	2.00	11 .046	2246	14	2232
		6	2.45	11 .040	2240	14	2226
		9	3.00	11 .034	2234	14	2220
		16	4.00	11 .027	2227	14	2213
		25	5.00	11 .021	2221	14	2207
		36	6.00	11 .017	2217	14	2203
		49	7.00	11 .013	2213	14	2199
		64	8.00	11 .010	2210	14	2196
		84	9.17	11 .007	2207	14	2193
		100	10.00	11 .005	2205	14	2191
		121	11.00	11 .003	2203	14	2189
		144	12.00	11 .002	2202	14	2188
		160	12.65	11 .001	2201	14	2187

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/21/22	1.0	0	0.00	--	N/A	N/A	N/A
	Unload	0.1	0.32	10 .173	2173	9	2164
		0.25	0.50	10 .168	2168	9	2159
		0.50	0.71	10 .162	2162	9	2153
		0.75	0.87	10 .158	2158	9	2149
		1	1.00	10 .154	2154	9	2145
		2	1.41	10 .142	2142	9	2133
		3	1.73	10 .135	2135	9	2126
		4	2.00	10 .129	2129	9	2120
		6	2.45	10 .122	2122	9	2113
		9	3.00	10 .114	2114	9	2105
		16	4.00	10 .103	2103	9	2094
		25	5.00	10 .095	2095	9	2086
		39	6.24	10 .088	2088	9	2079
		49	7.00	10 .082	2082	9	2073
		64	8.00	10 .077	2077	9	2068
		81	9.00	10 .073	2073	9	2064
		100	10.00	10 .068	2068	9	2059
		121	11.00	10 .065	2065	9	2056
		144	12.00	10 .062	2062	9	2053
		169	13.00	10 .060	2060	9	2051
		3960	62.93	10 .031	2031	9	2022

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/24/22	0.5	0	0.00	--	N/A	N/A	N/A
	Unload	0.1	0.32	10 .015	2015	5	2010
		0.25	0.50	10 .013	2013	5	2008
		0.50	0.71	10 .011	2011	5	2006
		0.75	0.87	10 .009	2009	5	2004
		1	1.00	10 .008	2008	5	2003
		2	1.41	10 .003	2003	5	1998
		3	1.73	9 .199	1999	5	1994
		4	2.00	9 .197	1997	5	1992
		6	2.45	9 .194	1994	5	1989
		9	3.00	9 .191	1991	5	1986
		16	4.00	9 .187	1987	5	1982
		25	5.00	9 .184	1984	5	1979
		36	6.00	9 .182	1982	5	1977
		49	7.00	9 .179	1979	5	1974
		64	8.00	9 .177	1977	5	1972
		81	9.00	9 .175	1975	5	1970
		100	10.00	9 .173	1973	5	1968
		121	11.00	9 .171	1971	5	1966
		144	12.00	9 .169	1969	5	1964
		160	12.65	9 .168	1968	5	1963

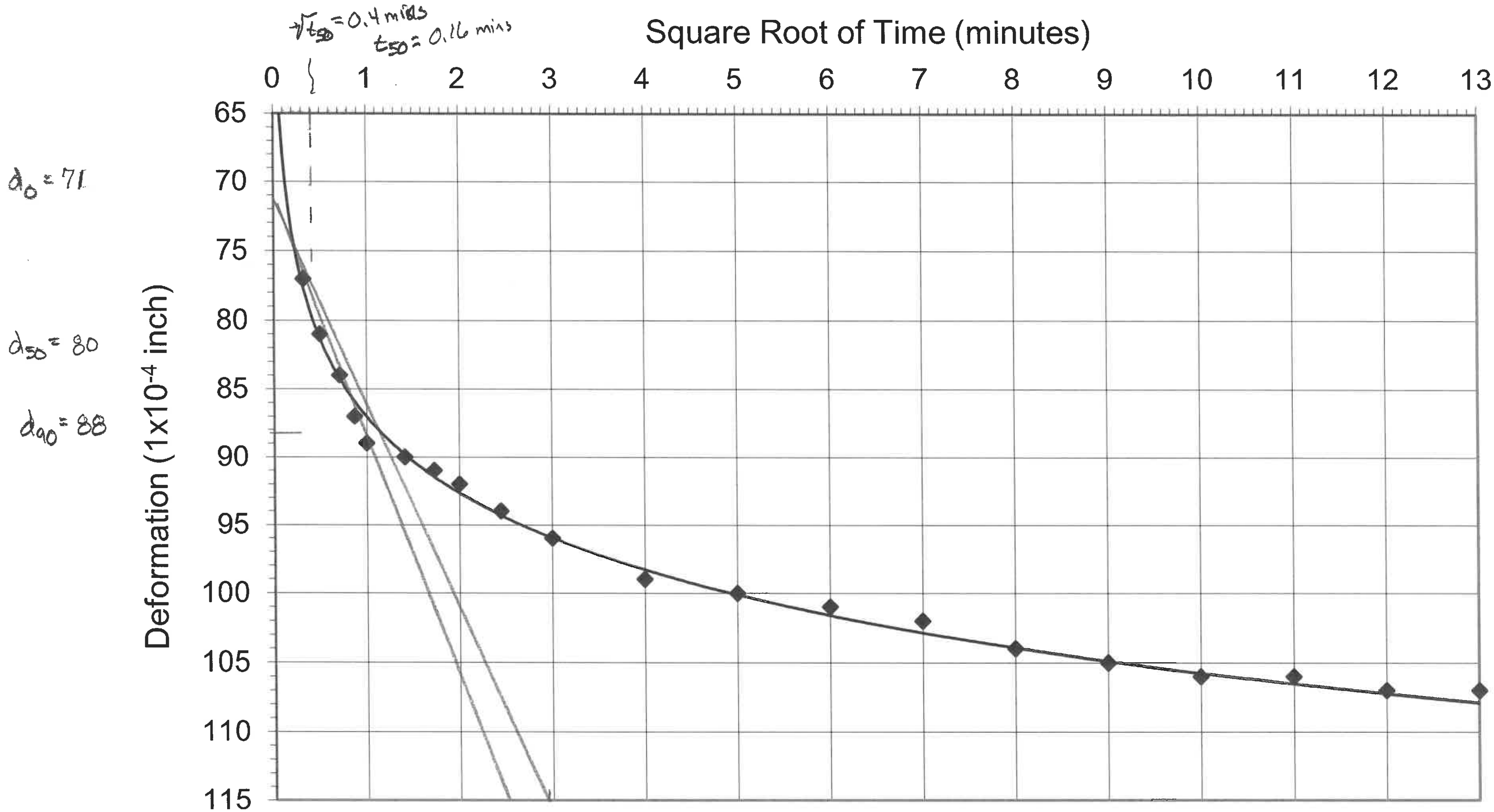
*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

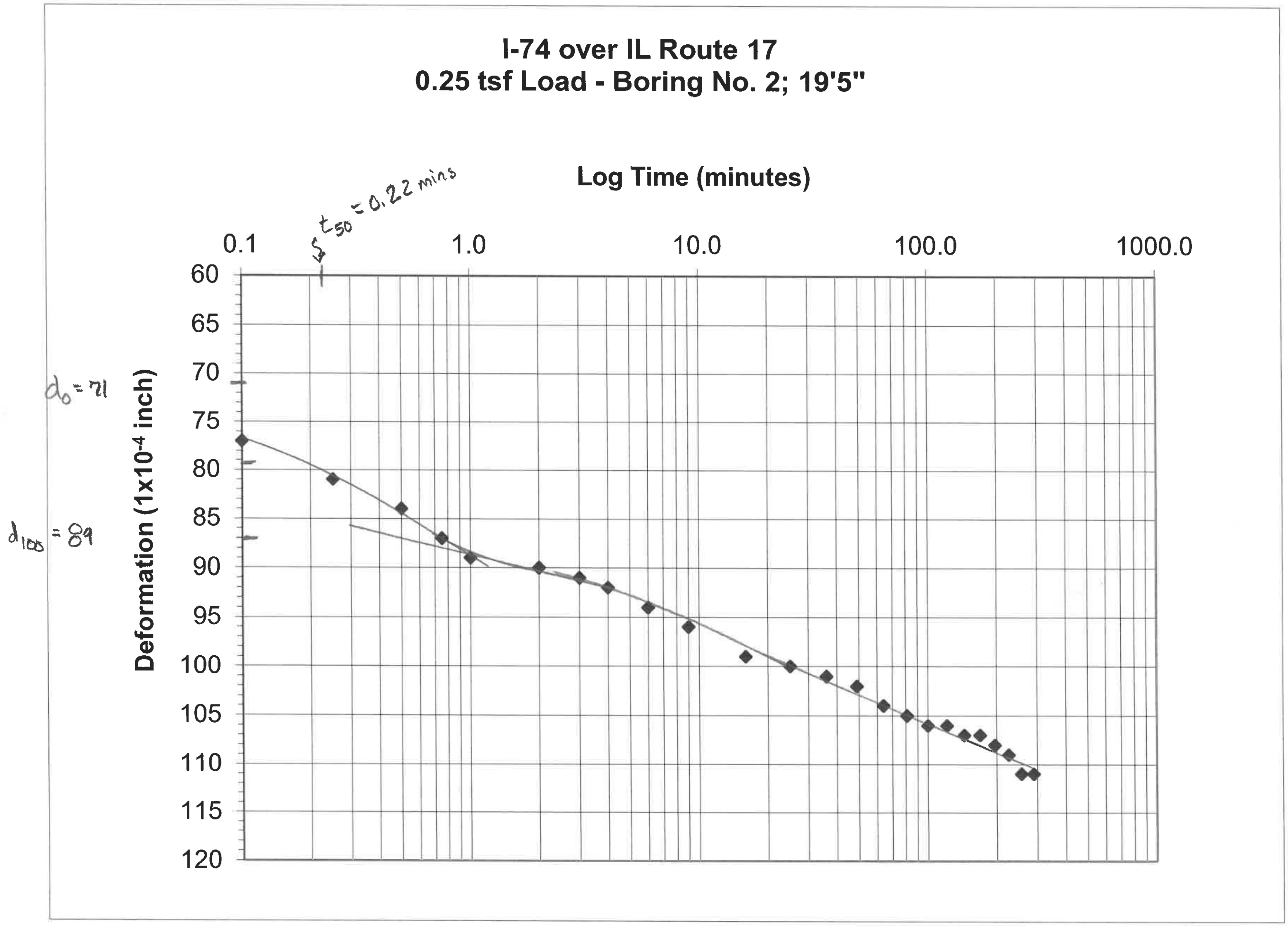
I-74 Over IL Route 17
Henry County, Illinois
Boring No. 2, 19'5"

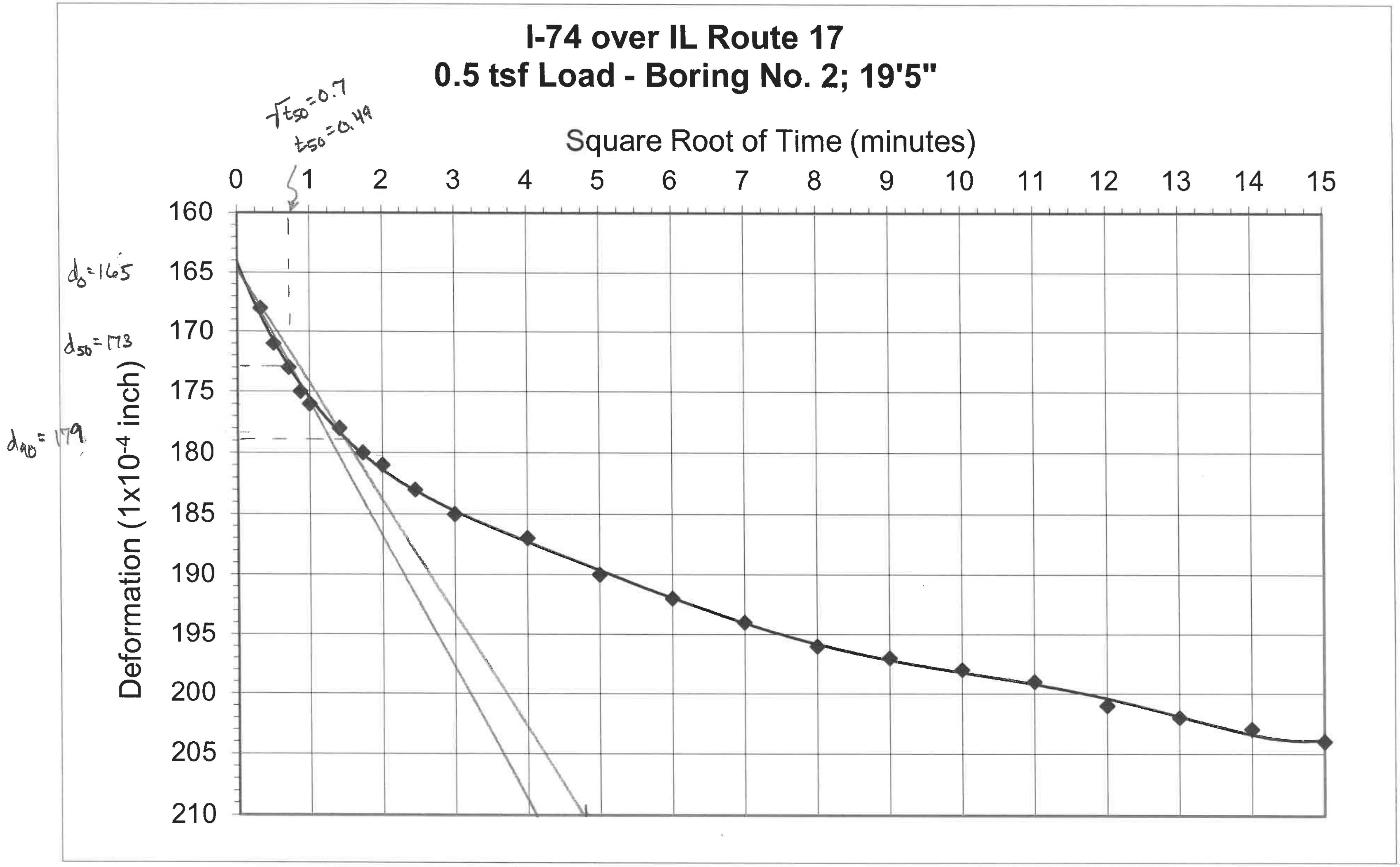
DATE	PRESS. (tsf)	ELAPSED TIME (MINS)	TIME SQ ROOT	ACTUAL DIAL RDG.*	DIAL RDGS. ($1x10^{-4}$ in)*	CORRECTION ($1x10^{-4}$ in)	CORR. RDGS. ($1x10^{-4}$ in)
1/24/22	0.25	0	0.00	--	N/A	N/A	N/A
	Unload	0.1	0.32	9 .146	1946	3	1943
		0.25	0.50	9 .145	1945	3	1942
		0.50	0.71	9 .143	1943	3	1940
		0.75	0.87	9 .140	1940	3	1937
		1	1.00	9 .139	1939	3	1936
		2	1.41	9 .132	1932	3	1929
		3	1.73	9 .128	1928	3	1925
		4	2.00	9 .124	1924	3	1921
		6	2.45	9 .119	1919	3	1916
		9	3.00	9 .113	1913	3	1910
		16	4.00	9 .105	1905	3	1902
		25	5.00	9 .098	1898	3	1895
		36	6.00	9 .092	1892	3	1889
		49	7.00	9 .086	1886	3	1883
		66	8.12	9 .081	1881	3	1878
		81	9.00	9 .076	1876	3	1873
		100	10.00	9 .070	1870	3	1867
		121	11.00	9 .066	1866	3	1863
		144	12.00	9 .064	1864	3	1861
		169	13.00	9 .061	1861	3	1858
		196	14.00	9 .057	1857	3	1854
		225	15.00	9 .054	1854	3	1851
		271	16.46	9 .049	1849	3	1846
		289	17.00	9 .048	1848	3	1845
		324	18.00	9 .045	1845	3	1842
		1232	35.10	9 .015	1815	3	1812
		1269	35.62	9 .014	1814	3	1811

*Actual Dial Readings are converted into 10^{-4} inches by multiplying the number left of the decimal by 200, and then adding the number right of the decimal to the product to give the dial reading in 10^{-4} inches.

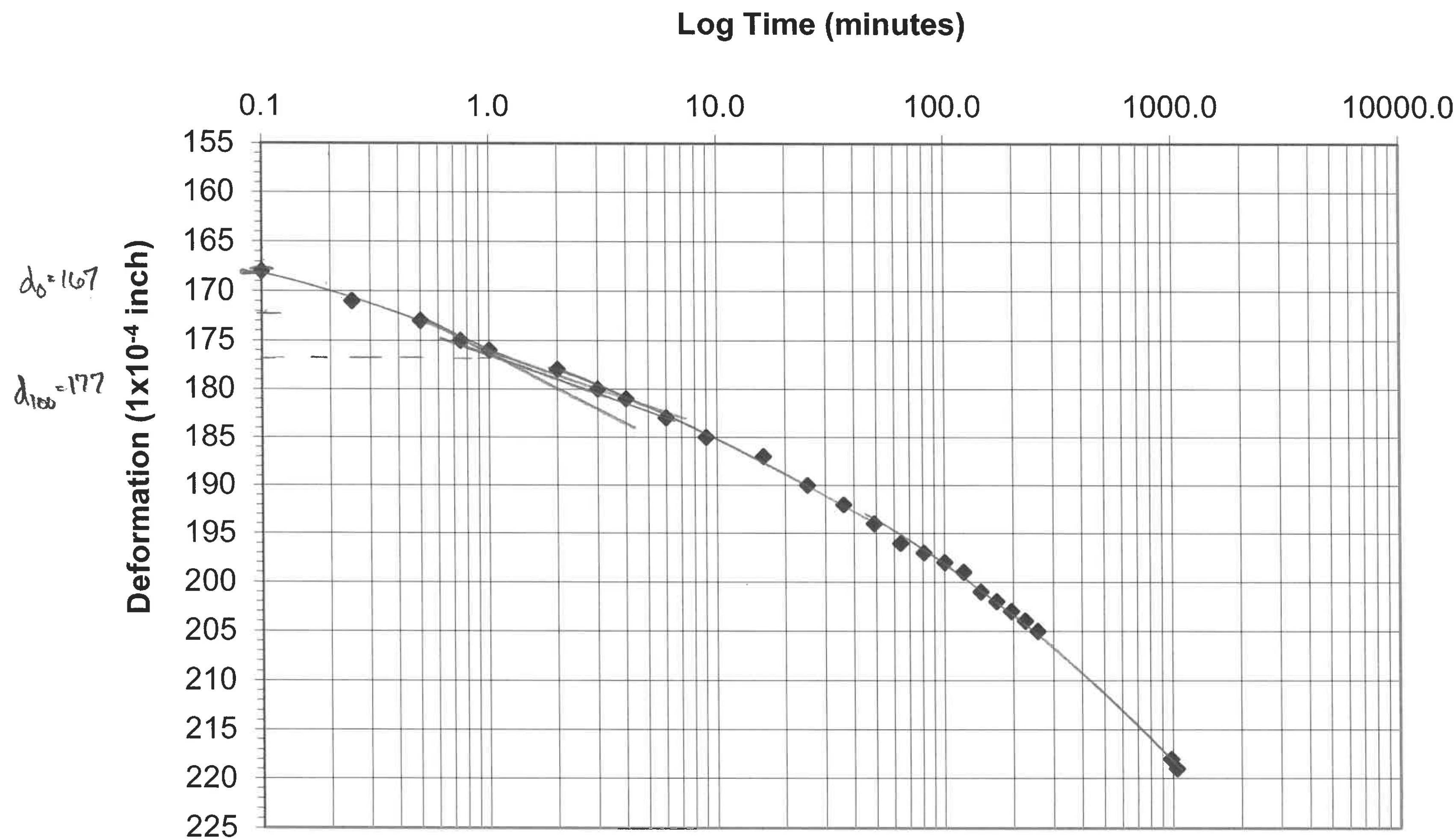
I-74 over IL Route 17
0.25 tsf Load - Boring No. 2; 19'5"

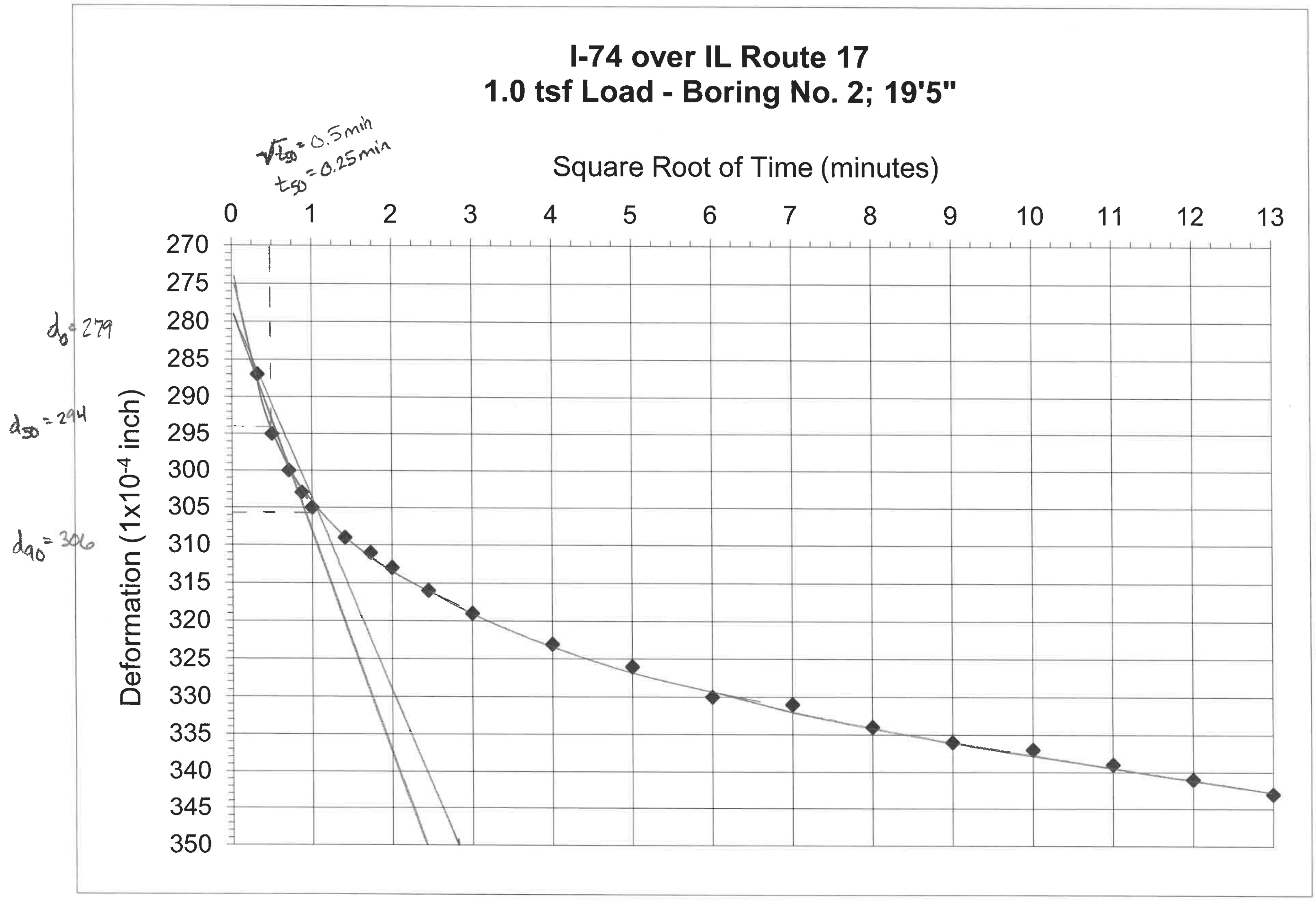


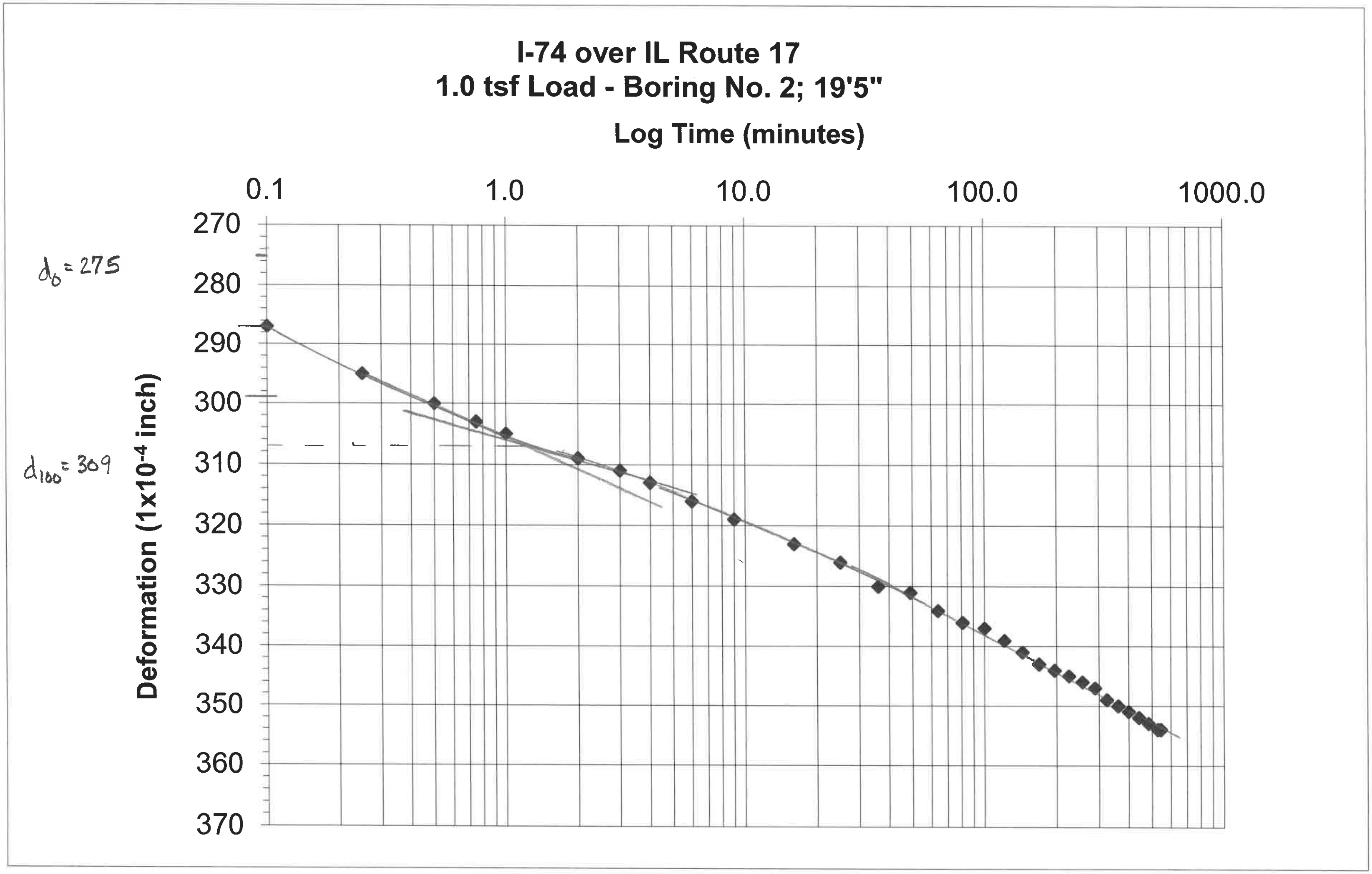

I-74 over IL Route 17
0.25 tsf Load - Boring No. 2; 19'5"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
60
65
70
75
80
85
90
95
100
105
110
115
120
t50 = 0.22 mins
d0 = 71
d100 = 89

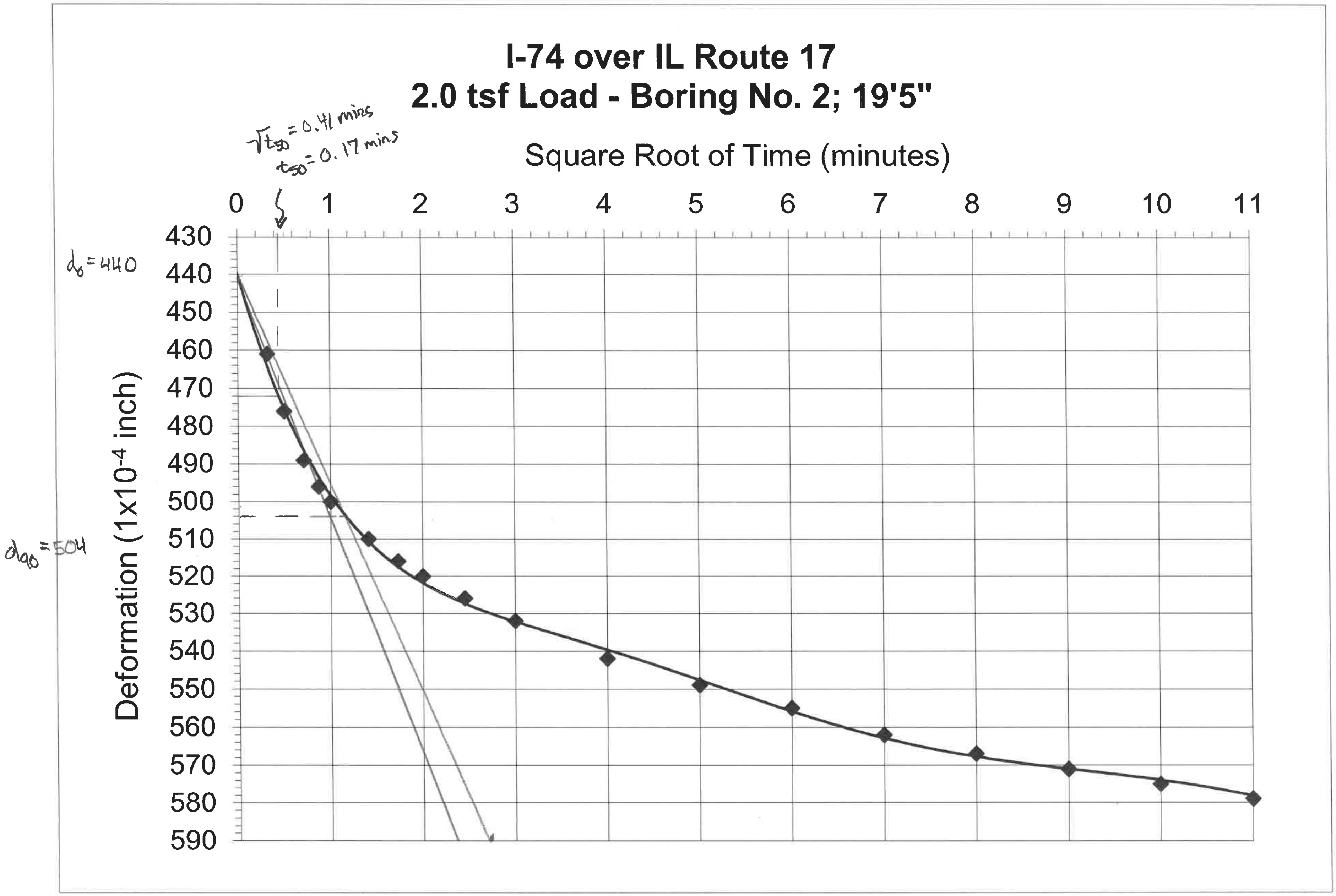

I-74 over IL Route 17
0.5 tsf Load - Boring No. 2; 19'5"
Square Root of Time (minutes)
Deformation (1x10-4 inch)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
160 165 170 175 180 185 190 195 200 205 210
√t50 = 0.7
t50 = 0.49
d0 = 165
d50 = 173
d90 = 179

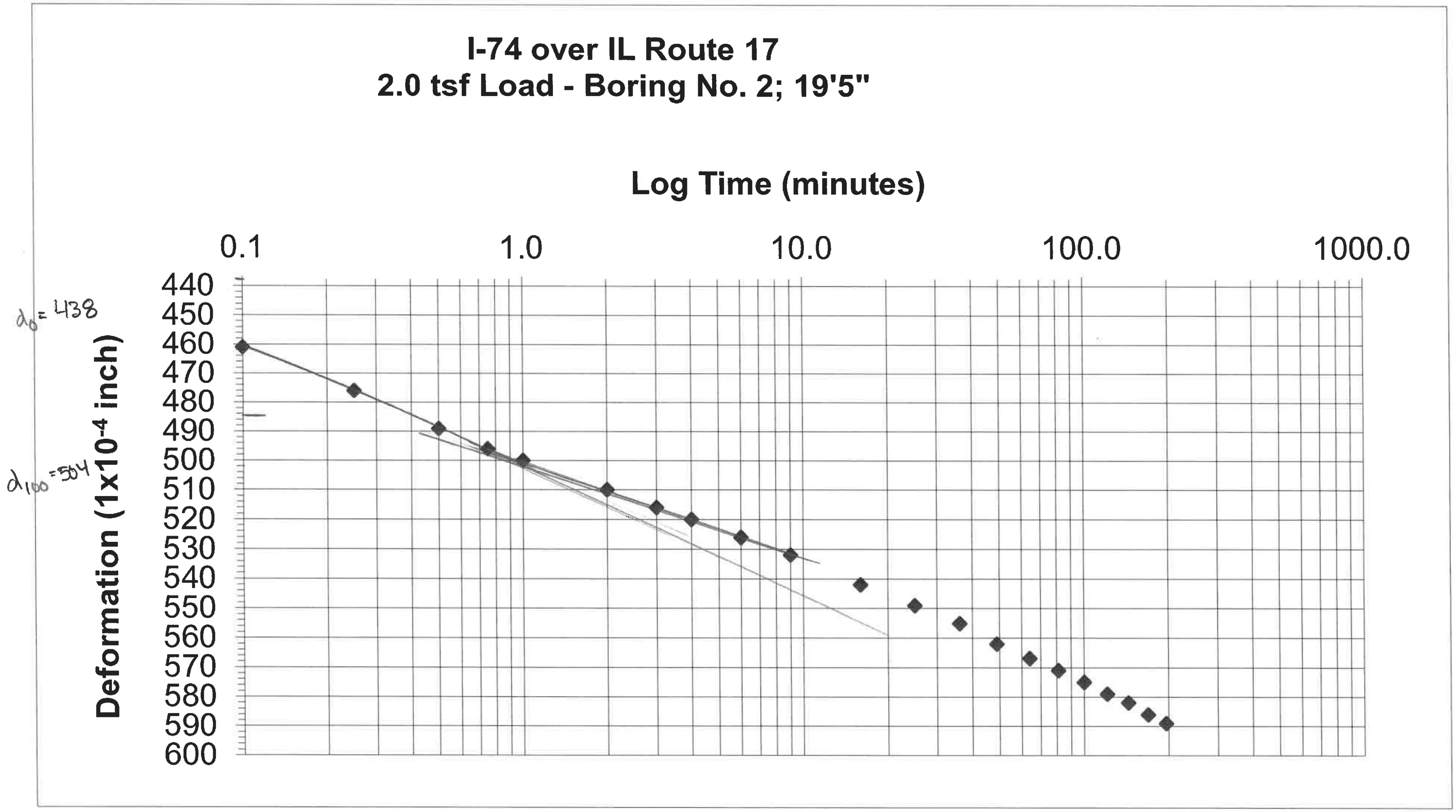
I-74 over IL Route 17
0.5 tsf Load - Boring No. 2; 19'5"



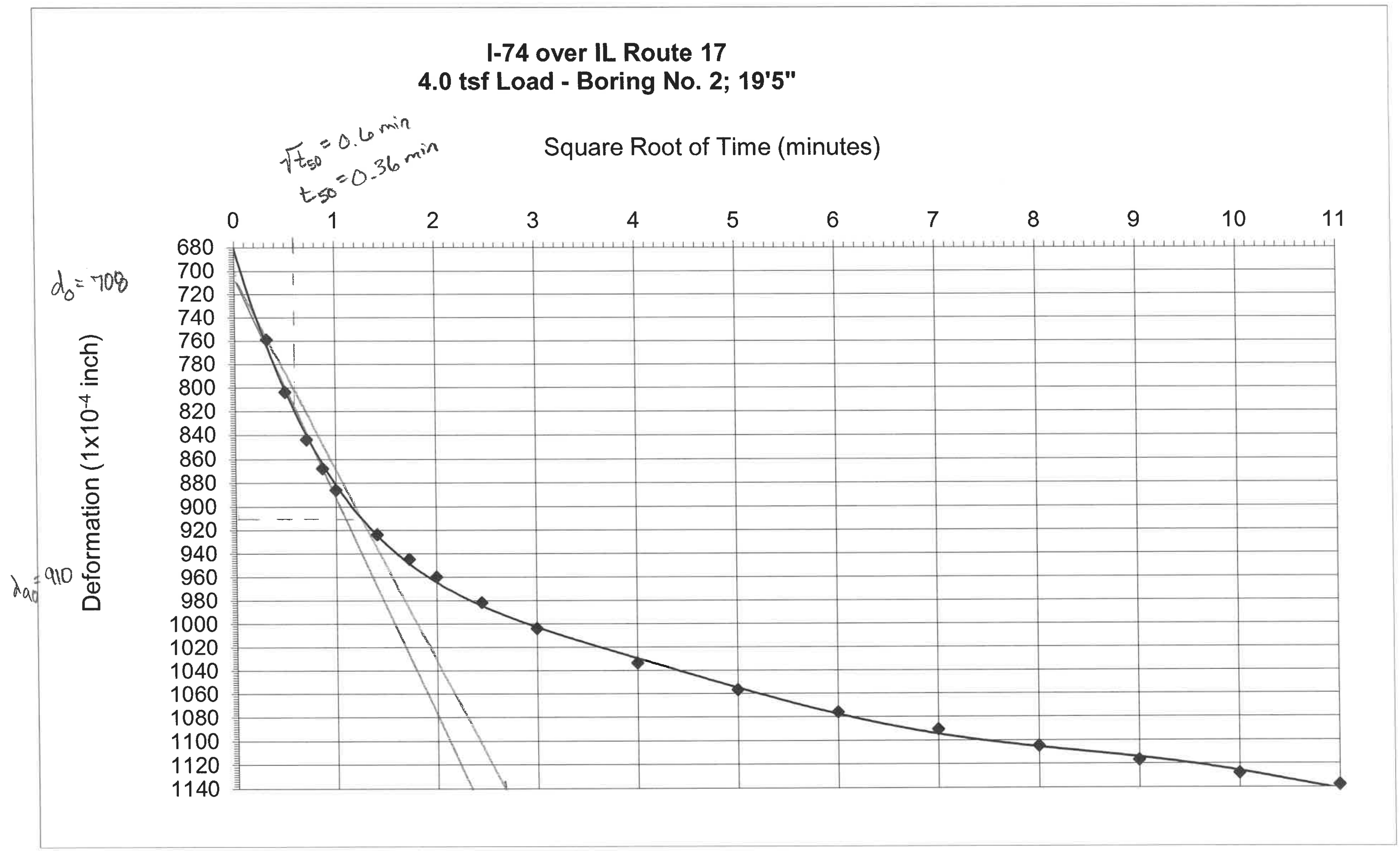

I-74 over IL Route 17
1.0 tsf Load - Boring No. 2; 19'5"
Square Root of Time (minutes)
Deformation (1x10-4 inch)
√t50 = 0.5 min
t50 = 0.25 min
d0 = 279
d50 = 294
d90 = 306
0
1
2
3
4
5
6
7
8
9
10
11
12
13
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350

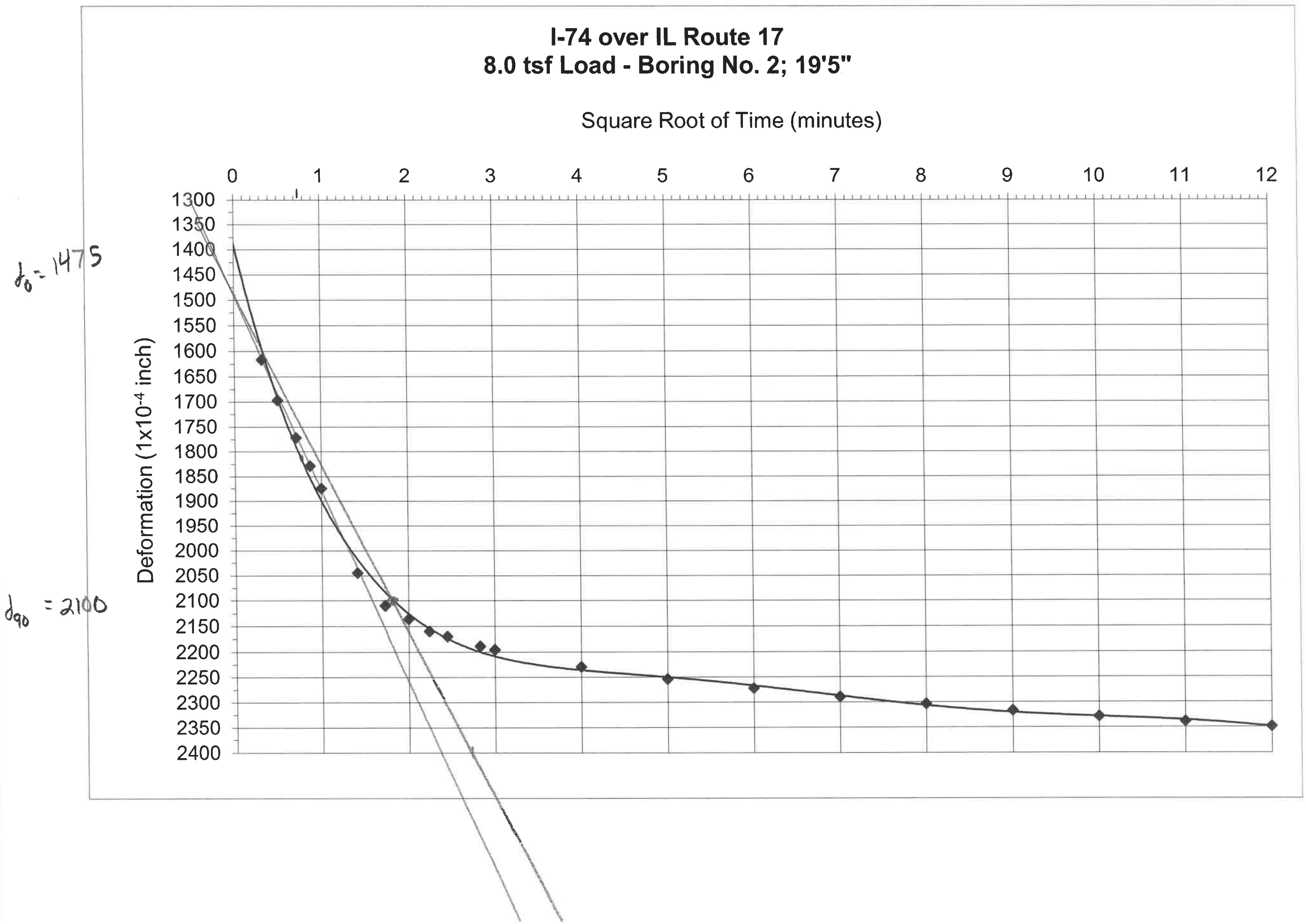

I-74 over IL Route 17
1.0 tsf Load - Boring No. 2; 19'5"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
270
280
290
300
310
320
330
340
350
360
370
d0 = 275
d100 = 309

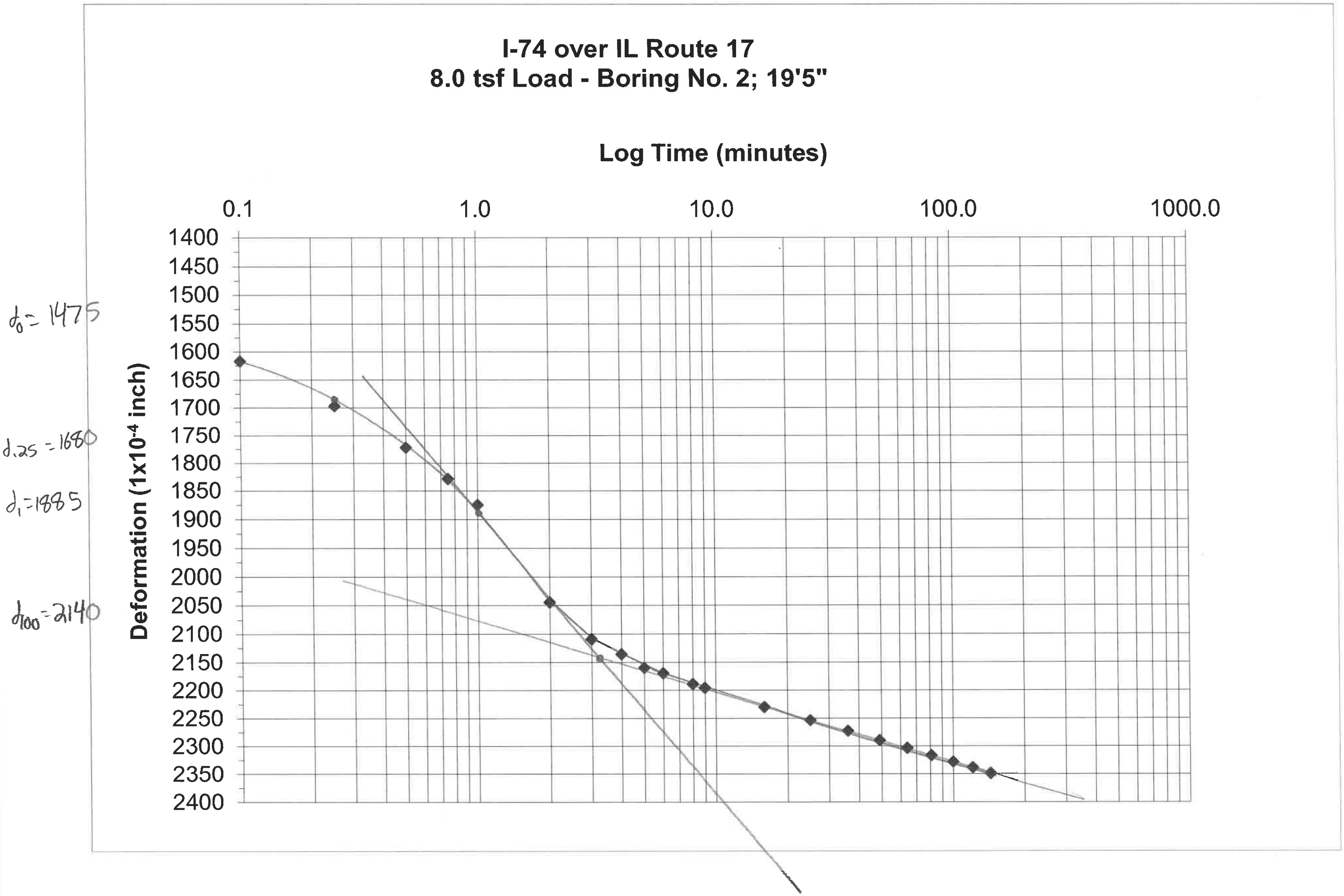

I-74 over IL Route 17
2.0 tsf Load - Boring No. 2; 19'5"
Square Root of Time (minutes)
0 1 2 3 4 5 6 7 8 9 10 11
Deformation (1x10-4 inch)
430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590
√t50 = 0.41 mins
t50 = 0.17 mins
d0 = 440
d90 = 504



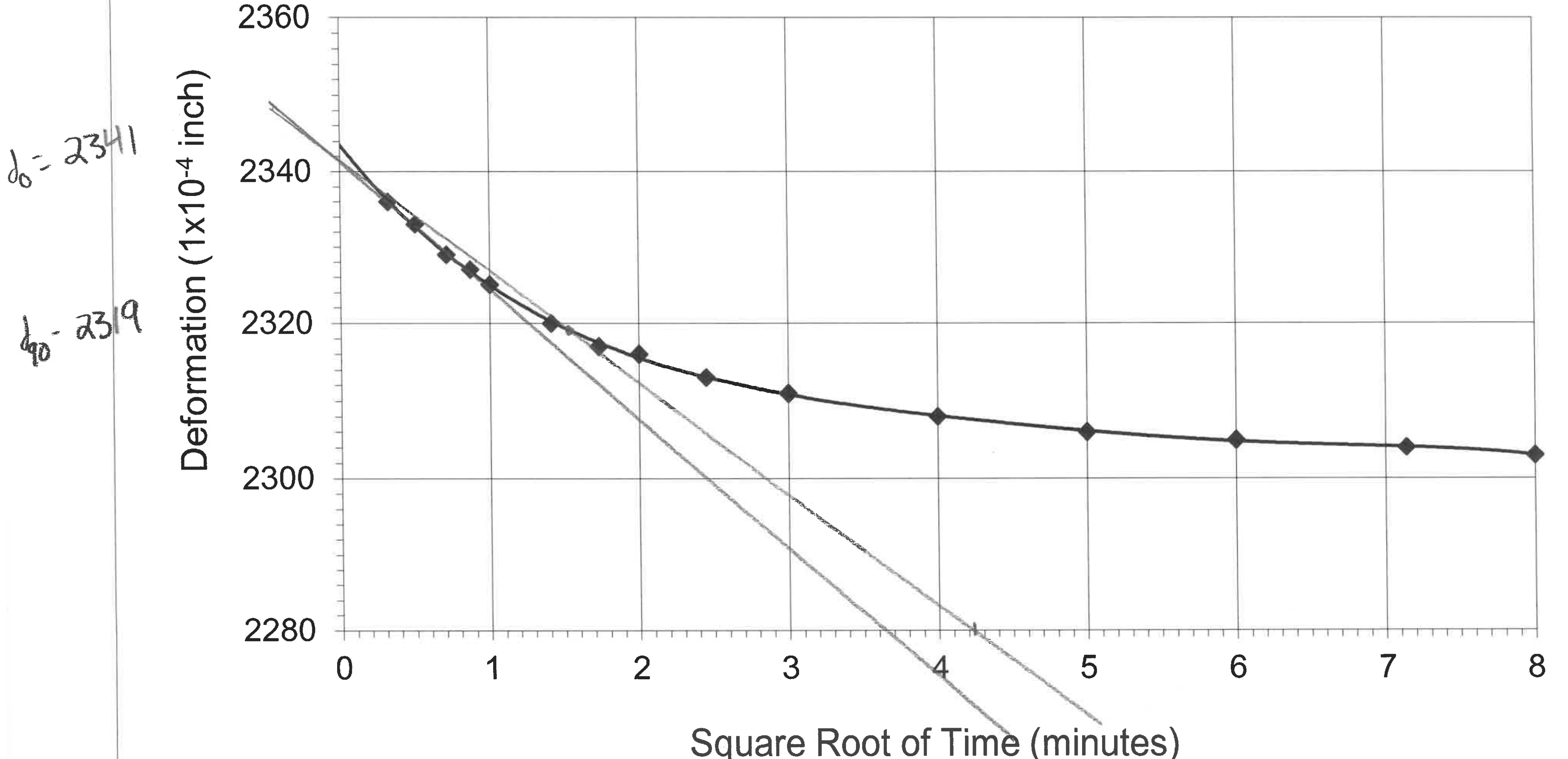
I-74 over IL Route 17
2.0 tsf Load - Boring No. 2; 19'5"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
440
450
460
470
480
490
500
510
520
530
540
550
560
570
580
590
600
d0 = 438
d100 = 504

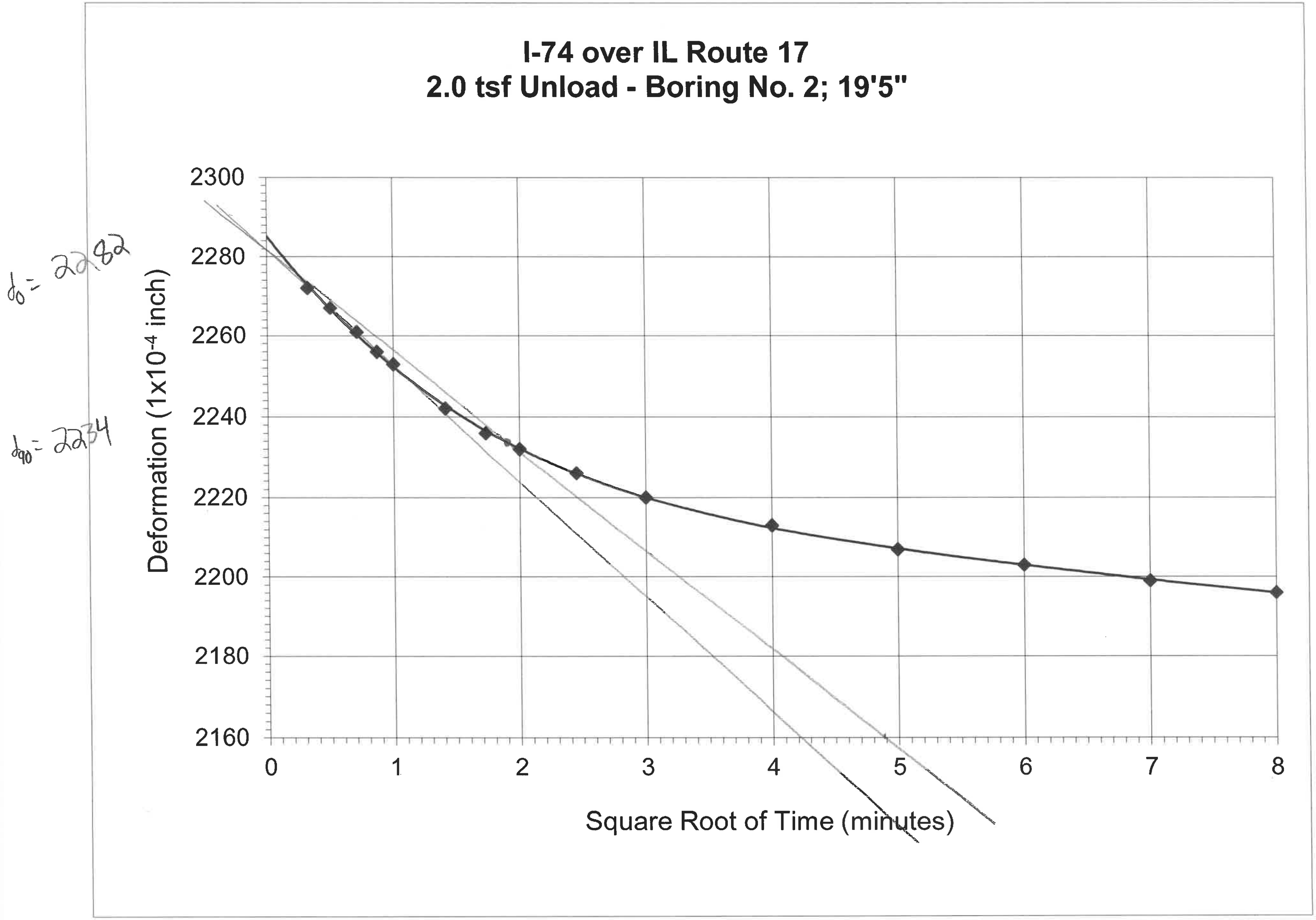

I-74 over IL Route 17
4.0 tsf Load - Boring No. 2; 19'5"
Square Root of Time (minutes)
Deformation (1x10-4 inch)
√t50 = 0.6 min
t50 = 0.36 min
d0 = 708
d90 = 910
0
1
2
3
4
5
6
7
8
9
10
11
680
700
720
740
760
780
800
820
840
860
880
900
920
940
960
980
1000
1020
1040
1060
1080
1100
1120
1140

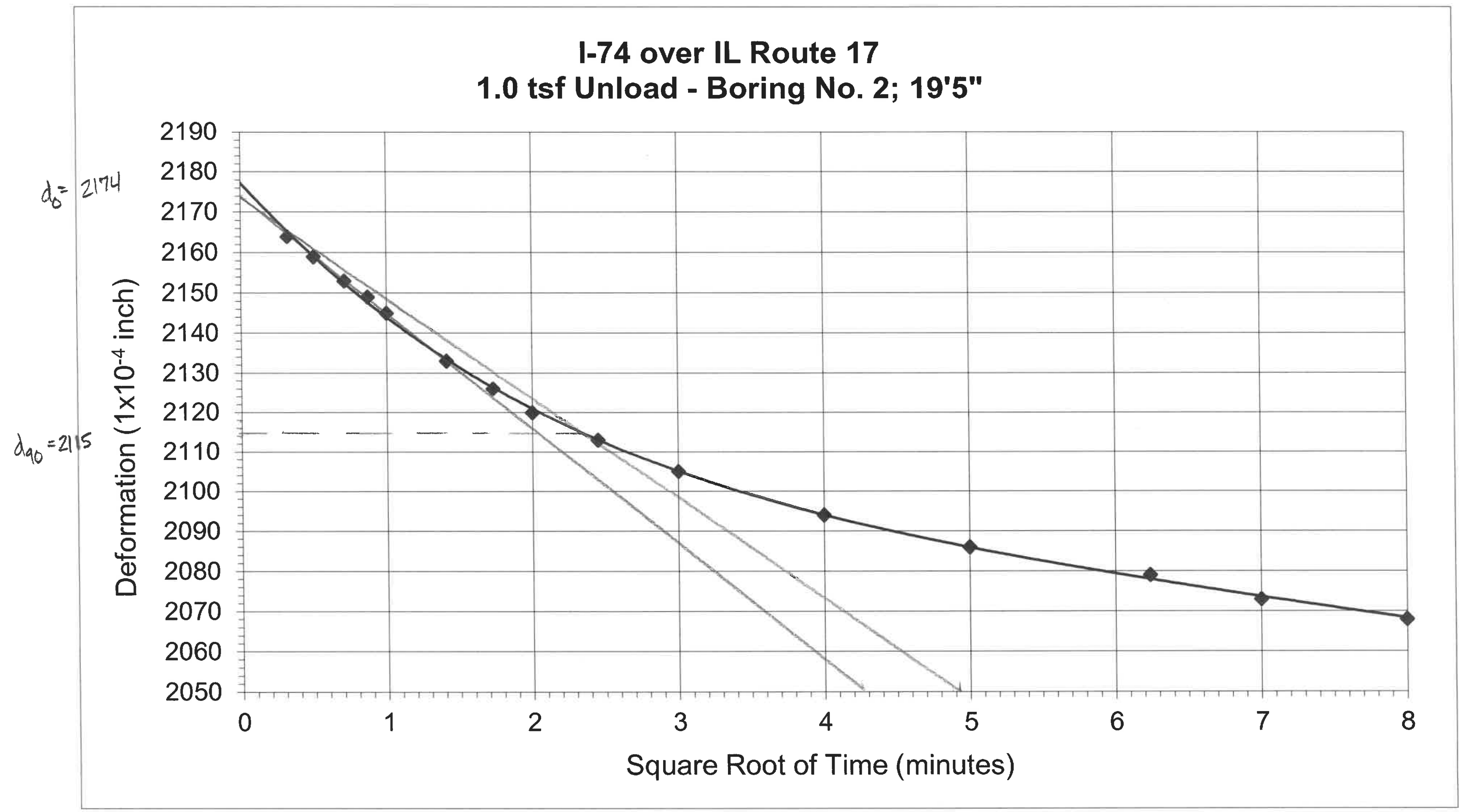

I-74 over IL Route 17
8.0 tsf Load - Boring No. 2; 19'5"
Square Root of Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
11
12
Deformation (1x10^{-4} inch)
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
2050
2100
2150
2200
2250
2300
2350
2400
d_0 = 1475
d_{90} = 2100

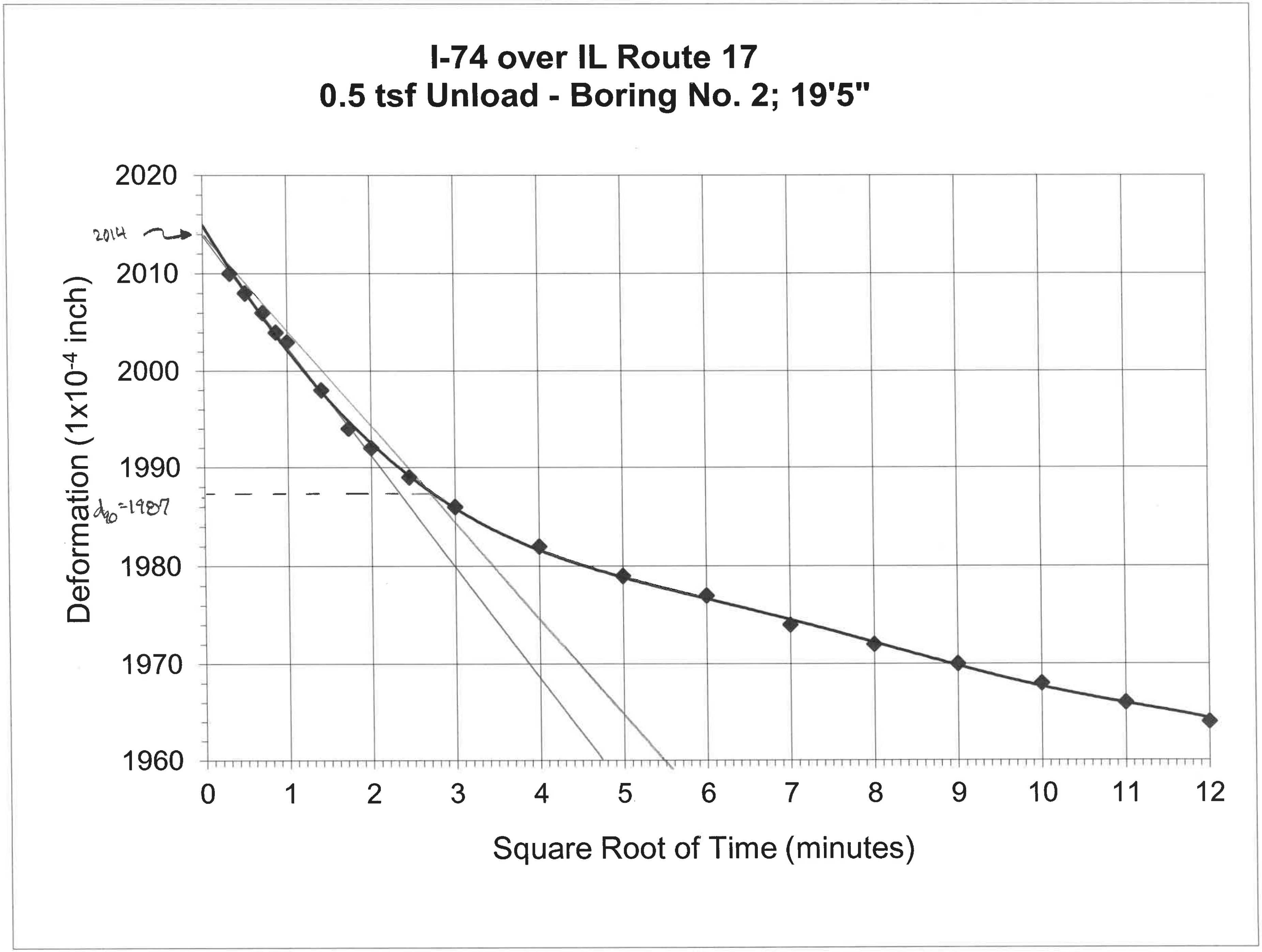

I-74 over IL Route 17
8.0 tsf Load - Boring No. 2; 19'5"
Log Time (minutes)
0.1
1.0
10.0
100.0
1000.0
Deformation (1x10-4 inch)
1400
1450
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
2050
2100
2150
2200
2250
2300
2350
2400
d_0 = 1475
$d_{.25}$ = 1680
d_1 = 1885
d_{100} = 2140

I-74 over IL Route 17
4.0 tsf Unload - Boring No. 2; 19'5"

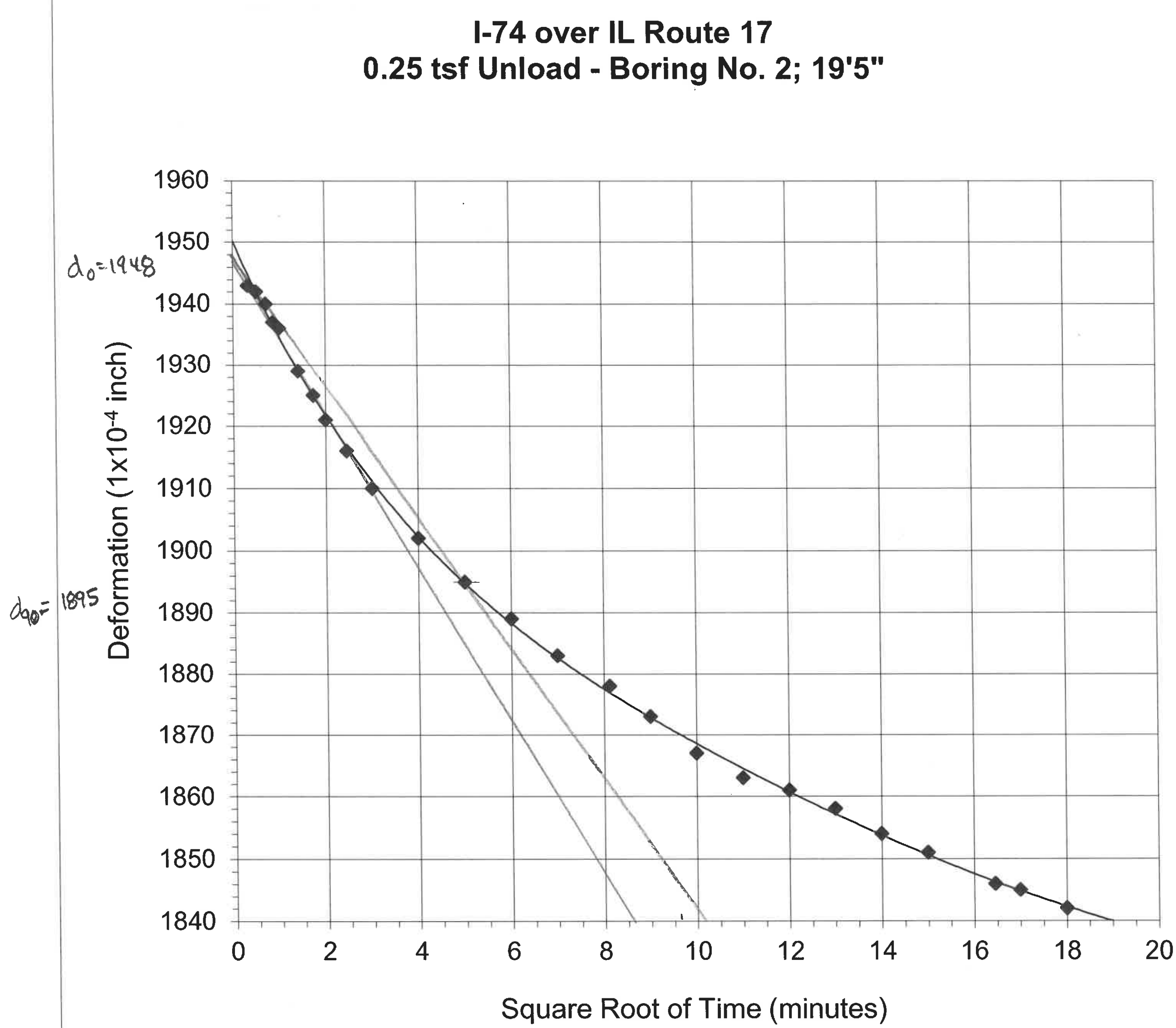


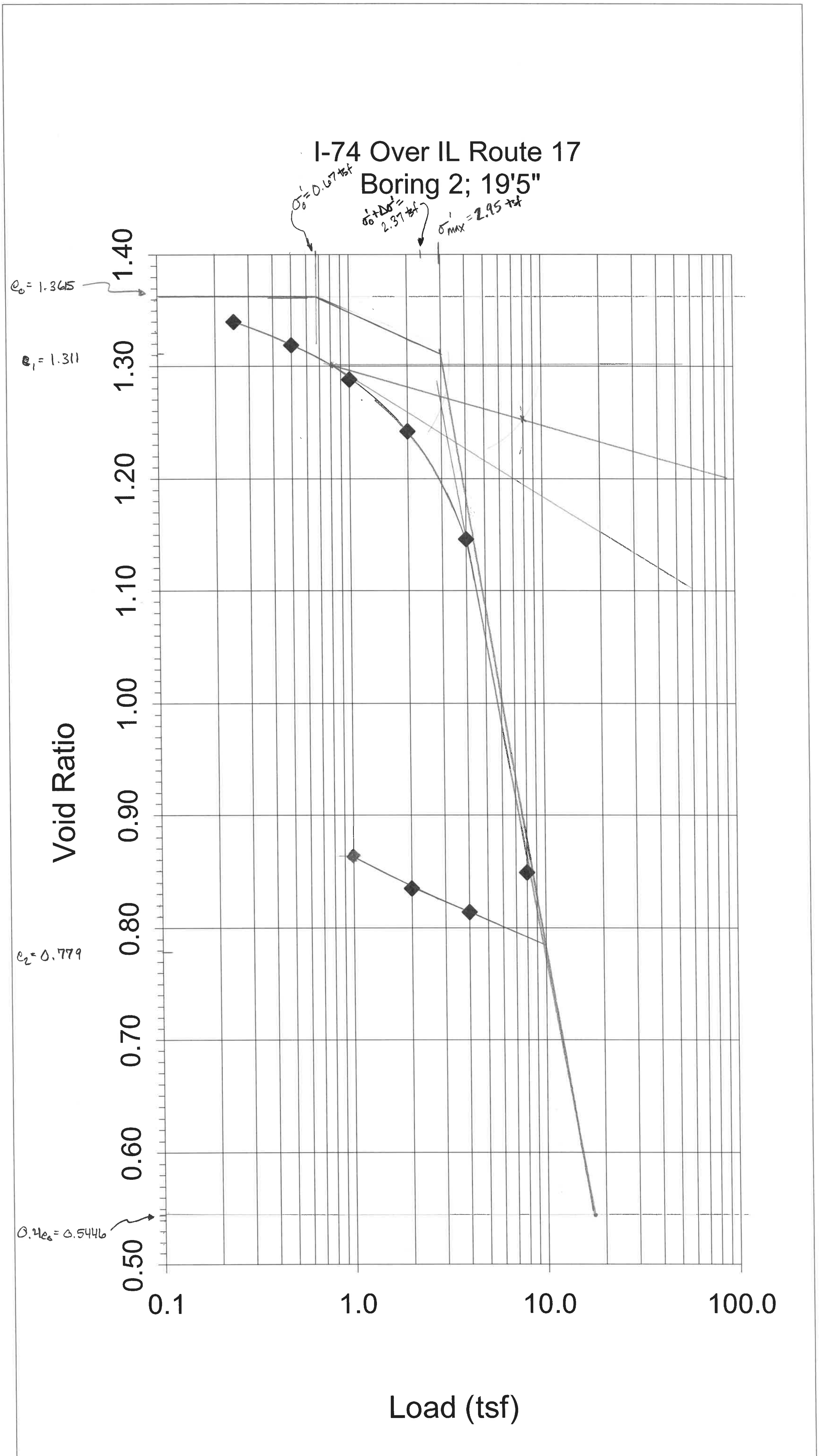

I-74 over IL Route 17
2.0 tsf Unload - Boring No. 2; 19'5"
Deformation (1x10^{-4} inch)
Square Root of Time (minutes)
2300
2280
2260
2240
2220
2200
2180
2160
0
1
2
3
4
5
6
7
8
d_0 = 2282
d_{90} = 2234

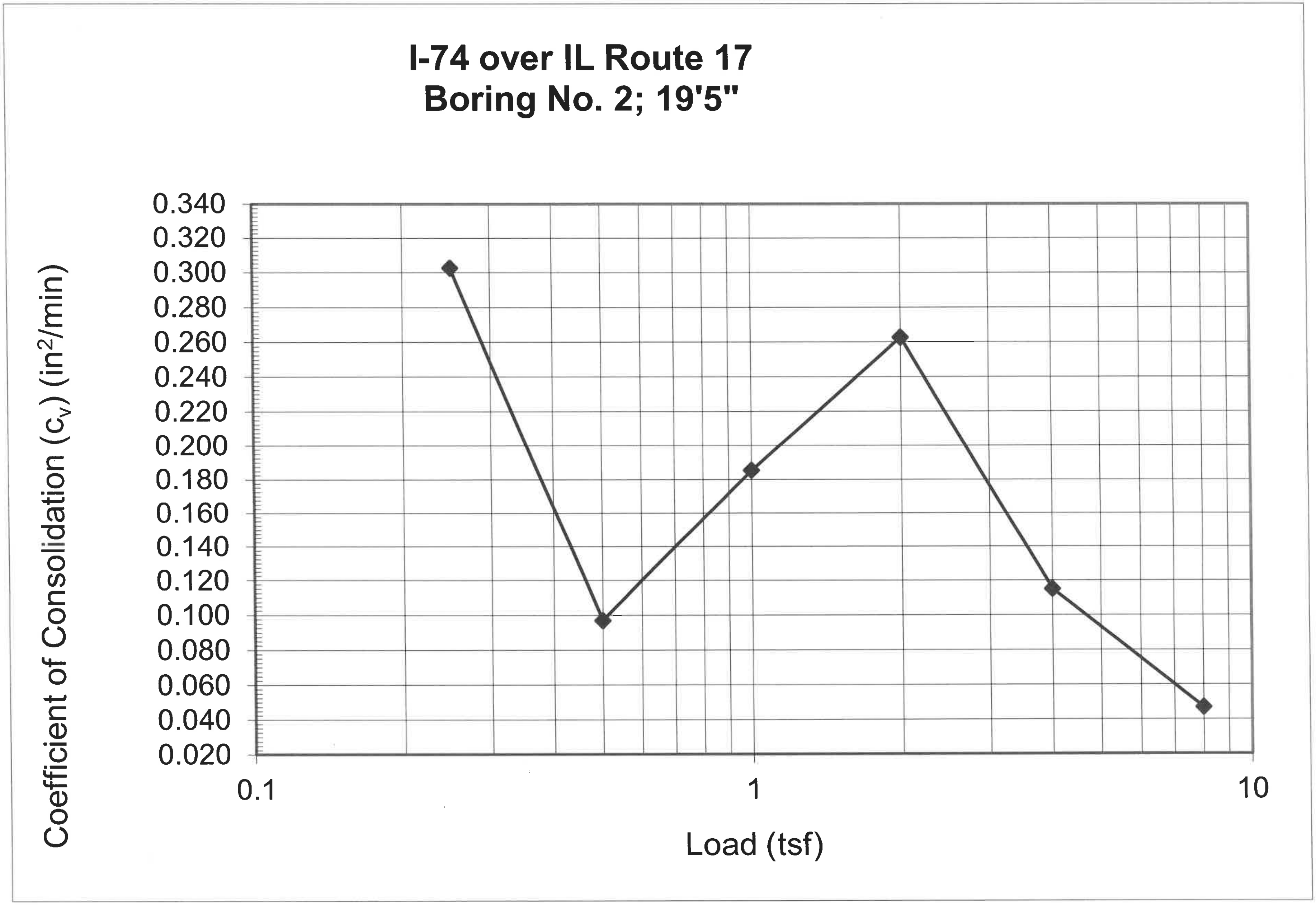

I-74 over IL Route 17
1.0 tsf Unload - Boring No. 2; 19'5"
Deformation (1x10-4 inch)
Square Root of Time (minutes)
2190
2180
2170
2160
2150
2140
2130
2120
2110
2100
2090
2080
2070
2060
2050
0
1
2
3
4
5
6
7
8
d0= 2174
d90 =2115

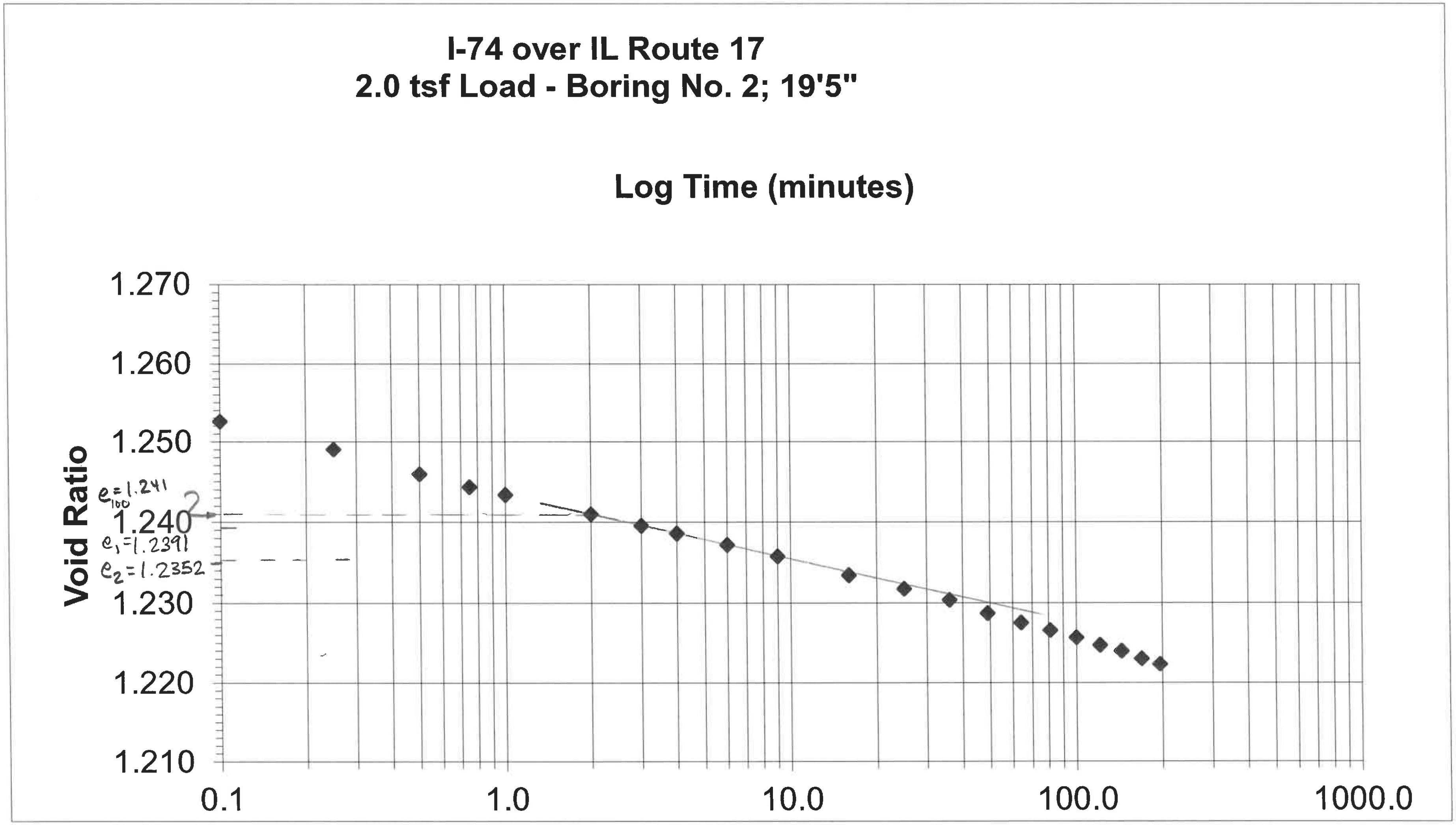


I-74 over IL Route 17
0.5 tsf Unload - Boring No. 2; 19'5"
Deformation (1x10-4 inch)
Square Root of Time (minutes)
2020
2010
2000
1990
1980
1970
1960
0
1
2
3
4
5
6
7
8
9
10
11
12
2014
d90=1987


I-74 over IL Route 17
0.25 tsf Unload - Boring No. 2; 19'5"
Deformation (1x10⁻⁴ inch)
Square Root of Time (minutes)
1960
1950
1940
1930
1920
1910
1900
1890
1880
1870
1860
1850
1840
0
2
4
6
8
10
12
14
16
18
20
d0=1948
d90= 1895


I-74 Over IL Route 17
Boring 2; 19'5"
σ'0 = 0.67 tsf
σ'0+Δσ' = 2.37 tsf
σ'max = 2.95 tsf
e0 = 1.3615
e1 = 1.311
e2 = 0.779
0.4e0 = 0.5446
Void Ratio
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.1
1.0
10.0
100.0
Load (tsf)


I-74 over IL Route 17
Boring No. 2; 19'5"
0.340
0.320
0.300
0.280
0.260
0.240
0.220
0.200
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
Coefficient of Consolidation (c$_v$) (in^2/min)
0.1
1
10
Load (tsf)



d_{100} = 511x10^{-4} → e_{100} = 1.241

APPENDIX E

SETTLEMENT CALCULATIONS

HR HURST-ROSCHE, INC.

PROJECT: I-74 over IL Route 17 SHEET NO: 1 OF: 3

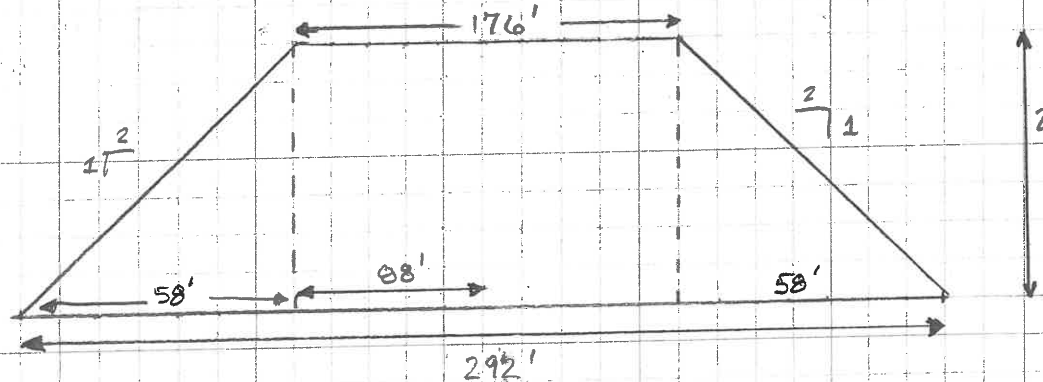
COMPUTATIONS FOR: Settlement Overburden Pressures DESIGNED: MEE DATE: 1/4/22

JOB CODE: 192-2211 CHECKED: DATE:

North End Placement of Fill (Boring Nos. 2 and 4)

Proposed Fill height ≐ 29 ft.

Per IDOT Geotech Manual, pg 6-33 → $\gamma = 125$ pcf, $Q_u = 1.0$ tsf for new embankment.



Considering fill will be placed as bridge cone with 2 to 1 sideslopes.
Utilize guidance in IDOT Design Guide for Cohesive Soil Settlement Estimate, Dec 2014

Pressure at embankment base & $p = 29\text{ ft}(125\text{ lb/ft}^3) = 3{,}625\text{ lb/ft}^2$

Boring 2 (WB)

		0'	809.4
Qu=2.8	Silty Clay		
		3.5'	805.9 (4.5' H_2O)
Qu=0.5, Qu=0.4	Silty Clay Loam		
		8.5'	800.9
Qu=1.0, Qu=1.3	Silty Loam		
		14.0'	795.4
Qu=1.6	Silt		
		16.0'	793.4
Qu=2.5, Qu=2.3	Muck		
		21.0'	788.4

Boring 4 (EB)

		0'	809.7
Qu=3.5, Qu=1.7	silty clay		(5.5 H_2O)
		6'	803.7
Qu=0.4, Qu=0.5	silty clay loam		
		11'	798.7
Qu=0.9	silty loam		
		13.5'	796.2
Qu=1.0, Qu=0.7	Muck		
		18.5'	791.2

Consider silty clay loam layers 3.

3.5' - 8.5' → Mid point = 6.0' Applied pressure $\sigma_z = \frac{2p}{\pi}\left[\beta + \frac{b\alpha}{2a}\right]$

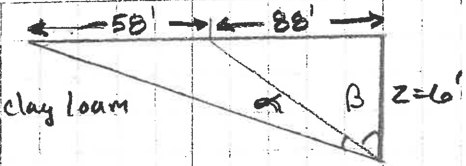
HURST-ROSCHE, INC.

PROJECT: I-74 over IL Route 17 | SHEET NO: 2 | OF: 3

COMPUTATIONS FOR: Settlement - Overburden Pressures | DESIGNED: MEE | DATE: 1/4/22

JOB CODE: 192 - 2211 | CHECKED: | DATE:

For z = 6 ft
B2 Silty clay loam



$\tan\beta = \frac{opp}{adj} \rightarrow \beta = \tan^{-1}\frac{88}{6} \Rightarrow \beta = 86.10°$

$\beta = 1.50$ radian

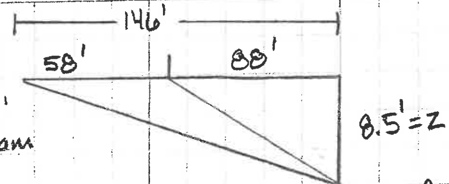
$\tan(\alpha+\beta) = \frac{146}{6} \Rightarrow (\alpha+\beta) = \tan^{-1}\frac{146}{6}$

$(\alpha+\beta) = 87.6° = 1.53$ radians

$\alpha = 87.6 - 86.1 = 1.5°$ — $\alpha = 0.027$ radians ✓

$\alpha = 1.53 - \beta = 1.53 - 1.50 = 0.03$ radians ✓

For z = 8.5 ft.
B4 Silty Clay Loam



$\beta = \tan^{-1}\frac{88}{8.5} \Rightarrow \beta = 84.48° = 1.47$ radian

$(\alpha+\beta) = \tan^{-1}\frac{146}{8.5}$

$\alpha+\beta = 86.67$

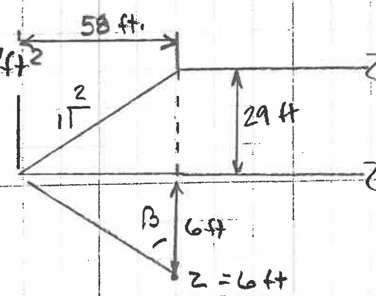
$\alpha = 86.67 - 84.48 = 2.19° = 0.038$ rads

$$\sigma_z = \frac{2p}{\pi}\left(\beta + \frac{b\alpha}{2a}\right)$$

$a = 58$ ft, $b = 292$ ft, $p = 3,625$ lb/ft²

At 6 ft depth: (Boring 2) $\sigma_6 = \frac{2(3,625)}{\pi}\left(1.50 + \frac{292(0.027)}{2(58)}\right) = 2,307.7(1.568) = 3,618$ lb/ft²

At end slope: $\sigma_6 = 3,618/2 = 1,809$ lb/ft²



For end cone loading: $\sigma_z = \frac{p}{\pi}(\beta)$

$\tan\beta_E = \frac{opp}{adj} = \frac{58}{6} \rightarrow \beta_E = \tan^{-1}\frac{58}{6} \Rightarrow \beta = 84.09°$

$\beta_E = 1.47$ radians

End cone $\sigma_6 = \frac{3,625}{\pi}(1.47) = 1,696$ lb/ft²

Total pressure at 6 ft depth: $\sigma_6 = 1,809 + 1,696 = 3,505$ lb/ft²

At 8.5 ft depth (Boring 4):

$\sigma_{8.5} = 2,308\left(1.47 + \frac{292(0.038)}{2(58)}\right) = 2,308(1.566) = 3,614$ lb/ft²

At end slope: $3,614/2 = 1,807$

$\beta_E = \tan^{-1}\frac{58}{8.5} \Rightarrow \beta_E = 81.66° = 1.43$ rads

End cone $\sigma_{8.5} = \frac{3,365}{\pi}(1.43) = 1,532$ lb/ft²

Total pressure at 8.5 ft: $\sigma_{8.5} = 1,807 + 1,532 = 3,339$ lb/ft²

HR **HURST-ROSCHE, INC.**

PROJECT: I-74 Over IL 17 SHEET NO: 3 OF: 3

COMPUTATIONS FOR: Settlement - Overburden Pressures DESIGNED: MEE DATE: 1/18/22

JOB CODE: 192-2211 CHECKED: DATE:

Boring No. 4; 6'2" Consol Sample

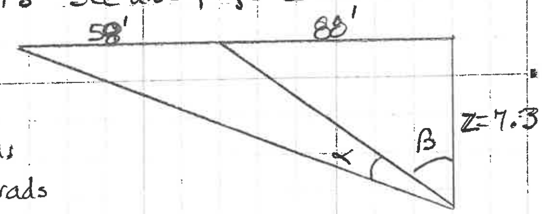
Using Average of Boring No. 2 & 4

Thickness = (5' + 5)/2 = 5 ft.

Intial over burden pressure of at center of silty clay loam:

Avg. Depth of Center of Layer = (8.5 + 6)/2 = 7.3 ft

Pressure at 7.3 ft due to endslope embankments: See also page 2



$\beta = \tan^{-1}\frac{88}{7.3} \rightarrow \beta = 85.26° = 1.488$ rads

$(\alpha + \beta) = \tan^{-1}\frac{146}{7.3} \rightarrow \alpha + \beta = 87.14° = 1.521$ rads

$\alpha = 1.521 - 1.488 = 0.033$ rads

$\sigma_{7.5} = \frac{2p}{\pi}\left(\beta + \frac{b\alpha}{2a}\right) = \frac{2(3,625)}{\pi}\left(1.488 + \frac{292(0.033)}{2(58)}\right)$

$= 2,308(1.571) = 3,626$

For endslope: $\sigma_{7.5} = 3,626/2 = 1,813$ psf

For end cone loading: $\sigma_{7.5} = \frac{p}{\pi}(\beta) = \frac{3,625}{\pi}(1.488) = 1,717$ psf

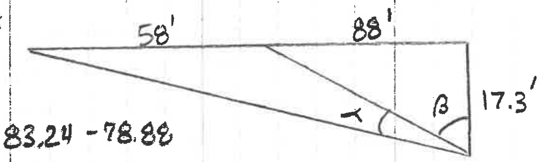
Total pressure at 7.5 ft ($\Delta\sigma$) = 1,813 + 1,717 = 3,530 psf = 1.77 tsf

For Consolidation sample B2; 19'5" (Muck)

Using Average of B2 & B4: Avg. Center Depth = $\left(\frac{13.5 + 18.5}{2}\right) + \left(\frac{16 + 21}{2}\right)/2 = (16 + 18.5)/2 = 17.3$ ft

Center of layer is 17.3 ft. depth

Pressure at 17.3 ft. due to embankment:



$\beta = \tan^{-1}\frac{88}{17.3} \rightarrow \beta = 78.88° = 1.377$ rads

$\alpha + \beta = \tan^{-1}\frac{146}{17.3} \rightarrow \alpha + \beta = 83.24$ $\alpha = 83.24 - 78.88$

$\alpha = 4.36° = 0.076$ rads

$\sigma_{17.3} = \frac{2(3,625)}{\pi}\left(1.377 + \frac{292(0.076)}{2(58)}\right) = 2,308(1.568) = 3,619$ psf

For embankment: $\sigma_{17.3} = 3,619/2 = 1,809$ psf

For endcone: $\sigma_{17.3} = \frac{3,625}{\pi}(1.377) = 1,589$ psf

Total pressure at 17.5 ft ($\Delta\sigma$) = 1,809 + 1,589 = 3,398 psf = 1.70 tsf

Silty Clay Loam Layer

Initial Effective Stress

Initial Dry Unit Weight of Silty Clay Loam: $\gamma_{d1} := 94.8 \ \frac{lb}{ft^3}$

Initial Moisture Content of Silty Clay Loam: $w_1 := 29.5 \ \%$

Unit Weight of Silty Clay Loam: $\gamma_1 := \left(\gamma_{d1} \cdot \left(1 + \frac{w_1}{100}\right)\right)$

$\gamma_1 = 122.8 \quad \frac{lb}{ft^3}$

Sample Depth: $D := 6.2 \ ft$

Water Depth: $D_w := 5 \quad ft$

Initial Effective Soil Pressure at Sample Depth:

$$\sigma_0 := \gamma_1 \cdot D_w + \left(D - D_w\right) \cdot \left(\gamma_1 - 62.4\right)$$

$$\sigma_0 = 686.3 \quad \frac{lb}{ft^2}$$

$$\sigma_0 := \frac{\sigma_0}{2000}$$

$$\sigma_0 = 0.34 \quad \frac{tons}{ft^2}$$

Compression Index $\left(C_c\right)$

$e_1 := 0.736 \qquad \sigma_1 := 1 \quad \frac{tons}{ft^2}$

$e_2 := 0.415 \qquad \sigma_2 := 100 \quad \frac{tons}{ft^2}$

$$c_c := \left(\frac{e_1 - e_2}{\log_{10}\left(\frac{\sigma_2}{\sigma_1}\right)}\right)$$

$$c_c = 0.161$$

Estimation of Settlement

Thickness of Compressible Layer: $H := 5$ *ft*

Initial Void Ratio: $e_o := 0.810$

Depth of Center of Compressible Layer: $D_c := 7.3$ *ft*

Effective Overburden Pressure at Center of Compressible Layer:

$$P_o := \gamma_1 \cdot D_w + \left(D_c - D_w\right) \cdot \left(\gamma_1 - 62.4\right)$$

$$P_o = 752.7 \quad \frac{lb}{ft^2}$$

$$P_o := \frac{P_o}{2000}$$

$$P_o = 0.38 \quad \frac{tons}{ft^2}$$

Increase in Pressure at Center of Compressible Layer: $\Delta P := 1.77 \ \frac{tons}{ft^2}$

Estimated Primary Settlement: $S := \frac{c_c \cdot H}{1 + e_o} \cdot \log_{10}\left(\frac{P_o + \Delta P}{P_o}\right)$

$$S = 0.34 \quad ft$$

$S := S \cdot 12 \qquad S = 4.0$ *inches*

Total Effective Pressure at Center of Compressible Layer:

$$P_T := P_o + \Delta P$$

$$P_T = 2.15 \quad \frac{tons}{ft^2}$$

Time for Consolidation

$c_v := 0.0139$ sq in/min

$$H := H \cdot 12$$

$H = 60$ *inches*

Time for 50% Consolidation

$$T_{50} := 0.197$$

$t_{50} := \frac{T_{50}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{50} = 12755$ minutes

$t_{50} := t_{50} \cdot \frac{1}{60} \cdot \frac{1}{24} \qquad t_{50} = 8.9$ days

$S_{50} := S \cdot 0.50 \qquad S_{50} = 2.0$ inches will occur

$S_{remain} := S - S_{50} \qquad S_{remain} = 2.0$ inches remaining

Time for 90% Consolidation

$T_{90} := 0.848$

$t_{90} := \frac{T_{90}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{90} = 54906$ *minutes*

$t_{90} := t_{90} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{90} = 38.1$ *days*

$S_{90} := S \cdot 0.90$ $S_{90} = 3.6$ inches will occur

$S_{remain} := S - S_{90}$ $S_{remain} = 0.4$ inches remaining

Time for 95% Consolidation

$T_{95} := 1.129$

$t_{95} := \frac{T_{95}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{95} = 73101$ *minutes*

$t_{95} := t_{95} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{95} = 50.8$ *days*

$S_{95} := S \cdot 0.95$ $S_{95} = 3.8$ inches will occur

$S_{remain} := S - S_{95}$ $S_{remain} = 0.2$ inches remaining

Muck Layer

HURST-ROSCHE, INC.

PROJECT: I-74 Over IL Route 17 SHEET NO: 1 OF: 1
COMPUTATIONS FOR: Settlement - Muck Layer DESIGNED: MEE DATE: 1/21/22
JOB CODE: 192-2211 CHECKED: DATE:

Primary settlement of Muck Layer

$\sigma_o' = 0.67$ tsf

$C_r = 0.081$ between 0 & 2.95 tsf (σ'_{max})
$C_c = 1.017$ for $\sigma' > 2.95$ tsf

For muck layer at center $\sigma_o + \Delta\sigma_o = 0.67$ tsf $+ 1.70 = 2.37$ tsf
Therefore since $(\sigma_o' + \Delta\sigma_o') < \sigma'_{max} = 2.95$ tsf, all settlement will be attributed to recompression.

Interstate 74 Over IL Route 17

Boring No. 2; 19'5"

Initial Effective Stress

Typical Dry Unit Weight of Soils Above Muck: $\gamma_{d1} := 94.8 \ \frac{lb}{ft^3}$

Typical Moisture Content of Soils Above Muck: $w_1 := 29.5 \ \%$

Unit Weight of Soil Above Muck: $\gamma_1 := \left(\gamma_{d1} \cdot \left(1 + \frac{w_1}{100}\right)\right)$

$\gamma_1 = 122.8 \ \frac{lb}{ft^3}$

Initial Dry Unit Weight of Muck: $\gamma_{d2} := 54.8 \ \frac{lb}{ft^3}$

Initial Moisture Content of Muck: $w_2 := 68.7 \ \%$

Unit Weight of Muck: $\gamma_2 := \left(\gamma_{d2} \cdot \left(1 + \frac{w_2}{100}\right)\right)$

$\gamma_2 = 92.4 \ \frac{lb}{ft^3}$

Sample Depth: $D := 19.4 \ ft$

Water Depth: $D_w := 5 \ ft$

Depth to top of Muck: $D_M := 14.8 \ ft$

Initial Effective Soil Pressure at Sample Depth:

$$\sigma_0 := \gamma_1 \cdot D_w + \left(D_M - D_w\right) \cdot \left(\gamma_1 - 62.4\right) + \left(D - D_M\right) \cdot \left(\gamma_2 - 62.4\right)$$

$$\sigma_0 = 1343.6 \ \frac{lb}{ft^2}$$

$$\sigma_0 := \frac{\sigma_0}{2000}$$

$$\sigma_0 = 0.67 \ \frac{tons}{ft^2}$$

Compression Index $\left(C_c\right)$

$e_1 := 1.311 \qquad \sigma_1 := 3 \ \frac{tons}{ft^2}$

$e_2 := 0.779 \qquad \sigma_2 := 10 \ \frac{tons}{ft^2}$

$$c_c := \left(\frac{e_1 - e_2}{\log_{10}\left(\frac{\sigma_2}{\sigma_1}\right)}\right)$$

$$c_c = 1.017$$

Recompression Index $\left(C_r\right)$

$e_3 := 0.863 \qquad \sigma_3 := 1 \qquad \frac{tons}{ft^2}$

$e_4 := 0.814 \qquad \sigma_4 := 4 \qquad \frac{tons}{ft^2}$

$$c_r := \frac{e_3 - e_4}{\log10\left(\frac{\sigma_4}{\sigma_3}\right)}$$

$c_r = 0.081$

Estimation of Settlement

Thickness of Compressible Layer: $H := 5 \quad ft$

Initial Void Ratio: $e_o := 1.3615$

Depth of Center of Compressible Layer: $D_c := 17.3 \; ft$

Effective Overburden Pressure at Center of Compressible Layer:

$$P_o := \gamma_1 \cdot D_w + \left(D_M - D_w\right) \cdot \left(\gamma_1 - 62.4\right) + \left(D - D_M\right) \cdot \left(\gamma_2 - 62.4\right)$$

$P_o = 1343.6 \quad \frac{lb}{ft^2}$

$P_o := \frac{P_o}{2000}$

$P_o = 0.67 \quad \frac{tons}{ft^2}$

Increase in Pressure at Center of Compressible Layer: $\Delta P := 1.70 \quad \frac{tons}{ft^2}$

Total Effective Pressure at Center of Compressible Layer:

$P_T := P_o + \Delta P$

$P_T = 2.37 \quad \frac{tons}{ft^2}$

Since total pressure (original + applied) will be less than maximum previously applied pressure of 2.95 tsf, all settlement will be associated with recompression of soil.

Estimated Primary Settlement:

$$S := \frac{c_r \cdot H}{1 + e_o} \cdot \log_{10}\left(\frac{P_o + \Delta P}{P_o}\right)$$

$S = 0.09 \quad ft$

$S := S \cdot 12 \qquad S = 1.1 \quad inches$

Time for Consolidation

$c_v := 0.2627$ sq in/min for 2.0 tsf load increment

$H := H \cdot 12$

$H = 60$ *inches*

Time for 50% Consolidation

$T_{50} := 0.197$

$t_{50} := \frac{T_{50}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{50} = 675$ minutes

$t_{50} := t_{50} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{50} = 0.5$ days

$S_{50} := S \cdot 0.50$ $S_{50} = 0.6$ inches will occur

$S_{remain} := S - S_{50}$ $S_{remain} = 0.6$ inches remaining

Time for 90% Consolidation

$T_{90} := 0.848$

$t_{90} := \frac{T_{90}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{90} = 2905$ *minutes*

$t_{90} := t_{90} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{90} = 2.0$ *days*

$S_{90} := S \cdot 0.90$ $S_{90} = 1.0$ inches will occur

$S_{remain} := S - S_{90}$ $S_{remain} = 0.1$ inches remaining

Time for 95% Consolidation

$T_{95} := 1.129$

$t_{95} := \frac{T_{95}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{95} = 3868$ *minutes*

$t_{95} := t_{95} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{95} = 2.7$ *days*

$S_{95} := S \cdot 0.95$ $S_{95} = 1.1$ inches will occur

$S_{remain} := S - S_{95}$ $S_{remain} := 0.0$ inches remaining

Secondary Settlement

From e vs. time log plot

$e_2 := 1.2391$ $e_1 := 1.2352$ $t_2 := 10.0$ mins $t_1 := 3.0$ mins

$$c_\alpha := \frac{e_2 - e_1}{\log_{10}\left(\frac{t_2}{t_1}\right)}$$

$c_\alpha = 0.007$

Void Ratio at End of Primary Conslidation for 2.0 tsf Load: $e_{100} := 1.241$

Time period interest from start of primary settlement: $t_x := 1$ years

Time for primary settlement (90%) to occur: $t_{90} = 2$ days

$$t_{90} := t_{90} \cdot \frac{1}{365}$$

$t_{90} = 0.0055$ *years*

Height of Compressible Layer: $H := 5$ ft

$$S_s := \frac{c_\alpha}{1 + e_{100}} \cdot H \cdot \log_{10}\left(\frac{t_x}{t_{90}}\right)$$

$S_s = 0.038$ *ft*

$S_s := S_s \cdot 12$

$S_s = 0.5$ *inches*

Time period interest from start of primary settlement: $t_x := 1$ years

Time for primary settlement (95%) to occur: $t_{95} = 2.7$ days

$$t_{95} := t_{95} \cdot \frac{1}{365}$$

$t_{95} = 0.0074$ *years*

Height of Compressible Layer: $H := 5$ ft

$$S_s := \frac{c_\alpha}{1 + e_{100}} \cdot H \cdot \log_{10}\left(\frac{t_x}{t_{95}}\right)$$

$S_s = 0.035$ *ft*

$S_s := S_s \cdot 12$

$S_s = 0.4$ *inches*

Time period interest from start of primary settlement: $t_x := 365$ days

$t_x := t_x \cdot \frac{1}{365}$

$t_x = 1$ years

Time for primary settlement (95%) to occur within silty clay loam layer (time period before piles are installed) :

$t_{95} := 51$ days

$t_{95} := t_{95} \cdot \frac{1}{365}$

$t_{95} = 0.1397$ *years*

Height of Compressible Layer: $H := 5$ ft

$$S_s := \frac{c_\alpha}{1 + e_{100}} \cdot H \cdot \log_{10}\left(\frac{t_x}{t_{95}}\right)$$

$S_s = 0.014$ *ft*

$S_s := S_s \cdot 12$

$S_s = 0.2$ *inches*

Time period interest from start of primary settlement: $t_x := 365$ days

$t_x := t_x \cdot \frac{1}{365}$

$t_x = 1$ years

Time for primary settlement (95%) to occur within silty clay loam layer (time period before piles are installed) with wick drains :

$t_{95} := 21$ days

$t_{95} := t_{95} \cdot \frac{1}{365}$

$t_{95} = 0.0575$ *years*

Height of Compressible Layer: $H := 5$ ft

$$S_s := \frac{c_\alpha}{1 + e_{100}} \cdot H \cdot \log_{10}\left(\frac{t_x}{t_{95}}\right)$$

$S_s = 0.021$ *ft*

$S_s := S_s \cdot 12$

$S_s = 0.2$ *inches*

Settlement Due to 10 ft. Surcharge

HR HURST-ROSCHE, INC.

PROJECT: I-74 Over IL Route 17 SHEET NO: 1 OF: 1

COMPUTATIONS FOR: Settlement - Surcharge DESIGNED: MEE DATE: 2/1/22

JOB CODE: 192-2211 CHECKED: DATE:

Surcharge Loading

Say 10 ft. additional surcharge applied.

$\Delta P = 39\ ft \times 125\ pcf = 4{,}875\ psf$

Embankment

$$\sigma_{7.5} = \frac{2(4{,}875\ lb/ft^2)}{\pi}\left(1.488 + \frac{242(0.033)}{2(58)}\right) = 3{,}103(1.571) = 4{,}875/2 = 2{,}437\ psf$$

Endslope

$$\sigma_{7.5} = \frac{P}{\pi}(B) = \frac{4{,}875}{\pi}(1.488) = 2{,}309/2 = 1{,}155\ psf$$

Total $\sigma_{7.5}$ = 3,592 psf + 1,155 = 4,747 psf = 2.37 tsf

Interstate 74 Over IL Route 17
Boring No. 4; 6'2"

Initial Effective Stress

Initial Dry Unit Weight of Silty Clay Loam: $\gamma_{d1} := 94.8 \ \frac{lb}{ft^3}$

Initial Moisture Content of Silty Clay Loam: $w_1 := 29.5 \ \%$

Unit Weight of Silty Clay Loam: $\gamma_1 := \left(\gamma_{d1} \cdot \left(1 + \frac{w_1}{100}\right)\right)$

$\gamma_1 = 122.8 \quad \frac{lb}{ft^3}$

Sample Depth: $D := 6.2 \ ft$

Water Depth: $D_w := 5 \ ft$

Initial Effective Soil Pressure at Sample Depth:

$\sigma_0 := \gamma_1 \cdot D_w + \left(D - D_w\right) \cdot \left(\gamma_1 - 62.4\right)$

$\sigma_0 = 686.3 \quad \frac{lb}{ft^2}$

$\sigma_0 := \frac{\sigma_0}{2000}$

$\sigma_0 = 0.34 \quad \frac{tons}{ft^2}$

Compression Index $\left(C_c\right)$

$e_1 := 0.736 \qquad \sigma_1 := 1 \quad \frac{tons}{ft^2}$

$e_2 := 0.415 \qquad \sigma_2 := 100 \quad \frac{tons}{ft^2}$

$$c_c := \left(\frac{e_1 - e_2}{\log_{10}\left(\frac{\sigma_2}{\sigma_1}\right)}\right)$$

$c_c = 0.161$

Estimation of Settlement

Thickness of Compressible Layer: $H := 5$ ft

Initial Void Ratio: $e_o := 0.810$

Depth of Center of Compressible Layer: $D_c := 7.3$ ft

Effective Overburden Pressure at Center of Compressible Layer:

$$P_o := \gamma_1 \cdot D_w + (D_c - D_w) \cdot (\gamma_1 - 62.4)$$

$$P_o = 752.7 \quad \frac{lb}{ft^2}$$

$$P_o := \frac{P_o}{2000}$$

$$P_o = 0.38 \quad \frac{tons}{ft^2}$$

Increase in Pressure at Center of Compressible Layer: $\Delta P := 2.37 \quad \frac{tons}{ft^2}$

Estimated Primary Settlement: $S := \frac{c_c \cdot H}{1 + e_o} \cdot \log_{10}\left(\frac{P_o + \Delta P}{P_o}\right)$

$$S = 0.38 \quad ft$$

$$S := S \cdot 12 \qquad S = 4.6 \quad inches$$

Total Effective Pressure at Center of Compressible Layer:

$$P_T := P_o + \Delta P$$

$$P_T = 2.75 \quad \frac{tons}{ft^2}$$

Time for Consolidation

$c_v := 0.0139$ sq in/min

$$H := H \cdot 12$$

$$H = 60 \quad inches$$

Time for 50% Consolidation

$$T_{50} := 0.197$$

$t_{50} := \frac{T_{50}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{50} = 12755$ minutes

$t_{50} := t_{50} \cdot \frac{1}{60} \cdot \frac{1}{24} \qquad t_{50} = 8.9$ days

$S_{50} := S \cdot 0.50 \qquad S_{50} = 2.3$ inches will occur

$S_{remain} := S - S_{50} \qquad S_{remain} = 2.3$ inches remaining

Time for 90% Consolidation

$T_{90} := 0.848$

$t_{90} := \frac{T_{90}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{90} = 54906$ *minutes*

$t_{90} := t_{90} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{90} = 38.1$ *days*

$S_{90} := S \cdot 0.90$ $S_{90} = 4.1$ inches will occur

$S_{remain} := S - S_{90}$ $S_{remain} = 0.5$ inches remaining

Time for 95% Consolidation

$T_{95} := 1.129$

$t_{95} := \frac{T_{95}}{c_v} \cdot \left(\frac{H}{2}\right)^2$ considering double drainage pathways

$t_{95} = 73101$ *minutes*

$t_{95} := t_{95} \cdot \frac{1}{60} \cdot \frac{1}{24}$ $t_{95} = 50.8$ *days*

$S_{95} := S \cdot 0.95$ $S_{95} = 4.4$ inches will occur

$S_{remain} := S - S_{95}$ $S_{remain} = 0.2$ inches remaining

Wick Drain Spacing Calculations

HURST-ROSCHE, INC.

PROJECT: I-74 Over IL Route 17 SHEET NO: 1 OF: 1
COMPUTATIONS FOR: Wick Drains DESIGNED: MEE DATE: 2/2/22
JOB CODE: 192-2211 CHECKED: DATE:

Settlement with Wick Drains

As the silty clay loam layer is the limiting layer with a consolidation time of 51 days for 95% consolidation, only the silty clay loam layer will be analyzed for timing with wick drains.

Silty clay loam parameters

$C_v = 0.0139 \text{ in}^2/\text{min} = 20.016 \text{ in}^2/\text{day} = 0.139 \text{ ft}^2/\text{day}$

$H = 5 \text{ ft} = 60 \text{ inches}$

At 30 days: $T_v = \frac{t\,c_v}{(H/2)^2} = \frac{30 \text{ days}(20.016 \text{ in}^2/\text{day})}{(60 \text{ inch}/2)^2} = 0.667 \rightarrow U_v = 84\%$ degree of consolidation would occur

$U = 1-(1-U_v)(1-U_h) \rightarrow U_h = 1-\left(\frac{1-U}{1-U_v}\right)$

Need 95% consolidation to limit settlement to < 0.4 inches at 30 days

$U_h = 1-\left(\frac{1-0.95}{1-0.84}\right) = 0.69$ would need 69% consolidation horizontally

For determining time for wick drainage:

$t = \frac{D^2}{8c_h}\cdot F(n)\cdot \ln\left(\frac{1}{1-U_h}\right)$ $F(n) = \ln\left(\frac{D}{d}\right) - 0.75$

Let $D = 1.05\,D_s$ w/ drain spacing (D_s)

$d = 2.4 \text{ inches} = 0.2 \text{ ft}$

$C_h = C_v = 0.139 \text{ ft}^2/\text{day}$

$U_h = 0.69$

Let $D_s = 3$ ft. $\rightarrow D = 1.05(3) = 3.15$ ft $F(n) = \ln\left(\frac{3.15}{0.2}\right) - 0.75 = 2.0$

$t = \frac{3.15^2}{8(0.139)}\cdot 2.0 \cdot \ln\left(\frac{1}{1-0.69}\right) = 8.92\,(2.0)(1.17) = 21$ days to achieve 69% horz. consol. at 3 ft spacing

Let $D_s = 4$ ft $\rightarrow D = 1.05(4) = 4.2$ ft $F(n) = \ln\left(\frac{4.2}{0.2}\right) - 0.75 = 2.29$

$t = \frac{4.2^2}{8(0.139)}\cdot(2.29)\ln\left(\frac{1}{1-0.69}\right) = 15.86\,(2.3)(1.17) = 43$ days > 30 days

Let $D_s = 3.5$ ft $\rightarrow D = 1.05(3.5) = 3.68$ ft $F(n) = \ln\left(\frac{3.68}{0.2}\right) - 0.75 = 2.16$

$t = \frac{3.68^2}{8(0.139)}(2.16)\ln\left(\frac{1}{1-0.69}\right) = 12.18(2.16)(1.17) = 31$ days

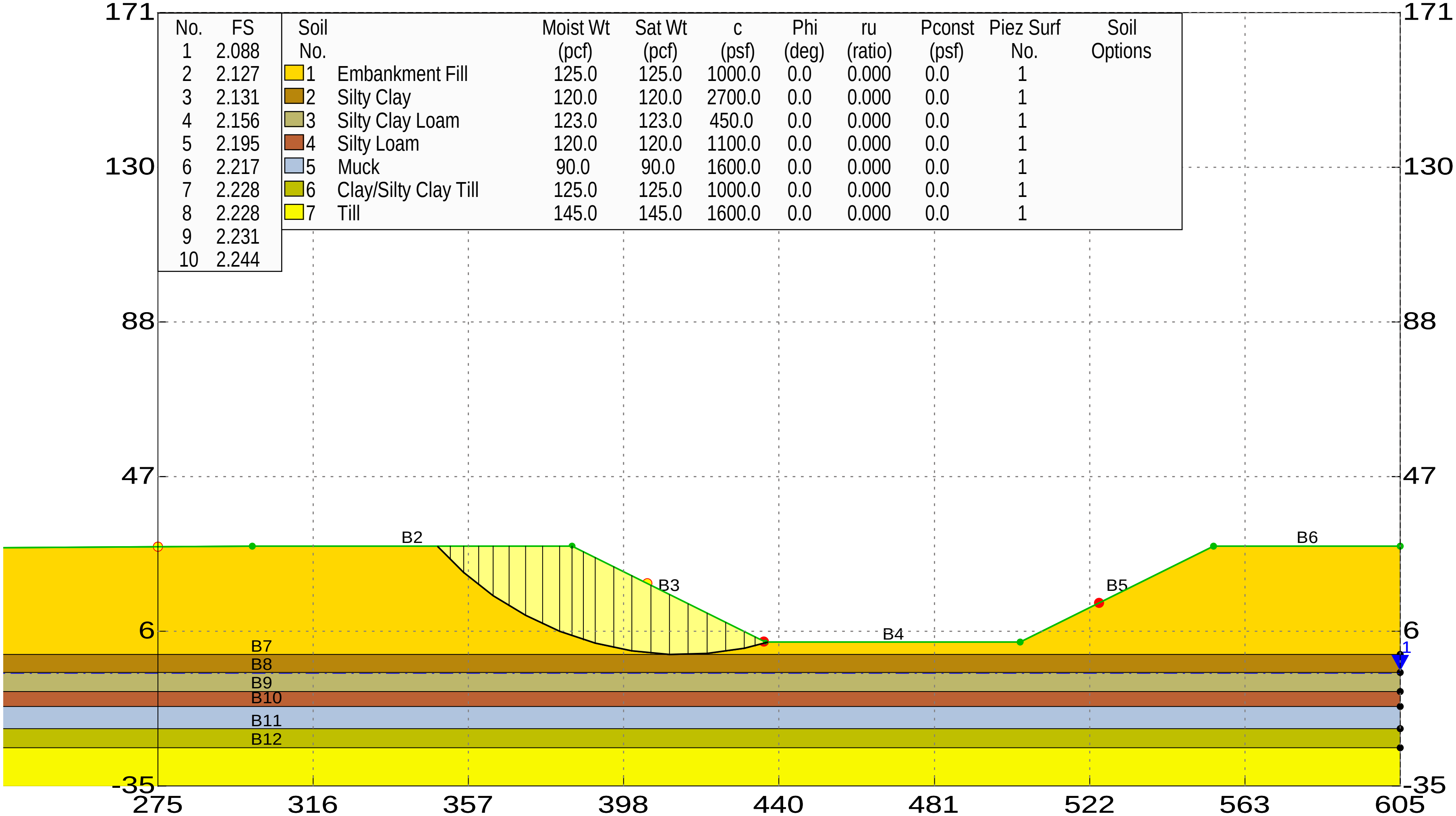
APPENDIX F

STABILITY ANALYSIS CALCULATIONS

Endslope – Static Conditions

I-74 Over IL RTE 17
North Abutment Fill Placement, Boring Nos. 2 and 4

Hurst-Rosche, Inc. \I-74 Stability Calc Case 1.gsd



No.	FS
1	2.088
2	2.127
3	2.131
4	2.156
5	2.195
6	2.217
7	2.228
8	2.228
9	2.231
10	2.244

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Embankment Fill	125.0	125.0	1000.0	0.0	0.000	0.0	1	
2	Silty Clay	120.0	120.0	2700.0	0.0	0.000	0.0	1	
3	Silty Clay Loam	123.0	123.0	450.0	0.0	0.000	0.0	1	
4	Silty Loam	120.0	120.0	1100.0	0.0	0.000	0.0	1	
5	Muck	90.0	90.0	1600.0	0.0	0.000	0.0	1	
6	Clay/Silty Clay Till	125.0	125.0	1000.0	0.0	0.000	0.0	1	
7	Till	145.0	145.0	1600.0	0.0	0.000	0.0	1	

GEOSTASE FS =2.088

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

*** GEOSTASE(R) ***

** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

** Current Version 4.30.31-Double Precision, August 2019 **

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date: 1/ 28/ 2022
Analysis Time:
Analysis By: Hurst-Rosche, Inc.
Input File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 1.gsd
Output File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 1.OUT
Unit System: English

PROJECT: I-74 Over IL RTE 17

DESCRIPTION: North Abutment Fill Placement, Boring Nos. 2 and 4

BOUNDARY DATA

6 Surface Boundaries
12 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	27.100	300.000	29.000	1
2	300.000	29.000	385.000	29.000	1
3	385.000	29.000	436.400	3.300	1
4	436.400	3.300	504.000	3.300	1
5	504.000	3.300	555.400	29.000	1
6	555.400	29.000	605.000	29.000	1
7	0.000	0.000	605.000	0.000	2
8	0.000	-4.800	605.000	-4.800	3
9	0.000	-9.800	605.000	-9.800	4
10	0.000	-13.800	605.000	-13.800	5
11	0.000	-19.800	605.000	-19.800	6
12	0.000	-24.800	605.000	-24.800	7

User Specified X-Origin = 275.000(ft)

User Specified Y-Origin = -35.000(ft)

MOHR-COULOMB SOIL PARAMETERS

7 Type(s) of Soil Defined

Soil Number Moist Saturated Cohesion Friction Pore Pressure Water
Water
and Unit Wt. Unit Wt. Intercept Angle Pressure Constant Surface
Option

Description	(pcf)	(pcf)	(psf)	(deg)	Ratio(ru)	(psf)	No.
1 Embankment Fill	125.0	125.0	1000.00	0.00	0.000	0.0	1
0							
2 Silty Clay	120.0	120.0	2700.00	0.00	0.000	0.0	1
0							
3 Silty Clay Loam	123.0	123.0	450.00	0.00	0.000	0.0	1
0							
4 Silty Loam	120.0	120.0	1100.00	0.00	0.000	0.0	1
0							
5 Muck	90.0	90.0	1600.00	0.00	0.000	0.0	1
0							
6 Clay/Silty Clay Till	125.0	125.0	1000.00	0.00	0.000	0.0	1
0							
7 Till	145.0	145.0	1600.00	0.00	0.000	0.0	1
0							

WATER SURFACE DATA

1 Water Surface(s) Defined

Unit Weight of Water = 62.400 (pcf)

Water Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.00

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	-5.00
2	605.00	-5.00

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

5000 Trial Surfaces Have Been Generated.

5000 Surfaces Generated at Increments of 0.3121(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 275.00(ft)
and X = 405.00(ft)

Each Surface Enters within a Range Between X = 436.00(ft)
and X = 525.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = -35.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 0 Iterations.

Number of Trial Surfaces with Non-Converged FS = 10

Number of Trial Surfaces With Valid FS = 4990

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 0.2 %

Statistical Data On All Valid FS Values:
FS Max = 62.441 FS Min = 2.088 FS Ave = 6.186
Standard Deviation = 6.129 Coefficient of Variation = 99.08 %

Critical Surface is Sequence Number 2854 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 413.889306(ft) ; Y = 86.638513(ft); and Radius = 86.647741(ft)

Circular Trial Failure Surface Generated With 11 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	349.193	29.000
2	356.265	21.930
3	364.104	15.721
4	372.606	10.457
5	381.659	6.208
6	391.140	3.030
7	400.925	0.966
8	410.882	0.043
9	420.880	0.273
10	430.784	1.654
11	437.126	3.300

Factor Of Safety For The Critical or Specified Surface = 2.088

Table 1 - Geometry Data on the 22 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.54	1.77	350.96	27.23	29.00	-44.99	0.00	5.00
2	3.54	5.30	354.50	23.70	29.00	-44.99	0.00	5.00
3	3.92	8.62	358.22	20.38	29.00	-38.38	0.00	5.00
4	3.92	11.73	362.14	17.27	29.00	-38.38	0.00	5.00
5	4.25	14.59	366.23	14.41	29.00	-31.76	0.00	5.00
6	4.25	17.23	370.48	11.77	29.00	-31.76	0.00	5.00
7	4.53	19.60	374.87	9.40	29.00	-25.15	0.00	5.00
8	4.53	21.73	379.40	7.27	29.00	-25.15	0.00	5.00
9	3.34	23.35	383.33	5.65	29.00	-18.53	0.00	3.52
10	3.07	23.66	386.54	4.57	28.23	-18.53	-26.57	3.24
11	3.07	23.15	389.61	3.54	26.70	-18.53	-26.57	3.24
12	4.89	22.19	393.59	2.51	24.71	-11.91	-26.57	5.00
13	4.89	20.78	398.48	1.48	22.26	-11.91	-26.57	5.00
14	4.98	19.06	403.41	0.74	19.79	-5.30	-26.57	5.00
15	4.98	17.03	408.39	0.27	17.30	-5.30	-26.57	5.00
16	5.00	14.71	413.38	0.10	14.81	1.32	-26.57	5.00
17	5.00	12.09	418.38	0.22	12.31	1.32	-26.57	5.00

18	4.95	9.20	423.36	0.62	9.82	7.94	-26.57	5.00
19	4.95	6.04	428.31	1.31	7.35	7.94	-26.57	5.00
20	2.81	3.39	432.19	2.02	5.41	14.55	-26.57	2.90
21	2.81	1.25	435.00	2.75	4.00	14.55	-26.57	2.90
22	0.73	0.09	436.76	3.21	3.30	14.55	0.00	0.75

Table 2 - Force Data On The 22 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ualpha Force Bot (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	781.2	0.0	0.0	0.0	0.0	0.0
2	2343.7	0.0	0.0	0.0	0.0	0.0
3	4224.6	0.0	0.0	0.0	0.0	0.0
4	5745.6	0.0	0.0	0.0	0.0	0.0
5	7755.7	0.0	0.0	0.0	0.0	0.0
6	9154.3	0.0	0.0	0.0	0.0	0.0
7	11091.9	0.0	0.0	0.0	0.0	0.0
8	12293.9	0.0	0.0	0.0	0.0	0.0
9	9752.8	0.0	0.0	0.0	0.0	0.0
10	9079.6	0.0	0.0	0.0	0.0	0.0
11	8885.4	0.0	0.0	0.0	0.0	0.0
12	13571.5	0.0	0.0	0.0	0.0	0.0
13	12706.8	0.0	0.0	0.0	0.0	0.0
14	11860.1	0.0	0.0	0.0	0.0	0.0
15	10598.1	0.0	0.0	0.0	0.0	0.0
16	9190.5	0.0	0.0	0.0	0.0	0.0
17	7556.9	0.0	0.0	0.0	0.0	0.0
18	5697.3	0.0	0.0	0.0	0.0	0.0
19	3737.2	0.0	0.0	0.0	0.0	0.0
20	1189.1	0.0	0.0	0.0	0.0	0.0
21	440.5	0.0	0.0	0.0	0.0	0.0
22	8.5	0.0	0.0	0.0	0.0	0.0

TOTAL WEIGHT OF SLIDING MASS = 157665.13(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 157665.13(lbs)

TOTAL AREA OF SLIDING MASS = 1261.32(ft2)

TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 22 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	1000.00	0.00	
2	1	1000.00	0.00	
3	1	1000.00	0.00	
4	1	1000.00	0.00	
5	1	1000.00	0.00	
6	1	1000.00	0.00	
7	1	1000.00	0.00	
8	1	1000.00	0.00	
9	1	1000.00	0.00	
10	1	1000.00	0.00	
11	1	1000.00	0.00	
12	1	1000.00	0.00	
13	1	1000.00	0.00	
14	1	1000.00	0.00	
15	1	1000.00	0.00	
16	1	1000.00	0.00	
17	1	1000.00	0.00	
18	1	1000.00	0.00	
19	1	1000.00	0.00	
20	1	1000.00	0.00	
21	1	1000.00	0.00	

22	1	1000.00	0.00

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

TABLE 3 - Effective and Base Shear Stress Data on the 22 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-44.99	350.96	5.00	220.95	0.00	0.00
1	-44.99	350.96	5.00	220.95	0.00	0.00
2	-44.99	354.50	5.00	662.84	0.00	0.00
2	-44.99	354.50	5.00	662.84	0.00	0.00
3	-38.38	358.22	5.00	698.59	1000.00	478.83
3	-38.38	358.22	5.00	698.59	1000.00	478.83
4	-38.38	362.14	5.00	1086.61	1000.00	478.83
4	-38.38	362.14	5.00	1086.61	1000.00	478.83
5	-31.76	366.23	5.00	1527.89	1000.00	478.83
5	-31.76	366.23	5.00	1527.89	1000.00	478.83
6	-31.76	370.48	5.00	1856.88	1000.00	478.83
6	-31.76	370.48	5.00	1856.88	1000.00	478.83
7	-25.15	374.87	5.00	2225.85	1000.00	478.83
7	-25.15	374.87	5.00	2225.85	1000.00	478.83
8	-25.15	379.40	5.00	2491.42	1000.00	478.83
8	-25.15	379.40	5.00	2491.42	1000.00	478.83
9	-18.53	383.33	3.52	2758.47	1000.00	478.83
9	-18.53	383.33	3.52	2758.47	1000.00	478.83
10	-18.53	386.54	3.24	2796.83	1000.00	478.83
10	-18.53	386.54	3.24	2796.83	1000.00	478.83
11	-18.53	389.61	3.24	2733.57	1000.00	478.83
11	-18.53	389.61	3.24	2733.57	1000.00	478.83
12	-11.91	393.59	5.00	2673.03	1000.00	478.83
12	-11.91	393.59	5.00	2673.03	1000.00	478.83
13	-11.91	398.48	5.00	2496.28	1000.00	478.83
13	-11.91	398.48	5.00	2496.28	1000.00	478.83
14	-5.30	403.41	5.00	2337.79	1000.00	478.83
14	-5.30	403.41	5.00	2337.79	1000.00	478.83
15	-5.30	408.39	5.00	2084.32	1000.00	478.83
15	-5.30	408.39	5.00	2084.32	1000.00	478.83
16	1.32	413.38	5.00	1849.61	1000.00	478.83
16	1.32	413.38	5.00	1849.61	1000.00	478.83
17	1.32	418.38	5.00	1522.80	1000.00	478.83
17	1.32	418.38	5.00	1522.80	1000.00	478.83
18	7.94	423.36	5.00	1217.22	1000.00	478.83
18	7.94	423.36	5.00	1217.22	1000.00	478.83
19	7.94	428.31	5.00	821.42	1000.00	478.83
19	7.94	428.31	5.00	821.42	1000.00	478.83
20	14.55	432.19	2.90	547.77	1000.00	478.83
20	14.55	432.19	2.90	547.77	1000.00	478.83
21	14.55	435.00	2.90	281.15	1000.00	478.83
21	14.55	435.00	2.90	281.15	1000.00	478.83
22	14.55	436.76	0.75	136.07	1000.00	478.83
22	14.55	436.76	0.75	136.07	1000.00	478.83

Table 4 - Base Force Data on the 22 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force (lbs)
1	-44.99	350.96	5.00	1104.74	0.00	0.00

1	-44.99	350.96	5.00	1104.74	0.00	0.00
2	-44.99	354.50	5.00	3314.21	0.00	0.00
2	-44.99	354.50	5.00	3314.21	0.00	0.00
3	-38.38	358.22	5.00	3492.94	5000.00	2394.17
3	-38.38	358.22	5.00	3492.94	5000.00	2394.17
4	-38.38	362.14	5.00	5433.07	5000.00	2394.17
4	-38.38	362.14	5.00	5433.07	5000.00	2394.17
5	-31.76	366.23	5.00	7639.47	5000.00	2394.17
5	-31.76	366.23	5.00	7639.47	5000.00	2394.17
6	-31.76	370.48	5.00	9284.42	5000.00	2394.17
6	-31.76	370.48	5.00	9284.42	5000.00	2394.17
7	-25.15	374.87	5.00	11129.23	5000.00	2394.17
7	-25.15	374.87	5.00	11129.23	5000.00	2394.17
8	-25.15	379.40	5.00	12457.09	5000.00	2394.17
8	-25.15	379.40	5.00	12457.09	5000.00	2394.17
9	-18.53	383.33	3.52	9720.47	3523.86	1687.34
9	-18.53	383.33	3.52	9720.47	3523.86	1687.34
10	-18.53	386.54	3.24	9056.33	3238.07	1550.50
10	-18.53	386.54	3.24	9056.33	3238.07	1550.50
11	-18.53	389.61	3.24	8851.49	3238.07	1550.50
11	-18.53	389.61	3.24	8851.49	3238.07	1550.50
12	-11.91	393.59	5.00	13365.15	5000.00	2394.17
12	-11.91	393.59	5.00	13365.15	5000.00	2394.17
13	-11.91	398.48	5.00	12481.38	5000.00	2394.17
13	-11.91	398.48	5.00	12481.38	5000.00	2394.17
14	-5.30	403.41	5.00	11688.96	5000.00	2394.17
14	-5.30	403.41	5.00	11688.96	5000.00	2394.17
15	-5.30	408.39	5.00	10421.62	5000.00	2394.17
15	-5.30	408.39	5.00	10421.62	5000.00	2394.17
16	1.32	413.38	5.00	9248.03	5000.00	2394.17
16	1.32	413.38	5.00	9248.03	5000.00	2394.17
17	1.32	418.38	5.00	7614.00	5000.00	2394.17
17	1.32	418.38	5.00	7614.00	5000.00	2394.17
18	7.94	423.36	5.00	6086.08	5000.00	2394.17
18	7.94	423.36	5.00	6086.08	5000.00	2394.17
19	7.94	428.31	5.00	4107.11	5000.00	2394.17
19	7.94	428.31	5.00	4107.11	5000.00	2394.17
20	14.55	432.19	2.90	1589.12	2901.09	1389.14
20	14.55	432.19	2.90	1589.12	2901.09	1389.14
21	14.55	435.00	2.90	815.65	2901.09	1389.14
21	14.55	435.00	2.90	815.65	2901.09	1389.14
22	14.55	436.76	0.75	102.02	749.79	359.03
22	14.55	436.76	0.75	102.02	749.79	359.03

SUM OF MOMENTS = 0.781597E-13 (ft/lbs);Imbalance (Fraction of Total Weight) = 0.4957323E-18

Sum of the Resisting Forces = 86551.98 (lbs)

Average Available Shear Strength = 896.43(psf)

Sum of the Driving Forces = -41443.96 (lbs)

Average Mobilized Shear Stress = -429.24(psf)

Total length of the failure surface = 96.55(ft)

Factor of Safety Balance Check: FS = 2.08841

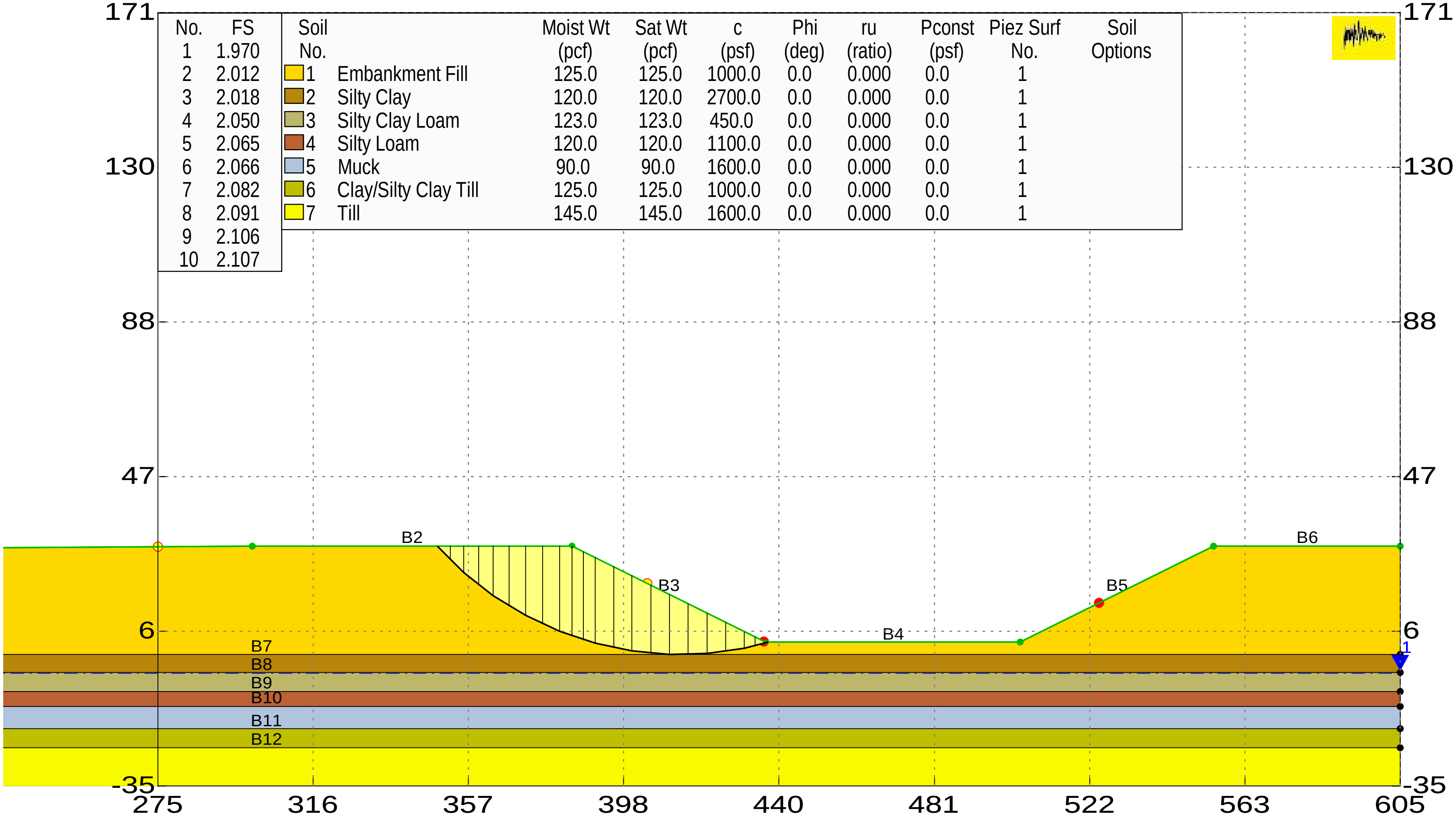
CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

**** END OF GEOSTASE OUTPUT ****

Endslope – Seismic Conditions

I-74 Over IL RTE 17
North Abutment Fill Placement, Boring Nos. 2 and 4

Hurst-Rosche, Inc. \I-74 Stability Calc Case 1.gsd



No.	FS
1	1.970
2	2.012
3	2.018
4	2.050
5	2.065
6	2.066
7	2.082
8	2.091
9	2.106
10	2.107

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Embankment Fill	125.0	125.0	1000.0	0.0	0.000	0.0	1	
2	Silty Clay	120.0	120.0	2700.0	0.0	0.000	0.0	1	
3	Silty Clay Loam	123.0	123.0	450.0	0.0	0.000	0.0	1	
4	Silty Loam	120.0	120.0	1100.0	0.0	0.000	0.0	1	
5	Muck	90.0	90.0	1600.0	0.0	0.000	0.0	1	
6	Clay/Silty Clay Till	125.0	125.0	1000.0	0.0	0.000	0.0	1	
7	Till	145.0	145.0	1600.0	0.0	0.000	0.0	1	

GEOSTASE FS =1.970

Simplified Bishop Method

kh = 0.01900

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

*** GEOSTASE(R) ***

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date: 2/ 15/ 2022
Analysis Time:
Analysis By: Hurst-Rosche, Inc.
Input File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 1.gsd
Output File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 1.OUT
Unit System: English

PROJECT: I-74 Over IL RTE 17

DESCRIPTION: North Abutment Fill Placement, Boring Nos. 2 and 4 - Seismic

BOUNDARY DATA

6 Surface Boundaries
12 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	27.100	300.000	29.000	1
2	300.000	29.000	385.000	29.000	1
3	385.000	29.000	436.400	3.300	1
4	436.400	3.300	504.000	3.300	1
5	504.000	3.300	555.400	29.000	1
6	555.400	29.000	605.000	29.000	1
7	0.000	0.000	605.000	0.000	2
8	0.000	-4.800	605.000	-4.800	3
9	0.000	-9.800	605.000	-9.800	4
10	0.000	-13.800	605.000	-13.800	5
11	0.000	-19.800	605.000	-19.800	6
12	0.000	-24.800	605.000	-24.800	7

User Specified X-Origin = 275.000(ft)

User Specified Y-Origin = -35.000(ft)

MOHR-COULOMB SOIL PARAMETERS

7 Type(s) of Soil Defined

Soil Number and Description	Moist Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Ratio(ru)	Pressure Constant (psf)	Water Surface No.	Water Option
1 Embankment Fill	125.0	125.0	1000.00	0.00	0.000	0.0	1	0
2 Silty Clay	120.0	120.0	2700.00	0.00	0.000	0.0	1	0
3 Silty Clay Loam	123.0	123.0	450.00	0.00	0.000	0.0	1	0
4 Silty Loam	120.0	120.0	1100.00	0.00	0.000	0.0	1	0
5 Muck	90.0	90.0	1600.00	0.00	0.000	0.0	1	0
6 Clay/Silty Clay Till	125.0	125.0	1000.00	0.00	0.000	0.0	1	0
7 Till	145.0	145.0	1600.00	0.00	0.000	0.0	1	0

WATER SURFACE DATA

1 Water Surface(s) Defined

Unit Weight of Water = 62.400 (pcf)

Water Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.00

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	-5.00
2	605.00	-5.00

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

SEISMIC (EARTHQUAKE) DATA

Specified Peak Ground Acceleration Coefficient (PGA) = 0.046(g)
Default Velocity = 0.115(ft) per second
Specified Horizontal Earthquake Coefficient (kh) = -.01900(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
(NOTE:Input Velocity = 0.0 will result in default Peak
Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
Specified Seismic Pore-Pressure Factor = 0.000
Horizontal Seismic Force is Applied at Center of Gravity of Slices

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

5000 Trial Surfaces Have Been Generated.

5000 Surfaces Generated at Increments of 0.3121(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 275.00(ft)
and X = 405.00(ft)

Each Surface Enters within a Range Between X = 436.00(ft)
and X = 525.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = -35.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 0 Iterations.

Number of Trial Surfaces with Non-Converged FS = 10

Number of Trial Surfaces With Valid FS = 4990

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 0.2 %

Statistical Data On All Valid FS Values:
FS Max = 47.162 FS Min = 1.970 FS Ave = 5.630
Standard Deviation = 5.279 Coefficient of Variation = 93.76 %

Critical Surface is Sequence Number 2854 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 413.889306(ft) ; Y = 86.638513(ft); and Radius = 86.647741(ft)

Circular Trial Failure Surface Generated With 11 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	349.193	29.000
2	356.265	21.930
3	364.104	15.721
4	372.606	10.457
5	381.659	6.208
6	391.140	3.030
7	400.925	0.966
8	410.882	0.043
9	420.880	0.273
10	430.784	1.654
11	437.126	3.300

Factor Of Safety For The Critical or Specified Surface = 1.970

Table 1 - Geometry Data on the 22 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.54	1.77	350.96	27.23	29.00	-44.99	0.00	5.00
2	3.54	5.30	354.50	23.70	29.00	-44.99	0.00	5.00
3	3.92	8.62	358.22	20.38	29.00	-38.38	0.00	5.00
4	3.92	11.73	362.14	17.27	29.00	-38.38	0.00	5.00
5	4.25	14.59	366.23	14.41	29.00	-31.76	0.00	5.00
6	4.25	17.23	370.48	11.77	29.00	-31.76	0.00	5.00

7	4.53	19.60	374.87	9.40	29.00	-25.15	0.00	5.00
8	4.53	21.73	379.40	7.27	29.00	-25.15	0.00	5.00
9	3.34	23.35	383.33	5.65	29.00	-18.53	0.00	3.52
10	3.07	23.66	386.54	4.57	28.23	-18.53	-26.57	3.24
11	3.07	23.15	389.61	3.54	26.70	-18.53	-26.57	3.24
12	4.89	22.19	393.59	2.51	24.71	-11.91	-26.57	5.00
13	4.89	20.78	398.48	1.48	22.26	-11.91	-26.57	5.00
14	4.98	19.06	403.41	0.74	19.79	-5.30	-26.57	5.00
15	4.98	17.03	408.39	0.27	17.30	-5.30	-26.57	5.00
16	5.00	14.71	413.38	0.10	14.81	1.32	-26.57	5.00
17	5.00	12.09	418.38	0.22	12.31	1.32	-26.57	5.00
18	4.95	9.20	423.36	0.62	9.82	7.94	-26.57	5.00
19	4.95	6.04	428.31	1.31	7.35	7.94	-26.57	5.00
20	2.81	3.39	432.19	2.02	5.41	14.55	-26.57	2.90
21	2.81	1.25	435.00	2.75	4.00	14.55	-26.57	2.90
22	0.73	0.09	436.76	3.21	3.30	14.55	0.00	0.75

Table 2 - Force Data On The 22 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ualpha Force Bot (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	781.2	0.0	0.0	-14.8	0.0	0.0
2	2343.7	0.0	0.0	-44.5	0.0	0.0
3	4224.6	0.0	0.0	-80.3	0.0	0.0
4	5745.6	0.0	0.0	-109.2	0.0	0.0
5	7755.7	0.0	0.0	-147.4	0.0	0.0
6	9154.3	0.0	0.0	-173.9	0.0	0.0
7	11091.9	0.0	0.0	-210.7	0.0	0.0
8	12293.9	0.0	0.0	-233.6	0.0	0.0
9	9752.8	0.0	0.0	-185.3	0.0	0.0
10	9079.6	0.0	0.0	-172.5	0.0	0.0
11	8885.4	0.0	0.0	-168.8	0.0	0.0
12	13571.5	0.0	0.0	-257.9	0.0	0.0
13	12706.8	0.0	0.0	-241.4	0.0	0.0
14	11860.1	0.0	0.0	-225.3	0.0	0.0
15	10598.1	0.0	0.0	-201.4	0.0	0.0
16	9190.5	0.0	0.0	-174.6	0.0	0.0
17	7556.9	0.0	0.0	-143.6	0.0	0.0
18	5697.3	0.0	0.0	-108.2	0.0	0.0
19	3737.2	0.0	0.0	-71.0	0.0	0.0
20	1189.1	0.0	0.0	-22.6	0.0	0.0
21	440.5	0.0	0.0	-8.4	0.0	0.0
22	8.5	0.0	0.0	-0.2	0.0	0.0

TOTAL WEIGHT OF SLIDING MASS = 157665.13(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 157665.13(lbs)

TOTAL AREA OF SLIDING MASS = 1261.32(ft2)

TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 22 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	1000.00	0.00	
2	1	1000.00	0.00	
3	1	1000.00	0.00	
4	1	1000.00	0.00	
5	1	1000.00	0.00	
6	1	1000.00	0.00	
7	1	1000.00	0.00	

8	1	1000.00	0.00
9	1	1000.00	0.00
10	1	1000.00	0.00
11	1	1000.00	0.00
12	1	1000.00	0.00
13	1	1000.00	0.00
14	1	1000.00	0.00
15	1	1000.00	0.00
16	1	1000.00	0.00
17	1	1000.00	0.00
18	1	1000.00	0.00
19	1	1000.00	0.00
20	1	1000.00	0.00
21	1	1000.00	0.00
22	1	1000.00	0.00

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

TABLE 3 - Effective and Base Shear Stress Data on the 22 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-44.99	350.96	5.00	220.95	0.00	0.00
1	-44.99	350.96	5.00	220.95	0.00	0.00
2	-44.99	354.50	5.00	662.84	0.00	0.00
2	-44.99	354.50	5.00	662.84	0.00	0.00
3	-38.38	358.22	5.00	677.15	1000.00	507.69
3	-38.38	358.22	5.00	677.15	1000.00	507.69
4	-38.38	362.14	5.00	1065.18	1000.00	507.69
4	-38.38	362.14	5.00	1065.18	1000.00	507.69
5	-31.76	366.23	5.00	1511.13	1000.00	507.69
5	-31.76	366.23	5.00	1511.13	1000.00	507.69
6	-31.76	370.48	5.00	1840.12	1000.00	507.69
6	-31.76	370.48	5.00	1840.12	1000.00	507.69
7	-25.15	374.87	5.00	2213.14	1000.00	507.69
7	-25.15	374.87	5.00	2213.14	1000.00	507.69
8	-25.15	379.40	5.00	2478.71	1000.00	507.69
8	-25.15	379.40	5.00	2478.71	1000.00	507.69
9	-18.53	383.33	3.52	2749.40	1000.00	507.69
9	-18.53	383.33	3.52	2749.40	1000.00	507.69
10	-18.53	386.54	3.24	2787.76	1000.00	507.69
10	-18.53	386.54	3.24	2787.76	1000.00	507.69
11	-18.53	389.61	3.24	2724.50	1000.00	507.69
11	-18.53	389.61	3.24	2724.50	1000.00	507.69
12	-11.91	393.59	5.00	2667.32	1000.00	507.69
12	-11.91	393.59	5.00	2667.32	1000.00	507.69
13	-11.91	398.48	5.00	2490.57	1000.00	507.69
13	-11.91	398.48	5.00	2490.57	1000.00	507.69
14	-5.30	403.41	5.00	2335.28	1000.00	507.69
14	-5.30	403.41	5.00	2335.28	1000.00	507.69
15	-5.30	408.39	5.00	2081.81	1000.00	507.69
15	-5.30	408.39	5.00	2081.81	1000.00	507.69
16	1.32	413.38	5.00	1850.23	1000.00	507.69
16	1.32	413.38	5.00	1850.23	1000.00	507.69
17	1.32	418.38	5.00	1523.42	1000.00	507.69
17	1.32	418.38	5.00	1523.42	1000.00	507.69
18	7.94	423.36	5.00	1220.99	1000.00	507.69
18	7.94	423.36	5.00	1220.99	1000.00	507.69
19	7.94	428.31	5.00	825.20	1000.00	507.69

19	7.94	428.31	5.00	825.20	1000.00	507.69
20	14.55	432.19	2.90	554.79	1000.00	507.69
20	14.55	432.19	2.90	554.79	1000.00	507.69
21	14.55	435.00	2.90	288.18	1000.00	507.69
21	14.55	435.00	2.90	288.18	1000.00	507.69
22	14.55	436.76	0.75	143.10	1000.00	507.69
22	14.55	436.76	0.75	143.10	1000.00	507.69

Table 4 - Base Force Data on the 22 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force (lbs)
1	-44.99	350.96	5.00	1104.74	0.00	0.00
1	-44.99	350.96	5.00	1104.74	0.00	0.00
2	-44.99	354.50	5.00	3314.21	0.00	0.00
2	-44.99	354.50	5.00	3314.21	0.00	0.00
3	-38.38	358.22	5.00	3385.75	5000.00	2538.44
3	-38.38	358.22	5.00	3385.75	5000.00	2538.44
4	-38.38	362.14	5.00	5325.88	5000.00	2538.44
4	-38.38	362.14	5.00	5325.88	5000.00	2538.44
5	-31.76	366.23	5.00	7555.67	5000.00	2538.44
5	-31.76	366.23	5.00	7555.67	5000.00	2538.44
6	-31.76	370.48	5.00	9200.62	5000.00	2538.44
6	-31.76	370.48	5.00	9200.62	5000.00	2538.44
7	-25.15	374.87	5.00	11065.69	5000.00	2538.44
7	-25.15	374.87	5.00	11065.69	5000.00	2538.44
8	-25.15	379.40	5.00	12393.56	5000.00	2538.44
8	-25.15	379.40	5.00	12393.56	5000.00	2538.44
9	-18.53	383.33	3.52	9688.50	3523.86	1789.02
9	-18.53	383.33	3.52	9688.50	3523.86	1789.02
10	-18.53	386.54	3.24	9026.95	3238.07	1643.93
10	-18.53	386.54	3.24	9026.95	3238.07	1643.93
11	-18.53	389.61	3.24	8822.11	3238.07	1643.93
11	-18.53	389.61	3.24	8822.11	3238.07	1643.93
12	-11.91	393.59	5.00	13336.59	5000.00	2538.44
12	-11.91	393.59	5.00	13336.59	5000.00	2538.44
13	-11.91	398.48	5.00	12452.83	5000.00	2538.44
13	-11.91	398.48	5.00	12452.83	5000.00	2538.44
14	-5.30	403.41	5.00	11676.41	5000.00	2538.44
14	-5.30	403.41	5.00	11676.41	5000.00	2538.44
15	-5.30	408.39	5.00	10409.07	5000.00	2538.44
15	-5.30	408.39	5.00	10409.07	5000.00	2538.44
16	1.32	413.38	5.00	9251.15	5000.00	2538.44
16	1.32	413.38	5.00	9251.15	5000.00	2538.44
17	1.32	418.38	5.00	7617.11	5000.00	2538.44
17	1.32	418.38	5.00	7617.11	5000.00	2538.44
18	7.94	423.36	5.00	6104.95	5000.00	2538.44
18	7.94	423.36	5.00	6104.95	5000.00	2538.44
19	7.94	428.31	5.00	4125.98	5000.00	2538.44
19	7.94	428.31	5.00	4125.98	5000.00	2538.44
20	14.55	432.19	2.90	1609.51	2901.09	1472.85
20	14.55	432.19	2.90	1609.51	2901.09	1472.85
21	14.55	435.00	2.90	836.03	2901.09	1472.85
21	14.55	435.00	2.90	836.03	2901.09	1472.85
22	14.55	436.76	0.75	107.29	749.79	380.66
22	14.55	436.76	0.75	107.29	749.79	380.66

SUM OF MOMENTS = -0.186517E-13 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.1182998E-18

Sum of the Resisting Forces = 86551.98 (lbs)

Average Available Shear Strength = 896.43(psf)

```
Sum of the Driving Forces =   -43941.48 (lbs)

Average Mobilized Shear Stress =    -455.11(psf)

Total length of the failure surface =      96.55(ft)


Factor of Safety Balance Check: FS =  1.96971


      CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop
               Method. This Method Is Valid Only If The Failure Surface
               Approximates A Circular Arc.

             *** SEISMIC SLOPE DISPLACEMENT DATA ***
      (Note: kv is set = zero for displacement calculations)
      Seismic Yield Coefficient (ky) =  0.36577(g)
      Calculated Newmark Seismic Displacement =    0.000(ft)


      Average Elevation of Point of Application of kh on Sliding Mass =   14.032(ft)

      Non-Symmetrical Sliding Resistance Has Been Specified
      for Downhill Sliding.

                    **** END OF GEOSTASE OUTPUT ****
```

Sideslope – Static Conditions

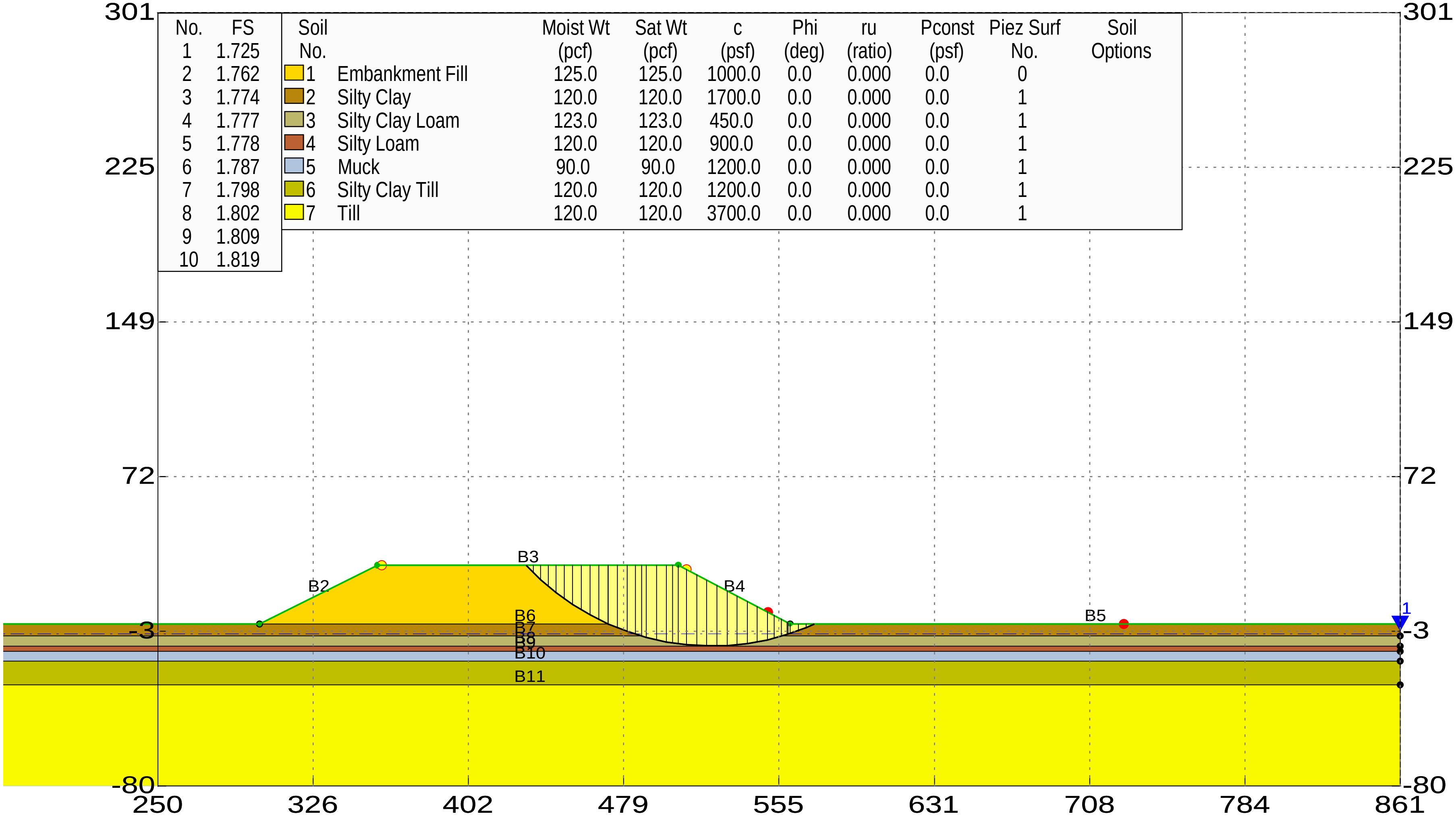
I-74 Over IL Route 17
North Abutment Sideslope Fill Placement Boring 4 Only

Hurst-Rosche, Inc.

\I-74 Stability Calc Case 3 Sideslope.gsd

No.	FS
1	1.725
2	1.762
3	1.774
4	1.777
5	1.778
6	1.787
7	1.798
8	1.802
9	1.809
10	1.819

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Embankment Fill	125.0	125.0	1000.0	0.0	0.000	0.0	0	
2	Silty Clay	120.0	120.0	1700.0	0.0	0.000	0.0	1	
3	Silty Clay Loam	123.0	123.0	450.0	0.0	0.000	0.0	1	
4	Silty Loam	120.0	120.0	900.0	0.0	0.000	0.0	1	
5	Muck	90.0	90.0	1200.0	0.0	0.000	0.0	1	
6	Silty Clay Till	120.0	120.0	1200.0	0.0	0.000	0.0	1	
7	Till	120.0	120.0	3700.0	0.0	0.000	0.0	1	



GEOSTASE FS =1.725

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

*** GEOSTASE(R) ***

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date: 1/ 28/ 2022
Analysis Time:
Analysis By: Hurst-Rosche, Inc.
Input File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 3 Sideslope.gsd
Output File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 3 Sideslope.OUT
Unit System: English

PROJECT: I-74 Over IL Route 17

DESCRIPTION: North Abutment Sideslope Fill Placement Boring 4 Only

BOUNDARY DATA

5 Surface Boundaries
11 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	0.000	300.000	0.000	2
2	300.000	0.000	358.000	29.000	1
3	358.000	29.000	506.000	29.000	1
4	506.000	29.000	561.000	0.000	1
5	561.000	0.000	861.000	0.000	2
6	300.000	0.000	561.000	0.000	2
7	0.000	-6.000	861.000	-6.000	3
8	0.000	-11.000	861.000	-11.000	4
9	0.000	-13.500	861.000	-13.500	5
10	0.000	-18.500	861.000	-18.500	6
11	0.000	-30.000	861.000	-30.000	7

User Specified X-Origin = 250.000(ft)

User Specified Y-Origin = -80.000(ft)

MOHR-COULOMB SOIL PARAMETERS

7 Type(s) of Soil Defined

Soil Number Moist Saturated Cohesion Friction Pore Pressure Water Water

and Description	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Ratio(ru)	Constant (psf)	Surface No.	Option
1 Embankment Fill	125.0	125.0	1000.00	0.00	0.000	0.0	0	0
2 Silty Clay	120.0	120.0	1700.00	0.00	0.000	0.0	1	0
3 Silty Clay Loam	123.0	123.0	450.00	0.00	0.000	0.0	1	0
4 Silty Loam	120.0	120.0	900.00	0.00	0.000	0.0	1	0
5 Muck	90.0	90.0	1200.00	0.00	0.000	0.0	1	0
6 Silty Clay Till	120.0	120.0	1200.00	0.00	0.000	0.0	1	0
7 Till	120.0	120.0	3700.00	0.00	0.000	0.0	1	0

WATER SURFACE DATA

1 Water Surface(s) Defined

Unit Weight of Water = 62.400 (pcf)

Water Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.00

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	-5.00
2	861.00	-5.00

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

5000 Trial Surfaces Have Been Generated.

5000 Surfaces Generated at Increments of 0.3601(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 360.00(ft)
and X = 510.00(ft)

Each Surface Enters within a Range Between X = 550.00(ft)
and X = 725.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = -80.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 0 Iterations.

Number of Trial Surfaces with Non-Converged FS = 15

Number of Trial Surfaces With Valid FS = 4985

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 0.3 %

Statistical Data On All Valid FS Values:
FS Max = 31.493 FS Min = 1.725 FS Ave = 4.220
Standard Deviation = 2.582 Coefficient of Variation = 61.17 %

Critical Surface is Sequence Number 2372 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 522.289383(ft) ; Y = 113.115938(ft); and Radius = 124.027941(ft)

Circular Trial Failure Surface Generated With 17 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	431.144	29.000
2	438.217	21.931
3	445.836	15.454
4	453.953	9.612
5	462.513	4.443
6	471.462	-0.019
7	480.742	-3.746
8	490.291	-6.713
9	500.049	-8.902
10	509.951	-10.297
11	519.934	-10.890
12	529.931	-10.676
13	539.879	-9.658
14	549.713	-7.842
15	559.368	-5.240
16	568.783	-1.868
17	572.915	0.000

Factor Of Safety For The Critical or Specified Surface = 1.725

Table 1 - Geometry Data on the 37 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.54	1.77	432.91	27.23	29.00	-44.99	0.00	5.00
2	3.54	5.30	436.45	23.70	29.00	-44.99	0.00	5.00
3	3.81	8.69	440.12	20.31	29.00	-40.37	0.00	5.00

4	3.81	11.93	443.93	17.07	29.00	-40.37	0.00	5.00
5	4.06	15.01	447.87	13.99	29.00	-35.74	0.00	5.00
6	4.06	17.93	451.92	11.07	29.00	-35.74	0.00	5.00
7	4.28	20.68	456.09	8.32	29.00	-31.12	0.00	5.00
8	4.28	23.26	460.37	5.74	29.00	-31.12	0.00	5.00
9	4.46	25.67	464.74	3.33	29.00	-26.50	0.00	4.98
10	4.46	27.89	469.20	1.11	29.00	-26.50	0.00	4.98
11	0.04	29.01	471.44	-0.01	29.00	-26.50	0.00	0.04
12	4.64	29.95	473.78	-0.95	29.00	-21.88	0.00	5.00
13	4.64	31.81	478.42	-2.81	29.00	-21.88	0.00	5.00
14	4.04	33.37	482.76	-4.37	29.00	-17.26	0.00	4.23
15	3.22	34.50	486.39	-5.50	29.00	-17.26	0.00	3.37
16	2.30	35.36	489.14	-6.36	29.00	-17.26	0.00	2.40
17	4.88	36.26	492.73	-7.26	29.00	-12.64	0.00	5.00
18	4.88	37.35	497.61	-8.35	29.00	-12.64	0.00	5.00
19	2.98	38.11	501.54	-9.11	29.00	-8.02	0.00	3.00
20	2.98	38.53	504.51	-9.53	29.00	-8.02	0.00	3.00
21	3.95	37.98	507.98	-10.02	27.96	-8.02	-27.80	3.99
22	4.99	36.05	512.45	-10.44	25.60	-3.40	-27.80	5.00
23	4.99	33.71	517.44	-10.74	22.97	-3.40	-27.80	5.00
24	5.00	31.17	522.43	-10.84	20.34	1.22	-27.80	5.00
25	5.00	28.43	527.43	-10.73	17.70	1.22	-27.80	5.00
26	4.97	25.49	532.42	-10.42	15.07	5.84	-27.80	5.00
27	4.97	22.36	537.39	-9.91	12.45	5.84	-27.80	5.00
28	4.92	19.04	542.34	-9.20	9.84	10.46	-27.80	5.00
29	4.92	15.54	547.25	-8.30	7.25	10.46	-27.80	5.00
30	3.42	12.43	551.42	-7.38	5.05	15.08	-27.80	3.54
31	3.42	9.71	554.84	-6.46	3.25	15.08	-27.80	3.54
32	2.82	7.22	557.96	-5.62	1.60	15.08	-27.80	2.92
33	0.67	5.80	559.70	-5.12	0.68	19.71	-27.80	0.71
34	0.96	5.08	560.52	-4.83	0.25	19.71	-27.80	1.02
35	3.89	3.96	562.95	-3.96	0.00	19.71	0.00	4.13
36	3.89	2.56	566.84	-2.56	0.00	19.71	0.00	4.13
37	4.13	0.93	570.85	-0.93	0.00	24.33	0.00	4.53

Table 2 - Force Data On The 37 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ualpha Force Bot (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	781.2	0.0	0.0	0.0	0.0	0.0
2	2343.7	0.0	0.0	0.0	0.0	0.0
3	4137.5	0.0	0.0	0.0	0.0	0.0
4	5679.6	0.0	0.0	0.0	0.0	0.0
5	7612.3	0.0	0.0	0.0	0.0	0.0
6	9093.9	0.0	0.0	0.0	0.0	0.0
7	11064.5	0.0	0.0	0.0	0.0	0.0
8	12447.2	0.0	0.0	0.0	0.0	0.0
9	14295.0	0.0	0.0	0.0	0.0	0.0
10	15532.3	0.0	0.0	0.0	0.0	0.0
11	138.6	0.0	0.0	0.0	0.0	0.0
12	17348.5	0.0	0.0	0.0	0.0	0.0
13	18386.1	0.0	0.0	0.0	0.0	0.0
14	16746.8	0.0	0.0	0.0	0.0	0.0
15	13790.4	0.0	105.1	0.0	0.0	0.0
16	10075.6	0.0	203.5	0.0	0.0	0.0
17	21954.8	0.0	705.3	0.0	0.0	0.0
18	22611.4	0.0	1046.6	0.0	0.0	0.0
19	14067.3	0.0	770.9	0.0	0.0	0.0
20	14220.8	0.0	849.5	0.0	0.0	0.0
21	18606.3	0.0	1249.5	0.0	0.0	0.0
22	22294.9	0.0	1698.8	0.0	0.0	0.0
23	20834.9	0.0	1791.3	0.0	0.0	0.0

24	19279.5	0.0	1820.9	0.0	0.0	0.0
25	17567.0	0.0	1787.7	0.0	0.0	0.0
26	15656.6	0.0	1691.6	0.0	0.0	0.0
27	13714.6	0.0	1532.8	0.0	0.0	0.0
28	11525.8	0.0	1311.7	0.0	0.0	0.0
29	9383.2	0.0	1028.4	0.0	0.0	0.0
30	5198.7	0.0	526.0	0.0	0.0	0.0
31	4041.8	0.0	322.6	0.0	0.0	0.0
32	2467.7	0.0	113.0	0.0	0.0	0.0
33	468.5	0.0	5.3	0.0	0.0	0.0
34	587.9	0.0	0.0	0.0	0.0	0.0
35	1848.5	0.0	0.0	0.0	0.0	0.0
36	1197.7	0.0	0.0	0.0	0.0	0.0
37	463.1	0.0	0.0	0.0	0.0	0.0

TOTAL WEIGHT OF SLIDING MASS = 397464.22(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 379084.05(lbs)

TOTAL AREA OF SLIDING MASS = 3203.97(ft2)

TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 37 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	1000.00	0.00	
2	1	1000.00	0.00	
3	1	1000.00	0.00	
4	1	1000.00	0.00	
5	1	1000.00	0.00	
6	1	1000.00	0.00	
7	1	1000.00	0.00	
8	1	1000.00	0.00	
9	1	1000.00	0.00	
10	1	1000.00	0.00	
11	2	1700.00	0.00	
12	2	1700.00	0.00	
13	2	1700.00	0.00	
14	2	1700.00	0.00	
15	2	1700.00	0.00	
16	3	450.00	0.00	
17	3	450.00	0.00	
18	3	450.00	0.00	
19	3	450.00	0.00	
20	3	450.00	0.00	
21	3	450.00	0.00	
22	3	450.00	0.00	
23	3	450.00	0.00	
24	3	450.00	0.00	
25	3	450.00	0.00	
26	3	450.00	0.00	
27	3	450.00	0.00	
28	3	450.00	0.00	
29	3	450.00	0.00	
30	3	450.00	0.00	
31	3	450.00	0.00	
32	2	1700.00	0.00	
33	2	1700.00	0.00	
34	2	1700.00	0.00	
35	2	1700.00	0.00	
36	2	1700.00	0.00	
37	2	1700.00	0.00	

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH

NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

TABLE 3 - Effective and Base Shear Stress Data on the 37 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-44.99	432.91	5.00	220.92	0.00	0.00
1	-44.99	432.91	5.00	220.92	0.00	0.00
2	-44.99	436.45	5.00	662.75	0.00	0.00
2	-44.99	436.45	5.00	662.75	0.00	0.00
3	-40.37	440.12	5.00	593.28	1000.00	579.73
3	-40.37	440.12	5.00	593.28	1000.00	579.73
4	-40.37	443.93	5.00	998.06	1000.00	579.73
4	-40.37	443.93	5.00	998.06	1000.00	579.73
5	-35.74	447.87	5.00	1458.54	1000.00	579.73
5	-35.74	447.87	5.00	1458.54	1000.00	579.73
6	-35.74	451.92	5.00	1823.65	1000.00	579.73
6	-35.74	451.92	5.00	1823.65	1000.00	579.73
7	-31.12	456.09	5.00	2234.95	1000.00	579.73
7	-31.12	456.09	5.00	2234.95	1000.00	579.73
8	-31.12	460.37	5.00	2558.00	1000.00	579.73
8	-31.12	460.37	5.00	2558.00	1000.00	579.73
9	-26.50	464.74	4.98	2919.35	1000.00	579.73
9	-26.50	464.74	4.98	2919.35	1000.00	579.73
10	-26.50	469.20	4.98	3197.06	1000.00	579.73
10	-26.50	469.20	4.98	3197.06	1000.00	579.73
11	-26.50	471.44	0.04	3134.70	1700.00	985.55
11	-26.50	471.44	0.04	3134.70	1700.00	985.55
12	-21.88	473.78	5.00	3343.27	1700.00	985.55
12	-21.88	473.78	5.00	3343.27	1700.00	985.55
13	-21.88	478.42	5.00	3566.89	1700.00	985.55
13	-21.88	478.42	5.00	3566.89	1700.00	985.55
14	-17.26	482.76	4.23	3843.53	1700.00	985.55
14	-17.26	482.76	4.23	3843.53	1700.00	985.55
15	-17.26	486.39	3.37	3947.57	1700.00	985.55
15	-17.26	486.39	3.37	3947.57	1700.00	985.55
16	-17.26	489.14	2.40	4223.15	450.00	260.88
16	-17.26	489.14	2.40	4223.15	450.00	260.88
17	-12.64	492.73	5.00	4300.47	450.00	260.88
17	-12.64	492.73	5.00	4300.47	450.00	260.88
18	-12.64	497.61	5.00	4366.78	450.00	260.88
18	-12.64	497.61	5.00	4366.78	450.00	260.88
19	-8.02	501.54	3.00	4434.39	450.00	260.88
19	-8.02	501.54	3.00	4434.39	450.00	260.88
20	-8.02	504.51	3.00	4459.79	450.00	260.88
20	-8.02	504.51	3.00	4459.79	450.00	260.88
21	-8.02	507.98	3.99	4359.15	450.00	260.88
21	-8.02	507.98	3.99	4359.15	450.00	260.88
22	-3.40	512.45	5.00	4111.57	450.00	260.88
22	-3.40	512.45	5.00	4111.57	450.00	260.88
23	-3.40	517.44	5.00	3800.57	450.00	260.88
23	-3.40	517.44	5.00	3800.57	450.00	260.88
24	1.22	522.43	5.00	3498.16	450.00	260.88
24	1.22	522.43	5.00	3498.16	450.00	260.88
25	1.22	527.43	5.00	3162.23	450.00	260.88
25	1.22	527.43	5.00	3162.23	450.00	260.88
26	5.84	532.42	5.00	2836.05	450.00	260.88
26	5.84	532.42	5.00	2836.05	450.00	260.88
27	5.84	537.39	5.00	2477.37	450.00	260.88
27	5.84	537.39	5.00	2477.37	450.00	260.88
28	10.46	542.34	5.00	2129.97	450.00	260.88
28	10.46	542.34	5.00	2129.97	450.00	260.88

29	10.46	547.25	5.00	1750.88	450.00	260.88
29	10.46	547.25	5.00	1750.88	450.00	260.88
30	15.08	551.42	3.54	1442.94	450.00	260.88
30	15.08	551.42	3.54	1442.94	450.00	260.88
31	15.08	554.84	3.54	1161.88	450.00	260.88
31	15.08	554.84	3.54	1161.88	450.00	260.88
32	15.08	557.96	2.92	1101.83	1700.00	985.55
32	15.08	557.96	2.92	1101.83	1700.00	985.55
33	19.71	559.70	0.71	1045.36	1700.00	985.55
33	19.71	559.70	0.71	1045.36	1700.00	985.55
34	19.71	560.52	1.02	964.01	1700.00	985.55
34	19.71	560.52	1.02	964.01	1700.00	985.55
35	19.71	562.95	4.13	828.01	1700.00	985.55
35	19.71	562.95	4.13	828.01	1700.00	985.55
36	19.71	566.84	4.13	660.76	1700.00	985.55
36	19.71	566.84	4.13	660.76	1700.00	985.55
37	24.33	570.85	4.53	557.61	1700.00	985.55
37	24.33	570.85	4.53	557.61	1700.00	985.55

Table 4 - Base Force Data on the 37 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force (lbs)
1	-44.99	432.91	5.00	1104.59	0.00	0.00
1	-44.99	432.91	5.00	1104.59	0.00	0.00
2	-44.99	436.45	5.00	3313.77	0.00	0.00
2	-44.99	436.45	5.00	3313.77	0.00	0.00
3	-40.37	440.12	5.00	2966.38	5000.00	2898.67
3	-40.37	440.12	5.00	2966.38	5000.00	2898.67
4	-40.37	443.93	5.00	4990.32	5000.00	2898.67
4	-40.37	443.93	5.00	4990.32	5000.00	2898.67
5	-35.74	447.87	5.00	7292.69	5000.00	2898.67
5	-35.74	447.87	5.00	7292.69	5000.00	2898.67
6	-35.74	451.92	5.00	9118.23	5000.00	2898.67
6	-35.74	451.92	5.00	9118.23	5000.00	2898.67
7	-31.12	456.09	5.00	11174.74	5000.00	2898.67
7	-31.12	456.09	5.00	11174.74	5000.00	2898.67
8	-31.12	460.37	5.00	12790.02	5000.00	2898.67
8	-31.12	460.37	5.00	12790.02	5000.00	2898.67
9	-26.50	464.74	4.98	14534.42	4978.65	2886.29
9	-26.50	464.74	4.98	14534.42	4978.65	2886.29
10	-26.50	469.20	4.98	15917.05	4978.65	2886.29
10	-26.50	469.20	4.98	15917.05	4978.65	2886.29
11	-26.50	471.44	0.04	133.87	72.60	42.09
11	-26.50	471.44	0.04	133.87	72.60	42.09
12	-21.88	473.78	5.00	16716.33	8500.00	4927.73
12	-21.88	473.78	5.00	16716.33	8500.00	4927.73
13	-21.88	478.42	5.00	17834.43	8500.00	4927.73
13	-21.88	478.42	5.00	17834.43	8500.00	4927.73
14	-17.26	482.76	4.23	16242.50	7184.09	4164.85
14	-17.26	482.76	4.23	16242.50	7184.09	4164.85
15	-17.26	486.39	3.37	13303.58	5729.12	3321.36
15	-17.26	486.39	3.37	13303.58	5729.12	3321.36
16	-17.26	489.14	2.40	10152.44	1081.80	627.15
16	-17.26	489.14	2.40	10152.44	1081.80	627.15
17	-12.64	492.73	5.00	21502.37	2250.00	1304.40
17	-12.64	492.73	5.00	21502.37	2250.00	1304.40
18	-12.64	497.61	5.00	21833.90	2250.00	1304.40
18	-12.64	497.61	5.00	21833.90	2250.00	1304.40
19	-8.02	501.54	3.00	13324.92	1352.21	783.92
19	-8.02	501.54	3.00	13324.92	1352.21	783.92
20	-8.02	504.51	3.00	13401.26	1352.21	783.92
20	-8.02	504.51	3.00	13401.26	1352.21	783.92

21	-8.02	507.98	3.99	17393.84	1795.58	1040.96
21	-8.02	507.98	3.99	17393.84	1795.58	1040.96
22	-3.40	512.45	5.00	20557.86	2250.00	1304.40
22	-3.40	512.45	5.00	20557.86	2250.00	1304.40
23	-3.40	517.44	5.00	19002.85	2250.00	1304.40
23	-3.40	517.44	5.00	19002.85	2250.00	1304.40
24	1.22	522.43	5.00	17490.80	2250.00	1304.40
24	1.22	522.43	5.00	17490.80	2250.00	1304.40
25	1.22	527.43	5.00	15811.14	2250.00	1304.40
25	1.22	527.43	5.00	15811.14	2250.00	1304.40
26	5.84	532.42	5.00	14180.27	2250.00	1304.40
26	5.84	532.42	5.00	14180.27	2250.00	1304.40
27	5.84	537.39	5.00	12386.87	2250.00	1304.40
27	5.84	537.39	5.00	12386.87	2250.00	1304.40
28	10.46	542.34	5.00	10649.86	2250.00	1304.40
28	10.46	542.34	5.00	10649.86	2250.00	1304.40
29	10.46	547.25	5.00	8754.39	2250.00	1304.40
29	10.46	547.25	5.00	8754.39	2250.00	1304.40
30	15.08	551.42	3.54	5107.09	1592.72	923.35
30	15.08	551.42	3.54	5107.09	1592.72	923.35
31	15.08	554.84	3.54	4112.33	1592.72	923.35
31	15.08	554.84	3.54	4112.33	1592.72	923.35
32	15.08	557.96	2.92	3218.71	4966.13	2879.03
32	15.08	557.96	2.92	3218.71	4966.13	2879.03
33	19.71	559.70	0.71	743.32	1208.81	700.79
33	19.71	559.70	0.71	743.32	1208.81	700.79
34	19.71	560.52	1.02	985.17	1737.31	1007.18
34	19.71	560.52	1.02	985.17	1737.31	1007.18
35	19.71	562.95	4.13	3422.56	7026.94	4073.75
35	19.71	562.95	4.13	3422.56	7026.94	4073.75
36	19.71	566.84	4.13	2731.23	7026.94	4073.75
36	19.71	566.84	4.13	2731.23	7026.94	4073.75
37	24.33	570.85	4.53	2528.50	7708.69	4468.98
37	24.33	570.85	4.53	2528.50	7708.69	4468.98

SUM OF MOMENTS = -0.220268E-12 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.5541838E-18

Sum of the Resisting Forces = 130885.16 (lbs)

Average Available Shear Strength = 846.96(psf)

Sum of the Driving Forces = -75878.47 (lbs)

Average Mobilized Shear Stress = -491.01(psf)

Total length of the failure surface = 154.53(ft)

Factor of Safety Balance Check: FS = 1.72493

CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

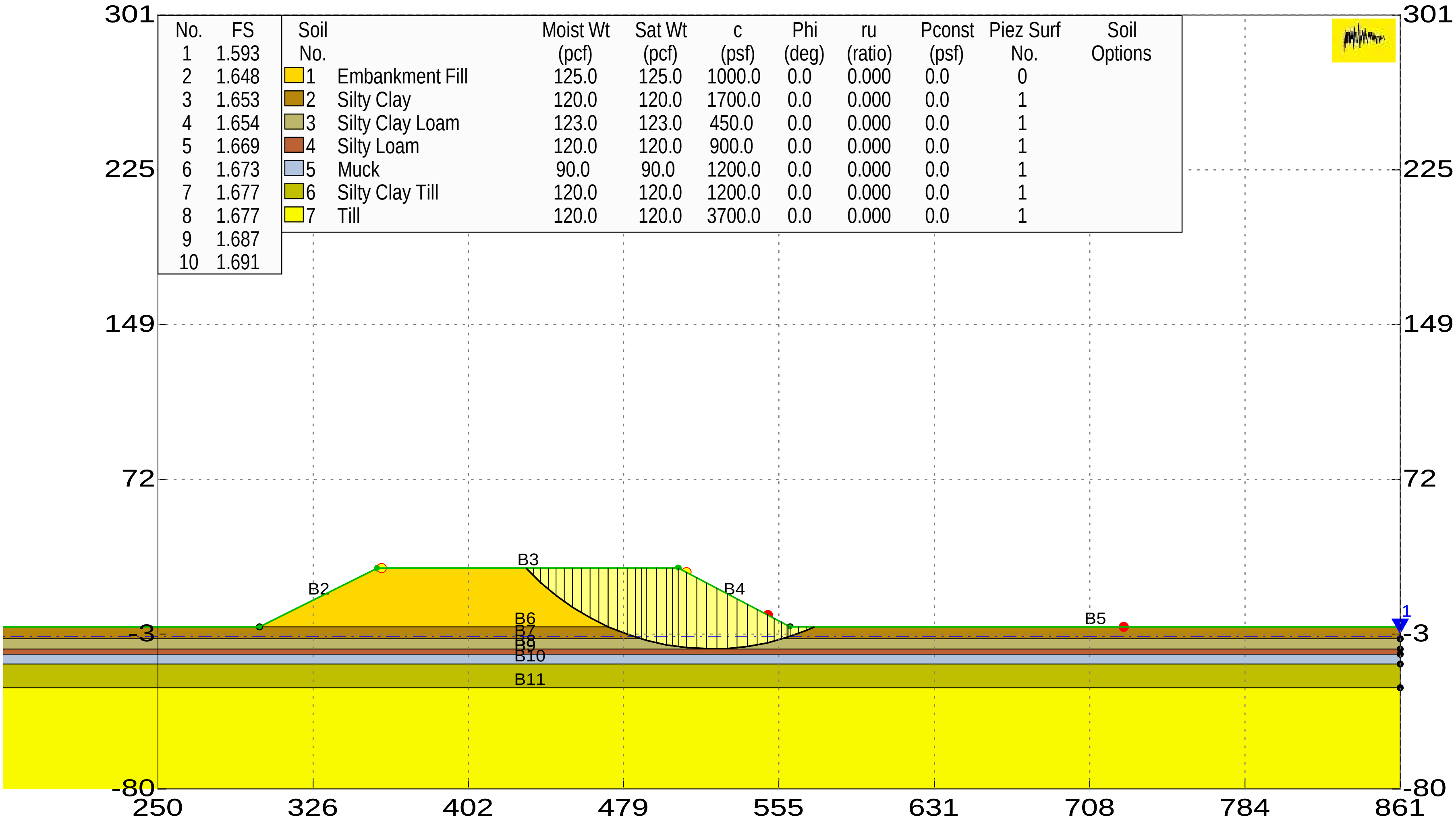
**** END OF GEOSTASE OUTPUT ****

Sideslope – Seismic Conditions

I-74 Over IL Route 17
North Abutment Sideslope Fill Placement Boring 4 Only

Hurst-Rosche, Inc.

\I-74 Stability Calc Case 3 Sideslope.gsd



No.	FS
1	1.593
2	1.648
3	1.653
4	1.654
5	1.669
6	1.673
7	1.677
8	1.677
9	1.687
10	1.691

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Embankment Fill	125.0	125.0	1000.0	0.0	0.000	0.0	0	
2	Silty Clay	120.0	120.0	1700.0	0.0	0.000	0.0	1	
3	Silty Clay Loam	123.0	123.0	450.0	0.0	0.000	0.0	1	
4	Silty Loam	120.0	120.0	900.0	0.0	0.000	0.0	1	
5	Muck	90.0	90.0	1200.0	0.0	0.000	0.0	1	
6	Silty Clay Till	120.0	120.0	1200.0	0.0	0.000	0.0	1	
7	Till	120.0	120.0	3700.0	0.0	0.000	0.0	1	

GEOSTASE FS =1.593

Simplified Bishop Method

kh = 0.01900

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.1

*** GEOSTASE(R) ***

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date: 1/ 28/ 2022
Analysis Time:
Analysis By: Hurst-Rosche, Inc.
Input File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 3 Sideslope.gsd
Output File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 3 Sideslope.OUT
Unit System: English

PROJECT: I-74 Over IL Route 17

DESCRIPTION: North Abutment Sideslope Fill Placement Boring 4 Only - Seismic

BOUNDARY DATA

5 Surface Boundaries
11 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	0.000	300.000	0.000	2
2	300.000	0.000	358.000	29.000	1
3	358.000	29.000	506.000	29.000	1
4	506.000	29.000	561.000	0.000	1
5	561.000	0.000	861.000	0.000	2
6	300.000	0.000	561.000	0.000	2
7	0.000	-6.000	861.000	-6.000	3
8	0.000	-11.000	861.000	-11.000	4
9	0.000	-13.500	861.000	-13.500	5
10	0.000	-18.500	861.000	-18.500	6
11	0.000	-30.000	861.000	-30.000	7

User Specified X-Origin = 250.000(ft)

User Specified Y-Origin = -80.000(ft)

MOHR-COULOMB SOIL PARAMETERS

7 Type(s) of Soil Defined

Soil Number Moist Saturated Cohesion Friction Pore Pressure Water
Water

and Description	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Ratio(ru)	Constant (psf)	Surface No.	Option
1 Embankment Fill	125.0	125.0	1000.00	0.00	0.000	0.0	0	0
2 Silty Clay	120.0	120.0	1700.00	0.00	0.000	0.0	1	0
3 Silty Clay Loam	123.0	123.0	450.00	0.00	0.000	0.0	1	0
4 Silty Loam	120.0	120.0	900.00	0.00	0.000	0.0	1	0
5 Muck	90.0	90.0	1200.00	0.00	0.000	0.0	1	0
6 Silty Clay Till	120.0	120.0	1200.00	0.00	0.000	0.0	1	0
7 Till	120.0	120.0	3700.00	0.00	0.000	0.0	1	0

WATER SURFACE DATA

1 Water Surface(s) Defined

Unit Weight of Water = 62.400 (pcf)

Water Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.00

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	-5.00
2	861.00	-5.00

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

SEISMIC (EARTHQUAKE) DATA

Specified Peak Ground Acceleration Coefficient (PGA) = 0.046(g)
Default Velocity = 0.115(ft) per second
Specified Horizontal Earthquake Coefficient (kh) = -.01900(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
(NOTE:Input Velocity = 0.0 will result in default Peak
Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
Specified Seismic Pore-Pressure Factor = 0.000
Horizontal Seismic Force is Applied at Center of Gravity of Slices

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

5000 Trial Surfaces Have Been Generated.

5000 Surfaces Generated at Increments of 0.3601(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 360.00(ft)
and X = 510.00(ft)

Each Surface Enters within a Range Between X = 550.00(ft)
and X = 725.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = -80.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 0 Iterations.

Number of Trial Surfaces with Non-Converged FS = 15

Number of Trial Surfaces With Valid FS = 4985

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 0.3 %

Statistical Data On All Valid FS Values:
FS Max = 18.210 FS Min = 1.593 FS Ave = 3.738
Standard Deviation = 1.973 Coefficient of Variation = 52.80 %

Critical Surface is Sequence Number 2372 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 522.289383(ft) ; Y = 113.115938(ft); and Radius = 124.027941(ft)

Circular Trial Failure Surface Generated With 17 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	431.144	29.000
2	438.217	21.931
3	445.836	15.454
4	453.953	9.612
5	462.513	4.443
6	471.462	-0.019
7	480.742	-3.746
8	490.291	-6.713
9	500.049	-8.902
10	509.951	-10.297
11	519.934	-10.890
12	529.931	-10.676
13	539.879	-9.658
14	549.713	-7.842
15	559.368	-5.240
16	568.783	-1.868
17	572.915	0.000

Factor Of Safety For The Critical or Specified Surface = 1.593

Table 1 - Geometry Data on the 37 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.54	1.77	432.91	27.23	29.00	-44.99	0.00	5.00
2	3.54	5.30	436.45	23.70	29.00	-44.99	0.00	5.00
3	3.81	8.69	440.12	20.31	29.00	-40.37	0.00	5.00
4	3.81	11.93	443.93	17.07	29.00	-40.37	0.00	5.00
5	4.06	15.01	447.87	13.99	29.00	-35.74	0.00	5.00
6	4.06	17.93	451.92	11.07	29.00	-35.74	0.00	5.00
7	4.28	20.68	456.09	8.32	29.00	-31.12	0.00	5.00
8	4.28	23.26	460.37	5.74	29.00	-31.12	0.00	5.00
9	4.46	25.67	464.74	3.33	29.00	-26.50	0.00	4.98
10	4.46	27.89	469.20	1.11	29.00	-26.50	0.00	4.98
11	0.04	29.01	471.44	-0.01	29.00	-26.50	0.00	0.04
12	4.64	29.95	473.78	-0.95	29.00	-21.88	0.00	5.00
13	4.64	31.81	478.42	-2.81	29.00	-21.88	0.00	5.00
14	4.04	33.37	482.76	-4.37	29.00	-17.26	0.00	4.23
15	3.22	34.50	486.39	-5.50	29.00	-17.26	0.00	3.37
16	2.30	35.36	489.14	-6.36	29.00	-17.26	0.00	2.40
17	4.88	36.26	492.73	-7.26	29.00	-12.64	0.00	5.00
18	4.88	37.35	497.61	-8.35	29.00	-12.64	0.00	5.00
19	2.98	38.11	501.54	-9.11	29.00	-8.02	0.00	3.00
20	2.98	38.53	504.51	-9.53	29.00	-8.02	0.00	3.00
21	3.95	37.98	507.98	-10.02	27.96	-8.02	-27.80	3.99
22	4.99	36.05	512.45	-10.44	25.60	-3.40	-27.80	5.00
23	4.99	33.71	517.44	-10.74	22.97	-3.40	-27.80	5.00
24	5.00	31.17	522.43	-10.84	20.34	1.22	-27.80	5.00
25	5.00	28.43	527.43	-10.73	17.70	1.22	-27.80	5.00
26	4.97	25.49	532.42	-10.42	15.07	5.84	-27.80	5.00
27	4.97	22.36	537.39	-9.91	12.45	5.84	-27.80	5.00
28	4.92	19.04	542.34	-9.20	9.84	10.46	-27.80	5.00
29	4.92	15.54	547.25	-8.30	7.25	10.46	-27.80	5.00
30	3.42	12.43	551.42	-7.38	5.05	15.08	-27.80	3.54
31	3.42	9.71	554.84	-6.46	3.25	15.08	-27.80	3.54
32	2.82	7.22	557.96	-5.62	1.60	15.08	-27.80	2.92
33	0.67	5.80	559.70	-5.12	0.68	19.71	-27.80	0.71
34	0.96	5.08	560.52	-4.83	0.25	19.71	-27.80	1.02
35	3.89	3.96	562.95	-3.96	0.00	19.71	0.00	4.13
36	3.89	2.56	566.84	-2.56	0.00	19.71	0.00	4.13
37	4.13	0.93	570.85	-0.93	0.00	24.33	0.00	4.53

Table 2 - Force Data On The 37 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ualpha Force Bot (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	781.2	0.0	0.0	-14.8	0.0	0.0
2	2343.7	0.0	0.0	-44.5	0.0	0.0
3	4137.5	0.0	0.0	-78.6	0.0	0.0
4	5679.6	0.0	0.0	-107.9	0.0	0.0
5	7612.3	0.0	0.0	-144.6	0.0	0.0
6	9093.9	0.0	0.0	-172.8	0.0	0.0
7	11064.5	0.0	0.0	-210.2	0.0	0.0
8	12447.2	0.0	0.0	-236.5	0.0	0.0
9	14295.0	0.0	0.0	-271.6	0.0	0.0
10	15532.3	0.0	0.0	-295.1	0.0	0.0
11	138.6	0.0	0.0	-2.6	0.0	0.0
12	17348.5	0.0	0.0	-329.6	0.0	0.0

13	18386.1	0.0	0.0	-349.3	0.0	0.0
14	16746.8	0.0	0.0	-318.2	0.0	0.0
15	13790.4	0.0	105.1	-262.0	0.0	0.0
16	10075.6	0.0	203.5	-191.4	0.0	0.0
17	21954.8	0.0	705.3	-417.1	0.0	0.0
18	22611.4	0.0	1046.6	-429.6	0.0	0.0
19	14067.3	0.0	770.9	-267.3	0.0	0.0
20	14220.8	0.0	849.5	-270.2	0.0	0.0
21	18606.3	0.0	1249.5	-353.5	0.0	0.0
22	22294.9	0.0	1698.8	-423.6	0.0	0.0
23	20834.9	0.0	1791.3	-395.9	0.0	0.0
24	19279.5	0.0	1820.9	-366.3	0.0	0.0
25	17567.0	0.0	1787.7	-333.8	0.0	0.0
26	15656.6	0.0	1691.6	-297.5	0.0	0.0
27	13714.6	0.0	1532.8	-260.6	0.0	0.0
28	11525.8	0.0	1311.7	-219.0	0.0	0.0
29	9383.2	0.0	1028.4	-178.3	0.0	0.0
30	5198.7	0.0	526.0	-98.8	0.0	0.0
31	4041.8	0.0	322.6	-76.8	0.0	0.0
32	2467.7	0.0	113.0	-46.9	0.0	0.0
33	468.5	0.0	5.3	-8.9	0.0	0.0
34	587.9	0.0	0.0	-11.2	0.0	0.0
35	1848.5	0.0	0.0	-35.1	0.0	0.0
36	1197.7	0.0	0.0	-22.8	0.0	0.0
37	463.1	0.0	0.0	-8.8	0.0	0.0

TOTAL WEIGHT OF SLIDING MASS = 397464.22(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 379084.05(lbs)

TOTAL AREA OF SLIDING MASS = 3203.97(ft2)

TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 37 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	1000.00	0.00	
2	1	1000.00	0.00	
3	1	1000.00	0.00	
4	1	1000.00	0.00	
5	1	1000.00	0.00	
6	1	1000.00	0.00	
7	1	1000.00	0.00	
8	1	1000.00	0.00	
9	1	1000.00	0.00	
10	1	1000.00	0.00	
11	2	1700.00	0.00	
12	2	1700.00	0.00	
13	2	1700.00	0.00	
14	2	1700.00	0.00	
15	2	1700.00	0.00	
16	3	450.00	0.00	
17	3	450.00	0.00	
18	3	450.00	0.00	
19	3	450.00	0.00	
20	3	450.00	0.00	
21	3	450.00	0.00	
22	3	450.00	0.00	
23	3	450.00	0.00	
24	3	450.00	0.00	
25	3	450.00	0.00	
26	3	450.00	0.00	
27	3	450.00	0.00	
28	3	450.00	0.00	
29	3	450.00	0.00	
30	3	450.00	0.00	

31	3	450.00	0.00
32	2	1700.00	0.00
33	2	1700.00	0.00
34	2	1700.00	0.00
35	2	1700.00	0.00
36	2	1700.00	0.00
37	2	1700.00	0.00

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

TABLE 3 - Effective and Base Shear Stress Data on the 37 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-44.99	432.91	5.00	220.92	0.00	0.00
1	-44.99	432.91	5.00	220.92	0.00	0.00
2	-44.99	436.45	5.00	662.75	0.00	0.00
2	-44.99	436.45	5.00	662.75	0.00	0.00
3	-40.37	440.12	5.00	551.01	1000.00	627.77
3	-40.37	440.12	5.00	551.01	1000.00	627.77
4	-40.37	443.93	5.00	955.80	1000.00	627.77
4	-40.37	443.93	5.00	955.80	1000.00	627.77
5	-35.74	447.87	5.00	1422.75	1000.00	627.77
5	-35.74	447.87	5.00	1422.75	1000.00	627.77
6	-35.74	451.92	5.00	1787.86	1000.00	627.77
6	-35.74	451.92	5.00	1787.86	1000.00	627.77
7	-31.12	456.09	5.00	2204.92	1000.00	627.77
7	-31.12	456.09	5.00	2204.92	1000.00	627.77
8	-31.12	460.37	5.00	2527.98	1000.00	627.77
8	-31.12	460.37	5.00	2527.98	1000.00	627.77
9	-26.50	464.74	4.98	2894.56	1000.00	627.77
9	-26.50	464.74	4.98	2894.56	1000.00	627.77
10	-26.50	469.20	4.98	3172.27	1000.00	627.77
10	-26.50	469.20	4.98	3172.27	1000.00	627.77
11	-26.50	471.44	0.04	3092.55	1700.00	1067.21
11	-26.50	471.44	0.04	3092.55	1700.00	1067.21
12	-21.88	473.78	5.00	3309.32	1700.00	1067.21
12	-21.88	473.78	5.00	3309.32	1700.00	1067.21
13	-21.88	478.42	5.00	3532.93	1700.00	1067.21
13	-21.88	478.42	5.00	3532.93	1700.00	1067.21
14	-17.26	482.76	4.23	3817.26	1700.00	1067.21
14	-17.26	482.76	4.23	3817.26	1700.00	1067.21
15	-17.26	486.39	3.37	3921.30	1700.00	1067.21
15	-17.26	486.39	3.37	3921.30	1700.00	1067.21
16	-17.26	489.14	2.40	4216.20	450.00	282.50
16	-17.26	489.14	2.40	4216.20	450.00	282.50
17	-12.64	492.73	5.00	4295.46	450.00	282.50
17	-12.64	492.73	5.00	4295.46	450.00	282.50
18	-12.64	497.61	5.00	4361.76	450.00	282.50
18	-12.64	497.61	5.00	4361.76	450.00	282.50
19	-8.02	501.54	3.00	4431.23	450.00	282.50
19	-8.02	501.54	3.00	4431.23	450.00	282.50
20	-8.02	504.51	3.00	4456.64	450.00	282.50
20	-8.02	504.51	3.00	4456.64	450.00	282.50
21	-8.02	507.98	3.99	4356.00	450.00	282.50
21	-8.02	507.98	3.99	4356.00	450.00	282.50
22	-3.40	512.45	5.00	4110.24	450.00	282.50
22	-3.40	512.45	5.00	4110.24	450.00	282.50
23	-3.40	517.44	5.00	3799.24	450.00	282.50

23	-3.40	517.44	5.00	3799.24	450.00	282.50
24	1.22	522.43	5.00	3498.64	450.00	282.50
24	1.22	522.43	5.00	3498.64	450.00	282.50
25	1.22	527.43	5.00	3162.71	450.00	282.50
25	1.22	527.43	5.00	3162.71	450.00	282.50
26	5.84	532.42	5.00	2838.34	450.00	282.50
26	5.84	532.42	5.00	2838.34	450.00	282.50
27	5.84	537.39	5.00	2479.66	450.00	282.50
27	5.84	537.39	5.00	2479.66	450.00	282.50
28	10.46	542.34	5.00	2134.10	450.00	282.50
28	10.46	542.34	5.00	2134.10	450.00	282.50
29	10.46	547.25	5.00	1755.01	450.00	282.50
29	10.46	547.25	5.00	1755.01	450.00	282.50
30	15.08	551.42	3.54	1448.97	450.00	282.50
30	15.08	551.42	3.54	1448.97	450.00	282.50
31	15.08	554.84	3.54	1167.91	450.00	282.50
31	15.08	554.84	3.54	1167.91	450.00	282.50
32	15.08	557.96	2.92	1124.61	1700.00	1067.21
32	15.08	557.96	2.92	1124.61	1700.00	1067.21
33	19.71	559.70	0.71	1075.63	1700.00	1067.21
33	19.71	559.70	0.71	1075.63	1700.00	1067.21
34	19.71	560.52	1.02	994.29	1700.00	1067.21
34	19.71	560.52	1.02	994.29	1700.00	1067.21
35	19.71	562.95	4.13	858.28	1700.00	1067.21
35	19.71	562.95	4.13	858.28	1700.00	1067.21
36	19.71	566.84	4.13	691.03	1700.00	1067.21
36	19.71	566.84	4.13	691.03	1700.00	1067.21
37	24.33	570.85	4.53	595.82	1700.00	1067.21
37	24.33	570.85	4.53	595.82	1700.00	1067.21

Table 4 - Base Force Data on the 37 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force (lbs)
1	-44.99	432.91	5.00	1104.59	0.00	0.00
1	-44.99	432.91	5.00	1104.59	0.00	0.00
2	-44.99	436.45	5.00	3313.77	0.00	0.00
2	-44.99	436.45	5.00	3313.77	0.00	0.00
3	-40.37	440.12	5.00	2755.05	5000.00	3138.85
3	-40.37	440.12	5.00	2755.05	5000.00	3138.85
4	-40.37	443.93	5.00	4778.99	5000.00	3138.85
4	-40.37	443.93	5.00	4778.99	5000.00	3138.85
5	-35.74	447.87	5.00	7113.74	5000.00	3138.85
5	-35.74	447.87	5.00	7113.74	5000.00	3138.85
6	-35.74	451.92	5.00	8939.28	5000.00	3138.85
6	-35.74	451.92	5.00	8939.28	5000.00	3138.85
7	-31.12	456.09	5.00	11024.62	5000.00	3138.85
7	-31.12	456.09	5.00	11024.62	5000.00	3138.85
8	-31.12	460.37	5.00	12639.89	5000.00	3138.85
8	-31.12	460.37	5.00	12639.89	5000.00	3138.85
9	-26.50	464.74	4.98	14410.97	4978.65	3125.45
9	-26.50	464.74	4.98	14410.97	4978.65	3125.45
10	-26.50	469.20	4.98	15793.60	4978.65	3125.45
10	-26.50	469.20	4.98	15793.60	4978.65	3125.45
11	-26.50	471.44	0.04	132.07	72.60	45.58
11	-26.50	471.44	0.04	132.07	72.60	45.58
12	-21.88	473.78	5.00	16546.58	8500.00	5336.05
12	-21.88	473.78	5.00	16546.58	8500.00	5336.05
13	-21.88	478.42	5.00	17664.67	8500.00	5336.05
13	-21.88	478.42	5.00	17664.67	8500.00	5336.05
14	-17.26	482.76	4.23	16131.50	7184.09	4509.95
14	-17.26	482.76	4.23	16131.50	7184.09	4509.95
15	-17.26	486.39	3.37	13215.06	5729.12	3596.57

15	-17.26	486.39	3.37	13215.06	5729.12	3596.57
16	-17.26	489.14	2.40	10135.73	1081.80	679.12
16	-17.26	489.14	2.40	10135.73	1081.80	679.12
17	-12.64	492.73	5.00	21477.28	2250.00	1412.48
17	-12.64	492.73	5.00	21477.28	2250.00	1412.48
18	-12.64	497.61	5.00	21808.81	2250.00	1412.48
18	-12.64	497.61	5.00	21808.81	2250.00	1412.48
19	-8.02	501.54	3.00	13315.45	1352.21	848.88
19	-8.02	501.54	3.00	13315.45	1352.21	848.88
20	-8.02	504.51	3.00	13391.78	1352.21	848.88
20	-8.02	504.51	3.00	13391.78	1352.21	848.88
21	-8.02	507.98	3.99	17381.26	1795.58	1127.21
21	-8.02	507.98	3.99	17381.26	1795.58	1127.21
22	-3.40	512.45	5.00	20551.22	2250.00	1412.48
22	-3.40	512.45	5.00	20551.22	2250.00	1412.48
23	-3.40	517.44	5.00	18996.20	2250.00	1412.48
23	-3.40	517.44	5.00	18996.20	2250.00	1412.48
24	1.22	522.43	5.00	17493.19	2250.00	1412.48
24	1.22	522.43	5.00	17493.19	2250.00	1412.48
25	1.22	527.43	5.00	15813.53	2250.00	1412.48
25	1.22	527.43	5.00	15813.53	2250.00	1412.48
26	5.84	532.42	5.00	14191.72	2250.00	1412.48
26	5.84	532.42	5.00	14191.72	2250.00	1412.48
27	5.84	537.39	5.00	12398.32	2250.00	1412.48
27	5.84	537.39	5.00	12398.32	2250.00	1412.48
28	10.46	542.34	5.00	10670.52	2250.00	1412.48
28	10.46	542.34	5.00	10670.52	2250.00	1412.48
29	10.46	547.25	5.00	8775.05	2250.00	1412.48
29	10.46	547.25	5.00	8775.05	2250.00	1412.48
30	15.08	551.42	3.54	5128.44	1592.72	999.86
30	15.08	551.42	3.54	5128.44	1592.72	999.86
31	15.08	554.84	3.54	4133.67	1592.72	999.86
31	15.08	554.84	3.54	4133.67	1592.72	999.86
32	15.08	557.96	2.92	3285.27	4966.13	3117.59
32	15.08	557.96	2.92	3285.27	4966.13	3117.59
33	19.71	559.70	0.71	764.84	1208.81	758.85
33	19.71	559.70	0.71	764.84	1208.81	758.85
34	19.71	560.52	1.02	1016.11	1737.31	1090.63
34	19.71	560.52	1.02	1016.11	1737.31	1090.63
35	19.71	562.95	4.13	3547.71	7026.94	4411.30
35	19.71	562.95	4.13	3547.71	7026.94	4411.30
36	19.71	566.84	4.13	2856.38	7026.94	4411.30
36	19.71	566.84	4.13	2856.38	7026.94	4411.30
37	24.33	570.85	4.53	2701.78	7708.69	4839.28
37	24.33	570.85	4.53	2701.78	7708.69	4839.28

SUM OF MOMENTS = 0.206057E-12 (ft/lbs);Imbalance (Fraction of Total Weight) = 0.5184300E-18

Sum of the Resisting Forces = 130885.16 (lbs)

Average Available Shear Strength = 846.96(psf)

Sum of the Driving Forces = -82165.79 (lbs)

Average Mobilized Shear Stress = -531.70(psf)

Total length of the failure surface = 154.53(ft)

Factor of Safety Balance Check: FS = 1.59294

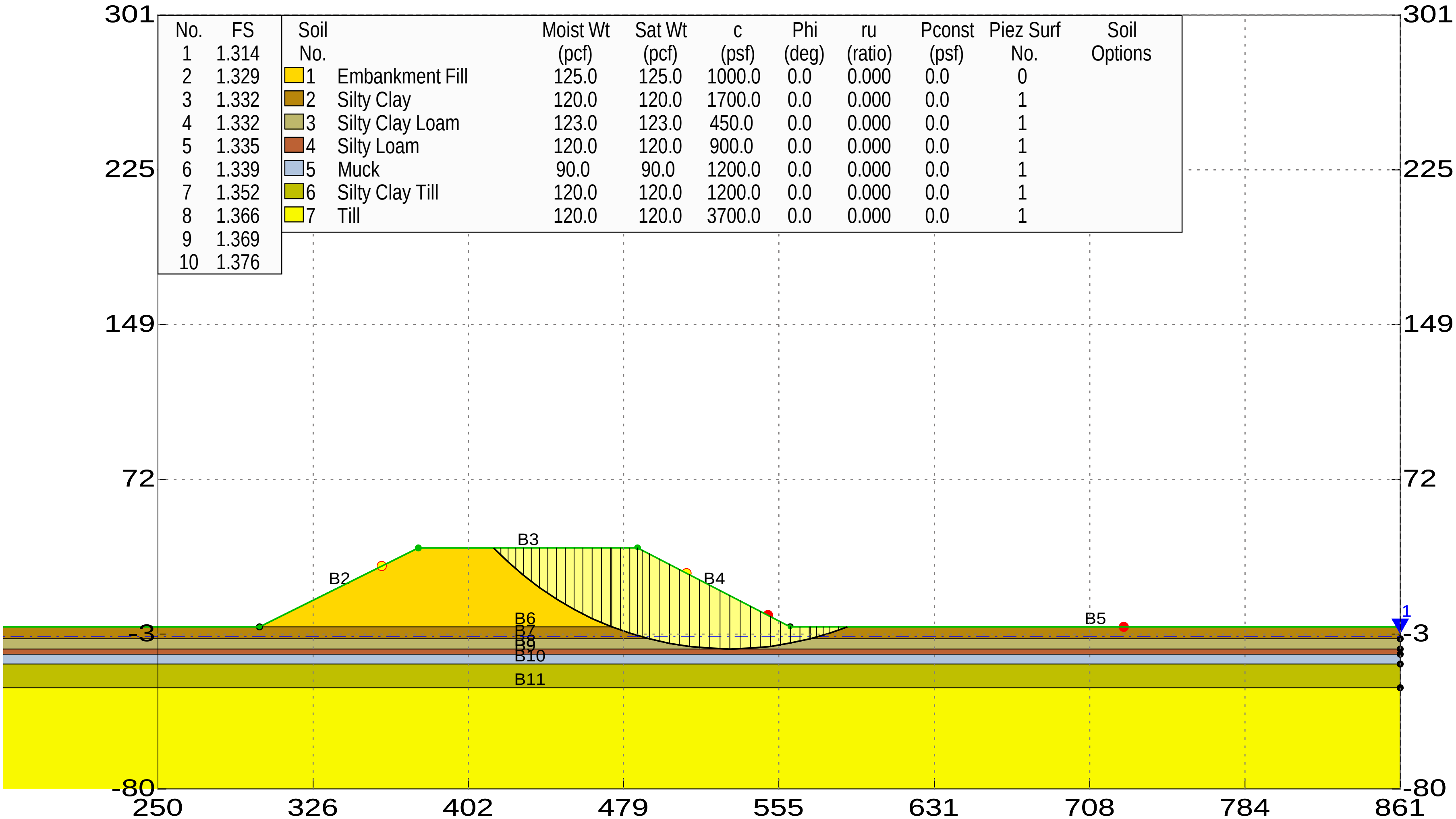
CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

```
       *** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) =  0.16059(g)
Calculated Newmark Seismic Displacement =    0.001(ft)


Average Elevation of Point of Application of kh on Sliding Mass =    9.506(ft)

Non-Symmetrical Sliding Resistance Has Been Specified
for Downhill Sliding.

              **** END OF GEOSTASE OUTPUT ****
```

10 ft. Surcharge – Static Conditions

I-74 Over IL Route 17
North Abutment Sideslope Fill Placement Boring 4 Only

Hurst-Rosche, Inc. \I-74 Stability Calc Case 5 Sideslope.gsd



No.	FS
1	1.314
2	1.329
3	1.332
4	1.332
5	1.335
6	1.339
7	1.352
8	1.366
9	1.369
10	1.376

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Embankment Fill	125.0	125.0	1000.0	0.0	0.000	0.0	0	
2	Silty Clay	120.0	120.0	1700.0	0.0	0.000	0.0	1	
3	Silty Clay Loam	123.0	123.0	450.0	0.0	0.000	0.0	1	
4	Silty Loam	120.0	120.0	900.0	0.0	0.000	0.0	1	
5	Muck	90.0	90.0	1200.0	0.0	0.000	0.0	1	
6	Silty Clay Till	120.0	120.0	1200.0	0.0	0.000	0.0	1	
7	Till	120.0	120.0	3700.0	0.0	0.000	0.0	1	

GEOSTASE FS =1.314

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

*** GEOSTASE(R) ***

** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

** Current Version 4.30.31-Double Precision, August 2019 **

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date: 2/ 15/ 2022
Analysis Time:
Analysis By: Hurst-Rosche, Inc.
Input File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 5 Sideslope.gsd
Output File Name: X:\Projects\Current\192-2211 IDOT D4 WO 10 Woodhull TSL & SGR\Engineering_Calcs\Stability Calcs\I-74 Stability Calc Case 5 Sideslope.OUT
Unit System: English

PROJECT: I-74 Over IL Route 17

DESCRIPTION: North Abutment Sideslope Fill Placement Boring 4 Only - Static

BOUNDARY DATA

5 Surface Boundaries
11 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	0.000	300.000	0.000	2
2	300.000	0.000	378.000	39.000	1
3	378.000	39.000	486.000	39.000	1
4	486.000	39.000	561.000	0.000	1
5	561.000	0.000	861.000	0.000	2
6	300.000	0.000	561.000	0.000	2
7	0.000	-6.000	861.000	-6.000	3
8	0.000	-11.000	861.000	-11.000	4
9	0.000	-13.500	861.000	-13.500	5
10	0.000	-18.500	861.000	-18.500	6
11	0.000	-30.000	861.000	-30.000	7

User Specified X-Origin = 250.000(ft)

User Specified Y-Origin = -80.000(ft)

MOHR-COULOMB SOIL PARAMETERS

7 Type(s) of Soil Defined

Soil Number and Description	Moist Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Ratio(ru)	Pressure Constant (psf)	Water Surface No.	Water Option
1 Embankment Fill	125.0	125.0	1000.00	0.00	0.000	0.0	0	0
2 Silty Clay	120.0	120.0	1700.00	0.00	0.000	0.0	1	0
3 Silty Clay Loam	123.0	123.0	450.00	0.00	0.000	0.0	1	0
4 Silty Loam	120.0	120.0	900.00	0.00	0.000	0.0	1	0
5 Muck	90.0	90.0	1200.00	0.00	0.000	0.0	1	0
6 Silty Clay Till	120.0	120.0	1200.00	0.00	0.000	0.0	1	0
7 Till	120.0	120.0	3700.00	0.00	0.000	0.0	1	0

WATER SURFACE DATA

1 Water Surface(s) Defined

Unit Weight of Water = 62.400 (pcf)

Water Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.00

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	-5.00
2	861.00	-5.00

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

5000 Trial Surfaces Have Been Generated.

5000 Surfaces Generated at Increments of 0.3601(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 360.00(ft)
and X = 510.00(ft)

Each Surface Enters within a Range Between X = 550.00(ft)
and X = 725.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = -80.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 0 Iterations.

Number of Trial Surfaces with Non-Converged FS = 52

Number of Trial Surfaces With Valid FS = 4948

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 1.0 %

Statistical Data On All Valid FS Values:
FS Max = 32.061 FS Min = 1.314 FS Ave = 3.835
Standard Deviation = 3.069 Coefficient of Variation = 80.03 %

Critical Surface is Sequence Number 1839 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 531.093863(ft) ; Y = 148.676343(ft); and Radius = 159.598373(ft)

Circular Trial Failure Surface Generated With 20 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	415.151	39.000
2	422.247	31.954
3	429.771	25.367
4	437.692	19.263
5	445.980	13.668
6	454.602	8.602
7	463.525	4.087
8	472.713	0.139
9	482.130	-3.225
10	491.739	-5.994
11	501.503	-8.155
12	511.382	-9.700
13	521.340	-10.624
14	531.335	-10.922
15	541.330	-10.593
16	551.284	-9.640
17	561.159	-8.065
18	570.917	-5.874
19	580.517	-3.077
20	589.047	0.000

Factor Of Safety For The Critical or Specified Surface = 1.314

Table 1 - Geometry Data on the 44 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.55	1.76	416.93	37.24	39.00	-44.80	0.00	5.00
2	3.55	5.28	420.47	33.72	39.00	-44.80	0.00	5.00
3	3.76	8.69	424.13	30.31	39.00	-41.21	0.00	5.00
4	3.76	11.99	427.89	27.01	39.00	-41.21	0.00	5.00
5	3.96	15.16	431.75	23.84	39.00	-37.61	0.00	5.00
6	3.96	18.21	435.71	20.79	39.00	-37.61	0.00	5.00
7	4.14	21.14	439.76	17.86	39.00	-34.02	0.00	5.00
8	4.14	23.93	443.91	15.07	39.00	-34.02	0.00	5.00

9	4.31	26.60	448.14	12.40	39.00	-30.43	0.00	5.00
10	4.31	29.13	452.45	9.87	39.00	-30.43	0.00	5.00
11	4.46	31.53	456.83	7.47	39.00	-26.84	0.00	5.00
12	4.46	33.78	461.29	5.22	39.00	-26.84	0.00	5.00
13	4.59	35.90	465.82	3.10	39.00	-23.25	0.00	5.00
14	4.59	37.87	470.42	1.13	39.00	-23.25	0.00	5.00
15	0.39	38.93	472.91	0.07	39.00	-19.66	0.00	0.41
16	4.51	39.81	475.36	-0.81	39.00	-19.66	0.00	4.79
17	4.51	41.42	479.87	-2.42	39.00	-19.66	0.00	4.79
18	3.87	42.78	484.06	-3.78	39.00	-16.07	0.00	4.03
19	2.29	43.07	487.14	-4.67	38.40	-16.07	-27.47	2.38
20	3.45	42.41	490.01	-5.50	36.91	-16.07	-27.47	3.59
21	0.03	42.01	491.75	-6.00	36.01	-12.48	-27.47	0.03
22	4.87	41.27	494.20	-6.54	34.74	-12.48	-27.47	4.99
23	4.87	39.82	499.07	-7.62	32.20	-12.48	-27.47	4.99
24	4.94	38.20	503.97	-8.54	29.65	-8.89	-27.47	5.00
25	4.94	36.40	508.91	-9.31	27.09	-8.89	-27.47	5.00
26	4.98	34.44	513.87	-9.93	24.51	-5.30	-27.47	5.00
27	4.98	32.31	518.85	-10.39	21.92	-5.30	-27.47	5.00
28	5.00	30.02	523.84	-10.70	19.32	-1.71	-27.47	5.00
29	5.00	27.57	528.84	-10.85	16.73	-1.71	-27.47	5.00
30	5.00	24.97	533.83	-10.84	14.13	1.88	-27.47	5.00
31	5.00	22.20	538.83	-10.68	11.53	1.88	-27.47	5.00
32	4.98	19.29	543.82	-10.36	8.93	5.47	-27.47	5.00
33	4.98	16.22	548.80	-9.88	6.35	5.47	-27.47	5.00
34	4.86	13.04	553.71	-9.25	3.79	9.06	-27.47	4.92
35	4.86	9.74	558.57	-8.48	1.26	9.06	-27.47	4.92
36	0.16	8.08	561.08	-8.08	0.00	9.06	0.00	0.16
37	4.60	7.55	563.46	-7.55	0.00	12.65	0.00	4.71
38	4.60	6.52	568.06	-6.52	0.00	12.65	0.00	4.71
39	0.56	5.94	570.64	-5.94	0.00	12.65	0.00	0.58
40	3.00	5.44	572.42	-5.44	0.00	16.24	0.00	3.12
41	3.30	4.52	575.57	-4.52	0.00	16.24	0.00	3.44
42	3.30	3.56	578.87	-3.56	0.00	16.24	0.00	3.44
43	4.26	2.31	582.65	-2.31	0.00	19.83	0.00	4.53
44	4.26	0.77	586.91	-0.77	0.00	19.83	0.00	4.53

Table 2 - Force Data On The 44 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ualpha Force Bot (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	781.2	0.0	0.0	0.0	0.0	0.0
2	2343.7	0.0	0.0	0.0	0.0	0.0
3	4087.5	0.0	0.0	0.0	0.0	0.0
4	5636.3	0.0	0.0	0.0	0.0	0.0
5	7505.1	0.0	0.0	0.0	0.0	0.0
6	9016.0	0.0	0.0	0.0	0.0	0.0
7	10948.3	0.0	0.0	0.0	0.0	0.0
8	12397.5	0.0	0.0	0.0	0.0	0.0
9	14333.6	0.0	0.0	0.0	0.0	0.0
10	15698.4	0.0	0.0	0.0	0.0	0.0
11	17580.9	0.0	0.0	0.0	0.0	0.0
12	18839.9	0.0	0.0	0.0	0.0	0.0
13	20615.0	0.0	0.0	0.0	0.0	0.0
14	21748.5	0.0	0.0	0.0	0.0	0.0
15	1896.1	0.0	0.0	0.0	0.0	0.0
16	22440.9	0.0	0.0	0.0	0.0	0.0
17	23314.4	0.0	0.0	0.0	0.0	0.0
18	20625.0	0.0	0.0	0.0	0.0	0.0
19	12274.2	0.0	0.0	0.0	0.0	0.0
20	18190.6	0.0	111.3	0.0	0.0	0.0
21	148.6	0.0	1.8	0.0	0.0	0.0

22	24962.1	0.0	478.7	0.0	0.0	0.0
23	24067.0	0.0	813.8	0.0	0.0	0.0
24	23412.0	0.0	1104.8	0.0	0.0	0.0
25	22295.3	0.0	1345.9	0.0	0.0	0.0
26	21243.1	0.0	1538.5	0.0	0.0	0.0
27	19914.7	0.0	1682.5	0.0	0.0	0.0
28	18558.6	0.0	1777.8	0.0	0.0	0.0
29	17026.7	0.0	1824.4	0.0	0.0	0.0
30	15397.1	0.0	1822.0	0.0	0.0	0.0
31	13673.0	0.0	1770.8	0.0	0.0	0.0
32	11808.3	0.0	1670.8	0.0	0.0	0.0
33	9906.1	0.0	1522.0	0.0	0.0	0.0
34	7741.9	0.0	1305.3	0.0	0.0	0.0
35	5744.9	0.0	1067.4	0.0	0.0	0.0
36	155.5	0.0	31.0	0.0	0.0	0.0
37	4186.1	0.0	749.4	0.0	0.0	0.0
38	3602.4	0.0	445.8	0.0	0.0	0.0
39	400.0	0.0	33.6	0.0	0.0	0.0
40	1957.0	0.0	85.2	0.0	0.0	0.0
41	1789.9	0.0	0.0	0.0	0.0	0.0
42	1409.0	0.0	0.0	0.0	0.0	0.0
43	1180.9	0.0	0.0	0.0	0.0	0.0
44	393.6	0.0	0.0	0.0	0.0	0.0

TOTAL WEIGHT OF SLIDING MASS = 511247.05(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 490223.71(lbs)

TOTAL AREA OF SLIDING MASS = 4117.65(ft2)

TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   44 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	1000.00	0.00	
2	1	1000.00	0.00	
3	1	1000.00	0.00	
4	1	1000.00	0.00	
5	1	1000.00	0.00	
6	1	1000.00	0.00	
7	1	1000.00	0.00	
8	1	1000.00	0.00	
9	1	1000.00	0.00	
10	1	1000.00	0.00	
11	1	1000.00	0.00	
12	1	1000.00	0.00	
13	1	1000.00	0.00	
14	1	1000.00	0.00	
15	1	1000.00	0.00	
16	2	1700.00	0.00	
17	2	1700.00	0.00	
18	2	1700.00	0.00	
19	2	1700.00	0.00	
20	2	1700.00	0.00	
21	2	1700.00	0.00	
22	3	450.00	0.00	
23	3	450.00	0.00	
24	3	450.00	0.00	
25	3	450.00	0.00	
26	3	450.00	0.00	
27	3	450.00	0.00	
28	3	450.00	0.00	
29	3	450.00	0.00	
30	3	450.00	0.00	
31	3	450.00	0.00	
32	3	450.00	0.00	

33	3	450.00	0.00
34	3	450.00	0.00
35	3	450.00	0.00
36	3	450.00	0.00
37	3	450.00	0.00
38	3	450.00	0.00
39	2	1700.00	0.00
40	2	1700.00	0.00
41	2	1700.00	0.00
42	2	1700.00	0.00
43	2	1700.00	0.00
44	2	1700.00	0.00

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

TABLE 3 - Effective and Base Shear Stress Data on the 44 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-44.80	416.93	5.00	220.18	0.00	0.00
1	-44.80	416.93	5.00	220.18	0.00	0.00
2	-44.80	420.47	5.00	660.54	0.00	0.00
2	-44.80	420.47	5.00	660.54	0.00	0.00
3	-41.21	424.13	5.00	420.43	1000.00	760.81
3	-41.21	424.13	5.00	420.43	1000.00	760.81
4	-41.21	427.89	5.00	832.16	1000.00	760.81
4	-41.21	427.89	5.00	832.16	1000.00	760.81
5	-37.61	431.75	5.00	1308.70	1000.00	760.81
5	-37.61	431.75	5.00	1308.70	1000.00	760.81
6	-37.61	435.71	5.00	1690.16	1000.00	760.81
6	-37.61	435.71	5.00	1690.16	1000.00	760.81
7	-34.02	439.76	5.00	2128.33	1000.00	760.81
7	-34.02	439.76	5.00	2128.33	1000.00	760.81
8	-34.02	443.91	5.00	2478.04	1000.00	760.81
8	-34.02	443.91	5.00	2478.04	1000.00	760.81
9	-30.43	448.14	5.00	2877.86	1000.00	760.81
9	-30.43	448.14	5.00	2877.86	1000.00	760.81
10	-30.43	452.45	5.00	3194.45	1000.00	760.81
10	-30.43	452.45	5.00	3194.45	1000.00	760.81
11	-26.84	456.83	5.00	3555.78	1000.00	760.81
11	-26.84	456.83	5.00	3555.78	1000.00	760.81
12	-26.84	461.29	5.00	3837.99	1000.00	760.81
12	-26.84	461.29	5.00	3837.99	1000.00	760.81
13	-23.25	465.82	5.00	4160.59	1000.00	760.81
13	-23.25	465.82	5.00	4160.59	1000.00	760.81
14	-23.25	470.42	5.00	4407.33	1000.00	760.81
14	-23.25	470.42	5.00	4407.33	1000.00	760.81
15	-19.66	472.91	0.41	4594.47	1000.00	760.81
15	-19.66	472.91	0.41	4594.47	1000.00	760.81
16	-19.66	475.36	4.79	4509.65	1700.00	1293.37
16	-19.66	475.36	4.79	4509.65	1700.00	1293.37
17	-19.66	479.87	4.79	4703.17	1700.00	1293.37
17	-19.66	479.87	4.79	4703.17	1700.00	1293.37
18	-16.07	484.06	4.03	4956.35	1700.00	1293.37
18	-16.07	484.06	4.03	4956.35	1700.00	1293.37
19	-16.07	487.14	2.38	4988.41	1700.00	1293.37
19	-16.07	487.14	2.38	4988.41	1700.00	1293.37
20	-16.07	490.01	3.59	4870.09	1700.00	1293.37
20	-16.07	490.01	3.59	4870.09	1700.00	1293.37

21	-12.48	491.75	0.03	4872.20	1700.00	1293.37
21	-12.48	491.75	0.03	4872.20	1700.00	1293.37
22	-12.48	494.20	4.99	4956.40	450.00	342.36
22	-12.48	494.20	4.99	4956.40	450.00	342.36
23	-12.48	499.07	4.99	4705.29	450.00	342.36
23	-12.48	499.07	4.99	4705.29	450.00	342.36
24	-8.89	503.97	5.00	4464.83	450.00	342.36
24	-8.89	503.97	5.00	4464.83	450.00	342.36
25	-8.89	508.91	5.00	4190.56	450.00	342.36
25	-8.89	508.91	5.00	4190.56	450.00	342.36
26	-5.30	513.87	5.00	3927.40	450.00	342.36
26	-5.30	513.87	5.00	3927.40	450.00	342.36
27	-5.30	518.85	5.00	3631.77	450.00	342.36
27	-5.30	518.85	5.00	3631.77	450.00	342.36
28	-1.71	523.84	5.00	3347.59	450.00	342.36
28	-1.71	523.84	5.00	3347.59	450.00	342.36
29	-1.71	528.84	5.00	3031.77	450.00	342.36
29	-1.71	528.84	5.00	3031.77	450.00	342.36
30	1.88	533.83	5.00	2727.94	450.00	342.36
30	1.88	533.83	5.00	2727.94	450.00	342.36
31	1.88	538.83	5.00	2393.16	450.00	342.36
31	1.88	538.83	5.00	2393.16	450.00	342.36
32	5.47	543.82	5.00	2071.12	450.00	342.36
32	5.47	543.82	5.00	2071.12	450.00	342.36
33	5.47	548.80	5.00	1718.70	450.00	342.36
33	5.47	548.80	5.00	1718.70	450.00	342.36
34	9.06	553.71	4.92	1382.94	450.00	342.36
34	9.06	553.71	4.92	1382.94	450.00	342.36
35	9.06	558.57	4.92	1020.22	450.00	342.36
35	9.06	558.57	4.92	1020.22	450.00	342.36
36	9.06	561.08	0.16	838.09	450.00	342.36
36	9.06	561.08	0.16	838.09	450.00	342.36
37	12.65	563.46	4.71	828.30	450.00	342.36
37	12.65	563.46	4.71	828.30	450.00	342.36
38	12.65	568.06	4.71	765.74	450.00	342.36
38	12.65	568.06	4.71	765.74	450.00	342.36
39	12.65	570.64	0.58	944.35	1700.00	1293.37
39	12.65	570.64	0.58	944.35	1700.00	1293.37
40	16.24	572.42	3.12	1002.01	1700.00	1293.37
40	16.24	572.42	3.12	1002.01	1700.00	1293.37
41	16.24	575.57	3.44	919.14	1700.00	1293.37
41	16.24	575.57	3.44	919.14	1700.00	1293.37
42	16.24	578.87	3.44	803.74	1700.00	1293.37
42	16.24	578.87	3.44	803.74	1700.00	1293.37
43	19.83	582.65	4.53	743.43	1700.00	1293.37
43	19.83	582.65	4.53	743.43	1700.00	1293.37
44	19.83	586.91	4.53	558.83	1700.00	1293.37
44	19.83	586.91	4.53	558.83	1700.00	1293.37

Table 4 - Base Force Data on the 44 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force (lbs)
1	-44.80	416.93	5.00	1100.91	0.00	0.00
1	-44.80	416.93	5.00	1100.91	0.00	0.00
2	-44.80	420.47	5.00	3302.72	0.00	0.00
2	-44.80	420.47	5.00	3302.72	0.00	0.00
3	-41.21	424.13	5.00	2102.16	5000.00	3804.03
3	-41.21	424.13	5.00	2102.16	5000.00	3804.03
4	-41.21	427.89	5.00	4160.78	5000.00	3804.03
4	-41.21	427.89	5.00	4160.78	5000.00	3804.03
5	-37.61	431.75	5.00	6543.49	5000.00	3804.03
5	-37.61	431.75	5.00	6543.49	5000.00	3804.03

6	-37.61	435.71	5.00	8450.82	5000.00	3804.03
6	-37.61	435.71	5.00	8450.82	5000.00	3804.03
7	-34.02	439.76	5.00	10641.63	5000.00	3804.03
7	-34.02	439.76	5.00	10641.63	5000.00	3804.03
8	-34.02	443.91	5.00	12390.19	5000.00	3804.03
8	-34.02	443.91	5.00	12390.19	5000.00	3804.03
9	-30.43	448.14	5.00	14389.31	5000.00	3804.03
9	-30.43	448.14	5.00	14389.31	5000.00	3804.03
10	-30.43	452.45	5.00	15972.23	5000.00	3804.03
10	-30.43	452.45	5.00	15972.23	5000.00	3804.03
11	-26.84	456.83	5.00	17778.90	5000.00	3804.03
11	-26.84	456.83	5.00	17778.90	5000.00	3804.03
12	-26.84	461.29	5.00	19189.97	5000.00	3804.03
12	-26.84	461.29	5.00	19189.97	5000.00	3804.03
13	-23.25	465.82	5.00	20802.96	5000.00	3804.03
13	-23.25	465.82	5.00	20802.96	5000.00	3804.03
14	-23.25	470.42	5.00	22036.64	5000.00	3804.03
14	-23.25	470.42	5.00	22036.64	5000.00	3804.03
15	-19.66	472.91	0.41	1901.03	413.77	314.80
15	-19.66	472.91	0.41	1901.03	413.77	314.80
16	-19.66	475.36	4.79	21615.27	8148.30	6199.27
16	-19.66	475.36	4.79	21615.27	8148.30	6199.27
17	-19.66	479.87	4.79	22542.86	8148.30	6199.27
17	-19.66	479.87	4.79	22542.86	8148.30	6199.27
18	-16.07	484.06	4.03	19963.01	6847.20	5209.39
18	-16.07	484.06	4.03	19963.01	6847.20	5209.39
19	-16.07	487.14	2.38	11885.57	4050.48	3081.63
19	-16.07	487.14	2.38	11885.57	4050.48	3081.63
20	-16.07	490.01	3.59	17481.67	6102.31	4642.68
20	-16.07	490.01	3.59	17481.67	6102.31	4642.68
21	-12.48	491.75	0.03	142.01	49.55	37.70
21	-12.48	491.75	0.03	142.01	49.55	37.70
22	-12.48	494.20	4.99	24709.75	2243.44	1706.82
22	-12.48	494.20	4.99	24709.75	2243.44	1706.82
23	-12.48	499.07	4.99	23457.88	2243.44	1706.82
23	-12.48	499.07	4.99	23457.88	2243.44	1706.82
24	-8.89	503.97	5.00	22324.14	2250.00	1711.81
24	-8.89	503.97	5.00	22324.14	2250.00	1711.81
25	-8.89	508.91	5.00	20952.78	2250.00	1711.81
25	-8.89	508.91	5.00	20952.78	2250.00	1711.81
26	-5.30	513.87	5.00	19637.01	2250.00	1711.81
26	-5.30	513.87	5.00	19637.01	2250.00	1711.81
27	-5.30	518.85	5.00	18158.87	2250.00	1711.81
27	-5.30	518.85	5.00	18158.87	2250.00	1711.81
28	-1.71	523.84	5.00	16737.97	2250.00	1711.81
28	-1.71	523.84	5.00	16737.97	2250.00	1711.81
29	-1.71	528.84	5.00	15158.86	2250.00	1711.81
29	-1.71	528.84	5.00	15158.86	2250.00	1711.81
30	1.88	533.83	5.00	13639.68	2250.00	1711.81
30	1.88	533.83	5.00	13639.68	2250.00	1711.81
31	1.88	538.83	5.00	11965.80	2250.00	1711.81
31	1.88	538.83	5.00	11965.80	2250.00	1711.81
32	5.47	543.82	5.00	10355.58	2250.00	1711.81
32	5.47	543.82	5.00	10355.58	2250.00	1711.81
33	5.47	548.80	5.00	8593.51	2250.00	1711.81
33	5.47	548.80	5.00	8593.51	2250.00	1711.81
34	9.06	553.71	4.92	6803.11	2213.68	1684.18
34	9.06	553.71	4.92	6803.11	2213.68	1684.18
35	9.06	558.57	4.92	5018.78	2213.68	1684.18
35	9.06	558.57	4.92	5018.78	2213.68	1684.18
36	9.06	561.08	0.16	135.28	72.64	55.26
36	9.06	561.08	0.16	135.28	72.64	55.26
37	12.65	563.46	4.71	3903.20	2120.54	1613.32
37	12.65	563.46	4.71	3903.20	2120.54	1613.32
38	12.65	568.06	4.71	3608.42	2120.54	1613.32
38	12.65	568.06	4.71	3608.42	2120.54	1613.32
39	12.65	570.64	0.58	543.34	978.12	744.16

39	12.65	570.64	0.58	543.34	978.12	744.16
40	16.24	572.42	3.12	3130.56	5311.26	4040.84
40	16.24	572.42	3.12	3130.56	5311.26	4040.84
41	16.24	575.57	3.44	3159.89	5844.37	4446.43
41	16.24	575.57	3.44	3159.89	5844.37	4446.43
42	16.24	578.87	3.44	2763.15	5844.37	4446.43
42	16.24	578.87	3.44	2763.15	5844.37	4446.43
43	19.83	582.65	4.53	3370.44	7707.21	5863.69
43	19.83	582.65	4.53	3370.44	7707.21	5863.69
44	19.83	586.91	4.53	2533.54	7707.21	5863.69
44	19.83	586.91	4.53	2533.54	7707.21	5863.69

SUM OF MOMENTS = 0.312639E-12 (ft/lbs);Imbalance (Fraction of Total Weight) = 0.6115220E-18

Sum of the Resisting Forces = 162880.42 (lbs)

Average Available Shear Strength = 861.49(psf)

Sum of the Driving Forces = -123920.39 (lbs)

Average Mobilized Shear Stress = -655.43(psf)

Total length of the failure surface = 189.07(ft)

Factor of Safety Balance Check: FS = 1.31440

CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

**** END OF GEOSTASE OUTPUT ****

APPENDIX G

UNCONFINED COMPRESSION TEST RESULTS

Illinois Department of Transportation

Shelby Tube Test Results

Boring No.: 2 | Route: I-74 | Tube Length/Diameter: 30 in / 3 in | Page: 1 of 2

Station: 22+57 | Section: (37-24HVB) BR | Ground Surface Elev.: 809.4 ft. | Date: 1/21/2022

Offset: 30 ft. | County: Henry | Begin Sampling Depth: 791.4 ft. | Job No.: D-94-102-05

Latitude: 41.180660 | Structure No.: 037-0019 (Existing) | Ground Water Elev.: 805.1 ft. | Soils Lab Project No.:

Longitude: -90.332338 | Contract No.: 68510 | Drilled by: Koby Lemon | Prepared by: Koby Lemon

Sample No.	Depth (ft)	Elev. (ft)	Qu (tsf)	Moist. (%)	Unit Wt. (pcf)	c (psf)	Φ (deg)	c' (psf)	Φ' (deg)	Soil Type, Description and Observations
1	18.25	791.2	3182	68.7	92.4	--	--	--	--	MUCK, Dark Brown, Moist, Very Stiff
2	18.75	790.7	3207	119	75.9	--	--	--	--	MUCK, Dark Brown, Moist, Very Stiff

The Unit Wt. column represents the Moist Unit Weight.
The Qu column represents the Unconfined Compressive Strength using AASHTO T 208.
The c and Φ column represents cohesion and friction angle for total stress using AASHTO T 296 (unconsolidated-undrained triaxial testing).
The c' and Φ' column represents cohesion and friction angle for effective stress using either AASHTO T 297 (consolidated-undrained triaxial testing), or AASHTO T 296 with pore pressure measurement.

Illinois Department of Transportation

Shelby Tube Test Results

Boring No.: 4
Route: I-74
Tube Length/Diameter: 30 in / 3 in
Page: 2 of 2

Station: 22+36
Section: (37-24HVB) BR
Ground Surface Elev.: 809.7 ft.
Date: 1/21/2022

Offset: 35 ft.
County: Henry
Begin Sampling Depth: 804.7 ft.
Job No.: D-94-102-05

Latitude: 41.180720
Structure No.: 037-0020 (Existing)
Ground Water Elev.: 804.0 ft.
Soils Lab Project No.:

Longitude: -90.332684
Contract No.: 68510
Drilled by: Koby Lemon
Prepared by: Koby Lemon

Sample No.	Depth (ft)	Elev. (ft)	Qu (tsf)	Moist. (%)	Unit Wt. (pcf)	c (psf)	Φ (deg)	c' (psf)	Φ' (deg)	Soil Type, Description and Observations
1	5.58	804.1	1286	28.8	123.1	--	--	--	--	SILTY CLAY LOAM, Gray, Orangish-Brown and Black, Mottled, Soft

The Unit Wt. column represents the Moist Unit Weight.
The Qu column represents the Unconfined Compressive Strength using AASHTO T 208.
The c and Φ column represents cohesion and friction angle for total stress using AASHTO T 296 (unconsolidated-undrained triaxial testing).
The c' and Φ' column represents cohesion and friction angle for effective stress using either AASHTO T 297 (consolidated-undrained triaxial testing), or AASHTO T 296 with pore pressure measurement.